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Interrelations within the Management Control Systems Package

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1 Introduction

1.1 Motivation

Chenhall (2003) states that "the ultimate goal of MCS [management control system] research is to provide findings that assist managers in achieving their goals or those of their organisations" (p. 134). It has been acknowledged that different 'management controls and/or management control systems (MC(S))' work together to form the 'management control systems package (MCSP)' of an organisation (Otley 1980; Fisher 1995; Abernethy, Chua 1996; Malmi, Brown 2008). In order to understand what can be done to optimise the MCSP from the perspective of organisational goal attainment, researchers should try to develop a better knowledge of how and why MCSPs work in different situations (Merchant, Otley 2006). Therefore, in order to holistically understand the performance effects of certain MCSPs in combination with certain contingency settings, contingency-based research is called upon to follow a systems approach to fit (Drazin, van de Ven 1985; Fisher 1995). This means that firstly, interrelations within the MCSP need to be considered and secondly, conflicting contingencies need to be accounted for when measuring for performance effects of MCSPs in combination with certain contingency settings (Drazin, van de Ven 1985; Fisher 1995; Grabner, Moers 2013). In spite of the suggestion to follow a systems approach to fit, there has been little theorising and empirical research on MC(S) interrelations within the MCSP (Abernethy, Chua 1996; Simons 1995; Malmi, Brown 2008).

1.2 Objectives

This thesis aims to provide guidance on the issue of interrelations within the MCSP by fulfilling four main objectives. Firstly, by explaining why a systems approach to fit should be followed and in particular, why it is essential to consider interrelations within the MCSP when measuring for performance

effects. Secondly, by identifying the best fitting conceptual framework for research on MC(S) interrelations. Thirdly, by discussing how complementary theory can be utilised to measure for interdependencies between MC(S) and thereby be of great value for the design of internally consistent MCSPs. Lastly, by pointing out important findings as well as shortcomings of prominent studies on MCSP design.

1.3 Contribution

By pursuing the stated objectives, this thesis contributes to the existing literature in the following ways. Firstly, a compact but comprehensive overview of contingency theory is provided which includes an easy-to-understand visualisation of the different approaches to fit as well as a summary of suggestions for contingency-based research. Secondly, after a review and discussion of the most prominent MC(S) frameworks, the MCSP framework of Malmi & Brown (2008) is identified as the most fitting framework for research on MC(S) interrelations. Thirdly, several findings and theories of Brynjolfsson & Milgrom (2012) are extended to MC(S) research, in order to complement Grabner & Moers' (2013) findings and recommendations for research on MC(S) interdependencies. Lastly, key findings and shortcomings of prominent research papers on MCSP design are identified.

1.4 Structure

This thesis is structured as follows: Section 2 provides important definitions. Section 3 explains why interrelations within the MCSP need to be considered. Section 4 covers the three approaches to MCSP design and prepares for section 5, where contingency theory is thoroughly discussed. After the rationale of contingency theory is explained, there follows a categorisation of different approaches to fit, as well as a reflection on those approaches. Subsequently, suggestions on performance measurement and research methodology are presented. Section 6 deals with MC(S) frameworks. The most prominent

frameworks are reviewed and the MCSP framework is compared to the object of control framework (OOC framework). Finally, advantages and shortcomings of the MCSP framework are outlined.

Section 7 discusses how complementary theory can be utilised to design internally consistent MCSP by measuring for MC(S) interdependencies. After Grabner & Moers' (2013) model of MCSP design is presented and the differences between a systems approach and a reductionist approach are analytically shown, there follows an outline of empirical implications for research on MC(S) interdependence. Additionally, the interdependence matrix of Brynjolfsson & Milgrom (2012) is presented and it is discussed why it can prove difficult to change internally consistent MCSPs. Section 8 introduces four prominent research papers on MCSP design and points out the respective key findings and shortcomings of those studies. Section 9 concludes the thesis with a summary and by listing opportunities for future research.

2 Definitions

Flamholtz et al. (1985) note that "there are about as many definitions of control as there are theorists" (p. 36). While his statement is slightly exaggerated, there is indeed a lot of variation in the definition of MC(S) and a MCSP (Merchant, Otley 2006; Fisher 1995; Malmi, Brown 2008). Therefore, relevant terms and definitions used throughout this thesis are outlined below.

Flamholtz et al. (1985) state that it is the intent of organisational control to influence people to take actions and make decisions that are consistent with organisational goals. These goals are imposed on the organisation by its owners, dominant coalitions, and external authorities. Malmi & Brown (2008) suggest that "systems, rules, practices, values and other activities management put in place in order to direct employee behaviour should be called **management controls (MCs)**" (p. 290). To list some examples, MCs can be action plans, budgets, reward and compensation practices, simple rules,

mission and vision statements, as well as employee selection and training (Malmi, Brown 2008). A more detailed overview follows when control frameworks are reviewed in section 6.

Malmi & Brown (2008) state that single MCs which work as a system (e.g. strategy scorecards) or MCs that form an intentionally designed and coordinated system with other MCs should be called **management control systems (MCSs)**[1]. Similarly, Grabner & Moers (2013) define that "MC practices form a system if these practices are interdependent and the design choice has taken the interdependencies into account" (p. 7). However, in this thesis there is no need to differentiate between MCs and MCSs, as they are addressed simultaneously. Therefore, the abbreviation **MC(S)** will be used to refer to **'MC and/or MCS'**.

It can be further differentiated between **formal MC(S) and informal MC(S)**. The former refers to MC(S) that are cybernetic in nature. Cybernetic MC(S) compare an observable output to an ex-ante set target and corrective action is taken if the two differentiate. Formal MC(S) include financial budgeting systems and incentive compensation systems. Informal MC(S) are not cybernetic; for example, a firm's culture, its human resource practices, and any kind of guidelines or simple rules that it implements (Fisher 1995).

Otley (1980), found that the portfolio of MC(S) in an organisation tended to be composed of loosely coupled elements, which often do not form a coordinated holistic system. This is caused by the fact that MC(S) are implemented by different interest groups, in different departments of the organisation, at different times (Ferreira, Otley 2009; Malmi, Brown 2008). Therefore, Otley (1980) chose the term **management control systems package (MCSP),** when talking about the whole set of a firm's MC(S) (Ferreira, Otley 2009).

