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„The Person Principle in the Unified Process - A Design Science Research Study on Supporting Performance-Related Leadership Interaction in ICT Project Teams“

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Mag. David Haselberger

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Declaration of Authorship

I, David Haselberger, declare that this thesis titled, "The Person Principle in the Unified Process - A Design Science Research Study on Supporting Performance-Related Leadership Interaction in ICT Project Teams" and the work presented in it are my own. I confirm that:

- This work was done wholly or mainly while in candidature for a research degree at this University.
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- I have acknowledged all main sources of help.
- Where the thesis is based on work done by myself jointly with others, I have made clear exactly what was done by others and what I have contributed myself.

Signed:

_____

Date:

_____

May 2019

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List of Publications

Key facets of this doctoral dissertation were either presented at scientific conferences or published in scientific journals or as book chapters. Specifically, contents of subsequently listed publications were highly relevant to this thesis:

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Abstract

Information and Communication Technology (ICT) projects face tough challenges by virtue of technical and social complexity. Effective teamwork notably contributes to project success. Interpersonal interaction affects team member well-being and team performance. Team leadership is significantly related to team performance.

Team leadership in complex environments, specifically in ICT projects, is researched only scarcely. While benchmark project management process descriptions and software development methodologies highlight the importance of interpersonal interplay, hardly any indicators are described that would provide cues allowing one to learn on interpersonal team situations. The Unified Process (UP), a well-documented software development process standard, lacks in-depth descriptions on team processes, constructive communication and collaboration. Openly accessible, situation-appropriate learning resources on interpersonal interaction for persons holding leadership functions within ICT project teams, in particular in small and medium businesses, are sparse.

This interdisciplinary doctoral dissertation fills the gap identified above by describing a design science research study on the iterative development and validation of the *rhea.framework*, a socio-technical system to support team leaders' experiential learning on performance-relevant interpersonal interaction in ICT project teams.

The *rhea.framework* is the main contribution of this thesis. It supports team leaders' experiential and social learning through structured written personal reflection and continual case-based interpersonal reflection in a group of leadership peers.

A team leadership knowledge base can be used to compare personal reflections with peer reviewed reference experience descriptions on team leadership in ICT projects. This knowledge base holds an ontology of leadership experience. Semantic relationships between experience description keywords were automatically established. Through crowd sourcing, experience descriptions were classified to categories of a normative leadership model that

was elaborated in a systematic literature review. Contrasting ontology communities and document similarity clusterings to a selective literature review, four key team leadership reflection anchors were differentiated. Three technical representations - a wiki, a mobile application, and a web application including a knowledge-based recommender system - were implemented.

The framework was validated through peer debriefing, a focusgroup and a case study on framework use in a course on constructive communication for Master students in Computer Science with a specialization in Service Science Management and Engineering. The framework web representation was evaluated in two expert audits with persons in leadership positions from industry. After refactoring, it was rated satisficing in understandability, completeness, language clarity and usefulness.

The *rhea.framework* advances the area of experiential learning on team leadership in ICT project contexts. As an open educational resource, it offers conceptual guidelines for continuous self-directed and interpersonal team leadership reflection. With a focus on social identity and interpersonal facilitation in teams, evident from knowledge base core contents, it can be considered an extension to software development methodology - constituting a *Person Principle* along the Unified Process.

While design artifacts were validated using qualitative and triangulated qualitative and quantitative research methods in this thesis, future research should address the evaluation of long term effects of tool-supported personal and case-based interpersonal reflection of interactions in ICT project team leadership in industry contexts.

Zusammenfassung

Informations- und Kommunikationstechnologie (IKT) Projekte stehen aufgrund technischer und sozialer Komplexität vor großen Herausforderungen. Projekterfolg ist wesentlich durch effektive Teamarbeit bestimmt. Zwischenmenschliche Interaktion beeinflusst Teamleistung sowie das Wohlbefinden der Teammitglieder. Teamleitung hängt signifikant mit Teamleistung zusammen.

Teamleitung in komplexen Umgebungen, speziell in IKT-Projekten, wird bisher eher selten erforscht. Während maßgebende Projektmanagement-Prozess Beschreibungen und Softwareentwicklungsmethodologien die Bedeutung des interpersonellen Zusammenspiels im Team unterstreichen, werden kaum Indikatoren beschrieben, die Anhaltspunkte für das Lernen in zwischenmenschlichen Teamsituationen bieten. Der Unified Process (UP), ein umfassend dokumentierter Standard für Softwareentwicklungsprozesse, enthält keine detaillierten Beschreibungen zu Teamprozessen, konstruktiver Kommunikation oder Zusammenarbeit. Offen zugängliche, situationsgerechte Lernressourcen zu zwischenmenschlicher Interaktion für Personen, die Führungsaufgaben in IKT-Projektteams ausüben, sind - insbesondere für kleine und mittlere Unternehmen - spärlich.

Diese interdisziplinäre Dissertation schließt die oben genannte Diskrepanz, indem sie eine Design-Science-Forschungsstudie zur iterativen Entwicklung und Validierung des *rhea.frameworks* beschreibt. Dieses ist ein sozio-technisches System, welches erfahrungsbasiertes Lernen von TeamleiterInnen zu leistungsrelevanter zwischenmenschlicher Interaktion in IKT-Projektteams fördert.

Das *rhea.framework* ist der Hauptbeitrag dieser Arbeit. Es unterstützt erfahrungsbasiertes und soziales Lernen von TeamleiterInnen durch strukturierte schriftliche Reflexion und kontinuierliche fallbezogene interpersonale Reflexion in einer Gruppe von Führungskräften.

Eine Wissensdatenbank zur Teamleitung kann verwendet werden, um persönliche Reflexionen mit von ExpertInnen geprüften Referenz-Erfahrungsbeschreibungen zur Teamleitung

in ICT-Projekten zu vergleichen. Diese Wissensdatenbank enthält eine Ontologie von Team-Leitungserfahrungsbeschreibungen. Semantische Beziehungen zwischen Schlüsselwörtern von Erfahrungsbeschreibungen wurden automatisch hergestellt. Durch Crowd Sourcing wurden Erfahrungsbeschreibungen in Kategorien eines normativen Führungsmodells klassifiziert, das in einer systematischen Literaturrecherche erarbeitet wurde. Im Vergleich von Ontologie-Communities und Clustern semantisch ähnlicher Erfahrungsbeschreibungen mit Ergebnissen einer selektiven Literaturrecherche wurden vier Schlüsselthemen - oder eher Reflexionsanker - der Teamleitung unterschieden. Drei technische Darstellungen des Frameworks - ein Wiki, eine mobile Anwendung und eine Webanwendung einschließlich eines wissensbasierten Empfehlungssystems - wurden implementiert.

Das *rhea.framework* wurde durch Peer-Debriefing, eine Fokusgruppe und eine Fallstudie zur Nutzung des Frameworks in einem Kurs zu konstruktiver Kommunikation für MasterstudentInnen in Informatik mit Spezialisierung in Service Science Management und Engineering validiert. Die Darstellung des Frameworks als Webanwendung wurde in zwei ExpertInnenaudits mit Personen in Führungspositionen in der Industrie bewertet. Nach dem Refactoring wurde das Framework hinsichtlich Verständlichkeit, Vollständigkeit, Sprachverständlichkeit und Brauchbarkeit als zufriedenstellend bewertet.

Das *rhea.framework* erweitert den Bereich des erfahrungsbasierten Lernens zur Teamleitung in ICT-Projektkontexten. Als Open Educational Resource bietet es konzeptionelle Richtlinien für die kontinuierliche selbstgesteuerte und zwischenmenschliche Reflexion von Teamleitung. Mit einem Fokus auf soziale Identität und interpersonale Prozessbegleitung in Teams, der sich aus den Kernthemen der Wissensdatenbank ableiten lässt, kann es als Erweiterung zu Softwareentwicklungsmethodologie betrachtet werden - ein *Person Prinzip* entlang des Unified Process.

Während Designartifakte in dieser Arbeit mit qualitativen und triangulierten qualitativen und quantitativen Forschungsmethoden validiert wurden, sollte sich die zukünftige Forschung mit der Evaluierung langfristiger Auswirkungen werkzeuggestützter persönlicher und fallbezogener interpersonaler Reflexion von Interaktionen bei der Leitung von IKT-Projektteams in industriellen Kontexten befassen.

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Part I

Introduction

Chapter 1

Motivation and Relevance

Information and Communication Technology (ICT) projects are complex endeavors - a team of usually highly specialized experts, sometimes dispersed around the world, works together over an often strictly limited period of time to accomplish some kind of worth for a customer, user, stakeholder, and for the organization(s) they are embedded in, in the form of products or services, habitually involving rapidly evolving technologies [84], [268], [499]. ICT projects tend to be complex in the process from stakeholder requirement analysis to implementation.

The more complex a project, the higher the risk of failure according to the yearly Standish Chaos Reports [241], [242], [243], [245]. For example, from 2011 to 2015 around 20 percent of ICT projects failed. About 50 percent of projects were challenged. Interestingly, unsuccessful closing of sometimes promising project outsets can frequently be traced back to people- as opposed to technology issues [273], [244], [531], [429].

Effective teamwork is crucial in business informatics for it is highly related to projects' succeeding in time, in scope and in budget [486]. Teams are the core learning units of organizations [543, p. 219]. They hold the potential to deal appropriately with challenging organizational circumstances. Team performance is a multi-dimensional process of teamwork and individual task work to meet or exceed standards for products or processes of project stakeholders [252], [520]. The persons in a team and their relationships to each other are substantial for effective teamwork and project success. Work load, rapid change, technological and stakeholder demands, and associated labor market risks influence team members' health [548, p. 3]. Interpersonal relationships within a team and with project stakeholders can impact team members' feelings of well-being [466, p. 622/623]. Team members' health is highly important to team performance [146, p. 351].

Several studies reveal that interpersonal interactions between persons holding leadership roles or functions and other team members have a high impact on team performance [127], [114], [564], [220], [288], [582], [646]. Yet, leadership in complex team contexts - such as ICT projects - remains hardly investigated [634]. Team performance models shed light on significant factors contributing to team participants' working together [425], [544], [587]. Still, these models give few pointers to dealing with different, ever-specific interpersonal situations in practice.

Software development methodologies can support teams in dealing with project complexity by outlining structured ways of proceeding in work tasks. They describe reliable practices that allow for approximative estimations of effort, cost, or time needed to build products that satisfy users and other stakeholders. The Unified Process (UP) is a well-documented, widely implemented standard software development process. Yet, it has blind spots on team processes, constructive communication and collaboration. Although interpersonal interactions are valued as preconditions for successful software development, they are not extensively discussed [473], [204, p. 98], [420].

Benchmark project management process descriptions as the Project Management Body Of Knowledge (PMBOK) - a source of information on management practices for many professionals - highlight the importance of people working together to excel in task work, but no in-depth pointers are given how to handle interpersonal situations [154], [486].

In ICT project team environments, persons holding leadership functions often deal with ill-structured situations [203, p. 7]. Team leaders need to develop skills and congregate specialized domain knowledge in a short time frame [495]. Hereby situational assessment abilities are necessary. Besides understanding the business logic, team leaders may bring emotional intelligence into the field [517], foster reflective conversation and work out a shared vision with team members [543, p. xiii]. Supporting self-organized structures enables quick and flexible response to changing system circumstances (whether the system is a product, the team or an organization) [364]. Leadership focus on control and documentation often appears less effective in ICT projects than in rather structured, more predictable settings [580]. Seasoned project managers - contrary to suggested project management standards - don´t necessarily want full control of their projects[154, p. 1]. Situation-specific, flexible leadership that supports self-organized structures can underpin team performance [363], [321, p. 416].

To *"know how to play together"* is a continuous learning process within teams [543, p. xviii/4]. Large organizations provide ample opportunities for members to learn about project

management or leadership. Small and Medium Enterprises (SMEs), though described as the backbone of economy [593], often lack access to professional learning environments on interpersonal processes in teams [495, p. 9].

In the field of human computer interaction (HCI), design to support deep - or transformative - reflection is described as challenging [530], [214], [58]. Slovak [557] refers to a lack of understanding of facilitating deep reflection via technology in the context of social and emotional learning concerning design requirements, the scaffolding of reflection processes and appropriate integration of technology support (p. 21).

Design research to facilitate social and emotional learning appears to frequently hold a technology focus rather than considering embedding social contexts [557, p. 17]. Slovak and Fitzpatrick [558] suggest ethnographically informed and participatory study approaches to generate domain knowledge to guide design decisions (p. 21).

The personal ideas of human beings (*"Menschenbilder"*) persons hold influence interpersonal interactions.

Learning on leadership can be described as a meaningful experiential process taking feelings and environmental conditions into account [505].

In summary, the following practice-relevant gaps can be identified:

- GP(Gap Practice) 1: ICT projects frequently fail due to people as opposed to technical issues [244], [243], [242], [241].
- GP 2: ICT team leadership needs to take into account complexity and rapid changes in work environments.
- GP 3: Persons with leadership functions work on time-constrained schedules calling for accessible, situation-appropriate leadership learning opportunities.
- GP 4: Particularly in small and medium businesses situation-specific learning resources on leadership supporting team performance are sparse.

Further, gaps can be determined in research on leadership team interactions in ICT project team contexts [266]:

- GR(Gap Research) 1: Interpersonal relationships in ICT project teams, although highly contributing to project success, are not researched extensively [611, p. 345], [634], [561].
- GR 1.1: The Unified Process mentions the importance of people in projects, yet provides no leadership tools to support team performance. (It has blind spots concerning team processes, constructive communication and collaboration.)
- GR 1.2: The PMI competency development framework focuses on task-related interactions, giving little attention to person-related issues. Yet, effective teamwork in ICT projects is a highly important issue in the field of business informatics as it is directly related to whether a project can succeed in time, in scope and in budget [486].
- GR 1.3: The leadership framework of Exemplary Leadership highlights interpersonal relations, but doesn´t consider project-specific circumstances [357].
- GR 1.4: There is a gap in research on the influence of leaders on group emotions [646, p. 471].
- GR 2: Ideas of human beings (*"Menschenbilder"*) are frequently not reflected in research on leadership, although highly influencing day-to-day practice of leaders as well as researchers.
- GR 3: Research on supporting changing, complex interpersonal environments encountered in ICT projects is missing.
- GR 3.1: Experience descriptions of emergent process facilitation (such as supporting creativity, personal development of team members and team learning in work teams) are hardly present in ICT literature, although highly valued by practitioners.
- GR 3.2: Many ICT project risks concern complexity and interpersonal relationships, while in literature planning and monitoring are extensively described. Descriptions of consulting or coaching are not necessarily taking into account special circumstances (complexity, rapid changes) of ICT projects.
- GR 3.3: Case study research on interpersonal interaction in ICT project teams is hardly found in ICT literature repositories.
- GR 3.4: Real-world case vignettes are frequently missing from leadership best practice descriptions.
- GR 4: There appears to be a lack of understanding in technology design to support deep - or transformative - reflection processes [557, p. 21]. This includes:
- GR 4.1: design informed by the embedding (social) context,
- GR 4.2: scaffolding of reflection processes, and
- GR 4.3: appropriate use of technology support.

Chapter 2

Business Challenges

Examining gaps in research and practice, the following business challenges become apparent:

- BC(Business Challenge) 1: How can persons holding leadership functions be supported in their efforts of promoting team performance in complex, changing, ever-unique interpersonal situations in ICT project team environments?
- BC 2: What atmosphere facilitates learning of persons holding leadership functions within teams?

An interdisciplinary study approach appears crucial to investigate the problem field marked out by business challenges. Theories in social science, particularly

- social identity theory [270], [272], [294], [6], [584],
- intersubjective systems theory [577], [578], [344],
- organizational systems theory [613], [362], [366] and the notions of
- generative, significant learning [505], [543], [439] as well as
- functional leadership [256], [417],

can supplement the design process of a satisficing practice-relevant socio-technical support system in ICT project team leadership.

2.1 Design Problem

Contributing to a formative science of business informatics [459], the primary outcome of this thesis is a leadership framework supporting experiential learning on promoting team performance in complex environments, such as ICT projects.

The framework integrates with the Unified Process by addressing people aspects [317, p. 16-19].

It may be used as a navigation system for learning about interpersonal processes in teams. Core topics - or rather reflection anchors - of team leadership that constitute a *Person Principle* spanning the Unified Process are derived from experience descriptions in literature (such as case studies and organizational patterns).

Considering business challenges, the following design intents appear relevant for the implementation of the leadership learning framework:

- DI(Design Intent) 1: Design a socio-technical system to support sustained interpersonal learning on team leadership of stakeholders in ICT project environments.
  - DI 1.1: Represent dynamic, situation-specific interpersonal leadership interactions effectively within a socio-technical system to support team leaders' experiential learning.

Figure 2.1 shows a system perspective on the framework partly resembling the eXtreme Programming (XP) concept [62], [61]. Trace dependencies, as in the Unified Process, signify historical or process dependencies.

Interpersonal interactions significantly influencing team performance can be described in written reflections. These descriptions are called flows in this thesis. Thus, flows can be traced to experiences in interpersonal interactions. They are based on personal principles. Principles here are (tacit) individual cognitive-emotional models or maps. These can be traced to dispositions of a person holding leadership functions in a team. Personal dispositions influence interpersonal interactions.

Interactions have an effect on team performance. Leadership team interactions (LTIs) are helpful, facilitative interactions of a person holding leadership functions in a team with other team members in order to support team performance - especially in difficult, problematic

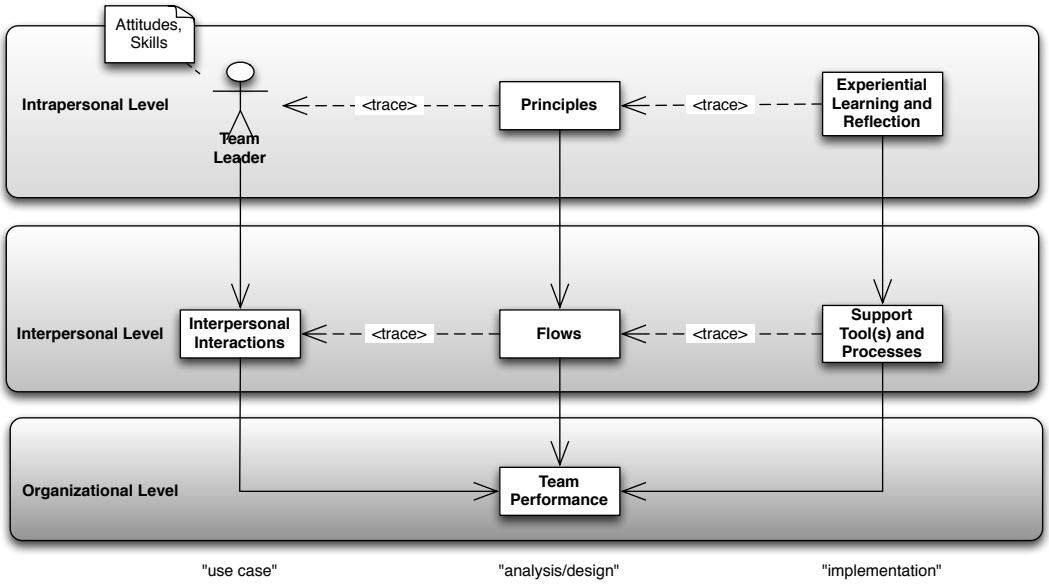

Figure 2.1 Framework System View (compare [265])

situations.

This system view points to aims of a socio-technical learning framework on leadership team interaction:

- Support experiential learning through personal reflection on leadership in teams
- Support learning from experience together with peers
- Support learning from others' experience
- Increase of personal leadership capacities (to foster team performance) and well-being
- Support the refinement of learnings in team leadership in complex team contexts

The design problem laid out through the business challenges can be formulated adhering to a design science research template [630]:

- *Improve leadership team interactions*
  - *by implementing a socio-technical support system*
  - *such that*
    - *complexity of interpersonal team situations can be approached in a way that supports (inter)personal experiential learning,*
    - *personal experiences can be shared with peers and compared to others' experiences to broaden one's horizon, and increase the repertoire of behavior alternatives,*
    - *scalable opportunities for reflection are offered,*
  - *in order to foster team performance in complex environments.*

2.2 Research Questions

Taking gap analyses into account, the following research questions emerge in the context of stated business challenges:

- Business Challenge 1:
  - RQ(Research Question) 1: What leadership interactions help establish team performance in complex environments?
    - RQ 1.1: Which benefits grow from aligning them with the phases of the Unified Process?
    - RQ 1.2: What are characteristics of significant leadership team interactions?
- Business Challenge 2:
  - RQ 2: What interactions of team leaders support the unfolding of emergent processes (creative interpersonal processes, team self-organization)?
  - RQ 3: How can universities prepare Informatics students for effectively working in and leading ICT project teams?

RQ1, RQ1.1, RQ1.2, RQ2 and RQ3 are open, exploratory, and descriptive questions. A mixed-methods approach focusing on qualitative research appears suitable to address these knowledge questions.

2.3 Social Context

The social context of this design science research study (see chapter 3, p. 13) ensues from stakeholders who may influence the design process or may be affected by it [630].

Peers in leadership in ICT project team environments are the core target group directly concerned by stated business challenges. Their primary interest is to facilitate interpersonal interaction in order to foster team performance. They want to learn about supportive leadership team interactions in their work contexts.

Key stakeholders of a socio-technical team leadership support system are further business consultants with a focus on interpersonal interactions in teams as well as academic professionals in leadership education. They are interested in fostering a team (leadership) learning atmosphere. They share with team leaders a continued interest in studying leadership in teams.

Chapter 3

Methodology

"Design science is the design and investigation of artifacts in context [630]." In this thesis, a framework for formal and informal ICT project team leaders to reflect on leadership interactions supporting team performance is developed following a design science research approach.

Design science research (DSR) stems from a problem-solving paradigm. *"Design science ... creates and evaluates ICT artifacts intended to solve identified organizational problems [279, p. 77]."* In fact, it is the interaction between an artifact and a problem context - also called treatment [630] - that may contribute to solving a problem. In order to find out about viable design solutions, the context is investigated. Artifacts crafted in DSR frequently rely on existing theories that are applied, tested, modified and extended in the research process [403], [621]. Solutions to problems in design science are designed artifacts. A design can be seen as a decision about what to do [630]. There may be many solutions to a specific problem. Design solutions are evaluated by utility to stakeholder aims within the context that sets the problem. There is not one single best solution [630]. A schematic representation of design science is shown in figure 3.1. Artifacts are elaborated to deal with a specific situation that evolves in a particular domain or knowledge context. This knowledge context is investigated to define design problems and document influences of artifact use. The research endeavor is based on stakeholder aims.

Knowledge questions may frame design decisions and artifact implementation. Implementation in DSR means to apply a design in the original problem context. Answers to knowledge questions are not depending on stakeholder aims, but contribute to a scientific discourse. Yet, they need to be combined with the assumption of fallibility [630].

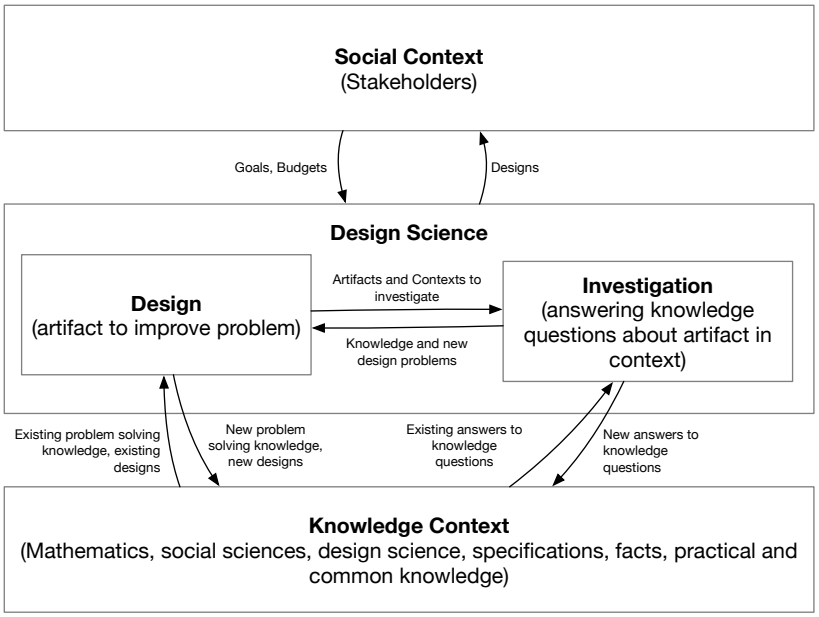

Figure 3.1 Design Science Research Schema (compare [630])

"An artifact is something created by people for some practical purpose [630]." It interacts with a context. DSR deals with creating artifacts that define ideas, practices, technical capabilities, and products contributing to the analysis, design, implementation, management, or use of information systems[601]. Artifacts are:

- constructs, providing vocabulary and symbols to define problems and solutions,
- models, representing design problem and solution space,
- methods, defining processes for problem solving, as well as
- instantiations to show that constructs, models, or methods can be implemented in a working information system (IS).

An information system is essentially a network people utilize to share knowledge, information, or data [457], [551]. Often it is composed of people, processes, technologies and work systems [279] [552]. In DSR, technology and behavior are seen as inseparable in information systems. *"The resultant IT artifacts extend the boundaries of human problem solving and organizational capabilities by providing intellectual as well as computational tools [279, p. 76]."*

Given a particular business that can be differentiated, design science research is conducted by building and validating artifacts to meet the identified business challenges. DSR is complemented by behavioral science to develop and justify theories in order to explain phenomena related to the specific business need [279].

Effective DSR adheres to the following research guidelines [279, p. 82-90]:

- A purposeful artifact is created (Guideline 1).
- It is designed for a particular problem domain (Guideline 2).
  Hereby, a problem is defined as the differences between a goal state and the current state of a system considering goal criteria and constraints upon the system in a specific domain. Problem solving means reducing these differences [279, p. 85].
- The utility of the artifact in the specific domain is examined (Guideline 3).
- The artifact solves a priorly unsolved problem or solves a known problem more effectively or efficiently (Guideline 4).
- It is rigorously defined, formally represented, coherent and internally consistent (Guideline 5).
- A search process that enables finding solutions in the problem domain is incorporated or enabled within the artifact or research process (Guideline 6).
  DSR is not about finding all possible solutions, but about finding satisficing solutions to problems [552]. It is important to establish that artifacts do work and to characterize the environments in which they work [279, p. 90].
- Research results are communicated effectively (Guideline 7).

The design task consists of (1) problem investigation, (2) treatment design and (3) treatment validation[630]. These tasks are iterated in a design circle. The design circle is integrated to an engineering circle, which extends to implementing and evaluating a validated treatment in the original problem context. Evaluation is the investigation of a treatment as applied by stakeholders in the problem domain. The engineering cycle is shown in figure 3.2. In this figure, question marks signify knowledge questions, while exclamation marks point to design problems. *"Design science research projects do not perform the entire engineering cycle but are restricted to the design cycle [630]."*

Knowledge questions may be approached following an empirical cycle. The empirical cycle is laid out by Wieringa [630] as a check list for empirical research endeavors. Not

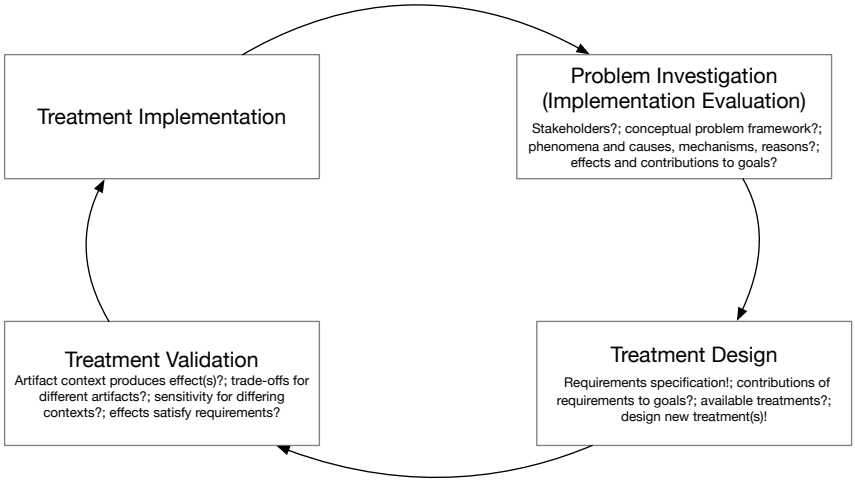

Figure 3.2 Design Science Research Engineering Cycle (compare [630])

all items are relevant for each investigation. The first three and the last two items concern the research context. Item 1 asks for the knowledge goal of the research. What is the intent of the research? Item 2 asks whether the research has an improvement goal and, thus, is utility-driven. Item 3 reviews current knowledge. Item 17 asks for contributions of research to the knowledge goal - the research implications. Item 18 asks for contributions to the improvement goal - the implications for practice. Items 4 to 16 are presented in figure 3.3. In the empirical cycle, validation is concerned with the match between research setup and inferences from the data [630]. In this thesis, the empirical cycle is attended to as implicit rigor check list in handling knowledge questions.

3.1 Thesis Overview

Figure 3.4 outlines an overview of the methodological process followed in this design science research study. Conforming with the DSR engineering circle (see figure 3.2), a design problem is stated and, further, investigated. Findings of the problem investigation shape treatment development. Answers to knowledge questions as well as treatment designs are validated. Knowledge questions are validated in the context of applied research methods. Treatments are validated concerning their utility (using scientific methods). A summary of the methodological structure of this thesis is presented in figure 3.5. The detailed methodological structure of this thesis is shown in figure 3.6.

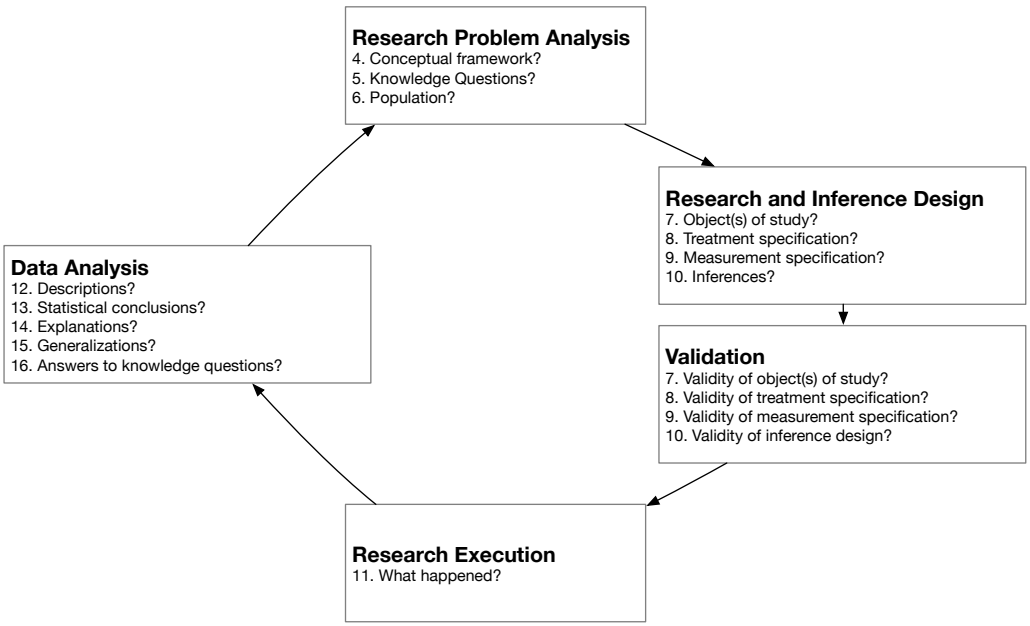

Figure 3.3 Design Science Research Empirical Cycle (compare [630])

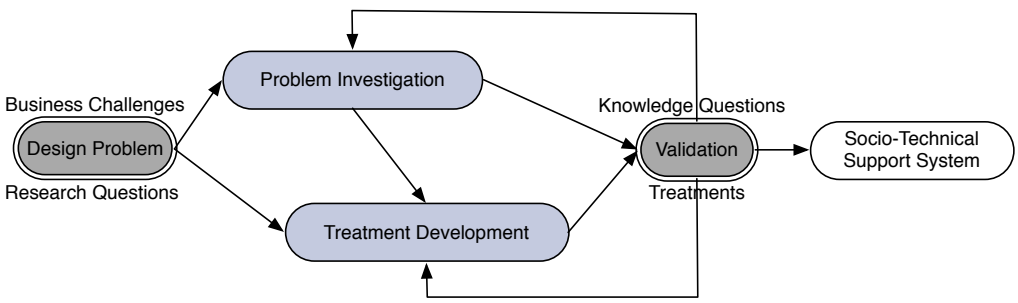

Figure 3.4 Thesis Methodological Process

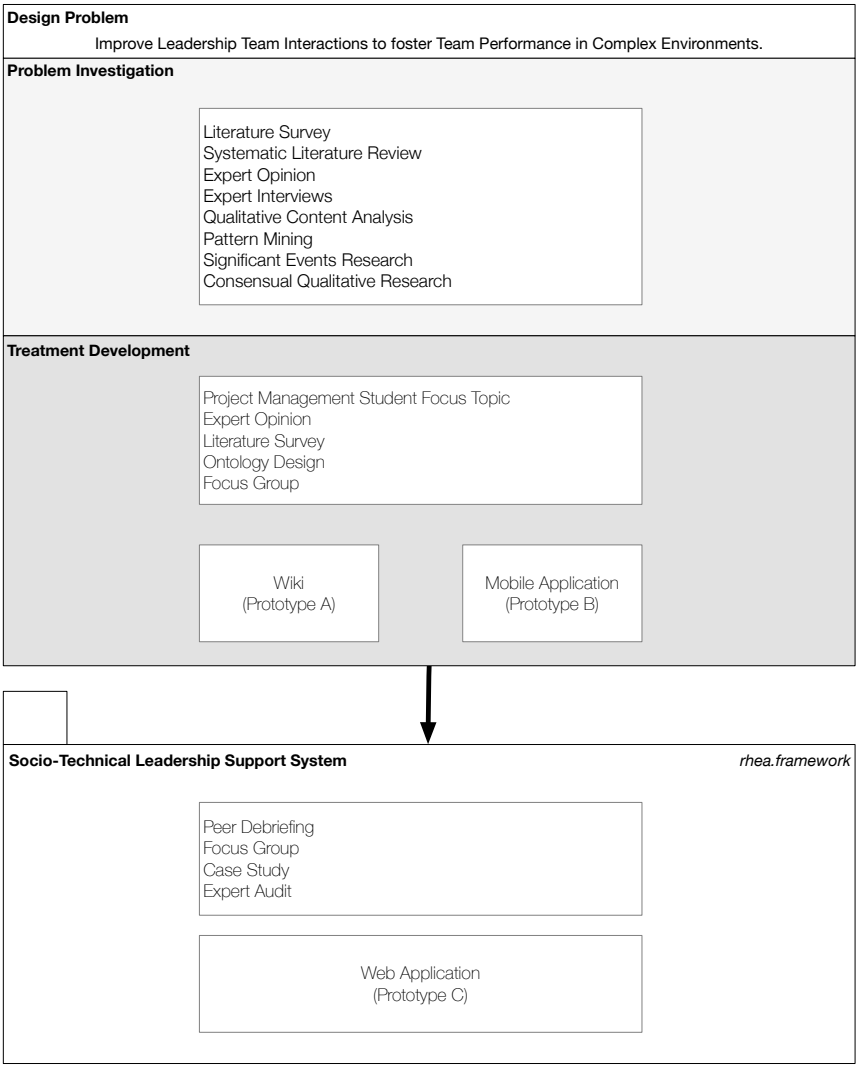

Figure 3.5 Thesis Methodological Structure - Summary

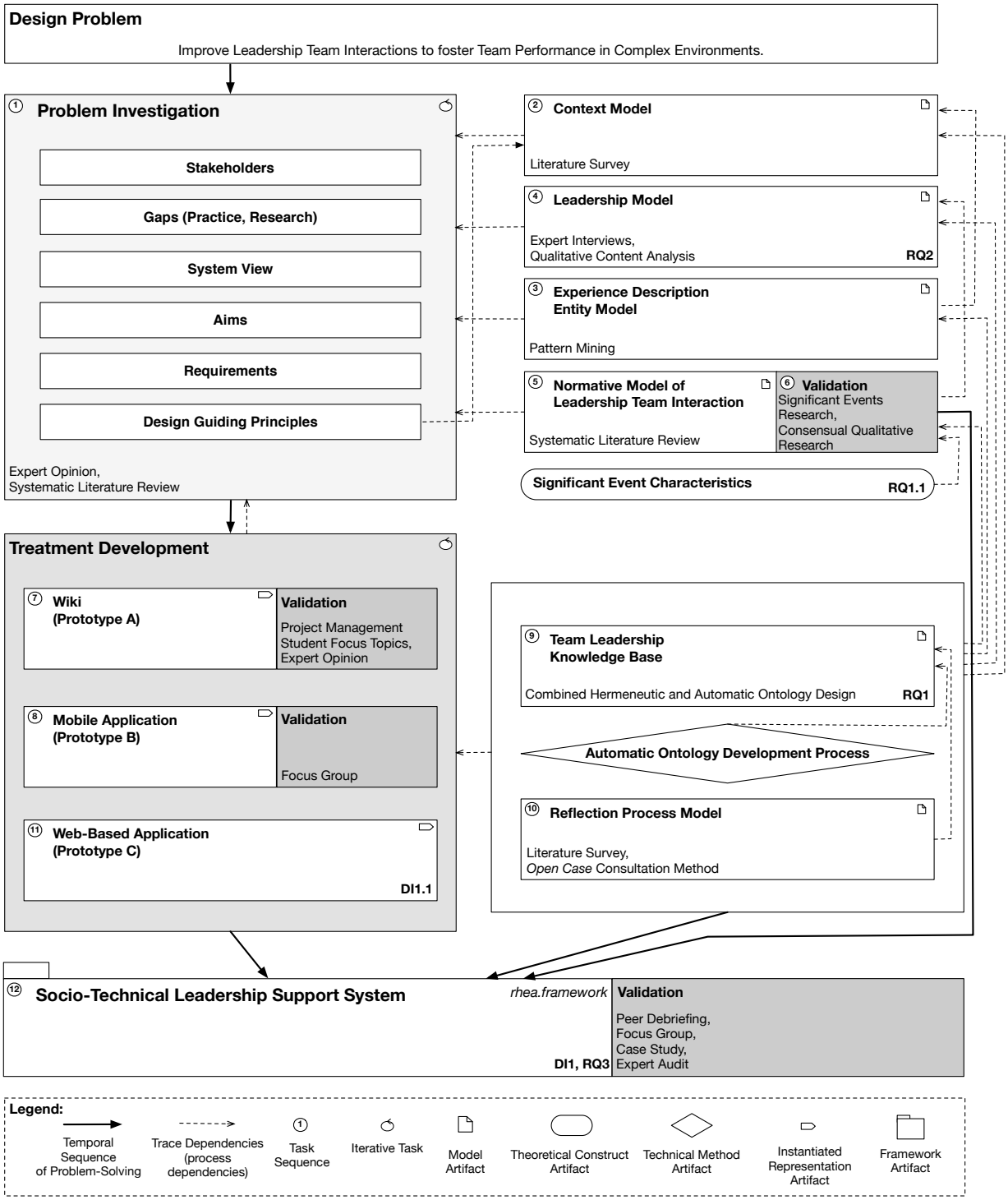

Figure 3.6 Thesis Methodological Structure - Detail

The next chapter illustrates studies related to the design problem. It includes the results of a systematic literature review on leadership team interactions (section 4.1, p. 23) and gives a selective overview of (experiential) leadership learning initiatives (section 4.2, p. 29).

In the following part, the framework design search process is presented. First (chapter 5, p. 39), the knowledge context, or theoretical background, of the design problem is elaborated. Hereby, a context model is formed. Design guiding principles are deducted from the context model (section 5.5, p. 108). They refine the design scope.

Chapter 6 (p. 111) describes iterative design and validation tasks to develop a satisficing socio-technical leadership support system. In an initial domain sensing phase (section 6.1, p. 112), stakeholders of this design study were considered. Practice and research gaps were noted. Expert interviews on facilitative leadership were conducted. A qualitative content analysis of these interviews yields an approximate model of leadership capacities supporting team performance and emergent team processes (section 6.1.1. p. 113). From project managers' shared experiences within workshop settings, one team leadership pattern was elaborated [265]. The pattern structure contributes to the design of an experience description entity model, also called *flow template* in this thesis (section 6.1.2, p. 120). Requirements of a socio-technical leadership support framework are deducted from sharings of potential stakeholders and context information (section 6.1.3, p. 122).

In the course of this DSR study, interviews with project managers in ICT teams were carried out following a significant events research approach [597], [195]. The systematic literature review aided the organization of a normative model of leadership team interactions supporting team performance (section 6.2, p. 123). Research and practice gaps were further explored.

The normative model was validated in a consensual qualitative research inquiry based on the significant events interviews (section 6.2.2. p. 128).

Within this inquiry, characteristics of significant events in experience descriptions on leadership in teams were gathered (section 6.2.2.2.2, p. 139). These are integrated in the design of an (inter)personal reflection process model (section 6.6, p. 207).

Three technical artifact instance representations of the socio-technical system are presented in chapters 6.3 (p. 148), 6.4 (p. 157), and 7.6 (p. 281). The first prototype is a wiki implementation to share and collect experience descriptions. The second prototype is a mobile application to support personal reflection and sharing of written experience descriptions with selected peers. The third prototype is a web-based learning support tool

that enables comparing personal reflection with reference experience descriptions within a team leadership knowledge base.

The elaboration of an initial viable team leadership knowledge base is described in chapter 6.5 (p. 165). To arrive at essential team leadership reflection anchors, or *core flows* in this thesis, a selective literature survey was conducted following a hermeneutic approach [560]. Selective literature survey findings were contrasted and complemented with a semi-automatically developed ontology graph of reference experience descriptions, also called *reference flows* in this thesis, that were collected in the course of the systematic literature review.

In the contributions part of this thesis a socio-technical team leadership support system - the *rhea.framework* - based on the elaborated reflection process model, including the team leadership knowledge base (integrating the normative leadership team interaction model), is introduced (chapter 7, p. 223). The framework documentation is validated in a peer debriefing (section 8.1, p. 301). The framework architecture is validated in a focus group (section 8.2, p. 303). A case study validates the utility of the framework, specifically as leadership learning tool for students in Informatics (section 8.3, p. 307), [269]. The framework web representation is validated through two expert audits with practitioners from industry (section 8.4, p. 315).

Subsequently, artifacts elaborated in this DSR study and research questions are discussed in relationship to business challenges (chapter 9, 327). A *Person Principle* extending the Unified Process is considered based on the *rhea.framework* (section 9.2, p. 332).

Finally, implications of the design science research study process outlined in this work as well as resulting artifacts for future research (and practice) are examined (chapter 10, p. 345).

3.2 Terminology

Central to the framework developed in the course of this thesis are **Significant Events** of **Leadership Team Interaction (LTI)** in ICT project team contexts.

- **Significant Events** refer to events in interpersonal processes that are described by participants to effect personal perspectives and interpersonal relationships [597], [195], [238], [496]. They are often described by adjectives with emotional implication, expressed in superlatives and compared to other personal experiences (section 6.2.2.2.2, p. 139).

- A **Leadership Team Interaction (LTI)** is an *"observable interpersonal interaction between a person holding a leadership role or function and one or more team members [266, p. 1]"* that contributes to team performance [611, p. 347].

- **Flows** are written personal reflections of significant leadership team interaction within the context of the framework developed in this thesis. They are experience descriptions of performance-related interpersonal leadership interaction in team environments. The name suggests a connection to descriptions of work-flow as frequently found in management literature. It can be associated with Heraclitus' process philosophy. Further, it can be related to the flow theory by Mihály Csíkszentmihályi [150] defining flows as satisfying experiences of optimal challenge, deep concentration and activity.

- **Reference Flows** are peer reviewed case studies, best practices or organizational patterns describing leadership team interactions supporting team performance that are retrieved from literature and online repositories.

- **Core Flows** represent essential reflection anchors of team leadership. They are specifically related to theories on social identity [270], [272], [294], [6], [584], functional leadership [256], [417], generative, significant learning [505], [543], [439], intersubjective systems theory [577], [578], [344], and organizational systems theory [613], [362], [366].

Chapter 4

Related Work

4.1 Conceptual Frameworks on Team Leaders' Interpersonal Interaction

Team performance is a widely researched phenomenon [519], while connections between leadership and team performance are less explored [646] - particularly in the field of ICT projects [607]. In the course of this thesis, a systematic literature review [266], [264] was conducted following the guidelines of Kitchenham [340], Beecham et al.s' review protocol [64] as well as Staples' and Niazi's experience report [570] to get insights on the state of the art in leadership team interaction frameworks. The research questions of the systematic review are [266, p. 3]:

- SRQ (Systematic Review Question) 1: What frameworks on team leaders' interpersonal interactions in ICT teams exist?
- SRQ 1.1: What categories of interactions related to team performance in ICT teams can be discerned?
- SRQ 1.2: What project risks concerning interpersonal relationships in ICT teams are addressed?
- SRQ 2: What interactions support both ICT team performance and interpersonal relationships?
- SRQ 2.1: Are the interactions compatible with a humanistic idea of human beings?

Iteratively, peer reviewed contributions were collected from the following sources:

- An upfront Google search for *"project manager interaction pattern"*

  This search yielded 46170000 results on 20th February 2013. It revealed online pattern collections, specifically leadership patterns and anti-patterns by Ward Cunningham [153] as well as an online repository of organizational patterns by Coplien and Harrison [146], to be included in the study.

- Pattern Languages of Programs (PLoP) conference proceedings

  In a first systematic review iteration, online conference proceedings of PLoP conferences by the Hillside Group (https://hillside.net, last visited: 5. 2. 2018) from 1994 to 2013 were skimmed. From references in articles, the Scrum PLoP online pattern repository [4] was retrieved and included in the survey.

- Selected articles on project management and leadership

  Papers associated with leadership or critical incident research were considered for integration, specifically: [634], [116], [646], as well as [256] - all providing direct evidence about the research questions. Again references in selected articles were scanned for inclusion.

- IEEE library and ACM digital library

Search terms to search these databases were derived following a strategy described by Beecham et al. [64, p. 4]. Search queries for the IEEE database were:
((("Abstract":Leadership) AND "Abstract":Team) AND "Ab- stract":Interaction,
((("Abstract":Leadership) AND "Abstract":Team) AND "Ab- stract":intervention),
((("Abstract":Leadership) AND "Abstract":Team) AND "Ab- stract":Behavior),
((("Abstract":Project Management) AND "Abstract":Team) AND "Abstract":Interaction),
((("Abstract":Project Management) AND "Abstract":Team) AND "Abstract":intervention),
((("Abstract":Project Management) AND "Abstract":Team) AND "Abstract":Behavior),
((("Abstract":leadership) AND "Abstract":team) AND behavior), (("Abstract":Leadership) AND "Abstract":pattern).
Search queries in the ACM digital library were:
(Abstract:project and Abstract:management and Abstract:team) and (Abstract:interaction),
(Abstract:project and Abstract:management and Abstract:team and Abstract:interaction),
(Abstract:leadership and Abstract:team) and (Abstract:interaction),
(Abstract:leadership and Abstract:team and Abstract:interaction),
(Abstract:leadership and Abstract:team and Abstract:intervention),
(Abstract:leadership and Abstract:team) and (Abstract:intervention),
(Abstract:leadership and Abstract:pattern),
(Abstract:leadership and Abstract:behavior).

- References in taxonomy papers

References in papers holding leadership taxonomies were considered for integration.

The systematic search was conducted from February 2013 to January 2014.

Acceptance criteria for extracting data from an article were the presence of interaction descriptions or of taxonomies in the full text. Some framework not researched in an ICT context were integrated because they were retrieved by skimming references of accepted articles. An interrater reliability test was conducted to test search process reliability [264, p. 27-28]. An academic expert on project management was asked to extract data following specified inclusion and acceptance criteria. Test results are shown in table 4.1.

The kappa value can be interpreted as fair agreement among both coders. They agreed on more than half of the articles to be accepted in the review [266, p. 5].

In total, 2780 articles were scanned for integration, while 218 were used in the systematic review. Further, 62 of those were accepted, while 156 were rejected. Article counts in each

	N Coders	N Agreements	N Disagreements	N Cases	Percent Agreement	Scott's Pi	Cohen's Kappa
Accepted	2	14	10	24	58.3 %	0.161	0.211

Table 4.1 Systematic Literature Review Interrater Reliability Test Results (from [264])

search iteration are presented in table 4.2.

Iteration	Found	Considered	Rejected	Accepted
PLoP conference proceedings	832	35	17	18
Further references	174	16	12	4
Selected papers	4	4	1	3
Further references	315	28	22	6
IEEE and ACM	658	116	86	30
References in taxonomy papers	797	19	18	1
Total	*2780*	*218*	*156*	*62*

Table 4.2 Systematic Literature Review Findings per Iteration (compare [266])

Impact of taxonomy papers was measured using the Scholarometer web tool (http://scholarometer.indiana.edu, last visited: 30. 10. 2018) which provides citation counts of resources in Google Scholar. Highest impact scores in Scholarometer could be found for [266, p. 6]: [116], [255], and [646]. A follow-up is: [643]. Meta-studies accepted in the review process are: [116], [170], [255], and [643]. Other meta-studies mentioned in article references are: [481], [215], [56] as well as [305].

Table 4.4 lists accepted taxonomy papers (SRQ 1), including 4 meta-analyses on leadership behavior and 16 articles holding key dimensions of leadership team interaction. *"Twenty articles collected in this study describe frameworks on interpersonal leadership interaction applied in ICT-team environments. 9 taxonomies originate from an ICT environment [266, p. 12]."*

No studies retrieved in the systematic review state an underlying idea of human beings that research is based on. Only recently, supporting emergent interpersonal processes, such as creativity, are more attended to in literature on ICT project team leadership. Key dimensions of leadership interaction in teams described in found articles form the baseline for the development of a normative model of leadership team interaction (SRQ 1.1) and a taxonomy of project risk (SRQ 1.2) - described in section 7, p. 223.

ID	Reference	Software Development Process	Project specific	Researched in ICT Context	Based on Psychological Theory	Scientific Methods applied	Participants	Citation Count (Scholarometer)
T1	[52]	No	No	Yes	No	Literature Review		7
T2	[388]	No	No	No	No	Literature Review, Analysis of group problem solving in four-person groups, System of coding interaction	140	172
T3	[148]	No	No	Yes	No	(Expert's view)		2
T4	[395]	No	Yes	Yes	No	Literature Review, Qualitative Content Analysis	10	0
T5	[375]	No	No	No	No	Literature Review		0
T6	[590]	No	Yes	Yes	No	Field Research of Best-In-Class Practices, Surveys, Participant Observation, In-Depth Retrospective Interviewing	400	39
T7	[646]	No	No	No	No	Literature Review		550
T8	[643]	No	No	No	No	Literature Review, Survey Field Study (Validation of Taxonomy)	275	274
T9	[170]	No	No	Yes	No	Literature Review on ISI Web of Science Index (Keywords: team or group, leadership, performance and/or effectiveness; retrieved 85 articles)		4
T10	[255]	No	No	No	No	Literature Review		408
T11	[116]	No	No	No	No	Literature Review		353
T12	[46]	No	No	No	No	Data Analysis for Companies (Analysis of Leadership Index)	Group of Italian MBA Students, 32 Companies	2
T13	[619]	No	No	No	No	Studies of Teams		16
T14	[487]	No	Yes	No	Yes	Hermeneutic Approach (not further specified)		3
T15	[592]	No	Yes	Yes	No	Field Study (35 Multinational High-Technology Product Developments)	35	0
T16	[173]	No	Yes	Yes	No	Interviews with Project Managers, Grounded Theory	10	0
T17	[634]	No	Yes	Yes	No	Literature Review, Critical Incident Interviews, Grounded Theory	23	1
T18	[455]	No	Yes	No	No	Literature Review, Design Workshops	20	0
T19	[603]	No	No	Yes	No	(Re-iterative Design Research Approach based on broad Literature Review), Focus Groups	4	3
T20	[31]	No	No	No	No	Literature Review		0
	Summary	*0*	*7*	*9*	*1*			

Table 4.4 Systematic Literature Review Accepted Taxonomy Papers (compare [266])

ID	Resource	Number of LTI descriptions (Placeholders, Anti-Patterns)
W1	[146]	30 (0, 0)
W2	[153]	5 (0, 1)
W3	[4]	33 (0, 0)
W4	[141]	1 (0, 1)
P1	[199]	5 (0, 0)
P2	[589]	10 (0, 0)
P3	[468]	1 (0, 0)
P4	[404]	6 (0, 0)
P5	[374]	3 (0, 0)
P6	[151]	3 (0, 0)
P7	[615]	5 (0, 5)
P8	[142]	13 (0, 0)
P9	[300]	6 (0, 0)
P10	[74]	5 (0, 0)
P11	[75]	3 (0, 0)
P12	[76]	3 (0, 0)
P13	[108]	3 (0, 0)
P14	[65]	1 (0, 0)
P15	[103]	6 (0, 0)
P16	[469]	2 (0, 0)
P17	[131]	1 (0, 0)
P18	[145]	10 (0, 0)
P19	[152]	11 (0, 0)
P20	[262]	2 (0, 0)
P21	[198]	2 (2, 0)
P22	[391]	3 (3, 0)
P23	[98]	1 (1,0)
P24	[516]	2 (2, 0)
P25	[461]	1 (1, 0)
P26	[26]	6 (6, 0)
P27	[527]	4 (4, 0)
P28	[399]	3 (3, 0)
P29	[603]	20 (20, 0)
P30	[591]	2 (2, 0)
P31	[385]	7 (7, 0)
P32	[107]	1 (1, 0)
P33	[555]	2 (2, 0)
P34	[488]	9 (9, 0)
P35	[594]	5 (5, 0)
P36	[35]	2 (2, 0)
P37	[163]	6 (6, 0)
P38	[373]	1 (1, 0)
P39	[559]	4 (4, 0)
P40	[96]	1 (1, 0)
P41	[639]	1 (1, 1)
P42	[452]	1 (1, 0)
P43	[646]	3 (3, 0)
P44	[31]	5 (5, 0)
P45	[327]	2 (2, 0)

Table 4.5 Systematic Literature Review LTIs by Sources (compare [266])

4.1.1 Team Leadership Interaction Descriptions

In the systematic literature review 4 web-resources and 45 articles, three of which also include leadership interaction taxonomies, were included as resources on interaction descriptions supporting team performance in line with a humanistic idea of human beings (*"Menschenbild"*) (SRQ 2). 262 leadership interaction descriptions were named in accepted resources (SRQ 2.1). Yet, many do not include extensive guidelines of application or case examples that can be used as learning resources. The complete list of named leadership team interactions can be found in a technical report [264]. Table 4.5 shows counts of interaction descriptions accepted in the systematic literature review related to resources they are from.

The collection of leadership team interaction descriptions retrieved in the systematic review is used in the development of a team leadership ontology described in section 6.5, page 165.

4.2 Approaches to Team Leadership Learning

While experience-based learning activities have a long history in business and educational contexts, experience-based leadership development is an approach rather recently taken [23, p. 281]. Many leadership development strategies revolve around action learning [456] used to increase reflection, problem-solving and decision-making skills. Typical leadership development activities include [155, p. 434]:

- feedback,
- coaching,
- mentoring,
- consulting,
- networking,
- action learning,
- specifically designed job assignments,
- case studies,
- computer simulations,

- leadership trainings by internal or external experts, and
- experiential learning opportunities.

Bolden et al. [91] review several leadership development opportunities in private and public institutions. Table 4.6 lists presented leadership development initiatives alongside significant aspects. Most presented initiatives feature some kind of reflection activity, yet no reflection process model.

Dalakoura [155] differentiates between leader education and leadership education. The first describes an individualistic view on personal development. The latter defines as a social process involving all participants of an organization highlighting each members responsibility towards organizational directives. Leadership development focuses on the capacities of people within an organization to effectively contribute to leadership processes [155, p. 438], [158, p. 586], [176]. It is necessary in complex, unpredictable organizational contexts [483], [412], [402], [71], [299], [68], [335], [144], [538]. *"The successful integration of the leadership development program into everyday organizational practices is a critical success factor to effective leadership development at all levels [155, p. 434]."* Successful integration is depending on the support of organizations' top executives.

A leadership learning model specifically dealing with psychodynamics within organizational contexts is presented by James and Arroba [319]. *"Those taking up leadership roles are part of the system in which they exercise leadership, and leadership can only be understood by considering the leader-system dynamics [319, p. 300]."* They conceptualize two dynamic, interlinked key abilities of leaders in organizational systems focusing on emotions and behaviors related to underlying emotions, namely:

- Reading: *"to Read what is less obvious and below the surface in organizational systems [319, p. 299]"*, considering a situations' context, and
- Carrying: *"to manage what is Carried by those in leadership roles [319, p. 299]"*, tuning into personal thoughts and feelings present in a situation and making conscious choices about action taking.

This model can be seen as a bridge to learning about emotion and emotionality in complex organizational circumstances. *"An understanding of leadership behaviour as emerging from the interaction of the individual personal characteristics of the leader, the group and the organization dynamics that he or she enters into on taking up a leadership role can help managers develop a more fine-grained approach to intervening in their organizations [319, p. 304]."*

Programme	**Highlights**
NHS Chief Executive Programme	Vast amount of learning options from action learning to modular programmes. Participants are free to choose activities. This implies that each activity contributes to developing leadership qualities.
NCSL Leadership Development Framework	Different career stages and organizational levels are considered. The model seeks to develop leaders continually.
ACEVO - Leadership Journey	Emergent group learning process to develop and examine leadership capabilities. 12 executives from different organizations join in a peer learning experience for one year. The programme is run by a consultancy organization. It holds action learning sets and individual as well as group challenges in sequences of two-day residential modules. A focus is set on peer group interaction.
Lead2Lead	Participants from (often different) organizations are carefully paired up together. They receive training in observation and reflection techniques. Then they shadow each other on their workplaces. Lastly they engage in a facilitated debriefing session.
International Masters in Practising Management (IMPM)	A degree programme combining management development with management education. It focuses on developing managers in their own jobs and organizations. The programme is designed following a particular collection of mindsets: the reflective mindset referring to *"managing self"*, the analytic mindset referring to *"managing organizations"*, the worldly mindset referring to *"managing contexts"*, the collaborative mindset referring to *"managing relationships"* and the action mindset referring to *"managing movement"*.
The Leadership Game	The Leadership game is an action learning event for experienced managers. It integrates experiential learning with expert analysis, feedback and coaching in a two-day programme. It is run in conjunction with the Tavistock Consultancy Service. Focus is set on contextualizing emotional dynamics and dealing with authority or giving and taking. Emotional aspects of leadership can be explored in context and through activities.

Table 4.6 Leadership Development Programmes (from [91])

James and Arroba [319] describe a leadership development programme consisting of two 5-day modules and a final follow-up day. In the first module, participants of the programme, usually middle to senior managers of average age around mid- to late thirties, are provided with information on leadership and organizational system dynamics in the form of lectures. Some months later, participants meet again. During the second module, a team of three tutors accompanies them in exploring collective, hidden and unconscious aspects of organizational systems in reflective processes. *"The experiences of the tutors as part of the system are a rich source of intelligence about the dynamics of the learning organization created for the week [319, p. 308]."* Participants are seen as actors from and returning to a particular organizational system. A focus is set on looking *"underneath the surface"* and to foster awareness within participants about emotionality in organizations.

On the first day of the second module, after some input from the tutors, participants present and analyze on scenarios from their work environments in small groups along with the tutors. On the second day, participants reflect on their personal models of leadership and authority, personal experiences with leadership and authority figures and assumptions about leadership and the choices they make in their leadership role during a series of exercises. Emphasis is set on what participants carry with them in leadership situations. The third day, reading organizational dynamics is central. Theoretical psychodynamic concepts are anchored and discussed in the context of case examples of management teams, individual leaders and organizations. After this, an intergroup exercise is offered. Tutors provide a list of organizational roles and participants choose their role. It resembles a business simulation, however, the only information given are a name for the organization and its business sector. While participants choose their role in the organization, tutors take up roles such as shareholders, journalists or customers. They take part in the system to be studied. The exercise has a duration of about three hours. Following, experiences made during the exercise are reflected.

The next day, participants are further debriefed. *"At this point the debrief is allowed to flow between Reading the dynamics of the organization as a system created in the intergroup exercise and a personal exploration of what was being Carried into, during and out of the exercise in terms of personal feelings, thoughts and experiences [319, p. 312]."* The reflective process highlights the importance of processing the experience. Participants can explore the ideas of providing opportunities to reflect experiences in work situations in the organizations they work in and how they can assist their staff to reflect and process complex workplace experiences. *"This stage of the module is about taking the notion of unconscious*

and organization dynamics back into the workplace and away from the here-and-now events of the programme, so the afternoon is spent in small groups in which participants have an opportunity to explore their leadership roles in depth [319, p. 312]."

On the final day of the module, participants first work on careers. Lastly, participants are invited to personally shape a collage that captures what the week meant to them. The role of the tutors during the second module is varied. They are lecturers, facilitators of interpersonal processes, consultants, and coaches. In reflection processes, they frequently offer hypotheses on system dynamics based on their experiences while taking part in the programme module, as opposed to giving (prescriptive) expert feedback. *"Being able to recognize that Reading organizational dynamics is a difficult and not exact science, and living with the ambiguity and uncertainty of that, is part of the learning [319, p. 310].*

Haslam et al. [270] discuss a social identity approach to leadership development. In this approach, leadership is seen as a process of social influence constituted by group members' capacity to prototype, represent, co-create and champion shared social identity [572], [271], [294], [606]. Haslam et al. [272] propose three capacities for effective identity leadership:

- Reflecting on group identities within the organization,
- Representing participants of these identities, and
- Realizing identity-related aspirations of group members.

The ASPIRe (Actualizing Social and Personal Identity Resources) diversity management model outlines three core phases of activities in order to differentiate employees' organizational identities and eventually align them as components of an organic superordinate identity [270, p. 2]. The leadership capacities map to three workshops associated with the three core phases of the ASPIRe framework.

Before the first workshop, interested peers participate in a Readying session. They receive information on group and social identity processes related to leadership and organizational development. Next, participants enter a Reflecting workshop. Subgroup identities that matter to particular groups of employees in participants' organizations are identified - by means of social identity mapping [149], [188]: *"This mapping process asks people to identify the group – typically a subgroup (e.g., a work team or unit) – that they identify most strongly with in their organization and then (a) to identify the main other groups that their (sub)group has dealings with and (b) to indicate the nature of relations between their (sub)group and these other groups [270, p. 3]."*

In the following Representing workshop, goals and aspirations associated with subgroup identities are differentiated. Obstacles to achieve goals are clarified. In the last workshop concerned with Realizing, consent is searched for superordinate goals. Further, strategies that allow superordinate goals and important subgroup goals to be achieved are shaped. *"Importantly, after each of the three core workshops, participant leaders are instructed to work with the teams for which they have responsibility by taking them through the various activities that leaders have learned about and trialled in the workshop – thereby effectively guiding team members through the ASPIRe process [270, p. 3]."* In the beginning of workshops, leaders share experiences they had implementing the ASPIRe process in their organizations.

Workshops end in a Reporting session, discussing the importance of receiving feedback on subgroup and superordinate goals. During the whole programme leaders can work directly with groups they are engaged in leading.

Hezlett [281] points out aspects to consider to support experience-based leadership development:

- Not all learning experiences happen in work contexts [408],
- Too much or too little challenge may result in less development [121], [172], [413], and
- Reflection processes may be underpinned with feedback (by peers or experts) and structured reflection protocols [281, p. 380], [412], [16], [197].

Part II

Design Search Process

Chapter 5

Knowledge Context

Design science research problems are frequently improvement problems. Problems have a context in which improvement is aimed for. To understand the design problem it is necessary to understand its embedding context [630]. The knowledge context provides a theoretical frame for design elaboration. It is based on existing scientific or engineering theories, current design specifications, useful facts about currently available artifacts, lessons learned from other design science research projects and common sense [614, p. 208-224].

Figure 5.1 depicts a context model in which a team leadership learning framework can be operated.

Team leaders are team members interacting with other team members - and stakeholders - within organizational constraints. The team has a particular size and setup. Organizational values are subtly influencing interpersonal issues in the team. Interpersonal issues or challenges emerge in the course of a teams' work towards shared goals. Projects can, for example, be seen as team environments that have a defined or flexible scope, are constrained in time and continue to exist related to a limited budget. Interpersonal interactions of team members and stakeholders contribute to team performance. Team performance increases value in products or services for customers and in profit for the organization. In teams, individuals with unique attitudes and experiences in interpersonal relations, in communication, and in their field of expertise work together. They have various motivations for contributing to team tasks. Together, team members generate a unique dynamic group configuration. The team interacts with users, customers, and other stakeholders to develop an artifact. Interaction partners can contribute to, e. g., requirements analysis, producing, decision-making, planning, or conflict resolution.

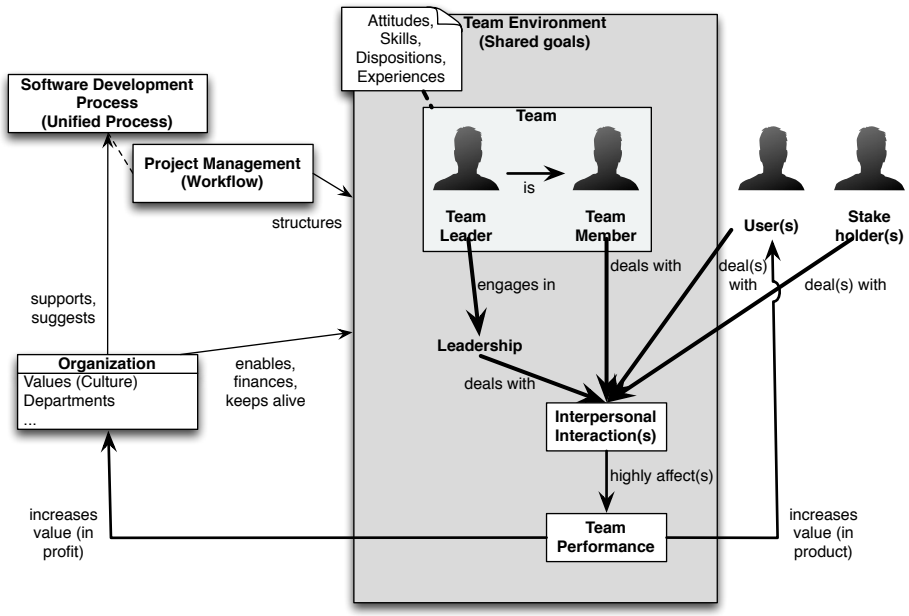

Figure 5.1 Framework Context Model (compare [265])

Subsequently, the context model is characterized in detail. It is a conceptual framework for artifact design.

Significant phenomena are described in order to shape design efforts [630]. Descriptive generalizations - design guiding principles emerging in the problem domain - function as propositions for artifact design and implementation (section 5.5, p. 108).

5.1 Team Environment

Organizations are engaged to deploy teams and team-based structures to increase productivity and quality, enhance participation and improve customer contact [140], [248]. Changing environmental conditions, such as shorter innovation or product life-cycles, complex problems, advances in technology or extensive collaboration with clients, demand flexibility and adaptability. Teamwork is important to successfully encounter such work challenges [416], [110]. Working in teams is prevalent in ICT projects [588, p. 25], [165].

The combined effort of persons with different attitudes and experiences working together as a team creates dynamic capabilities to deal with uncertainty and changing demands [517, p. 62], [463, p. 51]. Katzenbach and Smith [331] highlight: *"Teams are not the solution to*

everyone's current and future organizational needs. They will not solve every problem, enhance every group's results, nor help top management address every performance challenge. Moreover, when misapplied, they can be both wasteful and disruptive. Nonetheless, teams usually do outperform other groups and individuals. They represent one of the best ways to support the broad-based changes necessary for the high-performing organization. And executives who really believe that behaviorally based characteristics like quality, innovation, cost effectiveness, and customer service will help build sustainable competitive advantage will give top priority to the development of team performance (p. 24/25)."

5.1.1 (Social) Group

A (social) group can be defined as: *"any set of human beings who either are, recently have been, or anticipate being in some kind of interrelation [3]."*.

Haslam et al. [272] argue that what turns a collective of people into a (social) group is based on social identity - deriving a sense of self from group membership (p. 50) - and self-categorization - the cognitive process of recognizing oneself as a member of a group (p. 52). Personal interest factors such as attraction, trust or similarity can be described as outcomes of group formation [272, p. 58/59], [294], [6], [584].

5.1.2 Team

A team can be seen as a strongly interdependent social group [209, p. 10]. Salas, Dickinson, Converse, and Tannenbaum [521] define *"team"* as a distinguishable set of two or more people who interact dynamically, interdependently, and adaptively toward a common and valued goal/objective/mission, who have been assigned specific roles or functions to perform, and who have a limited life span of membership (p. 4). This definition is close to Johnson and Johnsons' [324] characterization: *"A team is a set of interpersonal interactions structured to achieve established goals. More specifically, a team consists of two or more individuals who*

- *are aware of their positive interdependence as they strive to achieve mutual goals,*
- *are aware of who is and is not member of a team,*
- *have specific roles or functions to perform,*
- *and have a limited life span of membership (p. 532)."*

Constructing the ALL Teamwork Framework, Baker et al. [38] differentiate four team characteristics:

- two or more individuals
- shared or common goals
- task interdependency
- desired productive outcome

Teams may be classified depending on the context they operate in [324, p. 534].

In summary, a team consists of two or more individuals who interact to interdependently achieve one or more common goals that are directed toward the accomplishment of (a) productive outcome(s).

5.1.3 Teamwork Features

Patzak and Rattay [465] see the following aspects of teamwork as potentially advantageous in business environments (p. 55/56):

- More creativity
- Productive competition through reciprocal motivation of team members
- Direct communication accelerating information distribution
- A view on a problem that is more whole than individual views alone
- Identification of the team members with the team solution
- Team decision-making generating higher acceptance of choices
- Support of individual learning in the team

They further describe potential disadvantages of teamwork in business settings [465]:

- Communication in the team is time intensive
- Discussions can go in *"unproductive"* directions
- Very heterogenous teams need time to find team norms and rules

5.1.4 Project

Sterrer and Winkler [574] define projects as temporary tasks with specific features (such as risky, unique, socially or technically complex, or dynamic). They can be distinguished from other organizational task work by higher complexity. They are embedded in a project specific environment that influences project directions.

Patzak and Rattay [465] define projects as time-constrained, complex endeavors. This means that every project from its beginning has a speculated project goal and end. Essentially, projects can be distinguished from other organizational tasks through a unique constellation of environmental conditions that inherently involve uncertainties in project progression (p. 18).

ICT projects may be defined as projects where significant aspects of the product or result are dependent on ICT [561, p. 4]. Jacobson et al. [317] provide the following definition of software development project: *"A software development project transforms a 'delta' (or change) of users' requirements into a delta (or change) of software product ... [317, p. 87]."*. Customers define value for the organization the project is embedded in, while other stakeholders define constraints [283, p. 13].

In order to differentiate project team environments, Zhou, Cheung and Hsu [650] developed a dimensional scaling model of project teams, depicted in figure 5.2. They compared taxonomy classification systems of project teams and found 7 common underlying distinguishing dimensions:

- Skill differentiation (Main dimension)
  This dimension describes the functional and demographic diversity of teams including gender, age, education, and work experience.

- Interdependence (Main dimension)
  This dimension includes collaboration, coordination, cooperation, integration and other interpersonal relations team members form to work together towards project goals. Also external interdependence is represented here.

- Authority differentiation (Main dimension)
  This dimension reflects the degree of team member participation in decision-making.

- Virtuality (Secondary dimension)
  This dimension measures the extent of virtual tool use to coordinate and execute team

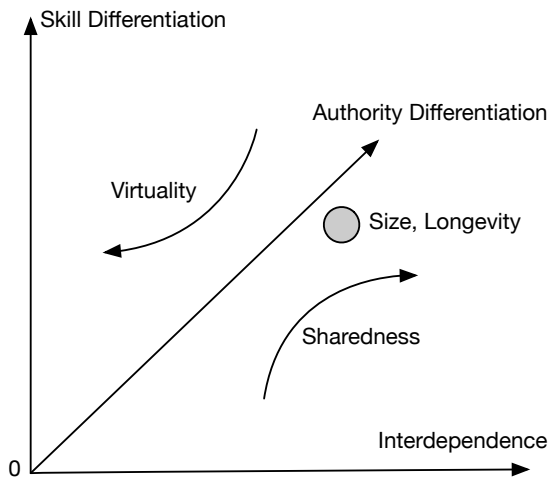

Figure 5.2 Dimensional Scaling Project Team Model (compare [650])

processes, informational value provided by these tools and interaction of team members using such tools [337, p. 700].

- Sharedness (Secondary dimension)
  This dimension describes shared team cognition such as shared team mental models [406], shared team situation models [498], shared goal orientation [15] and shared knowledge [355].

- Team size (Peripheral dimension)
  This dimension measures the number of team members.

- Longevity (Peripheral dimension)
  This dimension represents how long team members work together within a project.

The priority of dimensions may change depending on the given situation. In the model diagram, a point represents the project team moving along the arrows. Secondary dimensions are shown as curved lines for their relationship to main dimensions is not linear. Peripheral dimensions are represented as size (team size) and color shade (light color represents a short-term project, dark color a long-term project) of the point representing the team.

To sum up, in a project team people work together under conditions that are unique to the particular organizational setting in order to achieve goals that emerge from these unique circumstances and set (or at least allow to estimate) a time-frame to project closure or goal achievement. People engage in a project process to elaborate some kind of product [317].

5.1.5 Teams in Information and Communication Technology Projects

ICT projects have specific characteristics that influence team work. Taylor and Woelfer [634] differentiate the following aspects that require special attention from project leaders (p. 4/5):

- transience, changing and interdisciplinary membership and lack of co-location of team members
- high levels of uncertainty and ambiguity, technical complexity, and task interdependency
- requirement of team members with specific technical knowledge and skills - often in demand across an organization
- project leaders as interface between the team and internal as well as external other parties, such as clients, users, contractors or suppliers.

Table 5.1 presents differences between non-technical and ICT projects uncovered by Snyder and Parth [561, p. 12].

Non-technical Projects	**ICT Projects**
Usually have a dedicated team.	Project team is shared with other projects and with daily operations.
Are months and sometimes years long.	Are usually weeks long and occasionally months long, rarely years long.
Include team development.	Do not have enough time to do team development.
Have a well-defined priority.	Have multiple priorities that often change.
Technological risk is often constant during the course of the project.	Technological risk is different across different projects.
Team members work on predefined tasks in one project.	Team members must multitask across different projects as well as with daily operations.

Table 5.1 Differences between Non-Technical and ICT Projects (from [561, p. 12])

Major challenges of ICT projects - or communication problems internal and external to ICT project boundaries - can be identified in subsequent areas [36, p. 4/5]:

- Scope: Linkage between business processes and project goals or objectives, integrated view of project requirements, effective use of project management and software development methodologies
- Costs: Estimates, effective funding approval processes, understanding of technical interfaces

- Schedule: Activity-based instead of deliverables-based schedule, integrated master schedule, consistent task assignment
- Quality: Measurements for deliverable completeness, consistent and complete project plans and deliverables, understanding of completed deliverables
- Stakeholder satisfaction: Communication of project completion criteria, communication of solutions to requirements through deliverables, adequate reporting
- Effort: Reuse of deliverable and processes, clear roles and responsibilities, consistent use of tools, techniques and processes.

ICT project teams exist for the duration of the project. They are typically interdisciplinary. Team members may work in several project environments simultaneously. Teams may be geographically dispersed. People may work together in virtual teams. *"Electronically linked teams or virtual teams are a specific form of teams, meaning that face-to-face meetings take place seldom or not at all [209, p. 11]."*

ICT projects frequently imply uncertainty, complexity and task interdependence. Mantei [398] compared three team structures found in ICT business, distinguished primarily on the dimensions decision authority (one person - more team members) and centralization of communication exchange (centralized - decentralized), in their suitability for programming tasks to be performed. She argues that the success of a team structure depends on the task to be accomplished. Team structures that support one aspect of a task may be wrong for another [398, p. 111].

5.1.6 Team Development

Team efforts and team organization change over time. Tuckman and Jensen [602] propose a widely known and frequently cited sequential team development stage model synthesizing findings of more than 50 research papers. It explicates the following five phases:

- Forming
  Team members in this phase focus on orientation within the team environment. They meet each other and agree on goals. Interpersonal as well as task boundaries are tested. Dependency relationships with leaders, other team members or preexisting standards are established. *"... members usually behave positively and politely and might be anxious out of uncertainty [209, p. 17]."*

- Storming
  Interpersonal conflict and polarization together with emotional reactions to task work are core to this team development phase. These behaviors may be interpreted as resistance to team influence and task requirements. *"In this difficult phase conflicts arise between team members and they confront each other. Team members realize how much work there is to do; they might question the goals and approaches of the team or might resist doing their work [209, p. 17]."*

- Norming
  In this phase, team cohesion develops, new standards are set and new roles are taken in. Personal opinions are stated concerning tasks. *"During this phase, team members agree on rules, boundaries, values, working methods and processes. Motivation is usually high and a sense of team cohesion is established [209, p. 17]."*

- Performing
  In this team development phase, team members' roles become flexible and functional. Interpersonal team structure elaborated in prior phases can now support task performance. *"When teams reach the performing stage, they perform their tasks effectively and interdependently and need little external guidance. By now team members know their roles, strengths and weaknesses, have insight into the team processes and manage arising conflicts [209, p. 18]."*

- Adjourning
  From a life-cycle perspective on team development, separation is an important issue for many team members. *"In the fifth phase, adjourning, the team completes its task and reaches personal conclusions [209, p. 18]."*

It is important to notice that in this model every team member is seen to participate in each team development phase.

Besides sequential stage models depicting a linear team development process, recurring phase models - defining team phases that members may or may not participate in - can be found in research on team development [324, p. 27/28].

5.1.7 Team Competencies

Persons in interpersonal relationships are central to teams. Competency can be described as the characteristics - such as knowledge, skills, mindsets, or thought patterns - that, when

applied, result in successful performance [181]. Parry [464] sees competencies as clusters of related knowledge, skills and attitudes that affect job aspects and correlate with performance, can be measured against standards, and that can be enhanced via training and development (p. 60). Team competencies are the qualities of a team, on an individual as well as on a team level, that facilitate working together effectively [37, p. 5], [118]. They are a main factor for team performance in a work environment [209, p. 39]. A team effectiveness model developed by Cannon-Bowers, Tannenbaum, Salas, and Volpe [119] highlights that team competencies influence team performance besides environmental, personal and task factors. Similarly, Rasker, van Vliet, van den Broek, and Essens [491] see individual and team factors together with organizational, situational and task factors comprising the operational environment of teams.

Organizational and situational configurations, such as supervisory control or available resources, frame the team environment. Task characteristics, such as task organization, task type and complexity, as well as work characteristics, such as team norms and work structure, influence individual task competency, based on motivation, attitudes, and team competency. Individual task competencies together with team competencies of team members determine team effectiveness.

Cannon-Bowers et al. [119] differentiate three clusters of team competencies for effective teamwork: team knowledge competencies, team skill competencies and team attitude competencies (p. 5):

- The first refers to knowledge about what team skills are required and how they are applied as well as when particular team behaviors are appropriate. Moreover, it is knowing about the mission and objectives of the team as well as the responsibilities and relationships of the team members.

- The second is defined as learned capacities to interact with other team members at some minimal proficiency level. In a broad literature review, Cannon-Bowers et al. [119] sorted 130 team skill competency labels into eight categories: adaptability, situation awareness, performance monitoring/feedback, leadership, interpersonal relations, coordination, communication, and decision-making, which are all directly related to team performance.

- Team attitude competencies, found in the third cluster, are described as internal dispositions that influence team member's choices or decisions to act in a particular way.

<table>
<tr><th colspan="2">Attitudes and Experiences</th><th colspan="2">Skills</th></tr>
<tr><td>Attitudes and Dispositions</td><td rowspan="3">Group Decision Making/Planning (Problem identification; Information gathering, evaluation, and sharing; Understanding decisions; Setting goals)</td><td rowspan="3">Adaptability/Flexibility (Assistance; Reallocation of tasks; Providing and Accepting Feedback; Monitoring and adjusting performance)</td><td rowspan="3">Interpersonal Relations (Sharing work; Seeking mutually agreeable solutions; Considering different ways of doing things; Managing and influencing disputes</td></tr>
<tr><td>Experiences</td></tr>
<tr><td>Implicit Theories about Teamwork</td></tr>
<tr><td colspan="4">Communication (Providing clear and accurate information; Listening effectively; Asking questions; Acknowledging requests for information; Openly sharing ideas; Paying attention to non-verbal behavior)</td></tr>
</table>

Figure 5.3 ALL Teamwork Model (compare [38, p. 240])

Cannon-Bowers and Salas [118] delineate three types of team knowledge, skills, and attitude competencies (p. 6):

1. Individual competencies are knowledge, skills and attitudes of team members needed to perform on task requirements.

2. Team competencies held at the individual level are knowledge, skills and attitudes of team members that can be transported between various teams and team environments. These include knowledge about teamwork skills, skills in communication and decision-making, or an orientation towards teamwork.

3. Lastly, team competencies held at the team level are knowledge, skills and attitudes of team members specific to a particular team and work task.

Baker et al. [38] developed the ALL Model for Understanding Teamwork based on Cannon-Bowers' et al. [119] categorization and Cannon-Bowers' and Salas' refinements [118] in the course of the Adult Literacy and Life skills survey (ALL). The ALL is an international comparative study measuring skills that are important in everyday work life carried out by the Government of Canada, the US National Center for Education Statistics (NCES) and the Organization for Economic Cooperation and Development (OECD). Team knowledge, skill, and attitude competencies within the ALL model for understanding teamwork that are held at the individual level and relate to team performance were derived in a comprehensive literature review on teamwork models [37, p. 6].

Figure 5.3 depicts core competencies of the ALL framework. Team skill competencies are [38]:

- Communication,
  defined as *"establishing effective communication between self and others; it involves the exchange of clear and accurate information and the ability to clarify or acknowledge the receipt of information (p. 238)"*,

- Group decision-making/Planning,
  defined as *"the ability of a team to gather and integrate information, use logical and sound judgment, identify possible alternatives, select the best solution, and evaluate the consequences (p. 238)"*,

- Adaptability/Flexibility,
  defined as *"the process by which a team is able to use information gathered from the task environment to adjust strategies through the use of compensatory behavior and reallocation of intra-team resources (p. 238/239)"*, and

- Interpersonal relations,
  defined as *"broad area that encompasses cooperation and dealing with conflict within the team. Therefore, effective interpersonal relations include working cooperatively with others, working together as opposed to working separately or competitively, and resolving disputes among team members" [38, p. 238].*

Leadership was not considered in the framework. The focus of the ALL model for understanding teamwork is dealing with the ability to work in a team, not to lead one - potentially hinting at an implicit role-bound definition of leadership.

Knowledge competencies are critical elements of each core skill competency. Communication is considered as the basic team skill competency because it enables the expression of attitudes and experiences and is needed for the other three core skill competencies.

Two specific attitude competencies are described in the ALL teamwork framework [38, p. 239]:

- Belief in the importance of teamwork,
  defined as *"the belief that teamwork is critical for successful performance of team tasks"* and

- Collective orientation,
  defined as *"an attraction to, or desire to be part of, a team"*.

Team attitude competencies have an effect on the realization of team skills in practice [38, p. 246].

Teamwork competencies like communication, decision-making, flexibility [38, p. 240], productive conflict resolution, role clarity, or accountable interdependence [7] contribute to effective working together. In summary, personal attitudes, skills and knowledge as well as the interpersonal climate among team-members can be seen as important ingredients of teamwork. These affect how competencies are put into practice and, directly or mediated via competencies, influence team performance.

5.1.8 Team Performance

Teams are collectively responsible for creating value for stakeholders. Baker and Salas [39] highlight that teamwork (or process) skills just as team inputs and outputs are not readily quantifiable. Assessing team performance in practice situations is complex [390], [407]. Reviewing leadership in team contexts, van Knippenberg [611] recognizes a lack of integrative process theory of team performance (p. 359).

5.1.8.1 Definition

In research articles, the terms *team performance* and *team effectiveness* are both used to either conceptualize (measurable) outputs of team work or to group team processes to arrive at team work results.

Salas, Cooke and Rosen [520], for example, define team performance as *"multilevel process (and not a product) arising as team members engage in managing their individual- and team-level taskwork and teamwork processes [359] in: [520, p. 541]."* Team effectiveness is *"an evaluation of the outcomes of team performance processes relative to some set of criteria [252] in: [520, p. 541]."* Performance is the activities engaged in when working on a task, while effectiveness involves appraisal of outcomes of that task. Similarly, Lyubovnikova et al. [390] see team performance widely accepted as a function of a multifaceted cluster of team members' inputs [512] that may be assessed subjectively or objectively by the extent a team meets objectives [644]. The degree to which standards of quality, quantity and timeliness of stakeholder expectations are met can be congregated as team productivity, a key dimension of team performance [338]. Team effectiveness, capturing the capability of a team for cooperation, using skills to generate ideas and develop its work can be portrayed as constitutive part of team performance besides team productivity [410]. Hackman and Wageman [255] explain team effectiveness as a cluster of three team performance processes:

task motivation of team members, the appropriateness of strategies to work on team tasks, and the amount of skill and knowledge team members bring to the task.

Cohen and Bailey [140] specify three major dimensions of team effectiveness: performance effectiveness (or productivity), attitudinal outcomes such as satisfaction or commitment, and behavioral outcomes observed, for example, in absenteeism or turnover.

Van Knippenberg [611] argues that team work results in performance of a job or task. Team performance is thus an output of team processes at the team level (p. 346). A dynamic input - throughput (or process) - output team effectiveness model that shows team performance as outcome of team processes is presented by Tannenbaum, Beard, and Salas [587]. Team performance in this model feeds back to individual and task characteristics that again influence work structure and team characteristics.

Pina et al. [478] differentiate a unidimensional model of team effectiveness using objective measures of team performance or team productivity [545], [350], [573] from a multidimensional model including more aspects to team effectiveness than objectively measurable facets [252], [256], [449], [254] (p. 8). Team effectiveness can be described including three components: team performance (including objective team performance and subjective assessments), perceived team viability (discussing whether team members may continue to work together), and team member satisfaction with the team and co-created values [326].

In this thesis, team performance is defined as a combination of team and individual task work (reciprocally influenced by team members' individual and team competencies and embedded in an organizational and situational setting) in order to meet or exceed standards for a product or processes of stakeholders. Effectiveness in work teams is the extent whereto a team meets or exceeds standards for a product or processes of stakeholders [252]. It is linked to stakeholder satisfaction, a dimension of project success (besides delivering on time and within budget).

5.1.8.2 Qualities

The Center for Creative Leadership (CCL) outlines the following features of team effectiveness:

- outcomes meet or exceed stakeholder expectations,
- team members feel satisfied with process and elaborated products,

- team members could learn [328, p. 7].

Further, dimensions of team effectiveness are specified, namely: a clear purpose, empowering team structure, strong organizational support, positive team internal relationships (or high quality of team member exchange), harmonious external relationships and efficient information management [328, p. 9/31].

Hackman [250] proposes to consider the following factors of team effectiveness: an engaging clear direction, good team design (including motivating, clear task structures, composition of team members, established team norms), and a supportive organizational context providing learning possibilities for team members. Moreover, an enabling performance situation - having sufficient knowledge, skill and strategies to tackle a task - as well as expert coaching and process assistance - helping team members to work interdependently and promoting autonomous work within the team - are mentioned.

Johnson and Johnson [324] highlight that an effective team is more than the sum of its parts. Team members commit themselves to maximize personal and other team members' success. They engage in working together and believe that team success depends on the efforts of all its members. Team members in high performing teams work interdependently and personally accountably towards clear operational goals. Features of such teams are two-way communication, distributed leadership, and power based on expertise. High performing teams feature a decision-making process that invites team members to challenge one anothers' information and reasoning and to work out conflicts constructively (p. 20).

5.1.8.3 Key Dynamics

In the research project *Aristotle*, the tech-giant Google set out to uncover what makes teams within the company perform.

An organizational belief was that it is the combination of people within a team - putting the best heads together - that fundamentally predicts team performance [182]. Van Knippenberg, when discussing a functional leadership perspective, suggests that making the right decision in composing the team - a situation many designated team leaders may not find themselves in - may be more important than leadership during team task performance [611, p. 360]. Belbin [69] discusses assignment of appropriate roles based on personality characteristics. Royce [513] describes having few, but the best people on a team as the number one principle of software project management. In the teams studied in the *Aristotle* project no significant evidence could be found that team composition was key to team performance. After more

than 200 interviews with Google employees and searching patterns in more than 250 attributes of more than 180 teams at the company, researchers unveiled five key dynamics of high performing teams shown in figure 5.2.

1	Psychological Safety	Team members feel safe to take risks and be vulnerable in front of each other.
2	Dependability	Team members get things done on time and meet Google's high bar of excellence.
3	Structure and Clarity	Team members have clear roles, plans, and goals.
4	Meaning	Work is personally important to team members.
5	Impact	Team members think their work matters and creates change.

Table 5.2 Team Performance Key Dimensions at Google (from [514])

In high performing teams that participated in the project, researchers could find an equality in distribution of conversational turn taking. This means that in some teams, team members each spoke during each task, or that leadership shifted between team members from task to task. Yet, every person on the team spoke approximately the same amount of time. Moreover, team members in high performing teams showed average social sensitivity, which means they could emotionally attune to each other to a moderate extent. Average social sensitivity as well as equal distribution of turn-taking were considered aspects of psychological safety, *"a sense of confidence that the team will not embarrass, reject or punish someone for speaking up [187] in: [182])."* Psychological safety describes a team climate of interpersonal trust and respect in which team members are comfortable being themselves. *"Individuals on teams with higher psychological safety are less likely to leave Google, they're more likely to harness the power of diverse ideas from their teammates, they bring in more revenue, and they're rated as effective twice as often by executives [514]."*

Interestingly, overlaps between dimensions of team performance presented by the CCL [328] and Hackman [250] and key dynamics of high performing teams in the *Aristotle* project can be found. Clear purpose and direction, efficient information management as well as team structure considerations relate to structure and clarity.

Strong organizational support and inspecting the quality of internal and external relationships link to dependability and psychological safety. The Standish Group ranks executive sponsorship, which is defined as emotional and financial backing of a project, emotional maturity, so-called soft skills, and user involvement in project decisions as the most important factors for success in ICT projects [273]. Social interdependence theory describes a process of interpersonal acceptance based on individuals promoting mutual goal accomplishment as

a result of their perception of positive interdependence that impacts team performance [324, p. 100/124/125]. Group potency, team members belief that they are effective as a team, may be attributed to dependability [209].

Personal meaning of work to team members and considerations on impact of the teams' work are not explicitly represented in CCLs and Hackmans' models. Yet, if individual efforts can not be distinguished from others' in a work team, social loafing may occur [50], [209, p. 11/12]. Strategies to reduce social loafing include increasing the perceived value of a task, regarding individual contributions as important, or fostering team cohesion and team member commitment [50, p. 447/448] in: [209, p. 12].

Similar to results of the *Aristotle* project, findings by Adams, Ruiz and Simon [7] highlight that a common purpose, clear goals and roles, accountable interdependence, mature communication, conflict resolution as well as psychological safety can promote team performance.

Team members' health significantly contributes to team performance [548], [466].

In a study by Liu and Cross [387] working out key factors of project team technical performance, 133 project teams were asked on influence factors on team performance technical outcomes, namely on effectiveness, efficiency and innovation.

- Effectiveness is defined as the extent to which project outputs achieve performance expectations of key stakeholders [596] in: [387].
- Efficiency in this study is the ability of the team to meet budget and schedule goals [414] in: [387].
- Innovation is defined as creative accomplishments of a team in generating new ideas, methods, approaches, inventions or applications [361] and the degree of novelty of project outcomes [159] in: [387].

Table 5.3 delineates measurement approaches for each of these technical team performance outcomes. Often, project team performance is measured by external perceptions of managers or supervisors, followed by internal team perceptions and, lastly, by customers and stakeholders.

Of six input and six team process factors that were put in relation to team performance outputs, cooperation and team harmony (originally the team process factor cooperation) were found to be the single shared predictors of team performance. During data analysis, the construct cooperation was separated into cooperation, representing technical aspects of work

Outcome	Measure
Effectiveness	Quality, functionality and reliability of project outcomes; meeting stakeholder requirements; achieving project goals related to quality; meeting market focuses
Efficiency	Adherence to budget; adherence to schedule; resource utilization with constraints; best methods for meeting project goals; speed to market; work processes to manage the project; completion time
Innovation	Count of innovative ideas, methods, inventions or elaborated applications; number of presented patents; degree of novelty of a product; the implementation of new ideas to improve product quality; the degree of product or process improvement; the ability of predicting and adjusting market and technology change

Table 5.3 Technical Team Performance Measures (compare [387, p. 1152])

coordination, and team harmony, representing affective aspects of work coordination [387, p. 1158]. Cooperation emerged as significant positively related predictor for effectiveness and efficiency. This suggests that teams may set up effective business processes and opportunities for information flow. A moderate level of functional diversity that team members bring to the team, stable team composition or team cohesion and task-appropriate knowledge and skills of team members may promote cooperation. Team harmony was a significantly positive predictor of efficiency and a significantly negative predictor for innovation. This can be interpreted in the way that teams in which team members tend to agree with each other and have less task-related conflict, budget and schedule goals may be met more easily under resource constraints. Yet, innovative performance is reduced. Organizations that encourage innovative team work may allow for task-related conflict and keep budget and schedules more flexible.

This finding is in line with the key dynamic of psychological safety as confidence in the team to be able to speak up that team members share in high-performing Google teams (seeking innovative products or processes). Interestingly, Liu and Cross [387] found out that while task-related conflict may foster innovation, relationship conflict can reduce innovation pointing to a significant impact of team cohesion, linked to trust, team spirit and team member support, on team performance (p. 1161). They suggest project managers may *"strive for a mutually-supportive environment in which each team member is treated equally and with respect [387, p. 1161]."* Team cohesion as well as knowledge and skills of team members are significantly positively related to innovation [387, p. 1161].

Management support and communication were significantly positively related to effectiveness. *"These two findings emphasize the need for effective communication both internal*

and external to the team [387, p. 1161]." Setting clear project goals is significantly positively related to efficiency. High functional diversity is negatively linked to efficiency [387, p. 1161]. This may suggest that team diversity should be maintained at task-appropriate levels. Liu and Cross [387] argue that functional diversity may be a proxy construct for project complexity, which was not measured directly.

Higgs et al. [282] found that team diversity was positively related to performance on complex tasks, but negatively related to line tasks. Surowiecki [583] claims that diverse teams, depending on the type of tasks, under appropriate circumstances may outperform individuals.

Commitment and effort of team members, related to personal meaning and considerations on work impact, did not appear to directly influence technical project team performance outcomes in Liu and Cross' study. Leadership, too, did not appear to directly affect project team performance. Though, these team performance factors may influence outcomes in a mediated relationship [387, p. 1162]. This finding is in line with van Knippenbergs' conclusions on team leadership as aspect of the multilevel nature of team performance [611, p. 360].

5.2 Business Processes as Meaning Attractors

5.2.1 Meaning Attractors

In systems theory, structures stabilizing through recursive operation can be called attractors. A mathematical example of attractive tendencies can be found in fixed points [446]. Attractors become clearer as an attractive process shapes a system in the direction of the attractors [364, p. 94]. Kriz [364] introduces meaning attractors or sense attractors as attractor dynamics in perceiving and thinking that meaningfully reduce a perceived situation and at the same time stabilize this reduced arrangement. In this conceptualization, meaning emerges with varying intensity based on aspects such as biographical or social characteristics [364, p. 184].

In order to (inter)act within a rich experiential environment, we need to (co-)create structure [364, p. 40/41]. More structuring means more perceived control or predictability and reduced experience of the moment. Less structuring means richer experience of the moment, but less perceived control or predictability [364, p. 46].

5.2.2 Meaning Attractors in Business Contexts

"Software development processes can be seen as a way of structuring experience to simplify or enable labeling of phenomena in software development, making them accessible to perception, to communication, to evaluation, play and categorization, and thus, may form decisions and directions of the project team in the development of the product. Software development processes tap highly critical boundaries for the survival of a project, such as time-to-market, cost, schedule, product quality or user satisfaction based on prior experience of what worked and what didn't work brought into a specific structured form that got established in a particular community of people involved in ICT-projects. Therefore, software development processes may be described as a set of meaning attractors that formed through reproduction [268]." Other interpersonal (work) process descriptions that allow for structuring work environments, such as project management process descriptions, are highly relevant in complex business situations. As software development processes, they emerge from repeatedly successful practices and derive from particular practice situations. Thus, business processes may be defined as sets of meaning attractors.

Depending on the organizational environment, distinct sets of business practices form attractive tendencies. *"A flexible process can reduce interval and contribute to good communication in a domain that must deal with change. But one can't just install a process; a process must emerge from the structures of communication and production beneath it [146, p. 387/388]."* Sharing experiences with like-minded people and collecting best practice descriptions allows for retrieving repeating organizational patterns that appear supportive for dealing with work challenges. Such experiential patterns can be seen as meaning attractors that may support structuring what is frequently called organizational or, in case of the ICT industry, software development processes.

5.2.3 Project Management

Project management can be defined as *"the knowledge, tools, and techniques for controlling requirements, setting a realistic scope, creating feasible schedules, defining responsibilities, and managing expectations [342]."* How project managers interact with project team members and how they are perceived by them influences team work [147].

The division of organizational task work and interacting in interpersonal relationships is outlined by Motschnig and Ryback [439] as two agendas of project management. Katz [330]

emphasizes that project management includes human skills besides technical, conceptual and organizational skills. Human skills may include valuing team members' experiences, supporting interdependent work, fostering a shared vision, facilitating in team conflicts and establishing clear communication channels between project stakeholders. Senge [543], Ryback [517] and Argyris [24] highlight collaboration in management as essential for organizational success.

5.2.3.1 Research Perspectives

In an extensive literature review, Padalkar and Gopinath [460] differentiate three major thematic perspectives on project management in research literature (besides general themes such as comparing project management literature across industry sectors):

1. The deterministic perspective
   Since the 1960s, a focus on measuring projects regarding cost, schedule and quality as well as efficient scheduling approaches can be determined. Deterministic papers, for example presentations of prescriptive project methodologies or models, frequently have an a priori conceptual, heuristic, or theoretical basis. Most papers retrieved in the systematic literature review [460] follow this perspective. Project phenomena are seen through a reductionist lens. Conceptual and analytical models are used to elaborate efficiency-oriented methods. Project methods, project strategy and knowledge management are the most prominent topics from the years 2000 to 2015.

2. The explanatory perspective
   Starting in the mid-1980s, explanations for project phenomena, such as factors of project performance, are derived empirically. Evidence is aggregated into prescriptions, models, or frameworks for use in practice. In the systematic literature review, this perspective is described as current dominant lens of enquiry [460, p. 1309]. Empirical methods are used to research project phenomena resulting in a multitude of variables, factors, methods and practices. From 2000 to 2015, success factors, performance management, project methods and risk management were the most researched topics from an explanatory viewpoint.

3. The non-deterministic perspective
   In this perspective, gaining more relevance since the mid-2000s, projects are seen as complex social systems. Topics addressed revolve around project complexity, uncertainty, interdependence between project entities or managing project risks. From

a rather non-deterministic perspective, customer orientation as opposed to solely product orientation may appear as key of project management. Studies may blend empirical research and conceptual modeling.

Project methods, predominantly discussed from a deterministic perspective, appeared to be the largest topic in project management research within the systematic literature review, followed by success factors, risk management, performance management and knowledge management [460, p. 1310]. As phenomena such as performance, risk, project complexity and organizational factors are highly interdependent and involve intractable or unknown variables as well as human cognitive factors, Padalkar and Gopinath [460] suggest adopting a non-deterministic perspective in exploring these areas. A non-deterministic research perspective may also facilitate examining scheduling and planning by appreciating systemic interconnections of time within project phenomena [460, p. 1315].

5.2.3.2 Project Life-Cycle

In practice, project management methodologies are implemented to deal with unique organizational complexities that constitute the project environment. The Rational Unified Process, a software development methodology, offers project management task descriptions in a project management workflow [367]. Project management standards promoted by PRINCE2 (PRojects IN Controlled Environments 2), PMI (Project Management Institute), or IPMA (International Project Management Association) offer concepts, methods, measurables, and tools to facilitate project management tasks. Frequently, project management activities are situated along a project life-cycle that consists of sequential phases with work task iterations [465, p. 24]:

1. Start Phase
   A project team is constituted or forms. Project management in this phase includes working out a detailed project plan together with the team. Hereby, relevant project environmental aspects need to be considered. Finally, a project handbook is finished including detailed project plans, norms, and communication channels. The project is known to relevant project stakeholders. Clear, jointly accepted project goals [465, p. 57] and a shared project vision [543] are carried by the team.

2. Work Phase
   The team cooperates in order to create value for relevant stakeholders. Team norms and values develop. Project management focus is on team organization and decision-

making within the team, possibly including management of meetings or dealing with conflicts.

3. Completion Phase
   In this phase, project work is finished. The project team dissolves into different directions. Feedback on project work is collected and reflected. Project management may include planning a closing team workshop, planning final work tasks and post-project phases, the evaluation of project success, project work analyses and planning strategies for next steps. An important aspect of this phase is learning from paths taken together in the project and emotional conclusion within the project team.

Social factors, communication and language aspects, although considered important in practice, are hardly integrated in project management standards emphasizing project process and documentation strategies.

5.2.3.3 Project Management Experiences in the ICT Industry

Britcher [109], a former employee at IBM that participated in the FAA (Federal Aviation Administration) Advanced Automation System project, describes management in ICT as engineering practice based on planning the particulars of an endeavor and necessarily *"... imposing the laws of classical production on the lawlessness of computer programming, including the earned value system and managing reserves [109, p. 208]."* Managers define products and activities involved in creating them. They define schedules and budgets. They plan. Tasks are mapped to people or teams. *"Successful managers build in reserves: financial, schedule, and quality [109, p. 72]."* Britcher mentions a manager at IBM that only took on projects that agree to his rules: beating the schedule, lowering costs, improving product quality and not working overtime. *"Everyone bottomed out. Within weeks, a young programmer who never read code pored over it. An unusually shy tester opened up at a meeting. A dominating manager listened. A man afraid to go home and face his children left work on time. A young woman, reluctant to give talks, gave one. A tense, obsessive architect stopped talking for a while. An inveterate meeting-goer wrote down a schedule. A reticent programmer led. A maverick sought help; a careerist gave it to him. A programmer found a bug and was comforted. A sense of purpose reigned. ... Everyone taught everyone else [109, p. 75/76]. "*

5.2.3.4 Project Management Maxims

Considering the impact of management on team performance, Royce [513] formulates subsequent maxims (p. 44/45):

- *"A well-managed project can succeed with a nominal engineering team."*
- *"A mismanaged project will almost never succeed, even with an expert team of engineers."*
- *"A well-architected system can be built by a nominal team of software builders."*
- *"A poorly architected system will flounder even with an expert team of builders."*

Crucial capacities of successful ICT project managers are, according to Royce [513, p. 45]: hiring skills (placing experienced people to appropriate positions), customer-interface skills (avoiding adversarial relationships among stakeholders), decision-making skills, team-building skills (establishing trust, motivating progress, consolidating different opinions into a common team direction), selling skills (selling stakeholders on team decisions and achievements).

5.2.4 ICT Engineering Methodologies

" Developing software in the real world involves gracefully adapting to change and handling a wide variety of environments and requirements [84, p. 23]."

ICT engineering methodologies are approaches to assign and manage tasks and responsibilities in a project with the aim to produce, within time and budget constraints, high-quality products and services that meet the needs of its users [367]. They specify who is doing what, when to do it, and how to reach a certain goal. This means that ICT engineering methodologies in this thesis are any engineering conventions or policies a team relies on to successfully deliver a product or service [139].

Advantages of implementing an ICT engineering methodology in a software development project can be seen in [19, p. 2]:

- Decision making based on understanding the fundamentals of how software is developed
- Promotion of reuse and consistency among project teams

- Best practices such as code inspections, configuration management, change control, architecture modeling
- Improvement of maintenance and support efforts

"Software development processes are utilized in ICT-projects to organize and simplify complexity. They label and categorize experiences of involved persons and suggest work procedures that proofed to be successful. If procedures are not adequate for a situation any more, if labels are too general, a reorganization of development in the team may be appropriate [268]."

Developing approaches in the ICT industry, often summarized with the umbrella-term *"agile"*, are oriented towards dealing with change effectively. Agility is the ability to balance flexibility and stability [284]. Agile approaches are based on a set of values formulated by a group of representatives of the ICT industry including Kent Beck, Alistair Cockburn, Ward Cunningham, Jeff Sutherland and Jim Highsmith. These values are collected in the agile manifesto first presented in 2001 (http://www.agilemanifesto.org, last visited: 17. 3. 2018). Agile approaches value individuals and interactions over processes and tools, working software more than comprehensive documentation, collaborating with customers rather than negotiating contracts and responding to change more than following a plan.

eXtreme Programming (XP) can be seen as an example of agile methodology. The goal of XP is to produce high quality software productively. It outlines four key development activities:

- Coding (programming and giving feedback on programming problems and solutions),
- Testing of developed components,
- Listening (addressing communication between programmers and stakeholders such as customers), and
- Designing (organizing the logic of a system to be implemented).

XP activities are based on the following values [62]:

- Communication (requirements specifications and other relevant information needs to be effectively disseminated within the project team),
- Simplicity (starting with simple solutions and adding features iteratively),

- Feedback (from the system through writing tests, from customers on product functionality, from the team to estimate the time needed for implementation),
- Courage (writing code as early as possible and refactoring code if necessary, knowing when to throw code away, persistence when facing complex problems),
- Respect (respect for team members, stakeholders and self-respect).

From these values, three major principles evolve: Feedback, assuming simplicity and embracing change. Values and principles support a best practice collection of 12 outlined XP practices, including pair programming, establishing coding standards, designing for simplicity, frequently updated product releases or not working overtime [62].

Agile approaches are seen as alternatives to more plan-oriented approaches. Plan hereby refers to documented process procedures such as milestone plans, and documented product development strategies that involve requirements, designs, and architectural plans. An example of a plan-oriented approach is the linear, sequential waterfall model where development goes through consecutive stages of conception, initiation, analysis, design, construction, testing, deployment and maintenance [86]. Still, planning is of importance in agile methods as well [85, p. 64]. Agile approaches place more value in planning than in documentation. In projects, applying agile or plan-oriented development methods can be justified depending on project characteristics that suggest either the one or the other. For projects featuring characteristics that promote agile as well as plan-oriented methods, hybrid approaches that combine agile and plan-oriented procedures seem necessary [293], [128], [316], [85, p. 69].

Case studies show that flexible guidelines supporting self-organization within teams can help team members to respond to changes in the project environment [580]. To deal with rigid system dynamics or narrow understanding of problems, Kriz [362] proposes to support self-organization processes. It appears to be of key relevance to try to understand the functions of blocking or hindering system dynamics and to constitute as well as evaluate alternatives that may take over these functions and their benefits [364, p. 70/71]. Self-organization processes can often be uncovered even in highly structured, hierarchical business organizations [362].

Investigating a company that switched from hierarchical management to self-organized teams, Barker [47] found that from value consensus of team members, normative and increasingly rationalized rules evolved. Opposed to the advantages of self-organized teams, such as motivation of team members to work together to achieve collective goals, team members felt highly stressed due to heightened social awareness and involvement in the team [628], [47].

Improving and formalizing activities and tasks of a development process alone doesn't necessarily improve productivity and product quality [30]. Boehm and Turner [84] suggest not to focus so much on methods, but on people, values people involved in a project hold, communication between stakeholders and expectations of stakeholders. *"People's characteristics, which vary from person to person and even from moment to moment, form a first-order driver of the team's behavior and results. Such issues as how well they get along with each other and the fit (or misfit) of their personal characteristics with their job roles create significant, project-specific constraints on the methodology [139]."*

5.2.5 The Unified Process as Reference ICT Engineering Methodology

The Unified Process (UP) is a *"de facto"* standard process for modern object-oriented or component-based software development. The Unified Process is [367], [317, p. 418/419], [19, p. 9]:

- oriented towards best practices
  It is oriented toward practices that proved worthwhile in a large range of projects.

- based on software engineering principles that proved worthwhile in practice
  The Unified Process takes an incremental or iterative, requirements-driven, and architecture-based approach to development.

- described clearly and in detail
  The Unified Process contains step by step instructions of what is to do by whom when. It is very well documented and can be seen as a comprehensive collection of experience. The Unified Process implies a knowledge base.

- highly maintained
  Besides trusted practices, new insights in software engineering are incorporated.

- provides management transparency
  Models, prototypes and executable builds that can be tested and refined after iterations as well as milestones after each iteration and phase that can be seen as significant decision points for the course of the project provide visibility of project development.

- highly adaptable
  The software development process can be designed being rather structured or dynamic. The Unified Process is adaptable to different requirements or environments, such as

small or big projects, smaller or larger teams. It is flexibly adaptable to organizational needs. It can be seen as a template to be reused, a process framework that has to be adapted to the situation.

The UP is a process framework. A project is an instance of the process.

- extensible
  The UP doesn´t prescribe a single way of carrying out an activity. Other sources can be called on for guidance.

- disseminated widely
  There is lots of information about the Unified Process available.

Anwar [22, p. 22/23] describes advantages of the UP in comparison to strictly sequential software development processes:

1. Improved governance.
   Teams in the UP produce results such as working software on a regular basis. So, it is possible to observe whether the team is on track in development.

2. Regular feedback to stakeholders.
   Stakeholders can be involved in the development process early in the project and give feedback on presented results.

3. Improved risk management.
   Through incremental development higher risks can be addressed earlier in development.

4. The actual requirements are implemented.
   Through iterative development changes in requirements can be taken into account early in development.

5. What works can be discovered early.
   The skeleton of the system to be built, the architecture, the basic functionality of the system is implemented early in the project. In further iterations, developers find out if the architecture and design of the system meet the changing needs of stakeholders.

6. Developers focus on what matters.
   If the UP is tailored to the particular situation and instantiated effectively, developers spend less time on documentation and more time on software development.

An objective of the UP is to help people involved in a project to excel as a team in an engineered process [317, p. 418]. It provides a way in which a project team can work together on tasks and describes how a project team can collaborate with users and stakeholders [317, p. 419]. Benefits of the UP for teams are seen by Booch, Jacobson and Rumbaugh [317] in that (p. 27):

- *"Everyone on the development team can understand what he or she has to do to develop the product."*
- *"Developers can better understand what other developers are doing - at earlier or later stages of the same project, in similar projects in the same enterprise, at different geographical locations, and even in projects in other companies."*
- *"Supervisors and managers, even those who cannot read code, can, thanks to architectural drawings, understand what developers are doing."*
- *"Developers, supervisors, and managers can transfer between projects or divisions without having to learn a new process."*
- *"Training can be standardized within a company. Training can be obtained from colleges and shortcourses."*
- *"The course of software development is repeatable, meaning that it can be scheduled and cost estimated with sufficient accuracy to meet expectations."*

Though the UP is an engineered process for software development, it is not concerned with interpersonal interactions. Dealing with interpersonal conflicts, cultural differences or team member selection are highly important aspects of software development not sufficiently discussed in the Unified Process.

5.2.5.1 UP Overview

Software systems being built in the UP are made up of components interconnected through interfaces, thus the UP is component-based. Moreover, the UP makes use of the Unified Modeling Language (UML), a visual modeling standard, when developing blueprints of aspects of a software system. Distinguishing characteristics of the UP are especially that it is use case driven (see section 5.2.5.2.1, p. 70), architecture-centric (see section 5.2.5.2.2, p. 73), as well as iterative and incremental (see section 5.2.5.2.3, p. 74).

Use cases are basic to the development process. A *use case* is *"a piece of functionality in the system that gives a user a result of value. Use-cases capture functional requirements. All the use-cases together make up the use-case model [...] which describes the complete functionality of the system [317, p. 5]."* The *architecture* is comprised of the *"most significant and dynamic aspects of the system [317, p. 6]."*

In the UP, projects unfold in 4 phases, namely inception (see section 5.2.5.2.3, p. 76), elaboration (see section 5.2.5.2.3, p. 77), construction (see section 5.2.5.2.3, p. 77) and transition (see section 5.2.5.2.3, p. 78), that give insight on the progress of the project and are usually concluded with a major milestone, where a well-defined set of objectives is met and management makes important business decisions such as go/no-go decisions or decisions on the project schedule, budget and requirements. Each phase consists of one or more iterations that can end with minor milestones. Each iteration can be seen as a mini project that results in a project increment. *"In every iteration, the developers identify and specify the relevant use-cases, create a design using the chosen architecture as a guide, implement the design in components, and verify that the components satisfy the use-cases [317, p. 7]."*

During a project, people hold different positions in the development of software. The UP defines several roles people can take in. *Worker* defines the position people may have during a part of a project. Each worker has particular responsibilities and has a particular set of activities in the software development process. An *activity* can be seen as a tangible unit of work performed by a worker that is defined through a set of responsibilities, has defined boundaries and a well-defined result, a set of artifacts, based on particular input. Related activities make up a *workflow*, a collaboration of workers and artifacts. A worker in the sense of the UP can be realized as a group of people working together. Or, one individual may be many workers in a project.

Each project cycle, which consists of the four phases inception, elaboration, implementation and transition, results in a product release. In the course of a project, the project team has to deal with change, iterations and the organizational pattern within which the project is generated, while also considering business constraints such as time, cost and quality. *"Every cycle, every phase, and, yes, every iteration changes the system from one thing to something else [317, p. 20]."* The product eventually consists of several representations:

- A use case model
  with use cases and all relationships to users

- An analysis model

for the refinement of use cases and allocation of behavior of the system to a set of objects that provides the behavior

- A design model
  that defines the static structure of the system and use cases that represent collaborations among subsystems, classes, interfaces
- An implementation model
  that comprises system components and the mapping of classes to components
- A deployment model
  that describes the physical nodes of the system and the mapping of components to these nodes
- A test model
  describing test cases that verify the use cases
- A representation of the architecture
- A domain or business model
  that describes the business context of the system

Parts of these models have trace dependencies via links to other models.

In the UP, four aspects of software development are perceived as equally important: people, project, product and process supported by tools [317, p. 15/16].

The UP is a complete set of activities needed to transform users' requirements into a product. Various *people*, like developers, software architects or testers work with customers, stakeholders, the prime movers of development, in a *project*. At the end of a project stands a *product* release. A product consists of artifacts created in the project, such as *model*s, which are semantically closed abstractions of a system, source code, executables and documentation. *Tools* can be used to automate activities in the UP. Project success in the UP is reached, when customers are satisfied, which means that, depending on the marketplace relationship, the project manager concludes that customers will be satisfied when feedback from beta tests has shaped the product or, for products contracted with a client, when the system passes acceptance testing. Acceptance tests are based on requirements that were spelled out in a contract in the beginning of the project as well as additional requirements that were added in the course of the project. *"Since successful products and custom systems are typically*

extended via minor, then major revisions, in a very real sense the 'project' never ends [317, p. 405]."

5.2.5.2 UP Characteristics

Developing with the UP is based on three characteristics that are outlined in the following:

5.2.5.2.1 Use Case Driven

Use cases describe the functional requirements of a system, what the system may be used for. These functional requirements are captured in a use case model. Non-functional requirements can be attached to use cases. Requirements in a more general sense can be described as needs. Stakeholders, users and developers are involved in capturing use cases.

Plain natural language is used for describing use cases. Further, use case diagrams show part of the use case model. In an intuitive way, they describe sequences of interactions between the system and actors that generate observable results of value to the actors. An actor is some type of user outside the system that takes a coherent set of roles when interacting with the system and communicates with it through messages. An important part of use cases, the flow of events, describes the interactions between system and actors. A particular flow is a scenario. Scenarios can be utilized for testing the system.

Besides capturing value adding requirements of a system, use cases are basic to analysis, design and implementation of the system as well as to the planning of iterations. *"The use cases help project managers plan, assign, and monitor many of the tasks that developers carry out [317, p. 39]."* In the first iterations of development, use cases that are very risky or highly important to the architecture, the baseline of the system, are worked on. Afterwards, use cases are chosen based on the importance of the functionality they represent for the customers. From the requirements, developers construct use case realizations with classifiers that have class-like attributes and operations. The constituted analysis model is a detailed specification of the requirements. From analysis use case realizations, classes and subsystems are designed that are then implemented as system components and, finally, tested. Use cases are traceable to other elements of the system and thus support the integrity of the system.

Visual Modeling The use case driven approach in the UP is substantially supported by conceptual modeling that enables the visual representation of complex situations and

relationships. A model can be defined as an abstraction of aspects of an original where the complexity of attributes and relationships is reduced and different viewpoints are made possible [167, p. 66]. Firesmith presents principles for creating a *"good"* model [210, p. 103]:

- Abstraction
  A *"good"* model holds essential characteristics and behaviors of modeled entities.
- Completeness
  It is ensured that all necessary abstractions are drawn.
- Confirmability
  The correct way of building correct models is indicated.
- Independence
  Low coupling between models is ensured.
- Information Hiding
  Insignificant information is hidden. Independence and information hiding may increase understandability of the model.
- Localization
  It is ensured that al necessary characteristics of an entity are used for the modeling of the entity.
- Modularity
  Complexity and size of models are controlled.
- Uniformity
  Consistency is kept in modeling among various models.

Conceptual models, formal models following a limited graphical notation, are often rendered as graphs in which nodes are connected through edges [167, p. 68]. In the UP, the UML is used to show different aspects of models. The UML is an object-oriented visual modeling language in which key concepts and connections between these are geometrically depicted. Key developers of the UML are Booch, Rumbaugh and Jacobson [95]. UML is standardized by the OMG, the Object Management Group, which consists of numerous organizations such as IBM or Sun Microsystems. In 1997, version 1.0 of the UML was released, version 2.0 followed in 2005 [624, p. 2].

Object-oriented models can be created for systems of diverse levels of complexity. An object can be defined as an *"abstraction that models all relevant aspects of a single tangible or conceptual entity or thing from the [...] solution space [210, p. 29] in: [167, p. 68]."* Classification is the process to represent types of objects in an abstract way. Classes generically describe attributes and behaviors of objects. From abstract object descriptions in object classes specific object instances can be created through instantiation. Attributes or properties of these instances can hold values, and their operations, methods, functions can be invoked and executed. Basic concepts of object-orientation are [167, p. 70/71]:

- Abstraction
  Abstraction is a concept that is similar to classification. Classification supports abstraction. Focus is set on summoning similar essential properties and functionalities of things or events, not on concrete occurrences thereof.

- Encapsulation
  Encapsulation allows hiding an objects' attributes from other objects that interact with it. Information internal to the object can only be retrieved through public operations or attributes. This separation of public interface and private representation facilitates interaction, reusability, change and co-existence of objects.

- Inheritance
  Through inheritance, attributes and behaviors of a concept can be transferred to its children. These can have further attributes and behaviors to those inherited. Often, inherited attributes and behaviors can be overwritten and newly defined. Child-classes are often called specializations, while parent-classes are often called generalizations.

- Polymorphism
  Polymorphism describes the ability of an object to appear in various forms. In different classes, operations can be defined that can be invoked in the same way. Depending on the context, instantiated objects react on invocation with the behavior that was specified in the respective class [212, p. 5]. Objects in different sub-classes can respond differently to a call defined in a specific class context.

In UML, diagrams are used as representations of model aspects. Using different sorts of diagrams, various perspectives on a complex model are uncovered. UML 2.0 comprises 13 types of diagrams in three categories that can be utilized to describe aspects of a system in the UP:

- Structure diagrams
  Class Diagram, Object Diagram, Component Diagram, Composite Structure Diagram, Package Diagram, Deployment Diagram

- Behavior diagrams
  Use Case Diagram, Activity Diagram, State Machine Diagram

- Interaction diagrams
  Sequence Diagram, Communication Diagram, Timing Diagram, Interaction Overview Diagram

5.2.5.2.2 Architecture-centric

"We can think of the architecture of a system as the common vision that all workers (i. e., developers and other stakeholders) must agree on or at least accept. The architecture gives us a clear perspective of the whole system, which is necessary to control its development [317, p. 59]."

Brooks [111] perceives conceptual integrity of a system as the most important consideration in systems design, especially in large systems (p. 42/232). The architecture helps to understand the system as it describes the most relevant model elements of the system. Furthermore, it fosters reuse, organizes development and is useful to evolve the system [317, p. 62]. Moreover, contextual aspects of the system, such as usability, performance, business and technical circumstances as well as the system aesthetics are laid out in the software architecture. The architecture is represented as several views, or perspectives, on the system. Thus, it is highly important to portray the architecture of the system clearly and understandably for stakeholders, such as system analysts, project managers, developers or customers. Diagrams of the architecture together with a textual description of the system architecture are collected in the software architecture description. In constituting the software architecture, significant decisions are made about [317, p. 61]:

- the organization of the software system,

- structural elements and interfaces the system is composed of, as well as their behavior, which is specified in the collaborations among them,

- the clustering of structural and behavioral elements to subsystems,

- the architectural style, a particular high level structure along with key mechanisms, that guides the organization of the system.

Several constraints or enablers, such as considerations on system software, middleware products, standards and policies, or general non-functional requirements, influence the software architecture. Use cases can be seen as the drivers of architecture. Architecturally significant use cases comprise

- use cases that customers need most in the next release of the software,
- that bear the most serious risks of the system and
- that cover the most important functionality of the system.

Conversely, architecture guides the selection of use cases to be worked on iteratively.

Further, the experience of team members with previous architectures and architectural patterns that appeared to be useful is influential in the construction of the architecture.

Architectural patterns can be represented as templates of solutions to commonly occurring problems in designing an architecture. *"These templates assign a name to a pattern and present a summary of the problem and the forces that give rise to it, a solution in terms of a collaboration with participating classes, and interactions among objects of those classes. The templates also provide examples of how the pattern is used [...] along with variants of the pattern, a summary of the benefits and consequences of using this pattern, and references to related patterns [317, p. 71]."*

When a stable architecture is in place, the complete functionality of the system is implemented based on the use cases that represent needs of the customers and on the architecture. The stable architecture that consists of early versions of the use case model, the analysis model, the design model and an early executable, tested implementation of the system, is the architectural baseline. *"The architectural baseline is an internal release of the system that is focused on describing the architecture [317, p. 70]."* It includes the architecture description, which is kept updated throughout the life-cycle of a project to reflect changes and additions to the system that are architecturally relevant.

5.2.5.2.3 Iterative and Incremental

An iteration in the UP is a mini project, a collaboration between workers who are using and producing artifacts resulting in an internal release of the product. Each iteration includes

activities called workflows, initiated with a planning activity, and concluding with an assessment. Workers and artifacts can participate in more than one iterations. Moreover, iterations can overlap, meaning that an iteration is about to be concluded while another one starts.

In the UP, a project is planned in a rolling wave approach where things closer are planned in more detail than things further away. In general, the project is divided into four consecutive phases that end with well-defined milestones including a go/no-go decision on the project progress. In each phase, the project advances in iterations that address small parts of the system being developed following a fine-grained plan and specific goals mitigating critical risks. In each iteration the final system is assembled incrementally. *"An increment is the difference between the internal release of one iteration and the internal release of the next iteration [317, p. 101]."* Each iteration produces increments in models, code, executables by alternating through activities such as requirements analysis, design, implementation and test workflows.

A big advantage in iterative development is seen in obtaining feedback between development steps that enables adjusting the focus for the next steps. *"The iterations help management plan, organize, monitor, and control the project. The iterations are organized within the four phases, each with particular needs for staffing, funding, scheduling, and entry and exit criteria [317, p. 88]."* Iterative development helps to [317, p. 89]:

- deal with critical and significant risks early,
  The UP is a risk-driven development approach as risks are approached early in development, unlike the waterfall approach where serious risks can first be addressed late in development due to the rather linear nature of this process.

- constitute an architecture that guides software development,

- provide a framework to handle changes, e. g. in requirements,
  The system evolves incrementally. In the UP, executable builds of the software are produced early in development. Testing these builds enables stakeholders to give suggestions and identify requirements not yet paid attention to. Problems and issues encountered in early builds can be corrected early.

- build a system incrementally, and to
  Builds, executable software, are a form of closure that software system developers provide at regular intervals.

- work more effectively in a project team due to the development process.
  Iterations help project teams to get acquainted with activities in these iterations, and to learn about them. New team members can be trained by colleagues experienced in the UP. *"Managers can apprehend real progress by noting the completed iterations [317, p. 94]."*

Following, the four phases of the Unified Process project life-cycle - inception, elaboration, construction and transition - are discussed in more detail.

Inception *"During the inception phase, a good idea is developed into a vision of the end product and the business case for the product is presented [317, p. 12]."* Primary goals of this phase are defining the business case and the project scope, to reach consensus with stakeholders concerning the objectives of the project [20, p. 3].

System boundaries and the project environment are defined and interfaces to related systems outside the boundaries are identified. Requirements engineering starts and a use case model with the most critical use cases is constituted. New, risky and difficult parts of the system to be developed are outlined in an architecture description. Still, the architecture is rather tentative. Some parts of the system can be presented to stakeholders in the form of a proof-of-concept prototype to consider the scope of the project and key requirements. Critical risks that affect the ability to build the system are identified and prioritized. Evaluation criteria for the software system are put together. The project is roughly estimated. If there is consensus with stakeholders on the objectives of the project, the elaboration phase is planned in more detail. In parallel, the UP is tailored to the particular situation of the project [19, p. 8]. Key questions in this phase are [317, p. 12]:

- *"What is the system primarily going to do for each of its major users?"*
- *"What could an architecture for that system look like?"*
- *"What is the plan and what will it cost to develop the product?"*

The essential milestone criterion for this phase is viability of the project which can be tapped by [317, p. 85]:

- *"identifying and reducing risks critical to system's viability"*
- *"moving from a key subset of the requirements through use-case modeling into a candidate architecture"*

- *"making an initial estimate within broad limits, of costs, effort, schedule, product quality"*
- *"initiating the business case, that the project appears to be economically worth doing, again within broad limits"*

Elaboration In this phase, the problem domain is analyzed, most use cases of the system are specified and elaborated in detail. Functional requirements are outlined. The architecture is articulated as views of the use case model, the analysis model and design model, the implementation model and the deployment model [317, p. 12]. This results in the architectural baseline, which means that a sound foundation of the system is created.

An architectural prototype is built over one or several iterations addressing the critical use cases identified in the inception phase. As the architectural baseline is elaborated in this phase, it is often considered the most critical phase of the UP [492, p. 4]. The remaining critical risks are monitored, their impact on the business case estimated.

In the elaboration phase, the project plan is developed. At the end of this phase the decision is made whether to commit to the implementation and transition of the system.

Usually, people working in the inception phase on the project are carried over to elaboration by the project manager, partly to be used as a sort of *"team memory"*.

The construction phase is planned in the last iterations of the elaboration phase.

The essential milestone criterion of this phase can be described as the ability to build the system in an economic framework [317, p. 86] that can be fanned out in:

- *"Identifying and reducing the risks significantly affecting system construction"*
- *"Specifying most of the use cases that represent the functionality to be developed"*
- *"Extending the candidate architecture to executable baseline properties"*
- *"Preparing a project plan in sufficient detail to guide the construction phase"*
- *"Making an estimate within limits narrow enough to justify a business bid"*
- *"Finalizing business case"*

Construction In the construction phase the product is built. *"The vision evolves into a product ready for transfer to the user community [317, p. 12]."* All components of the

deployable system are developed and tested. The result of the construction phase may be a beta release of a product that can be handed over to the end users. Moreover, user manuals and descriptions of the current release can be assembled. Project managers, software architects and senior developers priorize use cases to be implemented, group them into builds as well as iterations and refine the risk list of the project to monitor the project's real risks. *"The team working in the construction phase, starting from an executable architecture baseline and working through a series of iterations and increments, develops a software product ready for initial operation in the user environment, often called beta testing [317, p. 382]."* Early releases may be deployed to receive user feedback [20, p. 4]. Finally, a project plan for the transition phase is laid out.

The key milestone criterion in construction is whether a system is capable of initial operation in the users' environment [317, p. 86]. The transition may be postponed by one release, if this milestone is not reached, the stakeholders are not ready for transition to users or the actual resource expenditures are not acceptable any more in comparison to planned expenditures [492, p. 6]. The product is constructed in iterative builds and increments. Thus, the viability of the system is evident in executable form.

Transition In the transition phase, beta releases of the software are deployed to the user community. Users report problems and request features not yet specified. Reported problems are corrected, some of the suggestions are integrated.

As there may be an unknown amount of workload after beta test feedback, the project manager may have some people who could already work in other projects standing by [317, p. 398]. After beta testing, the product is released to more users.

Activities in the transition phase are, for example, manufacturing the product, training the customer personnel, providing assistance in using the system and correcting problems found after deployment. Further, the business case is completed. In the transition phase service-oriented project staff is needed besides development-oriented staff.

The project is successful, if the requirements are met to the satisfaction of the stakeholders.

The essential milestone criterion in this phase is whether the system achieves final operational capability. Final operational capability can be achieved by [317, p. 86]:

- *"Modifying the product to alleviate problems not identified in earlier phases"*
- *"Correcting defects"*

The transition phase ends when the users are satisfied. User satisfaction depends upon the marketplace relationship. *"In the case of products for the marketplace, the project manager concludes that the vast mass of customers will be satisfied when the project has acted upon the feedback from the beta tests. At that point it issues a general release. [...] The transition phase terminates when the project transfers responsibility for continued maintenance to a support organization [317, p. 405]."* If a product was contracted for a client, the project manager considers the project as finished when the system passes acceptance testing.

Finally, the development cycle is reflected in a postmortem of the project where the project team analyzes what was done right and what was done wrong in the project. The next release cycle can be planned.

5.2.5.3 UP Flexibility

The UP is designed to be tailored and adapted to the specific development situation. Thus, each organization using the UP may extend and refine the process to fit their particular circumstances. Popular refinements of the UP differ in the categorization of workflows, in the emphasis on particular artifacts or in the description of transition and the continuation of a project after the transition phase.

In 2002, the company Rational introduced a UP platform providing a configurable process framework. In 2003, IBM acquired the Rational Unified Process (RUP) as a software process product accompanied by a hyperlinked knowledge base with detailed descriptions of development activities and sample artifacts. The RUP extended the UP, for example, by adding further workflows. The project management workflow is part of the RUP.

Besides the RUP, frequently applied refinements and variations include:

- The Basic Unified Process
  The Basic Unified Process is a simplified variation of the RUP developed by IBM.

- The Enterprise Unified Process
  The Enterprise Unified Process is an extension to the RUP that adds workflows, disciplines and two new phases to the process to deal with system support and retirement of a software system.

- The Essential Unified Process
  The Essential Unified Process is a lightweight variation of the UP. Here, several practices, such as use cases, iterative development, team practices, or process practices,

can be combined to form a process that fits a particular situation. It is supported by a set of playing cards where each of these cards describes a practice.

- The Open Unified Process
  The Open Unified Process is based on the Basic Unified Process and part of the Eclipse Process Framework, an open source process framework of the Eclipse Foundation.

- The Oracle Unified Method
  The Oracle Unified Method is based on the UP, business-process and use case driven and supports the use of the UML.

- Rational Unified Process-System Engineering
  The Rational Unified Process-System Engineering process is a variation of the RUP developed by Rational specifically for system engineering.

- The Agile Unified Process (AUP)
  The AUP is a simplified version of the RUP. Workflows and disciplines in the AUP comprise the model discipline in which viable solutions for the problem domain are sought, implementation, where models are transformed into executables, test, where the produced software is evaluated, deployment, configuration management, in which access to project artifacts is managed, project management, where activities in the project are directed, and environment, dealing with process, guidance and tools needed by the development team. The AUP is based on the following principles [21]:
  - *"Your staff knows what they're doing."*
  - *"Simplicity."* Documentation is held to a minimum.
  - *"Agility."* The AUP is rooted in the values and principles of agile software development.
  - *"Focus on high-value activities."*
  - *"Tool independence."* Tools are used that are best suited for the project.
  - *"You'll want to tailor the AUP to meet your own needs."*

  An iteration in development in the AUP ends either in a development release that is tested or in a production release that is deployed to the production area.

5.3 Team Leadership

Leadership is considered an important aspect of organizational success. It is heavily researched with varying focus since several decades. Connections between leadership and team performance have not yet been explored in depth [644]. However, even rather autonomous, self-managing teams appear to be influenced by leadership structures, internal and external to the team [611], [338], [303, p. 280]. *"At an abstract level of analysis, there at least is evidence that team leadership matters [611, p. 347]."*

Research perspectives succinctly influencing team leadership research are leader traits and character studies, a major research stream up to the 1940s, and investigations on leaders' effective behavior, prominent in leadership research from the 1940s. Task-oriented (advancing task accomplishment) and people-oriented (facilitating team interaction and development) behaviors can be differentiated [215]. A study uncovered that task-oriented leadership may reduce conflict in teams where team members hold rather different personal values, while person-oriented leadership can increase conflict in such situations [341]. In project environments, initiating team structure can be positively related to team performance [333].

Change-oriented behavior (championing to adapt to varying circumstances) [450], [229], [643], [55], [117], [304] and boundary-spanning behavior (supporting intra- and interorganizational collaboration and communication) [634], [116] are thoroughly referenced in leadership literature. Facilitating emergent processes (enabling creativity) can be seen as essential area of leadership behavior, specifically in ICT businesses [455]. This leadership behavior perspective is only recently more attended to in ICT-related scientific literature [266].

Van Knippenberg [611] remarks that leader trait and psychological state perspectives need to be more explicit about leader behavior through which traits and psychological states, such as personal values or feelings, affect team members and to integrate these perspectives with existing research on leader behavior (p. 355).

Besides trait and behavior approaches to leadership, Hackman and Walton [256] discuss functional leadership. McGrath [417] defines functional leadership as to do or get done whatever is not adequately dealt with concerning team needs. The emphasis is not on what a leader should do, but what needs to get done so that team requirements are met [634].

Hackman and Walton [256] present four main leadership functions within teams in

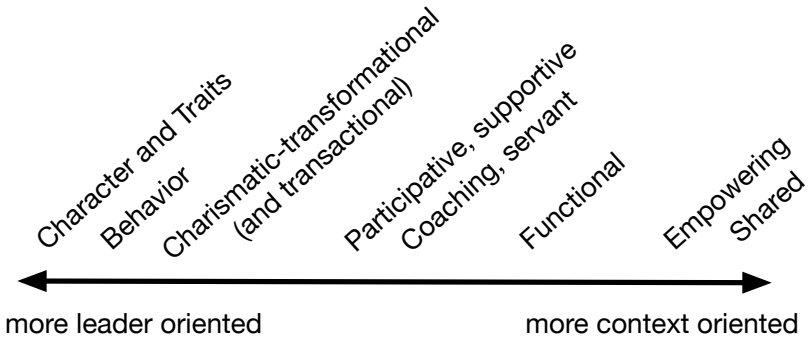

Figure 5.4 Continuum of Leadership Perspectives (compare [266])

organizational environments, as elaborated by McGrath [417]:

1. Diagnosing group deficiencies (monitoring/internal)
2. Taking remedial action to correct deficiencies (executive action/internal)
3. Forecasting impending environmental changes (monitoring/external)
4. Preventing deleterious environmental changes or their effects (executive action/external)

"Because the functional approach leaves room for an indefinite number of specific ways to get a critical function accomplished, it avoids the need to delineate the specific behaviors that a leader should exhibit in given circumstances – a trap into which it is all too easy for leadership theorists to fall [256, p. 77]." Leadership functions can be identified in various behaviors. *"Appropriate team leadership behavior, is then determined pragmatically by the nature of the team, the team goals, and the team circumstances [634, p. 3]."*

Situational [618], [277] and contingency leadership theories [586], [208] can be seen related to functional leadership because they consider situational characteristics, yet leader traits as well.

Leadership research approaches may be positioned on a continuum ranging from focusing the person in the leadership position or role to taking into account the team and organizational environment constituting performance-supporting leadership processes, as depicted in figure 5.4.

Van Knippenberg [611] differentiates generic leadership models not specific to teams, most prominently charismatic-transformational leadership research, from leadership ap-

proaches with a more distinct focus on teams, as, for example, empowering and shared leadership (p. 345).

Charismatic-transformational leadership research includes trait and behavior perspectives, further its supposed antipole transactional leadership as well as inspirational and visionary leadership [612]. It is researched approximately since the 1980s. This leadership research perspective can be seen as rather person-oriented, not necessarily referring to team processes.

Van Knippenberg [611] argues that it is hard to define transformational leadership because there is no consistent theory in place. As definitions already include performance outcomes to be measured, and transformational leadership models fail to specify what makes dimensions of leadership particularly transformational, it is not possible to develop valid measurements. Different transformational leadership dimensions communicate different expectations [90]. Since there are no valid measurements, there is no empirical knowledge base that enables building better theory inductively [611, p. 348]. The lack of clarity in conceptualization led to many studies linking transformational leadership to team performance with hardly any attempt of integration across studies [611, p. 349].

Another generic leadership research approach is to contrast participative, supportive, or coaching leadership [211] to directive leadership and performance management. Perceived charisma and status appear to effect team work [532], [169]. Yet, teams with high functional diversity, distributed information and complex work arrangements can benefit from rather participative leadership [563], [647]. Servant leadership may increase team potency (the beliefs of team members in their joint capability). Team potency, predicted by servant leadership, was found to influence team performance and goal as well as process clarity [306]. Servant leadership was further found to be related to trust in teams, predicting team potency and psychological safety. Team potency and psychological safety were related to team performance [535].

In contrast to more person-oriented leadership approaches, empowering leadership, shared leadership and functional leadership can be seen as highlighting team or organizational constellations that contribute to team performance. Van Knippenberg [611] argues that generic leadership approaches such as participative, coaching or servant leadership may better be represented by empowering, shared leadership perspectives more explicitly connected to team member self-management (p. 359). Empowering leadership can be defined as giving responsibility to team members, motivating them to take responsibility and promoting trust within the team. Effects of empowering team members were already explored in the 1950s and 1970s [503, p. 103], [234, p. 327]. Empowering leadership can support team

performance [575], particularly when team members are motivated to take responsibility [134], [338], when knowledge is shared appropriately in the team [122], [568], and when the own team is more empowered than surrounding teams [389]. However, empowering leadership may also contribute to work induced tension of team members [135].

"The behaviours that represent leadership, for example setting direction or managing conflict, can be, and often are, exhibited by anyone and everyone in the group [303, p. 280]." Shared leadership is conceptualized differently in various studies. It is frequently referred to for highlighting that team members share the leadership role to some extent. Occasionally, shared leadership research explores what kind of leadership is shared in a team. It is related to empowering leadership as team member engagement is central in shared leadership as well. Shared leadership appears to have positive effects on team performance [623], [78], [200], [123], [289], [419].

Empowering and shared leadership may be connected to self-management of team members [611, p. 359]. Hackman [251] highlights that team members practicing self-management take responsibility for outcomes and personal work performance, feel personally accountable, and help other team members. *"When looking at self-directed teams, team members are by definition involved in the leadership of their work [303, p. 280]."*

Leadership is related to a situational context. Zaccaro and Klimoski [645], for example, distinguish seven contextual imperatives that drive organizational leadership: cognitive, social, personal, political, technological, financial, and staffing.

Team leadership may support working out shared cognition and mental models [611, p. 359] including adaptive shifts in understanding according to ever specific, changing environments [15], [360].

The functional perspective to leadership - getting done what the team needs in order to perform - can be seen closely related to empowering and shared leadership for leadership functions are not necessarily connected to formal organizational roles. They can be, officially or unspoken, divided or shared among participants within a team. They are carried out in interpersonal interactions contingent to the situational requirements of the team to support team performance.

"To understand leadership in teams ... the entire team must be studied [303, p. 280]."

5.3.1 Leadership as Interpersonal Process

Leadership can be paraphrased as imagining, willing, inspiring and driving. It can be defined as an interpersonal influence process between persons holding leadership functions and other organizational participants based on mutual needs and aspirations oriented towards a collective goal [117], [296, p. 19], [451, p. 5]. Social influence can be seen as a change in a persons' belief, attitude, or behavior based on an action from another person [493, p. 1]. Leader and follower identities may shift over time and depending on situations [168]. This definition of leadership highlights leaders as agents for their team engaged in relationships with team members and others [178]. As opposed to management dealing primarily with order and control, leadership may be described as the management of meaning and the management or containment of emotions [439], [72], [117], [649], [356] by words and visible actions [224].

In ICT projects, the climate of interpersonal relationships among project team members, as well as internal and external stakeholders are strongly related to project success [220], [136], [433], [473], [646], [140], [453], [420]. Project team members and other involved stakeholders relate to each other through observable verbal and non-verbal communication in interpersonal interactions. Leadership team interactions are impacted and formed by intra- and interpersonal tensions of involved persons [261], [29].

Leader member exchange research explores the dyadic relationship between leaders and followers. In a team context, such relationships vary from team member to team member [275]. Leader member exchange differentiation was found to positively influence team performance in teams with high task interdependence [380]. Yet, leader member exchange differentiation may result in divergence in leader identification and team members' self-efficacy.

Similarity between leaders and followers may positively influence team empowerment and team effectiveness [339]. Similarity in perception of work goals or processes between leaders and followers may also contribute to team performance [143], [228]. The influence of leadership characteristics is not independent of team member characteristics [611, p. 354]. If interpersonal relationships within teams are not homogeneous, persons holding leadership functions that are central in a team appear more effective on team performance as well as team viability based on perceived charisma [44], [43].

"...people's attitudes and behaviors are profoundly affected by the situations in which they are embedded [476, p. 100]." Social identity theory inquires peoples' identity aspects

shaped through group membership, and social self-categorization, concerning peoples' self-attribution to specific groups over other groups. From a social identity perspective, leadership in teams can be seen as functions of influence by embodying, representing, and co-shaping team values and aspirations. Structures of social reality created by a leader must be objectifications of team identity [179]. *"That is, to be effective, leaders do not need to bring about some generalized notion of what is 'good'. Rather they must realize specific goods related to the values of the groups that they seek to represent [272, p. 193]."* Persons holding leadership functions are perceived by team members as the best for the job and engage in being perceived as modeling team values and vision.

According to Haslam et al. [272], social identity theory makes four essential contributions to the study of leadership (p. 51):

1. Our sense of self can be derived from group membership and the meanings related to this group membership.

2. Different forms of behavior within a group come from the definition of norms and values associated with belonging to that group.

3. When social identities are operative (or salient), the fate and standing of the group is what counts for an individual, not necessarily his or her own fate.

4. Social identity forms within a social context. *"In particular, if the meaning of who we are depends on comparisons with 'them,' then our own social identities will shift as a function of who we are comparing ourselves to in any given context [272, p. 51]."*

Findings of Turner [605] suggest that the act of self-categorization to a group, or self-definition in terms of the social identity associated with the group, can be sufficient to evoke group behavior. Self-categorization theory highlights a process that marks the transition from behavior informed by a person's sense of his or her own individuality to behavior informed by social identity [272, p. 52]. In this process, *"the self comes to be seen in terms of a category membership that is shared with other in-group members [272, p. 52]."* Group members come to see themselves as representatives of the group and perceive and respond to themselves and their environment according to values and norms of the group that guides behavior [272, p. 52/53]. The self is redefined through social identity. Norms and values vary from group to group. As people are able to act on the basis of social identity, they are able to coordinate their behavior with each other, know who is with them and who is not, or know what goals they strive to achieve [137], [272, p. 54]. A study by Hogg et al. [295] reveals that differentiated, personalized leadership is more effective in teams with low team identity

salience and team identification. A more team oriented leadership stance is more effective in teams with higher team identity salience and team identification. While social identity theory in leadership is researched on a group level, less research is conducted considering the interpersonal level between leaders and followers [202]. According to Haslam et al. [272], effective identity leadership is promoted by subsequent personal capacities (p. 205-215):

- Reflecting
  Observing and listening in order to understand team members' wishes, aspirations, norms, and values.
- Representing
  Ensuring that actions reflect and forward team values.
- Realizing
  Putting into practice what matters to the team - and being seen doing so.

In sum, leadership may be perceived as a group function unfolding in interpersonal relationships.

5.3.2 Power, Influence and Leadership

Leadership is an influence process within a group of people to attain a collective goal. Since power can be defined as a potential to influence or bringing about change using available resources [474, p. 14], [451, p. 9], a relationship between these concepts is apparent. Team members exhibiting leadership function eventually hold power, as do team members not bearing leadership function. For example, opposed to power related to formal position is the power of resistance and refusal of orders. *"The power inherent in a given formal position is, therefore, power invested in that position by all (or at least most) members of the social organization in which the position is located [474, p. 130]."* Leadership further needs to be distinguished from coercive processes where power is used over others.

Power may be derived from the position within an organizational system, through group members' liking or based on expert knowledge. Table 5.4 presents six bases of power within organizations [451, p. 10], [218], [493].

In a survey with 260 participants attending a leadership development program (73% male, 68% between 36 and 50 years of age, 64% upper-middle management and executive positions) and 45 volunteers answering a follow-up online questionnaire (64% male, 70% between 36 and 50 years of age, 43% executive positions), expert power, information power

Power Base	Description	Relationship Effects	Position/Personal
Referent Power	Related to followers' liking and identification	Leads to socially dependent change, no surveillance necessity	Person-oriented
Expert Power	Related to followers' perception of competence	Leads to socially dependent change, no surveillance necessity	Person-oriented
Legitimate Power	Related to formal authority	Leads to socially dependent change, no surveillance necessity	Position-oriented
Reward Power	Based on the capacity to reward others	Results in socially dependent change, with surveillance necessity	Position-oriented
Coercive Power	Derived from the capacity to penalize others	Results in socially dependent change, with surveillance necessity	Position-oriented
Information Power	Based on knowledge that others want and need	Leads to socially independent change	Position-oriented

Table 5.4 Six Power Bases (based on: [451, p. 10], [218], [493])

and referent power were identified as most frequently leveraged. Most participants believe that power based on relationships is highly relevant for effective leadership. They added that to better leverage the power of relationships, it is important to: invest, identify and repair [40].

Team members holding leadership functions that are prototypical to a team have referent or position power, and thus often do not need to demonstrate personal power. *"Prototypical leaders do not need to exercise power to have influence; they are influential because of their position and the depersonalization process that assimilates members' behavior to the prototype [294, p. 194]."*

Strong interpersonal bonds of group members to prototypical in-group leaders may even inhibit the use of power. Within a team, group prototypicality is apparently related to influence strategy effectiveness. *"Conformity processes in conjunction with consensual social attraction make prototypical members more influential. Under these circumstances people who are perceived to match the relevant in-group prototype are more likely to be endorsed as leaders and to be able to lead effectively [296, p. 24]."* Perceptions and evaluations of team members concerning the leader are more influenced by prototypicality, if participants identify strongly with the team. *"...prototypical leaders apparently have more freedom in how they act, than non-prototypical leaders have [610, p. 134]."*

Moreover, leaders that identify strongly with their team appear to be less prone to believe they influence more effectively than they really do [610]. Yet: *"As situational factors change, the attributes required to be influential and effective change as well [474, p. 81]."*

5.3.3 Influencefactor *"Menschenbild"* (Idea of human beings)

In social sciences, *"Menschenbild"* (idea of human beings) is defined as subjective theory or construct people form implicitly or explicitly to orient themselves concerning their decisions and actions [507, p. 11/13]. It has non-empirical character, yet can be empirically evaluated [308, p. 126]. It is learned, passed on and changed [507, p. 12]. According to such variability [511], myriads of dynamic, changeable ideas of human beings exist.

To follow connections from ideas of human beings to observable behavior, it appears important to expound basic assumptions on human beings: Proposing that human beings can not perceive reality *"as is"*[329], but bridged through elaborating symbols based on perceived physiological signals and associated with (inter)subjective meaning - a synthesis of reason and emotion [124] - and so constituting in varying degrees of consciousness personal experience, ideas of human beings, even if not expressed explicitly (in language), can be defined as anchors for orientation in (inter)subjective experiential fields [562].

Ideas of human beings are (inter)subjective in the sense that they are not existing independent of humans, but are elaborated in (inter)personal contexts including individual or community needs, goals or ideologies. They are self-referencing for humans constitute ideas of human beings. They are heuristic models reducing complexity [508, p. 8] holding reductive descriptive patterns and normative ideal conceptions [539, p. 85] of human beings and, thus, offer a set of markers to understand (or predict) behavior. Indeterminable, paradox, contingent aspects of human reality are cloaked in order to enable decision-making, communication and (inter)action. Such reduction and accentuation of qualities covers blind spots, yet in dynamic reconstitution may incrementally bring about insight to inform understanding of interpersonal phenomena [308, p. 126]. Ideas of human beings are central to personal and interpersonal perception of reality in that they help to define self, others, interpersonal relationships and societies. Interpersonal communication presupposes distinct ideas of human beings [507, p. 11].

Ideas of human beings construct the object they define, yet guide (inter)action. Thus, they entail consequences [539, p. 87].

In science, ideas of human beings are occasionally explicated to work out a specific

viewpoint and significant differences in perspective between individuals or communities. These meaningful narratives, developed and changed in interpersonal communication, help self-description [539, p. 86] and forming social identity. Regularly, they hold presuppositions and ideals of paradigmatic conceptions simultaneously. An idea of human beings may be seen as *"anthropological regulative [308, p. 129]"*, a model inherently describing values and norms, to inform interpersonal interaction.

In organizations, frequently implicit or unquestioned ideas of human beings - as such not open to dialogue - more than visions or organizational world views guide or legitimize actions [539, p. 73/76]. The personal ideas of human beings of individuals working together in teams shape interpersonal interactions.

A distinguishing function of ideas of human beings can, for example, be found in proposing that interactions between team members holding leadership function and other team members in line with a rather humanistic idea of human beings may tend to facilitate self-organization more than interactions focusing primarily on planning, assessing and rewarding. Maslow [405] differentiates theory X management, based on the assumption that workers need to be externally motivated, from theory Y management, stemming from the assumption that people are intrinsically motivated to work. He highlights that if factors like long-range health within an organization are important, theory Y management approaches become more attractive [405, p. 57].

As personal ideas of human beings influence interpersonal interactions, explication and critique thereof in personal reflection and interpersonal dialogue to uncover blind spots and, eventually, refine can be seen to promote more conscious, and so eventually more flexible, leadership interaction [511, p. 192].

5.4 Experiential Learning and Leadership

Team learning can be described as emergent team process dynamics where team members' diverse knowledge and capacities yield manifestations of collective knowledge and skill. In this context, emergence may be defined as follows: *"A phenomenon is emergent when it originates in the cognition, affect, behaviors, or other characteristics of individuals, is amplified by their interactions, and manifests as a higher-level, collective phenomenon [359, p. 55]."*

Teams frequently deal with changing requirements and goals, as well as time restrictions.

Learning in teams frequently happens in the process of problem solving. The European Association for the Education of Adults strategic statement of core competencies in our society [1] stresses a need for persistent, sustainable learning that involves skills and feelings alongside intellect.

Team learning is essentially related to team members' generative learning [543]. People engaging in this process are portrayed as being in continuous learning mode. Generative learning is learning that not only includes intellectual knowledge acquisition, but links to learners' surroundings and relationships. *"'Learning' in this context does not mean acquiring more information, but expanding the ability to produce the results we truly want in life. It is lifelong generative learning. And learning organizations are not possible unless they have people at every level who practice it [543, p. 132]."* This idea of learning correlates with significant, whole-person learning as described by the humanistic psychologist Carl Rogers. *"Significant learning combines the logical and the intuitive, the intellect and the feelings, the concept and the experience, the idea and the meaning. When we learn in that way, we are whole, ... [505, p. 20]."*

Participating in work teams, learning through experience is a primary learning path of team leaders. In this context, Bourne and Walker [99] emphasize leaders' abilities to interact in less well-defined areas (p. 236).

In a survey on learning habits of project managers, participants appeared to learn most in interpersonal relationships and through personal experience in the work context [267]. Meeting colleagues or significant others face to face as well as sharing and researching online was a characteristic response pattern of the 35 participating project managers. If possible, project managers preferred self-organized learning opportunities, face to face or online, over those with fixed schedule or content. A report on leadership development derived from interviews, a detailed online survey with 125 responsibles delivering leadership learning programmes, and insights from approximately 2000 participants in a leadership programme over one year, portrays similar findings [175, p. 4/21]. Represented leaders highly value collaboration with others (91 %), most are willing to share with others (80 %), many lack time for learning (65 %), and lack opportunity for sharing (36 %). They appreciate online (search) tools for learning (approximately 70 %).

"“Learning is the process whereby knowledge is created through the transformation of experience [347, p. 38]." A frequently referenced experiential learning model is Kolb's experiential learning cycle [348]. Here, four steps of experiential learning are differentiated. First, a learner actively experiences an activity. In a second step, the learner consciously

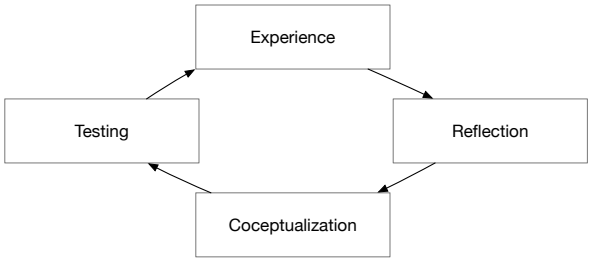

Figure 5.5 Experiential Learning Cycle (compare [347])

reflects on the experience. Thereafter, the learner conceptualizes a more abstract theory or model of personal observations. Lastly, the learner actively plans on testing the newly formed or altered model. The experiential learning cycle is presented in figure 5.5. Learners can enter the experiential learning cycle at any stage.

5.4.1 Reflective Practice

"There is no learning and personal development without reflection [475, p. 49]."

Reflection is central to experiential learning [349]. Reflective and generative components of learning seem necessary to incorporate concepts and critically question assumptions [472, p. 16/17], [430], [401] especially in complex, frequently changing environments [635].

Reflection as part of experiential learning within teams appears hardly explored scientifically [125]. Björklund and Eloranta [81] assume that reflecting on practical problems and receiving feedback on problem solutions in a trustful social environment can support learning efforts (p. 6). Personal reflection and feedback from others support the evolution of cognitive-emotional maps for action taking [278].

Reflecting on objectives, strategies and processes or ways of adapting these in various contexts in a team [627, p. 296] was found to be correlatively related to team performance and innovation [390]. Sharing and collaboratively elaborating mental models can improve team performance [489], [428].

Reflection allows to make implicit knowledge explicit, differentiate or adapt it, to again guide action taking. The interplay of personal reflection and interpersonal sharing is basic to team learning [543]. Systematic reflection on leadership challenges appears to foster learning in leadership [28], [171].

From a social identity perspective on leadership [272], reflection is a necessary practice to sense into team beliefs and the social environment surrounding the team. It includes listening to needs and wishes of team members and other stakeholders in a project endeavor, respecting roles and aspirations of (dialogue-)participants, allowing to decide in a way team members approve of.

Wood Daudelin [635] found that reflection, individually or within a helper group of experienced facilitators, can significantly increase learning (p. 44). Reflection in generative, significant learning may best be facilitated in a rather threat-free interpersonal atmosphere of mutual sharing [543], [234].

Interpersonal reflection may tap into supportive interpersonal capacities through in-group diversity [315], [234] (see also section 6.6.2.1, p. 209).

Synthesizing literature on reflective practice and learning from experience, Fleck and Fitzpatrick [214] differentiate five levels of reflective depth to support technology design targeted at aiding reflective processes (p. 217-218):

- RL(Reflection Level)0: Description/Revisiting - statement(s) about events without elaboration or explanation.
- RL1: Reflective Description/Revisiting with Explanation - descriptions include reasons for action and interpretation in a descriptive style, yet alternative explanations are not explored, analysis is limited.
- RL2: Dialogical Reflection/Exploring Relationships - Experiences are put in relationship to each other, iterative interpretation and questioning, considering various explanations, viewpoints and hypotheses.
- RL3: Transformative Reflection/Fundamental Change - revisiting an event with the intent to re-organize or take action differently, challenging personal hypotheses and asking fundamental questions leading to changes in personal practice and understanding.
- RL4: Critical Reflection/Wider Implications - Social and ethical circumstances are reflected.

Further, they highlight three conditions of reflection, namely [214, p. 217]:

- Reflection takes time.

- Reflection is a developmental process - it can be learned and refined and may be supported professionally.
- Reflection needs a reason for engagement.

5.4.2 Organizational Environment

Project team leadership is embedded in an organizational surrounding. How project team members learn is thus influenced by the organizational environment and in how far this environment promotes learning [259].

Learning in organizations appears to be largely informal, situated, and at times even contradictory. *"The social entity can often be divided against itself, with different tacit beliefs and concealed agendas harboured by different subgroups or individuals [524]."* People working together in organizations eventually establish learning situations influenced by their specific experiences of other communities, family, formal education as well as working practices and relationships to co-workers [203, p. 12]. Argyris and Schön [25] suggest that each member of an organization constructs a personal representation or image of the theory-in-use of the whole, the world view and values implied by their behavior or the maps they use to act upon (p. 16). This view of the whole is incomplete. Members of organizations are continuously working to add to and to get a more differentiated view of the whole. The organizational theory-in-use is continuously constructed through inquiries of members of the organization. It is encoded in private images and public maps forming the media of learning in organizations [25, p. 16/17].

From an organizational viewpoint, two major aspects can be differentiated on learning processes, a more *technical* concerned with effective processing, interpretation of and response to information inside and outside of the organization, and a more *social* focusing on experiences of participants in the organization [186, p. 2].

In the context of the former, Zuboff [652] highlights that information technology may be applied for different purposes to support learning.

In the latter learning is perceived as tied to interpersonal interaction. This perspective deals with how members of an organization process and put to use personal experiences. *"These experiences may derive from explicit sources such as financial information, or they may be derived from tacit sources, such as the 'feel' that a skilled craftsperson has, or the intuition possessed by a skilled strategist [186, p. 4]."*

While research on organizational learning mainly deals with observing and analyzing learning processes in organizations, literature on the learning organization frequently discusses ideal organizational development or normative models of organizational processes [392]. Senge [543], for example, proposes learning organizations as places of continuous learning to shape the organizations' future (p. 14/24). Those implement five core disciplines: The establishment of a shared vision for sustained engagement of members of an organization, personal mastery, the willingness of individuals to participate in continuous learning processes, the critical consideration of mental models shaping perception, learning in teams and systems thinking, the forming of a rather holistic view of an organizations' environment.

Assuming that learning is socially constructed in the context of organizations and that personal and shared beliefs and visions can motivate or support change processes, normative models (and organizational utopias) may serve as valuable frameworks to be considered and adapted in order to transform business processes adequate to the actual organizational situation. These may help to comprehensively label, categorize, cluster and (re)discover experiential patterns in organizational environments. They may be utilized to inform conceptual maps for action taking [265].

Dedicated soft skills courses in an organization may not provide sustainable outcomes, if these are not supported or valued in the team. Implementing technology products seems to be less a problem here [383], [129], [541], [113] than the appropriate use and integration of such technology within a team of reflective learners [557, p. 21]. *"Good models of learning"* that use technological support tools are sought for [495, p. 8].

5.4.3 Sharing Learning Experiences

"Individual knowledge, the interactions of knowledgeable team members, and the team´s ability to learn and apply new knowledge drive success [283, p. 27]."

Large organizations implement online learning platforms besides internal and external trainings to support members' learning [322]. Small and medium enterprises are often not able to afford the infrastructure for tailored learning environments [495].

To facilitate sharing and learning from experience, organizations frequently install best practice repositories [4], [146], [17]. *"The practices in these repositories are often generic, informal and have only anecdotal justification. However, they are relevant and widely consulted by industry practitioners in their day to day practice. These best practice repositories are often built autonomously and scattered around the Internet in free text formats with little*

structure. They may be maintained by an organization, an individual, or by the general public. For practitioners, it is often difficult to systematically explore repositories for a particular domain, and more difficult to make informed choices among the practices [651]."

Senge [543] perceives sharing experiences in teams as pivotal for organizational learning, sustained organizational development and, finally, longevity.

Services such as wikis, blogs, forums, document upload or mailing lists may support sharing of experience and co-constructing knowledge within learning communities. Large companies such as IBM, General Electric, Shell or Airbus implement online services such as blogs or wikis for sharing experiences [470]. A list of tools to meet organizational learning needs is presented in table 5.5 (based on [83], [497], [415]).

Need	**Function**	**ICT-supported Tools**
Communication	Sharing of ideas, information, creations, experience	Social Networking, Blogs, Podcasts, Video Podcasts, Web Conferencing
Collaborative publishing	Collaboratively working for a specific purpose in a shared work space	Authoring and Editing tools, Virtual Communities of Practice, Wikis
Documentation	Collecting evidence of experience	Blogs, Video Podcasts, ePortfolios, Open Journalism
Innovation	Creating something new to be seen or used by others	Mashups, Virtual Communities of Practice, Virtual Learning Worlds
Information exchange	Exchanging information, ideas, resources, materials	Social Bookmarking, RSS, Virtual Communities of Practice, Virtual Learning Worlds

Table 5.5 List of Support Tools for Organizational Learning (based on [83], [497], [415])

A framework to support organizational learning, used for example by NASA for more than 25 years, is the *Experience Factory*. It was designed for software organizations [54]. A core assumption within the *Experience Factory* framework is that people working together need to learn from past experience. Thus, an organization needs to provide for an environment that enables learning. Experience descriptions are collected to support learning in an Experience Management System (EMS). An EMS is implemented in an organization by [54]:

1. characterizing the organization, current business processes and existing knowledge,
2. defining user roles in the system, such as consumer (searching the EMS), maintainer (responsible for maintenance), provider (providing experience for the EMS), or topic manager (responsible for the maintenance of specific topics within the EMS),

3. defining a data model specifying acceptable values, a taxonomy suitable for the organization that is used to classify the experience to be included in the EMS,
4. defining the architecture of the EMS,
5. implementing the EMS and developing, installing and integrating tools to support the EMS,
6. keeping up regular maintenance of the system and populating it with experience entities, and
7. improving the system based on feedback.

Table 5.6 shows typical support tools used within an EMS [54].

Tool	**Description**
FAQ	Users submit questions to be answered by experts. Questions and answers are added to the EMS.
Focused Chat	Discussions are captured and can be added to the EMS.
email	Experiences exchanged through email are integrated in the EMS.
Project Presentations	Presentations can be filled with important information during a project and can be used in an EMS.

Table 5.6 EMS Support Tools (compare [54])

"The tools and procedures have to be defined in a manner causing as little disruption as possible to the employees' work. ... People tend to stick to software they are used to and if the EMS implementation includes what they are already using, the acceptance of the new system is much more probable [54, p. 4]."

Experience descriptions, such as best practices, come in many varieties [622]. Best practice collections can form a starting point in shaping team learning, yet arguably need to be adapted to specific team circumstances. Experience descriptions are collected and distributed in many (online) collections.

Zhu et al. [651] differentiate three major challenges in collecting practices in larger scale experience description repositories:

1. Information is constantly evolving,
2. best practices can be useful for more than one organization, implying a need to store them in rather abstract practice description formats and into categories enabling generalization and specialization to particular domains, and

3. best practices may be indexed and organized in a semi-automated way.

5.4.3.1 Experience Description Models

Interpersonal experiences can be mapped to various representation formats. In the following, typical conceptual approaches towards capturing and sharing experience on interpersonal processes within organizations are listed.

5.4.3.1.1 Tactic, Strategy and Best Practice

A tactic is a conceptual action to achieve a goal. Strategy may be a plan or perspective to arrive at a goal frequently consisting of a description of context and guiding policies for goal achievement as well as action plans or tactics [274]. Best practices are methods or techniques for goal achievement that are believed to be superior to alternatives by participants in a specific domain. Tactics, strategies and best practices are not necessarily empirically verified, but find widespread attraction and implementation.

5.4.3.1.2 Decision Model

In decision models [291], formal action axioms in the form of *"if (condition), then (condition)"* are connected including context-relevant information and knowledge in order to establish a decision-making approach [298]. A problem and alternatives to solve it can be formally elaborated [180].

Four stages of decision model elaboration may be differentiated:

- Formulation, elaborating a formal model of possible decisions (represented, for example, in a decision network or decision tree) including necessary decision logic,
- Evaluation, (algorithmically) producing formal recommendations for decisions within a given situation based on the formalized decision model,
- Appraisal, exploring implications of recommended formal decisions and determining a course of action (following the recommended decision, refining the formal model or doing something else),
- Refinement, refining the decision model corresponding to insights during appraisal.

5.4.3.1.3 Scenario

"Using scenarios to alter mental models for the purpose of strategic learning is one way in which scenarios and scenario planning provide new insights and different ways of seeing the world such that knowledge about implicit processes and functions can be shared and challenged. Another key feature in scenarios and scenario planning regarding the transfer of tacit, implicit knowledge is in their aim to uncover the structure within which actions take place [354]."

In elaborating a scenario, first, an issue along with constituting circumstances (or key factors) needs to be identified. Furthermore, research driving forces need to be determined. Key factors and driving forces are ranked, before scenario logics are developed. With scenario logics in place, scenario details are described, implications considered and scenario indicators specified [540], [354].

5.4.3.1.4 Micro Article

A micro article describes a problem in the form of a story holding a solution [424], [631]. Its length is approximately one page. Using stories to describe problems and solutions, the context in which problems arise can be portrayed more to the point from the perspective of the writer. Micro articles may be used for easier documentation and location of context-bound knowledge. They can also be used in a learning diary to capture the most important learning experience of the day.

A micro article may be structured as follows:

1. Topic - a short characterization of the contents as title (mandatory)
2. Story - a narration of the facts (mandatory)
3. Insights - important experiences related to the story (mandatory)
4. Conclusions - conclusions based on described experiences
5. Subsequent Questions - for further engagement with the described situation

5.4.3.1.5 Case Study

Case study research can be defined as follows:

"1. A case study is an empirical inquiry that

- *investigates a contemporary phenomenon in depth and within its real-life context, especially when*
- *the boundaries between phenomenon and context are not clearly evident.*

... 2. The case study inquiry

- *copes with the technically distinctive situation in which there will be many more variables of interest than data points, and as one result*
- *relies on multiple sources of evidence, with data needing to converge in a triangulating fashion, and as another result*
- *benefits from the prior development of theoretical propositions to guide data collection and analysis [640, p. 18]."*

Case studies integrate a variety of empirical methods to investigate a specific phenomenon. They are not merely data collection techniques, but cover scientific processes such as research design and data analysis [640].

5.4.3.1.6 Organizational Pattern

A pattern represents a reusable functional solution that can be implemented in particular problematic situations emerging through conflicting, well-defined forces within a context. *"It captures a general rule that is not dependent on the actor and/or the specifics of a certain situation. In addition, patterns capture the rationale behind a solution, i.e. 'why' a problem is solved in the way described by the pattern [276, p. 4]."*

Alexander [10], [13] elaborated a pattern-based approach to constructing buildings and neighborhoods. This pattern approach to build *"natural"* (responding to environmental requirements and conditions) as opposed to *"artificial"* (not sensitive to environmental requirements) towns was used as a model for pattern elaboration in software development [225], education [569], [77], [167], and in organizational development [146], [397], [142], [65], [66].

A pattern in organizational contexts solves a problem by adding structure to the organizational system. It is a *"recurring structural configuration that solves a problem in a context, contributing to the wholeness of some whole, or system, that reflects some aesthetic or cultural value [146, p. 14]. ... A good pattern takes the reader on an emotional journey. ... a pattern is an encapsulation of related forces. ... In application, they are decoupled–but in the broader scheme of things, they are always part of some whole that gives them context [146, p. 17]."*

Patterns point out serious problems and are supposed to improve the context they are considered for. They typically preserve reusable, *"good"* solutions. They are assumed to reduce complexity. Patterns, in combination with each other, contribute to some whole or larger system. They generate *"good"* design. Often, patterns that can be combined share a vocabulary [343, p. 18].

Differing from loosely structured best practice descriptions, patterns are often represented adhering to a defined pattern form. Hereby, prose style forms can be differentiated from pattern templates including named sections [167, p. 55].

In order to work out a viable solution it is highly necessary to understand and define all forces contributing to the problem to be solved. *"Rather than telling us exactly what to do step by step (like a micro-script), a generative patterns tells us how to* react *to the forces [343, p. 59]."* In the context of ever-specific interpersonal situations, forces may be dynamic and manyfold. Organizational patterns on interpersonal interaction can be consulted as inspirations, but can arguably be implemented systematically [146].

Decomposition, Encapsulation and Holism Alexander [11], [12] elaborates a foundation to his pattern-based construction process in the wholeness of structure (or living structure). *"This means that you cannot consider the environment by breaking it down into small parts, but you need to see it as a set of units, which support and enhance each other in a complex and interdependent whole [120]."*

Wholeness expresses a balance between inner forces and the surrounding environment. All parts of a system (or center) are in balance with the other parts [221]. Out of such balance between sub-wholes (centers) emerges a quality that can´t be reduced to the sum of its parts, the *"Quality Without a Name [10]"* that, according to Alexander, signifies living.

"To consider wholes rather as centres is a shift of thinking that makes the connection between sub-wholes (centres) and larger wholes (again centres) more explicit and tries to

avoid the question where a whole accurately starts and stops. . . . To speak of centres stresses the point that a form depends on its surrounding, that a pattern cannot be seen in isolation but gets its meaning from the context in that it is used [343, p. 69]." Similarly, in graph theory centrality highlights important nodes within a network [92].

Encapsulation is a process of bundling information related to a problem (including context states, forces, and solutions) constituting a center that may be accessed using a defined pattern vocabulary. Such information hiding can help dealing with complexity of a system [9].

As nature shapes objects that are similar in their general structure, but differ in detail - such as waves, raindrops or leaves - patterns need to be adapted to requirements of a particular situation [343, p. 54]. Patterns' composability with each other supports generating solutions appropriate to environmental conditions.

Pattern Properties Alexander [11] presents 15 properties that mark the design of living structure:

1. *"LEVELS OF SCALE is the way that a strong center is made stronger partly by smaller strong centers contained in it, and partly by its larger strong centers which contain it [11]."*

2. *"STRONG CENTERS defines the way that a strong center requires a special field-like effect, created by other centers, as the primary source of its strength [11]."*

3. *"BOUNDARIES is the way in which the field-like effect of a center is strengthened by the creation of a ring-like center, made of smaller centers which surround and intensify the first. The boundary also unites the center with the centers beyond it, thus strengthening it further [11]."*

4. *"ALTERNATING REPETITION is the way in which centers are strengthened when they repeat, by the insertion of other centers between the repeating ones [11]."*

5. *"POSITIVE SPACE is the way that a given center must draw its strength, in part, from the strength of other centers immediately adjacent to it in space [11]."*

6. *"GOOD SHAPE is the way that the strength of a given center depends on its actual shape, and the way this effect requires that even the shape, its boundary, and the space around it are made up of strong centers [11]."* (Good shape refers to the beauty of a center in balance with its surrounding [222].)

7. *"LOCAL SYMMETRIES is the way that the intensity of a given center is increased by the extent to which other smaller centers which it contains are themselves arranged in locally symmetrical groups [11]."*

8. *"DEEP INTERLOCK AND AMBIGUITY is the way in which the intensity of a given center can be increased when it is attached to nearby strong centers, through a third set of strong centers that ambiguously belong to both [11]."* (Occasionally a center cannot exist without other centers. It may be generated by other centers. Centers may depend strongly on each other [343].)

9. *"CONTRAST is the way that a center is strengthened by the sharpness of the distinction between its character and the character of surrounding centers [11]."*

10. *"GRADIENTS is the way in which a center is strengthened by a graded series of different-sized centers which then 'point' to the new center and intensify its field effect [11].* Centers may portray variations of surrounding centers while sharing many aspects with them.

11. *"ROUGHNESS is the way that the field effect of a given center draws its strength, necessarily, from irregularities in the sizes, shapes, and arrangements of other nearby centers [11]."* Using a pattern may bring about a great variety of results depending on the context of application.

12. *"ECHOES is the way that the strength of a given center depends on similarities of angle and orientation and systems of centers forming characteristic angles thus forming larger centers, among the centers it contains [11]."* This property highlights structural similarities between centers [343].

13. *"THE VOID is he way that the intensity of every center depends on the existence of a still place – an empty center – somewhere in its field [11]."*

14. *"SIMPLICITY AND INNER CALM is the way the strength of a center depends on its simplicity – on the process of reducing the number of different centers which exist in it, while increasing the strength of these centers to make them weigh more [11]."*

15. *"NOT-SEPARATEDNESS is the way the life and strength is merged smoothly – sometimes even indistinguishable – with the centers that form its surroundings [11]."*

These properties are interdependent. Changes in one aspect affect others and so the entire center, which again results in consequences in the centers' surrounding [11, p. 238]. Implementing a pattern changes its context [146]. The pattern properties may form criteria for the qualitative analysis of patterns in pattern networks.