[1] Malmi, Brown (2008) explicitly exclude decision support systems from their definition of MC(S). They propose to name systems that are used solely for the managements' own decision-making or employed to support decision-making by subordinates without a monitoring mechanism 'management accounting systems' instead. Other authors, such as Flamholtz et al. (1985) and Merchant, van der Stede (2012), do not exclude decision support systems from definition of MC(S).

Contingency factors describe specific characteristics of a firm (e.g. technology, culture - see section 5.1 for details). The terms **contingency set** and **context** refer to the combination of all contingency factors a specific organisation is exposed to (Fisher 1995).

3 Why to consider interrelations within the MCSP?

The field of MC(S) is studied in order to provide findings that enable managers to better achieve their goals and those of their organisations (Chenhall 2003). There are three main reasons why interrelations between MC(S) need to be considered in pursuit of this objective. Firstly, and most importantly, to prevent erroneous conclusions. If interrelations between MC(S) are not taken into account, it can lead to wrong findings on the performance effects of specific combinations of contingency factors and MC(S) (Fisher, 1998; Chenhall 2003; Malmi, Brown 2008; Grabner, Moers 2013). Details on possible measuring errors are discussed in section 7.3.1.

Secondly, the interdependencies between MC(S) need to be understood in order to predict the performance effects of the implementation of additional MC(S) into an existing MCSP. Unfortunately, MC(S) innovations (e.g. the balanced scorecard and value-based management) have so far mostly been studied separately. Thirdly, to gain a broader understanding how informal controls work and whether they complement or substitute formal controls (Malmi, Brown 2008).

Otley (1980) concluded already 30 years ago that an inappropriately simple model of contingency theory had been used to study MC(S). Since then many scholars repeated his call on contingency-based research to take interrelations within the MCSP into account (e.g. Flamholtz et al. (1985); Drazin, van de Ven (1985); Fisher (1995); Abernethy, Brownell (1997); Chenhall (2003); Malmi, Brown (2008); Grabner, Moers (2013)).

4 Research approaches to MCSP design

There are three research approaches to MCSP design, which result from different underlying theoretical concepts and vary in how the choice of MC(S) is hypothesised to be influenced by the firm's contingency factors. These are (1) the universalistic approach, (2) the situation-specific approach and (3) the contingency approach (Fisher 1995). The different approaches are discussed in order to familiarise the reader with the logic behind them and to highlight the differences.

The rational of the **universalistic approach** is that there is only one optimal MCSP design that can, to a certain degree, be employed in any organisation, regardless of its specific contingency setting. Accordingly, contingency factors would not play a role when designing the MCSP. However, conflicting empirical results could not be satisfactory resolved by the universalistic approach and provided the ground for contingency formulations which proposed relations between MC(S) and contingency factors (Otley 1980, Fisher 1995).

Contrary to the universalistic approach, the **situation-specific approach** assumes that, due to the high number of possible different combinations of contingency factors, each single organisation has its very unique contingency setting. Therefore, the suggestion of the situation-specific approach is that the MCSP must be individually designed for each organisation, as no comparison between firms is possible (Fisher 1995).

The **contingency approach** is located in-between the two extremes. Contingency theory[2] assumes identically to the situation-specific approach that the effectiveness of a MCSP depends on the contingency setting of the organisation. However, it suggests that conditional on a firm's contingency setting, recommendations for optimal MCSP design can be made (Fisher 1995).

[2] Chenhall (2003) notes that contingency theory is not a theory by itself, but describes an approach that uses a variety of theories to explain and predict contingency settings in which particular MC(S) configurations can be found and/or lead to increased performance.

The contingency approach has become the most dominant approach in research on MCSP design and is utilised by researchers in the fields of management accounting to understand and predict relations between MC(S) and contingency factors (Fisher 1995; Dent 1990).

5 Contingency theory

Contingency theory currently provides the widest accepted explanation of the MC(S) selection process and thereby of how the MCSP is hypothesised to be designed (Fisher 1995; Dent 1990). After contingency factors are explained in section 5.1 and the rationale of contingency theory is discussed in section 5.2, a categorisation of different approaches to fit follows in section 5.3. Section 5.4 provides a reflection on those approaches. Sections 5.5 and 5.6 deal with performance measurement and research methodology, respectively.

5.1 Contingency factors

"The term contingency means that something is true only under specified conditions" (Chenhall 2003, p. 157) **Contingency factors** describe firm characteristics. Those identified to play a role in MC(S) research can be divided into six groups:

- **External environment** (e.g. uncertain vs. certain; Fisher 1995)
- **Competitive strategy and mission** (e.g. defender vs. prospector; Fisher 1995)
- **Technology** (e.g. small patch, large patch, mass production; Fisher 1995)
- **Unit, firm, and industry** (e.g. firm size; Fisher 1995)
- **Knowledge and observability factors** (e.g. outcome observability; Fisher 1995)
- **Culture** (e.g. individualism vs. collectivism; Chenhall 2003)

Appendix A gives a detailed, but non-exhaustive list of identified contingency factors which Fisher (1995) gathered in his review on previous contingency-based research.

The terms **contingency set** and **context** refer to the combination of all contingency factors that a specific organisation is exposed to (Fisher 1995).

5.2 Contingency factors and MCSP design

The graph below shows the process of how the MCSP is theorised to be designed from a contingency-based view.