Connectivity - Pattern Languages As design problems are often interrelated - they refer to each other, depend on one another, can evolve in the context of a larger problem, or can be composed into problems of larger granularity - , design patterns may be seen as interrelated. They can be arranged as an interrelated network, a pattern language [310].

A pattern language reflects the structuring of a whole, a specific domain (a system, an architecture, e. g. of a complex organization). A pattern language is generative and shows morphological coherence. This means that patterns collected in some kind of hierarchical arrangement are not merely used as building blocks to be mechanically applied, but they may rather be seen as centers of differing hierarchical depth that amplify each other in structuring a larger center [343, p. 47].

Patterns in a pattern language unfold living structure in combination with each other. They may represent *"The Gate"* to the emergence of the *"Quality Without A Name"* [343, p. 59],[10]. Depending on the context, different sequences of patterns may be followed. *"But even the relatively unorganized sets of patterns in the design pattern catalog are extremely valuable. Even when patterns are not organized into a language, they still can be used together synergistically [325]".*

In pattern languages, sequences of effective pattern application - or paths through the pattern language - are de- and occasionally prescribed. Sequences through a pattern language can also be generated working through the language. Frequently, some sequences are acknowledged to be more effective than others [343, p. 59], [12]. The vocabularies of pattern languages need to be mastered in order to traverse pattern sequences of exemplary solution strategies.

In the field of organizational learning and development several pattern languages can be discerned. Yet, interfaces between these pattern languages are sparse. Patterns belonging to a particular language are often not easy to integrate into another pattern language.

A support tool for a pattern language needs, as Deng et al. [166] state:

1. **A Pattern catalog:** to navigate a pattern language, to find and validate design solutions.

2. **Pattern management:** to edit, create and delete design patterns.

3. **Pattern-based design:** using interaction design patterns as a resource.

Recognition and Elaboration - Mining The process to uncover and compile patterns is called pattern mining in the pattern community [276]. Patterns represent already established knowledge or already successful mental design constructs, not necessarily innovative solutions. Mining for patterns is about finding and explicating the common aspects of possible solutions to a situation. They stem from the experiences (including implicit knowledge) of practitioners in the specified domain - yet to be explored and consciously clarified [343, p. 60], [276], [164].

Patterns are phenomena of human problem solving behavior [276]. Pattern mining is a social process [343, p. 136]. Patterns may be derived inductively from cases in the specified domain, deductive from examining theory related to the domain, and frequently by combining inductive and deductive approaches [343, p. 135], [34], [10].

Inductive pattern mining may employ qualitative research methods [307], [334] such as expert interviews, observations (including self observations), case studies [431], focusgroups, grounded theory [276] or pattern mining workshop settings [311], [310], [632], [164].

Deductive analysis may be used to formulate a pattern. *"Deduction is needed to reason about the patterns – the recurrent patterns found by induction do not* explain *the relationships [343, p. 135]."* A general conceptual approach based on knowledge in the specified domain helps to frame examination. *"That means the conceptual approach guides what areas of interest to investigate in terms of patterns and the potential relationships between them [276, p. 6]."*

Patterns and pattern connections are frequently elaborated iteratively. Cases are searched, compared, and recurring significant aspects are marked. Found meaningful codes are grouped. They are organized to form design descriptions. These are compared to and integrate domain-relevant theoretical concepts. Relations between patterns are established. After each elaboration step, new findings, e. g. from new qualitative data, from examining domain-relevant theory, from comparing to similar systems, or from critical assessments of the pattern community, are integrated in the pattern (language) building process.

"There is a need to find patterns that are shared and accepted by other practitioners. The good solutions, or nuggets of wisdom, need to be documented in an accessible way. To share knowledge means to communicate information [343, p. 22]." The Hillside group

(http://www.hillside.net), for example, enables pattern writers to participate in a shepherding process [263] and writers' workshops [223] at events such as PLoP (Pattern Languages of Programs) or EuroPLoP conferences to refine design patterns in a community of interested peers.

5.4.3.1.7 Discussion

Leadership experience descriptions can be differentiated regarding

- *content*, such as descriptions of tacit knowledge, exemplary case illustrations or best practice considerations,
- *communication channels*, as via face to face communication, paper documentation or online media, and
- *format*, as in essays, structured forms, or diagrams.

Best practices, tactics or strategies are widespread means to capture organization-specific knowledge. Planning scenarios may support establishing shared mental models in order to support learning processes within organizations.

Decision models and use case scenarios (see section 5.2.5.2.1, p. 70, for a definition of use case) attempt to provide viable paths through problem domains and, thus, may support the structured exploration of organizational contexts. Similar to patterns, decision models focus on recurring (optimal) solutions for a specific constellation of forces or context conditions. With use case scenarios, possible variations of process progressions can be visualized and, thus, called to attention within their contexts.

Case studies enable approaching a phenomenon within organizations by means of blending rigorous research methods in a structured way. Case studies, similar to pattern descriptions, emphasize shared vocabularies and understanding within research or pattern communities.

Micro articles provide an entity structure similar to organizational patterns. Yet, they highlight the idea of small personal narratives on context-bound knowledge as opposed to generalized (or generative) solution descriptions.

5.4.3.2 Indexing Experience Descriptions

Indexing means to apply labels (meta-data) to describe and enable to find and reuse entities or objects such as experience descriptions [70, p. 493]. Knowledge bases suitable for semantic or conceptual indexing of such objects either integrate conceptual taxonomies or formal ontologies [249]. Meta-data supports users in searching and retrieving situation-relevant objects or contents.

Keywords appear highly relevant in subject-specific searching. Those are directly related to content, while meta-data such as title or abstract can help to decide which descriptions to look at more in depth [226, p. 6].

To be able to differentiate content more clearly, subject-based classification can be introduced. *"Subject-based classification is any form of content classification that groups objects by the subjects they are about [226, p. 6]."* A term is hereby a particular name of a particular concept - a keyword. Another definition for concept is subject.

Different ways of describing subjects that objects (entities, experience descriptions) can be classified to are listed in table 5.7. *"Categories are just terms in a subject-based classification, that is, a controlled vocabulary. The categories can be a plain list, or they can be arranged in a taxonomy [226, p. 13].*

Classification Approach	**Definition**	**Benefit for User**
Controlled Vocabularies	A closed list of named subjects. An indexing language. A set of properties of objects. The same concept may have multiple terms. The same term may be used to describe multiple subjects.	Meaningless terms, which are too broad or too narrow or only slightly different from an already existing term, can't be defined. Misspelling is prevented.
Taxonomies	An arrangement of terms in a controlled vocabulary into a hierarchy. *"The benefit of this approach is that it allows related terms to be grouped together and categorized in ways that make it easier to find the correct term to use whether for searching or to describe an object [226, p. 7]."* Taxonomies describe subjects used for classification, but are not necessarily meta-data, yet can be meta-data, if terms of the taxonomy are used to describe an object.	Taxonomies describe and provide information about subjects/concepts.
Thesauri	Thesauri are hierarchical subject taxonomies extended by introducing subject properties and non-hierarchical subject relationships.	Thesauri provide rich vocabularies to describe subjects/concepts.
Faceted Classification	In faceted classification, terms are divided into a number of facets. Facets are different axes of classification. Each facet holds a number of terms. *"In faceted classification the idea is to classify documents by picking one term from each facet to describe the document along all the different axes [226, p. 11]."*	*"... faceted classification could be seen as simply a very disciplined way to construct a thesaurus as well as to use it for classification purposes [226, p. 11]."*
Ontologies	Ontologies are high-level domain descriptions that consist of a set of types, properties, and relationship types [320, p. 11]. They frequently have open vocabularies.	The subject description language may be extended. Traversing relationships between subjects allows for generalization and specialization in domain aspects.

Table 5.7 Subject-Based Classification (based on [226])

5.5 Design Guiding Principles

Considering the context of team leadership in complex organizational environments - such as ICT projects -, four design guiding principles for a team leadership support framework emerge:

- An idea of human beings (*"Menschenbild"*) as paradigmatic perspective on team leadership (see section 5.3.3, p. 89)
- Leadership as a team function (see section 5.3.1, p. 85)
- Leadership as influencefactor on team performance (see section 5.1.8, p. 51, and section 5.3, p. 81)
- Experiential learning to inform interaction in complex, changing interpersonal situations (see section 5.4, p. 90)

In this thesis, these principles are axiomatic orientations for framework development as well as framework use in practice.

Chapter 6

Iterative Design Validation

Validation is a process of building an artifact depending on requirements and modifying it based on verification [258]. *"To validate a treatment is to justify that it would contribute to stakeholder goals when implemented in the problem context [630]."* Effects of the interaction between a prototype of an artifact and a model of the problem context are investigated and compared to artifact requirements[630].

The framework design vision (section 2.1, p. 9), related work (chapter 4, p. 23) and context considerations (chapter 5, p. 39), including design guiding principles (section 5.5, p. 108) provide a frame and directions in designing a supportive team leadership learning artifact.

The design of the leadership support framework in the context of this thesis includes three major revisions of an ICT-based framework representation contributing to learning on leadership in ICT project team environments.

The focus of the ICT-based framework representation shifted from providing a collaborative workspace for sharing and collecting experience descriptions to supporting reflection on work experience - personally and in groups of interested peers (including more experienced learners). The framework aims to assists personal learning in leadership. Organizational learning may be an appreciated secondary outcome of individual learning processes.

Figure 6.1 shows conceptual and technical contributions to framework development approximately aligned to a design validation process timeline. Subsequently, each contributions' elaboration and validation steps are described in detail.

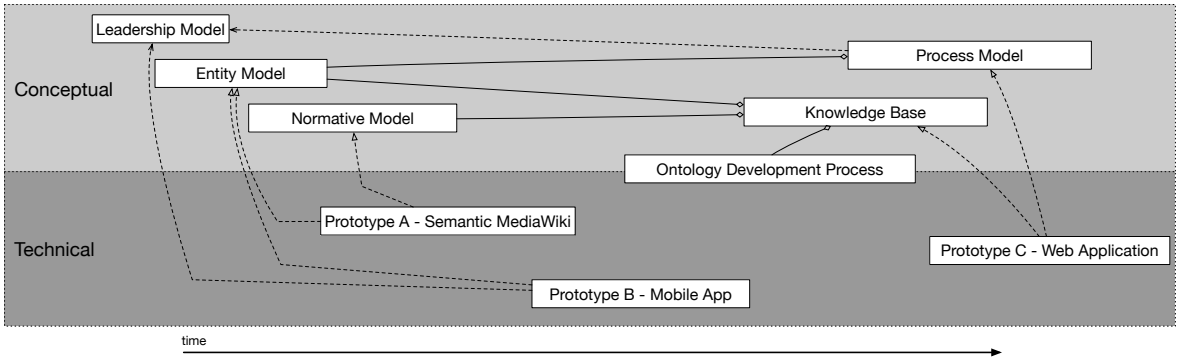

Figure 6.1 Framework Development Timeline

6.1 Domain Sensing

Domain sensing is an important preliminary step in research (and design) processes. In domain sensing, researchers sense into fields of interest - prior to hypothesis forming (or artifact development) [309].

This sensing into the field forms a core component of the organizational theory U change process [534]. There, it is portrayed as prerequisite for the emergence (or crystallization) of artifacts (such as organizational processes) that may differ from common and current solutions and holistically support organizations' performance.

In order to find out about perceptions of leadership capacities in complex team environments, expert interviews were conducted. Five persons with experience in leading teams in organizations and who reflected humanistic ideas of human beings in academic publications participated in interviews. Interviews were completed by findings from a group discussion with three project managers in the ICT industry.

Further, an organizational pattern was developed in the domain sensing phase based on informal experience descriptions from practitioners in the ICT industry. This pattern, including an overview of the framework domain model (see 5.1, p. 40) as well as the system view (see 2.1, p. 9) and an initial experience description entity model, was shepherded (a feedback process in pattern writing [263]) and discussed in a writers' workshop [223] at a EuroPLoP conference [265]. Insights from pattern writing inspired the elaboration of the basic framework entity, called *flow* in this thesis.

Finally, ICT project team leaders, ICT project team consultants and researchers shared

feedback on tool requirements in personal conversations in the domain sensing phase shaping framework design directions.

6.1.1 Leadership Capacities supporting Team Performance

ICT projects are complex social endeavors. Developing ICT-based solutions can hardly be rendered into a straight-forward mechanical production process, but consists of non-linear, creative, open-ended (inter)personal problem-solving and learning processes, or emergent processes [358]. Engineering methodologies following a causal production logic lack in supporting interpersonal emergent processes [266], [273], [109].

In order to get an idea of ways to conceptualize a leadership support framework taking into account team performance, context information on the target group - leaders involved in interpersonal team processes - appears valuable. Considering the necessity of open-ended, collaborative creative problem solving in ICT contexts, crystallizations of personal capacities that appear to be important in fostering emergent team processes and specific leadership behavior promoting such team processes are of particular interest.

The main research question of this pre-study may be summarized as: What are key capacities for team leaders to learn that enable them to support team performance, including emergent team processes or team learning?

To grasp what leadership capacities may facilitate team performance in complex team environments, five experts in the field of leadership and communication were interviewed [421]. All interviewees are professors at Universities with personal experience in leading organizations apart from research institutions. They have published articles on interpersonal relationships in organizations highlighting a humanistic idea of human beings. Interviews are completed with findings in a group discussion with three project managers in ICT businesses. A model on facilitating team performance with a focus on emergent team processes is developed.

This model together with context considerations on team leadership (see section 5.3, p. 81) and team performance (see section 5.1.8, 51) informs requirements for a framework on leadership supporting team performance in complex environments.

6.1.1.1 Method

The expert interview is a data collection and analysis instrument in qualitative research within social contexts that refers to a specific kind of knowledge, namely expert knowledge [421]. Interview participants hold a particular problem perspective. This perspective is supposedly typical of the institutional context in which the expert gathered knowledge and (inter)acts. The expert represents a typical problem theory, typical solutions and typical decision-making structures within this context [421, p. 469]. Experts take responsibility for the conception, the elaboration, implementation and control of a problem solution and so have privileged access to problem-relevant information concerning, for example, specific groups of people, social situations, or decision-making processes.

Depending on whether questions touch upon experts' personal (inter)action, institutional rules and maxims or rather on circumstances of (inter)actions of others, the type of knowledge generated through expert interviews is different. The first can be labeled as operational knowledge, the second as context knowledge. The first type of knowledge may help to reconstruct structural conditions of solution implementation in order to develop viable measures. The second type of knowledge may support problem structuring. Experts may be asked questions tapping both knowledge areas [421, p. 471].

6.1.1.1.1 Interviewee Selection

In the course of the iCom project at the University of Vienna [312, p. 7], an EU-funded project on international communication in ICT businesses [312, p. 13/14], experts in the field of leadership, organizational development, counseling and communication were invited for talks and workshop sessions. Five experts offered to participate in an interview. Two interviewees gave face to face interviews. One participant could be interviewed using a Voice over Internet Protocol (VoIP) service. Two interview participants responded to interview questions via email. Interviews took place from May to November 2013. Table 6.1 depicts demographic information of interviewees.

All interviewees have personal experience in leading organizations. Each interview participant published academic papers reflecting a humanistic idea of human beings and presenting insights in interpersonal relationships correlating with it. Interviewees have professional experience in (inter)personal counseling. They teach leadership, organizational development, counseling and international communication at Universities.

No.	Gender	Location	Academic Background	Interview Type
1	m	USA	Communication, Counseling	face to face
2	m	Germany	Counseling, Systems Theory	email
3	f	USA	Organizational Development	VoIP
4	m	USA	Leadership	face to face
5	m	Brazil	Organizational Development, Counseling	email

Table 6.1 Leadership facilitating Team Performance - Interviewee Demographic Information

Interview findings were compared to and completed with insights from a group discussion with three project managers from ICT businesses on ideal project manager capacities. The group discussion took place in the context of an iCom project workshop with participants from industry and academics from 31st of May to 1st of June 2012. The group discussion lasted one and a half hours. One of the discussion participants, besides working in projects in the ICT industry, is a professor in Computer Science at a University. This professor also published academic resources on organizations in ICT explicitly reflecting a humanistic idea of human beings. Group discussion participants were from the Czech Republic.

6.1.1.1.2 Interview Manual

An interview manual was developed to support structuring narratives of interview participants. To find out about leadership capacities in team environments supporting emergent processes, interviewees were asked the following questions:

- From your experience, what would you consider essential personal attitudes or values of an ideal team leader or project manager? (context knowledge)
- Based on your experience, what is facilitative behavior of team leaders or project managers when interacting in their project teams (at project start, contracting, controlling, transition, maintenance)? (operational and context knowledge)
- In your counseling, what do team leaders or project managers perceive as most helpful in troubling situations? (context knowledge)
- What do team leaders or project managers need to consider when interacting in a team? (operational and context knowledge)
- Can you remember a particular event in one of your counseling sessions with a project manager that you perceived as tremendously helpful or not helpful? (operational knowledge)

The last question enables the narration of significant events (see section 6.2.2.1, p. 129) that were either perceived as supporting or hindering team leadership.

6.1.1.1.3 Analysis

In the analysis of expert interviews, thematic units retrieved in several interviews are focused rather than single case interpretations. Sequentiality of mentions in interview passages is secondary to belongingness to thematic clusters [421, p. 476].

As organizatonal contexts of interview participants are fairly similar, interviews can easily be compared with each other. The interview manual outlines major thematic structures - personal capacities and facilitative behavior of leaders in complex team environments. Thematically relevant passages were transcribed for each interview. The group discussion was partially transcribed based on thematic units related to the research question.

In a first step, transcribed text is paraphrased or tagged following the course of conversation. The group discussion text is paraphrased as well. Then, paraphrased passages are sorted to thematic clusters within each interview and the group discussion text. Hereby, the terminology of the interviewees and group discussion participants is taken into account. Third, thematically coherent text passages from all interviews are clustered together with passages from the group discussion. In the following analysis step, the terminology of interviewees and discussion participants is left behind. Commonalities and differences of thematically coherent text passages from the interviews are conceptually coded. Expert knowledge is condensed to categories. Finally, categories are linked to construct a theoretical model on performance-related team leadership focusing on the facilitation of emergent team processes [421, p. 476/477]. The application TAMSAnalyzer (http://tamsys.sourceforge.net) was used for qualitative coding.

6.1.1.2 Results

After paraphrasing text passages in interview and group discussion texts, 44 codes were elaborated. These were condensed to 20 concepts. Concepts were clustered in 5 categories: mental models of leadership as interaction-guiding meta-concepts, personal qualities including personal aspirations, personal principles, interpersonal interaction descriptions and observations on ideal leader perception. In table 6.2, concepts are listed from most mentioned to least mentioned within each category excluding five general statements on ideal leader

perceptions. An in-depth exploration of results including vignettes from interviews and the group discussion can be found in Appendix A, p. 349.

Category	**Concept**	**Interview Passage Count**
Principles	Context Awareness	77
	Primacy of Interpersonal Relationships	54
	Flexibility	29
Interpersonal Interactions	Phenomenological Feedback	9
	Working with Shared Mental Models	8
	Facilitating Cohesiveness in the Team	8
	Unobstructive Availability	3
	Establishing a Safe Space	3
	Representing as Role-Model in the Team and towards Team Stakeholders	3
	Clear Expression in Verbal and Written Language	2
	Considering Feelings during Team Member Selection	2
Personal Qualities	Intent to Support (the Development of) People	16
	Patience	9
	Courage to Get in Contact with Others, Courage to be Helpless	3
	Playfulness	2
	Humor	2
	Compassion	1
Mental Model of Leadership	(Implicit) Mental Model of Leadership (that formed through personal experience, can be traced to an idea of human beings, and guides action taking)	1

Table 6.2 Expert Interview Results

6.1.1.3 Limitations

This pre-study summarizes the notions and understanding of ideal team leaders in complex environments derived from expert interviews with five professionals in leadership and communication. Findings are completed with insights from a group discussion with three project managers in ICT businesses. Results may inform requirements for a framework for team leadership in ICT projects.

The sample is rather specific as interview participants share a fairly similar professional background. Also group discussion participants share similar professional backgrounds.

Interview participants are academic experts on leadership and communication, group discussion participants are practitioners from the ICT industry. All interview participants published academic papers on interpersonal relationships explicitly reflecting a humanistic idea of human beings. One of the project managers participating in the group discussion published academic papers reflecting a humanistic idea of human beings as well.

The quality of interviews varied. Some interviewees engaged in extensive dialogues, others could only respond to interview questions via email. Interviews and the group discussion were analyzed following expert interview analysis steps outlined by Meuser and Nagel [421]. The sample size is rather small, yet sufficient information could be retrieved for the outlined purpose of the investigation [394]. Interrater reliability testing could support outcome validity, yet resource constraints didn't allow for this measure.

6.1.1.4 Discussion

Key capacities supporting team performance and, specifically, emergent processes can be organized in an initial model of team leadership, as depicted in figure 6.2.

How observable interpersonal leadership interactions are carried out is influenced by personal principles and qualities. These can be considered integrated to an (implicit) personal leadership mental model that evolved through personal experience and is related to an idea of human beings. The presented model is no general leadership model, but focuses primarily on leadership qualities, principles and interactions that appear to be pivotal for emergent process facilitation. Such support of self-organization can be seen as a highly important leadership function in ICT project environments.

Flexibility and context awareness may be identified as elemental aspects of experiential (generative, significant) learning (see section 5.4, p. 90).

In the expert interviews, personal principles were connected to reflective practice, e. g. concerning personal models of leadership or promotive interactions in teams. Providing opportunities for (inter)personal reflection on work situations appears to be a key intervention in supporting team learning - and leadership - in complex work contexts. Described concepts may be utilized as orientation markers in outlining a team leadership learning framework.

Expert interviews give an impression of leadership interactions supporting emergent processes in teams. Overall, interactions express a balancing function in the team. Many interactions that interviewees mentioned are not necessarily innovative. Yet, interestingly,

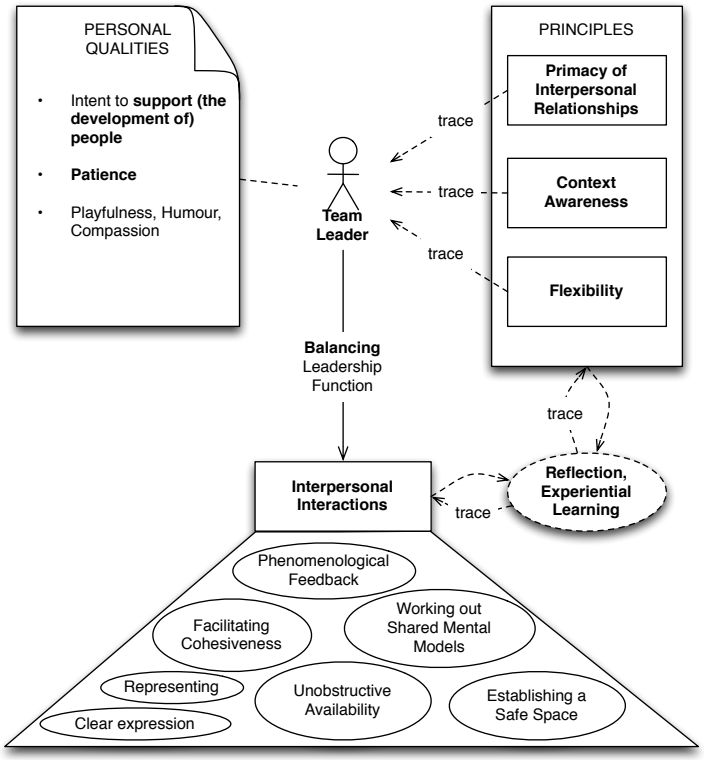

Figure 6.2 Initial Team Leadership Model

building on an intent to support the development of people within teams, well-known leadership interactions can acquire a significantly distinguishing - more caring, encouraging as opposed to judging, blaming - interpersonal relationship quality. Similarly, some interactions and environmental circumstances appear to be attended to more intensively, if the support of self-organization within the team, or team learning, is a prime concern. So, for example, higher priority may be attributed to taking time to allow for the co-shaping of mental models within the team, a slow, attentive pace in understanding processes within the project environment and establishing a safe space for experience sharing among team members.

6.1.2 Entity Model Elaboration

Experience descriptions are collected and attended to in organizational environments in order to learn about dynamic work contexts. Organizations implement ICT-based systems to collect and organize experience descriptions holding knowledge necessary for working together successfully. Online experience description repositories focusing on working together in organizations are highly valued learning resources for teams (see section 5.4, p. 90).

Interpersonal interactions in teams can be described in manifold ways. Descriptions might hold observations, theoretical comparisons, derived rule sets and step-by-step guides, and they can express personal attitudes related to interactions (see section 5.4.3.1, p. 98).

Pattern representation appears to be a viable experience description model. In the domain of organizational development, the pattern approach is well established for elaborating and collecting experience descriptions (see section 5.4.3.1.6, p. 100).

Based on informal sharings of project managers in a workshop in the course of the iCom project at the University of Vienna [312] and remarks by participants in expert interviews (see section 6.1.1, p. 113) - namely for team leaders to value all contributions within a project team, even if not all are included, and, to be in touch with team members, even if it appears to be difficult - an organizational pattern was elaborated and presented to the pattern community [265]. Pattern development was shepherded [263] by an experienced pattern author and accepted to a writers' workshop [343, p. 66] at a pattern conference.

Feedback in shepherding and in the writers' workshop helped to recognize the importance of case examples in experience descriptions. Pattern experts in the writers' workshop highlighted that not all possible forces that may contribute to the problematic interaction were defined in the presented pattern. Generalized, easy to follow steps for resolving conflicts in a team were lacking. Regarding the situation contingent dynamics of interpersonal

relationships, framework core entities, as elaborated in this thesis, slightly differ from organizational patterns.

6.1.2.1 Flow - The Framework Core Entity

The core entities of the leadership support framework are practice-relevant descriptions of leadership team interaction supporting team performance. These descriptions are also called *flows* in the framework, resembling flow as in work-flow and flow as motivational condition coined by Csíkszentmihályi [150]. Leaning on Alexanders' architectural [13] and organizational pattern definitions [146], both in a long-text format, a flow template was developed. This template was further compared to a pattern structure elaborated by Margain et al. [160].

While organizational patterns often follow rather strict conventions, for example by defining all forces within a given context that contribute to a particular situation, other description formats, such as many best practice descriptions, lack agreed-upon or outlined rules of instantiation.

The flow template outlines a recommended structure of experience description. It enables the integration of different forms of experience description, such as patterns, micro articles, scenarios, or case studies from various sources into the team leadership framework.

Writing flows may support (inter-)personal reflection. Alexander et al. [13] as well as Coplien and Harrison [146] mainly use text to describe patterns. As flows are experience descriptions coming forth in (inter-)personal (verbal) reflection, they are mainly text-based.

Key aspects of flows are:

- An evocative title
- A description explaining an intent, context, involved forces building inter- and intrapersonal tensions, eventually (aspired) interactions and (plausible) consequences within the context thereafter related to captured tensions
- Significant keywords
- One or more symbolic picture(s) or activity diagram(s) (optional; The Unified Modeling Language can be used to define activity diagrams related to a flow.)
- Resources, such as related literature or tools (optional)

- Categorizations based on leadership interaction, (project) risk, and Unified Process life-cycle phase (optional)
- Relationships to other flows (optional)

The flow template, the framework core entity model, holds a small set of properties compared, for example, to the unified description of process patterns by Jlaiel et al. [323].

A reflection guideline was created to accompany the flow template in order to support flow writing processes. It was evaluated in a project management course at the University of Vienna (see section 6.3, p. 148).

6.1.3 Initial Support Technology Requirements

"The requirements are not answers to questions that we ask the stakeholders. Instead, they are the result of design choices that we make jointly with, or on behalf of, the stakeholders [630]."

Requirements of the ICT-based framework representation are elaborated in line with the framework vision statement (see 2.1, p. 9). Design guiding principles (see 5.5, p. 108) provide directions and bounds for implementation.

In the iCom project [312, p. 13/14], where researchers and practitioners in the ICT field could get in contact and exchange experiences, several participants gave informal feedback on needs for a leadership support tool. Subsequently, a summary of initial technological requirements is presented:

- R (Requirement) 1: Support for (Inter)Personal Reflection - Utility, Usability
  Domain considerations on experiential learning in team leadership (see section 5.4, p. 90) highlight reflecting daily work as viable learning support. Research on learning habits of team leaders shows that besides learning from experience, and in interpersonal relationships, digital resources are frequently turned to for self-study [267].
- R2: Sharing Experiences (across company borders) - Utility, Security, Interoperability, Portability
  There appears to be a demand for sharing experience with interested peers - also across companies -, particularly in small and medium enterprises.
- R3: Easy to use, quick at hand, concise search - Utility, Usability
  Technological support resources need to be easy to use, quick at hand and include

concise options for applicability. To aid leaders in reflecting on ever-specific, unique team situations, experience description collections may include options for multi-faceted hierarchical traversal [556], [443], full-text or keyword matching. It was frequently stated by project managers or team leaders in business contexts at iCom events that a (search) tool might be minimally time consuming.
Hevner et al. [279] mention that design science research includes a search process, which may be part of the artifact to be designed as well.

6.2 Normative Model of Team Leadership Interaction

In a systematic literature review following the guidelines of Kitchenham [340], the review protocol by Beecham et al. [64] and an experience report of Staples and Niazi [570], leadership team interactions were collected. 2780 articles were skimmed for integration in the review, 218 were included. 62 resources were finally accepted (see also 4.1, p. 23). To categorize leadership team interaction descriptions, 20 accepted papers holding leadership interaction taxonomies were further analyzed and compared [264]. A preliminary list of interaction categories was used to form a starting point for a normative model on team leadership interaction [266, p. 5]:

- Communication:
  - Ensures quality of information
  - Tailors communication to audience
  - Maintains lines of communication
  - Actively listens
- Systems sensing:
  - Supports unfolding of shared vision
  - Holds holistic view of project
  - Enforces dialogue
  - Engages in focusing
- Conflict management:
  - Facilitates diversity

  - Enables holding contact
  - Bears creative tension
- Facilitating:
  - Creates a rather threat-free team environment
  - Cares for open work atmosphere
  - Cares about needs, wishes of team members
  - Motivation
- Effectiveness:
  - Maintains stakeholder involvement
  - Changes at required pace to meet project needs

In order to gain insight on commonalities of interaction categories described in literature, found taxonomies were flattened and leaf nodes holding leadership interaction key dimensions were extracted [266, p. 5]. These were clustered according to semantic resemblance. Cluster groups are listed in detail in a technical report [264].

Eighteen categories of leadership team interaction were discerned. Categories were aligned to meta-categories described by Burke et al. [116], Yukl et al. [643] as well as Taylor and Woelfer [634]. *"The meta-category 'Supporting emergent processes' was derived from research on innovative leadership by Olsson and Backstroem [455] ([85] in article, authors' note) and Ateg et al. [31] ([5] in article, authors' note) [266, p. 12]."*.

Figure 6.3 shows the count of articles associated with each category. The maximum is 20. Figure 6.4 depicts alignments of 8 articles describing meta-studies included in the systematic review to interaction categories.

Scholarometer is a web tool showing citation counts of papers within Google Scholar. Figure 6.5 shows the amount of papers of the systematic literature review with high Scholarometer scores within interaction categories. The maximum is 4.

High scoring categories (paper count, meta-study count, highly referenced paper count) are: *"Systems Sensing"* (14, 6, 3), *"Planning and Scheduling"* (11, 5, 4), *"Coaching"* (10, 7, 4) as well as *"Monitoring and Controlling"* (11, 7, 3) [266, p. 7]. Leadership team interaction categories and heuristics are presented in section 6.2, p. 123, and table 7.8, p. 283.

"A risk clustering was compiled based on risks and challenges explicated by Bartol [52] ([8] in article, authors' note), Lord [388] ([73] in article, authors' note), Creighton [148]

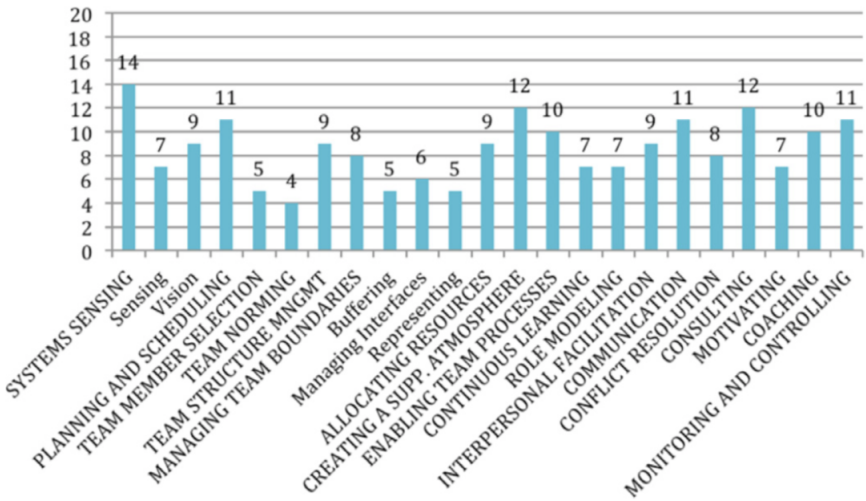

Figure 6.3 Systematic Literature Review - Count of Papers Per Category (from [266, p. 6])

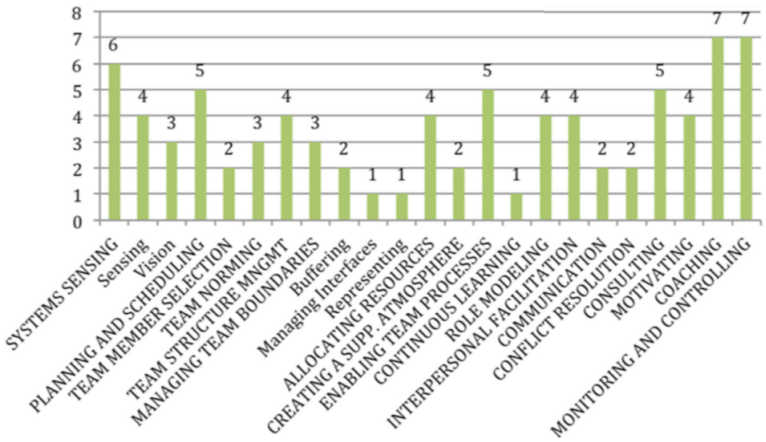

Figure 6.4 Systematic Literature Review - Count of Meta-Studies Per Category (from [266, p. 8])

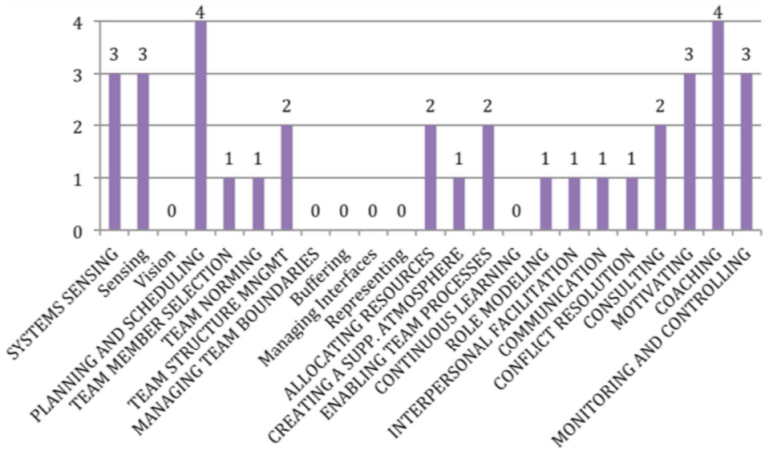

Figure 6.5 Systematic Literature Review - Count of Scholarometer High Scoring Articles Per Category (from [266, p. 8])

([29] in article, authors' note), Mandakovic and Gorricho [395] ([75] in article, authors' note), Thamhain [590] ([113] in article, authors' note), Zaccaro et al. [646] ([128] in article, authors' note), Hackman and Wageman [255] ([43] in article, authors' note), Ateg et al. [31] ([5] in article, authors' note) and Thamhain [592] ([115] in article, authors' note). Risks and challenges were grouped according to semantic resemblance. Next, groups were coded. Following, the risk clusters were completed by comparing them to the risk list established in a Delphi study by Schmidt et al. [536] ([100] in article, authors' note). Risks and risk areas not explicated in the articles of the systematic literature review were added. Newly added risk areas mainly concern funding, user involvement and leadership experience. The partitioning into structural and process-related risk areas was lent from Bartol [52] ([8] in article, authors' note). Risks and challenges were discussed with two researchers not involved in the study [266, p. 9]." Project risk categories and heuristics are presented in section 6.2, p. 123, and table 7.9, p. 285.

6.2.1 Model Comparisons

The leadership team interaction taxonomy was compared to benchmark models of leadership. Kouzes and Posners' [357] framework of Exemplary Leadership, backed by the Leadership Practice Inventory [481], outlines five categories of leadership practice, namely *"Model the Way"*, *"Inspire a Shared Vision"*, *"Challenge the Process"*, *"Enable Others to Act"*,

and *"Encourage the Heart"*. Each category describes two commitments to mobilize others and support extraordinary work. Dimensions of the conceptual model of leadership team interaction (LTI) from the systematic literature review can be aligned to commitments of the Exemplary Leadership framework [264].

"Three points are noteworthy: The framework of Exemplary Leadership does not explicitly refer to boundary-spanning practices that appear to be necessary in ICT project environments. With a focus on ICT-team environments, the taxonomy developed in the course of this systematic literature review differentiates three boundary-spanning leadership interaction dimensions, namely 'Buffering', 'Managing Interfaces' and 'Representing'. Secondly, task-related practices are not directly mentioned in the commitments of the framework of Exemplary Leadership, though task complexity, technology changes, goals and schedules can be perceived as risks for project team performance in ICT projects. Lastly, a key focus in the framework of Exemplary Leadership is set on interpersonal processes. Leadership is seen as a phenomenon evolving in interpersonal relationships [357, p. 30-32] ([65, p. 30–32] in article, authors' note). Emergent process facilitation and person-related leadership interaction categories of the taxonomy developed in this study could be frequently aligned. Interpersonal relationships in ICT-team environments appear under-investigated [266, p. 14]."

Leadership team interaction categories can further be compared to the PMI project manager competency framework [484], [264]. *"The key dimensions 'planning and scheduling' as well as 'monitoring and controlling' are strongly represented in the PMI project manager competency framework. This may be due to a focus on standardized, accepted management strategies. Competences of dealing with teams appear less emphasized in the PMI competency framework. Motivation seems to be fairly represented. Interactions supporting emerging interpersonal processes could hardly be aligned to PMI project manager competences, apart from 'conflict resolution'. Hardly any project manager competence deals with interpersonal diversity or supporting creativity [266, p. 14]."*

The Exemplary Leadership framework focuses on interpersonal relationships, but project circumstances are not necessarily addressed. The PMI competency framework accentuates task-related interactions, yet hardly discusses facilitating interpersonal relationships.

Core functions of interpersonal leadership [372] can be aligned to categories of the taxonomy of leadership team interaction supporting team performance, as presented in table 6.3.

Interpersonal Leadership Core Function	**LTI Taxonomy Categories**
"Supporting others"	*"Conflict resolution"*, *"Creating a supportive team atmosphere"*, *"Interpersonal facilitation"*
"Motivating others"	*"Motivating"*, *"Team structure management"*, *"Communication"*
"Developing others"	*"Enabling team processes"*, *"Coaching"*

Table 6.3 Interpersonal Leadership Core Functions to Leadership Team Interaction Taxonomy Mapping [372]

Kaulio [332] used the critical incidents technique with project leaders in multi-project settings to find out about critical incidents in their daily work life. Findings suggest that project leaders deal primarily with technical difficulties, dyadic leadership and issues of group dynamics, including project stakeholders. Tuuli and Rowlinson [608] highlight that leaders must develop dynamic capabilities to deal with continually changing task-related and person-related issues.

A key capacity in leading ICT project teams seems to be the ability to adjust the communication and interaction approach to a particular context and situation [173]. Hereby, personal reflection and sharing experience with team members appears to be valuable for inexperienced as well as experienced team leaders. The 2agendas@work framework by Motschnig and Ryback specifically focuses on this key competency [438].

6.2.2 Normative Model Validation

In order to validate the normative model of team leadership interaction, 11 project managers of ICT teams were invited to recount events in projects they had led and perceived as highly influential on the team or as learning opportunities for themselves.

The main intent of this study is an empirical validation of a normative model uncovered in a systematic literature review [266]. Basic underlying assumptions are:

- There exist events that significantly influence ICT project team performance, as perceived by team members holding leadership functions.
- There exist personal dispositions of team members holding leadership functions that help to facilitate team performance.

- Significant events can be consulted to refine a conceptual model of leadership team interactions (LTIs) supporting team performance in an ICT context.
- Descriptions of significant events in ICT projects hold specific similarities that form a kind of family resemblance [633].

Anchoring important change events in the course of a project to explore interpersonal processes is primarily rooted in the significant events research approach [496], [238] and draws from the critical incidents technique [213], [63]. In significant events research, focus is set on identifying, describing, explaining and predicting the effects of processes that bring about change in the researched field [238, p. 4]. Thereby, the critical incidents technique explores behavior that is either helpful or hindering to a specific task [636].

In this study, a consensual qualitative research approach appeared suitable to help deciding on descriptions of significant events based on family resemblance, elaborate categories, and compare them to LTI key dimensions [287], [286], [598]. Three researchers from the field of business informatics analyzed interview transcripts to arrive at consensus on classification.

In the next section, the research process of this study is described in detail. Subsequently, findings are presented. Finally, results are discussed.

6.2.2.1 Method

In significant events research, interpersonal processes are segmented into different episodes or events to gain understanding of these processes in the context of these meaningful units [496, p. 11]. It is qualitative change process research that *"relates processes to effects in contexts [194, p. 2]"*. Significant events research often complements randomized test trials and experimental or interpretative single-case causal research designs. This research approach stems from qualitative research on reciprocal effects of interpersonal interaction in counseling [190], [191], [192]. Process descriptions may be utilized to work out and refine conceptual models [191, p. 249].

For Elliott [194], qualitative research is especially useful in research fields lacking good definitions, descriptions or explanations (p. 3). It can support quantitative research by clarifying the meaning of quantitative data or by establishing the basis for sound quantitative research.

Similar to significant events research, the critical incidents technique is events-based. While the first is intended to support the understanding of process evolvement in the re-

searched area [496], the latter was elaborated as a tool to study activity requirements [213]. The critical incidents approach was developed for exploring behavior that is significantly helpful or hindering to a specific task [636]. *"The objective is to gain understanding of the incident from the perspective of the individual, taking into account cognitive, affective, and behavioral elements [133, p. 56]."* In organizations, the critical incidents technique can be applied to identify and resolve workplace problems. Accordingly, participants in organizations can gather information to be used in daily work practice [240, p. 67]. Incidents are researched in a context of operating background factors and conditions. A critical incident makes a significant contribution, negatively or positively, to a specific studied phenomenon [80], [246], [213, p. 11/12].

What is defined as significant needs to be specified as it depends on the quality of the researched phenomena.

In this study, attributes of significant events were clustered to form a kind of family resemblance. Persons holding a leadership role or function involved in LTIs are seen as *"expert witnesses"* to the process of their interactions. Focus is set on recurring events that are perceived as relevant for the team or the progress of the project in the sense that they are described as helpful or hindering to team performance. Underlying to this approach is the assumption that from invariances in a specific class of situations, process characteristics that hold across situations can be inferred [496, p. 19/20]. Observed fragments of process are connected to process outcomes.

In the course of this study, phenomenological data was collected in change process interviews [194] adapted to the context of ICT project leadership.

Findings were aligned to the LTI model in a team of three researchers following a consensual qualitative research approach [287].

6.2.2.1.1 Data Collection

Sample In the course of the EU-funded iCom project [312, p. 13/14] project managers were personally asked on several workshop occasions, if they would agree to be interviewed on interpersonal interactions in ICT projects. Further, an invitation was presented at a Project Management Institute (PMI) meeting.

Project managers were asked to participate in an interview for approximately one hour. They were informed that all data collected is being anonymized.

Hill et al. [287] recommend sample sizes of 8 to 15 participants randomly selected from a homogeneous population in consensual qualitative research. In total, 11 project managers from medium and large organizations responded to interview requests. Interviews took place from May to October in 2013. Nine interviews were face to face, two using a VoIP service. All interviews were recorded and transcribed. Eight participants were male, three female. Participants were from 33 to 48 years of age. Most were around 40 years old. Four interviewees had 10 to 15 years of experience as project manager, three between 5 and 10 years, two more than 15 years. The majority of interview partners (7) came from a higher education background. Table 6.4 displays demographics of interview partners.

In total, participants described 19 projects. The described positions were mostly project leader, followed by project manager, and further program manager, department leader, project team leader and project team member responsible for planning and organization. Team sizes were described ranging from 3 involved persons to 150 people. The average was 44 people. Median was 23 team members. Eight projects integrated some form of waterfall software development process, while four projects were led in a rather agile way. One described project did not implement a software development process. The projects took from 4 to 120 months, the average being 27 months. The median was 18 months. Five described projects explicitly held distributed project teams. Six participants mentioned that they were working in an international team. The project characteristics are listed in table 6.5.

Interpersonal skills appear to be important for stakeholder selection [14], [482], [648]. *"The skills therefore can be used as the final measures to qualify the selected stakeholders as the best possible participants [494]."* To gather information about interpersonal skills, interview participants were asked to distribute an online questionnaire elaborated using the open source tool LimeSurvey (https://www.limesurvey.org) to 2 to 5 team members.

Team members of 5 interviewees responded.

In total, twelve persons filled out the questionnaire. One interviewee received feedback from 4 team members, 2 interviewees from 3 team members and two interviewees from one team member.

While no general interpretation concerning the sample of interviewees can be deduced from these responses, a tendency, at least for some interview participants, can be found. The questionnaire is based on a simplified version of trait-scales elaborated by Truax and Carkhuff [599], adapted for course evaluation at Universities [477], [441], [209, p. 102-107]. The questionnaire is highly simplified to enable quick answering, which appeared to be an

Interview	**Age**	**Gender**	**Type**	**Date**	**Connection**	**Experience**	**Education**
1	43	m	face to face	5. 2013	iCom	10 - 15 y.	Higher Ed.
2	34	m	face to face	6. 2013	iCom	10 - 15 y.	Secondary Ed.
3	39	m	face to face	6. 2013	PMI	5 - 10 y.	Higher Ed.
4	47	m	face to face	6. 2013	PMI	15+ y.	Higher Ed.
5	36	f	face to face	7. 2013	PMI	10 - 15 y.	Higher Ed.
6	40	m	face to face	7. 2013	PMI	10 - 15 y.	Secondary Ed.
7	Not Available (na)	m	face to face	7. 2013	iCom	5 - 10 y.	Higher Ed.
8	na	f	face to face	7. 2013	PMI	na	na
9	na	m	face to face	7. 2013	iCom	na	na
10	48	f	VoIP	10. 2013	PMI	15+ y.	Higher Ed.
11	33	m	VoIP	10. 2013	iCom	5 - 10 y.	Higher Ed.
SUMMARY	40 (*Median*)	m (8)	face to face (9)	5. - 10. 2013	PMI (6)	10 - 15 y. (4)	Higher Ed. (7)
	40 (*Average*)	f (3)	VoIP (2)		iCom (5)	5 - 10 y. (3)	Secondary Ed. (2)
	33 (*Minimum*)					15+ y. (2)	
	48 (*Maximum*)						

Table 6.4 Normative Model Validation - Interview Participant Demographics

Position	Team Size	Software Development Process	Duration (in Month)	Distributed Team	Other
Project Leader	15	eXtreme Programming (XP)	9	No	International Team
Department Leader	27	Custom/Waterfall	18	Yes	International Team
Project Leader	12	Waterfall	20	Yes	
Project Leader	25	Scrum	15	No	High Priority Project
Project Leader	60	V-Model	31	Yes	International Team
Project Manager	60	EDM	48	No	International Team
Program Manager	150	Agile	60	Yes	
Project Leader	100	Custom/Waterfall	6		
Project Leader	100	Waterfall	24		High Time Pressure
Project Leader	20		9		
Project Leader	10		4		
Project Team Member - Planning and Organization		Waterfall	120	No	
Not available (na)					
na					
Project Manager	15	Custom/Waterfall	12	Yes	International Team
Project Leader	12	Scrum	18	No	
Project Team Leader	3	None	18	No	Academic Cooperation
SUMMARY					
Project Leader (9)		Custom/Waterfall (3)	18 (Median)	No (6)	International Team (6)
Project Manager (2)		Waterfall (3)	27 (Average)	Yes (5)	High Priority Project (1)
Department Leader (1)		Scrum (2)	4 (Minimum)		High Time Pressure (1)
Program Manager (1)		XP (1)	120 (Maximum)		Academic Cooperation (1)
Project Team Leader (1)		V-Model (1)			
Project Team Member (1)		Agile (1)			
		EDM (1)			
		None (1)			

Table 6.5 Normative Model Validation - Project Characteristics

important quality considering time-constraints of business environments. Team members of interviewees were asked to evaluate interviewees in the following 5 dimensions:

1. *General attitude*, describing a general impression of the way interviewees get in contact with team members,
2. *Realness*, depicting in how far team members perceive interviewees as communicating clearly and openly,
3. *Unconditional positive regard*, describing if team members feel to be met on eye-level by interviewees,
4. *Understanding*, depicting if interviewees are perceived to be responsive to team members' needs, and
5. *Competence*, describing team members' impressions of interviewees' field expertise.

The interview stakeholder selection questionnaire can be found in Appendix B, p. 361.

Interview Design To identify significant moments, an adapted version of the change process interview, which is used to reflect counseling processes [189], [641], [196], was applied. In change process research, persons involved in an interpersonal process are asked to describe important, helpful and hindering events [194, p. 11].

A similar approach can be found in the behavioral events interview that is based on the critical incidents technique and frequently utilized in recruitment [173].

The qualitative change process interview is about interviewee's understanding of what has changed, and what caused and influenced change - including circumstances that were perceived as hindering. In this research endeavor, events are studied that are valued as significant by the team leader with his/her personal attitudes, needs, wishes and aspirations.

Hill et al. [287] suggest to skim previous research, talk to people of the target group and consider personal experience concerning the research topic to build a semi-structured interview guideline to help participants of the study explore their experiences more deeply. A change process interview standard outline that is used in the context of counseling can be found at: http://experiential-researchers.org/instruments/elliott/changei.html (last visited: 13. 4. 2017). The adaptation from this change process interview guideline [194, p. 21-23] is presented in Appendix C, p. 365.

6.2.2.1.2 Data Analysis

"To increase validity of constituted categories, structures and patterns, as well as the reliability of the findings, the analysis of results may be based on qualitative consensual research [286]." Three researchers - including the author of this thesis - differentiated and categorized significant events in a consensual qualitative research endeavor.

Interviews were transcribed for qualitative data analysis. Then, attributes constituting significant events were collaboratively determined. Further, significant events were aligned to domains and categories from the LTI taxonomy retrieved in a systematic literature review (see section 6.2, p. 123, and table 7.8, p. 283).

Family Resemblance In this study, significant events are defined as a familiarity structure. To distinguish between significant events and other, less significant ones, a set of attributes that characterize significant events was specified [292]. The research team called this set of attributes a form of family resemblance. More precisely, the classification model of significant events as introduced in this research endeavor is defined as follows: Given I1, I2, I3, ... as objects of type *"experience description"* and q1, q2, q3, q4, ..., q8 as finite set of objects of type *"quality"* defining type *"significant event"*, then: *"experience description"* is of type *"significant event"*, if subset of *"quality"* objects is attributed to object *"experience description"*.

The concept of family resemblance or likeness was presented in philosophical investigations by Ludwig Wittgenstein [633, §65-71]. He defines family likeness referring to the concept of game such that games, although often non-identical, hold a differing subset of overlapping linguistic attributes associated to the concept of game. In cognitive sciences, family resemblance is explored in-depth in prototype theory. Objects are rather defined by different attributes with unequal status leading to a graded notion of categories [509].

Consensual Qualitative Research Consensual qualitative research (CQR) is a systematic qualitative research method that is carried out in a team of researchers, following a specific research procedure. It is used for the exploration of complex phenomena in an open-ended way. A main goal is to learn from participants in the research process about their experiences of the studied phenomena [598, p. 273]. CQR includes aspects of phenomenological [231], grounded theory [579], comprehensive process analysis [193] and from exploratory, discovery-oriented research approaches.

Descriptive-interpretive analysis methods, such as CQR, share a focus on research tasks of definition or description. Moreover, they can be used to build process models [194, p. 36].

In CQR, an emphasis is set on the agreement, consensus, of multiple judges in the process of constituting findings, the consistency of data collection across participants and on verbal reflection of meaning in the data [286, p. 197]. The process of seeking a common understanding of the data among several judges is essential to consensual qualitative research. Consensus is based on mutual respect, equal involvement and shared power of research participants [287, p. 523]. While consensus is sought, the right of each research participant to hold differing worldviews is preserved. Data analysis is typically carried out in three steps [287], [285], [286, p. 206]:

1. Domain Coding

   Domains are used to segment data. Domains can be derived from literature [423], prior research or the semi-structured protocols used for data collection. *"Often, significant incidents are organized in a classification system that is either established from theoretical models, e. g. based on literature or previous research, or inductively [571] (orig: Stauss, 1993, authors' note) to gather information about frequency and patterns of factors that influence the researched phenomena [240, p. 66]."*

   Frequently, team members independently group data into domains and afterwards work to consensus on several cases. To reduce repetition in this work, after the list of domains and the coding process for some cases are completed, the domain coding may be continued in pairs of researchers as long as their work is reviewed by other team members and auditors [286, p. 206].

2. Elaborating Core Ideas

   Interview participants' words are rephrased in a way comparable to other cases. Similarly to domain coding, after a common understanding of core ideas has been achieved in the team of researchers, work repetition may be reduced if one team member writes the core ideas and the other team members review them as internal auditors. Alternatively, team members may read each case independently and identify possible domains before formalizing the domain coding and constructing core ideas together in the team. Hereby, team members work through parts of the cases to reach consensus on domains and core ideas.

3. Cross-Analysis

   Cross-analysis is the comparison of cases with each other to find commonalities and differences. It can be carried out in the team, generating categories as a group, or by each team member separately, who then provides possible categories for discussion in the team [286, p. 207].

   Concerning the frequency of occurrence of a category, Hill et al. [287] propose that *"general"* results apply to all cases, *"typical"* results apply to at least half of the cases, and *"variant"* results apply to at least two or three, but less than half, of the cases.

   Feedback from persons not involved in the research may be helpful to find out whether the cross-analysis is understandable and makes sense [286, p. 209].

Auditors can provide crucial feedback throughout the process of analysis. Auditors engaged in the research may provide a more integrated, holistic perspective on the data, but their involvement with the data and team members may bias feedback. External auditors can give a perspective on the data not influenced by groupthink. Hill et al. [286] suggest that at least one external auditor be included, at least in the cross-analysis stage. Interview participants may also be asked to check for accuracy of the data.

Model Validation Process After arranging the consensual qualitative research process in a first meeting, the three researchers read three randomly selected interviews. Interview transcripts were sectioned in blocks of thoughts.

During the second meeting, significant events from the first interview were discussed. A category list was derived from the normative LTI model (section 6.2, p. 123, and table 7.8, p. 283). It included: person-related interactions, task-related interactions, change-related interactions, boundary-spanning interactions, and emergent process facilitation.

Concurrently, based on the three interviews the researchers had read, they distinguished qualities of the presentations of significant events by interviewees. This set of qualities appeared helpful in finding and determining significant events in the follow-up process. The research team considered the distinguishing qualities to form a family resemblance.

Researchers selected significant event descriptions of three interviews and formed core ideas collaboratively in face to face meetings to check for coding variations and to discuss category inclusion. The first interview was read through together. Significant events were

identified and core ideas elaborated. Then, significant events were aligned to categories from the normative LTI model together.

For the two other interviews, a moderator was chosen in the team to present his/her findings to the others, so they could compare and complement the selection of significant events. Again, core ideas were developed collaboratively and consensus was sought concerning categorization. Core ideas derived from significant events that didn't match the LTI category list were labeled with the category *"Other"*, before finding more appropriate labels collaboratively in comparing core ideas across interviews.

Finally, each team member analyzed three of the remaining interviews separately to specifically find significant events that could not be categorized in the LTI taxonomy. Findings were presented, compared and discussed in the team in face to face meetings. This approach to check for new data slightly resembles a check for stability of findings in consensual qualitative research. *"To check for stability, at least two cases may be withheld from the cross-analysis and later integrated to see whether the data for these cases fit into the elaborated categories and if the dispersion of general, typical and variant results changed significantly after coding these new cases [287]."* Yet, Hill et al. [286] state that stability can be assumed more rigorously if larger teams and more teams are involved in the consensual research process, and if larger samples are used. In this study, these suggestion could not be taken into account due to resource constraints. Results of the cross-analysis were sent to an external auditor from industry for assessment.

6.2.2.2 Findings

6.2.2.2.1 Stakeholder Selection

Subsequently, a summary of stakeholder selection results is presented.

1. General attitude

   Six participants (50%) in the questionnaire are of the opinion that the team leader responds in a way that notably supports making progress, six participants (50%) that the team leader responds in an encouraging, supportive way that significantly contributes to making progress.

2. Realness

Two participants (16.67%) perceive that the team leader tends to communicate openly and transparently, ten participants (83.33%) that the team leader communicates totally transparently, gives frank responses and is genuine and real.

3. Unconditional positive regard

   One participant (8.33%) states the team leader respects the team members' needs and requests to some minor degree. Eight participants (66.67%) express that the team leader is generally respectful towards team members and encourages them. Three participants (25%) communicate that the team leader is friendly, full of trust in team members, encourages them, and lets them perceive his/her respect.

4. Understanding

   Eight participants (66.67%) respond that the team leader often reacts to what the team members say such that they feel understood. Four participants (33.33%) articulate that the team leader completely understands the team members' needs and interests, and that he/she reacts towards team members in a supportive way.

5. Competence

   Six participants (50%) express that the team leader leaves a quite competent impression and is skilled in project team leadership. Six participants (50%) communicate that the team leader proves expertise in the project context and knows how to make team members enthusiastic.

Interview participants that were rated by team members appear to score fairly high on these 5 dimensions. Figure 6.6 presents the distribution of ratings in each category.

6.2.2.2.2 Family Resemblance of Significant Events

The following qualities of significant event descriptions of ICT project team leaders were discerned: Significant events

- appear to be mainly described by adjectives with emotional connotations.
- are frequently expressed in superlatives.

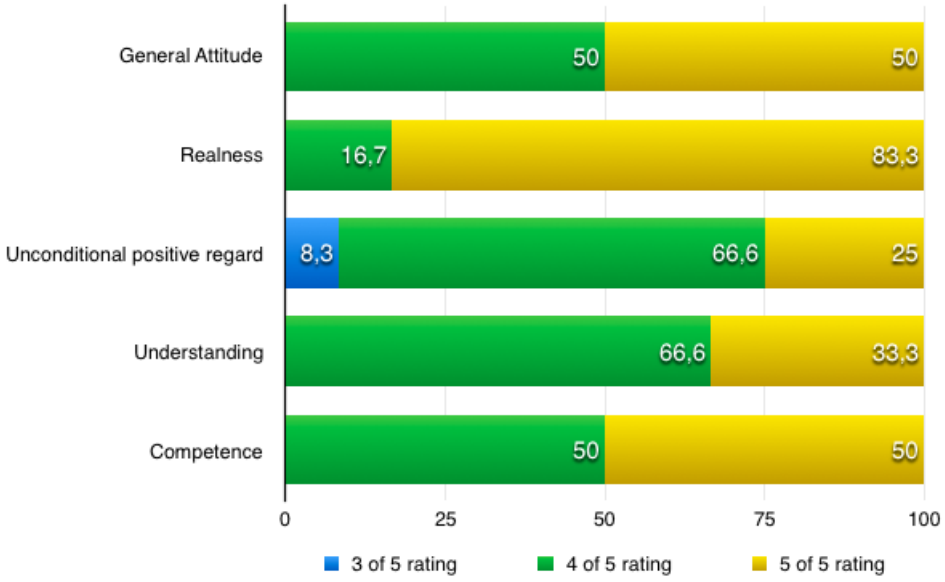

Figure 6.6 Normative Model Validation Interview Stakeholder Selection

- appear to precede a shift in a situation. The situation is described to be perceived differently afterwards.
- appear to be repeated several times in the course of an interview.
- appear to form, shape or align to some sort of ideal - an ideal value, or an ideal self or situational imagination.
- seem to form mental representations for comparison with other personal experiences.

An exemplary significant event that was mentioned in one of the interviews is sketched in the next paragraph:

"That was just wonderful, I never had anything similar before or after that project - that is why I wanted to finish the project, before I leave the company. I really enjoyed it and that this worked so great - thus the project could be finished successfully. We would never have completed the project, if the team had not bonded so well. That was the criterion for success. That was really good. I have never observed that in such an intensity before or after."

And a bit later:

"I've noticed that it incredibly motivates people, if they are working for someone, who is there, touchable, someone, who helps them and also takes over their work. . . . Acknowledge-

ment on a contents- as well as a human level has already achieved much."

Significant event interview vignettes were translated to English by one of the researchers. The two other researchers reviewed the translation.

6.2.2.2.3 Empirical Normative Model Validation

To validate a model of LTIs formed in a systematic literature review (section 6.2, p. 123, and table 7.8, p. 283), three researchers from the field of business informatics, including the author of this thesis, evaluated interview transcripts to find descriptions of significant events. Three randomly selected interviews were discussed in face to face meetings. Core ideas were collected together. Found significant events were further aligned to one of the categories of the LTI taxonomy in the researcher team. The qualitative analysis software Text Analysis Markup System (TAMS) Analyzer (http://tamsys.sourceforge.net) was used to record categorizations of significant event descriptions. Table 6.6 depicts the count of category alignments in the first three interviews.

Category	**Interview Passages**
BoundarySpanning>ManagingTeamBoundaries>Buffering	5
ChangeRelated>ContinuousLearning	7
ChangeRelated>SystemsSensing>Sensing	2
ChangeRelated>SystemsSensing>Vision	3
EmergentProcessFacilitation>CreatingASupportiveTeamAtmosphere	10
EmergentProcessFacilitation>EnablingTeamProcesses	22
EmergentProcessFacilitation>InterpersonalFacilitation	6
PersonRelated>Coaching	4
PersonRelated>Communication	10
PersonRelated>ConflictResolution	4
PersonRelated>Motivating	15
PersonRelated>TeamMemberSelection	14
PersonRelated>TeamNorming	3
PersonRelated>TeamStructureManagement	6
TaskRelated>AllocatingResources	2
TaskRelated>MonitoringAndControlling	3
TaskRelated>PlanningAndScheduling	5
Other>Mentoring	2
Other>CoLeadership	4

Table 6.6 Normative Model Validation - Significant Event Description to LTI Category Alignment Count

Almost all mentioned significant events could be aligned to one of the categories in

the LTI taxonomy (121 of 127 category tags = 95%). Most alignments could be made in the categories: *"Enabling Team Processes"*, *"Motivating"*, *"Team Member Selection"*, *"Creating a supportive team atmosphere"* and *"Communication"*. This high amount of counts in categories dealing with interpersonal processes could be traced back to the main interview focus on events in team leadership of personal importance as well as researcher bias in the consensual qualitative research process. Six event descriptions could not be properly aligned to one of the existing categories.

Each researcher in the consensual qualitative research team read through three of the remaining interview transcripts to find significant events that could not be aligned to a category in the LTI model. Findings were discussed and elaborated in face to face meetings.

Following, exemplary significant event descriptions from the category *"Enabling Team Processes"* are presented:

"The problem was that one could not communicate openly in the team, because we were always faster. They were upset then, because they had not been involved. The Austrian mentality in this team was simply not: we do this together, it was: we are better."

A little bit later, the interviewee comes back to this insight:

"This has hurt us then also financially to some extent. This has been very bad. This has bothered me from the beginning: This isolation, this arrogance. 'We do not need the others' - this is a very bad message in a project. This was not only in their minds, but they also talked in this way."

And a bit later:

"But it was still this: We need to be faster than the others. This is actually quite a super negative example for teamwork."

Another example of a significant event in the context of *"Enabling Team Processes"*:

"For me as a project manager, my main task is actually always making myself unnecessary. I'm just there until there is something to be set up, and when this becomes operational, then I'm gone. I should leave the scene in a way that the work can continue."

Two categories emerged in the process of discussing significant event descriptions that were not aligned to a LTI category and preliminarily collected in the category *"Other"*, namely *"Co-Leadership"* and *"Mentoring"*. Text passages related to the *"Co-Leadership"* category could be retrieved in interview 1 (1 text passage), interview 5 (2 text passages),

interview 8 (2 text passages) and interview 9 (1 text passage). Appearances of significant events of the category *"Mentoring"* were retrieved in interview 1 (2 text passages) and interview 11 (2 text passages). Both categories can be seen as variant findings [287].

Significant events of co-leadership were mentioned by four (of 11) interview participants. Significant events concerning mentoring were described by two (of 11) participants. The category *"Co-Leadership"* was consensually placed in the domain *"Person-Related Behavior"*. *"Mentoring"* was allocated in the domain *"Emergent Process Facilitation"* (see section 6.2, p. 123, and table 7.8, p. 283).

Subsequently, examples of significant event description of the category *"Co-Leadership"* are presented:

"It was a male (project manager, authors' note). With him it was great. I would have never believed that this would work. Honestly, well at the beginning, I was very skeptic. Two (project managers, authors' note) being equal - this does not exist.
There was certainly a ranking: he No1, me No2. But this was never an issue. We actually always agreed on our approach. Argued? (Not a question of the interviewer, authors' note) No, we did not argue. We did complement each other well.
I: How? He was more the type of a manager. He could handle this much better using management language, which did not interest me at all. I also told him: I do not want to do that at all. For this, he was perfect. And I was rather the one, who communicated with people and had covered this area. So far it was great. This was the complement. What he disliked, I liked to do, and vice versa. But this was a lucky strike."

A different significant event in the context of co-leadership was described as follows:

"And the rest was actually keeping at it – using the classical methods one just has at one's disposal: taking the minutes; I had also a colleague, we have, so to say, complemented each other: I supported him in his stream, he supported me in mine. In his phase I took the minutes and he conducted the meeting. We also agreed on this together, how we do this together. Rather quickly we came to the solution - because I also look with pleasure for co-thinkers. Yes, and finally I did then in my active phase in the project, he supported me and he accordingly wrote the minutes, so that also everything fit and I conducted the meeting. Therefore nothing went by the board."

Two interviewees shared important events that deal with *"Mentoring"*. One study participant reflected on the influence of the CEO of the organization on the project:

"Plus of course the backing from the CEO - without that nothing happens (/nothing gets done, authors' note).
I: So he was totally for it, for the project.
Absolutely, that was his idea.
This CEO had an absolute mentor personality who had no problem to let other people grow also beside him. This had even encouraged that. Absolutely felt it,- it also was absolutely the topic.
What I always quite like: In a good company the people are dispensable. Once people start to make themselves indispensable and hedging bets, I already have a problem. Then there is something wrong about it: And so in our case: At any time each of us must be dispensable for 2 months. That was a pre-condition. It was intended that everyone be dispensable."

Another interviewee described:

"Again co-operation partner, that was very important for me to have support, because there were many tricky situations - someone I can trust, with whom I can exchange (/communicate, authors' note), but can also make sparring in this situation, that was important for me, because otherwise I believe I would not have managed it. So, it would have been too many challenges for me at the same time."

The interviewee later stated when asked what had been very important during a rather rough period in the project:

"Support, not to be alone - the support"

6.2.2.2.4 Limitations

To enable quick participation of project team members of interviewees, a short questionnaire was disseminated among study participants. Though aligned to the scales by Truax and Carkhuff [599], these are not as extensive. Opportunities for time-saving participation appear to be important in business contexts. Scales were slightly adapted to fit the business environment from questionnaires checked for validity and reliability and used in action research at higher education institutions.

Eleven interviews are a small sample, yet in consensual qualitative research rather small sample sets are the norm. The interviewed group was rather homogeneous consisting mainly of male, mid-aged project managers in middle and large organizations. A more heterogeneous group including team leaders in small organizations or from different cultural backgrounds

may reveal more variation in findings. Yet, interviewees exposed various levels of experience in ICT project team leadership. Thus, findings can be seen as consistent among less as well as more experienced study participants. The normative model of leadership team interactions supporting team performance appears fairly valid with regard to significant event descriptions of interviewees.

Reliability in significant events research can be guarded by a transparent description of personal biases of involved researchers [286, p. 4]. Researcher bias was introduced due to the research focus of all members of the research team on interpersonal processes in ICT project teams. The normative model of LTIs to be validated was elaborated by one of the research team members. Interviews were conducted by the same person, yet before the normative LTI model was elaborated. One of the research team members has researched teamwork and conflict management in student groups of Informatics and since then developed an interest in significant events in team projects. Another researcher has been studying significant events in academic courses. Consequently, the general characterization of significant events is influenced by that background.

To deal with researcher bias, the results of the cross-analysis were sent to an auditor from industry. The final study was sent to all interview participants for feedback. Researcher bias could have been diminished by including more researchers, also researchers from other fields of study, and more auditors in the analysis process. Yet, resource constraints didn't allow for that measure.

As the main intent of the study was to validate the normative model developed in a systematic literature review, the consensual qualitative research process was adapted accordingly. One interview transcript was discussed together. Then, two interviews were discussed and coded collaboratively, the sessions being moderated by one of the research team members each. After this, the remaining interviews were checked for significant events that could not directly be aligned to already elaborated categories. This process minimized the expenses of collaborative qualitative analysis.

6.2.3 Discussion

6.2.3.1 Normative Model Validation

In this consensual qualitative research study, descriptions of significant events in the course of ICT projects were traced to categories of leadership team interaction supporting team

performance. With 95% of consensually agreed upon interaction category to significant event description mappings in three randomly selected interviews the assignment was fairly consistent. Thus, for the group of interview participants, the normative model of LTIs could be validated to a far extent.

For the differentiation of significant events from rather unimportant events or general explanations, common attributes of such significant event descriptions were sought and collected. These consensually defined attributes formed a kind of family resemblance and supported data selection during the consensual qualitative research process. They frequently served as anchors to come back to in the course of discussing the labeling of a text portion as significant event.

To get a more differentiated view on team leaders' opportunities and challenges of personal and team facilitation in the context of ICT projects, the notions of co-leadership, mentoring, coaching and consulting were distinguished.

The category *"Co-Leadership"* subsumed significant events dealing with issues concerning two or more people sharing leadership responsibilities in a project team environment. The phenomenon of co-leadership impacts team performance [174], [49]. It is, for example, examined by Pearce and Sims [467].

"Mentoring" describes interpersonal interactions of a person holding a leadership function in a team with project external, informal personal supporters that have domain experience or with informal learners in the team. A thorough exploration of mentoring processes is provided by Chao [130].

The strong overlap between the LTIs identified from significant events as part of this research and those extracted from the literature (section 6.2, p. 123, and table 7.8, p. 283) indicates that, indeed, events that managers perceived and described as significant or meaningful point to essential processes for leading project teams. Thus they indicate issues that need to be addressed as part of ICT project management research as well as education or training. The LTI categories can be used to indicate and train those professional capacities for interpersonal interaction that team leaders and/or members need to have in order to achieve team- and project success. The normative LTI model can also be used as classification scheme for interaction descriptions in knowledge bases or experiential data warehouses [54].

Another consequence of this research endeavor is the recognition that events that ICT managers perceived and described as more meaningful tend to be those that determine project success or failure and have, to some extent, been studied in the literature. Consequently, find-

ings confer with the theories of psychologists and neuroscientists [502], [405], [156], [157] who propagate the importance of feelings and emotions alongside cognition to contribute to leadership and decision-making.

Following the interviews, several interviewees shared that they enjoyed the opportunity to reflect on their own processes in projects they had led.

Significant events research and consensual qualitative research appear to be valuable research approaches in the dynamic research domain of team leadership. For example, significant events research lends itself to be applied to accompany case studies of particular team processes.

6.2.3.2 Normative Leadership Team Interaction Model

A nuanced characteristic of the elaborated normative leadership interaction model is its emphasis on emergent process facilitation in ICT project teams.

A distinguishing factor of emergent process facilitation from other leadership interactions - such as envisioning change or motivating others - is the consideration of team member agency. Emergent process facilitation means to enable and handle situation contingent emergent phenomena within the team process. It relates to team-level processes more than specific leader-follower relationships.

Taking seriously the claim that emergent team phenomena, such as creative or team learning processes, help or hinder team performance contingent to organizational, task and social constraints, it appears feasible to

1. contribute to a safe or supportive team atmosphere (living attitudes of reciprocal respect and positive regard in verbal and non-verbal interaction, responding to team member needs, active listening, un-obstructive availability), to

2. enable team processes (opening up or not hindering discussions on shared mental models, opening up space for creative experimentation during work hours, welcoming team member initiative, advocating team solutions), further to engage in

3. interpersonal facilitation (caring for the inclusion of all team members, appreciation of differences, giving phenomenological feedback - focusing on observations more than on interpretations) and

4. mentoring (supporting informal apprenticeship).

In the normative model of leadership interaction presented in this thesis, team performance thus is supported by interpersonal interactions between persons holding leadership functions and other team members that are:

- *person-related:* structuring the team and fostering pertinent collaboration (with a focus on dyadic interactions; AIM: efficiency in collaboration)
- *task-related:* handling resources and monitoring progress (AIM: efficiency in resources)
- *change-related:* tracking environmental circumstances and the project direction (*"big picture view"*, AIM: keeping direction)
- *boundary-spanning:* dealing with organizational interfaces to the team (AIM: positioning the team in the organizational context and protecting the team)
- *facilitating emergent process:* enabling and handling the emergence of team-level properties in the project process, thus supporting self-organization or team learning (AIM: team cohesion and team learning).

Observed behavior may refer to several of these interaction dimensions. The emphasis on facilitating team self-organization points to a necessity of learning on and reflecting interpersonal interactions in ICT project team leadership taking into account person-to-person and group dynamics in ICT project team environments.

6.3 Wiki (Prototype A)

In the following, a first prototype based on a design vision statement (section 2.1, p. 9), design guiding principles (section 5.5, p. 108) and stakeholder requirements (section 6.1.3, p. 122) is specified and discussed. Specification here describes the documentation of design decisions [630].

6.3.1 Codename *Rhea*

The codename for the leadership framework supporting team performance developed in the context of this thesis is - starting with the first tool prototype - *Rhea*. The philosopher Plato associated this word to *rheo* (to flow or discharge) when describing key teachings of the

pre-socratic philosopher Heraclitus. A more in-depth discussion of the name choice can be found in section 7.1, p. 224.

6.3.2 Concept

Digital collections of hands-on practice experience appear to be highly valuable for learning in ICT business contexts [267]. A key finding in a collection of case studies with 1184 participating project managers that was compiled by two consulting companies in 2015 is that there appears to be a demand for digital learning to be more practice oriented. 55% of participating managers needed support in *"doing"* rather than learning detached from daily work situations [542].

An information system that is often used for tacit knowledge sharing within organizations is a wiki, a mostly web-based tool to share information collaboratively [434], [546]. Wikis are a set of webpages interconnected through hyperlinks. Characteristics of wikis are [470]:

- easy to edit for users without requiring knowledge of HTML or any other scripting language
- links and references to other webpages to support visitors in understanding the context
- version control, tracking changes to wiki contents
- built-in search

Content may not only be read, but also edited by anyone who is interested [378].

Advantages in using wikis in organizations are bottom-up and informal knowledge collection, saving time in training employees to use the tool and reducing emails sent. Wikis can be organized in special interest groups such as communities of practice [409]. The use of wikis is backed by the following community values [434]:

- Openness
  "All wiki content should be open to everybody [434, p. 22]."
- Self-organization
  "Within a wiki, no formal roles should be assigned [434, p. 22]."
- Autonomy
  "Users should be allowed to decide autonomously what they want to contribute and how they wish to participate [434, p. 22]."

- Interest and personal relevance
  "The advancement and improvement of knowledge in a community is much greater if all users are personally interested in the topics and content of the wiki . . . [434, p. 22]."

- Diversity
  "On the one hand, . . . users will differ in their expertise with regard to specific topics. . . . On the other hand, users will differ with regard to their experience with the medium of wikis, and their position in a wiki community [434, p. 23]."

- Serendipity effect
  Information to solve a problem may be found by chance when browsing through links within a wiki. This may happen frequently in wikis due to non-hierarchical navigation options [434, p. 23].

Organizational and leadership pattern repositories can be published in wikis [146], [153]. Wikis may form repositories for information within an organization and potentially allow anybody, for example participants of other organizations, to contribute [470].

Semantic Mediawiki extends the Mediawiki platform. As the (Semantic) Mediawiki user and developer communities are quite large, information on system configuration is easy to retrieve. Semantic Mediawiki pages are versioned, which means that each change is saved and can be reversed. Further, many modules can be found to customize the wiki. Semantic Mediawiki can be configured as a knowledge management system and may be connected to the semantic web. The Semantic Mediawiki enables the use of properties for pages and information retrieval based on properties and categories.

To facilitate the use of the leadership team interaction template (section 6.1.2, p. 120), a contribution guideline was developed for users of the online tool.

A special wiki page called *watchlist* presents recent changes in page contents of a Mediawiki implementation. An editor guideline, as shown in figure 6.7, was provided to help users examine the quality of contributions.

6.3.3 Technology

Semantic Mediawiki is an open source collaborative content elaboration software written in the PHP scripting language and supported by a large developer community (https://www.semantic-mediawiki.org/wiki/Semantic_MediaWiki).

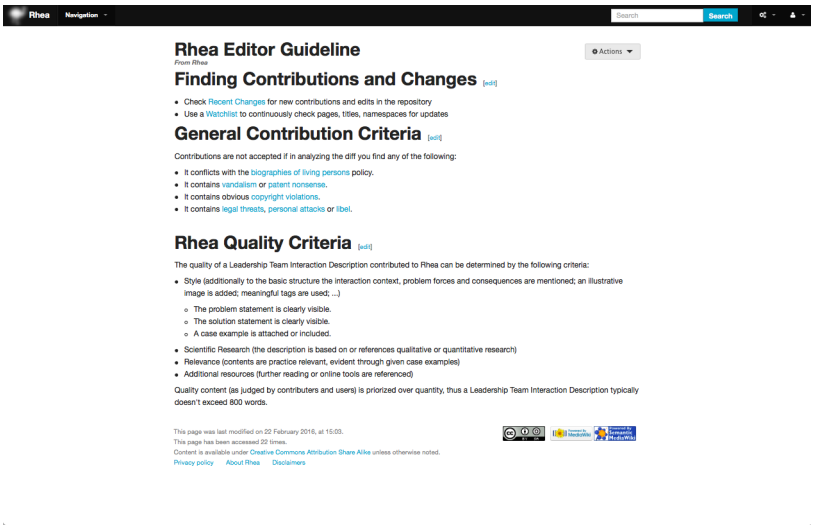

Figure 6.7 Wiki Prototype (Prototype A) - Editor Guideline

For the prototype, a wiki module was installed to allow only logged-in users to change, delete or add experience descriptions. Though, Mediawiki is not designed to protect sensitive data: *"MediaWiki is not designed to be a Content Management System (CMS), or to protect sensitive data. To the contrary, it was designed to be as open as possible. Thus it does not inherently support full featured, air-tight protection of private content [59]."*

For reviewing new content, the Watchlist-page showing new additions to the wiki platform can be used.

The basic framework entity model can be represented in Semantic Mediawiki *"classes"*. A class in Semantic Mediawiki is a data structure to represent a single page type. It consists of a template, a form, a category and properties [353, p. 188]. In the prototype, the *InteractionTemplate* defines the *LeadershipTeamInteractionDescription* category. This template includes links to other templates, namely the *AuthorTemplate* defining the category *Author*, the *LeadershipTeamInteractionTypeTemplate* defining the category *LeadershipTeamInteractionType* and holding categories from the normative leadership team interaction model, the *LeadershipTeamInteractionRiskTemplate* forming the category *LeadershipTeamInteractionRisk* and the *ResourceTemplate* defining the category *Resource*. An *InteractionForm* is shown in figure 6.8.

To allow for a more personalized experience, a mobile client application to Semantic Mediawikis' REST (Representational State Transfer) interface was considered. Using this

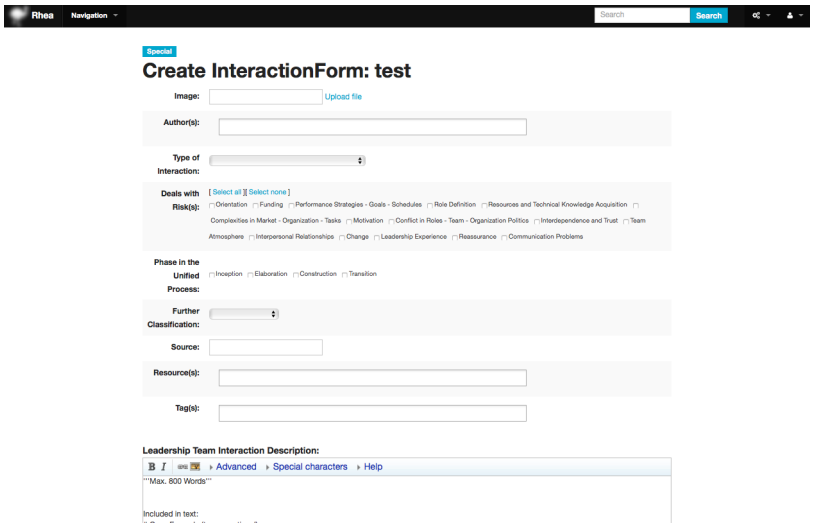

Figure 6.8 Wiki Prototype (Prototype A) - Interaction Form

interface, it is possible to retrieve page contents in data formats such as JSON (JavaScript Object Notation): e. g. http://.../rhea/api.php?action=browsebysubject&subject=Integrity_is_No._1&format=jsonfm. A list of experience descriptions can be collected by querying for the specified category: http://.../rhea/api.php?action=query&list=categorymembers&format=jsonfm&cmtitle=Category:LeadershipTeamInteractionDescription&cmlimit=1000.

Return values of page queries were neither consistent nor complete. They were lacking meta-information, such as linked templates or category definitions, specifically, if some fields of the template were not filled out.

6.3.4 User Interaction

From the landing page describing the platform (depicted in figure 6.9), users can reach the search page, the contribution guideline, and can start creating new contributions.

To allow searching content based on multiple values in different dimensions, faceted classification can be used [443]. In the prototype, experience descriptions can be classified concerning type (pattern, tactic, case story), leadership interaction, project risk, and Unified Process project phase, as shown in figure 6.10. The drill-down search extension is a feature of Semantic Mediawiki that is significant for searching through a potentially large collection of pages. Users can filter contents based on page properties and keywords. Every filter

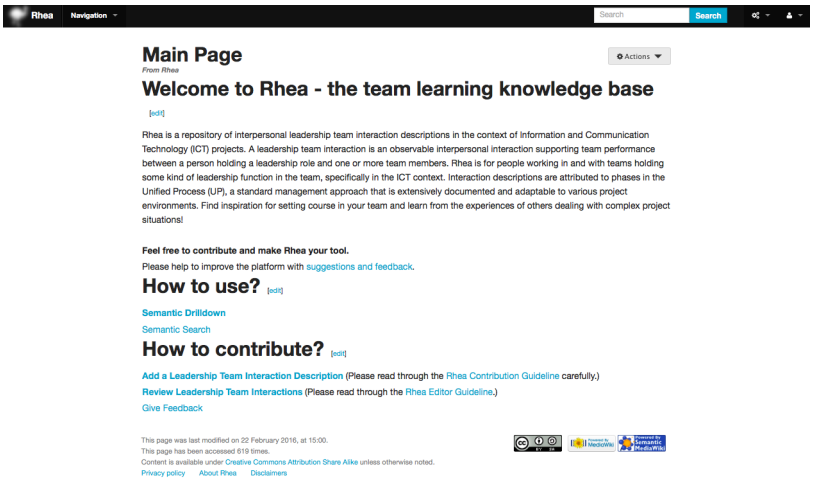

Figure 6.9 Wiki Prototype (Prototype A) - Landing Page

corresponds to a page property. Subcategories appear as filters as well. The semantic drill-down interface shows the number of wiki pages in each main category, an alphabetic listing of pages in the currently selected category, a list of property and subcategory filters, and discrepancies in the current data selection [353, p. 238].

6.3.5 Tool Use in Project Management Students' Focus Topic

To elaborate their elective focal topic in a project management course at the University of Vienna in 2014, two students chose to extract reference experience descriptions from articles implicitly outlining leadership team interactions. They were not instructed on experience description elaboration apart from the contribution guideline found on the wiki, presented in figure 6.11.

Both students structured experience descriptions each found in an article [26], [488] in line with the *InteractionTemplate*. One of those is shown in figure 6.12.

Contributors could follow the contribution guideline without further instruction to extract and elaborate high quality experience descriptions from literature.

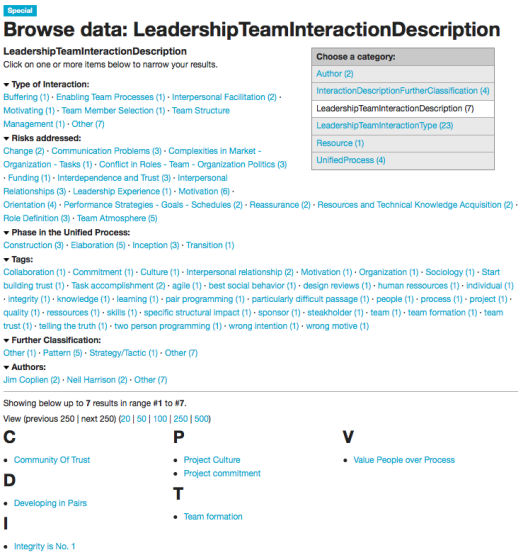

Figure 6.10 Wiki Prototype (Prototype A) - Drill-Down Search

6.3.6 Stakeholder Feedback (Wiki)

The prototype was presented to Ph.D. students in a doctorate course at the University of Vienna. Further, it was shown to an external stakeholder from ICT industry.

The prototype helped the discussion on what team leaders may expect from a learning support tool in practice. Particularly, it was suggested to consider email-newsletters to establish a community of active contributors and to regularly publish experience descriptions particularly relevant in daily work. As wikis tend to be openly structured, quality of contributions was discussed. A board of expert editors curating the online platform was advocated.

6.3.7 Discussion

Challenges when implementing wikis can be seen in:

- Security
  Access control is not a typical feature found in wikis. Authorization and authentication mechanisms can be cumbersome to implement [302].

Rhea Navigation Search Search

Rhea Contribution Guideline

Actions

From Rhea

Leadership Team Interactions are observable interpersonal interactions between a person holding a leadership role or function and one or more team members supporting team performance. Basic to each is a particular tense situation and an interpersonal leadership interaction to fit involved tensions. Case examples explicate leadership team interactions in a rather hands-on fashion.

Contents

[hide]

- 1 Leadership Team Interaction Description Components
- 2 Leadership Team Interaction Description Categorization
- 3 Leadership Team Interaction Description Relations
- 4 Quality measurement

Leadership Team Interaction Description Components

[edit]

Leadership Team Interaction Descriptions comprise the following constituents (leaning on common elements of organizational patterns):

1. **Context**(if possible): circumstances in which a particular situation of interpersonal tension emerges in the team and its environment (including e. g. project phase, team size, company core values, organizational structures, ...)
2. **Problem Statement**: a specific interpersonal problem in the project context involving the project team with team members or associates in a leadership role or function
3. **Forces**(if possible): tensions that influence/establish the problem situation (these can be listed)
4. **Solution Statement**: A leadership team interaction that fits the problem situation that is in line with an agile, rather humanistic value base
5. **Consequences**(if possible): the destinies of the tensions risen through involved forces (e. g. as a bulleted list)
6. **Case Example**: scientifically uncovered or personally experienced, this is the most important aspect of the Leadership Team Interaction Description. If no case examples can be found in practice, an invented case example can be inserted. Please note in the edit summary whether the case is from research, personal experience or invented. As they make particular project team situations plastically comprehensible, case examples are highly suited to run like a thread through the description. Common practice in organizational patterns is giving a teaser of a case example at the beginning of a pattern and solve it after running through consequences of a solution.
7. **Significant Image**(if possible): An image that makes a leadership team interaction description comprehensible in a blink is worth more than 1000 words, as it helps to recognize and grasp the meaning of the description. IMPORTANT NOTE: Rhea follows the Image Use Policy of Wikipedia. Please check the Image Use Policy to make sure that the image license is appropriate for this platform.
8. **Resources**(optional): Further reading, links to online tools contributing to the Leadership Team Interaction Description
9. **Expressive Tags**: At least 5 meaningful tags may be added to a description. Semantic tools such as Alchemy API may be used for suggestions.

Contributors need to consider an *appropriate representation form* for their Leadership Team Interaction Descriptions. They may be composed as continuous text, as bulleted list, through a series of diagrams or in another way that appears to fit.

Please cite properly. To cite a source or resource text reference, the Bibtex Extension can be used.

Suggestions for writing a Leadership Team Interaction Description can be gathered by browsing through the repository and learning from other contributors. Further, the pattern community offers rich sources on building pattern descriptions. Excellent guides on writing patterns can, for example, be retrieved here or, for first-time pattern writers, here. Keep in mind that in Leadership Team Interaction Descriptions primary focus is set on sharing and exchanging valuable experiences with others and shaping an interpersonal learning platform through significant personal insights and case examples. Unlike organizational patterns, Leadership Team Interaction Descriptions are not recipes to be applied in the same manner again and again, but are intended to provide hints and inspiration for personal decision finding within a team in complex project situations, especially in the ICT business environment. New insights may be utilized to re-shape already existing descriptions. New case examples that support a description may be added.

Leadership Team Interaction Description Categorization

[edit]

To simplify retrieving appropriate Interaction Descriptions Rhea allows semantic search queries and faceted search. To support faceted classification and semantic querying, Leadership Team Interaction Descriptions are tagged and ranked on three axes.

1. **Interaction Type**: each type includes heuristics for inclusion (to see the heuristics check out the specific type wiki-page)
2. **Risk(s)**: each risk includes heuristics for inclusion (to see the heuristics check out the specific risk wiki-page)
3. **Unified Process Project Life-Cycle Phase**: check out the Unified Process to get an overview of the development process and its four project life-cycle phases

Leadership Team Interaction Description Relations [edit]

If a description is associated with another, this can be specified by using the Properties

- Property:InContextOfInteraction,
- Property:ComesAfterInteraction,
- Property:ComesBeforeInteraction

in the continuous text.

Case examples can be linked to Tactics or Patterns using the Property

- Property:ExampleAssociatedWith

in the continuous text.

Quality measurement [edit]

The quality of a Leadership Team Interaction Description contributed to Rhea can be determined by the following criteria:

1. **Style** (additionally to the basic structure, the interaction context, problem forces and consequences are mentioned; an illustrative image is added; meaningful tags are used; ...)
2. **Scientific Research** (the description is based on or references qualitative or quantitative research)
3. **Relevance** (contents are practice relevant, evident through given case examples)
4. **Additional resources** (further reading or online tools are referenced)

Quality content (as judged by contributers and users) is priorized over quantity, thus a Leadership Team Interaction Description typically doesn't exceed 800 words.

Thank you for sharing your experience on Rhea and make it your knowledge base for team learning!

This page was last modified on 22 February 2016, at 13:07.
This page has been accessed 134 times.
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Privacy policy About Rhea Disclaimers

Figure 6.11 Wiki Prototype (Prototype A) - Contribution Guideline

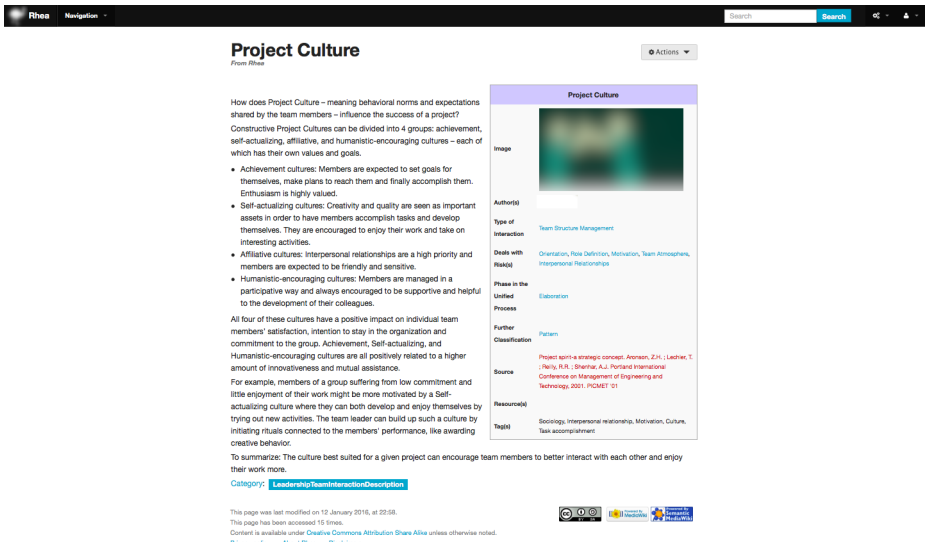


Figure 6.12 Wiki Prototype (Prototype A) - Leadership Team Interaction Description (see also [26])

- Data Migration
  Contents and meta-data are written in a wiki-specific form. Such a wiki-specific format often can not be easily transferred between one wiki to another [132], [370].

- Architectural Stability
  Open source wikis could be jeopardized in stability and content integrity through updates, bug patches and new releases [370], [620].

- User Training
  Users need to learn writing syntax and style of a wiki platform [370].

- Categorization of Information
  Users might not share an understanding of content structure. This may cause problems retrieving relevant information [470, p. 71].

The wiki prototype is rather easy to use, if users are acquainted with writing in Mediawiki. Browsing contents by means of a drill-down search appears fairly concise. Yet, authorization and authentication as well as user privacy are usually no major concerns in wiki environments as these oppose the intention to publicly share and offer information to some extent.

Wikis are frequently used to share information within and across organizations. The prototype lacks an extensive user base necessary to refine content and keep the platform up

to date. The platform as such does not necessarily support interpersonal reflection processes.

Scalability and features of the platform depend on open source community development.

A key contribution of the first prototype for framework development can be seen in the evaluation of the contribution guideline forming the initial personal reflection support document of the framework (chapter 7, p. 223).

6.4 Mobile Application (Prototype B)

6.4.1 Concept

The key idea of the second prototype (Prototype B) is to support (inter)personal reflection of interested peers. Thus, not the collection of experience descriptions is focused, but support of the reflection or learning process of individual learners in team leadership.

For prototype design, this means that individuals can choose for themselves what of their reflections they want to share, when they want to share it and with whom. Learners may be able to include peers from their learning networks or establish learning networks with the tool.

A study by a consulting company including more than 2000 participants in leadership highlights that 70 % of managers under 35 years of age use mobile devices to access digital learning environments [175, p. 23]. Mobile phones appear to be heavily used for learning by persons in leadership positions. Consequently, as ease of use and quick access were considered important for a leadership support tool (see R3, section 6.1.3, p. 122), a mobile application approach was taken for the second prototype (Prototype B).

Referring to the design vision statement (section 2.1, p. 9), stakeholder requirements (section 6.1.3, p. 122) and particularly stakeholder feedback on the first prototype (Prototype A), tool use scenarios were elaborated, including private reflection, team evaluation and feedback as well as optional expert opinion or peer review. The tool use scenarios are depicted in figure 6.13.

Similar to the interaction template of the first prototype (Prototype A), the second prototype (Prototype B) provides a structured environment to write down significant experiences in team leadership. The normative model of team leadership interaction (section 6.2, p. 123, and table 7.8, p. 283) is used to index experience descriptions within the software system.

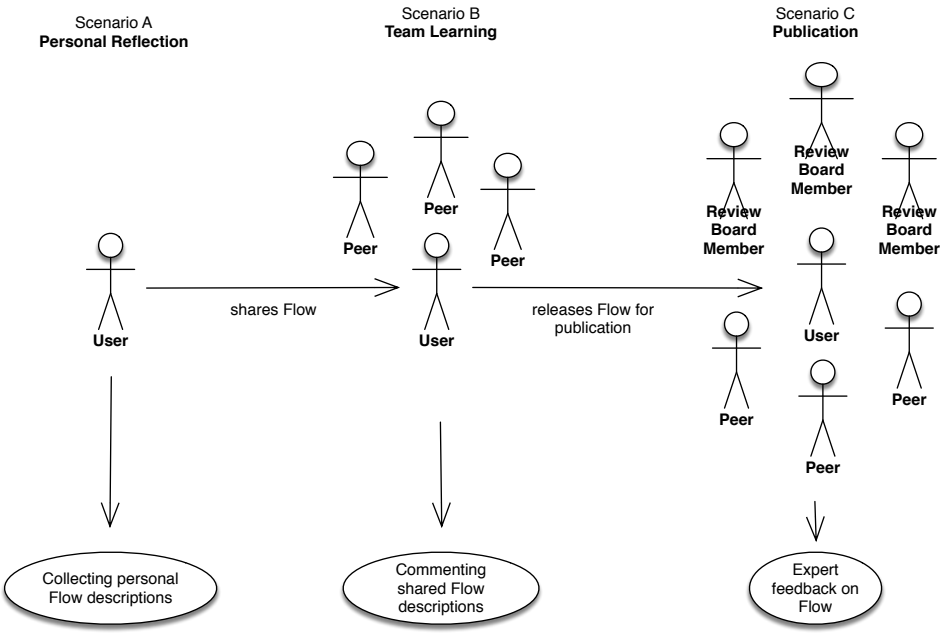


Figure 6.13 Mobile Prototype (Prototype B) - Scenarios

Users can invite other users of the application to give feedback on their flows. Shared content is only available to invited participants. After some feedback was given it is possible for users to apply for an expert peer review [54]. In a peer review, experts (e. g. users that published at least five experience descriptions on the platform) give hints and revision recommendations for the written reflection. After recommendations were considered and at least two expert reviewers approve changes, the user has the opportunity to publish the flow to the public. If a flow is publicly released, all users of the tool have access to it. The users' name and affiliation appear as part of the public experience description. A monthly newsletter can be compiled showing new additions to the platform.

The second tool prototype

- combines social networking, open journalism, authoring, and establishing a community of practice,
- supports participative learning systems and can be integrated in formal management systems [547],
- is a workflow tool or experience management system [54] representing interpersonal leadership team interaction experience descriptions, and

- is a reflection tool for practitioners with staged sharing options.

Sharing experience with persons outside of a specific company may benefit the reflection process as people are not in the same organizational environment and can bring in different perspectives.

6.4.2 Technology

The second leadership support tool prototype (Prototype B) is a mobile application written in the Swift programming language (https://www.swift.org). It is a native iOS (https://en.wikipedia.org/wiki/IOS) application. A key software component is the interface with a CloudKit (https://developer.apple.com/icloud/cloudkit/) data backend. CloudKit is a document store hosted by Apple Inc.. It allows to store content in private databases, sharing content with others by creating shared databases with shared contents and publishing content to a public database that is accessible for all users of a software system. CloudKit works with AppleID authentication. Registered users can access private databases and share with others. For public databases, content creating users, authenticated users and others can be specified to be allowed to read, write or create records of content. The client application is the only certified gateway to the remote data backend. User account-based keys are used to protect user data. Transmitted files are chunked and encrypted [5, p. 53].

The prototype was designed to specifically support personal reflection processes. It encapsulates system dependencies. The software system can be further developed incrementally.

6.4.3 User Interaction

The software system revolves around a searchable table view. It displays flows and a flow writing view. The flow editing view provides a toolbar option to share the flow with others. Flows can be shared by entering email addresses of co-learners. The application main view that presents the searchable flow collection that is stored in the data backend to the user is shown in figure 6.14. Figure 6.15 shows the beginning of the scrollable flow detail view. Figure 6.16 presents the flow edit view. Figure 6.17 depicts faceted classification options when editing a flow.

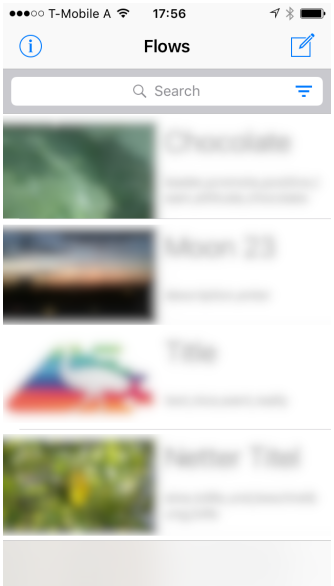


Figure 6.14 Mobile Prototype (Prototype B) - Main View

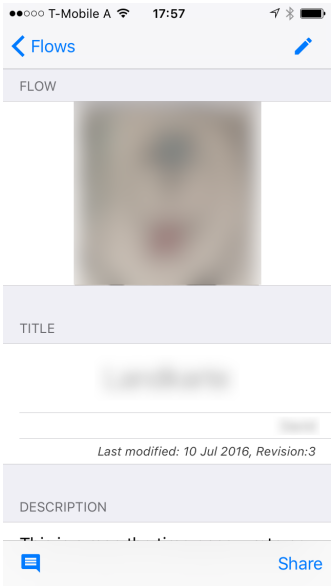


Figure 6.15 Mobile Prototype (Prototype B) - Scrollable Flow Detail View

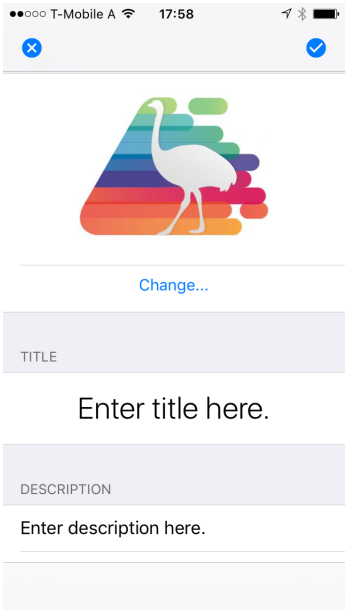


Figure 6.16 Mobile Prototype (Prototype B) - Scrollable Flow Edit View

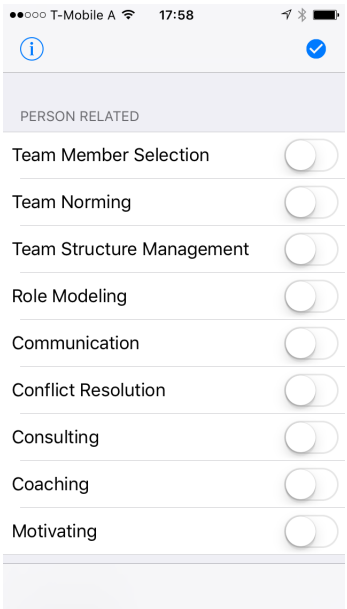


Figure 6.17 Mobile Prototype (Prototype B) - Exemplary Flow Classification Options

6.4.4 Focus Group: Mobile Application

To identify if the artifact satisfies needs of persons interested in ICT project team leadership, a focus group was carried out on the working mobile application prototype at the NetIdee Open Source Community Camp in the Impact Hub Vienna on the 18. 11. 2016 (https://www.whataventure.com/events2/netidee/2016/).

6.4.4.1 Method

Focus groups can be employed in qualitative research [126], [432]. They are typically applied to get in-depth information on perceptions, insights, attitudes, experiences, or beliefs, and to gather additional information in a quantitative or mixed-method research approach [352], [351]. In user experience research, focus groups may be applied for they elicit users' spontaneous reactions and ideas concerning the use of an interactive system. Moreover, organizational issues can be observed.

"In a focus group, you bring together from six to nine users to discuss issues and concerns about the features of a user interface. The group typically lasts about two hours and is run by a moderator who maintains the group's focus [448]." Focus groups are not well suited to test interface usability, as individuals in the group rarely have time to explore the system in-depth. *"They differ from usability studies in that they show participants' attitudes towards a particular item, whereas usability studies reveal how things are used [529, p. 4]."*

Watching a demonstration of a product is different to using it. *"In interactive systems development, the proper role of focus groups is not to assess interaction styles or design usability, but to discover what users want from the system [448]."* Thus, focus groups may be applied to evaluate conceptual models underlying a particular product. Typically, more than one focus groups are run to receive rather representative results. Yet, results in one group are not representative for other groups. As users commonly do not use the system for a long time or not at all, focus groups can produce incomplete data. To minimize such bias, use case scenarios from practice may be demonstrated [448].

Focus groups are susceptible to facilitator bias, thus involved researchers may explain personal research biases. To analyze focus group outcomes, the group moderator or facilitator may summarize reflections on the focus group session and mark insights, including themes, hunches, interpretations, and ideas mentioned by focus group participants.

A diagram of seating arrangements may be sketched. If the focus group is recorded, it

can be transcribed. Results of a focus group may be collected in a question-by-question format [368, p. 10]. To compare focus group sessions, coding categories are established based on patterns in transcripts and moderator notes. Next, codes are combined, subdivided, submerged or eliminated. Recurring ideas and themes connecting and organizing codes are differentiated [454].

6.4.4.2 Scenario

The focus group took place at the NetIdee Open Source Community Camp in the Impact Hub Vienna on the 18. 11. 2016 from 14:00 to 15:00. Three consultants in the ICT business field, two chief technical officers within ICT companies, two project team members of an ICT organization, and a programmer participated in the focus group.

Before entering the group discussion, an application prototype was presented. First, a short description of the main goals of the artifact was given. Main workflows, specifically adding flows, searching flows, showing flows and sharing flows, were shown - first on slides using screenshots, followed by a live application demonstration.

The guiding questions for the focus group were:

- How are you dealing with reflection of interpersonal processes in your projects right now?
- Is a tool to support reflection on interpersonal processes in (ICT) project team leadership generally important to you and your professional community [279, p. 87]?
- Why would this system be helpful to support dealing with interpersonal processes in teams [54]?
- What value does Rhea have for you or your professional community?
- Can you find what you expect to find within the system [54]?
- What organizational environment circumstances need to be considered to use Rhea most effectively?

6.4.4.3 Findings

In general, supporting personal reflection was appreciated in the group. One participant mentioned that the tool appears to imply an *"enormous deceleration (Entschleunigung)"*.

Another participant added that such a support tool for personal reflection is not yet available for project managers. It could support learning and thus be very valuable. A group member highlighted the benefit of reflecting before taking action. *"If you take 10 minutes of time to backpedal, things can be recognized."* Another participant saw a benefit of the application in allowing to address personal needs in reflection and feedback processes.

A major topic in the focus group was the application usage scenarios. Participants suggested to specialize more, as the add-on value of using a mobile application instead of different tools for personal reflection and sharing, such as note taking applications or messenger applications, needs to be clarified. One participant shared that project leaders are already supersaturated with mobile applications. Another group member wondered about possible motivations for using the application.

Three application features appear particularly relevant: the support of personal reflection, the support through feedback from peers and the opportunity to document and retrieve leadership case stories. A suggestion given by three participants was to reduce the application feature set to one of the three main features. One participant spotted that the application does not suggest a specific conceptual leadership model.

Two participants paraphrased that they would not want to share sensitive personal reflections on an online platform. Another group member explained that, even if data was securely stored, people could be traced based on their writing style or their written contents.

Using a taxonomy for faceted classification was considered a hurdle in using the application. It introduces high complexity. One participant shared that, using the application, he might just select the same three classifications for each writing. Another group member mentioned that the normative leadership model is a lot to learn in order to use the application.

One group member shared that information on personal improvements would be nice within the application. Another participant would appreciate an automatic web search based on personal reflections in the app showing relevant articles. One group participant suggested to represent contents of the app in a paper notebook, to deploy the notebook to interested peers and to invite those to a monthly face to face meeting in order to discuss flows together - maybe with an expert in interpersonal facilitation in work contexts. Peers in such meetings may not be from personal networks. In a diverse group of interested peers different, new perspectives may be given on personal work situations.

6.4.5 Discussion

A major contribution of the second prototype (Prototype B) was the focus on the support of individual learning processes rather than on building an experience description collection. Developing an application from scratch allows to customize features. In the mobile application, semi-automated content indexing procedures can, for example, be realized if users select classifications when writing experience descriptions [651].

The mobile application allows for sharing experience descriptions across company borders with user-selected peers [651]. No feedback is received from people outside personal networks, as a participant in the focus group highlighted.

The mobile application is not platform independent, and so, user reach is moderate compared to web-based solutions. With a lock-in on one specific operating system the application can't be considered easily accessible.

"Employees are drowning in a sea of data and sprawling digital tools, using an average of 6.1 mobile apps for work purposes today, according to a recent CCS Insight survey of IT decision-makers [418]." As highlighted in the focus group, the benefit of using a specific mobile application needs to be clearly outlined in order to facilitate work. The prototype can't be considered a learning tool on leadership that includes information on leadership for self-study. Feedback in the focus group gave the incentive to work out a leadership learning framework that is scalable from personal reflection on paper to ICT-supported and interpersonal learning.

6.5 Team Leadership Knowledge Base

In this section, the design process of a team leadership knowledge base (a reference domain model of team leadership in complex work environments such as ICT projects) is illustrated.

Reference experience descriptions, or *reference flows* in this thesis, are peer reviewed case studies, best practice descriptions or organizational patterns on leadership interactions supporting team performance.

The main intent of developing a knowledge base is making reference experience descriptions retrieved in a systematic literature review (see section 6.2, p. 123, and Appendix D, p. 369) accessible to persons holding leadership functions within a team. The development process addresses two important questions:

1. How to connect reference flows in various text-based forms gathered from different sources?
2. How to bring those connected reference flows into an intuitive, easily graspable, and coherent structure?

Reference flows are connected with each other based on semantic keyword relationships, adding a directed knowledge-layer to the experience description collection. To structure the knowledge base, crowd-sourced classification was aspired. To get more insight in shared meanings of experience descriptions, community detection and clustering algorithms were implemented as part of *blended reading*. So, core topics were inferred from several community and cluster groupings to arrive at top-level knowledge base descriptors.

The knowledge base may be utilized to

- guide reflection processes,
- get to know new perspectives on team situations, and
- compare and position personal experiences with reference experience descriptions.

6.5.1 Methodology

The development process of the knowledge base can be described as hermeneutic endeavor of context-specific pre-structuring, organizing and re-structuring to recognize latent meanings in texts [560, p. 24], [313, p. 30]. It combines qualitative data analysis (QDA) with text-mining procedures in a snowballing *blended reading* approach to semi-automatically develop an ontology of ICT project team leadership. Text mining, including grouping documents through community detection or clustering, is a semantic analysis supporting semi-automatic structuring of large amounts of textual data [280]. Yet, the extraction of latent meaning is not in the scope of automatic text analysis [629]. *"Clustering gives additional structure to sample data, and that can be useful. In the best case, the clusters relate to a goal that is similar to one that would be attempted with the extra effort of manual label assignment. In that case, the label is the answer to a useful question. If we are at a stage where the question has to be formulated, then the process of document clustering can be informative [625, p. 99]."*

The method triangulation was chosen in correspondence to RQ1 and RQ2 supporting the exploration of the ICT team leadership context through written reference experience

descriptions and context-related literature.

"Manual QDA relates on expert and world knowledge of the researcher for that (implicitly quantified through the assumption of its relevance), whereas computer-assisted (semi-)automatic methods need a lot of qualitative data, incorporating quantities explicitly. Thus, analyzing big data in QDA only makes sense as mixed method text analysis [629]."

Through the modular blending of text mining and qualitative analysis and interpretation, content categories and context-related meaning can be inferred [183, p. 102].

The knowledge base structure adheres to structured design principles.

Formed core topics and experience description classifications are validated through a comparison to pre-established categorizations (section 6.5.5.1, p. 199), the comparison to a clustering algorithm (section 6.5.5.2, p. 199), and - most importantly considering intersubjective validity - through an in-depth peer debriefing (section 8.1, p. 301) and two expert audits (section 8.4, p. 315).

6.5.1.1 Ontology Design

"Computational ontologies are a means to formally model the structure of a system, i.e., the relevant entities and relations that emerge from its observation, and which are useful to our purposes [247]." To form the team leadership knowledge base, an ontology of reference experience descriptions was created to complete and refine modules elaborated in a structured design process.

"The backbone of an ontology consists of a generalization/specialization hierarchy of concepts, i.e., a taxonomy [247]." An ontology-based approach for pattern language definition was adapted and implemented to work out interrelations between knowledge base entities [310] (see section 6.1.2, p. 120, for a discussion on the framework core entity model).

6.5.1.2 Structured Design

Structured design allows to traverse from top-level concepts to more detailed aspects of a system. This design approach was initiated to methodically design software. The basic idea of structured design is to divide tasks into subtasks or to divide problems into smaller pieces [642, p. 72/73] arriving at cohesive, loosely coupled modules interfacing with each other.

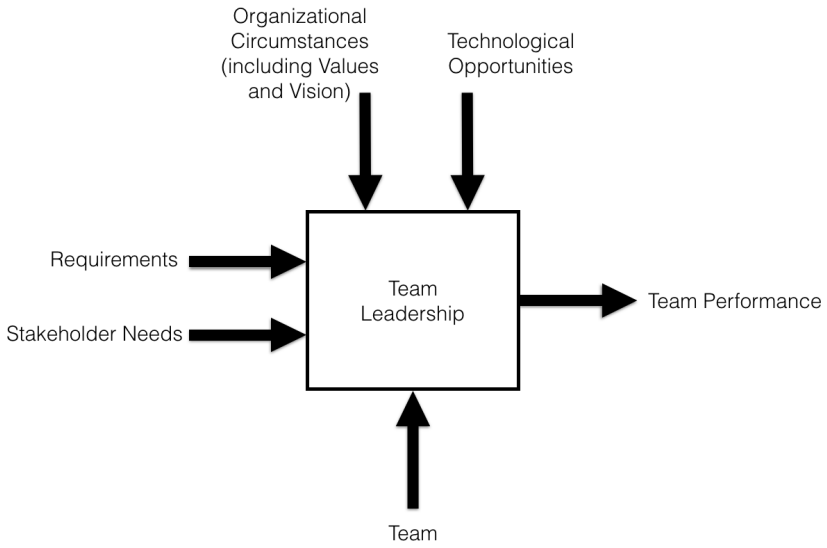


Figure 6.18 Leadership supporting Team Performance (Top Level View)

- Coupling describes the relationships between parts of a system. *"How much of one module must be known in order to understand another module? The more that we must know of module B in order to understand module A, the more closely connected A is to B [642, p. 85]."*
- Cohesion means, that parts of a module are tightly coupled with other parts of the same module, but loosely coupled with parts of other modules.
- Interfaces between modules and other systems need to be clearly indicated.

Structured design is frequently used as notation in conceptual design processes. Complementing object-oriented design notations, such as the Unified Modeling Language [515], a focus is set on visualizing system processes. In business environments, structured design is frequently employed to arrive at a shared understanding of the workings of a system by involved stakeholders, including developers, designers and customers. Figure 6.18 depicts a top-level view on leadership supporting team performance in complex situations (compare: [642, p. 132]). Requirements and stakeholder needs are inputs to team leadership. Organizational circumstances, including organizational values and visions, as well as technological opportunities are controlling factors of team leadership. The team can be described as *"mechanism"* - or perhaps more aptly *"organism"* - that is affected by team leadership. Team performance is the output of effective team leadership.

6.5.1.3 Development Process

The knowledge base development process is illustrated in figure 6.19. In general, it adheres to a modular *blended reading* analysis process [581] based on computer-supported analysis or *distant reading* to structure data and quantitatively analyze contents combined with interpretive, reviewing reading or *close reading*. Algorithmic analysis and single case reading are blended to complement and tentatively correct each other [581, p. 55]. Indeed, *blended reading* requires the successive combination of several computer-supported text analysis approaches with reading and interpreting single texts [581, p. 43].

In a first step of knowledge base elaboration, a preliminary reference model was developed based on keywords from selected literature and reference flow titles. The literature review was combined with an analysis of keyword frequencies in experience description titles - a first-order analysis technique in *blended reading* [581, p. 44].

A collection of topics was derived by synthesizing keyword findings of the selective literature review with keyword frequencies in experience description titles. Then, reference flows were mapped to topics. The preliminary reference model was completed by grouping topics to an initial core topic set and relating core topics to each other.

In the next step, keywords were automatically derived from experience description contents. These keywords were further aligned to each other based on semantic relatedness [313, p. 108].

Finally, community detection was used in the network of reference experience descriptions related through keyword semantic relationships. Comparing communities of experience descriptions with the priorly determined core topics, an initial knowledge base with a reduced set of four core topics, or *core flows* in this thesis, traversing reference experience description groupings was elaborated.

In a follow-up step, knowledge base core flows were refined by introducing core flow narratives. These were elaborated based on topic relevant literature. Further, case vignettes derived from literature and interviews with project managers on significant events in their work (section 6.2.2.1, p. 129) were integrated.

Core flows were then classified based on the normative leadership team interaction taxonomy (section 7.5.1, p. 281), the project risk taxonomy (section 7.5.2, p. 281) and concerning the Unified Process project life-cycle phases (section 5.2.5.2.3, p. 76) through crowd-sourcing.

Dictionary-based approaches of sentiment analysis were used to heuristically categorize reference flows in an emotional landscape.

In order to refine relationships between reference flows, weights of relationships are based on semantic probability and semantic relationship type.

Following community detection, some reference flows were re-categorized to core flows. Afterwards, reference flow categories were compared to a classification based on semantic similarity on document level.

So, several text analysis procedures were applied consecutively and continually contrasted to single case reading allowing for a more differentiated interpretation of reference flow groupings [183, p. 94].

Finally, the reference flow to core flow mappings were compared to the preliminary reference model. Further, the community detection approach used to arrive at reference flow groupings was compared to a commonly utilized clustering process.

The resulting minimal viable knowledge base is presented in section 7.4, p. 243.

Intersubjective understandability of categories is validated in a peer debriefing (section 8.1, p. 301) and two expert audits (section 8.4, p. 315).

6.5.2 Hermeneutic Core Topic Elaboration

"Designers come to the design situation with a pre-understanding of what the designed artifact will be. Even as they begin to examine the 'text' of the design situation—the parameters that 'define' it—they have a pre-understanding, a vague projection of the completed product. As they proceed with their interpretation and as their understanding increases by way of an interpretation of the parts, the projected whole is modified, refined, and clarified. This process is fluid, repetitive and continuous [560, p. 23]."

Finding thematic patterns is a recursive process started by acquiring a collection of texts and repeated reading [313, p. 76].

For the elaboration of the team leadership knowledge base, experience descriptions collected in a systematic literature review on leadership (see table 4.5, p. 28) were utilized. Experience descriptions were included in the knowledge base development process, if they were elaborated extensively - holding at least one minimal case story - and, if they passed a peer review process. This filtering process resulted in 104 experience descriptions to use in

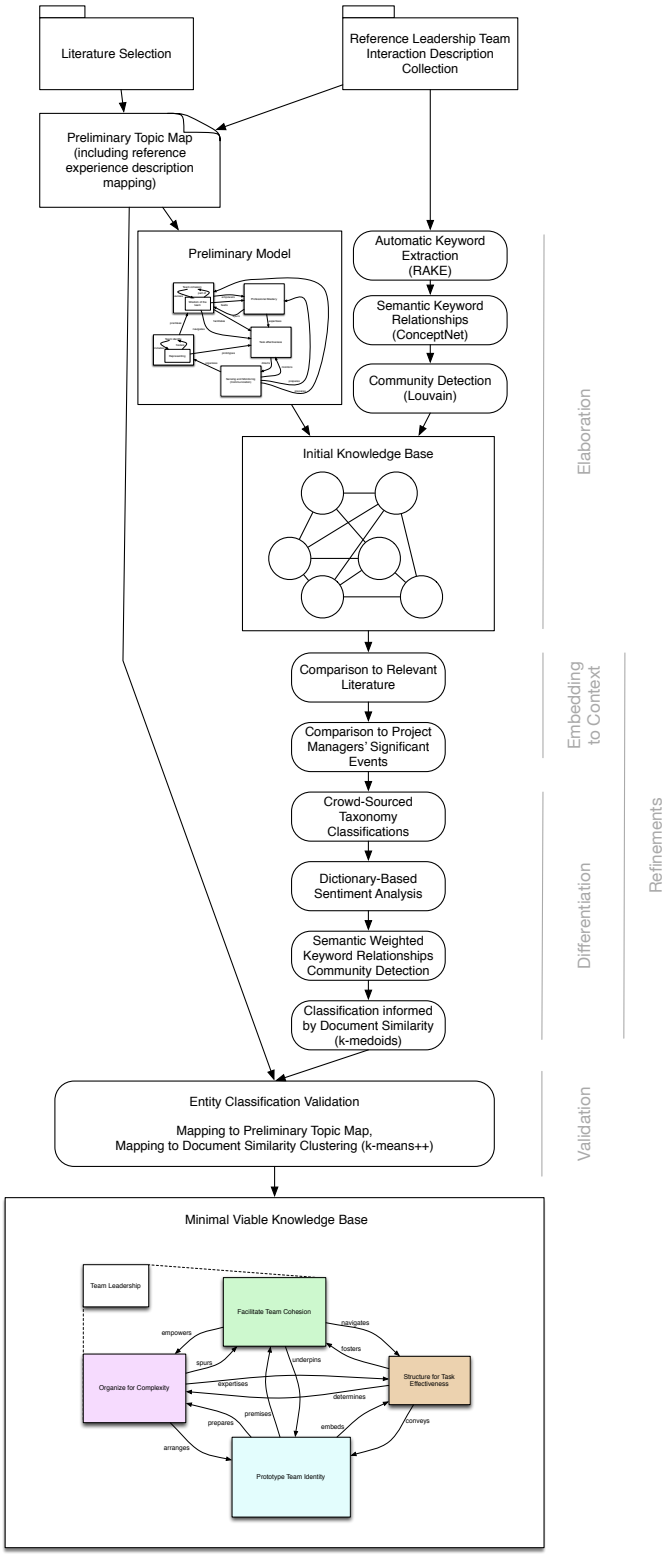


Figure 6.19 Knowledge Base Development Process

the design of the knowledge base.

To arrive at a preliminary model of a team leadership knowledge base, an initial topic collection was derived from a selective review of context-related literature. The topic set was contrasted to experience description titles and completed [73]:

Ideas on topics of team leadership and team learning in complex situations were already collected during a systematic literature review (section 6.2, p. 123).

Table 6.7 lists a selection of context-relevant literature that appears to be in line with design-guiding principles (section 5.5, p. 108) alongside relevant keywords. Works were selected for they are reference contributions concerning team leadership from a social identity perspective [272], group facilitation [638], [504] and self-organization within teams and organizations [543], [364], [583].

Author	**Title**	**Keywords**	**Reference**
Haslam, S. A., Reicher, S.and., & Platow, M. J.	The New Psychology of Leadership	Prototyping, Team Identity	[272]
Kriz, J.	Self-Actualization	Self-Organization, Complexity	[364]
Rogers, C. R.	Die klientenzentrierte Gesprächspsychotherapie - Client-Centered Therapy	Authenticity, Participation	[504]
Senge, P. M.	The fifth discipline : the art and practice of the learning organization	Team Learning	[543]
Surowiecki, J.	The wisdom of crowds: Why the many are smarter than the few and how collective wisdom shapes business	Team Wisdom	[583]
Yalom, I. D.	Theory and practice of group psychotherapy	Group Facilitation	[638]

Table 6.7 Team Leadership Knowledge Base Literature Selection

Word frequency counts allow for an explorative inspection in a text corpus [183, p. 97]. Word frequencies in the titles of experience descriptions were counted to complement keywords from the literature selection. Hereby, words within experience description titles were lemmatized [396, p. 32] using the natural language toolkit (NLTK) python framework (http://www.nltk.org). Table 6.8 shows the most frequent words with 16 to 2 mentions.

Based on the selective literature review and word frequency counts, the topic set was

Ct	Word	Ct	Word	Ct	Word	Ct	Word	Ct	Word
16	team	4	coach	3	ideal	2	round	2	complexity
7	meeting	4	firewall	3	effective	2	pegs	2	communication
7	pair	3	trust	3	customer	2	interesting	2	bubble
6	scrum	3	ritual	3	context	2	individual	2	apprentice
5	sprint	3	review	3	interrupt	2	happy	2	pattern
5	master	3	project	2	validation	2	group	2	leader
4	work	3	programming	2	stand	2	developing	2	community
4	retrospective	3	people	2	space	2	design	2	velocity
4	product	3	owner	2	snack	2	daycare		
4	episode	3	management	2	shrine	2	daily		

Table 6.8 Word Frequency Counts (= Ct) of Reference Experience Description Titles

refined as shown in table 6.9. It was further clustered, resulting in a set of core topics

Experience descriptions were categorized to topics and labeled accordingly to check the distribution of descriptions to topics [313, p. 76]. In this process, one topic was added to the list, namely *"Techniques and Tools for Self-Organization"*, to fit an experience description that could not be matched. The core topic list including experience description categorizations is presented in table 6.10.

Topic
Meeting Cultivation
Iterative development (includes Development Episode, Sprint, Periodic Demo, Crisis Programming Episode)
Ritual
Trust
Pair Programming
Apprenticeship
Vision
Water cooler and Team Space
Team Building
Task Delegation and Assignment
Coaching
Role Modeling (Join for Completion, Being around, Protect the victim, ambassador)
Interfacing (Firewall)
Team Learning and Retrospective
Communication Channels
Group Validation

Table 6.9 Preliminary Team Leadership Knowledge Base Model - List of Topics (based on Literature Selection and Reference Experience Description Title Word Frequency Counts)

Key	Topic	Core Topic	Experience Description Distribu-tion
T	Trust	Team cohesion	5
V	Vision		5
TB	Team Building		9
TD	Task Delegation and Assignment	Task effectiveness	7
ID	Iterative Development		14
SO	Tools and Techniques for Self Organization		1
PP	Pair Programming	Professional mastery	4
A	Apprenticeship		5
C	Coaching		5
MC	Meeting Cultivation	Sensing and Monitoring	7
CC	Communication (Channels)		12
R	Ritual	Team identity	3
WT	Water Cooler and Team Space		8
RM	Role Modeling	Representing	7
I	Interfacing		2
TL	Team Learning and Retrospective	Wisdom of the team	8
GV	Group Validation		2

Table 6.10 Team Leadership Knowledge Base - Initial Core Topic Set (with Reference Experience Description Distribution)

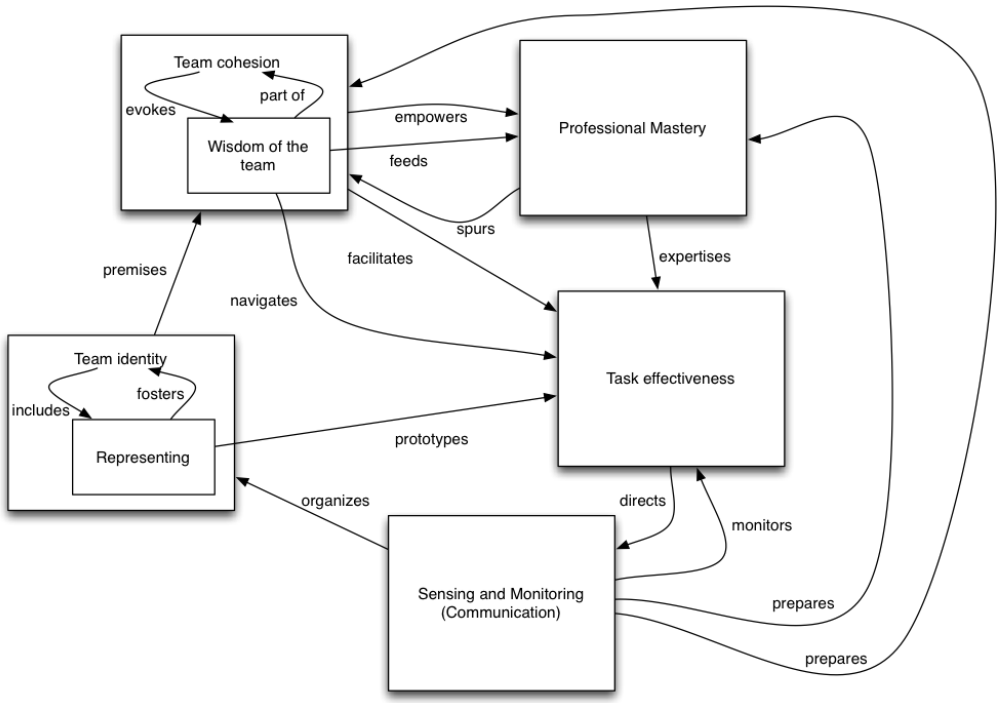


Figure 6.20 Preliminary Reference Model Core Topic Graph

Relationships between core topics were set up corresponding to findings in literature. Core topic *"stories"* were established by labeling relationships [201]. The resulting preliminary reference model is sketched in figure 6.20.

While a graph of core topics connected through directed, labeled relationships could be elaborated, several problems emerge with the design approach. In structured design, modularity is considered a crucial quality of well-functioning systems. How can core topic modularity be uncovered in the preliminary reference model? The categorization of experience descriptions to topics was carried out by the author. How can researcher bias in experience description categorization be diminished? Reference experience descriptions are categorized to topics, yet they lack relationships between each other. How can experience descriptions of different form and from different literature collections and online repositories be linked to each other? How can they be classified according to core topics? Can reference experience descriptions be organized to modules based on described contents? To tackle these problems, an ontology of reference experience descriptions was elaborated in a semi-automated development process.

6.5.3 Semi-Automated Ontology Development

Massive amounts of text on experiences in leadership exist in multiple formats (such as html, markdown, wiki, or pdf) and forms (as, for example, patterns, best practices, micro articles, decision models, or scenarios). Yet, (semantic) relationships between descriptions from various repositories are hardly found.

6.5.3.1 Procedure

To develop an ontology of reference leadership team interaction descriptions, an interrelated network of experience descriptions retrieved from different sources and in different form was aspired.

In an ontology-based approach for pattern language definition by Iacob and Folgi [310], software design patterns are systematically related to each other. In this approach, a team of researchers describes important issues in user interface design. The team later decides on important keywords of each issue.

An issue is related to another issue, if keywords can be related according to the following types of relationship: Equality (e. g. keyword 1 is equal to keyword 2), Equivalence (e. g. keyword 1 is a synonym of keyword 2), Specialization (e. g. keyword 1 is a sub-type of keyword 2), Composition (e. g. keyword 2 is a part of keyword 1), and Association (e. g. keyword 1 is *"related to"* keyword 2).

After considering keyword relationships in the team, important issues - based on how often they are addressed and implemented - are formulated to design patterns. In a case study, a pattern language holding 15 design patterns originating from 90 design issues could be modeled following this pattern language definition approach.

Due to resource constraints, a group of researchers could not be involved in the development process of an ontology of leadership experience descriptions. Algorithms were implemented for keyword extraction, entity relationship forming and entity clustering resembling the ontology forming process described by Iacob and Folgi [310].

The following steps were taken to form a keyword-based ontology of leadership team interaction descriptions:

1. Keywords were extracted from each experience description,

2. Keyword relationships were formed based on semantic relationship notations (such

as *"IsA"*, *"HasA"*, *"RelatedTo"* and other labels) to arrive at a keyword map (defining, for example, that entity 1 is related to entity 2, if keyword A of entity 1 is related to keyword B of entity 2).

Further, groups of closely related experience descriptions within the ontology were differentiated by community detection [386], [82].

6.5.3.2 Keyword Extraction

For keyword extraction, the unsupervised rapid automatic keyword extraction algorithm (RAKE) was used [510], [184]. While delivering increased keyword selection accuracy, keyword extraction algorithms based on supervised machine learning need to be trained on a considerable corpus of text in order to be effective [257]. With the RAKE algorithm, keywords are presented holding a score calculated by word frequency, word co-occurrences and the ratio of co-occurrence to word frequency. The algorithm can be efficiently computed and easily applied in various domains [510]. An open source implementation of this keyword extraction method in Python (https://www.python.org) can be found on GitHub (https://github.com/aneesha/RAKE).

In order to extract keywords, experience descriptions were formatted to plain text. The RAKE algorithm held the following input parameters: the smart stoplist [525] of words to exclude from keyword results, a keyword character delimiter of at least 5 characters, a delimiter of 3 words maximum to form a keyword (or keyphrase), and a minimum occurrence of keywords of at least twice in a text. A maximum of 12 high scoring keywords per experience description were used for ontology development. If no keywords were found, the experience description was excluded from the ontology development process. In total, 951 keywords were extracted.

6.5.3.3 Keyword Relationships

To find connections between keywords, a semantic tool for natural language processing was employed. WordNet [207], a lexical database of English words, was primarily considered. Yet, a tool that checks for more relationships than synonymity, super- or subordinate and part-whole for a wide variety of words and word combinations was aimed for.

ConceptNet 5.5 (http://conceptnet.io) is a semantic network that includes DBPedia (http://wiki.dbpedia.org), Wiktionary (https://www.wiktionary.org), a free multilingual dictionary,

OpenCyc provided by Cyc [377], a hierarchy of hypernyms presenting common sense in predicate logic, JMDict [106], a Japanese multilingual dictionary, as well as the Open Multilingual WordNet [93] as subnets together with relational knowledge contributed to the crowd-sourced knowledge project Open Mind Common Sense [553], and knowledge from people´s word associations in “games with a purpose” [444], [369], [616]. It is a *"knowledge graph that connects words and phrases of natural language (terms) with labeled, weighted edges (assertions) [566, p. 1]."* There are 36 generalized relationship types in ConceptNet, such as *"IsA"*, *"UsedFor"* or *"CapableOf"*. Edges or relationships in ConceptNet are directed and weighted. Weights represent the probability that a semantic relationship assertion is correct [567, p. 3681/3682].

To set keywords of leadership experience descriptions in relation to each other, all possible relationships between keywords were extracted from ConceptNet. Most relationships that could be extracted are one word to one word relationships. ConceptNet didn´t yield many results for keywords consisting of two or more words. Next, a directed, weighted multi-graph [94, p. 15/16], [45] of reference flows (Graph A) was developed using the networkx python framework (http://networkx.github.io) connecting reference experience descriptions with each other through keyword relationships. Subsequently, relationships between reference flows were combined to arrive at single directed connections from one graph node (or experience description) to another. Graphs were exported in .dot graphviz (http://www.graphviz.org) format.

Established keyword relationships allow knowledge-based measures of semantic relatedness [313, p. 108/110].

6.5.3.4 Combining Hermeneutic and Automated Text Analysis

"The other major aspect of structured design is organization of the system. That is, we must decide how to interrelate the parts of the system, and we must decide which parts belong where in relation to each other [642, p. 21]."

6.5.3.4.1 Community Detection

Community detection is a form of unsupervised classification [386], [393], [237].

The team leadership ontology graph was explored using the Gephi open source application [57]. A modularity-based algorithm, the Louvain algorithm, was applied for community

detection [82] respecting edge weights, using randomization for better decomposition of nodes and a resolution of 0.9 [371]. This algoritm was successfully used to arrive at topics in a large document collection [336].

Modularity is a quality index of community detection. A community of graph nodes is modular, if more edges can be found within it than expected by chance. Modularity refers to a random null model, where edges are randomly distributed while keeping node degree (the count of edges incident - or connected - to a node). It is thus assumed that a node can be connected to any other node within the graph. The modularity value of a community is a scalar value between -1 and 1 that represents the density of relationships (edges) inside the communities as compared to relationships between communities [82, p. 2].

The Louvain algorithm [82] that was used for community detection implements greedy optimization of modularity. In a first step, modularity is optimized locally by establishing communities for each node resulting in small communities. Hereby, after calculating community modularity each node is removed from its own community and placed into neighboring communities. Changes in modularity are compared. The node is finally placed into the community with the highest modularity increase. Iteratively, communities are then grouped into one node, and the first step is repeated.

The derived community partitioning of 97 nodes and 4776 relationships in a directed multi-graph (Graph A), depicted in figure 6.21, was visualized using the force-directed layout algorithm ForceAtlas2 [318]. Leadership experience descriptions without keywords or with keywords that are not connected to any other nodes were filtered from the ontology graph. In the graph (Graph A, figure 6.21), node color specifies community belongingness. Node size shows betweenness centrality, a measure signifying the centrality of nodes based on shortest paths between nodes passing through the node [216]. Edge size marks edge weight.

The modularity value of the graph is 0.12. Modularity taking into account resolution is 0.078. Communities have a rather dense, cohesive network of connections within, yet reference flows of communities are also well connected to those in other communities. Four communities were distinguished. Figure 6.22 shows the distribution of reference flows among modularity classes (or communities).

6.5.3.4.2 Labeling Communities

"A label for a cluster can summarize very large numbers of documents. A cluster's key words help give meaning to those labels [625, p. 113]."

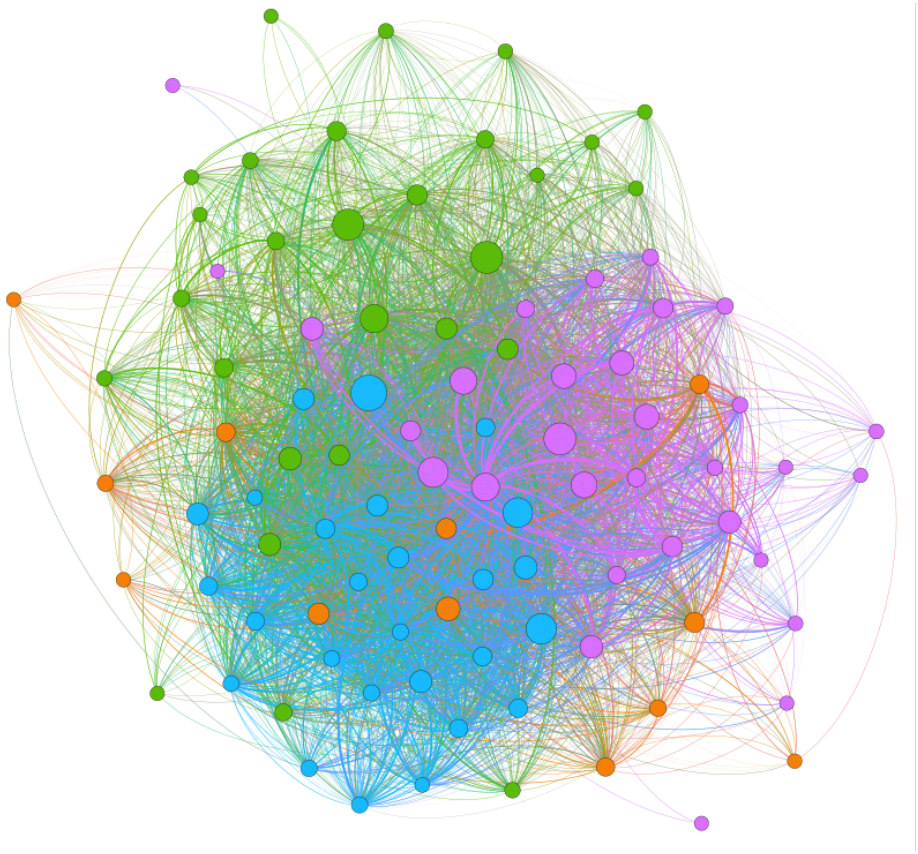


Figure 6.21 Community Partitioning of Reference Flow Graph with Force-Directed Layout (Graph A)

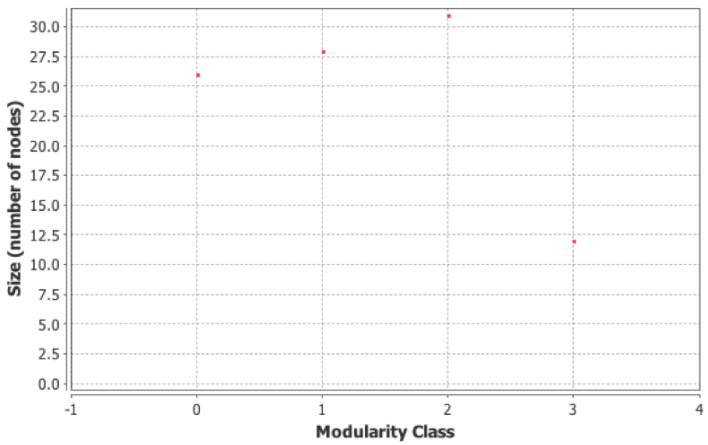


Figure 6.22 Distribution of Reference Flows (Nodes) in Graph A

A first attempt to label clusters, or modularity classes in the implemented community detection algorithm, was based on core topics elaborated in the selective literature review and keyword word frequencies in the clustered communities. The most frequent keywords are displayed in Table 6.11. Keywords such as *"Team"*, *"Person"*, or *"People"* are frequent in all four clusters. To differentiate clusters, significant keywords that were unique or rather rare were searched. Unique keywords for each community are listed in table 6.12.

Word	**Community 0**	**Community 1**	**Community 2**	**Community 3**	**Total**
Project	6	11	15	5	37
Team	11	10	10	4	35
People	17	3	2	3	25
Members	10	4	7	1	22
Group	12	3	1	0	16
Process	3	6	2	3	14
Pattern	3	4	7	0	14
Developers	3	4	4	0	11

Table 6.11 Team Leadership Knowledge Base - Keywords Frequencies

Community	**Unique Keywords**
0	Vision, Private, Norms, Master, Conduct, Formed, Reviews
1	Decisions, Interrupt, Potential, Resource, Velocity, Requirements, Local, Planning, Mercenary, Increase
2	Change, User, Distractions, Good, Sites, Diversity, Feedback, Release, Specific, Pressure, Tuning
3	Short, Manager, Practice

Table 6.12 Team Leadership Knowledge Base - Unique Keywords per Modularity Class

Communities were labeled based on the core topic set of the preliminary model and community keyword counts. Community 0 was labeled *"Team Identity and Cohesive Team"*. It was noted that community 0 is strongly linked to community 1. Community 1 was called *"Task Effectiveness"* or *"Task Effectiveness and Meetings"*. Community 2 was dubbed *"Monitoring and Calibrating"*, *"Sensing, Communication and Team Structure"* or *"Team building, structure, location, and communication"*. The third community of leadership experience was labeled *"Professional Development"*, *"Monitoring and Professional Development"* or *"Status, Practice and Professional Development"*. All of these labels appeared strongly interrelated.

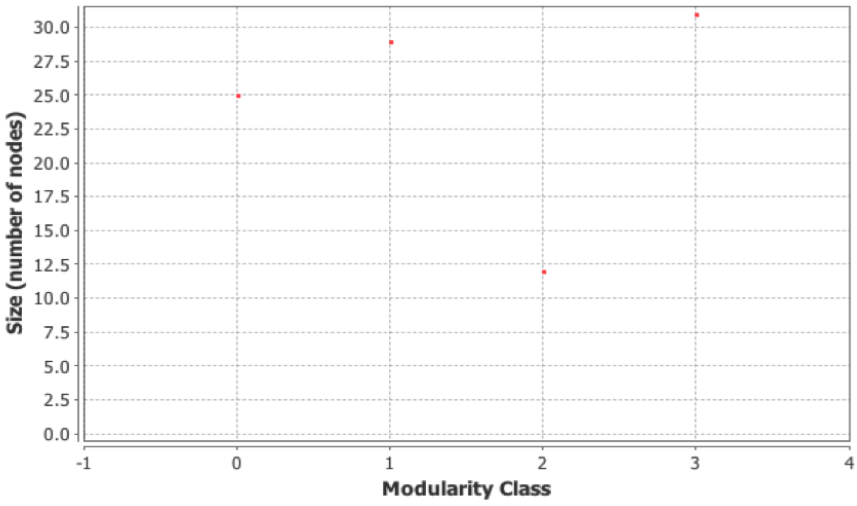


Figure 6.23 Node Distributions of Graph omitting Synonym and Antonym Relationships (Graph B)

6.5.3.4.3 Community Detection Adjustments

To get more insight in the relationships of ontology entities and core topics of experience descriptions within their communities, two additional directed, weighted graphs were generated from the keyword relationship set using a resolution of 0.9 each and randomization for node decomposition.

One graph (Graph B) was constructed omitting all synonym and antonym relationships. So, keyword connections between frequent words such as *"people"* or *"project"* were not integrated. The resulting graph contains 97 nodes and 4172 edges. It has a modularity value of 0.122 and a modularity value of 0.079 taking into account resolution. It holds 4 communities.

The second graph (Graph C) was developed omitting synonym, antonym and all generic *"relatedTo"* relationships. It contains 93 nodes and 1968 edges. The graph has a modularity value of 0.142, a modularity value (with resolution) of 0.102 and reaches 5 communities.

Distributions of experience descriptions within the graphs are shown in figure 6.23 and figure 6.24.

To find labels for the uncovered communities, the five experience descriptions with the highest degrees (which have most incoming and outgoing relationships) were highlighted for each community in the first graph (Graph A, figure 6.21). Table 6.13 shows experience

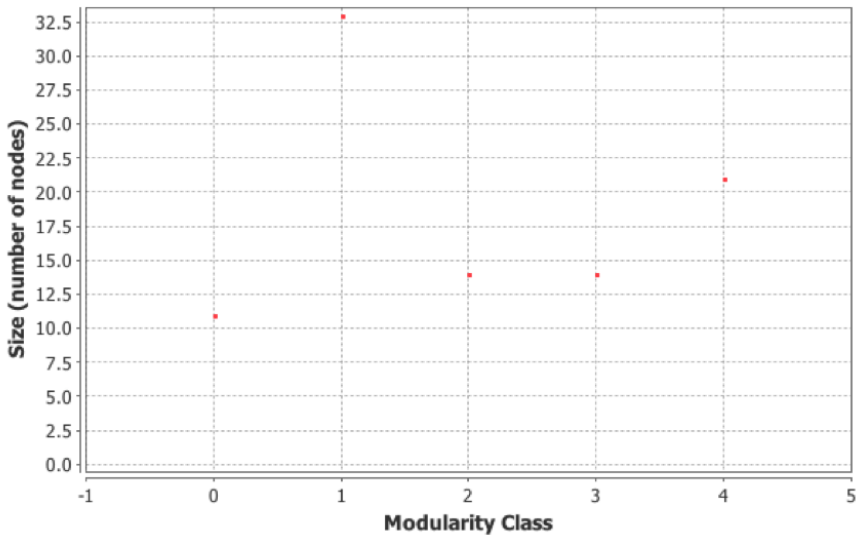


Figure 6.24 Node Distributions of Graph omitting Synonym, Antonym and Generic *"relatedTo"* Relationships (Graph C)

descriptions with high degrees in each community of the first graph.

In a next step, experience descriptions with high degrees in the first graph (Graph A) were searched in the two other graphs (Graph B, Graph C) to arrive at appropriate community labels. Community labels were extended to accommodate experience descriptions within the community. Community 0 was first named *"Team Identity and Cohesive Team"*. Based on the literature selection in the hermeneutic development approach, the label was changed to *"Identity"*. Community 1 was called *"Task Effectiveness"*. Referring to the literature selection, it was extended with *"Team Learning, Team Wisdom"*, arriving at the label *"Cohesion and Effectiveness"*. This was shortened to *"Cohesion"*. Community 2 was labeled *"Monitoring and Calibrating"*. Attending to the literature selection in the hermeneutic development approach, it was extended to include *"Sensing, Communication, Team Structure, and Team Building"* and *"Professional Development"*. An idea for a label was *"Complexity, Change and Organization"*. The core of the label - referring to reference flows included in the community - was *"Complexity"*. Community 3 was first dubbed *"Professional Development"*. Adhering to included experience descriptions, it was extended to include *"Monitoring, Practice, Professional Learning and Coaching, Communication Channels, Transparent Communication, Smooth Communication"*. Referring to the preliminary reference model, it was summarized arriving at *"Task Effectiveness"*.

Community	Reference Experience Description Title	Reference	Degree
0	Compass	[300]	160
0	Phasing it in	[145]	149
0	Protect the Victim	[300]	148
0	Development Episode	[146]	146
0	Shared Clear Vision	[8]	144
1	Team per Task	[146]	151
1	Ad Hoc Meeting	[142]	144
1	End to End	[374]	143
1	Body Speaks	[300]	140
1	Guruing by walking around	[146]	138
2	Master and Apprentice	[142]	155
2	Deploy along the Grain	[146]	151
2	Sacrifice one Person	[146]	150
2	Someone always makes Progress	[146]	147
2	Lock em up together	[146]	147
3	Face to Face before working remotely	[146]	143
3	Pair to Share	[151]	139
3	Standup Meeting	[76]	132
3	Wanderer	[142]	127
3	Standup Meeting	[199]	125

Table 6.13 Reference Experience Descriptions with High Degrees in Communities (Graph A)

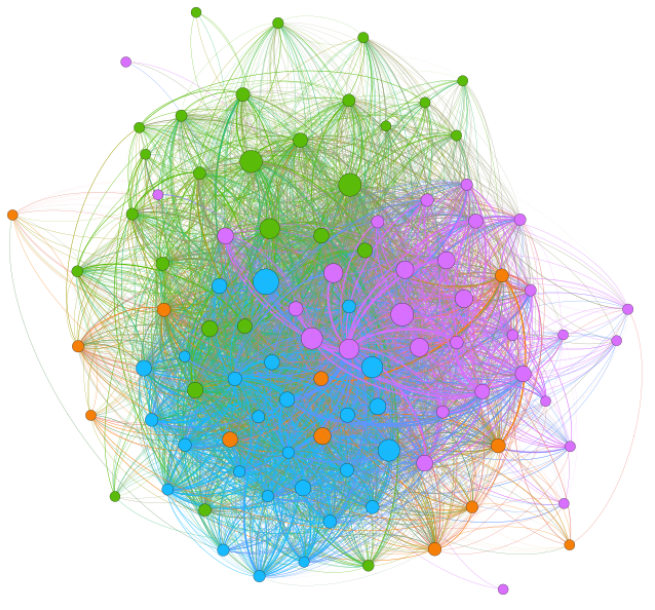


Figure 6.25 Reference Flow Graph (Graph A) with All Relationships (blue: Identity, violet: Complexity, green: Cohesion, orange: Task Effectiveness)

Figure 6.25, figure 6.26 and figure 6.27 show the three ontology graphs signifying core flow membership of experience descriptions.

6.5.3.5 Core Flow Relationships

Based on the selective literature review and the ontology of reference flows, labeled relationships between core flows were established. Further, reference flows were aligned to one core flow each. Experience descriptions' core flow membership in each graph was compared. If a reference flow was part of the same core flow community in at least 2 graphs, a *"partOf"* relationship to this core flow was established. Thus, a reference flow is solely part of one core flow. Nine reference flows that are part of different core flows in each graph were assigned after *close reading* attending to the preliminary reference model.

Central knowledge base nodes are tightly connected to many other nodes [447], [97], [92], [217]. Similarly, central reference flows are highly interconnected or basic to other reference flows within the knowledge graph structure. For the knowledge base, centrality was first defined as the sum of node degree and betweenness centrality of a reference flow. If centrality could not be calculated, experience descriptions were excluded from the ontology

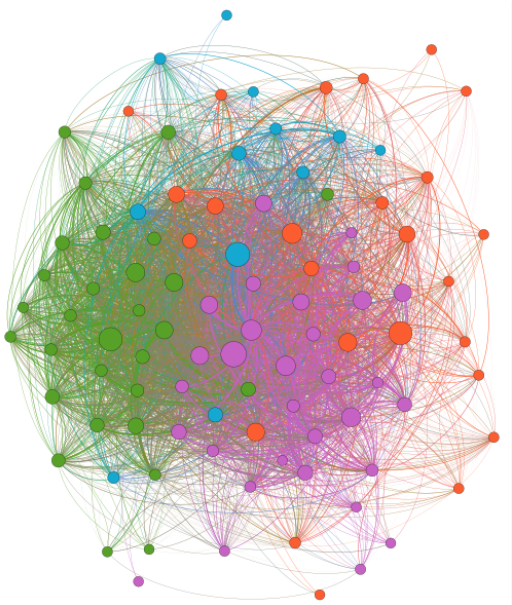


Figure 6.26 Reference Flow Graph (Graph B) excluding Synonym and Antonym Relationships (green: Identity, violet: Complexity, orange: Cohesion, blue: Task Effectiveness)

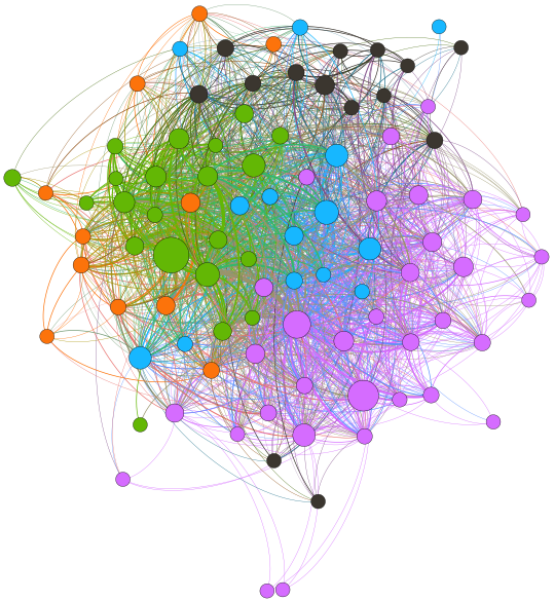


Figure 6.27 Reference Flow Graph (Graph C) excluding Synonym, Antonym and *"relatedTo"* Relationships (violet: Identity, blue: Complexity, green: Cohesion, orange: Team Wisdom [Cohesion], grey: Task Effectiveness)

at this stage of knowledge base elaboration.

After filtering experience descriptions, community detection and labeling, 28 reference flows were assigned to the core flow finally called *"Prototype Team Identity"*, 24 to *"Organize for Complexity""*, 17 to *"Facilitate Team Cohesion"* and 9 to *"Arrange for Task Effectiveness"*. Core flows are cohesive and closely related to each other. Modularity classes in the ontology graphs can be differentiated, but are not necessarily tightly coupled.

6.5.4 Knowledge Base Refinements

6.5.4.1 Core Flow Descriptions

To initiate a cohesive knowledge base of leadership team interaction facilitating team performance, core flow narratives were elaborated. These were created along the structure defined by the framework core entity model (section 6.1.2, p. 120).

Descriptions were influenced by contents of the selective literature review and of included reference flows.

Case vignettes were added from significant events interviews with project managers (section 6.2.2, p. 128) and from literature. Complementary best practices from resources that are not part of the ontology yet - specifically from [260] and [312] - were listed within the core flow descriptions.

Table 6.14 presents an overview of contents described in core flows.

Prototype Team Identity	**Organize for Complexity**	**Facilitate Team Cohesion**	**Arrange for Task Effectiveness**
Leadership as Group Function	Diversity	Collaboration	Techniques and Tools to complete Team Goals
Vision	Creativity	Conflict Management	Team Rules and Constraints Documentation
Differentiation, Buffering, Representing	Self-organization	Decision Making	
Trust as Emergent Dynamics		Team Learning	

Table 6.14 Core Flow Contents Overview

6.5.4.1.1 Comparison of Core Flow Descriptions to Leadership Models

Core flow descriptions were compared to contents of leadership models, namely Hackman's [253] team leadership conditions and Kouzes and Posners' [357] leadership practices. Further, core flows were matched to leadership capacities outlined by Motschnig and Ryback [439]. Table 6.15 depicts the comparison of core flow descriptions to leadership models.

Core Flow	**Team Leadership Condition [253]**	**Leadership Practice [357]**	**Leadership Capacities [439]**
Prototype Team Identity	A Real Team, Compelling Direction	Model the Way, Inspire a Shared Vision	Authenticity, Transparency
Organize for Complexity	Enabling Structure, Supportive Context, Expert Coaching	Challenge the Process	Contact, Thorough understanding
Facilitate Team Cohesion	A Real Team, Supportive Context	Enable Others to act, Encourage the Heart	Respect
Arrange for Task Effectiveness	Enabling Structure		Task or agenda

Table 6.15 Core Flow Descriptions to Leadership Model Comparison

6.5.4.2 Keyword Relationship Semantic Weights

ConceptNet 5.5 offers probability values of word connections. In the knowledge base, these probability values were utilized to calculate combined reference flow relationship weights.

To refine keyword relationships based on semantic categories, connection probability was multiplied by semantic weight. Semantic weights were derived from [550]. The semantic weights are listed in table 6.16, where a is the smallest weight and b is a ratio of the frequency of the sense number in WordNet over the maximum number of senses for the word. Table 6.17 shows the distribution of semantic weights in the knowledge base.

An ontology graph was constructed holding keyword relationships with semantic weights. The graph (Graph D) is shown in figure 6.28. Community detection with resolution 0.9 yielded 5 communities with modularity values of 0.133 and 0.098 considering resolution. Community sizes are sketched in figure 6.29. Communities were labeled based on affiliation of reference flows to core flows in the present knowledge base.

Finally, core flow categorizations were compared between the initial knowledge base and the graph with semantic keyword relationship weights (Graph D) for all reference flows included in the knowledge base.

Category	Weight	Semantic Relations
Similar	a	antonym, cause, entailment, participle of verb, pertainym, similar to, verb group
Hypernym	2 * a	derivationally related, instance hypernym, hypernym
Sense	4 * a + b	lemma-synset
Gloss	6 * a	lemma-gloss content words
Part	8 * a	holonym (part, member, substance), inverse gloss, meronym (part, member, substance)
Instance	10 * a	instance hyponym, hyponym
Other	12 * a	attribute, domain of synset (topic, region, usage), member of this domain (topic, region, usage)

Table 6.16 Relationship Categories with corresponding Weights (compare [550, p. 612])

Relationship Type	Count	Category Factor (based on 6.16	Semantic Category [550]
RelatedTo	696	2	Hypernym
Synonym	152	1	Similar
IsA	90	10	Instance
FormOf	39	2	Hypernym
Desires	26	12	Other
HasContext	23	8	Part
Antonym	23	1	Similar
AtLocation	21	12	Other
HasPrerequisite	10	12	Other
HasProperty	9	8	Part
UsedFor	6	12	Other
CapableOf	6	12	Other
Causes	6	1	Similar
HasA	5	8	Part
NotDesires	5	12	Other
SimilarTo	5	1	Similar
DerivedFrom	5	2	Hypernym
DistinctFrom	3	1	Similar
EtymologicallyRelatedTo	3	1	Similar
PartOf	3	8	Part
Entails	2	1	Similar
CreatedBy	2	12	Other
CausesDesire	1	12	Other
DefinedAs	1	6	Gloss
HasSubevent	1	8	Part
MadeOf	1	8	Part

Table 6.17 Distribution of Semantic Weights of Keyword Relationships

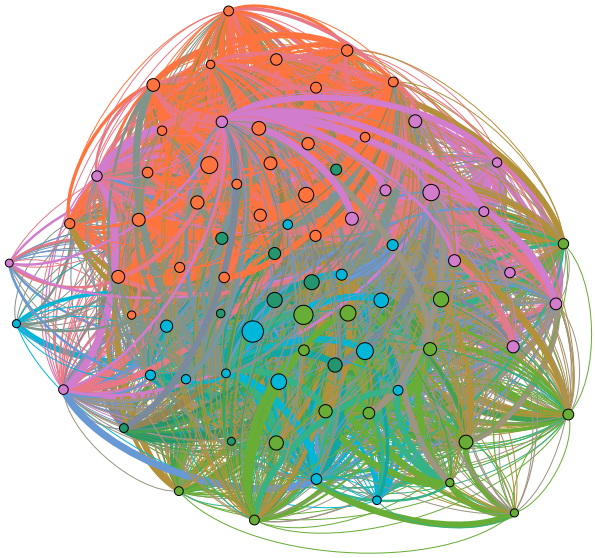


Figure 6.28 Reference Flow Graph (Graph D) with Semantic Weights for Keyword Relationships (orange: Identity, blue: Complexity, light green: Cohesion, dark green: Cohesion, violet: Task Effectiveness)

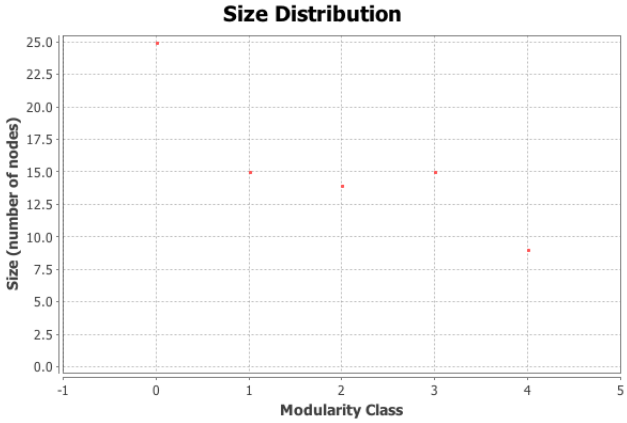


Figure 6.29 Node Distributions of Graph with Semantic Weights for Keyword Relationships (Graph D)

If core flow affiliation was not identical, reference flows were re-mapped either according to the knowledge base or the semantic graph based on semantic affiliation to key contents of core flow descriptions after *close reading*.

In total, 38 reference flows were considered for re-mapping. 17 were re-mapped.

Centrality of reference flows in the knowledge base is lastly based on degree and betweenness centrality values within the multigraph with keyword connections of semantic weight (Graph D). Node degree (combining in- and outdegree) and betweenness centrality were calculated in the Gephi graph visualization and manipulation application. Although betweenness centrality measures could not be retrieved for 8 reference flows, these were kept in the knowledge base graph due to their contents. Degree and betweenness centrality values were normalized to values between 0 and 1. Centrality in the knowledge base is the mean value of the sum of these measures. Reference flows with a centrality score close to 1 may be interpreted to be rather central in the abstract knowledge graph. Reference flows with a normalized centrality score close to 0 are less central in the graph structure.

6.5.4.3 Crowd-Sourced Taxonomy Classifications

Entities within the ontology were classified based on a normative team leadership interaction taxonomy (see section 7.5.1, p. 281), a project risk taxonomy (section 7.5.2, p. 281) and to project life-cycle phases of the Unified Process (section 5.2.5.2.3, p. 76) with the help of crowd-sourcing. Taxonomy classification by crowd-sourcing appeared to be a viable option to enrich the leadership team interaction ontology upon resource constraints.

6.5.4.3.1 Method

Reference flows were classified to taxonomy categories in two batches by *Master Workers* of the micro-task service *Amazon Mechanical Turk (MTurk)* each. In another batch, *Master Workers* helped to classify reference flows to Unified Process project life-cycle phases.

The work task was to classify one reference flow to one category. Instructions to workers were:

- Leadership team interaction taxonomy: *"Please categorize given experience descriptions to leadership team interaction categories."*
- Project risk taxonomy: *"Please categorize given experience descriptions to IT project*

risks, if the experience descriptions address a given risk."

- Unified Process project life-cycle phases: *"Descriptions for the IT project phases can be found here: https://en.wikipedia.org/wiki/Unified_Process#Project_lifecycle_.28\Phases_of_Unified_Process.29"*

For each taxonomy and for the Unified Process project phases inclusion criteria were specified. For the taxonomies, inclusion criteria were set by category heuristics (section 7.5.1, p. 281, and section 7.5.2, p. 281). For the Unified Process phases, the following inclusion criteria were provided:

- Inception: Develop an approximate vision of the system, make the business case, define the scope, cost estimate
- Elaboration: Capture system requirements, address known risks, establish system architecture; deliverable: plan for construction phase
- Construction: largest phase in project, remainder of the system is built in time-boxed iterations, deliverable: software for deployment
- Transition: In this phase the system is deployed to the target users; user feedback; software refinement; user training

Reference flows were sent as a .csv file and presented in four text fields, namely by Title, Intent, Solution and Reference. The reference flow collection provided for the classifications can be found in Appendix D, p. 369.

6.5.4.3.2 Demographics

The worker selection process within the used crowd-sourcing service is proprietary. While demographics of workers can't be accessed by requesters (customers), findings of a study by Buhrmester, Kwang and Gosling [115] suggest that: *"(a) MTurk participants are slightly more representative of the U.S. population than are standard Internet samples and are significantly more diverse than typical American college samples; (b) participation is affected by compensation rate and task length but participants can still be recruited rapidly and inexpensively; (c) realistic compensation rates do not affect data quality; and (d) the data obtained are at least as reliable as those obtained via traditional methods [115, p. 3]."* Amazon distributes the *Master* qualification to workers based on statistical models that

analyze worker performance with requester-provided and marketplace data points (https://www.mturk.com/worker/help).

6.5.4.3.3 Results

Each of the 78 reference experience descriptions were classified twice concerning leadership interactions and project risks and once concerning project phase. In average, workers spent around 6 minutes on classifying to a leadership team interaction category, in average 12 minutes on classifying to a project risk category and about 10 minutes classifying to a project phase. Agreements between categorizations were low (12 % on leadership team interaction - or 9 of 78 experience descriptions - and 19 % on project risk - or 15 of 78 experience descriptions). 22 reference flows were, for example, attributed to person-related as well as emergent process facilitation behavior. 29 reference flows hinted at structural as well as process project risks.

Attributions to project phases were fairly balanced (with a slight predominance of attributions to beginning project phases) with 20 attributions to *Inception*, 33 to *Elaboration*, 15 to *Construction* and 10 to *Transition*.

6.5.4.3.4 Discussion

Experience descriptions frequently encompass several interpersonal interactions or deal with a variety of risk areas. Such narrative expressiveness may hint at an explanation of the high variance in classifications. Resource constraints didn´t allow for more classification batches that maybe could have yielded clearer heuristic classification trends.

Moreover, classifications may be clearer, if persons helping to classify were explicitly trained on the taxonomies.

Reference experience descriptions needed to be drastically shortened to fit worker effort considering resource constraints (cost). The depth of descriptions could arguably be represented. Eventually, by reading the full narratives clearer heuristic classifications were feasible.

Finally, all classifications were included in the knowledge base.

6.5.4.4 Sentiment Analysis

To get an insight on emotional connotations in reference experience descriptions, two dictionary-based approaches were taken to annotate sentiments in experience descriptions.

A compound sentiment score was derived for each reference flow (and core flow) using VADER, the Valence Aware Dictionary and sEntiment Reasoner [230] (https://github.com/cjhutto/vaderSentiment).

Further, reference flows (and core flows) were related to eight basic emotions [480] using the NRC Word-Emotion Association Lexicon, version 0.92 [427], [426]. Relations between words within the description and emotions were counted based on the NRC word to emotion association dictionary. Counts were modeled as relationship weights within the ontology.

Such sentiment analyses eventually allow for interfacing knowledge base contents to learning resources on emotions and feelings.

6.5.4.5 Improved Classification informed by Document Similarity

The team leadership knowledge base can be traversed following semantic labeled weighted keyword relationships between reference flows. A probabilistic modularity-based community detection algorithm was used to arrive at groups of reference flows [82], (see section 6.5.3.4, p. 178).

Communities were distinguished in four community detection iterations. Communities in these iterations were tightly coupled. Comparing communities among each other and with a preliminary core topic set, four key topics, or core flows, were inferred. Reference flows were subsumed to one of the core flows based on membership in the derived communities and, eventually, semantic attribution to core flows by *close reading*.

Categorizations in iterative community detection were subsequently contrasted to reference flow clusterings based on document similarity. Mappings were refined accordingly.

6.5.4.5.1 Method

The k-medoids algorithm provides insight in what clusters may form around a central entity. *"We expect the documents in a cluster to be similar. Thus, we should be able to select a few that are 'typical' documents. The human expert can read and review these retrieved documents to understand the results of the clustering process and to reach some decision*

about their value [625, p. 113]." Subsequently, the algorithm implementation is described in detail.

Cosine similarity between two documents was calculated using the *spaCy* natural language processing toolkit (https://spacy.io, Version 1.9). Cosine similarity measures the angle of two non-zero vectors of an inner product space. It returns the similarity of vector orientation [585, p. 500]. In positive vector space it is bounded between 0 and 1. Within *spaCy*, document similarity is based on document representations of averages of word vectors of words within the documents. Word vector mappings were derived from the toolkits' english (en) word vector model.

This word vector model was initially implemented in *spaCy* using the GloVe algorithm [471]. In this unsupervised learning algorithm, words are represented as vectors in a word-word co-occurrence matrix respecting global (document) corpus statistics. A discussion of this algorithm and a comparison to other word vector modeling approaches, such as word2vec [422], [233], is out of the scope of this thesis.

An implementation of the k-medoids algorithm [462], [219, p. 468/469] in Python (https://github.com/alexprengere/medoids) was used for clustering reference flows based on document similarity. A medoid is an entity within a cluster that is in average most dissimilar to the other entities within the same cluster. It is the most central or representative entity within a cluster. k-medoids is a probabilistic clustering procedure where entities are clustered into k clusters. The cluster count (k) is an input parameter of the algorithm.

The k-medoids algorithm tries to minimize distances between entities that are classified to be part of a cluster and the medoid of the cluster. Specifically, after initial medoids are selected, entities are assigned to clusters of the closest medoids. Iteratively, entities that minimize the sum of distances within a cluster are then selected as medoids, and entities are reassigned to clusters of the closest medoids.

In the used k-medoids implementation, 4 initial medoids were chosen randomly. A distance function was developed based on cosine distance, that can be derived by subtracting the document (cosine) similarity value from 1.

In total, 20 document clusterings were collected and compared to the reference flow to core flow mappings within the knowledge base. These were handled as ground truth in the comparison. The ClusterEval application (https://github.com/cmdevries/ClusterEval) was utilized for comparison [161], [227], [162].

6.5.4.5.2 Findings

For all 20 document similarity clusterings compared to the knowledge base classifications, majority classification labels within medoid clusters were noted. If majority classifications were equally divided within a cluster, all these labels were collected. Table 6.18 shows majority labels as well as knowledge base classifications of medoids. In total, 23 different reference experience descriptions were distinguished as medoids in the document clusterings. Some reference flows were medoids in several document similarity clusterings. Overarching majority classifications of reference descriptions were derived from majority classifications within clusterings.

6.5.4.5.3 Discussion

The experience description *Community of Trust [146]* was a cluster medoid of rather large clusters (compared to the other medoid clusters) nine times - with a majority label of *Prototype Team Identity* of about 30 entities in average. This corresponds to the mapping within the knowledge base. Similarly, *Deploy along the Grain [146]* was a medoid 6 times forming clusters of average size 19. Here too, the majority label *Organize for Complexity* corresponds with the knowledge base classification.

The experience descriptions *Water Cooler [146]*, *Bootstrapping [589]*, *Sprint Retrospective [4]*, *Someone always makes Progress [146]*, *Piecemeal Growth [404]*, *Adhoc Meeting [142]*, and *Train Everyone [74]* were medoids from 4 to 1 time(s) with cluster sizes from 21 to 3. These medoid clusters hold majority classifications corresponding to the knowledge base mappings.

Face to Face before Remote [146], selected 5 times by the algorithm as medoid with clusters of average size 24, and *Cohesive Team [589]*, selected 3 times as medoid with clusters of average size 23, both hold the majority classifications *Prototype Team Identity* as well as *Facilitate Team Cohesion*. The medoid clusters may be seen as supporting knowledge base classification.

The experience descriptions *Forge the Team [153]* and *Guruing by walking around [153]* support knowledge base classifications. Yet, cluster sizes are low. In fact, *Forge the Team [153]*, while selected 5 times as medoid, forms clusters of size 1 in each clustering. *Guruing by walking around [153]*, selected 3 times, twice forms clusters of size 2 and once a cluster of size 3. Both appear to constitute marginal clusters in several clusterings.