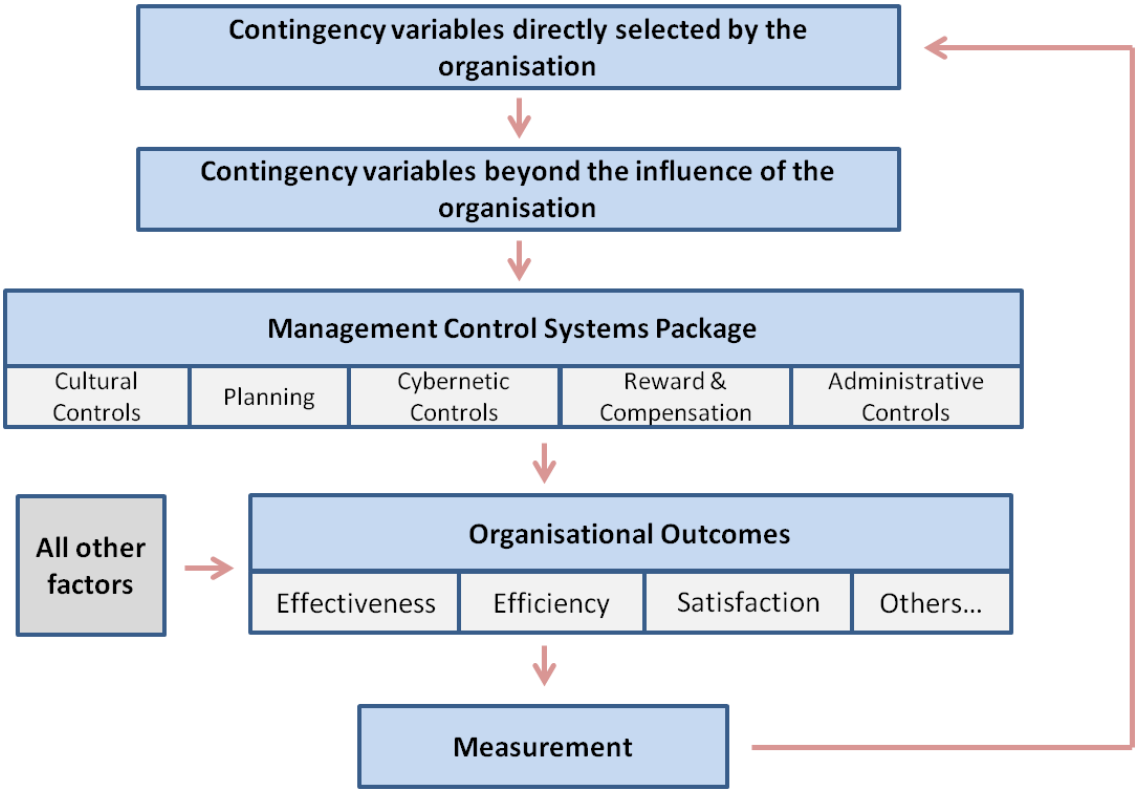


Figure 1: MCSP design process (Fisher 1995, p.33 mod.; Malmi, Brown 2008)

Contingency factors are in general perceived to be outside the organisation's control (Otley 1980). However, Fisher (1995) points out that at some point at the start of its entrepreneurial activities, each organisation chooses the markets it is going to participate in and the strategy it is going to pursue. Additionally, it has

the power to alter its market, product, and strategy decisions over time. Thereby, each organisation has a certain extent of control over the contingency factors that it is going to be exposed to in the long run. However, in the short run organisations are exposed to the contingency factors they have already chosen or that follow from certain previous decisions (e.g. if an organisation pursues a competitive strategy, a level of environmental uncertainty comes with it (Fisher 1995)).

In order to design a MCSP which helps to deliver the desired outcomes in the best way, the MCSP designer needs to adapt to the organisation's contingency set (Fisher 1995). Additionally, as already mentioned, the designer must consider the interrelations between the various MC(S) that compose the MCSP. After the resulting organisational output is measured via various variables (e.g. effectiveness, efficiency, and satisfaction - a discussion on output variables follows in section 5.5) the organisation might choose to alter its contingency set by changing its strategy or altering other fundamental decisions. A new composition of the contingency set triggers the process again. Fisher (1995) additionally mentions that in order not to bias measurement findings for MCSP performance, all other factors influencing the organisational outcome need to be controlled for. Unfortunately, he does not specify what exactly these 'other factors' are and how to control them.

5.3 Categorisation of research approaches to fit

Within contingency-based research four research approaches can be categorised which substantially differ in their analysis complexity. These are (1) the selection approach, (2) the interaction approach, (3) the level three approach, and (4) the systems approach (Drazin, van de Ven 1985; Fisher 1995).

The selection approach

Firstly, the **selection approach**[3] examines the relation between one contingency factor and one MC(S) without measuring for performance (Drazin, van de Ven 1985).

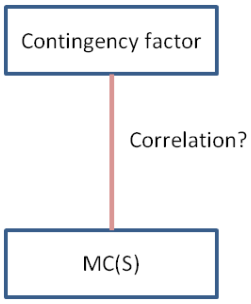


Figure 2: The selection approach (Fisher 1995, p. 35 mod.)

The interaction approach

Secondly, the **interaction approach** attempts to study the effect of pairs of contingency factors and MC(S) on organisational performance. Chenhall (2003) states that the interaction approach has been the most dominant approach to fit in contingency-based research. However, while the approach considers output implications, it neither takes interrelations between MC(S) into account, nor does it pay attention to conflicting contingencies (Drazin, van de Ven 1985).

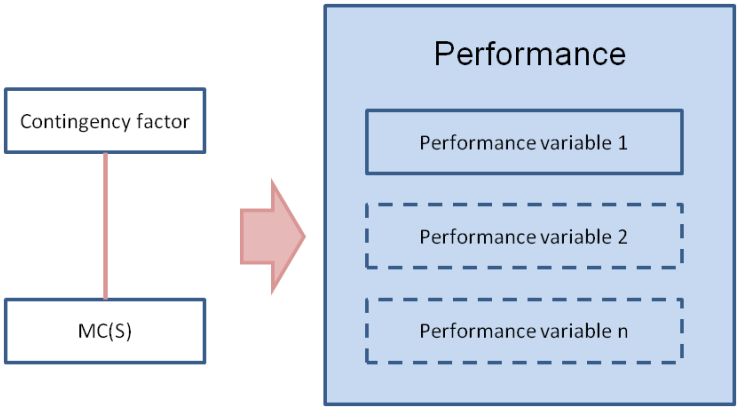


Figure 3: The interaction approach (Fisher 1995, p.35 mod.)

[3] Drazin & van de Ven (1985) note that the selection approach is in fact a congruence approach, not a contingency approach, as it measures only correlation.

The level three approach

Thirdly, the **level three approach** is situated between the interaction approach and the systems approach. It attempts to determine the effect of relations between one contingency factor and multiple MC(S) on outcome and takes interrelations between MC(S) into account. Thereby, it corrects one of the two shortcomings of the interaction approach (Fisher 1995).