Medoid	Majority Classifications in Clusterings (percentage within cluster, cluster size)	Medoid Count	Average Cluster Size	Majority Classification	Knowledge Base Classification
Community of Trust	PTI (40.62, 32), PTI (39.29, 28), PTI (38.24, 34), PTI (36.11, 36), PTI (44.00, 25), PTI (36.36, 33), PTI (43.48, 23), PTI/OFC (36.36, 33), PTI (41.38, 29)	9	30	PTI	PTI
Deploy along the Grain	OFC (35.71, 28), FTC (39.00, 21), OFC (40.00, 15), OFC (40.00, 15), FTC/OFC (35.29, 17), OFC (40.00, 15)	6	19	OFC	OFC
Water Cooler	FTC (50.00, 10), FTC (50.00, 10), FTC (57.14, 7), FTC (50.00, 10)	4	9	FTC	FTC
Bootstrapping	PTI (50.00, 8), PTI (50.00, 10), PTI (55.56, 9)	3	9	PTI	PTI
Sprint Retrospective	ATE (33.33, 21)	1	21	ATE	ATE
Someone always makes Progress	OFC (42.86, 7)	1	7	OFC	OFC
Piecemeal Growth	FTC (50.00, 6)	1	6	FTC	FTC
Adhoc Meeting	FTC (75.00, 4)	1	4	FTC	FTC
Train Everyone	OFC (100.00, 3)	1	3	OFC	OFC
Face to Face before Remote	PTI (36.67, 30), PTI (35.71, 28), FTC/PTI (37.04, 27), FTC (43.75, 16), FTC (41.18, 17)	5	24	PTI/FTC	PTI
Cohesive Team	PTI (36.36, 22), FTC (33.34, 24)	2	23	PTI/FTC	FTC
Forge the Team	OFC (100.00, 1), OFC (100.00, 1), OFC (100.00, 1), OFC (100.00, 1), OFC (100.00, 1)	5	1	OFC	OFC
Guruing by Walking Around	FTC/PTI (50.00, 2), OFC/FTC/PTI (33.33, 3), FTC/PTI (50.00, 2)	3	2	FTC/PTI	FTC
Sprint	FTC/OFC (27.03, 37), PTI (29.55, 44), PTI (32.26, 31), OFC (32.14, 28), PTI (32.35, 34), FTC (29.27, 41), FTC (31.25, 32), OFC (31.91, 47), PTI (31.58, 38), ATE/FTC/PTI (25.81, 31), PTI (31.58, 38), PTI/OFC (28.57, 35), OFC (32.14, 28), FTC/PTI/OFC (26.32, 38), FTC/OFC (27.8, 36), OFC (30.43, 23), PTI (33.34, 30)	17	35	PTI	ATE
Wanderer	FTC/PTI/OFC (29.17, 24), OFC (35.29, 34), PTI/OFC (32.14, 28), OFC (36.67, 30), PTI (31.25, 16), OFC (38.46, 26)	6	26	OFC	PTI
Compass	FTC (57.14, 7), FTC (66.67, 6), FTC (57.14, 7), FTC (57.14, 7)	4	7	FTC	PTI
Standup Meeting (A)	PTI (40.00, 25), OFC (35.71, 14), OFC (31.25, 16)	3	18	OFC	ATE
Collective Responsibility	PTI (40.00, 10)	1	10	PTI	OFC
Team Per Task	OFC (31.82, 22)	1	22	OFC	ATE
Gather Domain Knowledge	ATE/PTI (50.00, 2)	1	2	ATE/PTI	ATE
Show and Tell	FTC/PTI (50.00, 2)	1	2	FTC/PTI	FTC
Participant Observation	OFC/FTC (50.00, 2)	1	2	OFC/FTC	OFC
Effective Coach	OFC (100.00, 1)	1	1	OFC	OFC

Table 6.18 Majority Classifications in Document Similarity Clusterings (PTI = Prototype Team Identity, OFC = Organize for Complexity, FTC = Facilitate Team Cohesion, ATE = Arrange for Task Effectiveness)

The most frequently selected medoid is *Sprint [65]* (17 times) with rather large clusters (average size of 35) compared to other medoid clusters. Majority classifications in *Sprint [65]* clusters varied. The most frequent majority classification is *Prototype Team Identity* with 9 appearances, followed by *Organize for Complexity* with 8 appearances.

In the knowledge base, *Sprint [65]* is part of the core flow *Arrange for Task Effectiveness*. Due to the difference in classification, the experience description was categorized based on *close reading*.

A sprint can be defined as a specific work sequence [283] that helps identifying progress of team members and difficulties in production - referring to task effectiveness. Sprints - as engineering practices - per se do not *"... set up a safe environment ... [65]"* - as mentioned in the reference flow. Yet, such mentioning of a social context within the description of a productivity-enhancing strategy demonstrates the potentials of semantic expressiveness in narratives.

Wanderer [142] was selected as medoid 6 times with an average cluster size of 26. The most prominent majority classification in the clusters is *Organize for Complexity*, which doesn't correspond with the knowledge base classification *Prototype Team Identity*. As this medoid tends to form clusters of entities classified to be part of *Organize for Complexity* in 6 clusterings of rather large cluster sizes, the classification of this reference flow was changed in the knowledge base.

Compass [300], part of the core flow *Prototype Team Identity*, was central to clusters with majority classification *Facilitate Team Cohesion* 4 times with average cluster size 7. In *close reading*, this reference flow appeared in line with the core flow as derived from the majority classifications in clusters. The classification was changed in the knowledge base.

A reference experience description on standup meetings [76] being central to clusters of average size 18 appears to form clusters of majority classification *Organize for Complexity*. Similarly to the experience description *Sprint*, it is part of the core flow *Arrange for Task Effectiveness*, which holds the least reference flows of the four core flows. As this reference experience description outlines meeting rules, it appears to fit the core flow.

Collective Responsibility [74] and *Team per Task [146]* were each medoids once with cluster sizes of 10 and 22. They held different majority classifications than in the knowledge base with percentages below 41 percent. As they were medoids only once and majority classification fractions not significant in size, core flow membership was not changed.

Finally, 22 reference flows were categorized to "Prototype Team Identity", 23 to "Or-

ganize for Complexity"", 21 to "Facilitate Team Cohesion" and 12 to "Arrange for Task Effectiveness" in the team leadership knowledge base.

6.5.5 Entity Classification Validation

6.5.5.1 Comparison of Reference Experience Description Attributions to Preliminary Entity Clustering

Before ontology development, experience descriptions were classified to labels established in the course of a selective literature review (section 6.5.2, p. 170). In order to find out about the quality of reference flow to core flow mappings in the knowledge base, these were compared to the preliminary reference model. Table 6.19 shows counts of preliminary reference flow to team leadership core topic classifications related to reference flow to core flow mappings within the knowledge base.

The core flow *Prototype Team Identity* consists of many reference flows dealing with team vision and uniquely features reference flows dealing with interfacing to stakeholders. The core flow *Organize for Complexity* integrates many team building experience descriptions. *Facilitate Team Cohesion* holds reference flows on constructive communication. *Arrange for Task Effectiveness* mainly includes reference flows on iterative development. This core flow uniquely includes reference experience descriptions on techniques and tools for self-organization.

Reference flows dealing with trust are equally divided among the core flows *Prototype Team Identity* and *Organize for Complexity*. The majority of reference flows concerning team vision are integrated in *Prototype Team Identity*. Experience descriptions on task delegation and task assignment can mainly be found in *Prototype Team Identity* and *Arrange for Task Effectiveness*. Iterative development forms a major contribution to *Arrange for Task Effectiveness*. 3 of 5 reference flows concerning role modeling are part of *Facilitate Team Cohesion*.

6.5.5.2 Comparison of Reference Experience Description Communities to Document Similarity Clustering

Community detection procedures, specifically the Louvain algorithm used in the knowledge base development process, as well as text clustering approaches, such as the k-medoids

Label	**PTI**	**OFC**	**FTC**	**ATE**	**Total**
Trust	1	1	0	0	2
Vision	4	0	2	0	6
Team Building	3	4	1	1	9
Task Delegation and Assignment	4	1	1	3	9
Iterative Development	1	4	2	3	10
Techniques and Tools for Self-Organization	0	0	0	1	1
Pair Programming	1	1	0	0	2
Apprenticeship	2	2	0	1	5
Coaching	0	2	0	0	2
Meeting Cultivation	1	0	1	1	3
Communication Channels	1	4	4	0	9
Ritual	1	0	3	0	4
Water Cooler and Team Space	1	2	2	0	5
Role Modeling	0	2	3	0	5
Interfacing	2	0	0	0	2
Team Learning and Retrospective	0	0	1	2	3
Group Validation	0	0	1	0	1
Total	22	23	21	12	78

Table 6.19 Reference Flow Team Leadership Core Topics in Core Flows (PTI = Prototype Team Identity, OFC = Organize for Complexity, FTC = Facilitate Team Cohesion, ATE = Arrange for Task Effectiveness)

clustering used to refine the knowledge base, were found to hardly provide best community or cluster structures in every context [87], [379], [161].

In order to get more knowledge of core flow communities, core flow membership of reference flows was compared to a clustering derived from a frequently-implemented probabilistic clustering procedure - k-means(++) clustering.

6.5.5.2.1 Method

First, a tf-idf (term frequency–inverse document frequency) weighted document-term matrix was formed with the reference flow collection using scikit-learn (http://scikit-learn.org/stable/index.html). A tf-idf value signifies the importance of a word within a given corpus of texts (such as the collection of experience descriptions of the reference model). The count of a word in a document is offset by the count of this word within the corpus. A high weight results from high word frequency in a document and low document frequency of the word within the corpus.

Tf-idf is frequently used for weighing contents in text-based information retrieval (for example, more than 80 % of recommender systems in digital libraries use tf-idf) [67]). In order to arrive at tf-idf word representations, words were tokenized using a tokenizer from the NLTK (natural language toolkit, http://www.nltk.org). Tokenizing means that sentences of a text are split to arrive at sentence parts, words (tokens), found within the document.

Further, morphological affixes were stemmed from tokens using the english snowball stemmer implemented in the NLTK. An in-depth discussion of stemming algorithms is out of the scope of this thesis.

Stop words from the smart stoplist [525] were excluded from tf-idf weighting. Weights were calculated for unigrams, bigrams and trigrams (e. g. unigram: *"be"*, bigram: *"to be"*), trigram: *"to be or"*) for each reference flow. These were included in the document-term matrix, if document frequency was higher than 0.2 and below 0.8 (each within the range 0.0 to 1.0). Maximally, the top 200000 weights of unigrams, bigrams and trigrams, ordered by frequency within the text corpus, were included in the tf-idf weighted term-document matrix.

Similarly to the k-medoids clustering approach (see section 6.5.4.5.1, p. 194), the k-means clustering is prototype-based. This means that each cluster is represented by a specific prototype. In the case of k-medoids this prototype is an entity of the entities to be clustered, in k-means clustering, it is a centroid (an average) of similar points with

continuous values [490]. The number of clusters, k, is an input of the algorithm. For clustering reference flows, the k-means(++) implementation of sci-kit learn was used (http://scikit-learn.org/stable/modules/clustering.html#k-means).

The k-means algorithm starts by choosing k random data points as centroids of all data points. Next, data points are classified to their nearest centroids. To determine closeness between data points, the squared Euclidean distance is calculated. The Euclidean distance signifies the shortest straight line distance between two entities. The squared Euclidean distance is calculated faster than Euclidean distance. Using squared Euclidean distance, greater weight is placed on distance values the further entities are apart from each other.

After all entities are classified to centroid clusters, centroids are recalculated. This means that centroids are moved to the center of assigned entities. *"The algorithm chooses these centroids and builds the clusters in such a way that the inertia or within-cluster sums of squares are minimized [528]."*

Clustering steps are iterated until centroids don't change any more or a pre-defined tolerance value or maximum count of iterations is reached [490]. In the refined k-means++ algorithm, initial centroids are set far apart from each other. This increases result consistency [27].

The first centroid is selected from the input entity values and put in a set of initial centroids. For entities not in this set, the minimum squared Euclidean distance to any of the centroids in the set is calculated. The next random centroid is selected by means of a weighted probability distribution proportional to the squared Euclidean distance of the selected entity to the nearest centroid in the set of initial centroids. This procedure is continued until k centroids are attributed to the set of initial centroids. Then, the algorithm continues in the same way as k-means [490]. The k-means++ algorithm was utilized on the weighted reference flow tf-idf document-term matrix with a high tolerance and a maximum of 300 iterations.

To compare reference flows' core flow classifications to k-means++ clusters, the ClusterEval application (https://github.com/cmdevries/ClusterEval) was used [161], [227], [162]. Knowledge base classifications were defined as ground truth.

6.5.5.2.2 Findings

The quality metric purity refers to the fraction of a cluster which holds the majority classification. It is bounded between 0 and 1 with values closer to 0 pointing to less purity and

values closer to 1 to more purity. The more entities are equally distributed among clusters, the higher the cluster validation metric entropy [161], that signifies if a clustering is highly ordered (values closer to 0) or loosely ordered (values closer to 1) with regard to a ground truth (e. g. the knowledge base classifications). Micro purity calculates weighted values in relation to cluster size.

Comparing the core flow communities to the k-means++ clustering yields a micro purity value of 0.436 and a micro entropy value of 0.914. No clear structure of classification is represented in the clustering.

6.5.6 Discussion

6.5.6.1 Initial Viable Team Leadership Knowledge Base

Core flows, that were differentiated in the knowledge base development process, address key topics in team leadership. As top-level entities of the interrelated net of reference flows, they form a starting point for knowledge base enquiry.

Core flow narratives inherit from the framework core entity model. The flow template can be seen as a minimal ontology entity model with few necessary properties, such as a title, a description of an interpersonal situation and (possible) interaction to deal with involved tensions, and a collection of keywords (see section 6.1.2, p. 120). Core flow narratives pinpoint central facets of interpersonal interaction in team leadership related to team performance.

A major difference of core flows to patterns is a focus on supporting reflection processes, rather than on presenting solutions. Core flows can be described as reflection anchors orthogonal to team development phases and software development processes.

To guide navigation through the team leadership knowledge base, reference flows are heuristically categorized to Unified Process phases.

Reference experience descriptions are linked to others across core flows based on keyword relationships. This allows for knowledge-based computations of semantic relatedness of entities. The knowledge graph can be traversed following meaningful connections. In any case, keywords don't capture all meaning dimensions of an experience description. Keyword-based relationships do not represent all possible semantic relationships between experience descriptions.

Reference flows are related to core flows based on iterative categorizations in a *blended reading* elaboration process [581] assuming a satisfizing fit. Attribution of each reference flow to only one core flow may foster accessibility and ease of use of the knowledge base - acknowledging that reference flows narratives describe team situations that may also be relevant to other core flows.

Although longed for by practitioners - especially when time slots for (inter)personal reflection can't be scheduled -, the knowledge base is hardly suitable to deduct definite sequences of directly applicable leadership interaction for ever-specific dynamic interpersonal situations and circumstances. Reference experience descriptions vary in importance in relation to specific practice situations. They may disclose different perspectives on team situations and, thus, may support personal reflection as well as learning from others' experience.

Summarizing, table 6.20 presents the title, a key reflective question and the main intent of each core flow.

Title	**Key Question**	**Main Intent**
Prototype Team Identity (or: Participate in the Team)	Who are *"we"* and what is *"our purpose"*?	Team Identity
Organize for Complexity (or: Take Action)	What capabilities help us achieve our goals in our current environment?	Specialization, Diversity and Decentralization
Facilitate Team Cohesion (or: Balance and Suspend)	How are we going about this with each other?	Collaboration and Team Learning
Arrange for Task Effectiveness (or: Orient towards Team Goal Completion)	What technical tools and engineering strategies help us achieve our goals?	Domain-specific Task Framing

Table 6.20 Core Flows - Summary

6.5.6.2 Knowledge Base Design

The knowledge base design combines elements of structured design focusing on coupling, modularity and interfaces between modules with an ontology of reference experience descriptions of leadership in complex team environments. Such an *"inside view"* on interconnections between experience descriptions, or reference flows, derived from literature appears to represent the domain of dynamic interpersonal leadership processes in teams more accurately than static behavior classification.

The ontology of reference flows implicitly holds *"stories"* of leadership interaction that can unfold based on relationships between reference flows within the ontology graph. These may relate to cornerstones of personal reflection in practice [533]. The ontology is completed by categorizing reference flows to taxonomies of leadership interactions, project risks, as well as to Unified Process project life-cycle phases.

Various learning paths along the knowledge base can be pursued.

The knowledge base is not supposed to represent all possible solutions in the problem domain [552]. Adhering to a design science research approach, it may provide a viable, satisficing artifact to reflect on team leadership in ICT project team environments [279, p. 82/83].

It can be refined by practitioners in various ways, including establishing semantic relationships between reference flows, heuristic categorizations of reference flows to interaction or risk taxonomies, or selecting case studies, organizational patterns or best practices to be included.

6.5.6.3 Knowledge Base Development

The semi-automated ontology development process contributes to an iterative hermeneutic endeavor to represent the dynamic domain of team leadership in ICT project team environments.

It was pursued due to large amounts of text-based experience descriptions in literature and online repositories, a lack of connection between them, and resource constraints.

Resource constraints didn't allow for classifying and relating reference flows with each other in a team of researchers and experts from practice.

Keywords can be automatically extracted from text titles and descriptions. This allows a wide range of experience description forms, such as organizational patterns, micro articles, best practices, or case examples, to be related to others through semantic keyword relationships and, thus, integrate in the knowledge base.

Text mining procedures offered an additional perspective on semantic structures within texts [376, p. 2]. Algorithmic community detection and clustering approaches appear to support the exploration of complex semantically interlinked entities. They can enrich hermeneutic processes to arrive at rather meaningful data sets. Yet, text mining algorithms are not neutral, but based on programming intents.

For knowledge base structuring, algorithms were embedded in a modular *blended reading* process [581] combining *close* qualitative reading of single texts and *distant* computer-supported analysis. Knowledge base development can be considered rather experimental, as an innovative computer-supported semi-automated process was elaborated in a one-person project [376, p. 4].

For unstructured textual data, community detection and clustering provide a wide variety of classification options. Apart from a large bandwidth in algorithms, grouping results in community detection by means of the Louvain algorithm and in clustering by k-medoids or k-means(++) algorithms heavily depend on input parameters, algorithm start conditions and the data set. This means, for example, that the same initial entity set can result in highly diverse clusterings due to varying selections of initial medoids or cluster sizes.

So far, it appears no best solution of semantically linking entities may be derived strictly using algorithms. *"There is no, and probably will never be a 'one button' solution to CATA (computer-assisted text analysis, note by author), because of the simple fact, that generic approaches are not appropriate to satisfy specific and complex research needs [629]."*

Grouping rather similar documents allowed to infer and contrapose attributes of such groups, which contributed to refine core flow conceptualizations. Actually, community detection, clustering and keyword extraction appeared supportive in reasoning on the meaning of and arriving at labels for document groupings in the knowledge base [625, p. 112/113]. *"One view of the benefits of clustering is the summarization of properties of a document collection [625, p. 114]."* Unsupervised community detection and clustering suggested candidate experience descriptions for *close reading*.

The comparison of the community detection algorithm used for initial category elaboration to a standard clustering algorithm yielded no significance (section 6.5.5.2, p. 199). In fact, standardized evaluation procedures for unsupervised text mining are not available [183, p. 112]. External criteria validity and prognostic validity were approached by comparing the knowledge base categorizations to a categorization elaborated by the author prior to text mining (section 6.5.5.1, p. 199). Yet, validity can not be assumed solely based on this comparison.

However, the validity of the established team leadership knowledge base categories is evaluated in a peer debriefing (section 8.1, p. 301) and two qualitative-quantitative mixed-methods expert audits (section 8.4, p. 315). The quality of core flow classifications seems to best be determined by people that utilize the knowledge base as a learning resource in

practice (see section 8.3, p. 307).

6.6 Reflection Process Model

Following the design intent of framework development within this thesis (see DI1 in 2.1, p. 8, and the design science research template in 2.1, p. 9) and considering initial tool requirements (particularly R1 and R2 in 6.1.3, p. 122), a reflection process model to support experiential learning on team leadership was elaborated.

The reflection process model constitutes the basis of the team leadership support framework. At its core is the reflection of dynamic intra- and interpersonal tensions within a specific work team context. Team structure promoting team performance is described in terms of dynamic interpersonal processes.

The primary goal of reflection in this framework is deepened understanding of effects (and counter-effects) of interpersonal leadership interactions perceived as significant by a person holding a leadership function [430], [41, p. 15].

Methods inherent to the process model are reflective writing and dialogue, involving active listening.

The model can be implemented focusing on continuous personal reflection. Therefor, it includes a reflection template as well as a guideline describing a suggested structure and offering questions that may provide opportunities to approach team situations perceived as significant from various angles.

Further, it may provide guidelines for continuous personal and interpersonal reflection. A sequence description for case-based interpersonal reflection was adapted from the *open case* consultation method [312].

In personal and interpersonal reflection processes, the contents of the team leadership knowledge base (see section 6.5, p. 165, and section 7.4, p. 243) can be referred to for critical (self-)positioning.

The normative model of leadership team interaction supporting team performance (see section 6.2, p. 123, and section 7.5, p. 279) might provide a terminology to label aspects of a situation.

Continual meetings to reflect together with leadership peers are moderated or led by professionals in counseling, group dynamics and organizational development. The focus of

professional moderation of these experiential leadership learning groups is to facilitate group cohesion.

Subsequently, the elaboration of the reflection process model components is described in detail.

6.6.1 Personal Reflection

6.6.1.1 Reflection Template

Reflective writing can support experiential learning [430], [635] (see also section 5.4, 90). In business learning contexts, reflective writing is used to foster communication and leadership skills [125].

Written reflections in the leadership support framework developed in this thesis are documents - digital or on paper - that are elaborated by practitioners based on leadership interactions they perceive as significant in their work contexts. Reflections are written in order to gain insight in effects of leadership interactions in interpersonal relationships. They include observations of others' contributions as well as personal motivations, feelings, thoughts, wishes related to a significant event [595].

Within the framework, written reflections may follow the structure of the framework core entity model (see section 6.1.2, p. 120). Adapted from organizational pattern description templates, flows hold a narrative [445], [565] of a significant event in team leadership including considerations on the (interpersonal) context, in which the event occurred, the perceived tensions within this context, opportunities for change, and an examination of (assumed) consequences of interpersonal interactions.

Flows can be written, updated and collected continuously similar to entries in a reflective journal. Writing flows, similar to writing patterns [626], is an iterative endeavor. Other than in pattern writing, where a pattern evolves around a found or anticipated solution, in flow elaboration an emphasis is set on the differentiated phenomenological description of a significant event.

6.6.1.2 Reflection Guideline

A predefined document structure and accompanying reflective questions can support reflection processes [442], [430], [635]. Within the framework elaborated in this thesis, a reflection

guideline was developed to accompany the reflection template. It is based on the contribution guideline provided in the first support tool prototype (Prototype A, section 6.3, p. 148).

The guideline assumes to explain reflection template components. It provides guiding questions to reflect on interpersonal and personal contributions to the emergence of a significant event from a systemic, intersubjective perspective [617], [42].

6.6.2 Interpersonal Reflection

"Individuals differ in the way they think about and make sense out of their challenges in life. One of these individual differences is whether one tends to reflect alone or with others [635, p. 42]."

The framework component called *flow session* aims at supporting the reflection of significant leadership events in a group of like-minded peers. An interpersonal reflection sequence allows for case-based reflection within such a learning group.

The reflection sequence was adapted from the *open case* workshop method that was developed in the context of the EU-funded iCom project on international communication in ICT businesses at the University of Vienna [312, p. 113].

Similar to the open case setting, flow sessions offer opportunities to share and explore experiences - though with a focus on interpersonal leadership interactions in complex team environments in business contexts.

6.6.2.1 Dialogue and Active Listening - The Constituents of the Interpersonal Reflection Process

Learning in flow sessions is based on and enabled through dialogue. In the context of the reflection process model, dialogue describes a conversation between two or more persons in symmetrical - as between learning peers - or complementary - as between learning peers and moderators - relationship to each other with the goal of reciprocal understanding to arrive at insight [526, p. 256], [89], [314].

Following the notion of dialogue as art of thinking together, as expressed by Bohm referring to a flow of meaning between dialogue participants [89, p. 33], Isaacs distinguishes four personal capacities that allow and may be learned in dialogue [314, p. 83-184]:

- Listening

"The heart of dialogue is a simple but profound capacity to listen. Listening requires we not only hear the words, but also embrace, accept, and gradually let go of our own inner clamoring [314, p. 83]." Isaacs remarks that in listening we might at times encounter disruption, which he describes as not listening from within the here-and-now, but on the basis of emotional memory. He further implies that reflexive listening comprises to realize how *others* experience the world.

- Respecting
  Isaacs describes active respecting as a legitimation of the *other*. This entails an active search for the sources of the others' experience and the preservation of personal and the others' boundaries. It further refers to the ability to hold polarities or tensions without immediately acting on them.

- Suspending
  Suspending refers to an acknowledgement and observation of emerging personal thoughts and feelings. In a group, suspending means to offer personal viewpoints on a topic that concerns all group participants in a way that allows every participant to think about it. It is a search for an *"order in between"* extremes - the unresolved questions around which participants polarize.

- Voicing
  Voicing means to consciously decide to self-disclose to some extent based on a trust in personal feeling and thinking. It implies finding the right words, finding ones own voice. In dialogue, voicing allows for collaboratively arriving at new insights.

Central to dialogue capacities is a dialectical subjective experiencing process of empathic attunement and introspection. Empathically attuned listening may be described as a significant agent of intersubjective understanding.

Rogers and Farson [506] explore qualities of an empathic - active - listening process: They stress not to jump to conclusions too quickly or to impose personal judgments, but to identify meaning in content and emotional tone, to respond to feelings and to acknowledge verbal and non-verbal cues in communication. They note that in contact, personal attitudes become apparent to the other. This means that sooner or later people realize, if a person talks to them with sincere, caring interest or not - and react accordingly. Barrett-Lennard, a student of Rogers, adds that *"... one-way listening, of whatever depth and impact, lacks the mutuality found in some complete natural dialogue. A two-way flow in which each closely shares* and *listens, that is, a* symmetrical *dialogue, must involve a somewhat different inner*

process. This process would seem to depend on an easy fluency in running two closely linked, interweaving channels at once: close listening attention to the other while also forming and expressing one's own thought and feeling; ... [51, p. 360]"

Kohut brings to attention that empathy and introspection may be seen as informers of appropriate action [346, p. 125/126].

In the context of this framework, listening is central to interpersonal reflection in flow sessions and the primary inquiry instrument of flow session participants in their team environments. Similar to Balints' suggestion to seminar members to hold *"long interviews"* with patients in order to become good listeners [523], [41, p. 403/404], participants in flow sessions might be encouraged to empathically listen to co-workers, customers and project stakeholders.

6.6.2.2 Towards a Theoretical Foundation of Interpersonal Reflection Process Moderation

Glazer et al. [232], Wood Daudelin [635] and Valli [609] mention that reflection might be supported by facilitative supervision. In medicine training, case-based reflection of interpersonal doctor patient dynamics in a group of peers with a professionally trained group leader appear to be effective regarding psychological medicine skills, abilities and confidence [604].

Group leaders appear to have effect on participants' learning in case-based interpersonal reflection groups. While learning effects are moderated by presenting a case, listening and sharing viewpoints among peers, professional group leaders can support the reflection of intersubjective systems dynamics within a presented case and the group dynamics related to a presented case within the learner group [600].

Interpersonal reflection in a team of leadership peers in the context of the framework elaborated in this thesis are moderated or led by professionals in counseling, group dynamics and, eventually, organizational development.

The reflection process model aims at a limited, but significant change in leader personality (compare [41, p. 405]) in order to deal with emergent processes within a team - or facilitate working together -, and promote well-being of other team members and self with regards to team contexts (see section 2.1, p. 9). Empathically attuned interactions, including understanding and interpretive responses, between participants in continual interpersonal

reflection meetings account for an interpersonal process in which participants' personal experience concerning team leadership may gradually become enriched, more flexible and more complex (compare [578]).

Subsequently, an initial theoretical foundation for the moderation of interpersonal reflection on leadership interactions in teams in the context of the framework developed in this thesis is presented.

6.6.2.2.1 Leadership as Function in Interpersonal Relationship

A basic notion that underlies the framework developed in this thesis is that leadership unfolds in interpersonal relationship (see section 5.3.1, p. 85).

It can be portrayed as function [256], [417] transferred from members of a group, either publicly or implicitly, and accepted by the person then holding that leadership function within and for the group. Haslam et al. [272] illustrate this connection between leadership and personal identification processes of group members and leaders in terms of social identity and self-categorization. Social identities transform disparate individuals into social forces [272, 59]. *"They are the motors of both social stability and social change [272, 64]."*

Haslam et al. pinpoint that by prototyping group values and norms - by understanding the needs of group members and sharing a common purpose or vision - , leaders are given more range to influence and shape the directions of groups [272, 107]. Thus, leadership interactions have effects and counter-effects on people involved in the interaction - one or more group members and the person holding a leadership function (compare [41, p. 21]). Moderation in this framework aims at facilitating the reflection of these leadership effects in a team context.

Leadership team interactions that are perceived as significant - that are described by adjectives with emotional connotation, that appear to have preceded a shift in a situation, that form mental representations for comparison of other experiences (see section 6.2.2.2.2, p. 139) - can be described in the form of situation-constitutive interpersonal tensions. What are tensions in the framework elaborated in this thesis?

Tensions, or more specifically dialectical tensions, are oppositions that affect or constitute relating [60]. As such they may be described as personally meaningful arrangements of conditions, needs or goals that determine interpersonal interaction. Yet, dialectical tensions also refer to differences in attributed meaning between individuals. It is these differences in

meaning that are of central interest in interpersonal reflection moderation for they refer to subjective organizing principles in interplay - or organizing activity - within intersubjective systems [32].

"Developmentally, recurring patterns of intersubjective transaction within the developmental system [primarily mutually regulating relationships between the infant and caregivers, note by author] give rise to principles (thematic patterns, meaning-structures) that unconsciously organize subsequent emotional and relational experiences. Such organizing principles are unconscious, not in the sense of being repressed but in being prereflective; they ordinarily do not enter the domain of reflective self-awareness. These intersubjectively derived, prereflective organizing principles are the basic building blocks of personality development, and their totality constitutes one's character [577, p. 383].

The *self* refers to the psychological structure through which self-experience derives cohesion and continuity, and further assumes its characteristic shape and enduring organization [32, p. 28].

For clarification: *"At any stage the child's formative experiences are understood to emerge from the intersection of, and to be codetermined by, his or her psychological organization as it has evolved to that point and specific features of the caregiving surround [578]."*

Subjective experiences are confined by the intersubjective co-construction of meaning structures, that spans generations. Further context-related confinements can be seen in a pre-determination of meaning categories that emerge from the evolutionary development of the organism of a species, and the existential necessity to find viable arrangements within one's experiential context that strengthen chances of survival [366, p. 49].

The personal idea of human beings (*"Menschenbild"*, see 5.3.3, p. 89) may be portrayed as a kind of organizing principle.

Atwood and Stolorow propose the *need to maintain the organization of experience* as a central motive in the patterning of human action [32, p. 29]. They emphasize differentiation and integration as two ubiquitous psychological processes pivotal to the evolution of the subjective world [32, p. 31]. Similarly, Rogers proposes an organismic actualizing tendency as basis of differentiation and integration central to human motivation [503, p. 237]. It might be marked that intersubjective systems theory highlights the embeddedness of being - that subjective organizing principles form and sustain in intersubjective systems. Inferring from infant research, Bråten suggests that the human mind is inherently structured dialogical in that infants have an innate expectation that there is an *other* and how this *other* might be.

Bråten refers to an innate *virtual other* that is realized in the encounter with the actual *other*. He further highlights that emotions and feelings, or more specifically as-if feelings, already form when observing the others' actions due to the activity of mirror neurons in alterocentric participation [105], [177].

Experiences, especially affects, can be integrated along the current organization of experience within a sufficiently supportive intersubjective system. Selfobject needs can be described as the needs of a child for the development and preservation of self experiencing. They can further be seen as striving to integrate those aspects of experience, particularly affects, that could not yet be integrated into the cohesive whole of self-experiencing [53, p. 46/157]. Such striving actualizes in interpersonal relationships.

Selfobjects are subjective psychic representations related to expectations in order to support the development and preservation of a feeling of self. They are acquired in a subjective development process and include what a human being needs to grow and live, reactions to disturbances in development and the actual intersubjective context that is shaped by the personal history, yet also marked by specific aspects associated with the other person in the actual relationship, such as particular expectations, fears or avoidances [53, p. 18/19].

Representations of interactions which have been generalized [101], [100], [102], [205] may be portrayed as expectations of response that formed in experiences in communication with significant *others*.

Selfobjects can be described as expectations of response with the purpose to restitute coherent self-experiencing, and self esteem, by means of experience organizing activity, specifically by means of symbolizing [53, p. 47].

Self-restitutive functions - that can be identified as selfobject needs - are more or less prevalent in everyday interpersonal relationships. Selfobject needs, optimally, contribute to stable relationships, provided and to the extent the significant other can be perceived as *other*, as separate subjectivity, a unique individual with a personal history, values, motivations, needs, wishes, aspirations. Thus, a person organizes subjective experiencing, behavior and, further, interpersonal relationships in a specific way that is in accord to the personal history and experience, in particular also to personal needs that were as-of yet not sufficiently responded to. Further, the organization of subjective experiencing is essentially shaped by the interplay with the actual *other* in a given situation [53, p. 127]. Emotional experience is inseparable from the intersubjective context of attunement and malattunement in which it is felt [576].

In continual moderated case-based reflection on interpersonal interactions within a group of like-minded peers, participants may deepen sensitivity to selfobject functions and needs as well as associated feelings constitutive of or inherent to leadership functions within a specific team context.

The learning group may continually attempt to arrive at common understanding, a shared language or coherent narrative, in a process of synlogisation based on reciprocal attunement to, understanding, clarification, differentiation and integration of subjective meaning [366, p. 179-181].

Such intersubjective interaction is characterized by occurrences of intersubjective conjunction and disjunction of differently organized subjective worlds. Intersubjective conjunction hereby refers to moments in which the configurations of self and other structuring an interaction participants' experiences give rise to expressions that are assimilated into closely similar central configurations in the psychological life of another interaction participant. Intersubjective disjunction refers to moments in which the configurations of self and other structuring experiences of an interaction participant give rise to expressions that are assimilated by another interaction participant into configurations that significantly alter its subjective meaning for the first. Moments of intersubjective conjunction and disjunction can be pathways to more insight and understanding or obstruct interpersonal relating.

To tap into the illuminative contingencies of these moments in interpersonal interaction, it is necessary to participate in intersubjective interplay - or, to appropriately respond to offerings within the intersubjective system -, as well as to decenter and self-reflect - or, to keep an observational stance, and empathically grasp the meaning of the others' experience with respect to the organizing principles of one's own subjective world [32, p. 38/39], [53, p. 107].

Difficulties in understanding - or, failures in empathic attunement are inevitable. Empathic understanding of another persons' experience is based on personal, similarly structured ways of experience. Yet, the other persons' *other*ness, which is not accessible in the first place, needs to be taken into account [53, p. 136].

Changes in selfobject expectations where interaction participants face each other as the *other* and that are accompanied by feelings related to personal experiences of failing relationships, - or disruptions in selfobject relationships, may be noted and attended to in continual disruption-restoration processes that, optimally, deepen understanding and insight in constituent meanings in intersubjective interactions [345].

Transmuting internalization is a process of psychic structure building - experience organizing activity - in an atmosphere of *"optimal frustration"* that might unfold in interpersonal relationship, specifically in moments of disruption-restoration in which selfobject needs are empathically traced and attended to with care, yet eventually disappointed to some extent [345]. This allows for gradual affect integration and, optimally, contributes to the development of a flexible, resilient, vital self.

In the reflection process model developed in the course of this thesis, leadership team interactions are viewed as mutual interactions between differently organized subjective worlds of involved persons within a specific team context. Tension refers to the quality of relatedness, the experience of self and other in relationship within a specific work context, accessible through empathic attunement and introspection. At the core of the interpersonal reflection process is the intersubjective exploration of meanings that contribute to leadership team interactions and their perceived effects within a group of leadership peers.

6.6.2.2.2 Teams as Human Systems

Team members' relationships to each other constitute and sustain interpersonal dynamics that impact a teams' and eventually an organizations' longevity. These dynamics might be described in terms of organizational systems dynamics.

System in the reflection process model refers primarily to intersubjective relationships that are sustained through time. *"The essence of a human system is that it is composed of human beings who bring it into being by their actions and their experiences [613, p. 175]."*

From an organizational systems perspective, processes that sustain networks of relationships can be defined as *regulating feedback* processes. In this perspective, focus is set on relationship, rather than solely on constitutive *parts* [366, p. 73]. The limits of sustainability are the conditions of relationship networks' *stability* [613, p. 17].

Teams may be seen as open systems depending and contributing to their environments. The *interdependence* with environment imposes *constraints* on system constituents. *Organization* of the system can mitigate, but not remove constraints. *"Open systems cannot, by definition, be 'wholes' if this is taken to mean systems wholly independent of their surround. But in so far as any open system acts as a whole in relation to its surround it is useful to distinguish the* internal relations *which enable it to do so from the* external relations *which it thus sustains. It is thus both legitimate and necessary to move freely from the consideration of a system as a whole to the consideration of it as part of a larger system; it is equally*

legitimate and necessary to realize that its constituents may also be constituents of other systems [613, p. 17]." Such symmetrical and asymmetrical, or hierarchical, relationships between persons and networks of human beings and their exchange processes with their environments, that may also be technology-mediated, constitute what is referred to in the framework developed in this thesis as complex environment.

"Systems are thus tools of understanding *devised by human minds for understanding situations, including situations in which human beings appear as constituents. They are not* arbitrary *constructs. They must include the minimum number of relationships needed to constitute the situation which is to be understood. But this is defined by its relevance to the* concerns *of some human minds [613, p. 17]."*

Through inherent feedback processes, systems form structure - they self-organize and react as wholes to changes in their environment [366, p. 73/74]. Possibilities of organization are limited [613, p. 17]. The realization, - or actualization, of a specific organization may be seen as adaptation to the system environment with regards to the current possibilities of self-organization - and as one realized organization besides other possibilities of organization [366, p. 74]. Team performance might be seen as highly relevant to a teams' self-organizing capacity.

"To operate in a highly complex situation such as an ICT project, constituted and influenced by many, often interconnected, factors, it gets structured, either implicitly or explicitly [268, p. 271]." To sustain system longevity, self-organization in complex, changing circumstances includes transition processes of re-orientation, re-adjustment, taking steps in new directions - phase transitions or order to order transitions [365, p. 55] - that may be accompanied by team members' and leaders' feelings of anxiety, doubt, insecurity, and anger.

In cases - or flows - presented in meetings for interpersonal reflection, participants may consider leadership contributions concerning the realization of a teams' self-organizing capacities within the confines of the situation as presented.

6.6.2.2.3 Impact Factor Group Cohesion

In an extensive study on experiential learning groups, Lieberman, Yalom and Miles found that group leaders' behavior characterized by caring (protecting, encouraging, inviting members to seek feedback and support, real concern, love) and meaning-attributing (cognitizing behavior such as providing concepts for how to understand, clarifying, interpreting, attaching meaning

to person or group behavior, offering explanations for consideration, understanding how it is and what people are feeling as important goal, reflection of experience concerning the group or individuals) correlated with beneficial effects on group participants, while excessive stimulation (revealing feelings, challenging, confronting, revelation of personal values and beliefs, showing how it is done) and inordinate attention to executive functions (setting goals and directions of movement, sequencing, pacing, stopping, blocking, eliciting, questioning, release of emotion through suggestion, emphasis on prescriptive behavior of which form and type is constructed by the leader) were related to negative outcomes [381, p. 264].

Interpersonal reflection in the framework developed in this thesis emphasizes continual, moderated meetings within the same experiential learning group. The functions of moderators are to frame a constructive experiential learning setting and to facilitate group cohesion. Cohesion is the result of group qualities that impact group members in a way that they stay in the group - the attractiveness of a group to its members. It is based on group members' feelings of affiliation and a function thereof [637, p. 82]. It may be seen as the basis on which interpersonal experiential learning in a group can take place [637, p. 83].

Regarding case-based experiential learning in a group of practitioners, Balint recognizes that what they needed was an amicable group atmosphere, in which the insights could be processed that actual behavior is often very different from our good intentions and is only to a limited extent corresponding to the idea we had of it so far. Based on group cohesion, or solidarity within the group, mistakes, blind spots and limits of each participant can be illuminated and, eventually, accepted. A participant can handle the perception of personal mistakes easier, when he or she can feel that other group participants can understand this mistake and identify with it and when he or she can see that he or she is not the only one who makes mistakes. Participants in the group may realize that the leadership behavior of every participant, including the moderators or group leaders, is an expression of this persons' personality, which also applies to their habitual mistakes [41, p. 405].

In interpersonal reflection meetings in the context of the framework developed in this theses, participants primarily focus on leadership team interactions as presented in a case, the described interpersonal relationships and associated feelings, more than on relationships within the learning group between participants or between participants and moderators (compare [41, p. 410-414]). The interpersonal reflection process is characterized by a primacy of experience [502, p. 222] accessible through empathic attunement and introspection [344] that may support understanding and explaining intersubjective dynamics. Participants may realize that personal feelings emerging associated to a significant leadership team interaction

may not be acted upon, but observed as indicators to intersubjective system dynamics within the described situation (compare [41, p. 401], [42, p. 90]).

Interpersonal reflection process moderators primarily aim to establish a safe, confidential group atmosphere, in which participants can talk about their work and their feelings. Moderators discourage unwanted or intrusive questions about a presenters' life or history and eventually re-focus attention to the presented case (compare [522]). They prototype group behavior [637, p. 157], [41, p. 409], [272].

A cohesive group atmosphere between like-minded peers that allows for discussing problems and mistakes may help to avoid professional *"burnout"*. It may support arriving at deeper understanding of experience, particularly of feelings of stakeholders involved in work contexts and of personal feelings. The interpersonal reflection process may encourage team leaders to see their team members, customers, superiors, involved stakeholders, work associates as human beings who, like themselves, have a life and relationships within and outside of the work setting (compare [522]).

Part III

Contributions

Chapter 7

The *rhea.framework*

The *rhea.framework*, a socio-technical system supporting (interpersonal) experiential learning of peers in team leadership, can be seen as the main contribution developed in the context of this thesis. Subsequently, a comprehensive introduction to the *rhea.framework* - a leadership learning resource to support team performance in ICT project team environments - is given.

What is the *rhea.framework*?

At the core of the *rhea.framework* is a leadership learning process model. This process model is interrelated with a team leadership knowledge base integrating a normative leadership team interaction model.

The *rhea.framework* aims to

- support experiential learning through personal reflection on leadership in teams,
- support learning from experience together with peers,
- support learning from others' experience,
- increase personal leadership capacities (to foster team performance) and well-being,
- support the refinement of learnings in team leadership in complex team contexts.

Principles guiding design and implementation of the *rhea.framework* are presented in section 5.5, p. 108.

The *rhea.framework* integrates with the Unified Process by addressing people aspects [317, p. 16-19].

It is embedded in an ICT project team leadership context explained in detail in chapter 5, p. 39.

A systems view of the framework is presented in figure 2.1, p. 9.

7.1 Philosophical Underpinnings

The title of this framework goes back to a mythological figure, the Titaness Rhea. In greek mythology, Rhea is the daughter of Gaia, a primordial deity and personification of earth, and Uranus, son and husband of Gaia and personification of the sky. Rhea is the sister and the wife of Cronus, the leader of the first generation of Titans, ruling in the Golden Age until overthrown by his son, Zeus. Rhea is the mother of the Olympian gods.

The word can be translated to *"ground"*. The philosopher Plato, commenting on the pre-socratic philosopher Heraclitus, associated it with *"rheo"*, meaning *"flow"*, *"discharge"*.

This framework is inspired by Heraclitus' thought [235], [236]. *"Panta rhei"* - *"everything flows"* - is an aphorism coming from the philosopher Simplicius referring to Heraclitus. It is put in the context of Platos' interpretations of Heraclitus' philosophy. Although it can be read as a misinterpretation of Heraclitus' philosophy, the aphorism points to a core doctrine of Heraclitus' insights: the relationship between change and consistency. One of Heraclitus' river fragments indicates this relationship: *"On those who enter the same rivers, ever different waters flow (Heraclitus DK B12 in: [48])."* While the water is ever changing, the river stays. In fact, it is for water is constantly flowing what makes the river a river and not, for example, a lake [236]. Heraclitus can be interpreted as demonstrating that higher order structures emerge through inherent dynamic organizing processes.

The flow doctrine is related to Heraclitus' paradoxically appearing notion of the interconnection of opposites. *"As the same thing in us are living and dead, waking and sleeping, young and old. For these things having changed around are those, and those in turn having changed around are these (Heraclitus DK B88 in: [236])."* Entity properties may be opposing at the same time, yet describe the same entity at different times. Opposites replace each other by transformation. They are transformationally equivalent. For Heraclitus, conflict - and flow - between opposing positions appears not to be an interference to, but a precondition of life. Conflict and dynamic transformation (flow) can be seen as enabling emergent higher

order structure. In the *rhea.framework* situations can be described by dynamic conflicting, opposing, yet situation-constituent tensions (see also section 6.6, p. 207).

7.2 Overview

The *rhea.framework* is founded in the ***rhea.framework*** **Reflection Process Model**. This model describes personal and interpersonal leadership reflection processes. Moderated peer learning sessions (flow sessions) are alternated with personal written reflection on significant practice situations. The model provides a structured template for personal reflection and describes standard flow session conditions and procedures.

The ***rhea.framework*** **Team Leadership Knowledge Base** can be used for positioning and comparing personal written reflections. The knowledge base may be used as a compass through day-to-day team leadership issues. It discerns four main topics - core flows - of team leadership.

The categories of a **Normative Model** of leadership team interaction differentiate leadership interactions and ICT project risks. The taxonomies are integral parts of the knowledge base. Taxonomy categories can help to identify and label aspects of leadership behavior and environmental context in reflection processes.

7.2.1 Framework Architecture Design

As depicted in figure 7.1, the *rhea.framework* adopts the model view controller software architectural pattern. As models, representations and interactions between models and representations are decoupled, the framework can be implemented flexibly.

The interrelated components of the framework - the process model of continuous (inter)personal reflection and the team leadership knowledge base providing anchor points for experiential learning - can be represented in different forms.

The reflection process model provides a structured template for personal reflection and peer reflection procedures. The template can be printed and filled out by hand, yet note-taking mobile or web applications are equally useful for writing experience descriptions.

Groups can meet face to face for interpersonal learning, but in distributed teams, peer learning sessions may be supported by video conferencing technologies.

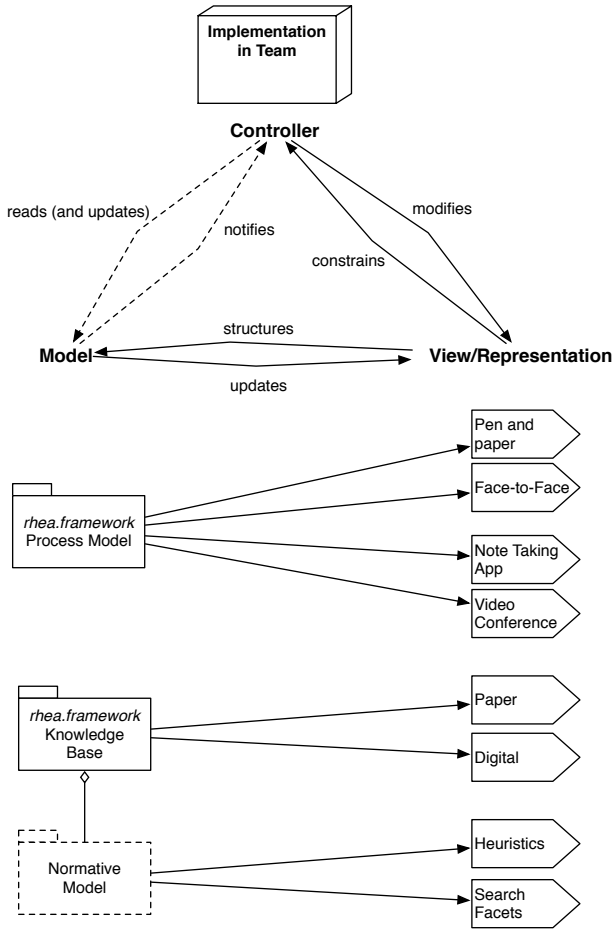


Figure 7.1 *rhea.framework* Model View Controller Pattern

All framework components may be altered or enhanced by implementing the framework in a specific business setting.

Implementing *rhea.framework* policies (section 7.3.3, p. 239) rigorously is highly recommended.

7.2.2 Concepts

Central concepts of the *rhea.framework* are presented in figure 7.2. A more in-depth discussion of these concepts can be found in section 3.2, p. 21.

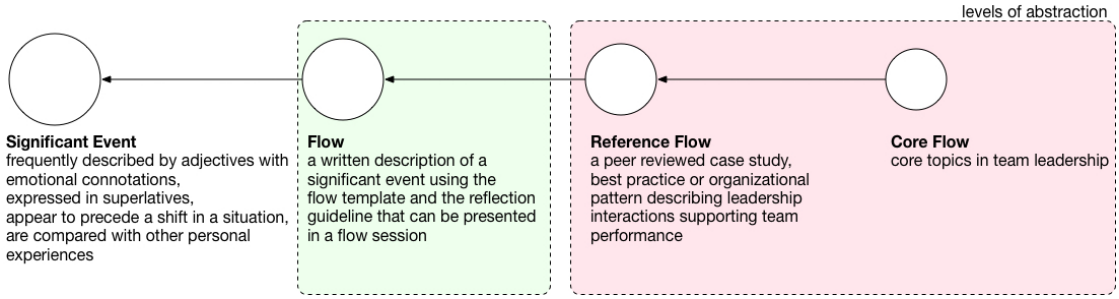


Figure 7.2 Thesis Central Concepts

7.2.3 Components

The *rhea.framework* consists of two key components, as depicted in figure 7.3:

A. The ***rhea.framework*** **Reflection Process Model** of professional reflection on leadership team interaction, and

B. the ***rhea.framework*** **Team Leadership Knowledge Base**.

The core of the *rhea.framework* is the ***rhea.framework*** **Reflection Process Model**. It is composed of two modules:

1. The *"Personal"* module: The **Reflection (Flow) Template (section 7.3.1, p. 233)** and the **Reflection Guideline (section 7.3.2, p. 236)**, as well as

2. The *"Interpersonal"* module: The **Flow Session Policy (section 7.3.3, p. 239)** and **Flow Session Procedure (section 7.3.4, p. 241)** (including an interpersonal **Flow Elaboration Guideline**).

As the *rhea.framework* supports personal reflection of leadership interaction in day-to-day work practice, the **Reflection (Flow) Template** provides a structured reflection template that can be used to explore work situations in depth. The **Reflection Guideline** describes the template and renders a viable course through the personal reflection process.

Flow sessions are meetings of peers to reflect on interpersonal leadership interactions together with others. The **Flow Session Policy** outlines requirements and constraints of flow session processes. The **Flow Session Procedure** describes a process structure to reflect significant interpersonal interactions in a group. It is particularly supportive in the first

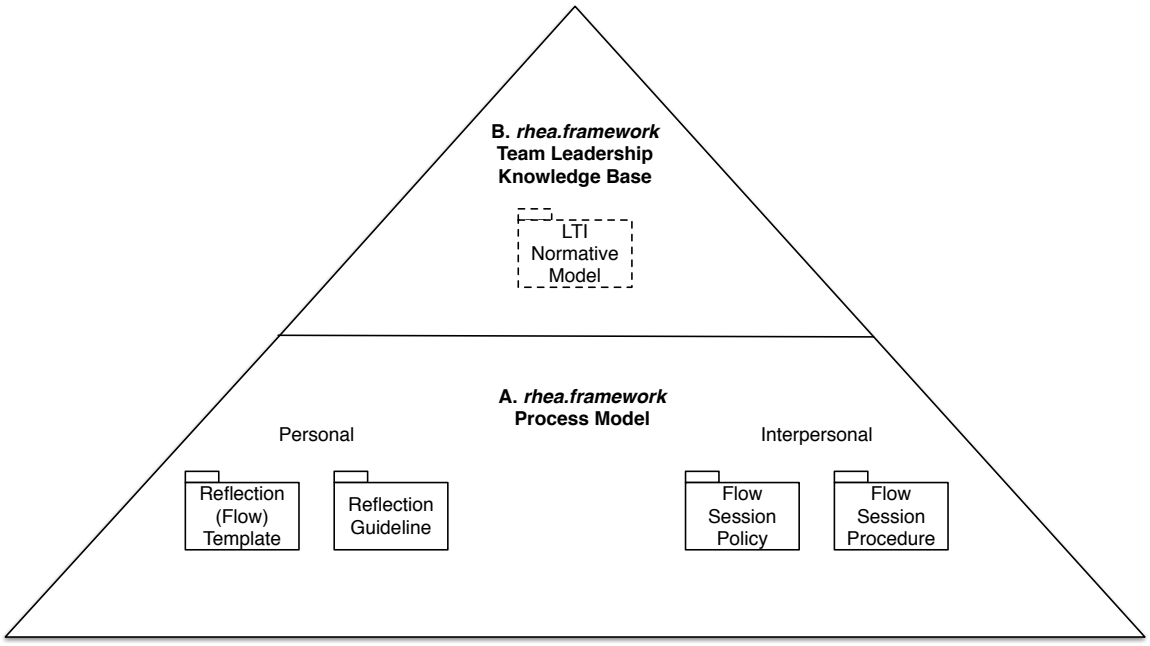


Figure 7.3 *rhea.framework* Components

meetings of interpersonal reflection.

The ***rhea.framework*** **Team Leadership Knowledge Base** is an ontology-based domain description of team leadership in ICT project team environments. It holds an interconnected collection of reference leadership team interaction descriptions (reference flows) that are central to leadership supporting team performance.

The knowledge base can be consulted as a learning resource on team leadership. It is intended to support personal reflection processes by providing experience descriptions retrieved from literature and online repositories for comparison. Personal written reflections (flows), that are elaborated using the reflection template and explored in flow sessions, can be compared to reference flows in the knowledge base.

A **Normative Model** of leadership team interaction supporting team performance adds expressive depth to leadership experience descriptions. It holds a taxonomy of interpersonal leadership interactions as well as a taxonomy of ICT project risks. The taxonomies may support labeling of experiences in team situations.

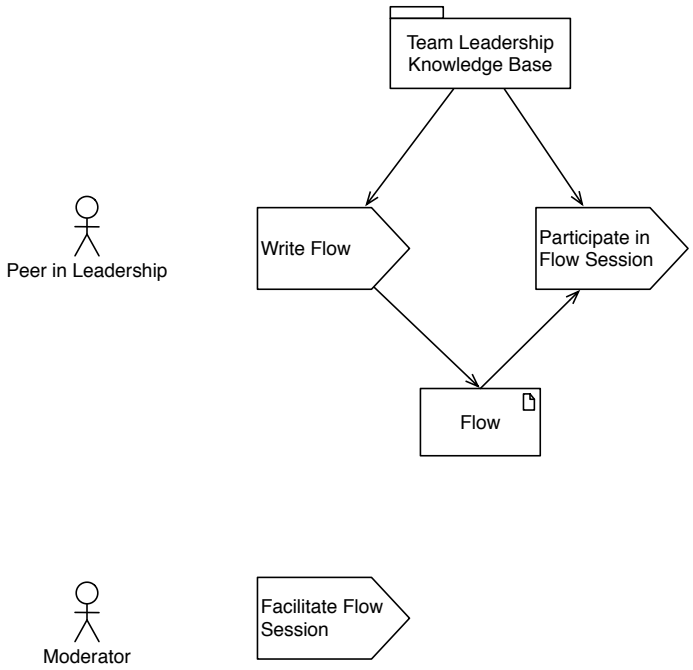


Figure 7.4 *rhea.framework* Roles

7.2.4 Roles

Roles and responsibilities in the *rhea.framework* are shown in figure 7.4.

Peer in Leadership:
Peers interested in increasing personal leadership capacities can use the *rhea.framework*. Main tasks of peers are writing experience descriptions - flows - on day-to-day work situations and to participate in moderated interpersonal reflection sessions - flow sessions-, if possible.

Moderator:
Moderators facilitate flow sessions. They are external to the group of peers (not related to group members in personal or organizational manner). They are professionally experienced in personal counseling, group dynamics and organizational development. Their main focus is to support group cohesion and interpersonal case-based reflection during flow sessions. Further, they keep track of flow session schedules.

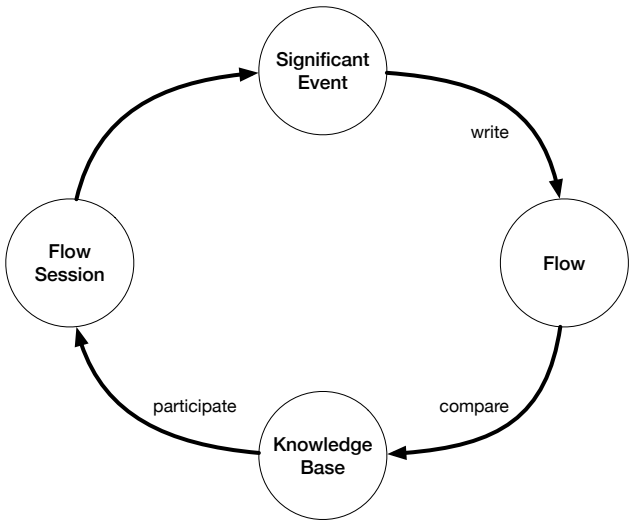


Figure 7.5 *rhea.framework* Activities

7.2.5 Activities

The *rhea.framework* aims to support (inter)personal reflection. Figure 7.5 shows continuous reflection process model activities. Figure 7.6 shows a UML view of the *rhea.framework* reflection process activities.

When a significant event occurs in day-to-day practice, a flow can be elaborated. Reflecting and working out flows can also be a scheduled daily routine. When a flow is elaborated, the knowledge base can be used to compare personal experiences with reference flows. Interactions can be labeled by normative leadership interaction and risk categories.

Optimally, personal reflection and flow elaboration is accompanied by interpersonal reflection sessions, or flow sessions. These moderated peer learning sessions may help clarify work situations and support experiential learning within the group of learners.

Typical framework usage may include the following stages:

A) A peer in team leadership encounters a significant event, an experience that is perceived to make a difference (see section 6.2.2.2.2, p. 139), such as, for example, a specific conflict among team members or a personally relieving conversation at work.

B) Using the flow template and taking into account suggestions for flow structuring in

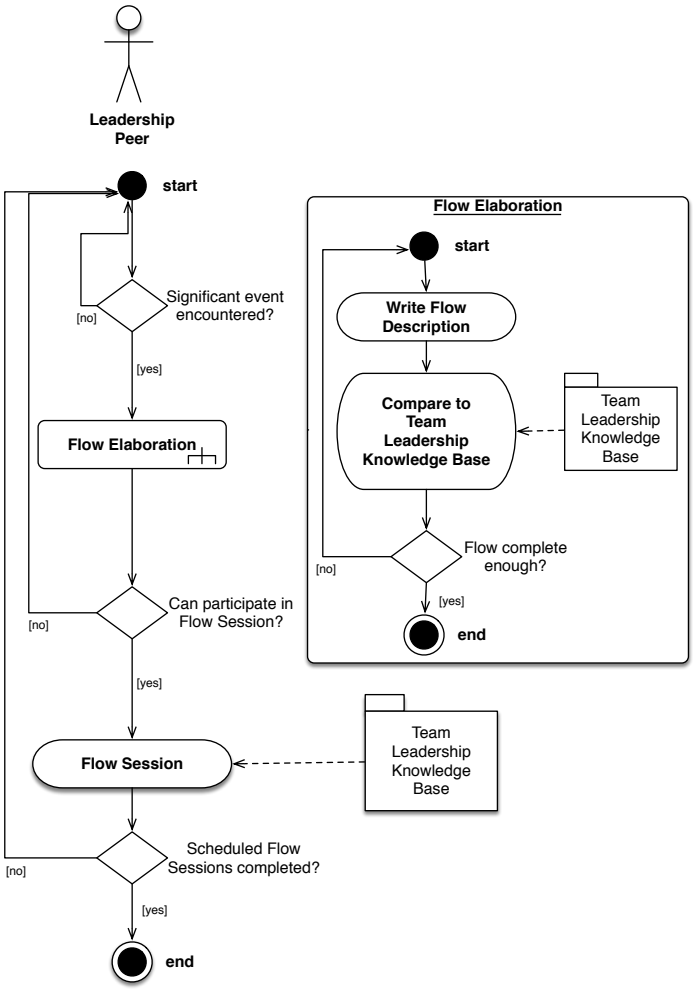


Figure 7.6 *rhea.framework* Activities - UML View (compare [269])

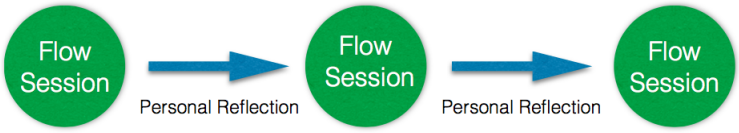


Figure 7.7 *rhea.framework* Reflection Process Model

the reflection guideline, a flow description is elaborated including context information, personal motivations and consequences of that situation.

C) The flow can be compared to the knowledge base, e. g. by comparing it to reference flows dealing with similar topics (starting by reading core flow descriptions) or interaction categories.

D) Other reference flows linked to those related to the personal experience description can be explored based on semantic relationships between knowledge base entities and categorizations.

E) Reference flows in the knowledge base can be compared to the personal situation. Are there other aspects to be considered that were not apparent before? What aspects of found reference flows do not fit the specific personal situation?

F) If it is possible to participate in a flow session, the personal written reflection (flow) can help to initially present the situation. The group of peers may support in uncovering qualities of the described situation - eventually promoting insight and flexibility in taking action.

A flow can be iterated, rewritten, and continuously refined and worked on in flow sessions.

7.3 Reflection Process Model

The ***rhea.framework*** **Reflection Process Model**, as outlined in figure 7.7, assists (inter)personal reflection processes. The model holds two modules. Reflection is supported by a semi-structured template - the ***rhea.framework*** **Reflection (Flow) Template (section 7.3.1, p. 233)**. The ***rhea.framework*** **Reflection Guideline (section 7.3.2, p. 236)** provides a de-

scription of the template structure and includes questions to support the personal reflection process.

Flow sessions provide opportunities for interpersonal reflection of work situations. They can accompany and enrich personal reflection processes. The **Flow Session Policy** (section 7.3.3, p. 239) describes the setting of flow sessions. The **Flow Session Procedure** (section 7.3.4, p. 241) holds an interpersonal reflection sequence that is particularly supportive in the opening meetings of an experiential leadership learning group.

Personal Reflection
• semi-structured Reflection (Flow) Template (section 7.3.1, p. 233) • faceted classification of significant personal experiences • reflection time slot in day to day (project) work
Flow Session
• semi-structured interpersonal reflection sequence • reflection in a group of like-minded peers • diverse learning group of team leaders (age, gender, experience, field) • independent of projects

7.3.1 Template

Title

Description (Intent, Context, Solution, Consequences)

Keywords

Picture

Ressources

Leadership Team Interaction Categories

Person-related	Person-related	Task-related	Change-related	Boundary spanning	Emergent Process Facilitation
Team Member Selection	Conflict Resolution	Planning and Scheduling	Continuous Learning	Buffering	Creating a Supportive Team Atmosphere
Team Norming	Consulting	Allocating Ressources	Sensing	Managing Interfaces	Enabling Team Processes
Team Structure Management	Coaching	Monitoring and Controlling	Vision	Representing	Interpersonal Facilitation
Role Modeling	Motivating				Co-Leadership
Communication	Mentoring				

Risk Categories

Structural	Orientation	Funding	Performance, Strategies, Goals, Schedules	Role Definitio n	Ressources and Technical Knowledge Acquisition	Complexities in Market, Organization and Tasks	Communic ation (Process)
Process	Motivation	Conflict in Roles, Team, Organization Politics	Team Atmosphere	Reassur ance	Interpersonal Relationships	Change	Leadership Experience

Unified Process Project Life-Cycle Phase

Inception	Elaboration	Construction	Transition

Related Flows

Related Flow	Relationship Type	Related Flow	Relationship Type

7.3.2 Reflection Guideline

In the *rhea.framework*, flows are written reflections on interpersonal interactions between a person holding a leadership function and one or more team members that impact team performance in a work context. Leadership is hereby seen as functional - supporting the performance of a team and the well-being of team members. It is not necessarily related to specific formal team roles.

Elemental to each flow is the description of a particular tense situation and interpersonal interactions to impact involved tensions. Significant interpersonal situations frequently (section 6.2.2.2.2, p. 139):

- appear to be mainly described by adjectives with emotional connotations.
- are frequently expressed in superlatives.
- appear to precede a shift in a situation. The situation is described to be perceived differently afterwards.
- appear to be repeated several times in the course of an interview.
- appear to form, shape or align to some sort of ideal - an ideal value, or an ideal self or situational imagination.
- seem to form mental representations for comparison with other personal experiences.

General Suggestions

Find a place where you can comfortably reflect and write - maybe in your office, on your couch at home, or in a café - whatever suits your needs and preferences best.
Actively schedule time to reflect on your work situation. Assembling a flow can take 30 minutes and more in the beginning, and less time, approximately 15 minutes, if you are more comfortable in your writing process.
Use the Flow Template and this guideline in a manner you find suitable. They are intended to provide helpful anchors in reflecting work situations, not to be rigidly followed.
Come back to your flows to refine, or change your descriptions whenever you consider worthwhile. Use the template to sketch out your insights.

7.3.2.1 Flow Template Facets

7.3.2.1.1 Title

The title of a flow.

A proper title may emerge only after a flow is described.

7.3.2.1.2 Description

A flow description may include the following aspects:

Intent: A significant interpersonal situation involving the project team with team members or associates in a leadership function impacting team performance. A focus is set on the personal perception of the situation as well as personal motivation for interaction in it as well as related feelings.

Context: Circumstances in which this particular situation of interpersonal tension emerges in the team and its environment (including e. g. interpersonal team atmosphere, team history, team size, project phase, company core values, organizational process structures, ...).

Tensions that are perceived to influence or establish the situation (may be listed).

(Intended) Solution: A leadership team interaction that (is intended to) impact(s) the tense situation.

Consequences (or Resulting Context): The (contingent) destinies of involved tensions risen through (intended) interaction.

Asking yourself questions such as the following may facilitate describing the situation [617, p. 138]:

How would this stakeholder perceive the situation?
What would that specific team member say about it?
In your view, how does colleague A perceive his/her relation to colleague B concerning the situation?
If the situation allows it and you feel comfortable with it, involved participants could be asked for feedback - in the group, one to one, or anonymously. Or, they could be asked to read through the Flow and comment on the description?

If you feel that the situation and involved tensions are sufficiently described, continue to outline consequences and (intended) solutions!

7.3.2.1.3 Keywords

3 to 5 expressive keywords may be added to a description to highlight flow key points.

7.3.2.1.4 Picture (optional)

An image may support recognizing the meaning of the interaction description.

An image could be a diagram that represents some relations or workflows, or a metaphoric representation (such as a drawing or a collage) of the issue. UML Activity diagrams [95] are recommended to depict relations and workflows.

7.3.2.1.5 Resources (optional)

Further reading, links to online tools contributing to the flow description.

7.3.2.1.6 Categories and Relationships

To relate a flow to reference flows in the *rhea.framework* team leadership knowledge base, it can be categorized. Relating flows may support linkability.

- **Interaction Type:** Heuristics for inclusion are presented in the normative taxonomy of leadership interaction (section 7.5.1, p. 281).
- **Risk(s):** Heuristics for inclusion can be found in the normative taxonomy of project risks (section 7.5.2, p. 281).
- **Unified Process Project Life-Cycle Phase:** Descriptions of Unified Process Life-Cycle Phases are presented in: [317] (section 5.2.5.2.3, p. 76).
- **Relations:** Related (reference) flows can be listed here (accompanied by a relationship label describing how flows are associated with each other).

7.3.3 Flow Session Policy

Flow Sessions support reflection and the development of team leadership capacities. Together with the *rhea.framework* Flow Template, flow sessions contribute to a continuous personal and peer reflection process.

While single flow sessions can be very worthwhile for addressing urgent situations, continuity of meetings combined with personal reflection between sessions allows for significant interpersonal learning. Personal qualities related to leading teams may only be tapped in a continuous interpersonal reflection process.

In a flow session, specific tense interpersonal situations from participants' work environment, henceforth called flows, are presented and collaboratively explored.

All flow session participants confirm confidentiality in the group.

7.3.3.1 Who participates?

5 to 8 persons interested in reflecting and developing their team leadership capacities.

Flow sessions can take place within project teams in an organization, or people from different teams within an organization can meet. Preferably, however, participants in flow sessions come from various organizations. For confidentiality reasons, people in a flow session group may come from organizations not competing with each other. Further, it may be preferable that people come from different work groups such that no two people enter as subgroups in the flow session group.

The group may be heterogenous in team leadership experience, age, gender, and organizational roles.

7.3.3.1.1 Participation Criteria

- Personal interest in reflecting and developing team leadership capacities in work contexts
- Interest in learning in a group of like-minded people, to learn from others' experiences
- Engagement and investing time in personal reflection on team leadership and group meetings

Concerns conflicting with participation:

- Focus on one particular tense urgent organizational or team situation, but apart from that no interest in or opportunity to invest time to contributing in a continuous (inter-)personal learning process; In this case, consulting and coaching provide ample helpful, superior options.
- Searching for a platform to promote solution frameworks; Other meeting formats, such as Un-Conferences and most kinds of business workshops, are superior options.
- No interest or no openness in sharing experiences in the flow session group due to company confidentiality rules or other reasons. Here, (continuous) one to one coaching or (informal) mentoring sessions are preferable. If a continuous exploration of personal qualities not necessarily limited to work contexts is aspired, other forms of support or self experience, such as professional psychotherapy, are recommended.

7.3.3.1.2 Session Moderator(s)

Session Moderators (1 or 2) may not come from the same professional background as the other participants, yet it could be supportive, if they have an overview of and, maybe even more crucial, an interest in the professional environments of participants.

Most importantly, session moderators have professional experience in personal counseling, group dynamics and organizational development.

They tend to not provide quick solutions, do not impose their personal solution building frameworks, but accompany learning group participants in reflecting presented situations.

Their main aim is to create a cohesive group atmosphere of interpersonal learning. They help establish group norms. They keep track of session schedules.

7.3.3.2 Where and When?

Flow sessions can be held in organizations. Preferably however, they are held in public institutions, such as Universities, that provide impartial ground for session participants. A benefit for Universities hereby is that senior students in project management or team work theory can participate in exchange with experts from practical work settings. Flow sessions offer vital connections between business research and actual business practice.

Institutions are responsible for selecting skillful flow session moderators with a professional focus on interpersonal dynamics. If flow sessions take place within a company, moderators external to the organization may be invited.

In the first flow session, meeting appointments are announced and agreed upon. A minimal flow session schedule encloses 6 monthly or bi-monthly meetings.

A typical flow session may last 180 Minutes (including 30 Minutes break). First, cases of participants are collected and prioritized collaborately. One or two cases may be selected for presentation, some others might be noted for presentation in the follow-up meeting. While the personal reflection template can be used to present an initial overview, it is recommended to recount from memory and to focus on sharing personally significant perceptions related to the presented situation.

7.3.4 Flow Session Procedure

The **Flow Session Procedure** is primarily based on the *open case* consultation method, as for example explained in [312]. In a flow session, participants present, work on, and cross-reference flows, specific tense interpersonal situations from participants' work environment.

During a session, participants can present or work on a personal flow, if they are motivated to do so and if the session schedule allows it. It is not mandatory for participants to present a flow each session, nor is it possible considering time constraints of flow sessions. Yet, participants may profit from flow session group members' perspectives on personal reflections.

All flow session participants confirm confidentiality in the group.

7.3.4.1 Flow Elaboration Guideline

It is particularly recommended to follow the steps of flow elaboration, as described here, in the beginning of flow session groups to guide through the session.

Roles in flow elaboration:

- Flow Provider
- Moderator
- Peers

7.3.4.1.1 Flow Elaboration Steps

1. The Flow Provider describes his/her flow, its intent, context, (intended) solution and consequences. He/She proposes 1-3 questions of interest. The Flow Provider may want to express his/her personal feelings about the situation, what moves them in it. The flow can be given a name or, if appropriate, a symbol/image/metaphor.
2. Peers reflect their understanding by trying to capture – in their own words – the essential meaning of what the Flow Provider has revealed. Peers may ask questions regarding what has been said. It is essential that Peers stay with the Flow Provider and try to understand his/her message. (e.g. You said you felt stressed, so do you still feel stressed now?)
3. Peers may ask whatever is of interest to them in the context of the described situation? (e.g. Did you already talk to the department head?)
4. All participants try to identify and clarify tensions at work in the given situation. Tensions could be drawn in a diagram (figure 7.8) - e. g. by indicating polarized aspects of tensions.
5. The Flow Provider reflects his/her feelings and meanings about the situation. In particular he/she identifies any significant, highly important events related to it, others listen actively.
6. Change of perspective - Peers take on the perspective of the Flow Provider and potentially other functions that are central in the described situation. They share

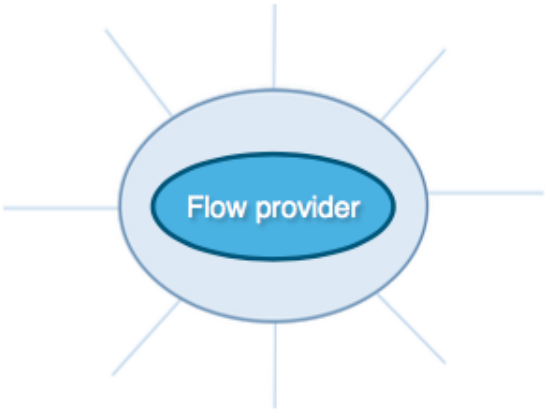


Figure 7.8 Flow Elaboration Tensions Diagram

feelings and views of the situation and its context. Peers suggest various options that might be helpful to consider in the situation. The Flow Provider gives feedback.

7. Reflection of Flow Provider - The Flow Provider explores the contributions of Peers' perspectives and reflects in how far anything/any person in the flow session contributed to moving the understanding of the situation forward. The Flow Provider explores what it is that he/she most wishes (or fears) to happen.

8. Reflection in flow session group - The flow session group reflects upon their process, insights (and potential solution strategies) on the situation.

7.4 Team Leadership Knowledge Base

The team leadership knowledge base comprises an interrelated collection of reference experience descriptions concerning interpersonal leadership team interactions, or reference flows, that can

- support team performance,
- serve as anchors in personal reflection and learning processes,
- be arranged along the Unified Process.

The ontology (or domain description) was initiated with 78 reference experience descriptions, primarily organizational patterns, that were collected in a systematic literature review [266].

Experience descriptions were connected based on relationships between description keywords [310].

Using community detection and document similarity clusterings, groups of experience descriptions could be discerned in a *blended reading* elaboration process [581], (see section 6.5, p. 165). Four areas could be identified forming core flows (or essential topics) in (project) team process leadership. These

- constitute a dynamic core topic of team leadership in complex work environments, such as ICT projects, supporting team performance,
- are highly related and interlinked to each other,
- can be used as anchors for reflecting day-to-day practice,
- are linkable to other team leadership experience descriptions, and thus may be further differentiated, completed or re-organized.

The core flows are:

- Prototype Team Identity (Who are *"we"* and what is *"our purpose"*?)
- Organize for Complexity (What capabilities help us achieve our goals in our current environment?)
- Facilitate Team Cohesion (How are we going about this with each other?)
- Arrange for Task Effectiveness (What technical tools and engineering strategies help us achieve our goals?)

In figure 7.9, core flows are shown as rounded nodes and relationships as directed, labeled arrows.

Core flow descriptions are designed using the ***rhea.framework*** **Flow Template (section 7.3.1, p. 233)**.

The form of the *rhea.framework* Flow Template is inspired by pattern descriptions [146], [13]. An evocative title is followed by a detailed experience description, including

- Intent: an account of a tense interpersonal situation,
- Context: the environment, in which the tense situation unfolds,
- (Intended) Solution(s): interactions or interaction strategies to balance tensions, and

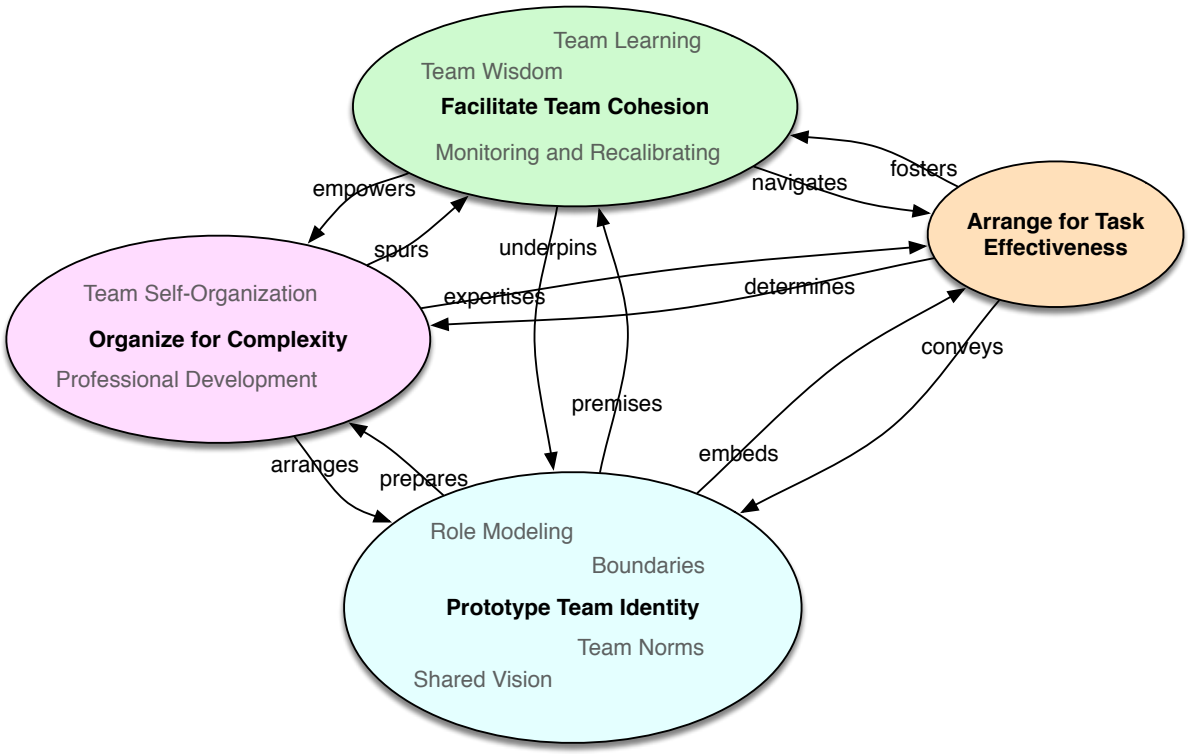


Figure 7.9 Interrelated Core Flows

- Consequences: illustrating the fates of tensions.

3 to 5 keywords are added to the description that highlight the most important aspects of the experience. An image, such as a symbolic metaphor, a tag cloud or a(n) (collection of) activity diagrams, can be attached to a flow. Further, resources such as related literature or support tools can be listed. The experience description can be categorized concerning leadership interaction type, (project) risk, and Unified Process project life-cycle phases.

Each reference flow within the knowledge base is related to one core flow.

The ontology of reference flows presented in this knowledge base is best used as a learning resource to compare personal experiences with the leadership knowledge of others and associated scientific research in an ongoing (inter)personal reflection process.

Reference flows are related to core flows in a *"partOf"* relationship. Thus, knowledge base exploration may best be started by delving into core flow descriptions and following up on linked reference flows.

Reference flows include intent descriptions as well as context and (intended or actual) solution descriptions including an elaboration of effects of interactions within the team.

Reference flows are categorized based on observable leadership team interaction behavior (e. g. conflict resolution, enabling team processes, role modeling) or risks (e. g. change, orientation) and aligned to life-cycle phases of the Unified Process.

Hackman [253] considers coaching and process assistance, along with a shared vision, an enabling work environment or transparent organization, as key factors to team performance. Table 7.1 arranges conditions for team performance to core flows.

Team Condition	**Core Flow**
Real Team	Prototype Team Identity, Facilitate Team Cohesion
Compelling Direction	Prototype Team Identity
Enabling Structure	Organize for Complexity, Arrange for Task Effectiveness
Expert Coaching	Organize for Complexity
Supportive Organizational Context	Organize for Complexity, Facilitate Team Cohesion

Table 7.1 Team Conditions [253] and Core Flows

A team structure promoting team performance in this reference model might be defined in terms of dynamic interpersonal processes.

The *right* time for a particular leadership intervention is of high importance to support team performance [619]. To learn about possible and adequate leadership team interactions

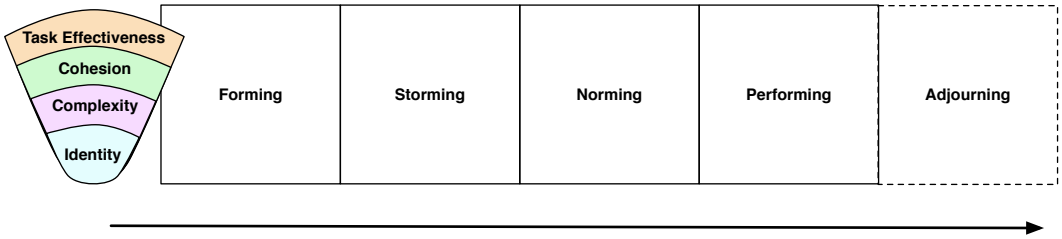


Figure 7.10 Core Flows and Group Development [602]

in ever-specific situations, reference flows in this knowledge base are preferably studied considering their centrality, a construct borrowed from graph theory, rather than in terms of objective time to put them to practice. Central nodes in a graph are strongly connected to many other nodes [216], [92], [97], [447]. Similarly, central reference flows are highly interrelated or pivotal to others.

The organization of the knowledge base as a dynamic network of interrelated reference flows with varying degrees of centrality correlates with Alexanders' [11] consideration of design patterns as centers in a problem space: *"I use the word center to identify an organized zone of space – that is to say, a distinct set of points in space, which, because of its organization, because of its internal coherence, and because of its relation to its context, exhibits centeredness, forms a local zone of relative centeredness with respect to the other parts in space [11, p. 84]."*

Core flows are interdependent. The interdependence of core flows can be addressed from global workspace theory [33]. This cognitive architectural model describes processes in the *"spotlight"* of conscious fleeting memory (which is associated with decision-making and action taking) to be determined by *"behind the scenes"* unconscious, contextual, organizing cognitive-emotional processes.

In reference to Tuckman's stages of group development [602], necessary and inevitable for team members including persons with leadership functions, core flows may be described as orthogonal reflection cornerstones with varying degrees of centrality at each stage of group development. Figure 7.10 shows core flows' orthogonal disposition to group development stages.

The Unified Process is a viable model for technical and strategic project organization. It can be completed with the interrelated, interdependent core flows of the *rhea.framework* team leadership knowledge base covering people issues in complex work environments. Due to the

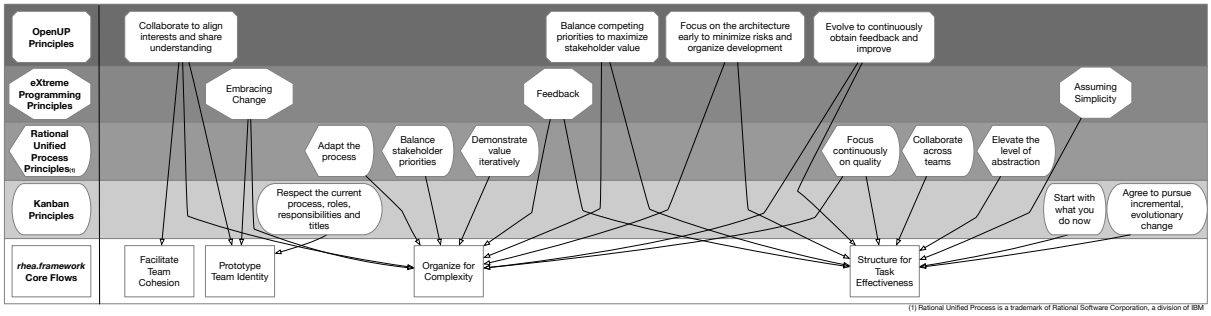


Figure 7.11 Software Development Methodology Interfaces to Core Flows

iterative, interrelated characteristics of the Unified Process, core flows can be hypothetically aligned to Unified Process life-cycle phases [317] (section 5.2.5.2.3, p. 76).

Moreover, the core flows were contrasted to key principles of development processes as outlined in the Open Unified Process, eXtreme Programming, the Rational Unified Process and Kanban. Attributions of development principles to core flows are shown in figure 7.11. While many principles deal with organizing team and task work, hardly any principles could directly be matched to the core flows *Facilitate Team Cohesion* and *Prototype Team Identity*. These core flows appear to be unique extensions to software development methodologies in regard to team leadership.

In the following, the core flows of the *rhea.framework* team leadership knowledge base are described in detail including collections of related reference flows.

7.4.1 Prototype Team Identity (or: Participate in the Team)

The core flow **Prototype Team Identity (or: Participate in the Team)** deals with how individuals of diverse backgrounds working together feel being valuable participants of a team.

Leadership and social identity - a shared sense of *"us"* - go side by side. Leadership effectiveness is related to leaders' ability to represent and advance the social identity of a group. Effective leaders transform by embodying the group they influence. *"To be a leader, one must be seen to speak not of 'me' (nor of 'them'), but for the very essence of 'us' [272, p. 108]"*. Leadership can be seen as a group process in which persons that prototype the team are influential to team and work processes. Haslam et al. [272] present the following four

key rules for effective leadership where people have a shared sense of social identity.

"Rule 1: Leaders need to be in-group prototypes. The more representative an individual is seen to be of a given social identity - the more he or she is clearly 'one of us' - the more influential he or she will be within the group and the more willing other group members will be to follow his or her direction. . . .

Rule 2: Leaders need to be in-group champions. In order to take followers with them, leaders must be seen to be working for the group to be 'doing it for us' - rather than to be 'in it' for themselves or for another group ('them'). In other words, leaders must advance the collective interest as group members see it. . . .

Rule 3: Leaders need to be entrepreneurs of identity. Leaders don´t just wait around until they and their policies come to be recognized as prototypical of the group. Rather, they work hard to construct identity in order to ensure that they and their policies are influential. . . .

Rule 4: Leaders need to be embedders of identity. It isn´t enough for a leader simply to construct a plausible version of identity. As well as this, the sense of who we are and how we believe the world should be organized that is associated with a particular sense of social identity needs to be translated into social reality [272, p. 75]."

In work teams, people of different backgrounds, with various occupations and expertise, with distinct values and aspirations are joining together to support organizations' longevity in generating value. Every team participant should hold some private information, even if it is a personal interpretation of known facts. In teams, cognitive diversity often needs to be actively selected.

Team members need to work together as a group, and want to feel a sense of belonging to with other team members to some extent. Social identity matters to team members for it tells who they are (within the organization and outside of it), how they relate to others, who they can and can't rely on, what is important in their environment and how to (inter)act with(in) it [272, p. 64].

Team cohesion and cooperation are emergent results of social identity. Trust and reciprocal respect are associated with social identity. The more meaningful a team is to a person, the more personal attraction to working with others within the team is expressed [272, p. 58]. *"Mutual social influence leads people to agree on what is important and to strive for the same*

goals. As a result, their efforts, rather than pulling in different directions and canceling each other out, become aligned and additive. What is more, people then are able to coordinate their activities and to support each other. In addition, they can expect support from each other and this gives them the confidence to act in the knowledge that others are behind them and will back them up . . . [272, p. 59/60]." Social identity allows team members to be effective - as representatives of a group that makes a difference, in the form of products, or services or other results.

A team needs to form that is sufficiently differentiated from other teams or work streams of an organization it is situated in. Yet, effective contact with its environment - including stakeholders from within and outside the organization - is pivotal. This includes that team members find a *"proper"* or satisfying place within the team, and get support in achieving their personal aspirations in the context of their work setting. The word team is frequently defined as a work group striving towards goals. In fact, it is necessary to share a vision of the services or products - a desired future - that team members work on together, and also, of how they want to or can work together. *"Vision is only useful if it allows us to see and then create a better future [272, p. 72]."* Successful decision-making demands not just a view of the world as it is, but of the world as it will or could be [583, p. 11]. Social identity determines how participants collaborate and on what they collaborate on [272, p. 143].

Independent of behavior or process, leaders' actions and vision need to promote group interests as specified by the group's norms and values [272, p. 132/133]. Team norms and communication channels appropriate to the organizational environment are set up and paid close attention to. Concurrently, boundaries are established to differentiate team membership and allow for effective work processes. Goals and team values are proposed as expressions of shared values, beliefs and priorities [272, p. 163].

Team leaders may turn to the group and its social context rather than relying on decontextualized knowledge and principles. They embody team norms and values. They represent their team's vision, values and interests [272, p. 209]. Being perceived as trustworthy, fair and charismatic is a consequence of in-group prototypicality.

To prototype team identity, team members actively listen to co-workers to understand their needs, values, beliefs, priorities, aspirations. They assist in establishing norms and conventions that regulate working together within the team, particularly by authentic role-modeling. *"Conventions obviously maintain order and stability. Just as important, though, they reduce the amount of cognitive work you have to put in to get through the day [583, p. 93]."* Team leaders champion team ideas - such as the idea of collective wisdom and

decision-making - and foster a team atmosphere that enables those [583, p. 281].

Leaders perceived as prototypical of the team can mobilize team members in new directions in line with shared goals [272, p. 107]. They engage in delivering (and being perceived as delivering) what really matters to the team [272, p. 205].

7.4.1.1 Core Flow Case Vignettes

- Team members' (psychological) health is essential to team performance. Long work hours are not necessarily related to increase of performance in the long term [260]. Team leaders may leave the office on time for they influence by prototyping.
- In an interview on significant events in a successful project, a project manager explains that he believes that it was very important for team performance to hold up a - as he dubbed it - *"Captain Kirk"* attitude. This attitude means *"whatever may come along our way, we will get through it"*.
- Another interviewee says that he created a logo and t-shirts with the logo on it for his team members.
- One project manager highlights that fun was esteemed in her team. In one report to higher management they included an *"easter egg"* on one slide - a joke in very small font, barely readable, that only people from the team could understand, because it was written in a particular language team members developed while working together.
- The Macintosh division at Apple in 1983 hung up a pirate flag in their building to differentiate from the rest of the company.
- Maslow [405] reflects on his experiences with Blackfoot members: *"... the leader had absolutely no power whatsoever that wasn´t deliberately and voluntarily given to him ad hoc by the particular people in the particular situation. That is to say, he didn´t really influence anyone or order anyone about. There was a kind of mutual give and take between the group and the chosen leader because generally the chosen leader considered himself quite objectively to be the best one for the job and the group considered him to be the best one for the job. ... the group tends to be grateful to the leader rather than resentful of him. That is, it is as if they recognized that they have placed a burden of responsibility upon his shoulders because he happens to be the one best fitted to do the job [405, p. 124]."*

7.4.1.2 Central Reference Flows

Reference flows (or organizational patterns, best practices) central to the core flow **Prototype Team Identity** are for example:

- *"Pair to Share"* [151]
- *"Phasing it in"* [146]
- *"Face to Face before Remote "* [146]

A more extensive list of related reference flows concludes the core flow description.

7.4.1.3 Complementary Best Practices

Complementing inspirational best practices (not yet included in the knowledge base):

- Fried and Hansson [260]: *"Go to sleep"*, *"Workaholism"*, *"Embrace constraints"*, *"Don't be a hero"*, *"You don´t create a culture"*, *"Send people home at 5"*, *"Sound like you"*.
- iCom Team [312]: *"Knowledge grows from sharing"*, *"Hold constructs flexibly"*, *"Communication matters, cultivate it"* and *"Meeting at eye level opens doors"*.

This core flow is related to leadership practices *"Model the way"* and *"Inspire a shared vision"* as described by Kouzes and Posner [357]. It is associated with the following enabling team conditions described by Hackman [253]: *"A Real Team"*, *"Compelling Direction"*.

7.4.1.4 Keywords

practices, group members, team members, prototype team identity, social identity, team values, leadership, related, identity, leaders, team performance, shared sense

7.4.1.5 Pictures

A metaphoric representation of the core flow is shown in figure 7.12.

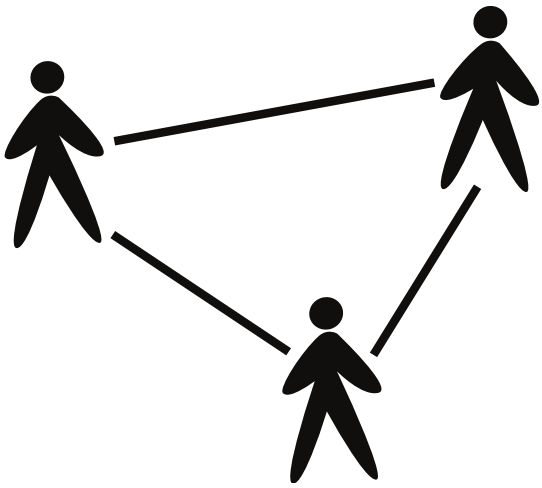


Figure 7.12 Prototype Team Identity

7.4.1.6 Resources

Haslam, S. A., Reicher, S. D., and Platow, M. J. (2011). The New Psychology of Leadership. Psychology Press.

Motschnig, R., and Ryback, D. (2016). Transforming Communication in Leadership and Teamwork : Person-Centered Innovations. Cham: Springer International Publishing.

7.4.1.7 Leadership Team Interaction Categories

Reference flows related to this core flow were categorized to a normative leadership interaction taxonomy elaborated in a systematic literature review (section 6.2, p. 123, and section 7.5.1, p. 281) via crowd-sourcing (section 6.5.4.3, p. 191).

Figure 7.13 depicts counts of crowd-sourced leadership interaction taxonomy categorizations of reference flows related to this core flow. See section 7.6.1.2.3, p. 291, for a description of the count retrieval method.

Most prominent category labels in this core flow are *"Creating a supportive Team Atmosphere"* and *"Team Member Selection"*.

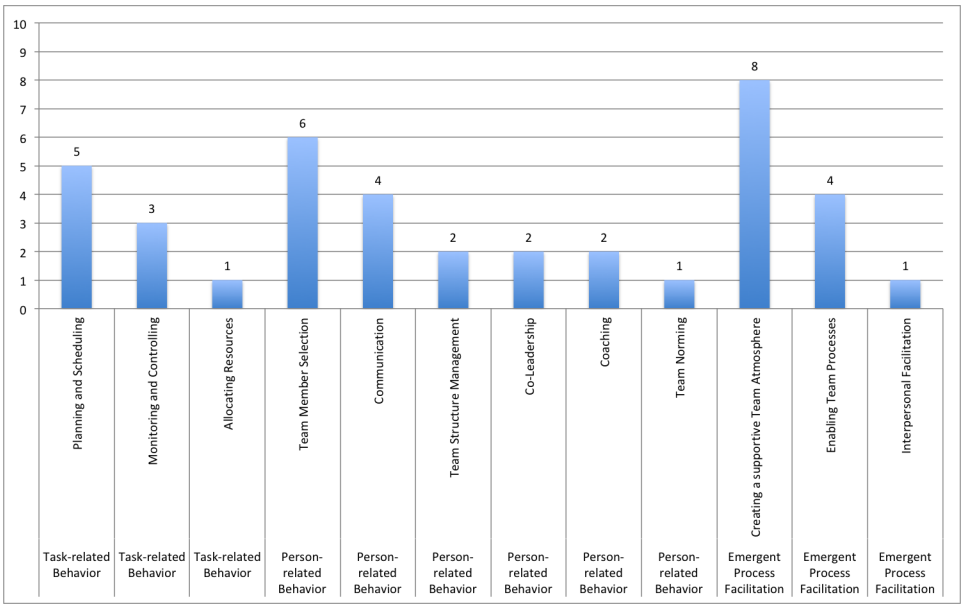


Figure 7.13 Prototype Team Identity - Leadership Team Interaction Category Count

7.4.1.8 Risk Categories

Figure 7.14 depicts counts of crowd-sourced (project) risk taxonomy (section 7.5.2, p. 281), categorizations of reference flows (see section 6.5.4.3, p. 191), related to the core flow. See section 7.6.1.2.3, p. 291, for a description of the count retrieval method.

Major risks addressed in this core flow appear to be *"Role Definition"* and *"Communication"* issues.

7.4.1.9 Unified Process Project Life-Cycle Phases

Figure 7.15 depicts counts of crowd-sourced Unified Process project life-cycle phase categorizations of flows (see section 6.5.4.3, p. 191) related to the core flow. See section 7.6.1.2.3, p. 291, for a description of the count retrieval method.

The core flow appears to be particularly central in the beginning of a new endeavor when team member are not yet familiar with each other and the situation.

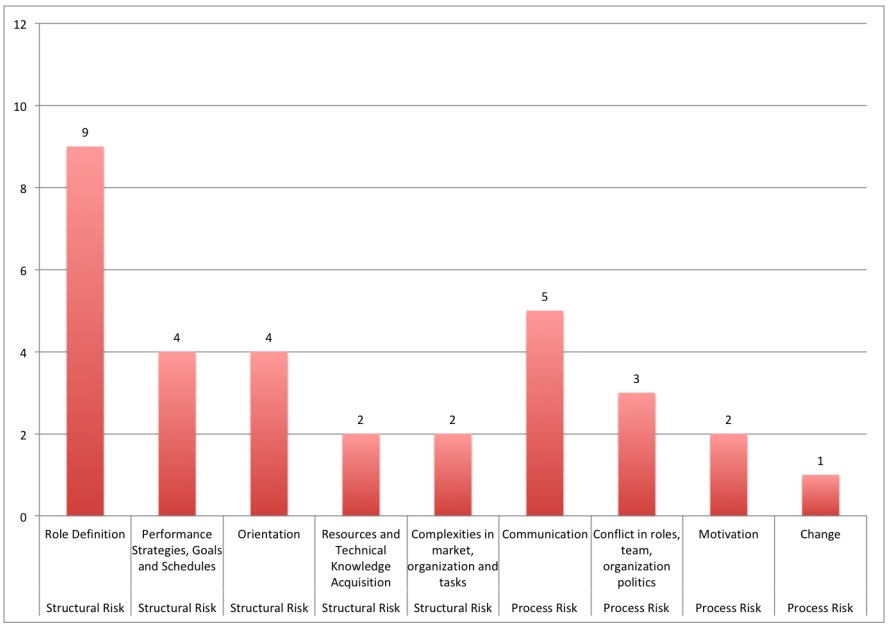


Figure 7.14 Prototype Team Identity - (Project) Risk Category Count

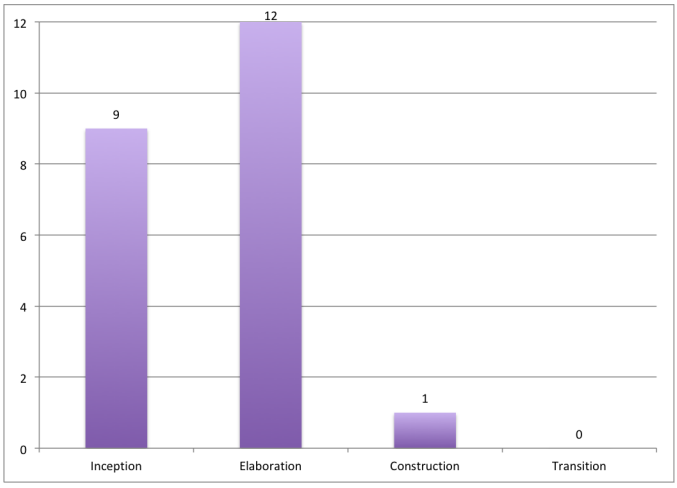


Figure 7.15 Prototype Team Identity - Unified Process Project Life-Cycle Phase Count

7.4.1.10 Related Reference Flows

Table 7.2 lists reference flows related to the core flow by centrality. See sections 6.5.4.2, p. 188, as well as 7.6.1.2.3, p. 291, for an explanation of the centrality calculation. Find short descriptions and references to listed reference flows in Appendix D, p. 369.

Reference Flow	Centrality Score (rounded)
Pair to share	0,77
Phasing it in	0,66
Face to face before remote	0,64
Norms of conduct	0,63
Firewalls	0,63
Shared clear vision	0,62
Apprentice	0,56
Bootstrapping	0,52
Stand up meeting	0,51
Architecture team	0,51
Community of trust	0,51
Productivity games	0,49
Failed project wake	0,46
Round pegs for round holes	0,46
Day care	0,45
Unity of purpose	0,45
Vision	0,43
Set the pegs	0,42
Delegate complexity	0,41
Smoke filled room	0,41
Virtual shared location	0,36
Get to know your peoples skills	0,06

Table 7.2 Prototype Team Identity - Related Reference Flows (listed by normalized centrality)

7.4.2 Organize for Complexity (or: Take Action)

The core flow **Organize for Complexity (or: Take Action)** outlines challenges and opportunities for team leadership in complex, rapidly changing work environments, such as ICT projects. The main intent is to find ways to deal with - or rather welcome and deploy - complexity in business or work requirements, (organizational) resources, stakeholder involvement and interpersonal team processes. This includes team opportunities such as remote team members or virtual teams.

Explicit or tacit organizational values and norms, organizational culture, that influence the team as well as values developed within the team add up to team process complexity. *"... the successful leader needs to be encultured and to employ culture... [272, p. 177]."* The constraints of business cases affect team leadership complexity.

Project management or software development process descriptions can be identified as agreed upon strategies or meaning attractors to handle project or task complexity (see section 5.2.1, p. 57).

This core flow interfaces with industry-standard project management processes. The Project Management Body Of Knowledge (PMBOK) [485], PRojects IN Controlled Environments 2 (PRINCE2) [290], as well as the project management workflow in the Rational Unified Process (RUP) [367] are standard, well-documented project management process descriptions widely implemented. Table 7.3 lists areas elaborated in these project management processes that specifically interface to the core flow.

Project Management Process Description	**Interfacing Process Areas**
PMBOK	Planning Process Group, Monitoring and Controlling Process Group
PMBOK	Project Human Resource Management, Project Communications Management, Project Stakeholder Management
PRINCE2	Directing a Project, Controlling a Stage
RUP	Project Management Workflow
RUP	Business case modeling, as presented in the Unified Process, is a design activity to organize for complexity by elaborating use cases of systems in business contexts and thus represents a precursor of necessities and opportunities for team performance

Table 7.3 Interfacing Project Management Process Areas

A context-appropriate balance between reductive organization and situational complexity is continually (re)established in order to effectively take action. In the ICT field, for example, many factors need to be considered to choose between rather plan-oriented management approaches (originating in engineering practice with less rapid technological change and large-scale working conditions) or people-oriented management approaches (originating in software development practice with rapidly changing technology and small-scale working conditions).

Change processes - in requirements, technology, the organization or the team - go with uncertainty. Change or phase transition in systems theory - the transition from a specific

organization of a system to another - frequently coincides with unstable sub-processes (while most aspects of the system stay stable and functional). The expression *"Die and become."* is a poetic approximation to phase transition processes [365, p. 55].

In highly complex work environments, such as ICT projects, change is a steady companion. Work teams are regularly challenged to reorganize and rebalance - or actualize - e. g. work processes, interpersonal work settings, tool use, communication channels with clients and stakeholders, interfaces with other parts of the organization, or team norms and personal values to encounter yet unfamiliar work circumstances. Effective organization in a complex, changing environment can't be prefabricated and imposed, but develops including aspects of security as well as creativity [364].

Supporting self-organizing capacity can help to adapt to complexity flexibly. Actualization of self-organized order can be illustrated as a dialectic process. Meaning represented in labels and categorizations is supplemented with experiential richness - novel interpretations or perspectives (on the edge of awareness) - revealing situations of choice to reorganize dynamic order. In a team, personal reflection and sharing experiences in reciprocal inquiry or dialogue can contribute to flexibly adapting to complex circumstances. People can draw on local knowledge and are able to specialize. Professional development of individuals within the team is appreciated and supported.

Promoting diversity may be highly important in small groups to support decision-making processes [88].

Conformity pressures (no team member says anything or drops in on perceptions of others) and group think (team members frequently interact with one another and influence one another so that critical thinking of individuals holds a potential for conflict within the team) can block gathering valuable experiences and insights to organize for task completion. New team members are usually less familiar with team tasks, but the team can gain from their diversity. *"Adding a few people who know less, but have different skills, actually improves the group's performance (Surowiecki 2005, p. 30)."*

Self-organization of (parts of) a team goes along decentralization in decision-making. *"If small groups are included in the decision-making process, then they should be allowed to make decisions [583, p. 190]."* Individuals are encouraged to take responsibility within their work environment. Team members are supported in finding creative, efficient ways to get tasks done. If team members are in charge of their work, this can increase team performance [583, p. 213].

"... decisions about local problems should be made, as much as possible, by people close to the problem. ... people with local knowledge are often best positioned to come up with a workable and efficient solution. The virtues of specialization and local knowledge often outweigh managerial expertise in decision-making [583, p. 212]." Bubbles (where a particular team direction is kept without critical reflection within the team) and crashes (where independence, diversity and private judgment are not held or not present in the team while persons in leadership function are convinced of a disruption without critical reflection including diverse perspectives of team members) can eventually be coped with by advocating independence, diversity and private judgement of team members.

Persons with leadership function within a team assist and facilitate dealing with changing circumstances by supporting team members in their own abilities to encounter change. Team leaders that are perceived by team members and stakeholders to authentically self-disclose appropriate to the specific context and to be aware of and responding to team members' and stakeholders' needs for safety, respect, acknowledgement, growth and striving in themselves and others - enable a work environment of team self-organization.

Facilitative team leaders listen to team members and stakeholders (in a way those feel empathically understood). They can say *"No."* or follow depending on the particular circumstances of the situation.

To encounter complex situational requirements, team leaders promote context-appropriate solutions within and by the team.

For example, virtual teams can be employed to implement specific artifacts. Team leaders may suggest co-location of team members within reach of each other - including the consideration of seating arrangements that support collaboration and private work. Team members from all over the world may be considered to find the best for a job to get done.

Emergent, creative processes within a team can unfold in dialogical interaction between team members [455]. *"Practice fields" [543, p. 240]*, *"play spaces" [364]* or *"significant learning communities" [440]* can provide for an atmosphere where it is safe to risk exploring new ideas. In such practice fields, participants hold a tendency of learning from mistakes. Creative ideas can be followed in such learning environments [583, p. 28].

7.4.2.1 Core Flow Case Vignettes

- A project manager describes in an interview that he didn't like the long distances for

his team members that worked together on a project to get from point A to point B in a very large company building. He mentioned having to *"visit many islands"*. So in a follow-up project, he was committed to co-locate people working together in a software development team.

- Another manager states that for him it is necessary to develop a basic rhythm during a project. In projects, unexpected things can happen. So it is necessary to follow a basic rhythm that can be trusted. Meetings can be beats of such a rhythm.
- A professor at a University, and director of a large organization, notes that for him it is necessary to keep being aware of different team directions and to value diverse contributions of team members.
- One project manager highlights that in decentralized teams he finds it tremendously valuable to have shared moments with each other - to go for a coffee once in a while or to have dinner together.
- A manager of a large project expresses gratitude for having a colleague to co-lead the project team with her. For her it is very satisfying that they can discuss tough decisions and complement each others' skills.

7.4.2.2 Central Reference Flows

Central reference flows of **Organize for Complexity** are for example:

- *"Master and Apprentice"* [142]
- *"Form follows function"* [146]
- *"Deploy along the Grain"* [146]

A more extensive list of related reference flows concludes the core flow description.

7.4.2.3 Complementary Best Practices

Complementary best practices (not yet included in the knowledge base):

- Fried and Hansson [260]: *"Throw less at the problem"*, *"Focus on what won´t change"*, *"Say no by default"*, *"Put everyone on the front lines"*, *"Nobody likes plastic flowers"*, *"The best are everywhere"*

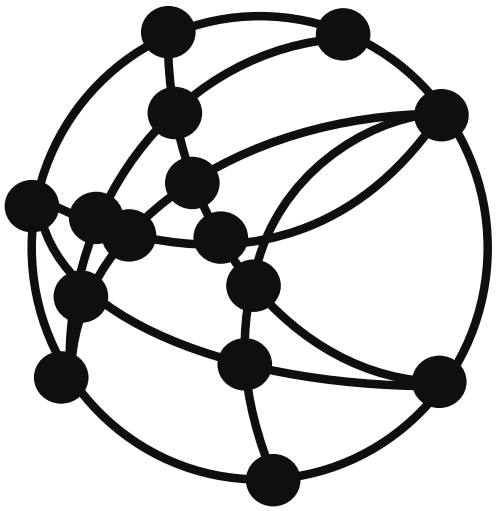


Figure 7.16 Organize for Complexity

- iCom Team [312]: *"Connect the dots"*

This core flow is linked to leadership practice *"Challenge the process"* in Kouzes and Posner [357]. It can be related to subsequent enabling team condition described by Hackman [253]: *"Enabling Structure"*.

7.4.2.4 Keywords

team members, systems theory, private judgement, scale working conditions, leadership function, small groups, team leaders, local knowledge, project management workflow, virtual teams

7.4.2.5 Pictures

A metaphoric representation of the core flow is shown in figure 7.16.

7.4.2.6 Resources

Rogers, C. R. (1978). On Personal Power - Inner Strength and its revolutionary Impact. Constable and Robinson Publishing.

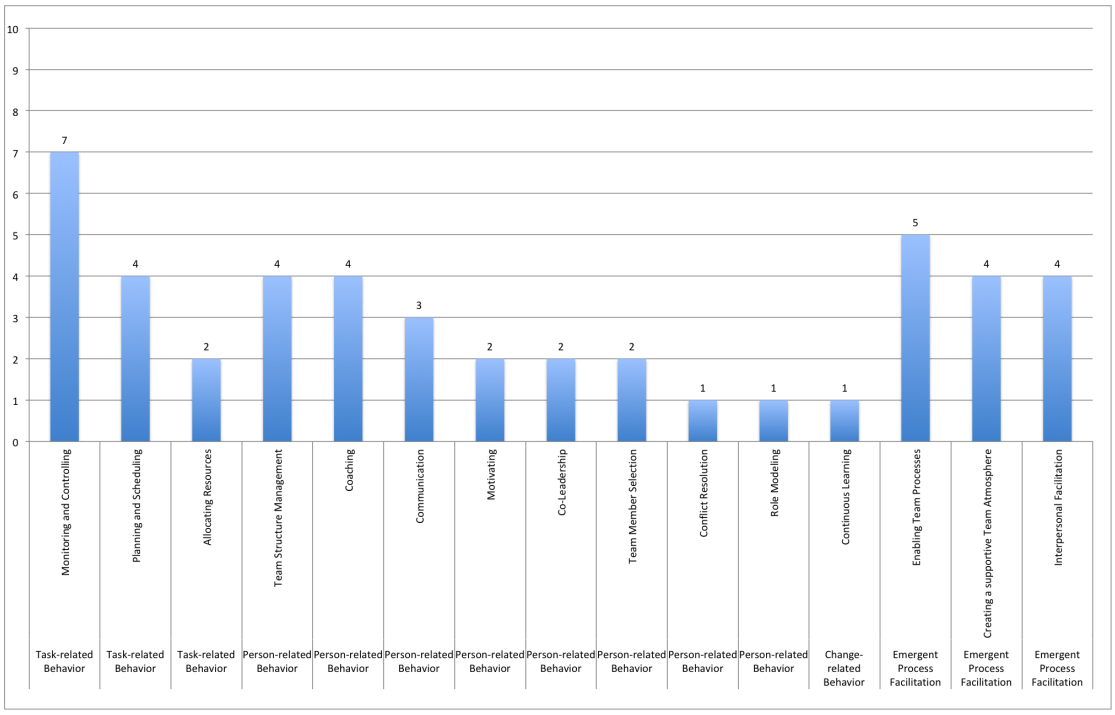


Figure 7.17 Organize for Complexity - Leadership Team Interaction Category Count

Curlee, W., and Gordon, R. L. (2010). Complexity Theory and Project Management. Hoboken, NJ, USA: John Wiley and Sons, Inc. http://doi.org/10.1002/9780470949986

7.4.2.7 Leadership Team Interaction Categories

Figure 7.17 depicts counts of crowd-sourced categorizations of reference flows related to the core flow (see section 6.5.4.3, p. 191) to a normative leadership interaction taxonomy elaborated in a systematic literature review (section 6.2, p. 123, and section 7.5.1, p. 281). See section 7.6.1.2.3, p. 291, for a description of the count retrieval method.

"Monitoring and Controlling" and *"Enabling Team Processes"* appear to be key leadership interaction areas in the context of this core flow.

7.4.2.8 Risk Categories

Figure 7.18 depicts counts of crowd-sourced (project) risk taxonomy (section 7.5.2, p. 281) categorizations of reference flows (see section 6.5.4.3, p. 191) related to the core flow. See

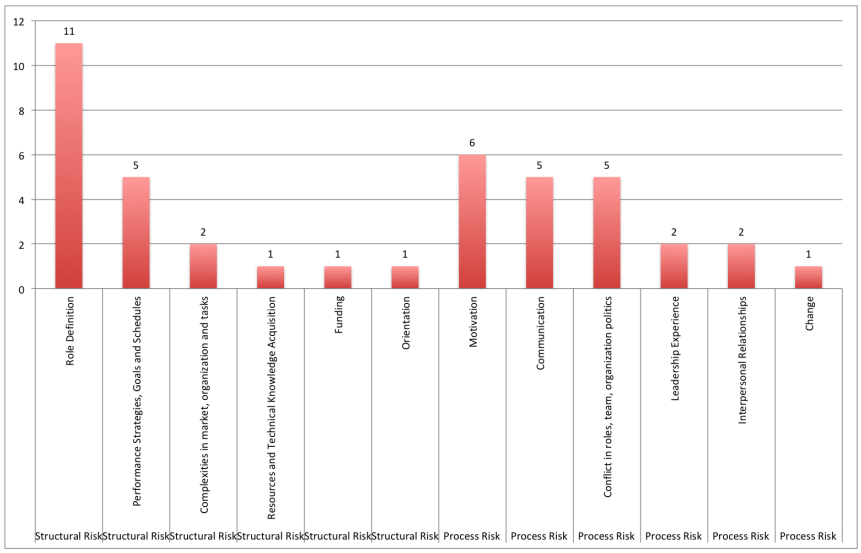


Figure 7.18 Organize for Complexity - (Project) Risk Category Count

section 7.6.1.2.3, p. 291, for a description of the count retrieval method.

Risks approached in this core flow include *"Role Definition"* and team member *"Motivation"*.

7.4.2.9 Unified Process Project Life-Cycle Phases

Figure 7.19 depicts counts of crowd-sourced Unified Process project life-cycle phase categorizations of reference flows (see section 6.5.4.3, p. 191) related to the core flow. See section 7.6.1.2.3, p. 291, for a description of the count retrieval method.

Core flow centrality increases when the team needs to find ways in working together to accomplish tasks throughout the project. Particularly in early iterations, team members need to find out how to handle situations in the problem domain together.

7.4.2.10 Related Reference Flows

Table 7.7 lists reference flows related to the core flow by centrality. See section 6.5.4.2, p. 188, as well as 7.6.1.2.3, p. 291, for an explanation of the centrality calculation. Find short descriptions and references to listed reference flows in Appendix D, p. 369.

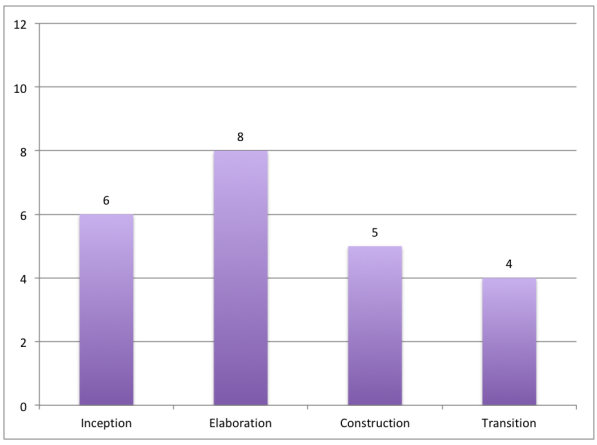


Figure 7.19 Prototype Team Identity - Unified Process Project Life-Cycle Phase Count

Reference Flow	**Centrality Score (rounded)**
Master and apprentice	0,98
Sacrifice one person	0,81
Form follows function	0,75
Deploy along the grain	0,73
Someone always makes progress	0,71
Forge the team	0,7
Diverse groups	0,63
Management by triggers	0,6
Wanderer	0,57
Developing in pairs	0,56
Re-negotiate complexity	0,47
Collective responsibility	0,47
Team space	0,45
Reciprocal visibility	0,44
Join for completion	0,37
Train everyone	0,35
Generics and specifics	0,34
Growing your team	0,32
Open up communication	0,28
Private space	0,24
Effective coach	0,2
Deliverables to go	0,05
Participant observation	0

Table 7.4 Organize for Complexity - Related Reference Flows (listed by normalized centrality)

7.4.3 Facilitate Team Cohesion (or: Balance and Suspend)

The core flow **Facilitate Team Cohesion (or: Balance and Suspend)** is about working together towards shared goals. In a cohesive team, the team satisfies emotional needs of its members. Team members work together complementarily - collaboratively - rather than individually.

Team cohesion is a dynamic, multifaceted, interpersonal process. Focusing on interpersonal process in a team means focusing on interpersonal relationships of team participants [637, p. 176].

People may consider themselves part of the team, but are not communicating with other participants (sufficiently). They may go their own directions presuming it is the team direction, not championing a team vision. Some person(s) block(s) team processes due to personal reasons or due to reasons related to team dynamics or organizational politics. Members may be excluded from communication for they challenge the status quo. Perhaps team wisdom, a diversity in perspectives and relationships that supports decision-making to bring the team forward in their tasks, can not unfold. Formal and informal leaders may compete against each other - tearing the team apart instead of, for example, pursuing co-leadership. Team polarization may hinder collecting necessary information to get to grips with a difficult situation. Often, who speaks first in a discussion can influence more than others [583, p. 186].

Cohesion is a function of team members' feeling of belonging to a team (compare [637, p. 82]). It is important from early on in a team effort, so that participants can manage and master difficult tasks and conflicts along the way (compare [637, p. 82/83]). Social interdependence theory points to promoting mutual goal accomplishment as a result of a teams' perceived positive interdependence which fosters group cohesion [324, p. 100/124/125]. Facilitating team cohesion may include coordinating to establish and facilitate communication [504], and to manage meaning [79] to increase security and trust within the team [637], [41].

Cohesion can foster team members' relative independence in opinion from each other. This means that team members' opinions are not highly determined by opinions of those around them, especially if the team is trusted to collectively decide (and self-organize). *"Collective decisions are most likely to be good ones when they're made by people with diverse opinions reaching independent conclusions, relying primarily on their private information [583, p. 57]."*

It can be supportive if team members decide rather simultaneously on important team directions, otherwise cascades (where some ideas are presented by prominent team members and influence others) can hinder that necessary information is considered. *"... we don't always know where good information is. That's why, in general, it's smarter to cast as wide a net as possible ... [583, p. 276]."* Discussing highly critical decisions with a co-leader, a mentor, a coach or a supervisor instead of acting solely on personal judgment can bring about a richer perspective on a situation and, thus, may open wider areas of choice.

Detailed domain knowledge is elaborated by rather independently working and decentrally organized individuals participating in the team.

A cohesive team needs ways to aggregate all sorts of sharing of involved participants to be able to learn from each others experience. It needs opportunities - such as status updates within the group in context-appropriate frequency that may be arranged by accessible flipcharts or online sharing resources - to turn private information and judgements into collective decisions.

Team members have to invest time and effort to reflect their activities and interactions in order to arrive at promotive decisions for their working together and their approaching of tasks. Cohesive, learning teams may inform decisions about [583]:

- Cognition problems - that have or will have a definite solution,
- Coordination problems - figuring out how to coordinate behavior with each other, knowing that everyone else is trying to do the same,
- Cooperation problems - handling the challenge of getting self-interested, distrustful people (team members, stakeholders, customers) to work together, even when narrow self-interest would seem to dictate that no individual should take part.

Persons in a leadership function within the team that facilitate team cohesion focus on the dynamics of interactions between team members. Team members are enabled to share with each other. Further, the team engages in reflecting on team members' sharings to inform decision-making and take steps. Facilitators of team cohesion do not only focus on current content, but consider interpersonal relationship process. Based on experience and reflection, they intervene in crucial points in the team process. Not every word that is said is a team intervention.

In critical circumstances facilitative team leaders need to hold tensions or allow tensions to arise within the team so that members are inclined to share their perceptions and find

creative - or innovative - solutions for their situations (or to resolve conflicts). This indicates that facilitative team leaders may be needed to contain emotions [79].

To foster an atmosphere of authentic reflection and team learning, they accept criticism. Feeling belonging, supported and accepted may increase motivation to collaborate and work together with each other. Team leaders facilitating team cohesion are balancing attentive focus between maintaining the team, or holding, and achieving the team task. Facilitative team leaders are sensitive to the requirements of reality [405, p. 132]. To learn about themselves as partners in interpersonal interactions, they attend to professional interpersonal learning settings - such as (multi-disciplinary) supervision.

Team learning through sharing and aggregating information and judgements of individual team members and, thus, sensing and monitoring team directions and achievements can support (re-)calibration of team organization to get tasks done adequately and satisfyingly in a team effort.

To maintain a broad field of opinions and experiences team members need to be supported in their (relative) work independence. This means that team members are supported in their personal strivings. *"The best CEOs, of course, recognize the limits of their own knowledge and of individual decision-making [583, p. 222]."*

7.4.3.1 Core Flow Case Vignettes

- One project manager explains in an interview that, for him, the most important thing about working together effectively is to give priority to interpersonal conflicts within the team. He explains that if he senses conflicts among co-workers he tries to immediately address them.
- A counselor working with organizational staff mentions in an interview concerning complex problems that involving people is crucial. More people have more perspectives on the problem. From there it can go to the next level. Each challenge is unique.
- A project manager that was interviewed really enjoyed working in a team where conflicts could be openly and professionally discussed. He liked that they could have confrontations in the team and afterwards go for a coffee together.

7.4.3.2 Central Reference Flows

Typical reference flows (or organizational patterns, best practices) supporting team cohesion are for example:

- *"Compass"* [301]
- *"End to End"* [374], or
- *"Cohesive Team"* [589]

A more extensive list of related reference flows concludes the core flow description.

7.4.3.3 Complementary Best Practices

Complementing inspirational best practices (not yet included in the knowledge base):

- Fried and Hansson [260]: *"Learning from mistakes is overrated"*, *"Meetings are toxic"*, *"They're not thirteen"*.
- iCom Team [312]: *"Every perspective is valuable"*, *"The team is the most wonderful place to learn"*, *"Transparency yields flow"*, *"Care for the atmosphere"*, *"Enable creativity in teams"* and *"Hiding consumes energy: Untie and focus"*.

This core flow is in line with leadership practices *"Enable others to act"* and *"Encourage the heart"* as elaborated by Kouzes and Posner [357]. It is associated with the following enabling team conditions described by Hackman [253]: *"A Real Team"*, *"Supportive Context"*.

7.4.3.4 Keywords

team members, cohesive team, means, team learning, team effort, facilitative team leaders, interpersonal process, opinions, conflicts, team cohesion, information

7.4.3.5 Pictures

A metaphoric representation of the core flow is shown in figure 7.20.

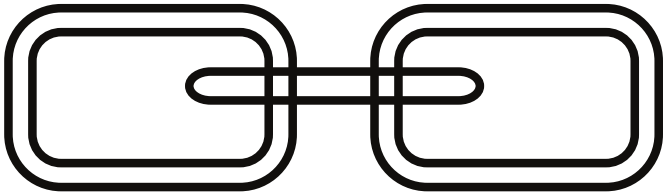


Figure 7.20 Facilitate Team Cohesion

7.4.3.6 Resources

Surowiecki, J. (2005). The wisdom of crowds: Why the many are smarter than the few and how collective wisdom shapes business. Anchor Books.

Yalom, I. D. (2008). The Theory and Practice of Group Psychotherapy. Basic Books.

7.4.3.7 Leadership Team Interaction Categories

Figure 7.21 depicts counts of crowd-sourced leadership team interaction taxonomy categorizations of reference flows (see section 6.5.4.3, p. 191) related to the core flow. See section 7.6.1.2.3, p. 291, for a description of the count retrieval method.

Leadership interaction appears to revolve around *"Creating a supportive Team Atmosphere"* and establishing *"Communication"*.

7.4.3.8 Risk Categories

Figure 7.22 depicts counts of crowd-sourced (project) risk taxonomy categorizations of reference flows (see section 6.5.4.3, p. 191) related to the core flow. See section 7.6.1.2.3, p. 291, for a description of the count retrieval method.

This core flow addresses risks in *"Interpersonal Relationships"* and *"Communication"*.

7.4.3.9 Unified Process Project Life-Cycle Phases

Figure 7.23 depicts counts of crowd-sourced Unified Process project life-cycle phase categorizations of reference flows (see section 6.5.4.3, p. 191) related to the core flow. See section 7.6.1.2.3, p. 291, for a description of the count retrieval method.

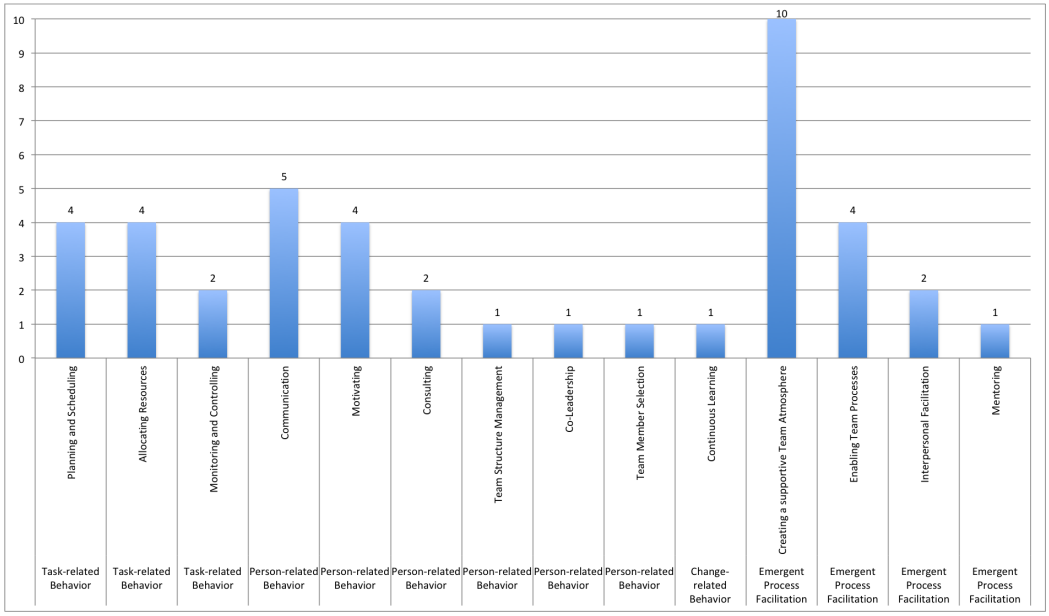


Figure 7.21 Facilitate Team Cohesion - Leadership Team Interaction Category Count

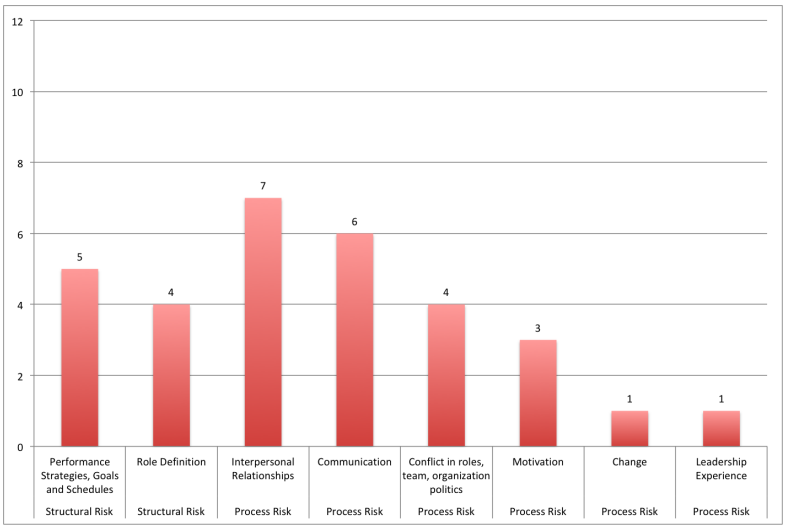


Figure 7.22 Facilitate Team Cohesion - (Project) Risk Category Count

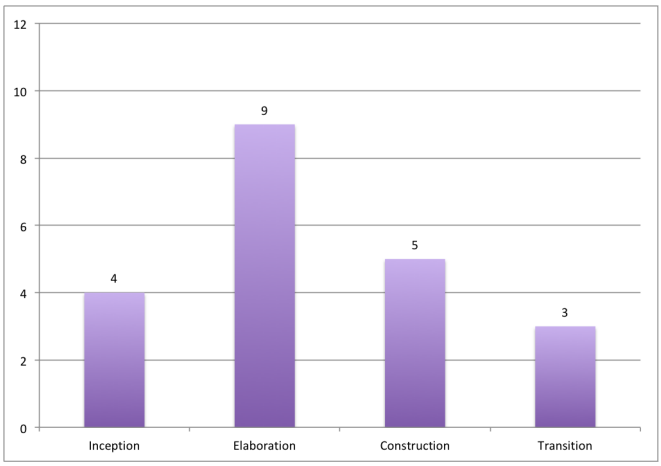


Figure 7.23 Facilitate Team Cohesion - Unified Process Project Life-Cycle Phase Count

This core flow increases in centrality, when team members with rather clear vision and goals tackle complex situations collaboratively and conflicts or uncertainties arise. When team members work on difficult tasks, a major focus is set on sustaining team cohesion.

7.4.3.10 Related Reference Flows

Table 7.7 lists reference flows related to the core flow by centrality. See section 6.5.4.2, p. 188, , as well as 7.6.1.2.3, p. 291, for an explanation of the centrality calculation. Find short descriptions and references to listed reference flows in Appendix D, p. 369.

7.4.4 Arrange for Task Effectiveness (or: Orient towards Team Goal Completion)

Teams work towards shared goals. The core flow **Arrange for Task Effectiveness (or: Orient towards Team Goal Completion)** spans approaches and tools to complete goals in time, budget and scope satisfying stakeholders and, succeeding, team members. As such, it is most specific to the business area the team operates in. It is about getting things done.

Artifacts need to be developed and tested. They should fulfill stakeholder requirements and operate as expected. Stakeholder or customer interview and observation techniques can support framing context-appropriate requirement descriptions according to stakeholder needs as well as realistic test scenarios [18]. In a project with many changes in requirements,

Core Flow	**Centrality Score (rounded)**
Compass	0,92
Protect the victim	0,74
End to end	0,71
Guruing by walking around	0,69
Lock em up together	0,69
Body speaks	0,66
Adhoc meeting	0,63
Coffee kitchen	0,63
Group validation	0,62
Show and tell	0,61
The Water Cooler	0,59
Social tracker	0,49
Reaffirmation ritual	0,48
Production potential	0,44
Grand finale	0,4
Solidarity ritual	0,39
Piecemeal growth	0,38
Cohesive team	0,24
Ambassador	0,17
Don't interrupt an interrupt	0,15
Informal labor plan	0,11

Table 7.5 Facilitate Team Cohesion - Related Reference Flows (listed by normalized centrality)

an overview of necessary steps to task completion needs to be kept. Directions have to be outlined. Designing system use cases or creating feature lists are exemplary techniques to elaborate insight in the (supposed) workings of a (software) system.

Difficulties in technology or tool use ought to be quickly recognized and dealt with. People in the team need to be informed of project changes or updates. Technical pitfalls have to be bridged and documented. In ICT projects, errors and bugs in an artifact should be kept to a minimum - especially in a release version. Team members need to be up-to-date with the status on problems their co-workers are tackling. Work processes, development approaches and artifact architecture (or basic prototypes) need to fit the system use case or feature set of an artifact.

In software development, the Unified Process [317] can be presented as an exemplary industry standard procedure for it is well-documented, frequently implemented and highly adaptable. According to organizational and stakeholder requirements it can be adjusted to fit a rather lean or agile work attitude within a team or streamlined, heavily-documented team conventions. Independent of scope, the Unified Process places development efforts around use cases - designs of actual areas of use of the systems to be implemented. Use-cases integrate stakeholder requirements in a structured, often visualized form. The use case descriptions, including visualizations of work processes and system interactions, should promote a shared understanding of the system and development directions for software engineers, managers, customers and stakeholders.

The Unified Process is architecture-centric, meaning that a lot of consideration is put into the choice of core technologies and tools for artifacts to be developed, based on stakeholder needs as well as experience of team members - following novelties and changes in the ICT field. System architecture is a result of the shared team and stakeholder vision. The elaboration of a minimal viable product in lean development or early prototyping in agile environments may be traced back to a focus on core technologies and tools functional in a specific application context.

The Unified Process is based on iterative, incremental development. An iteration consists of several activities including the design of use cases, implementing and testing features of an artifact, finally resulting in an internal release. Iterations in development can overlap. The final system is assembled incrementally in the course of one or more iteration(s). Between iterations, feedback on development difficulties within the team as well as of the artifact from internal testers or customers and stakeholders can be pulled in to further direct development. In lean and agile development procedures, short iterations resulting in functional artifacts are

crucial for dealing with development disruptions or changes in requirements.

The core flow interfaces to 11 of 12 eXtreme Programming (XP) engineering practices [62]. Table 7.6 lists XP practices alongside short descriptions and related core flows.

XP Practice	**Description**	**Interfacing Core Flows**
Test Driven Development	Automated tests, unit tests, are written before code implementation. Tests are run frequently during development to refactor code. Features are tested by users to steer further development.	Arrange for Task Effectiveness
The Planning Game	User stories (lightweight use cases) are collected and prioritized to guide development iterations.	Arrange for Task Effectiveness
On-site Customer/Whole Team	Users of the system to be developed are working together with developers. Important stakeholders are involved in decision-making.	Arrange for Task Effectiveness, Organize for Complexity
Pair Programming	Two developers work on a task on one workstation together.	Arrange for Task Effectiveness
Continuous Integration	Code is shared frequently with the development team. Team members work on the latest version of the artifact.	Arrange for Task Effectiveness
Refactoring, Design Improvement	Changes in code have effect on the system to be developed. Accordingly, the artifact design is adapted by changing parts of the system, including the architecture, to make it simple, efficient and generic.	Arrange for Task Effectiveness
Small Releases	Artifacts are released frequently integrating functionality of value to users.	Arrange for Task Effectiveness
Simple Design	Simple is best.	Arrange for Task Effectiveness
System Metaphor	Important parts of the system to develop, e. g. classes or functions, are named in a way that allows participants of the team, including designers, managers and customers, to interpret functionality.	Arrange for Task Effectiveness, Organize for Complexity
Collective Code Ownership	All team members are allowed to change parts of the code, if perceived appropriate.	Arrange for Task Effectiveness, Organize for Complexity
Coding Standards	A set of conventions and rules on how code is written (including syntax style and code documentation) is agreed upon by all participants of the team.	Arrange for Task Effectiveness, Prototype Team Identity
40-Hour Week, Sustainable Pace	People perform best when they can rest and regenerate. Continuous integration, code refactoring and test driven development can minimize unexpected problems in development.	Prototype Team Identity

Table 7.6 Extreme Programming Practices and *rhea.framework* Core Flows

eXtreme Programming practices can be integrated in development processes inheriting from the Unified Process.

Important information, conventions, standards and rules concerning a particular work endeavor, such as a specific project, can be collected in a document. In project management, this document is often called project handbook (DIN 69901-5:2009), project management plan (PMBOK), or project initiation documentation (PRINCE2). It usually contains

- a short description of the work endeavor and its surroundings (including shared goals and visions),
- organizational plans explicating team roles and team role assignments as well as
- contact information of team members and involved stakeholders,
- communication conventions (team internal and external communication channels, work documentation),
- applied project management and development process standards including tailoring specifications according to requirements of the work environment and change process descriptions,
- negotiated stakeholder support confirmations,
- requirements for design and implementation (including specifications of tools used for communication and task completion) and
- a basic task completion schedule.

This document defines how a work endeavor is carried out, monitored and calibrated. It results from inputs of team members and stakeholders. Often, it is reviewed and approved by stakeholders supporting the endeavor. It can be version-controlled and updated based on changes in work requirements and work environment circumstances.

Versioning systems can facilitate rapid development and continual releases of artifacts. Team communication can be supported by channel-based instant messaging systems. Ticketing systems can be used to highlight customer-relevant features and change requests.

7.4.4.1 Core Flow Case Vignettes

- In an interview on significant moments during a project, a project manager mentions that in a project he led team members were asked to form *"tandems"* with external stakeholders in order to facilitate collaboration.
- One project manager explains the setup of the project team work space: desks with laptops, a partition, behind it a large meeting table and a beamer. The walls can be used to share project plans. Besides the large room, there is a smaller room with a telephone. Team members usually work in the larger room next to each other.

7.4.4.2 Central Reference Flows

The following reference flows (or organizational patterns, best practices) cover, for example, setting up and tuning tools and technologies to allow for mostly obstruction-free, collaborative working:

- *"Team per Task"* [146]
- *"Team owns Individual Velocities"* [75]
- *"Effective Handover"* [589]

A more extensive list of related reference flows concludes the core flow description.

7.4.4.3 Complementary Best Practices

Complementing inspirational best practices (not yet included in the knowledge base):

- Fried and Hansson [260]: *"Illusions of agreement"*, *"Good enough is fine"*, *"Start at the epicenter"*.
- iCom Team [312]: *"Maximize the chance for success: Be agile"*, *"Two steps ahead"*.

This core flow is related to the following enabling team conditions described by Hackman [253]: *"Enabling structure"*, *"Expert Coaching"*.

Also the task-oriented agenda in the 2agendas@work framework can be consulted [439].

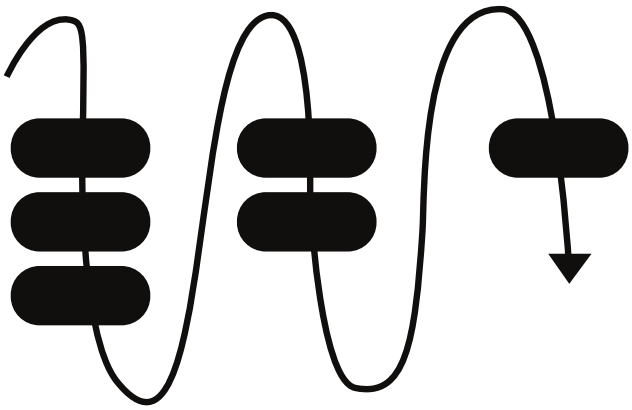


Figure 7.24 Arrange for Task Effectiveness

7.4.4.4 Keywords

team members, project, work processes, extreme programming practices, prototype team identity, task effectiveness, unified process, test driven development, core technologies, continuous integration, task completion, work endeavor

7.4.4.5 Pictures

A metaphoric representation of the core flow is shown in figure 7.24.

7.4.4.6 Resources

Alvarez, C. (2014). Lean Customer Development. O'Reilly Media, Inc.

Beck, K., and Andres, C. (2004). Extreme Programming Explained. Addison-Wesley Professional.

Jacobson, I., Booch, G., and Rumbaugh, J. E. (1999). The Unified Software Development Process - The complete guide to the unified process from the original designers. Addison-Wesley Object Technology Series.

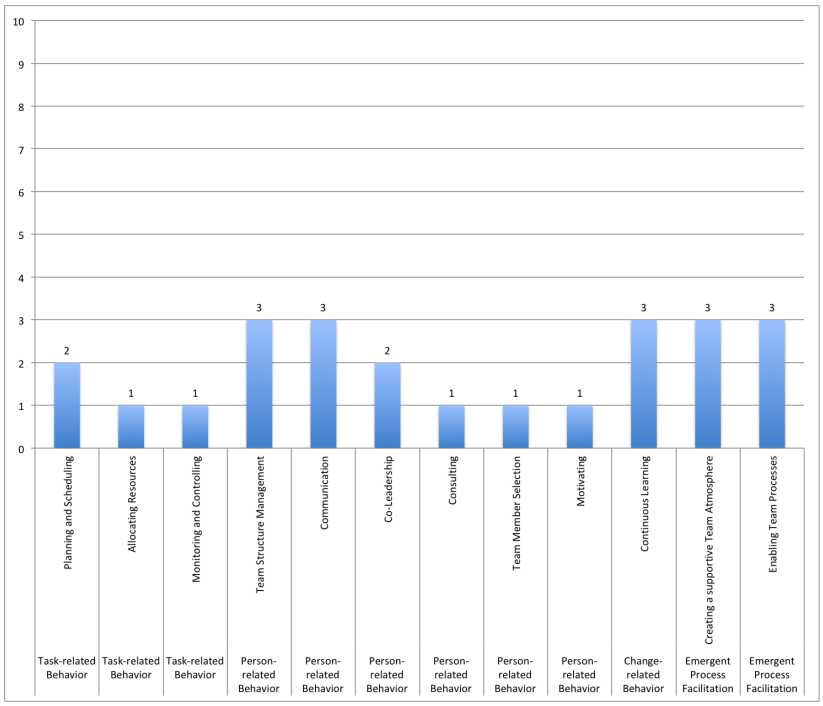


Figure 7.25 Arrange for Task Effectiveness - Leadership Team Interaction Category Count

7.4.4.7 Leadership Team Interaction Categories

Figure 7.25 depicts counts of crowd-sourced leadership team interaction taxonomy categorizations of reference flows (see section 6.5.4.3, p. 191) related to the core flow. See section 7.6.1.2.3, p. 291, for a description of the count retrieval method.

Leadership behavior in this core flow includes *"Team Structure Management"*, *"Communication"*, team leaders' *"Continuous Learning"*, and behavior related to emergent process facilitation.

7.4.4.8 Risk Categories

Figure 7.26 depicts counts of crowd-sourced (project) risk taxonomy categorizations of reference flows (see section 6.5.4.3, p. 191) related to the core flow. See section 7.6.1.2.3, p. 291, for a description of the count retrieval method.

This core flow in particular deals with *"Complexities in market, organization and tasks"*.

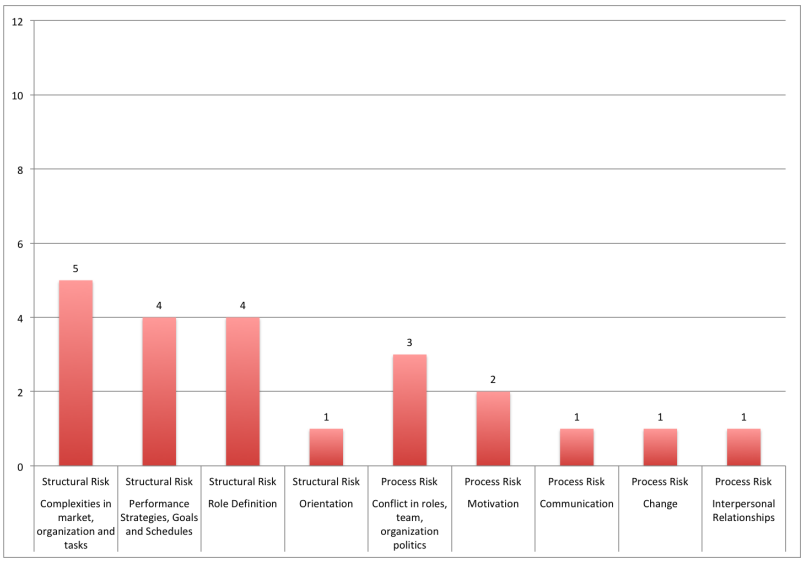


Figure 7.26 Arrange for Task Effectiveness - (Project) Risk Category Count

7.4.4.9 Unified Process Project Life-Cycle Phases

Figure 7.27 depicts counts of crowd-sourced Unified Process project life-cycle phase categorizations of reference flows (see section 6.5.4.3, p. 191) related to the core flow. See section 7.6.1.2.3, p. 291, for a description of the count retrieval method.

In the beginning of project iterations, the work environment for team members can be prepared. When team members implement solutions, having tools and techniques for effective task completion at hand is crucial.

7.4.4.10 Related Reference Flows

Table 7.7 lists reference flows related to the core flow by centrality. See section 6.5.4.2, p. 188, , as well as 7.6.1.2.3, p. 291, for an explanation of the centrality calculation. Find short descriptions and references to listed reference flows in Appendix D, p. 369.

7.5 Normative Leadership Team Interaction Model

The classification taxonomies of leadership interaction and project risks were elaborated in a systematic review on literature of team leadership interaction supporting team performance

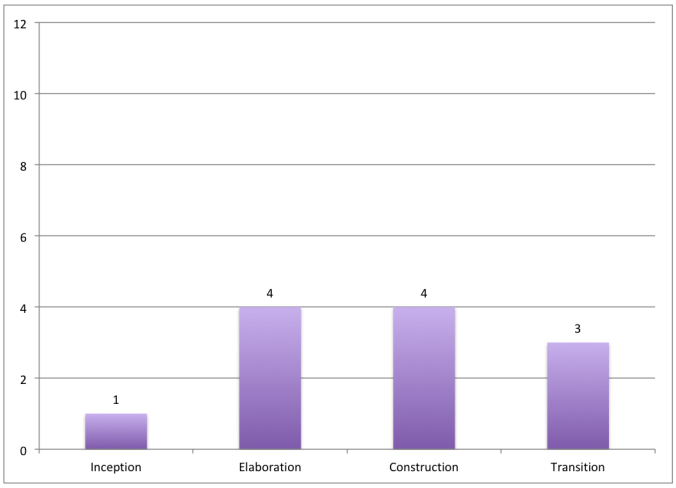


Figure 7.27 Arrange for Task Effectiveness - Unified Process Project Life-Cycle Phase Count

Reference Flow	**Centrality Score (rounded)**
Team per task	0,78
Standup meeting	0,59
Development episode	0,59
Interrupts unjam blocking	0,49
Feature assignment	0,48
Sprint retrospective	0,47
Gather domain knowledge	0,46
Team owns individual velocities	0,35
Fair memory	0,31
Sprint	0,28
Effective handover	0,24
Boot camp	0,02

Table 7.7 Arrange for Task Effectiveness - Related Reference Flows (listed by normalized centrality)

[266]. Heuristics were compiled by flattening retrieved leadership taxonomies and extracting leaf nodes [266, p. 5].

The taxonomies of the normative leadership team interaction model are completed in the *rhea.framework* by the project life-cycle phases uncovered in the Unified Process [317] (section 5.2.5, p. 65).

Presented taxonomies can be utilized to label personal experience. They can help to differentiate leadership team interactions in personal reflection and flow sessions.

7.5.1 Leadership Team Interaction Categories

The leadership team interaction taxonomy is presented in a tree-structure in figure 7.28. Heuristics of typical keywords for each category are listed in table 7.8.

7.5.2 Project Risk Categories

The project risk taxonomy is presented in a tree-structure in figure 7.29. Heuristics of typical keywords for each category are listed in table 7.9.

7.6 Framework Web Application (Prototype C)

The *rhea.framework* support application can be accessed at: https://rheafmwk.io. The source code can be found at: https://github.com/rheafmwk/rheafmwk. It provides reference experience descriptions for experiential learning, integrates with nominative taxonomies on leadership interactions and (project) risks. It explicates core topics of team leadership. It aligns reference experience descriptions to the Unified Process.

7.6.1 Implementation

7.6.1.1 Concept

The first prototype (Prototype A, section 6.3, p. 148) was a Semantic Mediawiki implementation to allow for online sharing of experience. While sharing written experience descriptions is easy once accustomed to the wiki platform, user privacy is hardly considered. Scalability

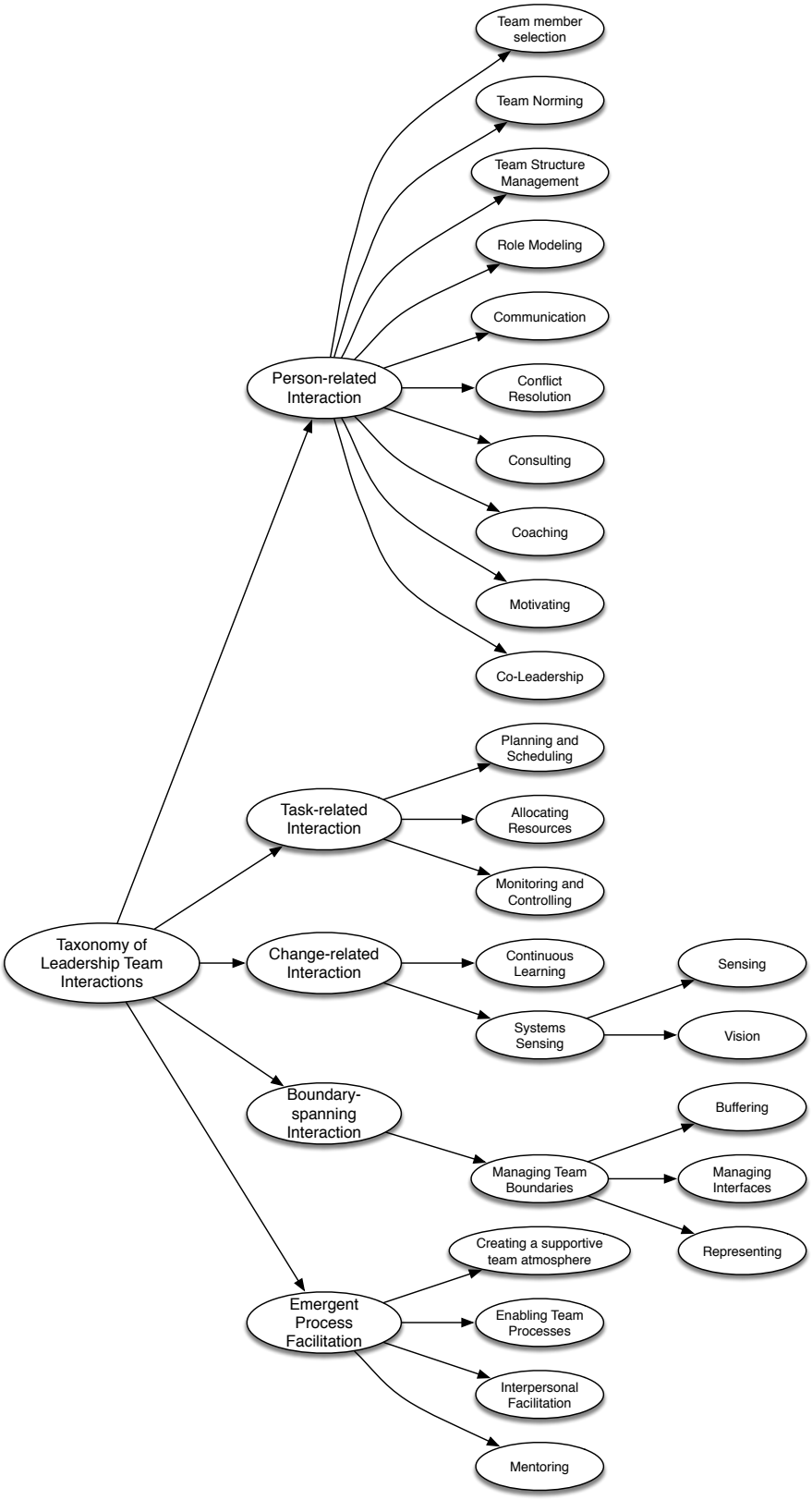


Figure 7.28 Leadership Team Interaction Categories

Leadership Team Interaction Category	**Heuristics (adapted from findings in each category)**
TEAM MEMBER SELECTION	Recruiting competent personnel, selecting team members
TEAM NORMING	Explicating norms and expectations, establishing team rules
TEAM STRUCTURE MANAGEMENT	Forming a team, verifying team structure, clarifying roles, clarifying task assignments
ROLE MODELING	Leading by example, taking risks to promote necessary change
COMMUNICATION	Providing feedback, establishing effective communication channels, listening attentively, communicating customer feedback and market situation, encouraging transparency, fostering dialogue competencies in team members, enabling utilization of language ambiguities
CONFLICT RESOLUTION	Negotiating and resolving conflicts, reducing conflict, discussing unavoidable changes with team
CONSULTING	Overseeing the project, assisting problem solving, proposing solutions, recalibrating actions, training team members to communicate with each other
COACHING	Training and developing team member skills and confidence, channeling abilities of people to be effective in team
MOTIVATING	Enhancing task motivation, providing recognition for achievements
CO-LEADERSHIP	Leading together
PLANNING AND SCHEDULING	Developing plans, providing and setting clear project goals and directions, searching and structuring information, offering clear strategies
ALLOCATING RESOURCES	Obtaining and maintaining resources the team needs
MONITORING AND CONTROLLING	Managing personnel resources, monitoring operations and performance, assessing work progress, reviewing efforts and talents
CONTINUOUS LEARNING	Practicing personal creative ability, challenging the process, accepting reasonable failure, advancing professionally, practicing improvisational abilities
SENSING	Interpreting internal and external events, mastering internal forces, giving sense, monitoring environmental change
VISION	Creating a vision, supporting a shared understanding of wholeness, envisioning change, inspiring a shared process
BUFFERING	Protecting team from external pressures, filtering external communication for team, helping different teams to communicate together, shield team from organizational conflict and power struggles
MANAGING INTERFACES	Organizing for border crossing, e. g. through transparency, defining cross-functional interface personnel, enabling team collaboration among interfacing team elements
REPRESENTING	Representing team for higher management, organizing team and work visibility, involving higher authority
CREATING A SUPPORTIVE TEAM ATMOSPHERE	Establishing a positive team climate, giving prerequisites for collective to emerge, fulfilling nontask needs for team members, relating to other individuals in the group, creating emotional spaces, listening actively and supporting cohesiveness of the group
ENABLING TEAM PROCESSES	Empowering people to take initiative, communicating on a meta-level, providing interesting and challenging work, fostering team member commitment, encouraging team self-management
INTERPERSONAL FACILITATION	Inspiring trust through personal credibility, providing support when someone is upset or anxious, providing encouragement, encouraging innovative thinking, focusing on interaction and creative processes, challenging people to question assumptions, celebrating
MENTORING	Informal apprenticeship

Table 7.8 Leadership Team Interaction Category Heuristics

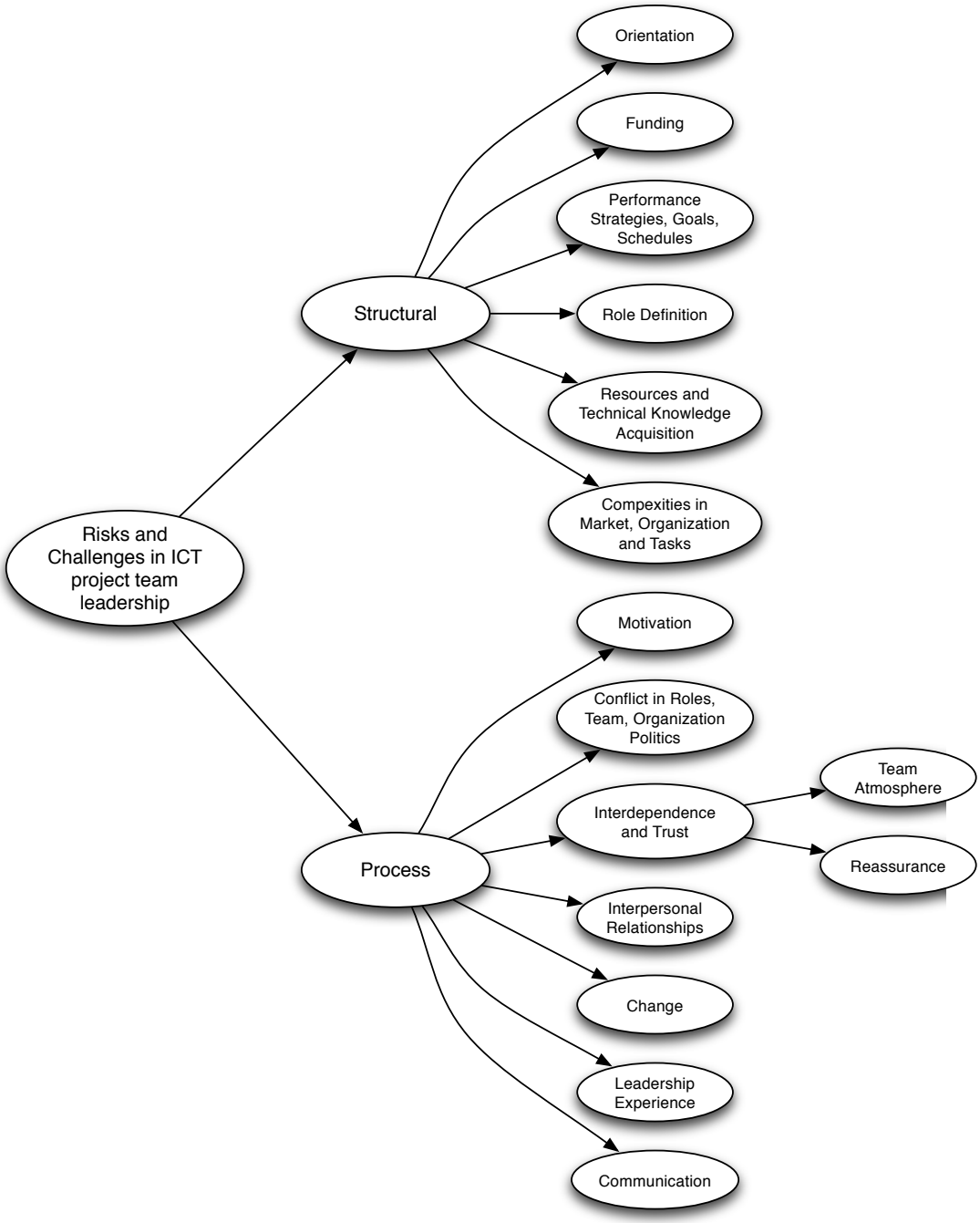


Figure 7.29 Project Risk Categories

Risk Category	**Heuristics (adapted from findings in each category)**
Orientation	Unclear mission or business objectives, identifying all stakeholders
Funding	Underfunding of development or maintenance
Performance Strategies, Goals, Schedules	Unclear tasks or project goals, no agreement on project plans, unclear requirements, changing scope, artificial deadlines
Role Definition	Unclear role definition, insufficient or inappropriate staffing
Resources and Technical Knowledge Acquisition	Perceived technical uncertainty, missing professional skills, insufficient resources
Complexities in Market, Organization and Tasks	Intense competition, stagnation in competitive environment, introduction of new technologies, stability of technical architecture, indecision, decentralized uncontrolled work processes
Motivation	Low motivation, apathy, low team spirit, perception of inadequate rewards and incentives, poor recognition and visibility of accomplishments, little work challenge
Conflict in Roles, Team, Organization Politics	Excessive conflict among team members, role conflict, power struggles, organizational conflict
Interdependence and Trust	
Team Atmosphere	Little team involvement, low degree of mutual trust and respect, problems in attracting and holding team members
Reassurance	Fear of failure and potential penalty, (unintentional) isolation of knowledge, decision alternatives are not fully explored
Interpersonal Relationships	Lack of cooperation, collusion, protectionism, lack of user involvement
Change	Excessive requests for directions, strong resistance to change
Leadership Experience	Disinterested, uninvolved management, lack of leadership credibility, wrong timing of intervention, excessive use of outside consultants, lack of controls over consultants, vendors and subcontractors
Communication	Poor communication among team members and with support groups, lack of performance feedback

Table 7.9 Project Risk Category Heuristics

is dependent on developments from the open source community. A major contribution of the first prototype to the framework elaborated in this thesis was the evaluation of an experience description contribution guideline. This guideline was refined and adapted to support personal reflection processes. Moreover, the Semantic Mediawiki provided faceted search options to explore a knowledge base. Reference flows in the knowledge base are categorized in several taxonomies and allow for faceted retrieval.

With the second prototype (Prototype B, section 6.4, p. 157), a shift was taken away from solely collecting experience descriptions in a publicly accessible online platform to supporting individual reflection processes through a mobile application.

While refactoring of this application may be easier than of a Semantic Mediawiki implementation, the user reach of the application was limited to a specific mobile platform. In a focusgroup, participants from industry stated that a remote database backend to collect written flows, while adhering to platform-specific security, is not ensuring user privacy. Focusgroup participants liked the idea of taking time to reflect, and to reflect together with others.

The main aim of the third prototype (Prototype C) is to support personal and interpersonal reflection processes with regards to team leaders' reflection opportunities by means of a web-based application.

The web application landing page presents framework aims and reflection process activities. The application provides tools and descriptions supporting the reflection of leadership practice, offers interfaces to a team leadership knowledge base and includes a newsletter to get information on flow sessions.

Complexity hiding is an underlying design goal in the third prototype. Framework descriptions are presented in a nested way, yet can be followed up gradually in more detail.

Considering the model view controller software architectural pattern (section 7.2.1, p. 225), the web application can be seen as a model representation of the *rhea.framework*.

Personal reflection is supported by an online reflection (flow) template. A pen and paper version of the template can be downloaded. The reflection guideline can be accessed within the web application as well.

Differing from the first two prototypes, no personal reflections are collected online within the third prototype. Yet, personal reflections can be compared to reference flows based on semantic document similarity. Through document similarity comparison, entry points for

exploring reference experience descriptions may be found.

An accessible learning interface to the *rhea.framework* team leadership knowledge base was developed in order to allow for self-paced studying.

Sharing experiences with peers is supported by providing the flow session policy and the flow session procedure description online. A newsletter may announce moderated flow session sequences for participation to interested peers.

7.6.1.2 Technology

7.6.1.2.1 Architecture

The framework prototype (Prototype C) is implemented as a Flask (http://flask.pocoo.org) web application in the Python programming language (https://www.python.org). Gunicorn (http://gunicorn.org) provides a web server gateway interface to the application. Requests are forwarded to gunicorn through an nginx (https://nginx.org) web server. The knowledge graph is accessed through a hosted neo4j (https://neo4j.com) database. Paper-based templates are stored in a digital asset storage server (https://phaidra.univie.ac.at). Newsletters are composed using a newsletter platform. The web application architecture is depicted in figure 7.30.

7.6.1.2.2 Graph Schema

The experience description locating schema [138] can be described as follows: Each reference flow is part of one core flow. Each reference flow is categorized to one or more leadership interaction categories and to one or more (project) risk categories based on crowd-sourcing results. Further, each reference flow is categorized to a Unified Process project life-cycle phase by crowd-sourcing.

Reference flows are related to each other through semantic relationships between keywords. Moreover, the knowledge base holds semantic keyword relationships to leadership interactions, risks, Unified Process life-cycle phase descriptions, and core flow descriptions.

Lastly, each reference flow holds a sentiment value calculated using the Valence Aware Dictionary and sEntiment Reasoner [230] and is related to basic emotions described in the NRC Word-Emotion Association Lexicon, version 0.92 [427], [426].

The locating schema is presented in figure 7.31.

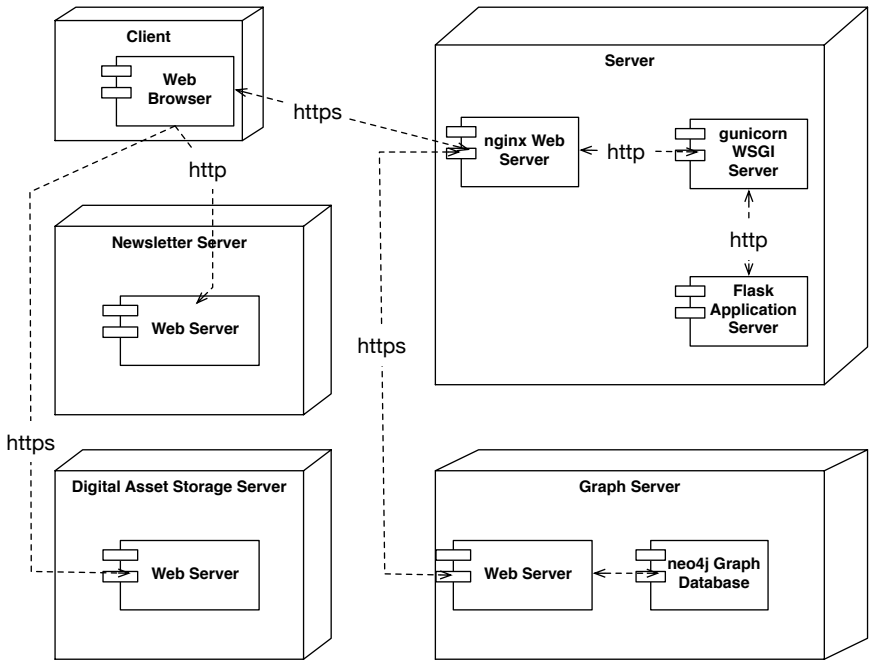


Figure 7.30 Web Application (Prototype C) - Deployment Architecture

Figure 7.31 Web Application (Prototype C) - Reference Experience Description Locating Schema

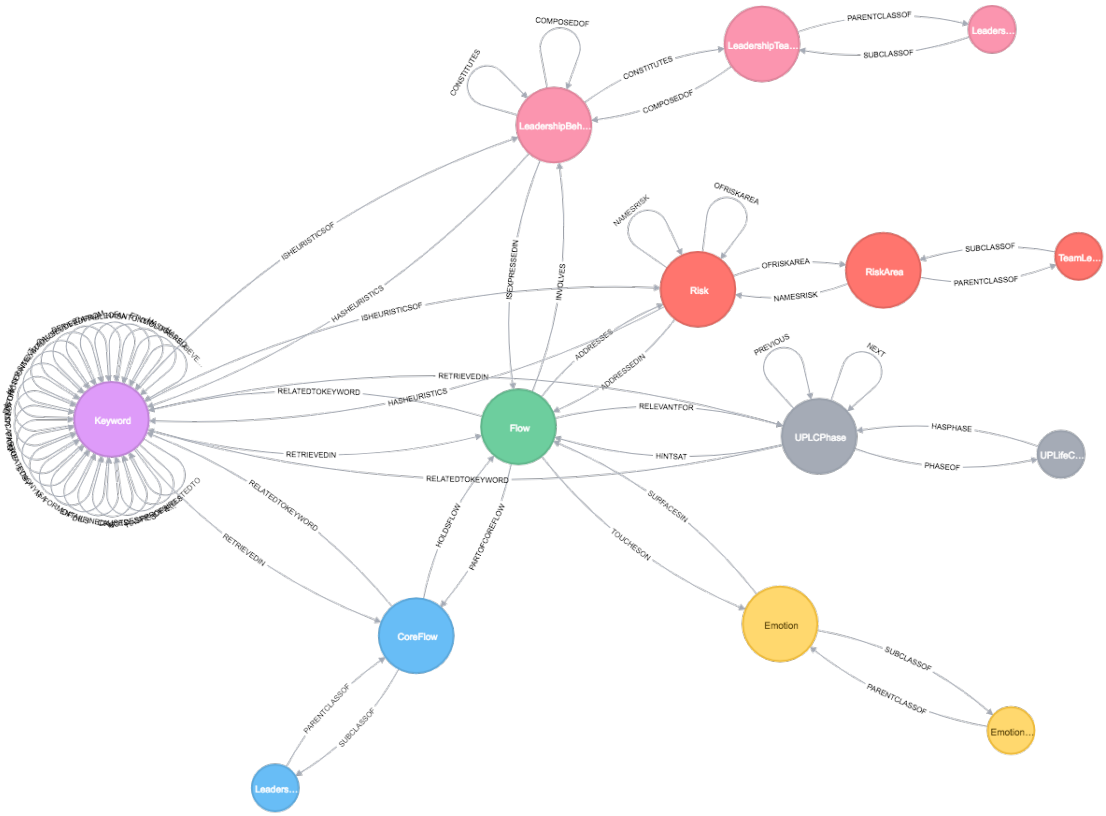


Figure 7.32 Web Application (Prototype C) - Graph Schema

The knowledge base is implemented in a neo4j graph database (https://neo4j.com). Relationships can be considered *"first class"* entities holding properties such as relationship weight. Entities are highly connected.

The knowledge base graph can be adapted to various business environments. Graph algorithms, such as centrality calculations, are supported. Further, labeled relationships may allow easily traversing the database even for non-technical peers.

The graph schema including labeled relationships is shown in figure 7.32. Graph nodes represent knowledge base entities, while relationships show knowledge base structure [500, p. 67].

In total, the knowledge base graph database holds 913 nodes, 14 labels, and 5919 relationships of 50 relationship types. Keyword to keyword relationship labels are listed in table 7.10.

Label
CAUSESDESIRE
SIMILARTO
HASPPROPERTY
DERIVEDFROM
DEFINEDAS
USEDFOR
NOTDESIRES
HASPREREQUISITE
DESIRES
ISA
HASCONTEXT
CAPABLEOF
ENTAILS
CREATEDBY
HASA
RELATEDTO
ATLOCATION
FORMOF
ANTONYM
SYNONYM
PARTOF
MADEOF
ETYMOLOGICALLYRELATEDTO
CAUSES
DISTINCTFROM
HASSUBEVENT

Table 7.10 Web Application (Prototype C) - Graph Schema Keyword To Keyword Relationship Labels

7.6.1.2.3 Exploring a Graph-based Data Model

Neo4j graph databases can be traversed using the Cypher query language (https://neo4j.com/developer/cypher-query-language/).

Cypher was used to retrieve coreflow taxonomy category counts:

- Core Flow Leadership Team Interaction Category Count:
  ```
  MATCH (n:CoreFlow) -[x:HOLDSFLOW]-> (r:Flow)
  <-[y:ISEXPRESSEDIN]- (b:LeadershipBehaviour) -[j:CONSTITUTES]-
  (k:LeadershipTeamInteractionArea) WHERE n.title="Insert Core Flow
  Title here" RETURN b.title, k.name, count(b)
  ```
- Core Flow (Project) Risk Count:
  ```
  MATCH (n:CoreFlow) -[x:HOLDSFLOW]-> (r:Flow) -[y:ADDRESSES]->
  (b:Risk) -[j:OFRISKAREA]- (k:RiskArea) WHERE n.title="Insert Core
  Flow Title here" RETURN b.title, k.name, count(b)
  ```
- Core Flow Unified Process Life-Cycle Phase Count:
  ```
  MATCH (n:CoreFlow) -[x:HOLDSFLOW]-> (r:Flow) -[y:RELEVANTFOR]->
  (b:UPLCPhase) WHERE n.title="Insert Core Flow Title here" RETURN
  b.name, count(b)
  ```

There are many algorithms to find out about important - or central - nodes in a graph, following different concepts of centrality and, thus, yielding different results [320, p. 10]. Node degree (the count of in- and outgoing relationships) centrality, for example, is based on the assumption that tightly connected nodes are more central than others. Betweenness centrality counts shortest paths through a node. PageRank defines centrality recursively based on incoming relationships and PageRank scores of related nodes in a graph.

Centrality algorithms such as degree centrality, betweenness centrality and PageRank can inform about the importance of a node in a knowledge graph structure, for example hinting at reference flows that many other nodes are connected to or that are pivotal for others. However, these abstract graph measures scarcely reveal the importance of reference flows to core flow contents. Further, centrality measurement scores can't be directly mapped to the relevance of reference flows in a specific practice situation.

Still, neo4j provides several centrality algorithms to explore node centrality in a graph (https://neo4j.com/docs/graph-algorithms/current/algorithms/centrality/, last visited: 10. 4. 2019). The neo4j implementation of the PageRank algorithm can be run in the knowledge

base graph as follows:

```
MATCH (node:Flow) WITH collect(node) AS nodes CALL algo.pageRank(nodes)
YIELD node, score RETURN node.title, node.pictureURL, score ORDER BY
score DESC
```

Further, betweenness centrality [216], [104] of graph nodes can be calculated using a neo4j procedure. Betweenness centrality for reference flows can be calculated as shown subsequently:

```
MATCH (node:Flow) WITH collect(node) AS nodes CALL algo.betweenness
([],nodes,'BOTH') YIELD node, score RETURN node.title, node.pictureURL,
score ORDER BY score DESC
```

The knowledge base graph is provided for download to be explored in depth.

7.6.1.2.4 Knowledge-based Experience Description Recommendation

The framework web representation aims to support reflection processes. Personal written reflections can be semantically analyzed and compared to reference experience descriptions within the team leadership knowledge base to get different perspectives on a specific situation. Hereby, a vector representation of documents is used for semantic comparison [313, p. 141].

The online reflection template is an information retrieval system that can fetch relevant sources from the corpus of reference flows in the knowledge base via document similarity measures. Document similarity is computed using the *spaCy* natural language processing framework (https://spacy.io).

spaCy is a memory-efficient, fast natural language processing framework. In the *spaCy* framework, documents can be represented as word vectors based on word vector models calculated with the GloVe algorithm [471]. Reference flows are stored within the web application as binary objects holding word vector representations based on an English language model from the *spaCy* Python framework.

User input in the online flow template can be converted to a word vector representation that is then compared to reference flow word vectors. A list of documents that are semantically similar is returned. Moreover, flow keywords are gathered using the RAKE algorithm [510]. A sentiment value is retrieved for the personal reflection with VADER sentiment analysis [230].

Confidentiality and user privacy requirements mentioned by participants of a focusgroup on the second prototype (Prototype B, section 6.4.4, p. 162) were considered in the web

application (Prototype C) implementation. Only the experience description provided by the user and sent over a secure (https) connection is used to retrieve relevant reference flows, yet no user meta-data. A similarity algorithm is used to compare user input to graph contents. No user data is permanently stored in the web application.

The web-based reflection template thus is an implementation of a knowledge-based recommender system [206].