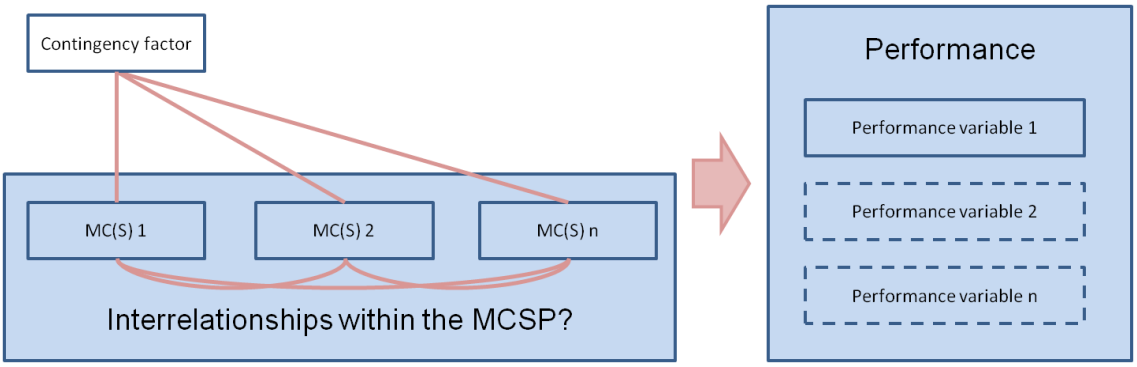


Figure 4: The level three approach (Fisher 1995, p.35 mod.)

The systems approach

Lastly, the **systems approach** is mentioned. While the level three approach takes only one contingency factor into account, the systems approach simultaneously addresses multiple contingency factors (Drazin, van de Ven 1985).

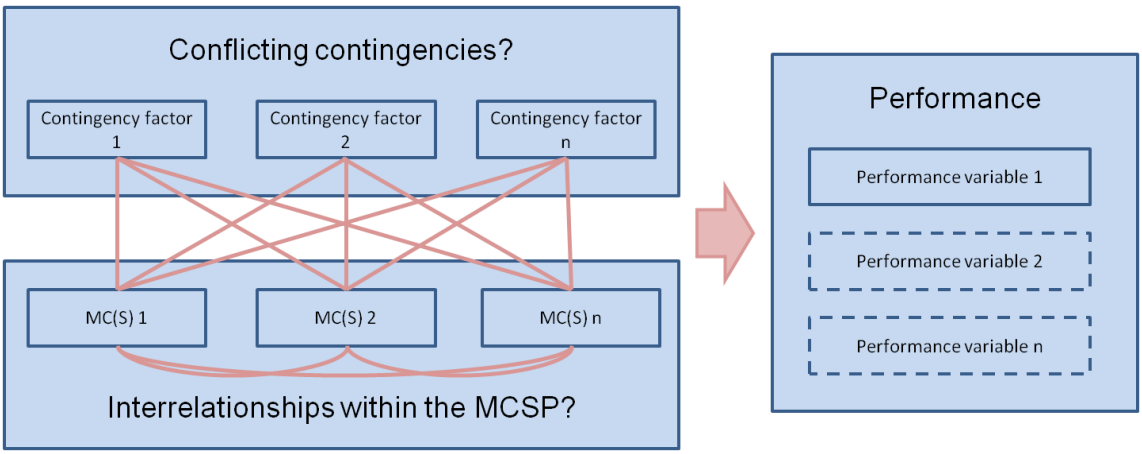


Figure 5: The systems approach (Fisher 1995, p. 35 mod.)

5.4 Reflection on research approaches to fit

Unfortunately, the design of MC(S) research studies has often been too simplistic. By not considering uni- and bidirectional relations between variables and/or not measuring for performance effects, findings may have been biased and/or do not indicate whether the MCSP lead to higher performance (Otley 1980; Fisher 1995; Drazin, van de Ven 1985; Chenhall 2003; Malmi, Brown 2008; Grabner, Moers 2013).

The approach which has the most shortcomings is the selection approach. It measures for a positive correlation between contingency factors and MC(S), but does not control for interdependencies between MC(S) or for conflicting contingency factors. Additionally, performance effects are not measured. Therefore, the approach does not allow to determine whether the positively correlated pairs are more effective than other combinations of contingency factors and MC(S). The selection approach used to be justified by the assumption of natural selection[4]. This seems, however, overly simplistic for a general assumption and is only applicable if it can be reasonably argued that the MCSP design is optimal (Drazin, van de Ven 1985; Grabner, Moers 2013). The selection approach embodies what Otley (1980) criticised most harshly in his review on contingency-based research. The interaction approach overcomes one shortcoming of the selection approach, as it allows to determine performance. However, since it also does not account for interrelations within the MCSP and conflicting contingency factors are not considered, the resulting findings are likely to be biased (Grabner, Moers 2013).

Both the selection approach and the interaction approach implicitly assume that MC(S) are independent of each other and subsequently do not affect each other's value. The level three approach and the systems approach abolish this assumption and take interrelations within the MCSP into account. However, while both account for interdependencies between MC(S), only the systems

[4] Natural selection suggests that only those organisations with the best MCSP design are able to survive. This argumentation implies that all observable MCSPs are somewhat optimal (Drazin, van de Ven 1985).

approach considers multiple contingency factors. Since contingency factors can conflict in the demands they put on the MCSP, the consideration of only one contingency factor might lead to a suboptimal fit between the full contingency set and the MCSP (Fisher 1995).

It is important to appreciate that the systems approach is the only approach which allows to holistically understand the output effects of a certain contingency setting in combination with a certain MCSP (Drazin, van de Ven 1985; Fisher 1995). Fisher (1995), Chenhall (2003), Malmi & Brown (2008), and Grabner & Moers (2013) therefore suggest that contingency-based research should be focused on the systems approach. All other approaches are considered reductionist approaches (Grabner, Moers 2013).

However, as Drazin & van de Ven (1985) noted, reductionist approaches can provide unique and supplementary information if they are applied additionally to the systems approach. For instance, the comparison of systems and interaction results can be of high value. If systems results are significant, but interaction results are not, it can be concluded that fit does not occur at the level of pairs of contingency factors and MC(S), but between the contingency setting and the MCSP. Otherwise, if interaction results are significant on certain pairs, it indicates that those relations are more critical for performance, implying that limited resources should be allocated there first. Interaction approach results can thereby complement systems approach results (Drazin, van de Ven 1985).

Unfortunately, the more holistic the research approach (i.e. the more variables and interrelations are considered), the more difficult it becomes to interpret results and build a theory on them (Chenhall 2003). This leads to the assumption that MC(S) research in the past may not have forgotten to account for interrelations between the some of the discussed variables, but chosen to intentionally neglect them in order to increase the interpretability of results.