7.6.1.3 User Interaction

The *rhea.framework* web application (https://rheafmwk.io) provides framework documentation and reflection process support tools. Web application routes are subsequently listed:

- **Overview**:
  The web application landing page. Framework aims and reflection process activities are described here. Within the reflection process activity description, links to the reflection template, the reflection guideline as well as flow session policy and procedure are presented. Links to a newsletter subscription, the online reflection template and the team leadership knowledge base are accessible from the landing page. Moreover, background information on framework development links to related literature. Figure 7.33 shows the web application landing page.

- **Reflection (Flow) Template:**
  The online reflection template. User input can be semantically compared to knowledge base contents. Figure 7.34 shows an exemplary comparison result. User input is stored in the browser cache. Written flows can be exported and imported as json (JavaScript Object Notation) file from and to the online template. A link to a print version of the template and to the online reflection guideline are accessible from here.

- **Reflection Guideline:**
  The reflection guideline. Taxonomy categories and Unified Process life-cycle phases can optionally be studied by expanding views as shown in figure 7.35.

- **Knowledge Base Information:**
  General information on the knowledge base. Core flows are introduced (see figure 7.36). Interfaces to software development methodology principles are shown. A link to the knowledge base visualization is presented. Further, the knowledge base graph can be downloaded from here.

- **Core Flow Description**
  Each core flow is presented through succinct key takeaways. Core flow relevance in Unified Process project life-cycle phases is depicted in a vertical bar chart. An emotional landscape of the core flow referring to eight basic emotions represented in the NRC Word-Emotion Association Lexicon, version 0.92 [427], [426] is visualized (see figure 7.37). Related reference flows are listed. The knowledge base graph is provided for download.

- **Knowledge Base Visualization:**
  A knowledge base visualization using hierarchical edge bundling [297]. This visualization technique allows a high level view with insights on low level structuring of relationships among leaves in a hierarchically organized network.

  The knowledge base can be represented as a hierarchical network with interrelated nodes. Through bundling adjacent relationships, visual clutter can be minimized.

  The visualization was realized using the d3.js (https://d3js.org) JavaScript visualization framework.

  In the knowledge base visualization, label groups were formed adhering to leaf node categories: reference flow labels based on core flow membership, core flows, leadership interaction category labels based on interaction meta-categories, risk categories based on risk meta-categories, Unified Process life-cycle phases, emotions. The following relationships were drawn between nodes:

  - node to keyword to node and
  - node to keyword to keyword to node with the sum of relationship weights between nodes as edge size, and
  - emotion-node to node and node to emotion-node with the frequency of words related to an emotion as edge size.

  The visualization may motivate to explore the knowledge base, to find connections between reference model contents that were not apparent before allowing new perspectives in reflection processes (DI1.1 , section 2.1, p. 8). An exemplary reference flow selection within the knowledge base visualization is depicted in figure 7.38.

- **Literature**
  Literature related to the *rhea.framework*.

rhea.framework Overview FlowTemplate KnowledgeBase Literature Evaluate!

rhea.framework

Experiential Learning in Team Leadership.

Introduction

Information and Communication Technology (ICT) projects frequently fail due to people-, not technology issues. Interpersonal interactions within a team influence team performance. While it's rare to set aside time to contemplate teamwork issues in a fast paced industry such as ICT, reflection is a worthwhile practice in steadily changing, complex environments. Reflection of personal practice is pivotal to experiential learning on team leadership. The development of team leadership capacities can be seen as a life-long learning process.

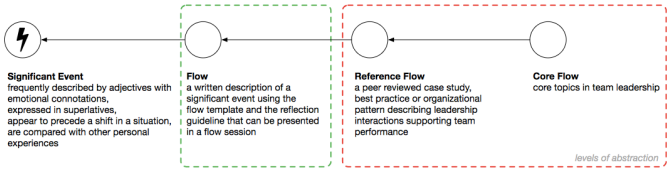
The *rhea.framework* offers **conceptual guidelines for continual self-directed and interpersonal team leadership reflection**. While team leaders may aim at some kind of reflective practice, and some project management and software development methodologies even describe the importance of reflection processes, the *rhea.framework* decisively supports experiential learning of persons holding leadership functions within a team through

- providing a structured reflection template with an easy to follow reflection guideline,
- an in-depth team leadership knowledge base for comparison and exploration, and
- offering opportunities to get in contact and share experiences with other team leaders in moderated, case-based reflection meetings.

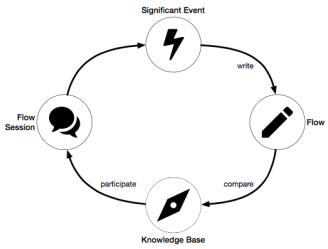
The *rhea.framework* is released as an **open educational resource**. It can be integrated in various organizational contexts and along other leadership learning approaches.

Concepts

The *rhea.framework* introduces the following concepts: *flows* referring to personal written reflections, *reference flows* describing case studies, best practices or organizational patterns from peer reviewed sources for comparison, and *core flows* denominating foundational topics in team leadership.



Activities



Flow: If a *significant event* occurs in day-to-day team leadership practice, a written reflection (or *flow*) is elaborated following the reflection guideline.

Knowledge Base: The knowledge base can be used to compare personal experiences with *reference flows*.

Flow Session: Moderated peer learning meetings (or *flow sessions*) support reflection in a group of like-minded peers. Subscribe to the newsletter to get updates on *flow sessions* in your area.

(*Flow sessions* are rigorously organized adhering to the *flow session* policy. The steps described in the *flow session* procedure description guide through peer learning sessions, particularly in the beginning.)

Next Steps

Start writing a Flow. Subscribe to the Newsletter. Study the Knowledge Base.

Community

Please support the improvement of the framework by filling out a framework evaluation (< 10 Min.). Thank you!

Please subscribe to the newsletter to get information on interpersonal reflection meetings (flow sessions) in your area, updates to the reference model, and news on advances in the practice of interpersonal interaction in team leadership.

Backgrounds

The *rhea.framework* emerged in an ongoing design science research study on interpersonal interaction in ICT-project teams. Find out more.

This website is designed for the demonstration and evaluation of the *rhea.framework* which is elaborated as part of a doctorate study at the University of Vienna, Austria. Version 1.2 (2018). This work is licensed under a Creative Commons Attribution-NoDerivatives 4.0 International License. Project source code is released under the Mozilla Public License (Version 2.0). Contact.

Figure 7.33 Web Application (Prototype C) - Landing Page

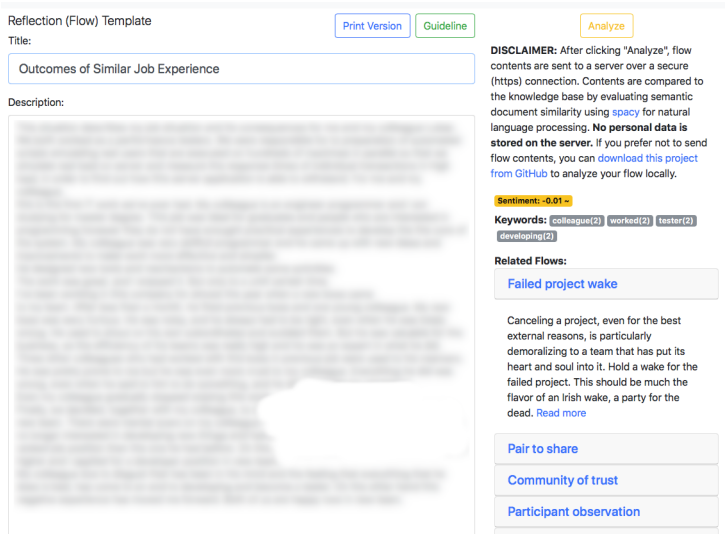


Figure 7.34 Web Application (Prototype C) - Reference Flow Recommendation Results Example

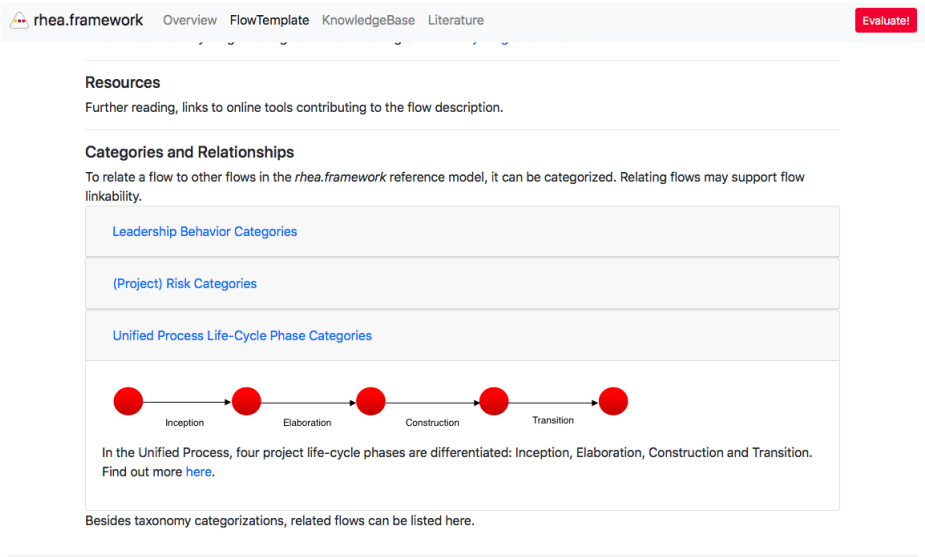


Figure 7.35 Web Application (Prototype C) - Unified Process Life-Cycle View Expanded

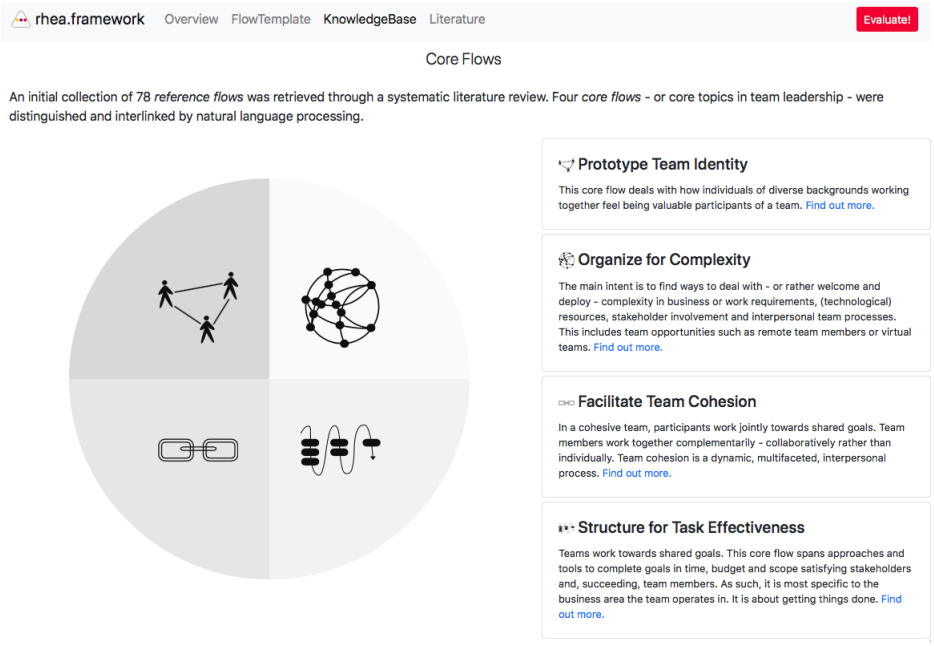


Figure 7.36 Web Application (Prototype C) - Knowledge Base

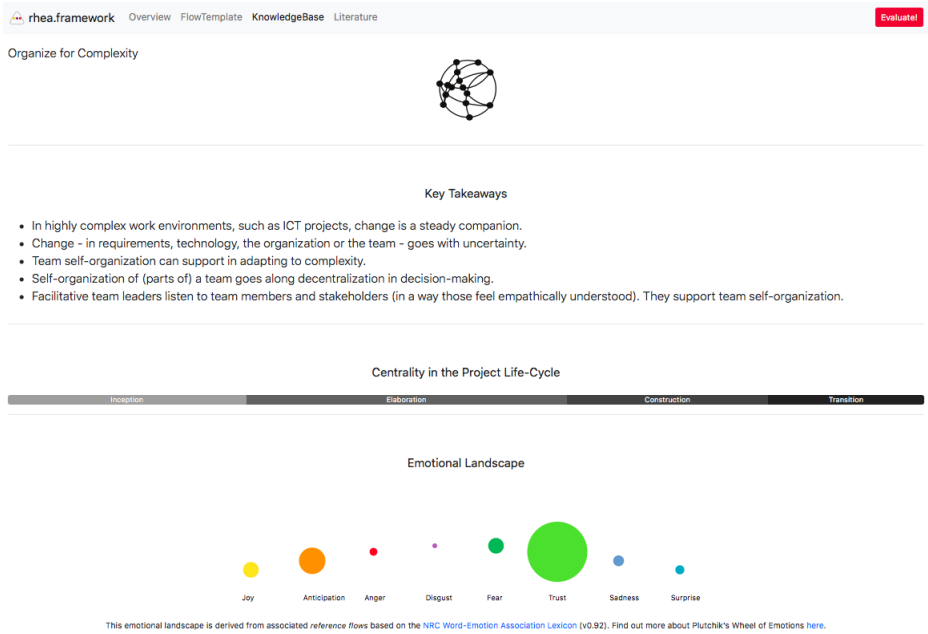


Figure 7.37 Web Application (Prototype C) - Core Flow Example

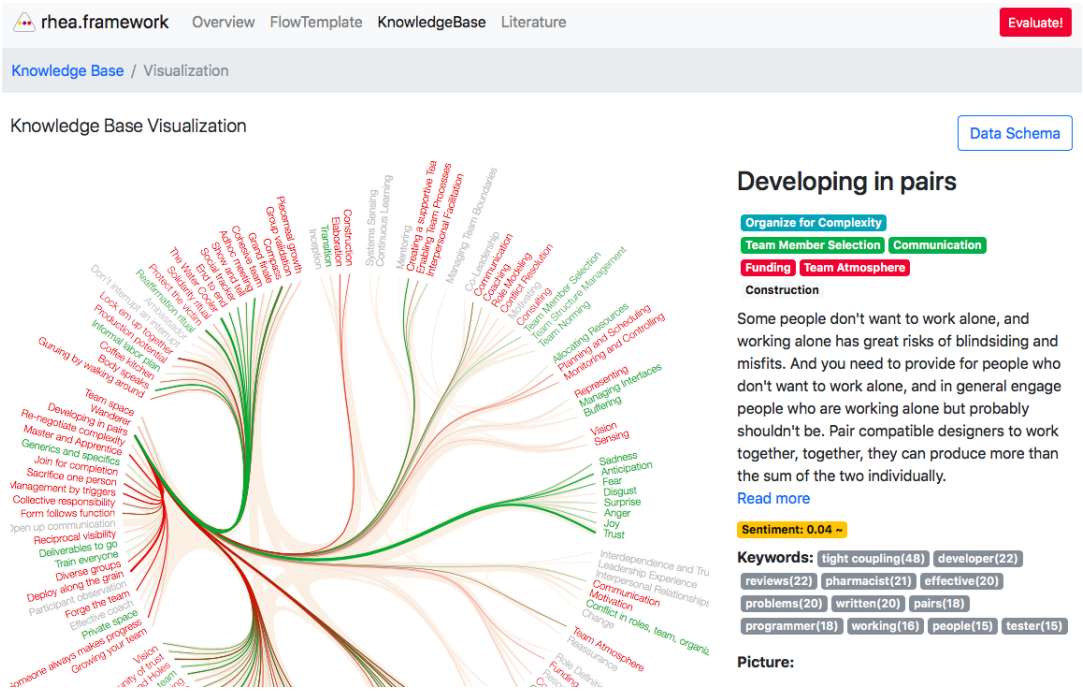


Figure 7.38 Web Application (Prototype C) - Reference Model Visualization

7.6.2 Exemplary Application Use

A. After reading through the information on the landing page, a flow is written on a work situation encountered just recently. The reflection guideline is used to get some information on reflection structure. Within the guideline, leadership interaction and risk taxonomies provide some interesting labels for the situation.

B. The written reflection is analyzed using the reflection (flow) template. Keywords hint at inherent topics within the reflection. More interestingly, a list of reference flows that appear semantically similar is suggested. Clicking on the first, a short description of the reference flow is presented. By clicking on *Read more*, the original resource is loaded.

C. Following up on reference flows suggested related to the personal reflection, the knowledge base visualization is opened. After clicking on one of the suggested reference flows in the visualization, connections to other reference flows based on semantic keyword connections are shown. Further, related leadership interaction and risk categories are highlighted. Clicking on related knowledge base entities reveals their relationships to other entities.

D. Findings within the knowledge base are contrasted and integrated in the personal written reflection.

7.6.3 Discussion

The *rhea.framework* web application was developed following the framework design guiding principles (section 5.5, p. 108). A focus is set on supporting experiential and social learning on team leadership in day-to-day work practice.

The system design intent was met by subsequent ventures (DI1 , section 2.1, p. 8):

1. Framework documentation and tools are introduced gradually to allow for self-paced studying [542, p. 19].
2. Opportunities for peer learning sessions can be announced by email newsletter.
3. Framework scalability is supported as follows:
    - The web application is released as open source project and can be adapted flexibly to various business needs.
    - The knowledge base is implemented in a graph database. Database entities can easily be created, read, updated or deleted.
    - The framework is accessible with a standard web browser.
    - Framework templates for print can be downloaded.

Considering levels of reflective depth (section 5.4, p. 90), the framework web representation may support RL0 (Revisiting) through the flow template. The template structure description as well as supportive questions in the reflection guideline point to RL1 (prompting explanation). Learners can decide for themselves how they want to shape their personal reflection process. The framework implementation supports self-directed learning [558]. The knowledge-based recommender system, though designed taking into account user privacy and confidentiality requirements, aims to support learners to *"see more"* by offering different perspectives on a situation. Suggested reference flows can be followed up in the scaffolded team leadership knowledge base representation and visualization to learn on related interpersonal interactions and explore team leadership topics. The web representation thus refers to dialogical reflection support (RL2).

"Levels 3 and 4 build on the processes of levels 0-2 where the resources available for reflection are engaged with at deep levels [214, p. 220/221]." To support transformative reflection, the web representation is embedded in an (inter)personal reflection process described in the *rhea.framework* reflection process model. *"It is worth reminding ourselves that in all situations, technologies and techniques can provide only the resources and support the conditions for reflection, but it is ultimately people who do the reflection [214, p. 222]."*

Chapter 8

rhea.framework Validation

The *rhea.framework* is evaluated to assess whether it satisfies the requirements and constraints of the problem it was meant to solve [279, p. 85].

8.1 Framework Peer Debriefing

In peer debriefing - or analytic triangulation -, transcripts, reports and methodology are presented to peers not involved in the research project [2]. Peer debriefing may help in uncovering taken for granted biases, perspectives and assumptions of the researcher. Debriefers may test emergent hypotheses for plausibility. *"It is a process of exposing oneself to a disinterested peer in a manner paralleling an analytical session and for the purpose of exploring aspects of the inquiry that might otherwise remain only implicit within the inquirer's mind [384, p. 308]."*

Eight practitioners of various professional fields reviewed the framework in-depth. Five practitioners read the framework documentation and contributed written feedback. One practitioner, who had received a copy of the framework documentation, was interviewed using VoIP technology. Two practitioners, who had received a copy of the framework documentation, gave their feedback face to face after a framework presentation. Responses were noted during these conversations. Peer debriefing feedback on the framework documentation was received from 19. 12. 2016 to 22. 7. 2017. Peer feedback is listed in table 8.2.

In general, peers perceived the framework intuitive, interesting, and suitable for long term interpersonal process support.

Reviewer	Current Occupation	Gender	Feedback
1	Consultant in Organizational Development, Agile Coach (Europe)	m	Interesting framework. It may need to be clearly specified who participates in flow sessions. The framework holds descriptions of complex interpersonal systems. Flow sessions may need good moderation on eye-level. University may provide fitting circumstances. The framework may be interesting for a heterogenous community with the shared interest of sharing experiences related to leading self-organized teams. Learning in this area may take long. Learning about leadership as function may include learning about paradoxes of organizations, with leaders as advocates of ambivalence. The documentation seems to be written for scientific staff. It might need a different presentation to attract team leaders from practice. What about people who do not have the opportunity to participate in a flow session? How is the framework supportive to them?
2	Coach, Leadership Trainer (Europe)	w	Very cool. Who participates in reflection processes? There is a big difference between one on one coaching and learning in a team. Learning with group dynamics has a different spin. The framework template could include opportunities to help reflecting on problematic situations. Circular questions could be supportive. How is the framework maintained? Where should flow sessions take place?
3	Consultant for ICT Businesses (Europe)	m	1) (concerning the core flow *Prototype Team Identity*:) I like the whole chapter very much – the flow description. 2) (concerning the core flow *Organize for Complexity*): Also a very good chapter. 3) (concerning the core flow *Facilitate Team Cohesion*): I continually like the detailed descriptions. 4) (concerning the core flow *Arrange for Task Effectiveness*): Again good paragraph. 5) I would have liked to have a solution in every situation that happened. In my opinion a higher, unreachable goal that is still worth to aspire to. (Authors' translation)
4	Professional Staff Member at the International Atomic Energy Agency (Africa)	w	The framework is useful - in particular due to the emphasis placed on exploring interpersonal relationships as a means of improving organizational efficiencies and cohesiveness which I believe is relevant and important for all organizational settings and not only for ICT fields.
5	University Professor for ICT Education and Management (Europe)	w	1) Makes a lot of sense and seems to be comprehensive and insightful 2) Helps to broaden your horizon ... of perspectives you may have overlooked 3) Would optimally be supported by a process model that helps to focus on most essential aspects over the life-time of a project 4) Mapping to core activities in ICT projects might be helpful for more specificity to the field of ICT (e. g. Scrum, eXtreme Programming, Unified Process)
6	Programmer (Embedded Devices) in ICT Project (Europe)	w	1) I learned a lot of things while reading, it was very interesting! 2) Contains many important aspects, from my perspective mainly: * strengthening team cohesion and role modeling of the project leader! for example, that the project leader also goes home on time * Positive regards towards individuals and their strengths and weaknesses * the aspect of fear from change I can perceive often with "old-established" colleagues * Collaboration of dispersed teams: I have often experienced, how important communication can be – the understanding of members of the other team, how much it can help to grasp their point of view 3) Strong focus on persons, and that it is important that working together in a team works, and that individual persons can work 4) To feel well/valued in order to perform best – I like that. (Authors' translation)
7	Psychotherapist (Europe)	m	The document is rather complex. It probably takes a bit of time for someone not acquainted with it to read and understand it, yet on the other hand the model is laid out broadly and supports long term processes. My overall impression of the framework is rather positive. *) Concepts such as coaching, mentoring, consulting, ... need to be clearly outlined. I hope I didn't read over the definitions. *) In the reflection guideline, the personal part in the interaction could be highlighted more: what were personal intentions, when did the situation change for oneself, what was on ones mind afterwards? *) In *Prototype Team Identity* as well as *"Facilitate Team Cohesion"* the *"we"*-aspect of a team was elaborated, yet I was thinking that for teams that can go through crises it may be important to again integrate personal differences. A leader then might be supportive, if not acting prototypical - making "mistakes" - and in handling this again behaving prototypical. Withdrawal from and resistance against the team may be important at times. (Authors' translation)
8	University Professor for Leadership (USA)	m	1) A relevant contribution 2) Interesting overlaps to other work: * Personal motivation factors: Mastery, Autonomy, Purpose [479] * Team success factors (Google Aristotle Project): Psychological safety, dependability, structure and clarity, meaning of work, impact of work [514]) 3) Intuitive and graspable

Table 8.2 Framework Peer Debriefing Feedback

The framework was refactored considering critical remarks: The flow session policy describes where flow sessions may take place and who may participate. The reflection guideline was revised with a stronger emphasis on personal motivation in interpersonal interaction. Supportive questions were added to the reflection template.

In the peer debriefing it was mentioned that the framework documentation is rather comprehensive. To make the framework more readily accessible to practitioners, core flows are presented holding key takeaways in the web-based framework application.

For team leaders that can't participate in a flow session, the web-based reflection template may be used to compare personal reflections to reference flows. It was suggested to map experience descriptions along an ICT project process timeline.

8.2 Focusgroup: Framework Deployment

To obtain feedback on understandability of the *rhea.framework* and viability of framework implementation in practice settings, a focusgroup was organized.

8.2.1 Method

The focusgroup was conducted following a guideline for focusgroups in software engineering [352]. A description of the focus group method can be found in section 6.4.4, p. 162.

Participant responses were transcribed from an audio recording of the focusgroup session and analyzed in a selective qualitative content analysis [411]. Responses were collected, paraphrased and summarized question by question.

8.2.2 Scenario

A focusgroup on the contents of the *rhea.framework* was organized at the University of Vienna on the 16. 6. 2017 from 14:00 to 16:00. Four persons joined in the focusgroup: a Professor at a University with a research focus on eLearning technologies who is a team leader at the University, a Professor at a University with a research focus on statistics and data mining who further founded an ICT company in industry, a project manager from the ICT industry and a Professor at a University with a research focus on project management who is the supervisor of this thesis. Two participants were acquainted with the framework documentation through

peer debriefing (section 8.1, p. 301). The author of this thesis moderated the focusgroup. The following guiding questions were prepared for the focusgroup session:

1. How are you dealing with reflection of interpersonal processes in your projects right now?
2. What is your learning preference on interpersonal issues?
3. Is a tool to support reflection on interpersonal processes in (ICT) project team leadership generally important to you and your professional community?
4. Can you find what you expect to find within the knowledge base?
5. Does it cover important leadership-related issues of (ICT project) teams?
6. What value does the *rhea.framework* have for you and your profession?
7. Is a digital representation of the knowledge base valuable to you?
8. What features of a digital representation are most relevant to you?
9. What kind of digital representation of the framework supports experiential learning best?
10. What organizational environment circumstances need to be considered to use the *rhea.framework* most effectively?
11. Is there anything else to be added?

8.2.3 Findings

Table 8.4 lists summaries of paraphrased responses in the focusgroup question by question.

Focusgroup participants perceive reflecting on interpersonal relationships as necessary, particularly in the ICT industry. They learn on interpersonal interaction through sharing personal experience with colleagues face to face, through observing and sharing experiences with role models or mentors, and through reading theoretical articles or case studies and relating read contents to the personal practice.

Communication channels such as email or telephone conversations were mentioned to be useful to share experience, yet communication constraints need to be considered.

No.	Question	Response Summary
1	How are you dealing with reflection of interpersonal processes in your projects right now?	talking to colleagues and team members about interpersonal relationships; high relevance in industry
2	What is your learning preference on interpersonal issues?	in industry: talking face to face because it is really often very personal - so it needs to stay between involved people; confidentiality is highly important; reading a paper with examples and reflecting on the paper; observing persons with leadership experience, and exchanging ideas; sometimes face to face talking, sometimes a phone call, sometimes email, although cautious phrasing is important then - or reading an article and reflecting how contents relate to personal practice
3	Is a tool to support reflection on interpersonal processes in (ICT) project team leadership generally important to you and your professional community?	a new topic - maybe a good idea to think about and have opportunities to do so; in industry sometimes best cases are helpful, or writing a journal - but this is really personal; what is a tool? if email is a tool it can be tried; applying theories to practice can help reflecting about interpersonal relationships
4/5	Can you find what you expect to find within the team leadership knowledge base? Does it cover important leadership-related issues of (ICT project) teams?	why the name flow? it is not so intuitive to read and hard to understand if the documentation is not read; mentoring may be the best way to learn about project management - the framework can support speaking on the same level, to share a similar mental model: this may support understanding; does the framework offer support to make good decisions? Does it support decision-making capacities in place? From reading short core flow descriptions alone hard to say if aspects of leadership are covered by the framework or not; Are considerations on the team environment included in the framework?
6	What value does the *rhea.framework* have for you and your profession?	reflection must be self-motivated, but the framework may help technicians to get more understanding of leadership - and in the industry technical staff gets often promoted to leadership positions; the framework might be beneficial for students as they could look up ideas and reflect in flow sessions - the framework as open educational resource could be valuable; the reflection template is helpful for structured reflection - it could be supportive in many teams: “Maybe I can now apply it in my profession?” and for reflection in the team on a flow; The normative taxonomies of the framework might be explained in the reflection guideline
7	Is a digital representation of the framework valuable to you?	A digital representation might help spread the idea; it might be faster as it is not necessary to deal with page numbers; a paper version would be valuable too
8	What features of a digital representation are most relevant to you?	search for some issue; references to related issues; different levels of reflection: where can I look for more, maybe examples; possibility to print out parts; high security: leadership issues are often personal and maybe can’t be put in words immediately: It may be necessary to talk about it.
9	What kind of digital representation of the framework supports experiential learning best?	application for the presentation of the framework; web based application: reaches more people, it is easier to go from more complexity to less complexity, more options for different modes of use
10	What organizational environment circumstances need to be considered to use the *rhea.framework* most effectively?	a democratic style of leadership: some space and freedom in organization; these circumstances need to be fulfilled in any ICT company; thinking about leadership for longer term relationships; an environment in which leaders can say they need help, and it is ok.
11	Is there anything else to be added?	*"As a practitioner I would like to see it in practice."*

Table 8.4 Framework Focusgroup Response Summaries

Possible advantages of the framework were seen in supporting technical staff interested in leadership, in contributing a team leadership knowledge base that allows speaking of leadership with a shared vocabulary - and, thus, may support the development of a shared mental model of leadership -, in providing case examples or reference experience descriptions in an open learning resource to compare personal reflections, and in supporting personal and team reflection using a structured reflection template. The term flow is not intuitively graspable and, thus, needs to be defined evidently.

Proposals of key features of a digital framework asset were the presentation of the framework in different levels of complexity, the opportunity to search for some issues, references between issues, a focus on user privacy, and the possibility to print out parts of the framework. A web based application was suggested.

Focusgroup participants perceived the framework as best fitting in a rather democratically organized environment.

8.2.4 Discussion

Focusgroup participants' interpersonal interaction learning habits correspond to stakeholder requirements (R1, R2, R3 in section 6.1.3, p. 122) and findings on project managers' experiential learning habits [267] (section 5.4, p. 90).

Suggestions and critical remarks, such as properly defining the term flow or presenting the framework in different levels of complexity, helped clarify the framework structure. They were incorporated in framework development.

Scalability requirements for an ICT-based framework application got apparent [54, p. 4]:

- The ontology-based knowledge base may be represented as a searchable, easy to grasp learning resource.
- The database of reference flows may be based on technology that allows customization.
- Peers interested in learning about team leadership who have no opportunity to participate in flow sessions may need recommendations of reference experience descriptions in the knowledge base that are related to the personal written reflection.

Focusgroup participants appreciated web-based as well as paper-based framework representations.

A key outcome of the focusgroup was adopting the software architecture model view controller pattern in elaborating framework representations.

Researcher bias was moderately handled by discussing focusgroup findings with one of the focusgroup participants acquainted with the framework (the supervisor of this thesis).

Findings in this focusgroup meeting significantly influenced directions in application development due to participants' supportive suggestions:

The framework is implemented as a web-based application. Framework contents are presented in scaffolded levels of complexity. The knowledge base visualization shows relationships between included reference experience descriptions. The reflection template can be downloaded in a print version.

The application can be used to receive recommendations for reference experience descriptions that are similar to personal written reflections.

User privacy was considered as no personal data is stored in the application and connections to the web application are established via https (Secure Hyper Text Transfer Protocol). The framework and its web representation are released as open educational resources under creative commons and open source licenses.

8.3 Case Study in Higher Education Setting

"In design science research, we use validation models to simulate implementations. For example, we study a prototype of an artifact, interacting with a model of the intended problem context, to develop a design theory about the interaction between the artifact and a context [630]."

The *rhea.framework* was introduced to students in the context of a student-centered course on communication at the Masaryk University in Brno, Czech Republic, as an open educational resource (http://phaidra.univie.ac.at/o:780694).

Students shared their impressions of the framework during the course, in course reaction sheets and in self evaluations at the end of the course. They further could voluntarily fill out a questionnaire concerning the reflection process model outlined in the framework.

One month after the last meeting, participants were asked to share their experiences and comments on using the reflection process model in a continuous (peer) reflection process and on using the reflection template. An email was sent to course participants they could respond

to, if they wanted. Two course participants responded to the follow-up email survey.

8.3.1 Method

In this case study, the framework was validated in a triangulated mix of qualitative and quantitative research methods. Written feedback was analyzed using qualitative content analysis [411].

Reaction sheets and course reflections were glanced through for references to the framework. Descriptions mentioning the framework or work-related reflection were coded. The questionnaire consists of three open questions and ten Likert-Scale items [382] on the *rhea.framework* reflection process model as a means of contributing to experiential learning on practice situations [436], [279], [54], [437]. For Likert-Scale items, participants were asked for agreement. Items had the subsequent format: 1 for *"No.""*; 2 for *"Rather no."*; 3 for *"Partly yes."*; 4 for *"Rather yes."*; and 5 for *"Yes."* Open questions were:

- What is your general impression of the Flow Session Setting? Describe in 3 - 5 adjectives
- What is your general impression of the *rhea.framework* Process Model (personal reflection combined with Flow Sessions)? Describe in 3 - 5 sentences
- What organizational environment circumstances need to be considered to use the *rhea.framework* most effectively, if any? Describe in keywords

The questionnaire can be accessed online: https://phaidra.univie.ac.at/view/o:780695.

Follow-up questions are listed subsequently:

- Do you think that further flow sessions (i.e. the variant of open case sessions we had in the 3rd block related to teams and leadership) would be beneficial for you? If so, please indicate in which way you think you and/or your environment could benefit from them. Which positive changes would you expect from them? If no, please share why.
- Do you think that further flow sessions on the same topic would be beneficial, i.e. the case/flow provider follows up his/her case in a flow session, say one month after the initial session?

- Do you think that your written reflections of your experience had any (positive or negative) effect on your learning? If so, can you try to describe the effect of thinking about and writing up team-leadership flows?
- Can you try to describe the particular benefits or drawbacks of first filling the reflection template (with consulting the reflection guidelines) and then participating in the face to face flow sessions plus reflecting on them?
- Can you try to describe the effect - on yourself - of writing reaction sheets to our course units?

All data was anonymized.

8.3.2 Scenario

The *rhea.framework* was presented to students in the third and final block, lasting 1.5 days, of a course on communication for Master students of Computer Science with a specialization in SSME (Service Science Management and Engineering). Grading in the course was solely *"pass"* or *"not pass"*. Before the *rhea.framework* was introduced, students participated in open case [312] sessions.

All in all, 18 participants (13 male and 5 female) participated in the course and passed it. All worked at least part-time while studying. Three participants had two or more years of experience in leading small teams. 17 reaction sheets were handed in after the first course block, 18 reaction sheets after the second and third block. 17 students elaborated self evaluations and participated in a survey on general course learning effectiveness. 15 participants elaborated a work-related team leadership experience description using the *rhea.framework* reflection template. 12 students filled out the questionnaire on the reflection process model.

8.3.3 Findings

In the last day of the third block, three flow sessions moderated by students who volunteered for moderation were held concurrently within one hour time plus 20 minutes reflection in the whole group. After the flow sessions, participants were invited to share their perception of the flow sessions in one word. *"The following words were mentioned (translated from Czech):*

balance; questions; interest; belongingness (= belonging together or connection); experiences; feedback; openness; relaxed feeling (= relief/letting go); opportunities/options; understanding; complex; eagerness; clarity; elaborate; naturalness/genuineness; exciting/intriguing [269]."

Open questions within the questionnaire on the reflection process model were answered by 10 of 12 questionnaire participants. In the process of qualitative coding, coding categories were elaborated by the author of this thesis. These were discussed, and agreed upon by the thesis supervisor. *"Category labeling was influenced by guiding questions in the questionnaire hinting at framework implementation in practice. Category labeling was tested on reactions that reflect leadership from the third meeting [269]."*

Table 8.6 shows questionnaire participants' responses in the resulting category tree.

Questionnaire (Qualitative Resp.)	
MODEL UTILITY	
Usefulness (4/10)	*"very useful analysis tool (R1)", "quite practical, can be used in team interactions (R4)", "helpful (R5)", "enables young leaders to reflect on leadership and soft skills in interpersonal interventions (R10)"*
Broader perspective on interpersonal situation (5/10)	*"wider and deeper understanding of issues related to leadership (R1)", "flow session helps through coherent, 'personalized' help from others (R2)", "helps to hear similar thoughts as personal and other points of view (R7)", "better understanding of problem (R8)", "look at problem from a broad perspective (R12)"*
Enables arranging and comparing to leadership areas (4/10)	*"helps somewhat to categorize problem and makes it easy to share (R2)", "complex (R5)", "smaller details easily noticeable (R8)", "hierarchies of terms for categorization (R12)"*
Tool coherence (3/10)	*"template definitely makes the description easier, template helps to focus on the problem (R2)", "clear (R5)", "roles are properly defined (R8)"*
Motivating (1/10)	*"fun to present (R7)"*
IMPLEMENTATION CONSTRAINTS	
Willingness to participate in experiential peer learning (3/10)	*"difficult to organize appropriate group if interested people for flow session: independent participants, willing to improve leadership skills, willingness of participants to solve problems, independent participants, willing to improve leadership skills (R1)", "important to find person that wants to share, luck to get open people (R6)", "willingness to participate (R10)"*
Group culture of open communication (4/10)	*"enough level of openness (R1)", "culture (R5)", "company culture, nationalities of actors, flat organizational structure (R8)", "recommended in corporate environment eg during retrospectives, open culture (R10)"*
Confidentiality (3/10)	*"question of confidence (R1)", "how confidential the information is shared (R2)", "personal knowledge between people (trust?, confidentiality?) (R8)"*
Group size (2/10)	*"company size or team size (R5)", "company size (R8)"*
Other environmental circumstances (3/10)	*"life situation and backgrounds of individuals in group (R4)", "how long team already works together, kind of project (R5)", "timing (R10)"*
MODEL UNDERSTANDING ISSUES	
Differentiation of model and other interpersonal processes: case study, group discussion (2/10)	*"similar to case study structure (R3)", "model appears similar to plain group discussion (R7)"*
Complexity and rigidity of process model (2/10)	*"categories and relationships may not be useful, description is enough, but maybe in other cases important (R4)", "more rigidity in ... (name of process model, authors note) than needed, not all problems fit guideline (R8)"*

Table 8.6 Case Study Questionnaire Results - Qualitative Content Analysis (from [269])

Four of 10 questionnaire participants emphasize the usefulness of the process model. Five of 10 participants consider the model to be helpful to get a broader perspective on interpersonal situations. Four participants indicate that the model may support comparing and arranging personal experience descriptions to leadership areas. Three participants mention coherence of reflection template and guideline as well as flow session policy and procedure.

Students mention personal willingness to participate in experiential peer learning, a group atmosphere of open sharing, and confidentiality as significant implementation constraints of the framework. Further, the group size needs to allow for interpersonal case-based learning.

The reflection model was mentioned to appear to be similar to other communication formats, such as open case or group discussion. Further, participants referred to the necessity that the reflection template may be adapted to personal preferences.

Ten participants consider the reflection process model to be convenient for less experienced team leaders. Two participants consider it helpful for students. One participant regards the reflection process model to be supportive for more experienced team leaders.

Quantitative questionnaire results are listed in table 8.7. *"The median of the sum of the quantitative questionnaire elements is 33 (of 50) or about 66%. The mean value is 34.4 or approximately 69%. Median and mean value of the sum of quantitative questionnaire elements hints at the interpretation that the process model was perceived as rather supportive for experiential learning; however there is room for improvement [269]."*

Leadership in work contexts was reflected in five reactions from the third course block. Table 8.8 shows coded text portions alongside categorizations. Contributions are slightly altered by the author for reasons of anonymization.

To gain more insight on participants' perspectives on the reflection process model, an email was sent to course participants asking to elaborate on using the model in a continuous reflection process and on using the structured reflection template. Table 8.9 lists portions of replies of both course participants who responded that may be considered relevant to the evaluation of model utility.

Both participants mention that continual flow sessions could be beneficial. They state that the template facilitates focusing on reflecting on personal experience.

No.	Item	Responses	Distribution					Points (in %)	Median	Arith. Mean	Standard Deviation
			NO (1)	RATHER NO (2)	PARTLY YES (3)	RATHER YES (4)	YES (5)				
1	Is the structure of the reflection template helpful?	12	0	0	6	3	3	75%	3.5	3.75	0.8660
2	Is the categorization of experiences in leadership team interaction categories helpful?	12	0	2	3	3	4	75%	4	3.75	1.1382
3	Is the reflection guideline clear and easy to understand?	12	0	2	4	6	0	67%	3.5	3.33	0.7785
4	Is the flow session policy clear and easy to understand?	12	0	1	3	6	2	75%	4	3.75	0.8660
5	Is the flow session procedure description clear and easy to understand?	12	0	0	3	8	1	77%	4	3.83	0.5774
6	Is the flow session procedure description helpful?	12	0	0	2	7	3	82%	4	4.08	0.6686
7	Is the reflection process model helpful to develop or refine personal leadership qualities?	11	0	2	5	2	2	67%	3	3.36	1.3790
8	Is the reflection process model innovative?	10	0	2	3	5	0	66%	3.5	3.30	1.4848
9	Is the reflection process model easily accessible?	10	0	1	4	3	2	72%	3.5	3.60	1.6514
10	Is it easy to read?	11	0	1	6	3	1	67%	3	3.36	1.2401

Table 8.7 Case Study Questionnaire Results - Quantitative Response Distribution (from [269])

Reaction Sheets (Third course block)	
Broader perspective on interpersonal situation (MODEL UTILITY)	*"I am grateful for being able to bring up, talk about, and get feedback on my situation in the flow session. All of the ideas and comments were highly interesting and have written them down. I will try to implement all of them in the near future and see if it makes a difference."*
Broader perspective on interpersonal situation (MODEL UTILITY)	*"What I liked the most was discussion about team-leadership interaction in smaller groups, kinda similar to open cases."*
	"It was interesting to get opinions from other perspectives, where I was given precious advice."
Group culture of open communication (IMPLEMENTATION CONSTRAINTS)	*"Thanks to the fact (I might have mentioned this before), that we already knew each other pretty good, we were even more open."*
	"Atmosphere was completely friendly and I enjoyed it."
Tool coherence (MODEL UTILITY)	*"Another thing that resonated in me during the last block was the ... flow exercise we did. Even thought we had only a night before to read through the guideline, I found some very interesting information in it. Specifically, appendices 1&2 listing leadership interaction and risk categories. Remembering those whilst in a leader role might be a good thing."*
Motivating (MODEL UTILITY)	*"I enjoyed the open case and flow sessions where we talked about work issues much more than the one with personal issues. I don't want to devaluate previous open case ..., but I just felt more comfortable with work stuff :)"*
Differentiation of model and other interpersonal processes: case study, group discussion (MODEL UNDERSTANDING ISSUES)	*"Best part was again case study, because we worked in smaller groups on an interesting topic that was really close to me and it helped me to realize some situations when I didn't know how to react. Probably I would react in a different way, maybe better. I learned that open-case and flow session have similar structure. I also learned to calm down my own feelings and ideas, and listen to case provider more. I would like to know how our open-case and flow session ended and if it was helpful for case-provider."*

Table 8.8 Case Study Reaction Sheets - Qualitative Content Analysis

8.3.4 Discussion and Limitations

"Blending quantitative findings with results of qualitative content analysis, the reflection process model appears to be perceived rather supportive for experiential learning within the group of course participants. Nevertheless, due to the modest sample size and investigation of a single course only, further research is needed to confirm or disconfirm the findings of the current case study [269]."

Differences in respondents' consistency in attributions to model effectiveness were found comparing written reactions and responses and quantitative questionnaire items. Only few course participants were experienced in team leadership in the ICT industry. This may explain why course participants found the reflection process model particularly suitable for less experienced team leaders. Implementing the *rhea.framework*, time needs to be allocated on introducing the framework and to share effects of personal reflection on leadership team interactions [269].

Email responses suggest further research on continual flow session sequences.

Question	**Response 1**	**Response 2**
Do you think that further flow sessions (i.e. the variant of open case sessions we had in the 3rd block related to teams and leadership) would be beneficial for you? If so, please indicate in which way you think you and/or your environment could benefit from them. Which positive changes would you expect from them? If no, please share why.	*"I guess further flow-sessions could be beneficial. As anywhere else the second attempt could be more effective and valuable... All participants are already aware of the rules and actions to be expected from each role and they feel more free and open. It's also expected that the mood of the group, the climate and relationships inside the group will be closer and better. ... Hence they can study the case more deeply and find more solutions."*	*"I think that the flow sessions would be beneficial, on the condition that the group participants offered topics to debate."*
Do you think that further flow session on the same topic would be beneficial, i.e. the case/flow provider follows up his/her case in a flow session, say one month after the initial session?		*"I think that a further flow session on the same topic would be valuable. It could motivate the provider to act on the issue and apply some of the proposed solutions in practice, instead of 'just' talking about the problem. After taking action, the provider would share his/her experience with the peers. The provider would also reflect on which solutions have worked and which not, and why."*
Do you think that your written reflections of your experience had any (positive or negative) effect on your learning? If so, can you try to describe the effect of thinking about and writing up team-leadership flows?	*"When I write the reflection of my experience I usually carefully think about all aspects of it."*	*"Individual questions in the flow template provided a structure of areas to think about. This made It easier for me to focus on the topic, that is, the problem itself. I didn't have to worry that I forgot to think about some *aspect* of the topic. In other words, I could fully concentrate on the content, not metacognition."*
Can you try to describe the particular benefits or drawbacks of first filling the reflection template (with consulting the reflection guidelines) and then participating in the face to face flow sessions plus reflecting on them?		*"As for the participation in the session, this was highly beneficial. Other group members provided inputs that I did not think about and helped resolve the issue."*
Can you try to describe the effect - on yourself - of writing reaction sheets to our course units?	*"It definitely allows me to remember more information from the course."*	*"Writing reflections helped me to understand my experience from the course by looking at it from a different point of view, after some time passed."*

Table 8.9 Case Study Email Responses

8.4 Framework Modeling Expert Audit

A model is an abstraction of aspects of an original (see also section 5.2.5, p. 65). It can be defined as *"the result of a construct done by a modeler, who examines the elements of a system for a specific purpose such as the redesign of an organization or the development of an information system at a given point in time with a specific language ... [537, p. 4]."* This definition highlights the involvement of the modeler in the modeling process.

"The emphasizing of the subjectivity in the modeling demands for specific measures for the management of the subjectivity in order to develop intersubjectively comparable and provable models [537, p. 4]."

To validate the *rhea.framework* in the framework domain, an expert audit with 25 persons in leadership positions in industry (mostly ICT) was carried out in an online survey [185] primarily based on the guidelines of modeling as presented by Schuette and Rotthowe [537].

Participants were asked about framework understandability, completeness, language clarity, originality and usefulness. The framework and its representation in the web application (Prototype C) were refactored based on expert feedback.

A second expert audit with 26 more participants in leadership positions in industry yielded satisficing results in all expert audit dimensions.

8.4.1 Method

In the IEEE Standard for Software Reviews (IEEE Std 1028-2008) audits are described as independent evaluation of conformance of artifacts to applicable standards or guidelines. In this study, the web representation of the *rhea.framework* (Prototype C) is assessed by auditors from industry according to modeling guidelines in an online survey. Responses were analyzed triangulating qualitative content analysis [411] with results of quantitative questionnaire items.

8.4.1.1 Participants

Auditors were approached through the web application Prolific (https://prolific.ac) that helps researchers find target participants for online questionnaires offering demographic screening for researchers and micropayments for questionnaire respondents.

Most participants in this web application are from the United Kingdom (around 45 %) and from the United States of America (around 29 %). Moreover, respondents are from countries such as Canada (around 3 %), Germany (around 2 %) or Australia (around 1.5 %). Half of the participants (around 50 %) live in the United Kingdom, approximately a third of the participants in the United States of America (around 29 %). The majority of respondents is caucasian (around 80 %). Most participants speak English as their first language (around 81 %).

The first expert audit was conducted on 1. 8. 2018. The second audit took place on 14. 8. 2018. In both audits, the following screening options were selected:

- Age: between 25 and 65 years
- Employment Status: Full-Time and Part-Time
- Leadership/Position of power/Supervisory duties: Yes
- Industry of work: Computer and Electronics Manufacturing, Information Services and Data Processing, Software
- Management Experience: Yes

In the second audit another screening option was introduced:

- Previous Study: participants of the first audit were not offered to participate in the second audit

The research endeavor was described on Prolific as follows:

In this study you will be asked to evaluate a leadership learning framework presented on a website. Please take your time (around 30 min) to check out the framework before answering the questionnaire. Please keep in mind that the website is a prototype (it is not optimised for mobile or quick loading times).
All data will be anonymised.
Question Overview:
> Demographics (Current work occupation, Gender, Age)
> How would you characterise the framework?
> Is the framework understandable?
> Is the framework complete? Does it provide the information you need to readily participate in team leadership reflection?
> Is the language used in the framework clear and easy to understand?
> In your view, what is original about the framework?
> Is it useful to you and your profession?

8.4.1.2 Questionnaire

A questionnaire was generated based on the guidelines of modeling [537] adapted from framework validity questionnaires by Motschnig and Güver [436], [435] and Motschnig and Hagelkruys [437].

Besides demographic information (*gender, age, current work occupation*) the questionnaire combines free-text questions (*How would you characterize the rhea.framework?, In your view, what is original about the rhea.framework?*) with Likert-scale [382] items. Likert-scale items (*Is the framework understandable?, Is the framework complete?, Is the language used in the framework clear and easy to understand?, Is it useful to you and your profession?*) were formatted as listed subsequently: 0 for *"No.""*; 1 for *"Rather no."*; 2 for *"Partly yes, partly no."*; 3 for *"Rather yes."*; and 4 for *"Yes."*.

Conditional free-text questions complete Likert-scale answer options. If respondents select other options than *"Yes."* referring to understandability, the following question is added: *What makes it hard to understand?*. If respondents select other options than *"Yes."* referring to completeness, the following question is added: *What could complete the framework?*. If respondents select other options than *"Yes."* referring to language clarity, the following question is added: *If it is hard to understand, do you have suggestions for improvement?*. If respondents select the option *"Yes."* referring to usefulness, the following question is added:

What do you consider particularly useful?. Otherwise the following question is added: *If you think the framework repeats previous ones, please indicate which frameworks are already in place that cover all the features of the rhea.framework supporting the reflection of team leadership practice?*.

The questionnaire was implemented using LimeSurvey (https://www.limesurvey.org). All responses were anonymized.

8.4.2 Expert Audit A - Findings

The first expert audit took place on the 1. 8. 2018. Survey participants named the following work occupations: *Full time IT consultant, Senior Product Manager, QA Supervisor, enterprise owner, Chief Technology Officer, Supervisor, Librarian, Business Developer, Chief Information Security Officer, Senior Software Engineer, Manager (Head of Client Services), Project Manager, employ manager, IT Manager, AAI Agent, Account manager, Support Lead - Consumer Technology Retail Support, Lead (Team-) Developer , Swing Shift Supervisor, IT Director, Internet Analyst, IT Manager, Head of IT Department, Partner in firm involved in IT, Business Analyst Team Leader for an independent software house, Computer Technician*.

The youngest participant was 26 years of age, the oldest was 60 years of age. The arithmetic mean in age distribution was 38 years of age, the median was 36 years of age. 16 participants (64 %) were male, 9 participants (36 %) were female.

Table 8.10 lists quantitative results of the first expert audit.

While the framework scores satisficingly on completeness and language clarity, results point at framework improvements in understandability and framework application. Table

Item	**Responses**	**NO (0)**	**RATHER NO (1)**	**PARTLY YES, PARTLY NO (2)**	**RATHER YES (3)**	**YES (4)**	**Points (in %)**	**Median**	**Arith. Mean**	**Standard Deviation**
Understandability	25	0	3	14	7	1	56	2	2.24	0.724
Completeness	25	1	2	5	6	10	70	3	2.92	1.176
Language Clarity	25	0	5	4	4	12	73	3	2.92	1.222
Usefulness	25	2	4	4	4	11	68	3	2.72	1.4

Table 8.10 Expert Audit A - Quantitative Results

8.11 shows highlights in qualitative results alongside exemplary participant responses. A complete listing of text-based responses can be found in Appendix E, p. 391.

Item	Response Count	Highlights	Exemplary Responses
Framework Characterization	25	Structured Experiential Learning Support, Decision Support in Team Leadership, Team Leadership Methodology, Situation Analysis Algorithm, Conflict Resolution Model, A Flow Diagram of Team Interaction	*The main skill of the rhea.framework is to support practitioners involved in team leadership in reflecting interpersonal interaction in their day-to-day work; A model to structurize learning from a significant event, using a flow as a form of reflection on that event, and discussing that flow for peers to learn from it; It is an algorythm to analyze situations described by the user and provide constructive feedback; It appears to be a model to facilitate conflict resolution.; a flow diagram that shows how things should happen when a certain occurrence appears. Its also a hub for training and development; Looks like a methodology framework for team management, It seems to be of an Agile orientation.; A methodology for effective team leadership*
Understandability	24	Practical Examples, Wording, Flowchart, Benefits, Layout, Problems to be solved, Complexity	*Lack of a real world and practical example; it's kind of sitting in isolation; where are the practicable application examples? All wind and no grounding; Mostly a sales pitch of the benefits, lack practical explanations of how to use. ; The framework could perhaps better be described in simple everyday terms, in order for less-formally trained leaders to better understand and hence implement it.; Things need to be simplified a little.; Some of the terminology used will put people off, such as not everybody knows the difference between a reference model and a normative model. The way it is structured is a little off putting as some times the highlighted links bring up a popup, other times it takes you to a new page. I think that given more time, i would have a better understanding of it, however, obviously there is a time limit with this study.; It is explained what it does before it explains what it is or why one might need it. It assumes one knows what a framework is. It was hard to figure out that this just a way to document team leadership activity and weight it against past leadership activity and build compliance to best process across the organization.; It is nit written in plain language. As currently written, it might appeal to academics, but I doubt too many people in the real world are going to take time to decipher the coined terminology.*
Completeness	13	Practical Examples, Links to Literature, Layout, Flowchart, Integration to Unified Process	*Would be better to have links to the literature. The core flows aren't really expounded upon and are instead distilled into key takeaways with no real practical examples.; Clear instructions on how to use, how to structure a flow session from the written flow etc; A set of rules which must be met to be defined for each step, this could be achieved through a series of example conditions or rules for each step of the flow.; The guidance for laying out a session is quite clear and easy to understand. I would include a learning objective at the top in short bullet points to enable the lead to refer back to this easily. It would help to define the objective first before laying out a session.; More prominence given to the iteration and incremental elements of the Unified Process - perhaps I just missed it.*
Language Clarity	13	Wording: Concise/Short, Benefits, Key Objectives, Terminology Description	*Comes across as too scientific. The level of language is quite complex and as such makes it hard to grok.; a little bit more descriptive, and easier vocabulary. For example, in my line of work this would come in handy, and I might even suggest it to my manager. The thing is, most of the people I work with, their English is not perfect, so I think easier vocabulary would do the trick.; Simplification of terminology.; I didn't find it hard to understand, though I think the ideas could often be put forward in a more concise way.*
Usefulness	19	Structured Reflection, Core Flows, Team Reflection, Cost Efficiency, Support	*The key takeaways of the Core Flows.; To analyze significant events in a more structured manner; the possibility of reducing costs and increasing efficiency; The information that is inside there and the methods of doing certain things; The Model Visualization; It's useful to provide a detailed framework to conduct an analysis of a stress situation. It's useful to be able to refer to similar situations experienced by others.; Steps taken within the flow chart can be utilized on different significant events that happen where i work*
Similar Frameworks	4		*I don't know of any.; SCRUM has something similar in the daily meetings.; I think there are similar workspace flows and collaborative development tools but nothing nearly as elaborate or scalable that could be applied to any organization. There features here are unique and far more progressive with advancements in technology being fully utilized.*
Originality	25	Depth, Support, Focus on Self Reflection, Structured Reflection, Team Reflection, Complexity	*I really didn't find anything original about it. Honestly, there's nothing there that stands out about this framework to me.; Nothing it is a collection of things from other methodologies or suggested methodologies in literature.; This tool is new to me. It looks interesting; A stronger focus on self reflection; Trying to achieve simplicity in complexity.; its a good hub of information which is full of information which could come in handy; I haven't seen a website-based approach to this before. The attempt to not shy away from complex leadership is welcome. Often there is a basic, non-prescriptive approach to these scenarios: platitudes instead of actionable content. The 'Key Takeaways' popups are good. Overall I think the way that the dry academic literature has been invigorated into a web/HTML is impressive and certainly cuts through a lot of the barriers to the study of people and project management.; I haven't come across such a similar structure in quite so much detail before, nor one that formalizes the process over a 6-12 month period.; I've never actually seen anybody try to produce a framework like this. I've been on team leading courses, but that was over 10 years ago, and they didn't provide much in the way of assistance. I did like the model visualization and the way that you just click on a phrase and it shows a description with links to other phrases. To me that was the most impressive part.*

Table 8.11 Expert Audit A - Qualitative Results

8.4.3 Refactoring

Based on findings in the first expert audit, the web-based framework representation was significantly revised considering understandability and framework use.

- Direct links to the GitHub project to be accessed from every framework webpage were removed, though a link is still provided in the online flow template, if people want to analyze their written reflections locally.
- The team leadership reference model (including core flow takeaways) and normative models of leadership interactions and risks were subsumed and introduced as team leadership knowledge base.
- Further, concept labels, such as flow or core flow, were listed in levels of abstraction.
- A title and an introduction to the framework describing its domain and use - highlighting structured personal and case-based interpersonal reflection opportunities and an in-depth team leadership knowledge base - were added to the landing page.
- The activity UML diagram was removed from the web representation. Instead, a simplified activity figure and description were added.
- A scaffolded introduction to the team leadership knowledge base was added.
- A graphic showing possibilities for integration in software development methodologies was developed (see also section 9.2, p. 332).
- Each core flow is described with key takeaways along Unified Process integration, an emotional landscape and related reference flows derived from the knowledge base graph.
- To simplify language, a native English speaker was asked for language improvement suggestions on the revised framework web representation.

8.4.4 Expert Audit B - Findings

The second expert audit took place on the 14. 8. 2018. Questionnaire participants held subsequently listed work occupations: *Field supervisor, IT Help Desk Engineer, secretary, Dev, Worker, sales manager, Software Developer, IT manager, employee, IT MANAGER,*

Information Technology Manager, Product owner, Full time Client Support, network infrastructure engineer, Programmer, Executive Leadership , Customer Support Agent, student, Information IT upper management e.g. IT Supervisor, administration, IT specialist , Service Manager, IT in the healthcare sector, Information Technology manager, Scrum Master and Software Developer, Manager.

The youngest participant was 27 years of age, the oldest was 59 years of age. The arithmetic mean in age distribution was 35 years of age, the median was 34 years of age. 19 participants (73 %) were male, 7 participants (27 %) were female.

Table 8.12 shows quantitative results of the second expert audit. Framework scores improved in all dimensions compared to the first expert audit. The framework scores satisficingly on understandability as well as usefulness, and on completeness as well as language clarity.

Item	**Responses**	**NO (0)**	**RATHER NO (1)**	**PARTLY YES, PARTLY NO (2)**	**RATHER YES (3)**	**YES (4)**	**Points (in %)**	**Median**	**Arith. Mean**	**Standard Deviation**
Understandability	26	0	0	8	10	8	75	3	3	0.8
Completeness	25	1	0	4	7	13	81	4	3.24	1.012
Language Clarity	26	2	0	2	8	14	81	4	3.23	1.142
Usefulness	24	1	1	4	4	14	80	4	3.21	1.141

Table 8.12 Expert Audit B - Quantitative Results

Table 8.13 shows highlights in qualitative results alongside exemplary participant responses. A complete listing of text-based responses can be found in Appendix E, p. 391.

8.4.5 Discussion

To validate framework modeling, expert audits were carried out with people that could eventually utilize framework contents in their work environments.

Specifically, the expert audits allowed validation of framework construction adequacy [537, p. 6/7] (in the dimension *Completeness*), language adequacy [537, p. 7/8] (in the dimension *Language Clarity*), clarity [537, p. 9/10] (in the dimensions *Characterization* and *Understandability*).

In the second expert audit, after significantly refactoring the framework web representation (Prototype C) according to participant feedback from the first expert audit, the framework scored satisficingly in these dimensions.

Item	Count	Highlights	Exemplary Responses
Framework Characterization	26	Structured reflection, Supporting Leadership Practice	*While the structure seems clear and easy enough to understand, there is still a lot of loopholes that could make it fail. It is idealistic.; A process to manage teams in software development.; The rhea.framework is a technologically driven process which aids in developing better practices in leadership and offers not just the ability to self work through an issue, but guidance generated from academic resources.; An educational and knowledge sharing platform.; rhea.framework providing a structured reflection template with an easy to follow reflection guideline, an in-depth team leadership knowledge base for comparison and exploration, and offering opportunities to get in contact and share experiences with other team leaders in moderated, case-based reflection meetings.; From what I can understand It is to support practitioners leadership in their day to day work*
Understandability	18	Framework Use in Practice, Complexity	*Lack of examples (pre-filled) or templates so someone unfamiliar but who wants to dwell on this can have somewhere to begin.; Theoretically the process makes sense but I think I would need to use it a few times before having a solid grasp of it. I would need to see how quickly and efficiently I could get from problem to solution and the effectiveness of putting more academic and cerebral ideas into practice in a real world setting with unique individuals and demands.; it uses a lot of complex narratives to describe what is a much simpler system; While it is understandable I think it could benefit from real world examples, as well as some discussion as to how it can fit in with existing methodologies.*
Completeness	12	Framework Use in Practice	*It seems that the system could benefit from user feedback in order to continually fine tune suggestions and approaches. In other words, add more practical use to the academic base and case study library upon which it's built.;an example with the framework and more description in the end could complete the framework.; It just seem too personally engaging and less on the professional side.; It needs a guide to walk you through the reference material. Just randomly clicking through the technical terms didn't feel an effective way to understand the framework.*
Language Clarity	10	Simpler Wording, Framework Use in Practice	*Maybe is some area use less academic wording.; You can have a case study or example as a narration to make your point which would make it easy to understand.; I feel that some of the words used could be simplified for those that may not use such terminology in their workplace. Other than that it is easy to understand.*
Usefulness	21	Structured Personal Reflection, Case-based Peer Reflection, Knowledge Base, Knowledge Base Visualization	*i think all the feature it has is very helpful for my job decisions; Significant event and core flow is really very useful for me; many stressful situations can occur within teams a reflection on events can dig down into events and help resolve issues; ""contact and share experiences with other team leaders"" this features is very useful for me; I think the knowledge base is particularly beneficial as you might arrive in similar situation from time to time and can help to make more informed decision in future.; No installation or fiddly nonsense, sourcing the project was a simple task for our team. Also, it is simple for our beginners to understand.; I think the data visualisation of the knowledge base is very useful in identifying similar issues and solutions. For example my team may adopt one of these solutions, find it greatly beneficial, and wish to use this visualisation to find similar solutions.*
Similar Frameworks	1		*I havent had the chance to get any other info on frameworks like this. its new to me i like the concept*
Originality	25	Open Source, Reflection Process, Bridging the gap between research and practice, Flexibility, Focus on Personal and Interpersonal Reflection	*nothing I have used similar tools with m team; It's new and it's open source. Maybe those things; It takes the reflection process to an entirely different level. By combining the three activities, it appears to allow for a far greater understanding for leadership practices than anything else out there presently.; The rhea.framework, to me, seems like having a consultant to help with issues and get ideas and suggestions from. Additionally it seems that the program can bridge the gap from peer reviewed, reputable academic research and the real world practicality that research seeks to address.; I think that its level of abstraction makes it enough flexible to adapt itself to most contests. Furthermore, concept like "Significant Event" and their comparison are very remarkable.; I feel that it's original because it covers so many different areas. Many resources like this are limited or only focus on basic aspects of management. The knowledge base visualisation is also very unique.; Many other organisations already offer the reflective framework such as the NHS. I like that it is original in nature as it originates from the person involved.; Knowledge base part is original about the rhea.framework. knowledge base can be compared to personal experience with reference flows what makes it really dimensional, innovative and original also.*

Table 8.13 Expert Audit B - Qualitative Results

"The central problem of treatment validation is that no real-world implementation is available to investigate whether the treatment contributes to stakeholder goals [630]." As most audit participants held leadership positions, questionnaire responses hint at framework usefulness in the problem domain [630], [279, p. 84/85] (in the dimension *Usefulness*). In the second expert audit, the framework scored satisficingly in this dimension.

Still, a significant next step to improve framework usefulness crystallized through the expert audits, namely to arrange and document case studies of framework use in practice.

Lastly, stakeholders' perspectives on framework originality were captured [279, p. 83] (in the dimension *Originality*). Particularly the structured personal reflection process as well as case-based peer reflections were highlighted. Further, the depth and visual representation of the knowledge base were remarked.

Part IV

Conclusions

Chapter 9

Conclusions and Limitations

The design science research study presented in this interdisciplinary thesis crosses business informatics and psychology associating scientific paradigms such as design science, systems theory in organizational development and humanistic psychology. With a focus on interpersonal interaction supporting team performance in ICT projects (GP1), two key challenges were identified in the context of this work, namely how persons holding leadership functions within a project team (GP2 , GP3) can be supported in their efforts to promote team performance (BC1) and what interpersonal climate may support team leaders' experiential learning (BC2 , GP4).

A framework to support personal and interpersonal reflection processes in team leadership - the *rhea.framework* - was elaborated in response to practice and research gaps as well as stakeholder requirements (GR1). In the course of the study, several research artifacts contributed to the design of the *rhea.framework*. Exploring the ICT project team leadership context, four design principles guiding artifact development and underlying framework application crystallized. These consolidate to a nascent design theory on supporting team leadership reflection describing leadership as a function in interpersonal relationship within a group (section 5.5, p. 108) and emphasizing the reflection of ideas of human beings (*"Menschenbilder"*) as constitutive to interpersonal interaction (GR2).

Based on expert interviews, an initial conceptual model on team leadership supporting team performance with a focus on emergent process facilitation was outlined. It specifically refers to leadership functions and case examples of interpersonal interaction that promote team self-organization (section 6.1.1, p. 113). A normative model of leadership team interaction was derived from a systematic literature review. It was validated analyzing

significant event interviews with ICT project managers. In this consensual qualitative research study, involved researchers agreed upon characteristics of significant events described by interviewees that define a kind of family resemblance (section 6.2.2.2.2, p. 139).

Based on a collection of reference experience descriptions - mostly organizational patterns from different pattern repositories -, a team leadership knowledge base was arranged. Relationships in the ontology of reference experience descriptions were primarily established in a semi-automated development process based on semantic relationships between description keywords.

Contents were grouped to normative categories of leadership interaction, (project) risk and to project life-cycle phases described in the Unified Process via crowd-sourcing. The knowledge base thus integrates several taxonomies [281].

Core topics of team leadership were developed in a hermeneutic *blended reading* approach by clustering interrelated experience descriptions and comparing these clusters with key findings in a selective literature review. The knowledge base may be seen as contribution to a leadership theory focusing intersubjective systems and social identity within teams (GR1.2 , GR1.3).

Three socio-technical prototypes were implemented consecutively and presented to or validated by potential framework stakeholders to find out about information system design to support team leadership reflection. The *rhea.framework* is presented in a web application that can be accessed at: https://rheafmwk.io.

The framework is organized following a model view controller software architectural pattern. Reflection support is scaffolded (GR4.2) [557, p. 215] through a structured personal reflection template integrating leadership interaction and project risk taxonomies. An additional reflection guideline describes template sections and provides questions to aid personal reflection.

The team leadership knowledge base endorses four core reflection anchors in team leadership. Each of these core flows groups an interconnected collection of peer reviewed reference experience descriptions. Yet, reference experience descriptions, or reference flows, are also connected across core flows via semantic keyword relationships.

Personal written reflections can be compared to reference flows. Relationships between reference flows can be explored.

Core flow narratives can be inspected. Core flow web representations include emotional

landscapes inferred from contents of related reference flows.

The flow session procedure holds process steps for case-based peer reflection. The personal reflection template may help to present a case in beginning flow sessions. Knowledge base use is embedded in the (inter)personal reflection process. The reflection template is provided online as well as in print (GR4.3). Thus, the framework may be presented as supporting transformative reflection processes (GR4) [214], (see section 5.4, p. 90).

Stakeholder confidentiality requirements voiced in informal feedback, interviews and focusgroups are integrated in the framework and technical representation design.

Referring to the Design Science Research Knowledge Contribution Framework, the artifacts elaborated in this thesis may be seen as improvement in the area of experiential learning on team leadership in ICT projects providing viable scenarios for continual practice reflection [239, p. 345-347].

Adhering to the model view controller software architectural pattern, the *rhea.framework* allows - differing from other possibilities of experiential learning in leadership contexts - various framework mappings and is widely adaptable to (inter)personal and organizational needs and preferences.

The framework supports a non-deterministic perspective on team leadership and project management [460] focusing on personal reflection of work practice and on the continuous critical revision of a team leadership knowledge base through findings in peer learning.

Rodges et al. [501] (in: [91]) propose a two-axis model of leadership development initiatives. Leadership development frameworks can be positioned depending on whether focus is set rather on individual leaders or leadership as a collective process and whether leadership qualities and behavior are rather prescribed or if emergent leadership conditions are respected. The model is sketched in figure 9.1. Eighty percent of leadership initiatives can be found in sector 1, about 15% in sector 2 and 5% in sectors 3 and 4. The *rhea.framework* may be positioned in sector 3 as the main aim is personal reflection of interpersonal team processes.

Subsequently, a discussion of research questions considering artifact and research contributions described in this thesis in the context of delineated business challenges follows.

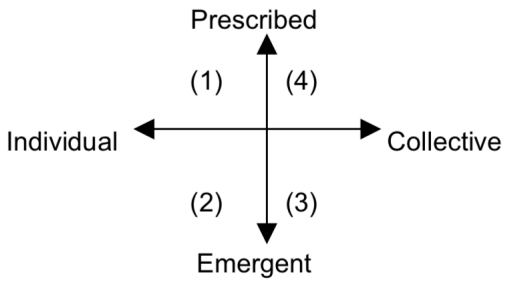


Figure 9.1 Leadership Development Framework Dimensions (from: [501])

9.1 Establishing Team Performance in Complex Environments (RQ 1)

Expert interviews allowed to develop a conceptual model on team leadership supporting team performance in ICT projects with a focus on emergent process facilitation.

In order to investigate what leadership interactions support team performance in ICT project teams, a systematic literature review was conducted. Normative categories of leadership interaction and project risks could be discerned.

However, in leadership behavior research consistent direct links between behavior and performance outcomes could not be established yet. Effective leadership behavior appears to be highly situation contingent. No specific leadership behavior variants could be discerned as universally effective. Yet it appears that leaders considerate regarding their behavior have more satisfied followers [451, p. 82].

In the context of this thesis, experience descriptions on leadership supporting team performance in ICT contexts, mostly in the form of organizational patterns, were collected. Relationships between collected experience descriptions were formed. An ontology was completed by working out key topics of team leadership in such complex environments - referring to interpersonal relationships within specific work circumstances. Reference experience descriptions are grouped to central team leadership reflection anchors (core flows). Key questions of core flows are listed subsequently (see also table 6.20, p. 204):

- Who are *"we"* and what is *"our purpose"*? (in *Prototype Team Identity*)
- What capabilities help us achieve our goals in our current environment? (in *Organize*

for Complexity)

- How are we going about this with each other? (in *Facilitate Team Cohesion*)
- What technical tools and engineering strategies help us achieve our goals? (in *Arrange for Task Effectiveness*)

Fleishman et al. emphasize that leadership models are necessary in elaborating leadership learning environments. *"Lacking a taxonomy of this sort, it seems unlikely that substantial progress can be made in the construction of leadership development programs and the generation of more effective models for understanding leader performance [215, p. 246]."* The *rhea.framework* integrates conceptual and normative models on team leadership. While the heuristics of the normative interaction model point to observable interpersonal interaction in an ICT project team - useful for analyzing a specific situation -, the core flows refer to a phenomenological process perspective on team leadership - and so aim to support continuous personal reflection.

The framework does justice to a leader-follower relationship research perspective [611, p. 360]. The design, architecture and development process of the knowledge base respond to challenges in collecting experience descriptions as outlined by Zhu et al. [651].

As information is constantly evolving, the entity model is text-based and the instantiation data model is easily extensible; as best practice collections may be valuable for several organizations, the framework is released as open educational resource. The ontology development can be automated to some extent.

The knowledge base is an initial learning resource integrating rather generalized interaction descriptions in complex work environments stemming from research in specific organizational contexts.

Interpersonal reflection meetings offer opportunities to differentiate and learn from unique interpersonal situations participants bring with them.

The minimal viable knowledge base developed in this thesis needs to be refined and updated to include a variety of case examples on team leadership in ICT team environments including references to feelings in interpersonal interactions. Further, knowledge base users may evaluate reference flow centrality and quality.

9.1.1 Integrating Flows in the *rhea.framework* Team Leadership Knowledge Base

Flow sessions as well as the *rhea.framework* reflection template can be viewed as vehicles for personal and interpersonal learning on team leadership in work situations. Flows can be compared or related to clusters of reference flows in the *rhea.framework* knowledge base to learn about similar or related team situations and to flexibly consider opportunities for action that correspond to learners' specific situation.

To update and maintain the knowledge base, case studies that correspond to experience description quality criteria may be collected from scientific peer reviewed sources.

9.1.1.1 Quality Criteria

Quality criteria for the integration of a case study (or an organizational pattern) to the *rhea.framework* knowledge base are:

1. Style (an interaction context, central tensions and consequences are described; eventually, an illustrative picture is added; meaningful keywords are used; ...)
2. Scientific Research (the description is based on or references qualitative or quantitative research; the description went through a peer-review process)
3. Relevance (contents are practice relevant)
4. Additional resources (further reading or online tools are referenced)

9.2 A *Person Principle* in the Unified Process (RQ 1.1)

The Rational Unified Process (RUP) identifies six key principles that underlie the development and maintenance of software-intensive systems:

1. **A**dapt the process. - including the practices *"Rightsize your process."* and *"Continuously reevaluate what you do."*
2. **B**alance stakeholder priorities. - including the practices *"Understand the domain."*, *"Describe requirements from the user perspective."*, *"Prioritize requirements for implementation."* and *"Leverage legacy systems."*

3. **C**ollaborate across teams. - including the practices *"Build high-performance teams."*, *"Organize around the architecture."*, and *"Manage versions."*

4. **D**emonstrate value iteratively. - including the practices *"Manage risk."*, *"Execute your project in iterations."*, *"Embrace and manage change."* and *"Measure progress objectively."*

5. **E**levate the level of abstraction. - including the practices *"Leverage patterns."*, *" Architect with components and services."*, *"Actively promote reuse."* and *"Model key perspectives."*

6. **F**ocus continuously on quality. - including the practices *"Test your own code."*, *"Leverage test automation appropriately."*, and *"Everyone owns the product."*

While the Unified Process offers time-based process descriptions in project disciplines and life-cycle phases, these key principles are not sequential. In fact, they reinforce each other [549].

Interfacing the Rational Unified Process principles to the *rhea.framework* core flows, connections can be established between *"Organize for Complexity"* and the principles *"Adapt the process."*, *"Balance competing stakeholder priorities."*, as well as *"Demonstrate value iteratively."*. Moreover, connections can be found between the core flow *"Arrange for Task Effectiveness"* and the principles *"Collaborate across teams."*, *"Elevate the level of abstraction."*, as well as *"Focus continuously on quality."*. The practice *"Everyone owns the product."* may also be seen related to the core flow *"Organize for Complexity"*.

While *"Build high-performance teams."* is mentioned as collaboration practice, no principle in the Rational Unified Process explicitly deals with team leadership capacities. The core topics elaborated in the *rhea.framework* , specifically *"Prototype Team Identity"* and *"Facilitate Team Cohesion"*, thus can be presented as significant extensions to Rational Unified Process principles (GR1.1).

Table 9.1 presents a mapping of core flows to the *four Ps in Software Development* as outlined in the Unified Process [317, p. 15/16].

Not only are core flows linked to reference leadership experience descriptions, but the *rhea.framework* also provides a reflection process model, including a reflection process activity, supporting experiential learning on team leadership in practice contexts.

Consequently, the contents of the *rhea.framework* may be introduced as a *Person Principle* along the Unified Process.

Core Flow	Mapping to four Ps in Software Development
Prototype Team Identity	People
Organize for Complexity	Project
Facilitate Team Cohesion	People
Arrange for Task Effectiveness	Product and Process

Table 9.1 Core Flow to Four Ps of Software Development Mapping

In the *rhea.framework* knowledge base, reference experience descriptions were aligned to Unified Process life-cycle phases through crowd-sourcing. Centrality of each reference experience description within the knowledge base ontology graph was calculated. Table 9.2 lists central reference flows aligned to life-cycle phases.

INCEPTION			**ELABORATION**		
Phasing it in	PTI	0,66	Pair to share	PTI	0,77
Face to face before remote	PTI	0,64	Form follows function	OFC	0,75
Sacrifice one person	OFC	0,81	Compass	FTC	0,92
End to end	FTC	0,71	Protect the victim	FTC	0,74
Lock em up together	FTC	0,69	Team per task	ATE	0,78
CONSTRUCTION			**TRANSITION**		
Master and Apprentice	OFC	0,98	Forge the team	OFC	0,7
Deploy along the grain	OFC	0,73	The Water Cooler	FTC	0,59
Wanderer	OFC	0,57	Production potential	FTC	0,44
Guruing by walking around	FTC	0,69	Standup meeting	ATE	0,59
Development episode	ATE	0,59	Sprint retrospective	ATE	0,47

Table 9.2 Reference Flows within the Unified Process life-cycle (with core flow labels and centrality scores)

The knowledge base can be traversed in multiple ways. Aligning reference experience descriptions to phases of the Unified Process allows time-based exploration of the knowledge graph. In figure 9.2, one sequence through the ontology based on Unified Process life-cycle phase categorizations is presented forming a critical path of team leadership in an ICT project. Shortest paths were calculated between nodes across project life-cycle phases traversing only keyword relationships. An exemplary shortest path Cypher query is listed subsequently:

```
MATCH (start:Flow  title:  'Sprint' ),
(end:Flow  title:  'Effective handover' ),
p = shortestPath((start)-[*]-(end))
WHERE NONE (r IN relationships(p) WHERE type(r)= 'ISHEURISTICSOF'
OR type(r)= 'HASHEURISTICS'
OR type(r)= 'HOLDSFLOW' OR type(r)= 'PARTOFCOREFLOW'
OR type(r)= 'ISEXPRESSEDIN' OR type(r)= 'INVOLVES'
OR type(r)= 'ADDRESSES' OR type(r)= 'ADDRESSEDIN'
OR type(r)= 'HINTSAT' OR type(r)= 'RELEVANTFOR'
OR type(r)= 'TOUCHESON' OR type(r)= 'SURFACESIN')
AND NONE (x IN nodes(p) WHERE x:UPLCPhase)
RETURN p
```

Following keywords connecting reference experience descriptions in the shown path (figure 9.2), a narrative of team leadership in an ICT project may be composed.

The key benefit of outlining such a critical path through the ontology can be seen in providing an additional perspective on the ICT project team leadership domain [146].

Semantic keyword relationships provide an additional knowledge layer distinguishing interconnected knowledge base contents from conventional assemblages of experience descriptions.

9.3 Characteristics of Significant Leadership Team Interactions (RQ 1.2)

In a consensual qualitative research study analyzing interviews with project managers in order to validate a normative leadership interaction model, qualities of leadership team interactions perceived as significant by interviewees were discerned. Three researchers agreed upon a set of descriptive characteristics forming a kind of family resemblance [633, §65-71] of significant events in team leadership (section 6.2.2.2.2, p. 139).

This set of distinguishing characteristics was added to the *rhea.framework* personal reflection guideline. It may support research on leaders' influence on group emotions (GR1.4).

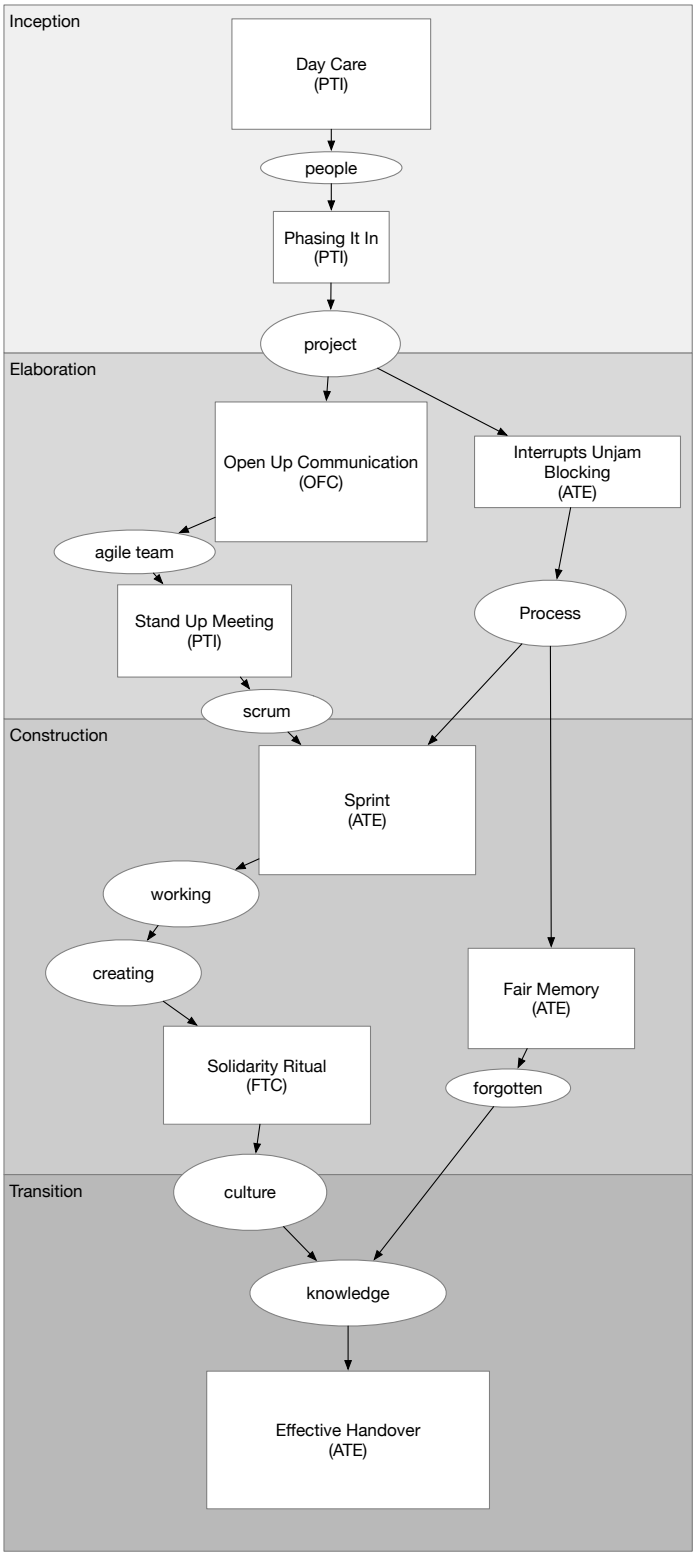


Figure 9.2 A Time-Based Path through the *rhea.framework* Team Leadership Knowledge Base

9.4 Supporting Emergent Team Processes (RQ 2)

A conceptual model of leadership capacities supporting the unfolding of emergent processes (creative interpersonal processes, team self-organization or team learning) was elaborated in a qualitative content analysis of expert interviews (GR3) with participants leading teams at universities or in industry and predominantly having published research on interpersonal relationships in humanistic psychology (depicted in figure 6.2, p. 119).

This conceptual model may support in arriving at a shared mental model on team leadership in complex work environments [611], [15]. Experience descriptions of facilitating emergent processes shared by interviewees are listed (GR3.1). Yet, intersubjective circumstances necessarily need to be considered. *"... conceptual analyses of the dynamics of team emergent states and team interaction processes suggest that the influence needs not be unidirectional from attitudinal responses to behavioral responses. Rather, team emergent states (e.g. shared understanding of the team and its task) and team interaction processes may mutually influence each other such that the nature of team interaction shapes emergent states as much as emergent states shape the nature of team interaction ... [611, p. 350]."*

Existing normative leadership behavior taxonomies were synthesized highlighting behavior categories related to emergent team processes (GR3.2), (see also section 6.2.3.2, p. 147). *"Managing emergent processes may form an additional major category of leadership behaviors in ICT-teams because of the specific circumstances these teams operate in [266, p. 9]."*

9.5 Preparing Informatics Students for ICT Project Team Leadership (RQ 3)

The ICT domain is unique in several respects (section 5.1.5, p. 45). In ICT teams, many highly specialized experts need to work together - at times in virtual work environments. Practitioners invent and push forward strategies, such as agile management or Kanban, in order to deal with complexity and tensions within the field.

Engineers in ICT - technicians - may lead development teams in business environments. Due to their knowledge and personal experience in technical implementation, they may fit team leadership in this specialized context better than other members of an organization with

different backgrounds.

An argument against leadership education in Informatics may be portrayed as such: *Only some of todays ICT students will be team leaders one day. So, those that are willing to manage, should attend specific courses. Software architects and technicians, however, get the real job done and may not be bothered with it. Technical excellence finds a place any time. Honestly, why should Informatics students engage in leadership education?* To tackle this argument, it is necessary to consider what is understood as leadership (section 5.3, p. 81).

Leadership can be set apart from (project) management. It can be described as an interpersonal relationship of mutual needs, aspirations and values between persons holding leadership functions and other organizational participants. *"Leadership roles elicit fantasies that reflect human needs and the drama of human attempts to connect and relate to others [319, p. 300]."* This view on leadership highlights leaders engaged in relations with others.

If we acknowledge that leadership is related to taking responsibility for (inter)personal interactions within a team in response to team members' work-related needs [112] - and thus perform as a team -, leadership concerns and affects each participant in ICT work environments. From this perspective, leadership education surfaces as highly important to professional future engineers. It makes a difference, if team members skillfully play together.

A follow-up argument may be: *But why research leadership education in the field of Informatics? There are massive amounts of research on leadership. There are dedicated scientific fields that study social interactions.* Informatics, in particular business informatics that combines ICT knowledge with social sciences, introduces a particular set of perspectives and methods that can help shed light on the complex phenomenon of leadership in ICT teams. Developing and evaluating artifacts for application in actual practice contexts and methods such as domain modeling provide valuable research angles to the problem field. Exploring leadership within actual ICT teams can further stem insights on specifics of team dynamics in ICT work environments.