5.5 Performance measurement

Another critical issue for MC(S) research is the measurement of performance. Studies should be designed in a way that allows to determine whether specific combinations of contingency factors and MCSP increase performance or not (Otley 1980). This is essential, in order to give advice on optimal MCSP design. However, many researchers still do not include organisational performance as a dependent variable and when they do, it is typically poorly defined (Fisher, 1995; Chenhall 2003).

The main question in performance measurement is what to measure for to evaluate performance. Otley (1980) noted that different firms may have different goals (e.g. some might prioritize growth of market share over profit goals in the short run). Additionally, many firms pursue competing goals, such as to attract and maintain shareholders, customers, and employees (Fisher 1995). This means that different companies are effective in different ways and the objectives of the specific organisations must be considered and reflected by the variables that are used for performance measurement. In most firms it will also be sensible to measure performance in several different variables instead of one (Otley 1980; Fisher 1995).

Otley (1980) additionally suggests measuring intervening variables (i.e. variables that are thought to pre-dispose organisations towards effective operations - e.g. employee satisfaction). Fisher (1995) and Chenhall (2003), on the other hand, state that higher performance may result without a change in intervening variables.

5.6 Research methodology

There are four basic research methodologies that helped to develop findings in the MC(S) literature. These are (1) analytical modeling, (2) field research (e.g. case studies) (3) experiments, and (4) surveys. The research methodology that

has been mostly used in contingency-based research is survey research (Fisher 1995; Merchant; Otley 2006).

However, there are some disadvantages. Fisher (1995) and Merchant & Otley (2006) list shortcomings of survey research in contingency-based research. They state that the superficiality of the survey instrument as well as respondent bias have negatively affected findings. Additionally, different measurement instruments were used without providing adequate information on the prevalent contingency setting and variables were defined inconsistently. Finally, most analysis has been conducted cross-sectional and did not address time-series effects, which makes it difficult to derive causal relations. Therefore, contingency-based research relying on survey instruments has not produced much cumulative outcome so far.

Contingency-based research following the systems approach is dealing with a highly inter-connected structure of contingency factors and MC(S) (Otley 1980). In order to reveal the complex patterns of interaction between these variables, Otley (1980) and Malmi & Brown (2008) suggest that researchers must be closely involved in their research and further develop hypotheses as they investigate organisations (i.e. they should follow an inductive approach).

Additionally, they should look for causal relations rather than associations. This is easier to accomplish by conducting longitudinal studies than by running cross-sectional studies (Otley 1980; Fisher 1995). Since a considerable period of close involvement is required, in order to be able to gain representative and reliable study results, Otley (1980), Fisher (1995), and Malmi & Brown (2008) suggest that case studies are the preferable research instrument to further develop contingency-based theory. Those should be conducted in carefully selected organisations, in order to get a range of values on the considered contingency factors (Otley 1980).

However, there are also limitations to the case study method. Firstly, evidence and results may be subject to researcher bias. Secondly, there are time and cost constraints that allow only a limited number of case studies to be

conducted. This conflicts with the need for a high number of research results in order to validate theories (Otley 1980; Fisher 1995). Still, since large-scale surveys proved to be of little value, the case study approach should be the preferred choice for further MC(S) research. Fisher (1995) suggests to additionally conduct experiments in order to complement case study findings, as those ensure tighter control over contingency factors and confounding variables.

To summarize the recommendations from this section: Contingency-based research is called upon to conduct longitudinal case studies, in order to derive findings on MCSP design. This needs to be done while accounting for relations between MC(S) and contingency factors as well as the interrelations within the MCSP (i.e. by following a systems approach to fit). Additionally, performance needs to be measured in accordance with the companies stated goals. However, as Otley (1980), Chenhall (2003) and Grabner & Moers (2013) accurately state, this is a challenging task.

6 MC(S) frameworks

It has been argued in the previous sections that contingency-based research needs to consider the interrelations between MC(S). But what kind of MC(S) do exist, how can they be categorised, and what is the best fitting framework for research on MC(S) interrelations? There are many conceptual frameworks that describe and classify forms and types of MC(S).[5] In order to provide an overview of the most prominent classifications and terminologies, the frameworks of Anthony (1965), Ouchi (1979), Simons (1995), Merchant & van der Stede (2007), and Malmi & Brown (2008) are going to be briefly discussed in sections 6.1 to 6.4. Subsequently, the MCSP framework and the OOC

[5] e.g. Anthony (1965), Ouchi (1979), Otley (1980), Flamholtz et al. (1985), Simons (1995), Fisher (1995), Otley (1999), Merchant & van der Stede (2007), Malmi & Brown (2008), and Ferreira & Otley (2009)

framework are compared in section 6.5 and a further evaluation of the MCSP framework follows in section 6.6.

6.1 Early frameworks

Anthony (1965) was one of the first to discuss management control in the literature. He separated it conceptually from strategic planning and operational control and described its function to ensure that resources are obtained and used in congruence with the goals of the respective companies. Anthony (1965) focused on formal MC(S) (accounting and financial controls), as he perceived them as tools of choice to fulfil the function of management control. His framework encouraged MC(S) research and teaching to keep focused on formal MC(S) for a considerable period of time (Merchant, Otley 2006).

Ouchi (1979) was the first one who considered management control in a broader scope, when he differentiated between three forms of management control: (1) behaviour control, (2) output control, and (3) clan control. The first two forms are relatively straightforward. Behaviour control addresses employees' behaviour; output control aims to control employees' output/performance. Clan control is more subtle and starts getting used when behaviour and output control cannot be exercised. This form of control works by selecting only the best fitting individuals as employees, teaching them accepted group values through a socialisation processes and by performing rituals and ceremonies. Through the utilisation of these practices the organisation obtains a committed set of employees, who display the attitudes and values that are most likely to lead to organisational success. Which form of control an organisation should choose depends on the management's "knowledge of the transformation process" and its "ability to measure outputs" (see Appendix B for more detail).

6.2 The LOC framework

The **levers of control framework (LOC framework)** was introduced by Simons (1994). He defines MC(S) for his framework as "formal, information-based routines and procedures used by managers to maintain or alter patterns in organisational activities" (Simons 1994, p. 170). Thereby, he intentionally excludes informal control processes, such as group norms or culture, which have been argued to be part of the MCSP of an organisation MCSP (Ouchi, 1979, Otley 1980; Fisher 1995; Malmi, Brown 2008). Simons (1994) differentiates between (1) beliefs systems, (2) boundary systems, (3) diagnostic control systems, and (4) interactive control systems.

A beliefs system is a set of shared beliefs that defines basic values, purpose, and direction. It is used to provide guidance and inspiration to opportunity-seeking employees. Examples are mission or vision statements. A boundary system, in comparison, provides limits and rules, in order to define the boundaries of employees' freedom. By implementing, for instance, clear rules, codes of conduct, and capital budgeting systems the management tries to avoid unwanted risks.

Diagnostic control systems are formal feedback and measurement systems that are used to correct deviations from performance standards through management by exception. Interactive control systems, on the contrary, require the regular and personal involvement of managers in the decisions of their subordinates. Regular management interaction is exercised for two reasons. Firstly, in order to focus the attention of the organisation on critical topics. Secondly, to force communication and enable organisational learning. Through management involvement a diagnostic control system can transform to an interactive one.

To summarise, the LOC framework is a useful instrument for the categorisation of formal control mechanisms and in order to understand how they can be employed in different ways. However, since it excludes informal MC(S), it is only

of restricted value to research on interdependencies between all components of the MCSP.

6.3 The OOC framework

Merchant & van der Stede (2007) built up on Ouchi (1977) and developed the **object of control framework (OOC framework)**, in which they identify four types of control: (1) action controls, (2) result controls, (3) personnel controls, and (4) culture controls.

Action controls directly steer and monitor behaviour, whereas result controls measure output and influence behaviour by linking rewards and punishments to results. Personnel controls are implemented through personnel selection and placement, personnel training, job design, and provision of resources. They ensure that employees have the necessary skills and resources for a job, help to communicate the expectations of the organisation, and aim to increase employee self-monitoring. Cultural controls are implemented in order to motivate mutual monitoring of employees. To shape the organisational culture, codes of conduct, group-based rewards, and social arrangements can be used (Merchant, van der Stede 2007). The OOC framework is further discussed in section 6.5, when it is compared to the MCSP framework.

6.4 The MCSP framework

The most recent and most comprehensive framework is the **management control systems package framework (MCSP framework)**. It was compiled by Malmi & Brown (2008) after analyzing and synthesising almost four centuries of MC(S) research. Their aim was to provide a model that can accommodate all forms of MC(S) that they perceived to be part of a MCSP. They developed a typology of five control elements which are: (1) planning controls, (2) cybernetic controls, (3) reward and compensation controls, (4) administrative controls, and

(5) cultural controls. Those elements can have various MC(S) components, as can be seen in figure 6 below.

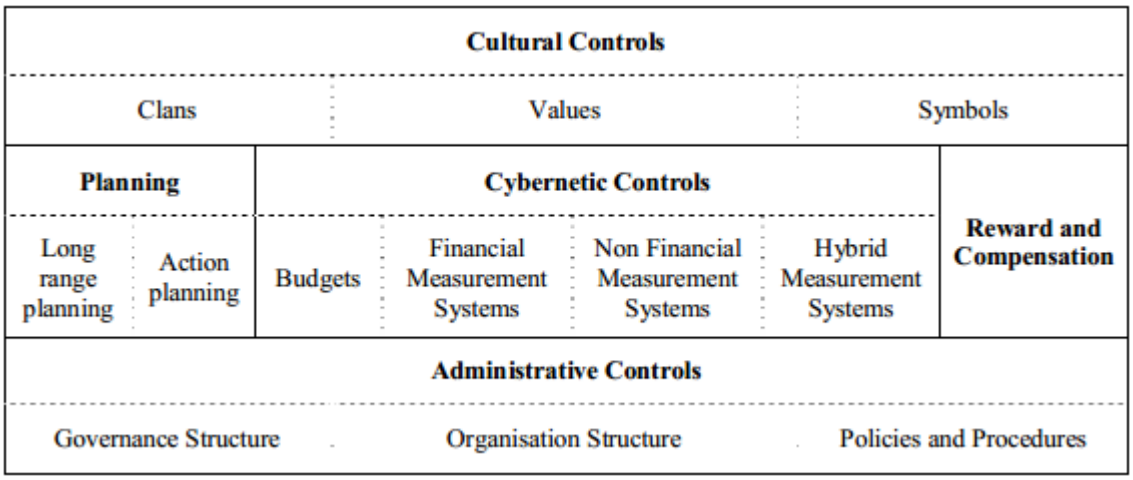


Figure 6: The MCSP framework (Malmi, Braun 2008, p. 291)

In the following the architecture of the MCSP framework in figure 6 is going to be explained. Malmi & Brown (2008) positioned cultural controls on top of the framework, in order to indicate that those are broad controls which are assumed to be only slowly adaptable. Thereby, they provide a context for the remaining controls. Planning controls, cybernetic controls, and reward and compensation controls form the central block of the framework. They are assumed to be tightly linked and run in temporal order from left to right. Administrative controls are positioned at the bottom. They create the structure in which planning controls, cybernetic controls, as well as reward and compensation controls are exercised.

Planning controls

Malmi & Brown (2008) divide planning controls, based on their planning horizon, into two subgroups. Firstly, long-range planning, which specifies goals and actions for a time period more than 12 months ahead. Long-range planning has a strategic focus. Secondly, action planning, which has a tactical focus and includes a planning range up to 12 months.

Flamholtz et al. (1985) note that planning is an ex-ante form of control. It sets out the goals and specifies the standards that need to be achieved by the

organisational departments. Thereby, planning directs effort and behaviour. Additionally, the planning process coordinates all individual and group actions in order to adjust them to organisational goals (Flamholtz et al. 1985; Malmi, Brown 2008).

Cybernetic controls

Cybernetics is a scientific discipline that studies communication and control processes in machines, living entities, and social systems (Merchant, Otley 2006). Cybernetic control is defined as "a process in which a feedback loop is represented by using standards of performance, measuring system performance, comparing that performance to standards, feeding back information about unwanted variances in the system, and modifying the system's comportment" (Green, Welsh 1988, p. 298). Fisher (1995) state that many accounting researchers agree that formal control systems must be cybernetic. Malmi & Brown (2008) identified four basic cybernetic MC(S): (1) budgets, (2) financial measurement systems, (3) non-financial measurement systems, and (4) hybrid measurement systems. They note that budgeting is the foundation of MCSP in most organisations. Budgets work as a control mechanism by comparing actual performance against goals that have been set. Examples for a financial measurement, a non-financial measurement, and a hybrid measurement system would be economic value added, employee satisfaction, and the balanced score card, respectively.