How can leadership education supporting students' experiential learning processes be implemented in a Informatics curriculum at Universities? In the context of this thesis, a case study was organized to validate the use of the *rhea.framework* in a higher education context [269]. This case study describes an exemplary scenario for supporting experiential learning on team leadership in a University context. Further, the framework developed in this thesis provides scalable implementation options. A web-based representation can be accessed online supporting self-paced learning. Finally, the framework is released as open

educational resource.

9.6 Limitations

Major challenges faced along the design science research process presented in this thesis were high interdisciplinary complexity inherent in the team leadership phenomenon and limited material resources as well as limited contact to industry partners.

The first was mainly dealt with by repeated analysis - accumulation and selection - and synthesis processes. These processes are reflected in this work by descriptions of elaboration steps and discussions of learnings. Sensing into the research field continually provided hints to follow up in literature study and empirical research.

Resulting designs, although presented sequentially in this thesis, were not elaborated linearly. Some findings arrived at in the beginning of the research process were only integrated much later, and others that appeared fairly important were omitted along the way.

The elaboration of design guiding principles based on an in-depth exploration of the design context was tremendously helpful in the design process (GR4.1). These provided a compass in artifact design and validation. They framed the design context and presented a corrective design quality measure.

The second challenge was primarily faced by inviting some interested stakeholders from industry and higher education continually to share feedback and criticism on findings and designs over the course of the design science research process. Such peer feedback was tremendously enriching to arrive at design decisions for invited stakeholders were acquainted with the previous design process and could offer targeted criticism.

Periodically, artifacts were presented to stakeholders that were not acquainted with the design process. These meetings were tremendously worthwhile to clarify concepts and functions within artifacts. Framework design in contact with practitioners is seen as highly relevant in the field of empirical software engineering research (GR4.1), [554, p. 10].

Case examples were mainly retrieved from peer reviewed scientific sources (GR3.4). The *rhea.framework* core entity model may be used as reference structure for case study research on interpersonal interaction in ICT project teams (GR3.3). Text classification based on crowd-sourcing worked fairly well, although such service could not be utilized

extensively due to resource constraints.

To explore a large number of textual data in order to arrive at theoretical topic abstractions, natural language processing and graph analysis algorithms appeared useful. Yet, intersubjective model validation can not be substituted.

9.7 Contribution Summary

The key contributions of this design science research study are:

1. An empirically validated open educational resource supporting experiential learning in team leadership - the *rhea.framework* (chapter 7, p. 223) [Framework Artifact],

2. the elaboration of a normative team leadership model accentuating emergent process facilitation or supporting team learning as significant aspect of leading teams in order to leverage team performance in ICT projects (section 6.1.1. p. 113) [Model Artifact],

3. a semi-automated process to develop a team leadership experience description ontology by means of automatic keyword extraction, semantic word relationships and crowd-sourced categorization (section 6.5, p. 165) [Technical Method Artifact],

4. a modular *blended reading* approach [581] combining *close* reading of single texts and *distant* computer-supported analysis to arrive at essential team leadership reflection anchors [Technical Method Artifact], and

5. the use of significant events research as well as consensual qualitative research in business informatics to gather characteristics of significant events in ICT project team leadership (section 6.2.2.2.2, p. 139) [Theoretical Construct Artifact].

This work contributes to design-oriented information systems research [459], [279], [630] in outlining the iterative design and implementation prototyping of the *rhea.framework*, an improvement in reflective practice [430], [214] on team leadership. This process framework to reflect on leadership experiences in individual and peer learning scenarios is a clear contribution to the real-world application environment [239] of ICT project teams, especially in small and medium enterprises. Framework modules synergically contribute to continuous learning processes.

The framework resonates with leadership theories that define leadership as a group function that can be exhibited in interpersonal interaction by different team members at different

times and that highlight the contingency of leadership effectiveness and organizational and task circumstances as well as team diversity by referring to team prototypicality and team member self-categorization. Integrating social identity theory, intersubjective systems theory and organizational systems theory and highlighting the necessity of reflecting personal ideas of human beings (*"Menschenbilder"*), the *rhea.framework* conforms to a contextualist perspective on team leadership processes.

In a case study in an academic context, participants considered the reflection process central to the framework rather supportive for experiential learning [269]. Experts from industry rated a web representation of the framework provided as open educational resource satisfizingly understandable, complete, clear and useful (8.12, p. 321).

Offering a structured writing template inspired by organizational pattern forms [146] alongside a reflection guideline, the framework design responds to a need for guidance in reflective writing [430].

The guideline specifies characteristics of significant events in team leadership uncovered in a consensual qualitative research process. Critical incidents may constitute entry points to start reflective writing[430]. In this thesis, the critical incidents technique is contrasted to significant events research, highlighting the indication of significant events research to support the understanding of interpersonal process evolvements. Interviews with ICT project team leaders on significant events were analyzed adhering to a consensual qualitative research approach to validate and extend a normative model of leadership team interaction - adding to the body of qualitative research methods in business informatics.

The framework notably integrates a team leadership knowledge base in the reflection process - digitally accessible through a recommender system and scaffolded representation. Accessibility of knowledge base contents through semantic comparisons with written personal reflections based on industry-standard word vector models, rather than solely offering online reading material, may be considered a select improvement in information systems design supporting dialogical reflection [214].

Print versions of basic resources such as the reflection template and team leadership core topic descriptions are available. Confidentiality of personal reflection surfaced as an essential stakeholder requirement in framework elaboration.

The case-based peer reflection process description integrated in the framework is an adaptation of the open case peer consultation method [312] to the team leadership context, extended by suggesting moderation through professionals in group dynamics and interpersonal

facilitation. Focusing interpersonal relationships related to presented cases in continuous peer learning sessions from an intersubjective systems theory perspective, transformative reflective processes may be supported - especially in combination with personal written reflection and critical comparisons to reference experience descriptions in the knowledge base. The framework thus may be placed alongside other group-based experiential learning scenarios for professionalization in interpersonal interaction within work contexts, yet integrating peer learning with opportunities for self-paced learning by structured written reflection and by accessible domain-specific reference experience descriptions for critical comparison it offers a uniquely versatile reflective practice design attuned to a specific professional domain.

The graph of interlinked and categorized experience descriptions forming the knowledge base adds structure to the domain of leadership in ICT project teams. The knowledge base design adheres to a graph-structured data paradigm [518].

The semi-automated ontology development process mapped out in this work presents an approach to tackle challenges of larger scale experience repositories [651]: A wide variety of textual experience representation formats can be integrated in the knowledge base. Interconnections based on semantic relationships between keywords as well as categorizations in multiple taxonomies allow for traversing as well as generalization and specialization of experience descriptions to specific domain aspects. Automatic keyword extraction, semantic linking and crowd-sourced classification offer semi-automated ways to organize an ontology of team leadership experience descriptions.

Unstructured text data is enriched with properties such as automatically inferred sentiment scores, taxonomical categorizations and weighted keyword relationships. The knowledge base ontology allows for reasoning on complex, semantic entities via domain knowledge in the form of a team leadership ontology using a graph query language. It thus constitutes a uniform high-level domain description using domain-specific vocabulary over texts of possibly heterogenous structure. Ontology relationships and categorizations may support navigating through evolving amounts of (textual) experience descriptions for domain participants [458].

To arrive at key topics of team leadership and associated clusters of experience descriptions, a unique modular *blended reading* approach was elaborated. First, a preliminary topic set was derived from a selective literature review and keywords from experience description titles. Experience description keywords were extracted and semantically related. Community detection was used to form a clustering of experience descriptions. Most frequent words and unique keywords in clusters were then extracted and compared to the preliminary topic set to arrive at central team leadership areas. Iteratively, several clusterings of experience

descriptions were constituted using community detection and clustering algorithms to revise these entity groupings related to forming core topics. Hereby, experience descriptions that would fall into differently labeled clusters were read and eventually rearranged. Thus, *close reading* of single texts was combined with *distant reading* text mining approaches of first (word frequency analysis, keyword extraction) and second order (unsupervised community detection, clustering) [581, p. 22/50]. Utilized semantic network analysis approaches may be considered an extension to the repertoire of hermeneutic *blended reading* text analysis strategies.

Elaborated team leadership key area descriptions were validated in peer debriefing, further in a focusgroup and two audits by experts in academic and practice disciplines related to team leadership. Feedback in validation suggests that team leadership core topic descriptions support the understanding of team leadership phenomena.

This thesis contributes to research on emergent creative and learning processes within work teams [358] distinguishing emergent process facilitation as pivotal leadership interactions to support team performance in complex work environments such as ICT projects in the current scientific discourse on ICT project team leadership.

Clearly, learning from experience is one way of learning besides others. Solely depending on experience as learning path in organizational contexts may hinder grasping situational aspects beyond the current frame of reference [400]. Yet, taking time for reflection can support understanding and foster new learnings - and so contribute in efforts of promoting team performance in ever unique interpersonal situations. Further, the framework presented in this thesis can be combined with other leadership learning strategies.

With a focus on interpersonal work contexts - specifically by pointing to team prototypicality and facilitating team cohesion as enabling factors to team leadership in order to tackle complex work challenges - and providing a concise reflection process model including a scaffolded team leadership knowledge base, the *rhea.framework* may be integrated to business processes such as software engineering methodologies. It may form an extension to the Unified Process [317] - a *Person Principle* providing conceptual guidelines for team leadership learning.

Chapter 10

Future Research

Design artifacts developed in this study were validated using qualitative and triangulated qualitative and quantitative research methods, yet the long term effects of reflecting interpersonal interactions in team leadership by means of the *rhea.framework* on team performance in industry contexts may be assessed in a follow-up evaluation study. *"In implementation evaluation, we ask the same questions as in problem investigation but with a different goal. The goal of implementation evaluation is to evaluate a treatment after it has been applied in the original problem context [630]."*

From a social science perspective, this avenue of research branches into:

- the assessment of team performance measurements appropriate to ICT project contexts and
- of the (mediated) effects of team leadership on team performance,
- the improvement of a nascent theory of team leadership supporting team performance from a group identity and intersubjective systems theory perspective
- based on case accounts of the effects of leadership interaction in interpersonal relationships in work team contexts
- by means of significant events research adapted to the research context of ICT project environments,
- the refinement of the personal reflection template and
- interpersonal reflection settings with a central focus on peer learning moderation, and

- the evaluation of effects of personal reflection and experiential learning in peers on leadership practice.

Considering design science research, the revision of a framework instantiation as user-friendly open educational resource may be aspired. This specifically includes the further exploration of visualization techniques of complex dynamic interaction representations, e. g. in directed multigraphs, to represent multicausal relationships in a way that is easy to grasp for learners.

From a business informatics view, the socio-technical leadership reflection support system may be enhanced by further refining the ontology development process presented in this thesis, including for example user involvement to arrive at centrality calculations.

Text comparison may be improved by elaborating a classification model of ontology entities. Moreover, a retrofitting word vector model could be developed from documents within the ontology for improved document similarity measures. The reference experience description ontology may contribute to the evaluation of natural language processing usefulness for social theory elaboration.

Finally, the *rhea.framework* reflection process model may be introduced in domains apart from ICT project team environments.

Appendix A

Expert Interview Results - Exploration

The author of this thesis translated interview passages from German to English.

A.1 Principles

This category holds personal concepts expressed by interview participants and group discussion members that are highly dynamic, related to personal team leadership mental models, influenced by personal qualities and impacting interpersonal interaction in teams.

- **Context Awareness - 77 interview passages**
  Context awareness describes a recognition of personal experiences related to the present situation including self-concerns, interpersonal relationships and environmental circumstances necessary to attune to the current circumstances flexibly. It can be related to a personal motivation to learn and inquire, and an openness to feedback or criticism and to be surprised. An interviewee considers leaders supporting emergent processes *"to be in the project not as finished expert, but willing to learn as they go"*. A project manager mentions in the group discussion that, ideally, team leaders *"can live with a certain amount of insecurity"*. Another interviewee states: *"But I guess what I think about is accurate, slow, deep understanding of the project, which is a, you know, feedback-loop process over time."*

  Interviewees consider it highly important that team leaders reflect and have clarity about goals, necessary tasks, and the product or service to develop. Further they need to be firm in business processes they utilize: *"They have to know their job."* They have

domain knowledge in their professional area, including professional problem solutions and expert knowledge based on experience, and knowledge of important processes besides management and programming.

An interviewee adds: *"There is always an audience. There is always a third-party. Sometimes it is the creator of the task, or it is the customer, or it is a public - you know, something that is more about image or reputation or - there is just always an external part. And it is important to always keep that party in mind as well."*

Participants in the group discussion agreed that an ideal team leader cares about other decisions in the company that do not concern him or her directly, but knows where the limit of caring for that is. Ideal team leaders recognize situations in other companies. When working with clients, they may be respectful of clients' needs but also of the capacity of the team. They have an overview of the organizational context they work in.

An interviewee states that leaders' support for the team at project inception depends on goal specifications of stakeholders. *"What facilitates the project begin most depends on whether clear operationalized goals were specified (by the client) or broad goals were defined or whether a specific client exists (e. g. a team wants to participate in an call for proposals or develop something themselves that can be offered then). (orig.: Was am meisten den Projektbeginn fördert hängt davon ab, ob bereits vorher (vom Auftraggeber) klar operationale Vorgaben oder nur grobe Ziele definiert sind oder es (noch) gar keinen konkreten Auftraggeber gibt (z.B. Team will sich an Ausschreibung beteiligen oder selbst etwas entwickeln, was dann angeboten wird).)"*

Particularly in the beginning of a project, structures, contents and parameters - boundaries and goals - of a project are laid out clearly in the team. *"It is also supportive, if tasks are task distribution is clearly discussed - and that people then also are responsible and have decision power concerning their task (and so people don't have to feel 'responsible' for everything, which can easily degenerate to 'know-it-all'/surveillance) (orig.: Förderlich ist auch, wenn klare Aufgaben-/Funktionsverteilung abgesprochen wird – und die entsprechenden Personen dann auch Verantwortung und Entscheidungsmacht für diese Aufgaben zugesprochen wird (und sich nicht ständig jeder für alles 'verantwortlich' fühlt was leicht in 'Besserwisserei' / Überwachung ausartet).)"* An interviewee highlights that supportive team leaders *"make sure that everyone understands the goals and objectives of the project as well as the necessary actions to be taken"*. They make sure they have a clear contract with everyone involved in the

endeavor.

Context awareness, monitoring parameters and expectations within the project with an openness to the process of how it happens, allows for balancing assertiveness and non-directivity, balancing focus on tasks and (inter)personal issues, and balancing distance in relationships. An interview participant pinpoints: *"Communicating of the balancing of situational facts and personal dispositions - as well as between the undesirable extremes between aloofness and chumminess. (orig.: Vermittlung des Ausbalancierens von sachlichen Gegebenheiten und persönlichen Ausrichtungen – wie auch zwischen den unerwünschten Extremen von Unnahbarkeit und Kumpelhaftigkeit.)"*

Leaders supporting self-organization try to understand different perspectives. They support work processes, as one interviewee notes, *"simultaneously quieting the noise and keeping the focus"*. Another interview participant suggests that team leaders supporting team performance *"see the big picture, but can zoom into a piece and then zoom out again."* A third interviewee emphasizes a *"Compromise to focus on the present moment."* When things flow, team leaders supporting complex team processes are rather observing the project patiently as it unfolds, but ready to get active when situations turn conflictual. The quality of activity then may be perceived as receptive or empathic rather than dominant and assertive. In these moments, team leaders are more (self-)aware and involved, but after dealing with the situation they return to observing the evolving process. In the closing phases of a project, gratitude may be expressed in project reviews. Here, sufficient assertiveness and clarity in wrapping up may be expressed.

Interview participants suggest that team leaders have goals besides project objectives that are more related to their own way of being. These are rather distinct from project goals or tasks, yet may be motivated by an intent to support people within the project team. An interviewee notes: *"So like if there is a problem to look at oneself first whether that is: I am not understanding well enough or I am not quite aware of what my problem is whether there is something that I don´t want to accept, that I am frustrated with, or, but in the broad sense more about the development of the people involved."* This self reflection goes, according to the interview participant, along *"appreciating that you can have more influence or control with yourself than you can with other people."*

Personal needs and aspirations of co-workers are reflected: *"Regarding time pressure and achievement of objectives, it is not supportive to ignore personal individual needs*

(too long) at the expense of mutual objectives. (orig.: Es ist nicht hilfreich, im Hinblick auf Zeitdruck und Zielerreichung die persönlichen Bedürfnisse der Einzelnen (zu lange) auf Kosten der gemeinsamen Zielvorgaben zu ignorieren.)" One interviewee suggests that teams may go on retreats for innovation processes.

Awareness of personal limitations and resources for self-care appears highly valuable for persons holding leadership functions in teams. *"And the same thing can be true, you know, in terms of, you know, like I said, in terms of perceiving tough problems and most helpful in the situation - the same thing can be true with overwhelming - to a certain extent to step back, giving yourself the self-care, making it again about one or zero things - that kind of process whether it is conflictual in yourself - there is too many demands - or it is conflictual between people, between two other people that don't involve yourself or between you and another self - all, a lot of it is a similar kind of process to slow down, be courageous and patient to take what is the crucial thing and then put it back into the mix for there are several things moving at the same time."*

- **Primacy of Interpersonal Relationships - 54 interview passages**
  One interviewee describes: *"Therefore everyone's input is considered carefully. Members are capable of listening actively to each other and empathize with them validating their contributions to the process of decision making, managing resources such as people and other resources, setting and reaching goals and objectives."* A project manager in the group discussion adds that an ideal leader knows he or she needs different people in the team.

  An interview participant clarifies that there is to some degree non-directivity in the communication process in the team: *"That there would be some sort of sense of how not acting is often the best action, something about patience or that often the solution is accepting things. And then there is a shift rather than having an active solution that solves the external problem - that many times accepting it is enough of a solution such that the way you think or feel about something shifts."* And a bit later in the interview: *"So, just try to trust that what needs to happen out there will happen out there if you are doing your own process of being empathic and being accepting and trying to be honest with yourself."* Another interviewee explains further: *"For leaders it is often similarly hard as important to trust resources and processes of self-organization within the group, instead of wanting to control or 'singularily manage' everything. (orig.: Für Leader ist es oft ebenso schwer wie wichtig, den Ressourcen in der Gruppe und Prozessen der Selbstorganisation zu vertrauen, als alles kontrollieren und 'selbst*

managen' zu wollen.)"

A project manager mentions that when delegating, an ideal project manager may not try to influence the learning processes of workers so they can learn on their own how they do it best. When work processes flow, the team leader may be largely not interacting in his or her function, but patiently attentive. When situations are conflictual, emotional or complicated, he or she is actively involved. Responsibilities are shared in the team.

"Everyone's contribution is validated although not everyone's detailed contribution is used." Leaders try to make sure that *"everyone has agreed with what happened"*. Oppositions are facilitated without taking sides.

Leadership includes a sensitivity to levels of communication as well as the history of the interpersonal processes. Three interviewees specifically mention that training in interpersonal relationships is advantageous. One interviewee remarks that a team leader *"absolutely has to understand how groups function"* and that this is a *"matter of training"*. Another interviewee mentions: *"Ideally the project manager would have training or experience himself in dealing with conflicts in groups."* Two interview participants highlight that process or generative communication - reflecting on team processes together or *"how we work in the team"* in a rather threat-safe environment - can support team work. Here, it appears to be important, as one interview participant states, that confidentiality is maintained by the leader.

An interview participant summarizes: *"Thinking and being in touch with everyone within the team or the project, appreciating the different styles and how you really have to do different things for balance. So that you feel like you know where everybody is at, even if they are not all contributing the same way. And then engaging them, if you can't, you know, have a sense of balance."*

- **Flexibility - 29 interview passages**
  According to an interviewee, a team leader in complex environments shows *"flexibility to change whenever is necessary for the wellbeing and good performance of the team."* Another interview participant explains in more detail: *"And I think the last thing would be something about flexibility to the individuals with which you are working. So this is kind of an extension to empathy. But it implies that you are somewhat a resource to adapt to however it is that these particular people need you, to adapt the best you can to a circumstance - that is true to other management styles - but there is a sense that the goal of adaptation is not necessarily the strategic thinking of how do I adapt most to get the solution, but the flexibility would be to allow an emergent outcome in*

working with a person or a group of people to be flexible enough to the needs and experiences of what is going on."

Flexibility may include compromises in caring for relationships and team outcomes depending on the specific situation. One interview participant observes flexibility of team leaders in getting in contact with others: *"And listening is in a context. So, they are also very context-sensitive. They are people who are very sensitive to their context. So, if the context needs them to be assertive, then they are responsive to that. If the context needs them to be a bit more laid back and let somebody else be assertive, then they do that. So they don´t have just one characteristic that they take around with them anywhere. They are sensitive to the context and they are bringing themselves as whole human beings to that context."* A project manager in the group discussion comments that an ideal leader *"needs to be able to translate business and technical languages as well as organizational cultural languages"* between different project stakeholders and team members. There is sensitivity for what tasks or functions can be delegated and what he or she wants to do him- or herself based on prior experience. An interviewee elaborates that team leaders in demand in organizations have experience in making complex decisions.

A.2 Interpersonal Interactions

In the following, observable behaviors of leaders that facilitate emergent processes that interviewees and group discussion participants described are collected. Essentially, these appear to carry out a balancing function within interpersonal relationships in the team.

- **Phenomenological Feedback - 9 interview passages**
  Five interview participants mention a specific approach to giving feedback. Phenomenological feedback is checking facts with involved persons in order to clarify and eventually find solutions. Involved persons take time to express their perceptions of a specific problematic or unclear phenomenon in the way an art reviewer might do: *"If you look at the way an art critic looks at an art work or a theatre critic looks at a theatre piece, they are not being judgmental in a sense of saying this is good or bad. If they are good at what they do, they really try to give a phenomenological review of what they are seeing - without saying good or bad. It just is what it is. And being able to do that is really a skill. To be able to say: Hm, you know, doesn't look that this is working very well.' It is a phenomenological statement. It is not: 'God, you really*

messed up.' (laughs) or even 'We really messed up'. So there is a sort of a way of being critical that has to do with just the phenomenology of what is going on. But it has to be fierce in the sense of: You can't hide that." This approach to feedback may help people to see where things can be improved. Another interviewee explicates: *"What is most helpful, I think, in terms of difficult people is to not think about it as it is a problem in a person, but that it is - to think about that it is probably something about the situation. It is a - part of this fundamental attribution idea of: we tend to ascribe things and attribute things to people as if it is part of their personality or it is something enduring and because of that it doesn't allow enough accurate perception and enough of the opportunity for a change to occur because it is sort of wrapped up. Whereas if you think about, you know, exercises: what if I was in that situation, or: can I see why the person might be doing this in a way that is understandable - even if your 'why' is incorrect it often gives you enough of a compassion that you no longer are stuck in the relation to the person, but you instead can try to perceive the situation and not the person as the problem and to think through it and also to help them, help the other person to evaluate the situation without having to sink into self-criticism or avoidance of responsibility."*

- **Working out Shared Mental Models - 8 interview passages**
  Three interview and group discussion participants agree that leaders need to invest time to allow for the forming of shared mental models within the team. One interviewee elaborates: *"I think it is important that everybody in the team understands what the methodology is that we are using. And they share a language. And they share mental models of what it is we are doing and more or less how things get done. So that the facilitator can take for granted that we all share the same sense of the project. And that sometimes takes time. Sometimes, you know, people come into the project they have not been on before, they are new, or the have an idea and they want everybody to listen to their idea, and they are more interested in that than they are in going ahead with the team. So, a good facilitator - the project manager - really needs to spend a good amount of time at the beginning making sure that everybody has the same understanding of expectations, of the language, of the scope of the project, of where the boundaries are around the project, what the deliverable time, you know, what the timeline is, how much specificity can we have at the beginning, how much can we not. So there is a lot of definitional work that gets done early on. And if that work gets done, then people don't have to worry all the time about what is going on here, what are the rules here, you know. So I think a good facilitator in any kind of complex team*

is a good communicator, knows how to explain and to express, but also is willing to have the patience until they are sure that everybody that is going to be working on this project is on the same page." Another interview participant adds that working out shared mental models has to be a time-limited team process: *"In this order it is also important that individual team members adapt their ideas to the actual requirement parameters without obstructing sight too early through too specific demands. Yet, it must be clear, that this is an open phase of finding, that has to be done sometime and that mutually reached objectives are attacked. (orig.: In dieser Reihenfolge ist es auch wichtig, die Vorstellungen der einzelnen Teammitglieder an die möglichen Bedingungsparameter zu adaptieren ohne zu früh die Sicht durch zu konkrete Vorgaben einzuschränken. Es muss aber klar sein, dass dies eine offene Findungsphase ist, die irgendwann beendet sein muss und dann eine gemeinsam erreichte Zielvorstellung auch in Angriff genommen wird.)"*

- **Facilitating Cohesiveness in the Team - 8 interview passages**
  This concept includes interviewees' remarks on leadership behavior regarding conflict resolution, consensus-building in the team and reflecting team processes. One interview participant mentions, for example, that in a conflict between two team members, both may have the opportunity to explain their views fully. And that, further, each can respond to the other, or the rest of the team may interact. Another interview participant suggests that everyone that is involved in a problem may become part of the solution.

- **Unobstructive Availability - 3 interview passages**
  Unobstructive availability is related to the notion of open doors to the leaders' office that is supposed to foster a sense of openness and transparency in the work environment frequently found in management literature. Yet, interview participants express a slightly deeper concern. Unobstructive availability is based on a receptive, responsive, and so not necessarily passive, position within the team. It is not interfering with processes when things work out, but getting active when a situation gets complicated.

- **Establishing a Safe Space - 3 interview passages**
  "What would foster creativity, create a safe environment." Three interviewees mention that it could be advantageous for emergent process facilitation to foster a safe space, a rather threat-free team environment. *"It is good to organize many group meetings with different focus each (brainstorming for new or alternative solutions // critical analysis of previous work steps / feedback concerning team processes and many more.) (orig.: Gut ist es, viele gemeinsame Sitzungen zu organisieren mit jew-*

eils unterschiedlichen Perspektiven (brainstorming für neue/alternative Lösungen // kritische Prüfung bisheriger Arbeitsschritte // feedback über Teamprozesse etc.))"

- **Representing as Role-Model in the Team and towards Team Stakeholders - 3 interview passages**
- **Clear expression in verbal and written language - 2 interview passages**
- **Considering feelings during team member selection - 2 interview passages**

A.3 Personal Qualities

Subsequently, mentions of specific personal dispositions or aspirations interviewees and group discussion participants attribute to leaders that succeed in complex team environments are listed.

- **Intent to Support (the Development of) People - 16 interview passages**
  All interviewees note that supportive leaders intend to support (the development of) people. They maintain and repair relationships based on such intent. One interviewee states: *"But that there would be some intent to foster the development of the people with which he or she interacts."* They are visibly interested in the people they are surrounded by in their workplace, valuing their feelings and needs. They are not solely motivated economically. *"To me it seems important that there is visible personal interest and amenability - not just on directed towards economical aspects. Part of this is the recognition of feelings and valuing of participants - which relate to needs, and that effect perspectives. (orig.: Wesentlich erscheint mir eine deutlich sichtbare Eben des personalen Interesses und Zugewandtheit – und nicht nur auf rein sachliche/ ökonomische Aspekte ausgerichtet. Hierzu gehört die Beachtung von Gefühlen und Bewertungen der Beteiligten - hinter denen Bedürfnisse stehen, und die sich auf Sichtweisen auswirken.)"* Another interviewee considers that ideal leaders may invest more time to form deeper connections to their co-workers.

  Such intent includes a willingness to support the success of the team and to appraise success as team success. An interviewee explains: *"One of the principles of comedy schemes that are improvised is that you always try to set the other guy up for a good joke. In other words: you are not worried about your joke, you are worried about his joke. And so the way good improv theatre works is: I am always looking to make you*

look good. And if that is done by everybody, then the outcome is actually beyond any - it's beyond the sum of the parts. An improv theatre, where people compete with each other or essentially want to be the star - doesn't work. You can't have a star in an improv theatre. So I think, another part of this process has to be this idea that somehow the other guys' success is more important than your own success. Doesn't mean that you disappear, but it means that the attitude is one of helping other people succeed."

An interview participant notes: *"make sure that everyone's contribution were validated and included as much as possible."* A project manager amends that an ideal manager is devoted to what he or she manages. An interview participant mentions that people that succeed in getting a team to do something outstanding and creative tend to be hopeful and enthusiastic.

- **Patience - 9 interview passages**
  Patience is mentioned as important personal quality by 4 interview or group discussion participants. One interviewee could observe an experiential quality of patient impatience with leaders succeeding in complex environments. *"I sometimes use the phrase 'patient impatience'. Because you do have to have a sense of impatience - you do have to want to get it done, but there is a sort of a - almost a meditative state - where you are both patient and impatient at the same time. So if you are impatient - how should I put this? If you are context-sensitive and you are sensitive to the evolution of a natural process, your patience is not indulgence. It's recognizing that certain things take a certain amount of time. You don't get impatient because the chicken doesn't come out of the egg sooner. You know, but you, and so - you can be impatient for it to be coming out, but you realistically have to be patient enough to understand how long it takes a chicken to get out of the egg. So, that sort of sense of balance between knowing the natural history of a process and being impatient to make sure - because you want it done. That is a sort of state of mind that I think is - separates a good process leader from somebody who is not attuned to the natural sequence of human processes."*

- **Courage to get in Contact with Others, Courage to be Helpless - 3 interview passages**
  One interviewee mentions that courage helps to find where people are in terms of their learning edge, their passions, and in terms of conflicts they have internally and with others.

  The courage to be helpless includes accepting one's own feelings, and to understand others views. This allows focus to go back to tasks eventually. A project manager

notes in the group discussion that the opposite of an ideal manager might be afraid of giving away responsibility.

- **Playfulness - 2 interview passages**
- **Humor - 2 interview passages**
- **Compassion - 1 interview passage**

A.4 Mental Model of Leadership

- **(Implicit) Mental Model of Leadership (that formed through personal experience, can be traced to an idea of human beings, and guides action taking) - 1 interview passage**
  One interviewee reflects of his sharings during the interview: *"Sometimes my thinking about these things is over-simple. But I feel like then I have a plan and so then it is easier to adapt that plan. If the plan is too complicated I get too attached to what is supposed to happen and that will frustrate me. And if I don´t have enough of a map of what is going to happen then I can´t adapt as well because I am disoriented and constantly trying to find some meaning-structure to figure out what the heck I am supposed to be doing. So to me it is partly that process - It doesn´t matter exactly I say these particular things, but I think what is more important is just to have* a *structure that is simple enough to guide you, but also simple enough that you can be flexible to see it other ways."*

  Leadership mental models are described to evolve through personal experience. They integrate personal ideas of human beings. Mentions of facilitative personal characteristics, accounts of leadership principles, and descriptions of how interpersonal interaction can be shaped, may be seen integrated in personal leadership models.

A.5 General Statements

Four statements of interview and group discussion participants indicate that perceiving a leader as ideal is related to a process of identification (see section 5.3.1, p. 85). One project manager highlights that where an ideal leader is to be found depends on the organizational context. Different organizational environments attract different leadership approaches.

Appendix B

Interview Stakeholder Selection Questionnaire

Dear Participant,
thank you for taking 5 minutes of your time to fill out this quick survey.

Please tick the number that appears most relevant for the team leader as perceived in this particular project.

There are 5 questions in this survey.

General Team Leadership Evaluation

1. **General attitude:** The team leader responds:
   Please choose only one of the following:
   - in a destructive, de-motivating way
   - ineffectively, presumptuously
   - minimally effectively
   - in a way that notably supports making progress
   - in an encouraging, supportive way that significantly contributes to making progress

2. **Realness:** The facilitator:
   Please choose only one of the following:
   - avoids questions, is not accessible and refuses open conversation
   - hides between his/her position and it is difficult to transparently communicate with him/her
   - gives clear answers to some minor degree
   - tends to communicate openly and transparently
   - communicates totally transparently, gives frank responses and is perceived as genuine and real
3. **Unconditional positive regard:** The team leader:
   Please choose only one of the following:
   - meets team members without any respect, does not consider their requests
   - hardly respects the team members' requests and demands
   - respects the team members' needs and requests to some minor degree
   - is generally respectful towards team members and encourages them
   - is friendly, full of trust in team members, encourages them, and lets them perceive his/her respect
4. **Understanding:** The team leader:
   Please choose only one of the following:
   - completely ignores the team members' needs
   - hardly responds to the team members' needs and interests
   - to a minor degree reacts to what the team members communicate
   - often reacts to what the team members say such that they feel understood
   - completely understands the team members' needs and interests, reacts to team members in a supportive way
5. **Competence:** The team leader:
   Please choose only one of the following:
   - appears to be lost in wide areas of the project context
   - seems to be quite incompetent in the project context

- appears reasonably competent in the project context and is sufficiently capable in leading the project team
- leaves a quite competent impression and is skilled in project team leadership
- proves expertise in the project context and knows how to make team members enthusiastic

Thank your for your cooperation!

Thank you for completing this survey.

Appendix C

Significant Events Interview Guideline

General aim of the study:
Collecting interpersonal interactions (communication, behavior) of team leaders in ICT project teams that support team performance.

All informations gathered are anonymized.

The interview transcript will be sent to the interviewee for correction and comment prior to further elaboration.

0. Definitions:
What is your definition of team performance?

1. Context:
Can you think of any projects that you lead/facilitated in which you had the feeling that your team and you as team leader did a really good job? Can you think of any projects that you facilitated/lead in which you had the feeling that the team did not work well together, where you were disappointed, that you are leading a project team you perceived as hard to work with?

Significant Events:
2. General experience of the process in the project:
What has the project been like for you (so far)? How has it felt to participate in the project?

3. Changes:
How are you doing now? What changes, if any, have you noticed in yourself since the project started? What changes have you noticed in the team?

4. Attributions:
In general, what do you attribute these various changes to? In other words, what do you think might have brought them about? (Both outside and inside the project)

5. Resources:
What personal strength, events, issues, circumstances, relationships in your current life situation have helped you to support the team and the project?

6. Challenges:
What personal strength, events, issues, circumstances, relationships in your current life situation have made it harder for you to support the team and the project?

7. Helpful aspects:
What have been the most helpful interactions in the project (so far)? (general aspects, specific events) On a scale from 0-10 where 10 is most helpful for you, the team, the project, where would you locate the particular events/aspects? What made these aspects/events helpful for you, the team, the project?

8. Hindering aspects:
What kinds of situations, aspects of the project have been hindering, unhelpful, negative or disappointing for you? On a scale from 0-10 where 10 is most helpful for you, the team, the project, where would you locate the particular events/aspects? What made these aspects/events helpful/unhelpful for you, the team, the project?

9. Difficult but OK aspects:
Were there situations, persons, aspects in the course of the project which were difficult or painful but still OK or helpful? On a scale from 0-10 where 10 is most helpful for you, the team, the project, where would you locate the particular events/aspects? What made these aspects/events helpful for you, the team, the project?

10. Missing aspects:
Was there anything missing to be supportive for the interpersonal interaction in your project team?

Demographic data:

- Personal:
  - Position in organization
  - Age
  - Gender
  - Experience (0-5 y., 5-10 y., 10-15 y., 15+ y.)
  - Education
- Project-specific:
  (For each of the projects mentioned, please fill in:)
  - Title of the project (can be fictional)
  - Short description of project objectives
  - Position in project
  - Team size
  - Software development process in use
  - Duration (approximately)
  - Costs of project (optional)
  - Amount of Stakeholders/Users directly involved (in contact with team leader or project team)
  - Additional important information, e. g. distributed team (optional)

Appendix D

Experience Description Collection

Title	Intent	Solution	Reference
Phasing it in	Growing projects must figure out how to grow long-term staff: whom to hire; how many to hire; and when to hire them. Projects must ramp up while minimizing the pains of growth.	Phase the hiring program. Start by hiring people to meet the basic core competencies of the business and gradually bring on new people as the project needs to grow.	Coplien and Harrison (2005)
Compass	At different points along the program the group allows impact of event(s) to divert it from course. Group members may drop into quarrels; allow despair; problems or difficulties to distract or even cease their work; wasting time and energy on procrastinations.	When a group drops into unproductive quarrels; a drop into a circle of despair; desolation and justifications; rechannel the group thinking and acting towards achieving it goals through teamwork.	Homsky (2004)

Title	Intent	Solution	Reference
Shared clear vision	The lack of a clear vision about a system can lead to indecision and contrary opinions among the stakeholders and can quickly paralyze the project.	The vision provides a mechanism for removing vague; ambiguous; or poorly defined requirements from the scope of the project. It is an objective filter for scrubbing requirements; and helps to define what is in or out of the system's scope.	Bramble et al. (2002)
The Water Cooler	Organizations need cross-team structures that guard against isolation.	Encourage social structures that are unrelated to workplace structures and which will likely cut across the formal partitioning of the organization.	Coplien and Harrison (2005)
Round Pegs for Round Holes	By assigning a task to the wrong person; you can waste time; get inferior results; and discourage both the individual and the team.	Therefore; discover each individual's preferences for working; and allocate tasks accordingly. First; you must observe how your people work. Then you must apply these observations in your decisions about"who does what" in the mix of team tasks.	Taylor (1998)
Firewalls	It's important to placate stakeholders who feel a need to "help" by having access to low levels of the project; without distracting developers and others who are moving towards project completion.	Create a role to shield other development personnel from interaction with external roles.	Coplien and Harrison (2017)
Bootstrapping	Your newly formed team must become productive quickly.	Therefore; partition some responsibilities; and share others.	Taylor (1998)

Title	Intent	Solution	Reference
Pair to share	Some new ideas take a long time to spread out.	Encourage people to work in pairs to facilitate spreading the new idea.	Cukier and Kon (2011)
Apprentice	A project must balance its need for growth with its need to develop and maintain deep domain expertise.	Turn new hires into experts through an apprenticeship program. Every new employee should work as an apprentice (not just a mentee) to an established expert.	Coplien and Harrison (2005)
Stand up Meeting	... information about where the current project is so that you can accurately control where it is going. Your organization is also working to establish and maintain a 'whole-team' that is does not suffer from Us vs. Them via Reciprocal visibility. Your team is in the process of improving its communications.	... introduce stand up meetings as feedback for management of an empirical process. The daily meetings will give the entire team relevant information to adapt to changes and new information within an iteration so that obstacles can be addressed in a timely manner and the goals of the iteration can be met.	Elssamadisy and West (2006)
Face to face before remote	Geographic distance makes communication harder.	Begin a distributed project with a fact-to-face meeting for everyone.	Coplien and Harrison (2005)
Day care	Your experts are spending all their time mentoring novices.	Put one expert in charge of all the novices; let the others develop the system.	Coplien and Harrison (2005)
Unity of purpose	Many projects have rocky beginnings as people struggle to work together.	The leader of the project must instill a common vision and purpose in all the members of the team.	Coplien and Harrison (2005)
Community of trust	It is essential that the people in a team trust each other; otherwise; it will be difficult to get anything done.	Do things that explicitly demonstrate trust; so it is obvious.	Coplien and Harrison (2005)

Title	Intent	Solution	Reference
Set the pegs	During your first encounters with the group you are aware that what you do at the beginning tends to have effect for a long time.	Use all first time events and first times an issue is raised to present the expected norms of behavior or preferred attitude you wish to set for the future.	Homsky (2004)
Productivity games	Individuals are so closely focussed on design and code that they are beginning to lose the shared culture of problem solving they developed earlier.	Teams develop a shared culture of communication over time as a result of collectively finding solutions in their area of productivity.	Taylor (1998)
Wanderer	The project manager; the architect; or the coach can only provide the coordinating services to the team; if she or he has a good notion of what is going on in the project. To gather this information is one of the most important tasks of management.	Practice „management by walking around“. Visit each team member regularly; for example once a day and ask for the status and current problems. Have a look at progress indicators; such as test cases and be sure to give more positive feedback than criticism.	Coldewey (2003)
Norms of conduct	A self-organizing team that is unable to get all issues out on the table runs the risk of things being left unsaid; questions remaining unanswered and possible solutions not being evaluated.	The team agrees to norms of conduct to enable itself to grow into high performance.	Scrum Patterns (2017)
Feature assignment	For every non-trivial project; it is impossible to partition the work cleanly.	Assign features to people for development. A feature development has a finite duration; and is therefore an assignment; not a role.	Coplien and Harrison (2005)

Title	Intent	Solution	Reference
Virtual shared location	Team members can meet neither at the same time nor at the same place; but must share informal and formal ideas and information.	Use a wiki.	Braithwaite and Joyce (2005)
Architecture team	You need to create an architecture that is simple and cohesive; but which accommodates a variety of constituencies.	Create a small team of resonating minds to define the initial architecture; in such a way that the team covers the expected partitioning of the system.	Coplien and Harrison (2005)
Vision	For a team to be truly effective all members need to be pulling in the same direction.	The individual who embodies the passion for this new product effort takes on the role of owning the product; around whom stakeholders and potential future coworkers rally to articulate and together define and refine a vision. The vision is a description of how the product supports a desired future towards which an envisioned future organization advances.	Scrum Patterns (2017)
Delegate complexity	You cannot deal with all complexity the project offers; and you cannot control it.	Therefore; share dealing with complexity. Decide who of the team shall deal with which topics. Give the authority to deal with complexity to the team members who are willing and able.	Marquardt (2010)

Title	Intent	Solution	Reference
Failed project wake	Canceling a project; even for the best external reasons; is particularly demoralizing to a team that has put its heart and soul into it.	Hold a wake for the failed project. This should be much the flavor of an Irish wake; a party for the dead.	Coplien and Harrison (2005)
Reaffirmation ritual	You are an organization that is working to establish and maintain a 'whole-team' that is does not suffer from Us vs. Them via Reciprocal visibility. Your team members tend to get 'heads-down' in their work and; especially with larger teams; the do not communicate outside of their tasks.	Solidarity Rituals to help teams establish their individuality and pride in their work. Celebrate success when a team passes a major milestone and remember important events as a team.	Elssamadisy and West (2006)
Smoke filled room	An organization must make a timely decision about urgent strategic directions.	Make the decision among power brokers as in the storied smoke-filled rooms stereotypically associated with tycoon businessmen.	Coplien and Harrison (2005)
Private space	Concentration is one of the most valuable assets in software development. It may cost up to 20 minutes for a brainworker to recover from a single interruption. In addition personal comfort calls for a minimum of privacy that may be endangered in a highly collaborative environment.	Make sure every team member has a private space he or she can retreat to when it is needed. This may be the simple opportunity to shut the door in a single or double office or a separate office to everyone's discretion.	Coldewey (2003)

Title	Intent	Solution	Reference
Participant observation	Even though you are assembling a team that includes most of the roles; customer to coder; communication is still role-to-role with lots of interpretation across the communication channel.	Live with; eat with; work with; and empathize with the other members of your team. Pair programming is only the beginning – do some pair testing; pair story writing; pair database design; pair forms entry. Have all of your people work alongside all of your other people.	Elssamadisy and West (2006)
Deploy along the grain	... in the past; the roles of analysis; design and implementation have been split among different people.	Deploy people along the grain of the domain. That is to say; give them dedicated; long term responsibility for a manageable piece of the system; thereby enabling them to exploit opportunities to consolidate and improve the reusability of their parts of the system as experience accrues.	Coplien and Harrison (2005)
Diverse groups	Homogeneous teams that comprise too many of the same kind of people easily fall into groupthink-like dysfunction.	Consider temperaments and diverse experience backgrounds when assembling a team. This diversity sometimes lines up with social classifications like age and gender; but more generally can be assessed on a personal level.	Coplien and Harrison (2005)

Title	Intent	Solution	Reference
Protect the victim	One of the group members made a mistake that has influence on the entire project. The other group members get upset at the individual. Anyone may make a mistake; but making one should not deteriorate team spirit; and group behavior can escalate sporadic anger into aggressive behavior towards one person.	Look for non-verbal clues for disagreement or discomfort in group members' behavior; Respond accordingly: either change activity; make a break even if it is not scheduled yet; or even stop whatever it is you're doing altogether and inquire of the group as to what may be disturbing them.	Homsky (2004)
Master and Apprentice	In an environment that uses documentation only if they are part of the delivery; knowledge transfer between team members becomes a matter of direct collaboration instead of document transfer. You cannot just pass a well-written document to the novice and expect her to read it. Rather you have to transfer tacit knowledge that resides in the heads of the experts only. Still; those who have the knowledge are usually occupied with the project work.	Pair up anyone who needs to learn something about the project with someone who is expert in this area. Let them do the work together until the apprentice has learned enough to work on his or her own. The main work — e.g. programming — should be done by the apprentice while the master watches and gives hints on how to do the work.	Coldewey (2003)
Sacrifice one person	Small distractions can add up; and sap the strength of the team.	Assign just one person to it until it gets handled.	Coplien and Harrison (2005)

Title	Intent	Solution	Reference
Form follows function	A project must delineate well-defined roles to help identify and leverage expertise relevant to emerging problems.	Group closely related activities (that is; those mutually coupled in their implementation; or which manipulate the same artifacts; or that are semantically related to the same domain). Name the abstractions resulting from the grouped activities; making them into roles. The associated activities become the responsibilities (job description) of the roles. Roles; rather than activities; become the basic project building blocks.	Coplien and Harrison (2005)
Management by triggers	When a project gets out of hands; adding even further levels of control and tracking is hardly possible and rarely helpful.	Therefore; enable developers to take local decisions. Encourage a communication culture of small neighborhoods. Within these developers can develop a common spirit without the need to share this spirit with the entire project team. Establish very few rules to adhere to; the core of the overall architecture.	Marquardt (2010)
Lock em up together	A team of different people must come up with a single; coherent architecture.	Gather everyone together to work out the architecture (or some other strategic issue). Put them all in the same room (literally.)	Coplien and Harrison (2005)

Title	Intent	Solution	Reference
Someone always makes progress	It is important to keep a team moving forward and to avoid getting stuck on the obstacles.	Whatever you try; ensure that someone on the team is making progress on the primary task.	Coplien and Harrison (2005)
Sprint retrospective	... you are reaching the end of a development iteration; and are getting ready for the next one. Naturally; no matter how well it went; you would like to improve.	At the end of each iteration; before the next one; hold a meeting for self-examination of the team's behavior during the previous iteration.	Scrum Patterns (2017)
Coffee kitchen	The daily work gives little room for social interaction beside the current problem. Still; a project needs space for the team members to interact just as humans; not as professionals; and creative work needs slack.	Provide a separate coffee kitchen for social interaction. Offer opportunities to have coffee; tea; or other beverages there and provide a place to store private mugs. Make the place comfortable enough so people like to go there; but be careful with seating facilities unless you have pregnant women in the team or others who need to sit down.	Coldewey (2003)
Forge the team	Recognise that differences of opinion within a team are an asset; not a liability. ... Differences of opinion become dysfunctional when they are not resolved.	When warring factions emerge; bring the individual chief protagonists together for counseling.	Leadership Patterns (2017)
Team space	Your physical work environment should be arranged to maximize people's productive time.	Therefore; create a physical space for casual; unplanned interactions between team members.	Taylor (1998)

Title	Intent	Solution	Reference
Re-negotiate complexity	Accepting every wish that a stakeholder mentions limits the project's options to make decisions that fit its situations.	Therefore; renegotiate all factors that contribute to the overall complexity; as soon as you become aware of them. (stakeholders may prescribe the team size; ...)	Marquardt (2010)
Grand finale	Having put so much effort into creating and maintaining group cohesion it is distressing for both group members and leaders to see it end. Especially with a successful group; when the project ends group members need a closure to the experience; and wish to preserve the good relations created; the memory of a good experience.	Make a 'grand finale' to your program. Use the good feelings to give a "final good taste" at the closure of the experience.	Homsky (2004)
Join for completion	How can you make the final tuning and qualification of your product efficient and focused?	Gather the whole team (developers; architects; domain experts; and internal and external testers) together in one location for the final tuning of the product before delivery.	Bricout et al. (2004)
Collective responsibility	You need a high performance team in which every individual is deeply committed to every aspect of success of the project.	Therefore; make the responsibility for completion and for the artifacts collective by the team; not by individuals. Let the team itself manage the fine-grained aspects of this.	Bergin (2005)

Title	Intent	Solution	Reference
Reciprocal visibility	Everyone involved in the project; including management; immediately adopts a posture of self-protection and blame avoidance.	Constraints to be met: All actions that affect the state of the project are expressed in a manner that includes the whole team; All information about the state of the project is public and omnipresent in the whole team environment; All communication (actions and information sharing) take place in a "safety zone" – i.e. no one can be punished (or rewarded) for their participation in the conversation.	Elssamadisy and West (2006)
Generics and specifics	Novices; even when mentored; tend to produce weak designs and cut and paste code.	Separate generic from specific parts of problems. Use an expert; a framework designer to design generic parts. Let the novice programmers design the specific parts.	Coplien and Harrison (2005)
Growing your team	Your team thinks it does good work; day in and day out. But you feel that things could be much better. Maybe the team is in denial about some problem; or maybe the work needs to move to the next level for some reason that you see and the team doesn't yet. In any case; every day seems more of the same old thing instead of a day in an adventurous journey.	Create an environment for your team to discover the need for change and to architect its own change. Play the role of coach; not director.	Leadership Patterns (2017)

Title	Intent	Solution	Reference
Train everyone	Everyone has different ideas about how the project will proceed. If the methodology is new to the company; much of this information is faulty.	Therefore; provide training that both shows everyone all the essential roles; but also brings the participants together as a team.	Bergin (2005)
Open up communication	How can an agile team be provided with information and communication channels needed to be self-organized; whilst addressing the need for information and control by the overall project management?	Create a communication plan for the agile project; basically addressing the how and not the details. Reach an agreement with the customer organization with regards to customer involvement and availability. Allow the agile team to collaborate with customer contacts directly and frequently. ... both parties need to open up their communication.	Pechau (2012)
Ambassador	Members of a team in one location find it hard to understand the point of view of members in another location. ... When misunderstandings caused by lack of knowledge of local conditions escalate; the trust vital for cooperation between sites breakes down.	Send an ambassador from one location to another; for an extended period. While visits build trust; longer visits maintain more trust for longer.	Braithwaite and Joyce (2005)
Deliverables to go	Your team maintains (or will shortly maintain) released software.You must scope and time your team's deliverables so that their recipients will use them.	Therefore; only release when users are ready to consume.	Taylor (1998)

Title	Intent	Solution	Reference
Adhoc meeting	There are events that cannot wait for the next general meeting. If an important client reported a severe crash of the system; you'd better react soon. Still; you may be reluctant to disturb everyone in her or his work or it might be unsure who can contribute to the solution.	When the issue arises; call everyone for an immediate adhoc meeting. Only those who are interested in the issue are going to participate. During this adhoc meeting start with a description of the problem at hand and then decide whether to go on to solve the issue immediately or whether to schedule another meeting. Limit the meeting to ten minutes; than ask who thinks that he or she can contribute to the solution. Give a break; so that everyone who answered no can leave without embarrassment.	Coldewey (2003)
Team per task	Crises are inevitable; and they are legion. If the project takes time to respond to each; its members will soon find themselves spending so much time responding to each crisis that the real work doesn't get done.	Let a sub-team handle the diversion; which allows the main team to keep working.	Coplien and Harrison (2005)
Guruing by walking around	...you aren't "managing" so much as you are "mentoring". It's hands-on teaching and learning; with frequent two-way dialogue (rather than lecturing).	Keep your door open. ... Be patient with newbies and do some hand-holding if necessary. And always try to share your knowledge rather than force-feeding it to others.	Leadership Patterns (2017)
Social tracker	The tracker needs fine-grained knowledge of the state of the project; but the knowledge is in individual heads.	Therefore; the tracker spends five minutes or so with everyone at least twice a week; preferably daily.	Bergin (2006b)

Title	Intent	Solution	Reference
End to end	When we take an interest in the customer's business and actively help them develop it; we make an investment towards our own future.	Therefore: when pitching and planning; get input from designers; developers and people with experience in maintaining systems; come up with the next chapter in the product's story and pitch that as well. During the project get developers and designers working closely together.	Laukkanen (2012)
Show and tell	You must eliminate the reinvention and wasted effort which results from general design and code solutions which are not communicated.	Therefore; conduct a periodic discussion session where individual's problems and solutions are reviewed and shared.	Taylor (1998)
Group validation	Product quality is crucial to the success of the enterprise.	Even before engaging QA; the development team — including the Customer — can validate the design.	Coplien and Harrison (2005)
Body speaks	Group members may have needs that should be met; or have important information that the group leader should be aware of. However; group members may be reluctant or too shy to openly express problems; present issues or preferences that bother them. They may think that criticism is disrespectful; or show lack of manners.	Look for non-verbal clues for disagreement or discomfort in group members' behavior; Respond accordingly: either change activity; make a break even if it is not scheduled yet; or even stop whatever it is you're doing altogether and inquire of the group as to what may be disturbing them.	Homsky (2004)

Title	Intent	Solution	Reference
Production potential	You observe a great deal of activity and communication; but little apparent progress on the software. You must translate this team activity into an accurate and fair assessment of team progress.	Therefore; measure team progress by a weighted mix of assessed progress in all spheres of work.Viewing progress in terms of the team's production potential helps to recognize the value of work done which contributes only indirectly to deliverables.	Taylor (1998)
Piecemeal growth	The project team needs to react to incomprehensible situations; dealing with many issues and requirements at once.	Therefore; introduce an attitude into the project to solve problems one at a time. Reduce the amount of things to care for at once by focusing on the next few important things; only one or two per person. Adapt an attitude that actively refuses to plan ahead for complex issues; even if that would seem smart and apparently could reduce the overall effort. The question to ask is: what could we try or show next?	Marquardt (2010)
Interrupts unjam blocking	A comprehensive scheduling plan is difficult if not impossible; yet; without some kind of plan; it becomes easy to fall into thrashing.	If a role is about to block on a critical resource; interrupt the role that provides that resource so they stop what they're doing to keep you unblocked.	Coplien and Harrison (2005)

Title	Intent	Solution	Reference
Gather domain knowledge	When complexity is a key problem to projects; and the ability to deal with complexity is largely depending on individuals; what should the team members learn and do to increase their personal ability to cope with complexity?	Therefore; increase your knowledge about the application domain. You will be able to apply your own judgment; and reduce the complexity associated with unknown settings and questions.	Marquardt (2010)
Solidarity ritual	You are an organization that is working to establish and maintain a 'whole-team' ... . Your team is in the process of building itself and establishing its culture. Different people bring different food for lunch; may speak different languages around the water cooler; have different artifacts in their cubicles. Assertion of identity; gender; and ethnicity are powerful forces acting on all of us.	... Solidarity rituals to help teams establish their individuality and pride in their work. Celebrate Success when a team passes a major milestone and remember important events as a team.	Elssamadisy and West (2006)
Cohesive team	You have an assigned development team; ... . You must now convert individual capabilities into a team productivity.	Therefore; stimulate an interest in the problem space; and use it as the common motivation to build team cohesion.	Taylor (1998)

Title	Intent	Solution	Reference
Effective coach	No process can work if you don't perform its practices. ... This is especially true as some of the practices are counter-intuitive to many programmers. Many practices that are counter-productive in practice are ingrained in many work environments. People do these things "naturally" even though they know that they don't work.	Therefore; someone on the team will have a full time role as Coach. The coach keeps the team faithful to the practices.	Bergin (2005)
Don't interrupt an interrupt	It's important to balance a desire that someone always makes progress with the thrashing that can accompany short-term priority calls.	If a developer is already working in "interrupt mode" on a critical issue; don't put that work aside until it is complete or until that issue itself becomes hopelessly tangled.	Coplien and Harrison (2005)
Informal labor plan	Developers will often find themselves obligated to more than one in-progress development task at a time.	Let individuals devise their own short-term plans.	Coplien and Harrison (2005)
Standup meeting	... the person receiving the information may not know the consequences that it implies for others on the team.	Therefore; hold a 15 minute stand-up meeting every day.	Bergin (2006b)

Title	Intent	Solution	Reference
Development episode	It's important to build on the collective strength of an entire team and to build a true gestalt from the team members.	Approach all development as a group activity as if no one had anything else to do. Expect the activity to follow the usual course of an episode where energy builds to a decision-making climax and then dissipates. At the height of the episode; purpose should be clear; terminology well understood; knowns well explored and unknowns identified. It is at exactly this point that individual strengths merge into a sort of common consciousness.	Coplien and Harrison (2005)
Developing in pairs	Some people don't want to work alone; and working alone has great risks of blindsiding and misfits. And you need to provide for people who don't want to work alone; and in general engage people who are working alone but probably shouldn't be.	Pair compatible designers to work together; together; they can produce more than the sum of the two individually.	Coplien and Harrison (2005)
Fair memory	A retrospective is focused on issues from the end of a development iteration. Experiences at the beginning of an iteration are forgotten. These experiences could have been used to improve the process.	A log is produced during the development iteration.	Scrum Patterns (2017)

Title	Intent	Solution	Reference
Sprint	We want to balance the need of developers to work undisturbed and the need for management and the customer to see real progress.	Give the developers the space to be creative; and to learn exploring the design space; doing their actual work; undisturbed by outside interruptions; free to adapt their way of working using opportunities and insights. At the same time keep the management and stakeholders confident by showing real progress instead of documents and reports... produced as proof. Do this in short cycles; Sprints; where part of the Backlog is allocated to a small team.	Beedle et al. (1998)
Team owns individual velocities	When a developer takes responsibility for a task she estimates the (ideal) time to complete the task. Enough tasks are taken and estimated to equal the developer's individual velocity for the iteration. People estimate differently.	Therefore; let the team own the individual velocities.	Bergin (2006a)
Effective handover	Your team is running at peak productivity; or nearing a critical delivery phase. A critical team member is departing; so you must minimize the lost productivity that will inevitably result.	Therefore; the departing developer should hand over to an existing developer; setting the replacement free to do new work.	Taylor (1998)

Title	Intent	Solution	Reference
Get to know your peoples skills	How can you know if your people are really up to the assigned task?	Ask the developers. Let them explain why they think they are ready. What they will do and how. Let them estimate the effort. Multiply by their individual velocity. Let others estimate the effort. Multiply by their respective individual velocity. Adjust the tasks so that this task gets done on time by the individual whose total time is lower. Once the iteration is finished; recalculate relative speeds. ...External incentives do not work.	Leadership Patterns (2017)
Boot camp	... there are many forces pushing organizations to multi-site development.	Have a co-located project kickoff. This starts with development iteration planning and includes doing the first several iterations together.	Scrum Patterns (2017)

Table D.1 Experience Description Collection

Appendix E

Expert Audit Responses

Framework Characterization (25 responses)
Checking team collaboration in complex and advanced environments in order to support and increase team leadership capabilities.
Everything that could help towards better personal interaction in complex environment is much welcomed and very interesting.
Framework that helps make decisions based on past workable experiences
The main skill of the rhea.framework is to support practitioners involved in team leadership in reflecting interpersonal interaction in their day-to-day work
A methodology for effective team leadership
It is an algorythm to analyze situations described by the user and provide constructive feedback
It focuses on support for growing and learning as leaders
I think it's a great way of communicating with your peers, and understanding what can be changed to improve day to day life.
A model to structurize learning from a significant event, using a flow as a form of reflection on that event, and discussing that flow for peers to learn from it
A means of formalizing and categorizing small-group conflicts in the work environment, utilizing a database of previously submitted analyses of past similar conflicts.
The Rhea Framework is a template and reflection system which assists managers in team leadership by providing flow structure recommendations to help compare personal experiences with reference flows. The result is that any notable interaction can then be labelled and classified into useful practical categories, hopefully facilitating meaningful progress!
Looks like a methodology framework for team management, It seems to be of an Agile orientation.
the solution to various personnel management problems
On first view, it could hinder timing of current standardsas it will require a different methodology to established team plans. I see it as an unnecessary series of steps within a team situation.
This framework provides a structure in which one can build a comprehensive plan for continual progressive development and compliance with operational procedures governing operational leadership processes and delivery.
A framework to work out issues And provide effective feedback nd tracking of projects. Teams and ways of working
The rhea.framework is a tool designed to guide leadership in addressing and taking learns from experiences through evaluation and discussion. It seems to be a workflow that enables us to do this in a measured and coherent way. It is facilitative approach rather than directive.
It appears to be a model to facilitate conflict resolution.
a flow diagram that shows how things should happen when a certain occurrence appears. Its also a hub for training and development
It uses an overwhelming amount of big words.
It is a learning framework regarding leadership with help and support from peers re their experiences and evaluations
An attempt to use a practical, workable approach to leadership in environments where there may be many opposing opinions, different personalities and complex projects. Synthesizing the academic literature into a simpler, manageable action plan.
It's a formalized support to a management development process. It helps to codify and understand workplace situations.
Trying to define a framework or a set of guidelines in order to help team leaders perform their role.
I would describe it as your traditional work flow structure used for day-to-day practices in a work environment. You begin with a significant even that leads to a written reflection or flow elaboration. This gives individuals times to talk about a project or assist others who have questions on the proceedings. Then you move on to a reference model where people pitch ideas and make recommendations. Then you proceed into the next stage which is a normative model. This will give people a chance discuss more time to talk about the project and come up with a plan to accomplish their goal.

Table E.1 Expert Audit A - Framework Characterization

Framework Understandability (24 responses)
Lack of a real world and practical example
Prototype Team Identity was rather difficult for me to comprehent
More of programming diagrams that people find it strenuous to understand
how implement it
Very few concrete examples and as such is very abstract. It's not overtly clear what problems the framework is trying to solve and why it is better than more common sense approaches.
CHanging entries in the Categories didn't seem to have an impact on the analysis
it's kind of sitting in isolation; where are the practicable application examples? All wind and no grounding
allot of lines and arrows, going back and forward, I need a bit more information to understand it, than the one provided. Maybe explaining in not so technical language and providing examples, would help.
Mostly a sales pitch of the benefits, lack practical explanations of how to use.
It is nit written in plain language. As currently written, it might appeal to academics, but I doubt too many people in the real world are going to take time to decipher the coined terminology.
The framework could perhaps better be described in simple everyday terms, in order for less-formally trained leaders to better understand and hence implement it.
On the model it shows the 4 sections but there isn't very much information on how to implement them just a few bullet points called key takeaways.
the connections with the different parts
There is no reference to each step. an example of a basic model within a team setting may have made the flow design clearer.
It is explained what it does before it explains what it is or why one might need it. It assumes one knows what a framework is. It was hard to figure out that this just a way to document team leadership activity and weight it against past leadership activity and build compliance to best process across the organization.
Lack of examples and seeing it be used in real world situations
I feel that the language of the components in the workflow is unnecessary. It could be simplified further from 'flow, normative etc' to basic terminology that makes this accessible and easier to understand for a wider audience. I would consider this when mentoring others in becoming team leaders as some people may find it harder to absorb this than others. The specific terminology used seems surplus to the needs of the exercises. I would alter these to 'event' 'experience' 'learning outcome' 'ongoing approach' or similar.
So many buzzwords/marketing speak. I was able to parse with some effort due to being familiar with the words/concepts, but this desperately needs some editing to be more easily understood.
there is a lot of information on there and some of it isn't very well laid out
Things need to be simplified a little.
The initial view of the website is overwhelming. The flowcharts and (in my opinion) overly long sentences make it somewhat intimidating. After some analysis the benefits of this becomes clearer - the flowcharts are good. The overall impression is that an established leader may well be put off by the academic slant of the programme, while someone with a background in the study of leadership would quickly orient themselves to it.
My initial concern is that it is very cumbersome. I did note that it would take 30 minutes (falling to 15 minutes) simply to complete a flow report, and when I looked at the model the linkages were so complex that my initial reaction was to recoil.
Some of the terminology used will put people off, such as not everybody knows the difference between a reference model and a normative model. The way it is structured is a little off putting as some times the highlighted links bring up a popup, other times it takes you to a new page. I think that given more time, i would have a better understanding of it, however, obviously there is a time limit with this study.
What diagram isn't the greatest visual representation of how a framework should look like. Some of the words used aren't very direct. For example, I could create a framework for individuals at my job, and go into more detail or depth. 1.Problem = Individual can't log into computer. Solutions = A.Check the user's account in uac to make sure that it isn't disabled and is active. B. Veryify that the user is using the right password. C. Reset the user's password with a temporary password, and tell the user to log in again. These comments above are direct, and tell the individuals exactly what needs to be done in order to accomplish the task at hand.

Table E.2 Expert Audit A - Framework Understandability

Framework Completeness (13 responses)
We are dealing with receptive and non-receptive individuals
Would be better to have links to the literature. The core flows aren't really expounded upon and are instead distilled into key takeaways with no real practical examples.
Clear instructions on how to use, how to structure a flow session from the written flow etc
Samples of all flow deliverables. Currently they are extremely vague, and I did not get a clear idea what they might look like. Also, while this really isn't a deficiency in the framework so much as the presentation, if you want to generate buy-in you should place more emphasis on explaining rhe benefits of this framework. Right now it looks like busywork without a great sense of why one should bother participating.
More emphasis on the individual - as in, leadership techniques and best practice always require consideration of the particular individuals involved (e.g. their strengths and weaknesses).
Again completion of the model section would be useful.
A set of rules which must be met to be defined for each step, this could be achieved through a series of example conditions or rules for each step of the flow.
A few more instruction as to downloading the frameork from github and how to apply it to the organization. Notknowing exactly what a framework is, i would have no idea what to do with it once I downloaded to roll it out to my team to use. What does one do with this framework once downloaded?
The guidance for laying out a session is quite clear and easy to understand. I would include a learning objective at the top in short bullet points to enable the lead to refer back to this easily. It would help to define the objective first before laying out a session.
The use of 'expressive keywords' to help describe the flow is a good approach that should be capitalized upon more. Often with these types of templates, the user can get stuck despite there being comprehensive guidelines. An idea would be to have a case study/worked-example to give the user more support and possibly overcome sticking points. Also, a tilt towards more emotive and expressive reflections would help too.
More prominence given to the iteration and incremental elements of the Unified Process - perhaps I just missed it.
Difficult question to answer as i haven't had enough time to look at all of it, so i choose this option more to indicate that i agreed with some of it. In terms of what is missing, i think that it just needs to be explained slightly before with worked examples being used rather than relying on using technical terms that not everybody will understand.
Their needs to be more information or guidance on how to work within this framework. It needs to be more detailed, and to go into depth on each persons responsibility.

Table E.3 Expert Audit A - Framework Completeness

Framework Language Clarity (13 responses)
Comes across as too scientific. The level of language is quite complex and as such makes it hard to grok.
It lists the hows, but not the whys?!
a little bit more descriptive, and easier vocabulary. For example, in my line of work this would come in handy, and I might even suggest it to my manager. The thing is, most of the people I work with, their English is not perfect, so I think easier vocabulary would do the trick.
Please see my earlier comment. You coin a lot of new terms here, and while definitions are provided, they are not intuitive. Using plain language would increase accessibility.
As per my previous answer, I believe the framework would be improved by the use of the simplest possible language wherever possible. Conciseness and clarity beat management argot, at least in my office!
Use clear familar language that is commonly used within a business, along with giving simple examples of how the flow would work using this clear language.
There was a lot of critical information that was assumed, suggesting to me there is definetely a specific audience. I don't think it would take much more than a few staements similiar to: This framework script is a tool used much like a plug in, script or applet that can be worked into your existing management applications across the network.
Simplification of terminology.
Largely the same answer as before, it needs an editor's eye to make the language easier to understand for those that might not already be familiar with some of the concepts presented.
The verbiage is a little on the extreme side.
Overall the site is reasonably easy to understand - once over the initial hurdle of understanding the aims. That's where it needs improvement: The front page uses overly complex and long sentences; the Aims list could be simplified more. Perhaps the front page design could be re-written by someone 'without' the academic background, and ask them to simplify as much as possible. This isn't an attempt to dumb it down, but instead to 'grab' the reader and get them excited and enthused.
I didn't find it hard to understand, though I think the ideas could often be put forward in a more concise way.
Cut down on the too technical wordings and replace with easier to understand phrases or at least a short description of what some of the terms actually mean. As it's written, it's aimed at a small group of people who will understand it. If you simplify with examples then you stand a better chance of appealing to more people. No body likes to read a document/framework and have to google a word or phrase from every paragraph. I think that you will find that a lot of team leaders have very little formal training so a simpler approach may appeal to more people.

Table E.4 Expert Audit A - Framework Language Clarity

Framework Usefulness (19 responses)
The model process to obtain the most of the decision process and team leadership events.
The key takeaways of the Core Flows.
Steps taken within the flow chart can be utilized on different significant events that happen where i work
how it supports when i have to decode
I like what the tool is trying to do
As I said in the previous question, schematizing the transfer of information, from manger to worker and so on. I think we should implement this in my line of work. It would change our weekly team meetings and make them less stressful.
To analyze significant events in a more structured manner
We spent and lit of time talki g anout "process" in this industry, the goal of which is to creative replicatable successes with disparate projects. However, we often find ourselves chasing our tales when that process fails, as it inevitably does. Our inability to formally document point of departure, however, means we tend to make the same mistakes and run into the same interpersonal issues repeatedly. Having a means to formally documented these could be a useful tool.
I think that anything that increases the opportunity for personal reflection and skill-sharing within the team at large can only be a good thing. Not to mention that the framework can form a valuable part of the resolution process, leadership training and evaluation practices, although I must stress I think it would only be a part of the latter, which obviously requires especially in-depth consideration of candidates.
the possibility of reducing costs and increasing efficiency
Arrange for Task Effectiveness
For someone new to leadership. It enables someone to understand how to facilitate discussion and encourage learning from experiences and critical reflection. It's more of a starting point that will enable them to understand what they need to achieve and through this they can then develop their own approach.
I am always willing to try new methods of conflict resolution to see what I find works best. I'm curious about the automated analyzing and if removing some human subjectivity from the process might be useful.
The information that is inside there and the methods of doing certain things
The Model Visualization
learning experience and developing skills and interaction with like minded people
Applying theory to real-world management. I like the discipline of having to complete the template etc.
It's useful to provide a detailed framework to conduct an analysis of a stress situation. It's useful to be able to refer to similar situations experienced by others.
As mentioned previously i liked the model visualization. I clicked on a few of the phrases and the comments made sense and caused me to think about my actions. Ideally i would like to spend quite a bit more time going through it all in depth as i'm sure that i could get some more use out of it, it's just quite a lot to take in having only been able to spend 20 odd minutes going through it.

Table E.5 Expert Audit A - Framework Usefulness

Framework Usefulness: Similar Frameworks (4 responses)
I don't know of any.
SCRUM has something similar in the daily meetings.
I think there are similiar workspace flows and collaborative developement tools but nothing nearly as elaborate or scalable that could be applied to any organization. There features here are unique and far more progressive with advancements in technology being fully utilized.
I can't think of any right now, but I have seen other diagrams used like this one. If you can be a little more descriptive, I feel like this framework can be a lot better in my opinion.

Table E.6 Expert Audit A - Framework Usefulness: Similar Frameworks

Framework Originality (25 responses)
Solification of flow processes by using an Universal language like RUP
Trying to achieve simplicity in complexity.
The basic flow of information you want potrayed
support the manager
Nothing really! Seems to be borrowing from lots of different techniques and trying to unify them into a single standard.
This tool is new to me. It looks interesting
A stronger focus on self reflection
the fact that you can actually schematize the sharing of information in a way of keeping it organized and reaching everyone.
The template to use the same structure for writing a flow each time
It addresses an important issue. I have never seen an attempt to create a formalized database of conflict incidents with the intent of doing meta-analysis on them to aid in dealing with future incidents. It may prove useful if you can obtain adequate buy-in.
I think that supporting individual reflection within the team is quite original, encouraging both personal responsibility and insight as well as (hopefully) enabling the team to coalesce more, thus functioning better as a single unit for future problem-solving, etc.
Nothing it is a collection of things from other methodologies or suggested methodologies in literature.
the ease and efficiency of communication
The langhuage used in the various flow steps, but exisiting methods would achieve similar results, it would just use different terms for the flow steps.
The ability to define a unified process and lifecycle of leadership development specific to my organization is unique. I like the feature to analyze my reflection of activity and get feedback and related flows.
The number of possibilities that can be worked on at the same time
I have used something similar within my current role, and I find it easier to adapt this to my own facilitation and mentoring style. I like the simplicity, but I feel like it's just slightly overcomplicated for what it needs to be.
It's a new form of conflict resolution to me. I've seen models that list some similar steps to what is recommended in the template, but the ability to "analyze" that information online rather than leaving it up to purely human interpretation is new to me.
its a good hub of information which is full of information which could come in handy
The Model Visualization.
It is unique in its field allowing interaction between peers comparing experiences re flow diagrams
I haven't seen a website-based approach to this before. The attempt to not shy away from complex leadership is welcome. Often there is a basic, non-prescriptive approach to these scenarios: platitudes instead of actionable content. The 'Key Takeaways' popups are good. Overall I think the way that the dry academic literature has been invigorated into a web/HTML is impressive and certainly cuts through a lot of the barriers to the study of people and project management.
I haven't come across such a similar structure in quite so much detail before, nor one that formalizes the process over a 6-12 month period.
I've never actually seen anybody try to produce a framework like this. I've been on team leading courses, but that was over 10 years ago, and they didn't provide much in the way of assistance. I did like the model visualization and the way that you just click on a phrase and it shows a description with links to other phrases. To me that was the most impressive part.
I really didn't find anything original about it. Honestly, there's nothing there that stands out about this framework to me.

Table E.7 Expert Audit A - Framework Originality

Framework Characterization (26 responses)
Academic, specialized tool, cater to specific people
Seems like a set of rules that enhance the team leadership experience by facilitating communication among team members using a series of steps outlined. It allows teams to distill and disseminate their involvement in a moderated setting.
I don't know
It's a simple and practical tool. It doesn't present me with any difficulties.
I don't know exactly
The rhea.framework is a technologically driven process which aids in developing better practices in leadership and offers not just the ability to self work through an issue, but guidance generated from academic resources.
An educational and knowledge shareing platform.
i think it's very specialised and it does the job it was made for
rhea.framework providing a structured reflection template with an easy to follow reflection guideline, an in-depth team leadership knowledge base for comparison and exploration, and offering opportunities to get in contact and share experiences with other team leaders in moderated, case-based reflection meetings.
It's a project to support the developing of projects made by group of people. It's an open projects that introduces some concepts as "flow", reference flow, etc.
rhea.framework is thoughtful, modern, fast and helpful framework. Specially the part where knowledge base can be used to compare personal experience with reference flow its really innovative and bring the dimension in framework.It is really precise and described well.
I think Rhea framework is a framework with tools for doing retrospective inside the team. This provides a guideline to follow to have a continuous feedback for the improvement of team in ICT environment but can be extended to other fields too.
While the structure seems clear and easy enough to understand, there is still a lot of loopholes that could make it fail. It is idealistic.
To summarize, the rhea.framework is based primarily upon leadership. The goal is the user to be using a continuous and self-directed style of reflection, in order to compare project management styles alongside software development, which provides a wonderful insight into improvements, and can be reviewed by different team leaders and facilitators. This therefore offers opportunities to get in contact and share experiences.
A process to manage teams in software development.
It's really a great invention for developing the leadership skills. i really like the whole system and its working system.,
The framework is an elaborate resource for team leaders and management on how to handle various situations in the workplace.
It helps to enable people and teach them better individual and general leadership skills for fast paced work areas.
Divided into three major guidelines, which one can follow to analyse an event. Flow, reference flow and core flow. As well as the three activities: Flow, knowledge base and flow sessions. What really stands out are the concept being implemented and what it entitles to. However the biggest aspect is the open source of the template, the abstract design which makes it applicable for pretty much every event and last but not least, the simplicity of it all. Easy to understand and implement. Pretty much cost free with a lot to gain.
its a method for improving team performance by reflection on significant events within the team
The total concepts of this framework is very good and the system also meet most of the leadership needs.This framework is going to help all team leader for developing their skill and knowledge .Thank you
a method for people to learn about and improve leadership skills
I believe it gives a structured approach to reflection in order to evaluate a situation and to learn from it.
It was thoughtful, dimensional and helpful framework. It has his uniqueness. I liked the framework.
It allows teams to take functions that they are already performing (in a Scrum agile team, a retrospective) and provide external context and solutions to it. I can see great benefit in this framework as my team often are very good at discussing the issue but not as good at determining beneficial solutions.
From what I can understand It is to support practitioners leadership in their day to day work

Table E.8 Expert Audit B - Framework Characterization

Framework Understandability (18 responses)
Lack of examples (pre-filled) or templates so someone unfamiliar but who wants to dwell on this can have somewhere to begin.
The framework website doesn't exactly translate conceptually to usage. How is the framework deployed? What virtual settings are ideal for this framework? Is it a standalone framework from which you operate in?
I don't know
The different parts on it
Theoretically the process makes sense but I think I would need to use it a few times before having a solid grasp of it. I would need to see how quickly and efficiently I could get from problem to solution and the effectivness of putting more academic and cerebral ideas into practice in a real world setting with unique individuals and demands.
Some of the concepts mentioned maybe a litle hard for an iniciate.
It is quite abstract, even if it fits most projects and situations
There are few things that described very shortly that is why it was look like missing some description what was needed to understand better and few terms also was hard to understand. There should be a demo example with the description. An example needed always to understand better.
I did not completely understand the Concepts piece. Although the author wants to explain various definitions. It can be started from steps to follow. Also, I think the language is particularly slightly hard to follow. eg. reflection is used again and again. But setting a baseline what does reflection mean in the context may be useful.
The guideline is somewhat vague, in that to get the desired result, the guideline should be smartly laid out and simple and specific.
It uses a lot of technical terms that are fine for those well-versed in management theory, but can make the summaries slow to read through as each term (like stakeholders or brainworkers) requires a few moments to contextualise and breaks the flow of the explanation. There's also no clear structure to learning about the rhea framework. It goes from a summary to a list of reference keywords with nothing in between. There's no clear path to follow to best understand it.
Some of the terminologies can be a little complex and some of the information overlaps making some parts overcomplicated.
I just have never heard of it until now so I cant lie and say i fully understand it
it uses alot of complex narratives to describe what is a much simpler system
The activities part is really hard to understand for me
I feel like it could be easier to understand if you simplified some of the language being used
In some point it was less descriptive. There should be more description in few points. And also an example is needed to understand better. Words used in sentence are too heavy and uncommon. There are more understandable synonyms for those word what can make more easier to understand the sentence for more people.
While it is understandable I think it could benefit from real world examples, as well as some discussion as to how it can fit in with existing methodologies.

Table E.9 Expert Audit B - Framework Understandability

Framework Completeness (12 responses)
While the concepts are fairly clear, the benefits are not exactly clear. I appreciate the references page and the recommended literature, but some of it is rather old (but most likely foundational e.g Surowiecki's seminal work on Crowds). The print version seems more elucidating than the virtual template. Perhaps integration would complete this?
I don't know
It seems that the system could benefit from user feedback in order to continually fine tune suggestions and approaches. In other words, add more practical use to the academic base and case study library upon which it's built.
consider also the character and the proactivity of the people
an example with the framework and more description in the end could complete the framework.
I think you can give a process. Start with X, do Y, then Z. Although Activities part is doing the same part. But I think the language part is making it sound a little abstract than tangible. Also while explaining flow etc. some example or case study should help to understand better.
It just seem too personally engaging and less on the professional side.
It needs a guide to walk you through the reference material. Just randomly clicking through the technical terms didn't feel an effective way to understand the framework.
Even though it compasses all the major outlines of actions to take in an event, it is rather abstract. Which is fine in most cases because of the broad approach there is a lot of room to fill in the blanks, but in complex, specific cases the template/guideline may not be sufficient.
reflections of the team on the event a major event to some people can be really insignificant for others in the team, a 360 view of the event might shed more light on the issue.
An example with the frame work and more descriptive starting and finishing points could complete the framework perfectly.
Again, just real world examples would draw me to it a lot more.

Table E.10 Expert Audit B - Framework Completeness

Framework Language Clarity (10 responses)
Maybe is some area use less academic wording.
Some of the wording is highly repetitive. Reflection for instance. On the other hand, the need to strike home the purpose of the Framework allows for this. There's a slight syntactical error on the home page. There's an em dash and a comma, which seems confusing. Although this is an extremely minor and pedantic detail, admittedly.
It was hard to understand sometime for heavy and complicated word choice in sentences. you should choose the less heavy and complicated word for better understanding to the more people.
You can have a case study or example as a narration to make your point which would make it easy to understand.
Make is as simple as possible. A word can have multiple meaning, so choosing what word to use in the instructional is important. The more self explanatory the instruction is, the better.
Some of the sentences have an awful lot of highly specific technical terms that might more percisely define an issue, but make the material far denser to understand. For example using the term "brainworkers" rather than just "worker" or "employee." While "brainworker" is a more percise term that's technically accurate, it also feels needlessly specific. So I'd recommend trying to avoid industry specific terms wherever possible, and use more generalised English.
I feel that some of the words used could be simplified for those that may not use such terminology in their workplace. Other than that it is easy to understand.
make it simpler and more concise
I felt like I understood it but at the same time if you just used simpler language then it would be easier to follow.
It was hard to understand some points for uncommon synonyms choice. But it would be better to choose easy and simple word for better understanding for more people.

Table E.11 Expert Audit B - Framework Language Clarity

Framework Usefulness (21 responses)
robotics technology
The main aim of the rhea.framework is to support practitioners involved in team leadership in reflecting interpersonal interaction in their day-to-day work.
Although I have a business degree and an MBA, I find that there can some times be a personal disconnect between what I've learned in academic settings and what I experience as the leader of a high pressured and fast moving team. Potentially, rhea.framework could aid in using the academic knowledge base with the self taught experience of daily leadership to form a more well rounded and technical approach to work. There is also the aspect of rhea.framework being instantaneous in terms of feedback, low cost and available around the clock which obviously differentiate it from what would traditionally be a consultant or internal support.
The description of situations, what to expect and what approaches are the better. Even someone that is not in a leadership position can learn from this.
i think all the feature it has is very helpful for my job decisions
the concept of collaboration and the definition of leadership
The Knowledge Base can be an important source of organized experiences in which get inspiration. On the other hand, it seems to need time to take advantage of the whole system.
I think the knowledge base is particularly beneficial as you might arrive in similar situation from time to time and can help to make more informed decision in future.
It provides a personal structure to continually grow in my profession.
No installation or fiddly nonsense, sourcing the project was a simple task for our team. Also, it is simple for our beginners to understand.
It seems to cover quite a wide range of potential issues in team management. The knowledge base was a nice summary of many issues, and the links to further information on each seemed like it'd remain useful even if you're already quite familiar with the concept discussed.
Significant event and core flow is really very useful for me
I feel that the parts where you are to consider people in my team and under me is very useful. Also the parts about delegation and how to assign work to others is very helpful.
The order of actions to take as well as having something to fall back on in case of situation where my base knowledge would fall short. Also the order of escalation one can follow if the first/second steps aren't sufficient. You're essentially not only writing down a significant event (flow), which helps you analyze and understand the event better and also makes you take appropriate measurements, but also letting it be reviewed by a peer to add some insight (reference flow). Which I think shortens the gap for asking for help by getting a flow reviewed.
many stressful situations can occur within teams a reflection on events can dig down into events and help resolve issues
""contact and share experiences with other team leaders"" this features is very useful for me
I think that we often run into conflicts and some are new that we have never dealt with before and I think it would be helpful to search the knowledge base for similar conflicts
I believe it is useful for the whole team. All tasks and productivity starts from the top and works its way down. Giving leaders more tools to better evaluate their practices helps improve the efficiency of the workforce. We are all human and prone to mistakes, so it's important that resources are available for support and improvement.
I already mentioned that knowledge base part is original of this frame work. I consider this part will be particularly useful addition for me.
I think the data visualisation of the knowledge base is very useful in identifying similar issues and solutions. For example my team may adopt one of these solutions, find it greatly beneficial, and wish to use this visualisation to find similar solutions.

Table E.12 Expert Audit B - Framework Usefulness

Framework Usefulness: Similar Frameworks (1 response)
I havent had the chance to get any other info on frameworks like this. its new to me i like the concept

Table E.13 Expert Audit B - Framework Usefulness: Similar Frameworks

Framework Originality (25 responses)
In the right hands it seems to provide unique perspective in some well known problems
It takes the reflection process to an entirely different level. By combining the three activities, it appears to allow for a far greater understanding for leadership practices than anything else out there presently.
It's new and it's open source. Maybe those things
The structure
The rhea.framework, to me, seems like having a consultant to help with issues and get ideas and suggestions from. Additionally it seems that the program can bridge the gap from peer reviewed, reputable academic research and the real world practicality that research seeks to address.
It's the idea of sharing knowledge and real life experience beetween people in leadership positions.
it's a framework designed for assess managerial decisions
approach and methodology
I think that its level of abstraction makes it enuogh flexible to adapt itself to most contests. Furthermore, concept like "Significant Event" and their comparision are very remarkable.
In my view knowledge base part is original about the rhea.framework where knowledge base can be compared to the personal experience with reference flow.
I think it is not targeted to a particular field and can be used in various context makes it unique according to me. I am not an expert about frameworks to say if it is unique or not. But I like the take.
I think the interpersonal concept of it.
Rhea is very adaptable and the language is clear, and I find also comprehensive. The framework is easy enough to understand, a beginner can apply it's proceedings upon explanation and with guidance, yet more advanced users can expand it's use for the greater good.
The natural language processing of the reflection flow seems unique. I'm not quite sure on how practical it'd be, whether it's just going to link to some keywords, and I'm wary of trying it out due to security concerns, but the concept of it is interesting.
Analyzing and developing the Leadership Reflection
I feel that it's original because it covers so many different areas. Many resources like this are limited or only focus on basic aspects of management. The knowledge base visualisation is also very unique.
leadership building has always been a crucial part of a work place
Terminology, as well as the broad definition. Leaving a lot of room to the supervisor, which can be good or less good depending on the issue/event and or goals. And as mentioned earlier, simplicity and easy to use, low cost high gain structure.
nothing I have used similar tools with m team
Developing the leadership skills
I think the whole concept of sharing your experiences and then uploading them to add to a knowledge-base is quite original. I think the focus on reflection is not new but definitely overlooked sometimes.
Many other organisations already offer the reflective framework such as the NHS. I like that it is original in nature as it originates from the person involved.
Knowledge base part is original about the rhea.framework. knowledge base can be compared to personal experience with reference flows what makes it really dimensional, innovative and original also.
A lot of frameworks encourage teams to find solutions through group discussion. Whilst this framework does that as well, it provides tried and tested solutions that teams can focus discussion around.
Seems like a original way to manage working within a team

Table E.14 Expert Audit B - Framework Originality

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