Reward and compensation controls

Reward and compensation controls are mostly linked to cybernetic MC(S). However, Malmi & Brown (2008) list them separately, as organisations can also provide rewards and compensation without the use of cybernetic systems. Bonner & Sprinkle (2002) explain how reward and compensation can work as control. They state that the general hypothesis is that monetary incentives increase the effort of individuals and groups, which leads in turn to an increased performance. Those individuals and groups can increase their effort by focusing their attention on specific tasks, devoting more time on tasks, working more

intensively, and learning how to do their tasks better. Thereby, management can indirectly steer employee behaviour by using reward and compensation controls.

Administrative controls

Three components of administrative controls are identified by Malmi & Brown (2008): (1) organisational design, (2) governance structure, and (3) policies and procedures. Organisational design can act as a control, since using a particular organisational structure encourages certain types of contacts and relations within the organisation (Abernethy, Chua 1996; Malmi, Brown 2008). Moreover, the variability of individuals' and groups' behaviour can be reduced through particular organisational designs and thereby increase the predictability of employee behaviour. This can be done by altering structural dimensions, such as functional specialisation, centralisation, and standardisation (Flamholtz et al. 1985). Malmi & Brown (2008) include organisational design in their framework, as they perceive it as something that management can influence. However, Flamholtz et al. (1985) note that organisational structure is not a control mechanism per se, since certain structures arise out of technological requirements or due to the nature of the environment.

Governance structure refers to the structure and the composition of organisations' internal boards and management levels (Abernethy, Chua 1996; Malmi, Brown 2008). Governance includes formal lines of authority and responsibility (Abernethy, Chua 1996) as well as systems that ensure that the representatives of various organisational units coordinate their activities (Malmi, Brown 2008). Policies and procedures help specifying and directing processes and behaviour. They encompass what Merchant & van der Stede (2007) call action controls in the OOC framework.

Cultural controls

Malmi & Brown (2008) recognise firm culture as a control mechanism when it can be influenced by the management and when it can be utilised to direct

behaviour. They identify three components of cultural controls: (1) value-based controls, (2) symbol-based controls, and (3) clan controls. Value-based controls are essentially what Simons (1995) termed the belief system in his LOC framework (see section 6.2). Malmi & Brown (2008) list two possible ways to influence the organisation's values. Firstly, managers can recruit employees who already share their values. Secondly, values can be taught via a schooling and professionalisation process.

Symbol-based controls rely on the utilisation of visible expressions, in order to develop a particular type of culture (Schein (1997) in Malmi, Brown 2008). Examples are open plan offices, in order to create a culture of communication and collaboration, and the requirement to wear uniforms, in order to create a culture of professionalism (Malmi, Brown 2008). Clan control was already mentioned when the framework of Ouchi (1979) was covered in section 6.1. The concept of clan control is that only fitting individuals are hired and taught to internalise clan values through a socialisation process as well as ceremonials and rituals (Ouchi 1979). This form of control is effective for groups within some kind of boundaries (e.g. professions, organisational units, and divisions) (Malmi, Brown 2008).

6.5 The MSCP framework vs. the OOC framework

In general, the MCSP framework and the OOC framework do not substantially differ and both can be used as a starting point for research on MC(S) interrelations. However, there is some variation in the categorisation of MC(S) between the two models, which strengthens the validity of the MCSP framework. Firstly, as planning does not have to be related to finance, Malmi & Brown (2008) conceptually decoupled it from budgets and financial measurement. In the framework of Merchant & van der Stede (2007) both planning and budgeting are aggregated as financial result controls. Secondly, Malmi & Brown (2008) identified a more comprehensive set of administrative controls than Merchant & van der Stede (2007) included as action controls in their framework. Thereby, they provide a more complete conception of MC(S).

Thirdly, the OOC framework lists the provision of necessary resources as a personnel control mechanism. Malmi & Brown (2008), however, excluded the provision of resources, as they argue that it is merely a condition that allows employees to work, but it does not guide employee behaviour.

6.6 Reflection on the MCSP framework

As mentioned, Malmi & Brown (2008) describe three components of cultural controls: (1) value-based controls, (2) symbol-based controls, and (3) clan controls. However, it is not obvious where the difference between value-based controls and clan controls lies, as they are very similarly explained. Additionally, clan controls are according to Ouchi's (1979) definition in fact a form of value-based controls. He states that they "include the recruitment of only a selected few individuals, each of whom has been through a schooling and professionalization process which has taught him or her to internalize the desired values and revere the appropriate ceremonies" (p. 844). Therefore, the proposed differentiation does not add any value, unless there is a particular reason for it, which has, however, not been mentioned by Malmi & Brown (2008).

Malmi & Brown (2008) exclude decision support systems from their definition of MC(S). While it can be useful to distinguish between MC(S) and decision support systems, they nevertheless interrelate. For example, two studies[6] that are reviewed in section 8 document interrelations between accounting practices and MC(S). This implies that internal consistency between MC(S) and decision support systems needs to be considered for optimal MCSP design. If decision support systems are excluded from the framework, a separate framework is needed additionally.

It should be noted that the MCSP framework is relatively new and it remains to be tested by research whether the chosen categorisation of MC(S) is optimal.

[6] Abernethy & Chua (1996); Kennedy & Widener (2008); Fullerton et al. (2013)

As the authors themselves note, the framework may still miss elements or contain unnecessary categories. However, Malmi & Brown (2008) managed to synthesise and expand the studies of many influential scholars in the field of MC(S) research and provide the most comprehensive framework to study MC(S). Especially noteworthy is that many different forms of informal controls have been included. Additionally, the MCSP framework shows advantages over the OOC framework, as discussed in section 6.4.

7 Complementary theory and MCSP design

As mentioned, optimal MCSP design depends on two factors. Firstly, the MC(S) need to match with the contingency set of the organisation. Secondly, the MC(S) need to be internally consistent (Drazin, van de Ven 1985; Fisher 1995). Grabner & Moers (2013) suggest that internal consistency is defined by the complementarity of MC(S) within the MCSP.[7] By utilising complementary theory they provide important guidance on research issues regarding the measurement of MC(S) interdependence. Their work is completed with findings from Brynjolfsson & Milgrom (2012), which have been extended to MC(S) research.

After the introduction of the analytical model of Grabner & Moers (2013) in section 7.1 and the formal comparison of the systems approach to the reductionist approach in section 7.2, section 7.3 points out empirical implications for research. Subsequently, section 7.4 provides a check list for MC(S) interdependence research. Section 7.5 introduces the interdependence matrix of Brynjolfsson & Milgrom (2012), which is a simple-to-use and very useful tool to identify clusters of complementarities. The final section points out why changing internally consistent MCSPs can prove difficult.

[7] Abernethy & Chua (1996), Fisher (1995), Chenhall (2003) and Malmi & Brown (2008) also suggested to look for complementary and substitutive relations between MC(S).

7.1 The analytical model of MCSP design

The formal analysis of complementarity is focused on the study of interactions between pairs (Brynjolfsson, Milgrom 2012). Grabner & Moers (2013) provide an analytical model. They state that the MCSP designer[8] is confronted with the following maximisation problem, when deciding on the components of the system:

$$\max_{x} \pi(\boldsymbol{x}, \boldsymbol{z}, \boldsymbol{p}) = \max_{x} V(\boldsymbol{x}, \boldsymbol{z}) - \vec{\boldsymbol{p}}\boldsymbol{x} \quad (1)$$

where

- $\pi(\boldsymbol{x}, \boldsymbol{z}, \boldsymbol{p})$ represents the overall value (i.e. performance effect minus costs)
- $V(\boldsymbol{x}, \boldsymbol{z})$ represents the pay-off function (i.e. performance effect)
- $\boldsymbol{x}$ is a vector of MC(S)
- $\boldsymbol{z}$ is a vector of contingency factors
- $\boldsymbol{p}$ is a vector that represents the implementation cost of the corresponding MC(S)

The model closely corresponds to the systems approach introduced in section 5.3. However, in the model of Grabner & Moers (2013) the MCSP designer does not maximise performance, but overall value (i.e. performance effect minus costs), as depicted in figure 7. Thereby, the authors account for the fact that MC(S) implementation costs influence MC(S) choice.

[8] Grabner & Moers (2013) talk about MCS design, not MCSP design, in their paper, in order to highlight that their model is about intentionally designed internally consistent systems. However, for the purpose of consistency the term MCSP design is used instead.

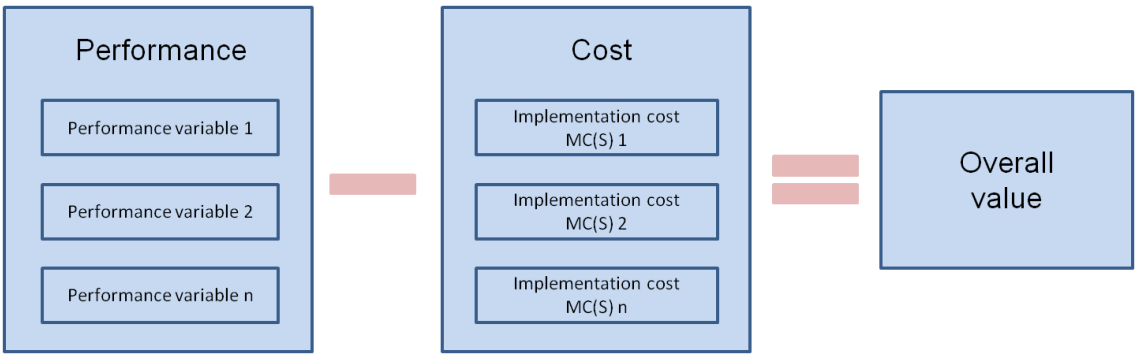


Figure 7: Overall value (Grabner, Moers 2013)

Since $\boldsymbol{z}$ and $\boldsymbol{p}$ are predetermined, the MCSP designer can only influence $\boldsymbol{x}$ in order to maximise performance. To maximise the overall value, the designer will choose a level of MC(S) where the marginal returns (i.e. performance effect) equals the marginal implementation cost of the specific MC(S), which is represented by the first order condition below:

$$V'_x(\boldsymbol{x}^*, \boldsymbol{z}) = \boldsymbol{p} \tag{2}$$

Equation 3 illustrates that the value of a specific MC(S) x_i is affected by all other MC(S) practices $\boldsymbol{x}$, all contingency factors $\boldsymbol{z}$, and its own adoption cost p_i.

$$\frac{\partial \pi}{\partial x_i} = V'_{x_i}(\boldsymbol{x}, \boldsymbol{z}) - p_i \tag{3}$$

By looking at equation 3 it furthermore becomes obvious that interdependencies between MC(S) are captured in the pay-off function. Adoption costs are to be considered, but do not impact on the MC(S) performance effect (Grabner, Moers 2013).

Complementarity means that the combined effects of something are bigger than the sum of the individual effects (Brynjolfsson, Milgrom 2012). Therefore, MC(S) are considered complementary if the performance effect of one MC(S) increases with the use of another MC(S) and vice versa (Grabner, Moers 2013).

Complements:
$$\frac{\partial^2 \pi}{\partial x_i \partial x_j} = \frac{\partial^2 V}{\partial x_i \partial x_j} > 0 \tag{4}$$

On the contrary, if the performance effect of one MC(S) decreases with the use of another MC(S) and vice versa, they are substitutes to each other.

Substitutes: $$\frac{\partial^2 \pi}{\partial x_i \partial x_j} = \frac{\partial^2 V}{\partial x_i \partial x_j} < 0 \quad (5)$$

7.2 Systems approach vs. reductionist approach

Grabner & Moers (2013) utilise their model to analytically demonstrate the difference between a systems approach and a reductionist approach.

The systems approach

Equations (1) to (5) are built on the premises of the systems approach. The systems approach appreciates that all other MC(S) and contingency factors together affect the performance of any MC(S), as represented by:

$$\frac{\partial^2 \pi}{\partial x_i \partial x_{j \neq i}} \neq 0 \quad and \quad \frac{\partial^2 \pi}{\partial x_i \partial z_k} \neq 0 \quad (6)$$

The reductionist approach

The assumption behind the reductionist approach, however, is that equation (1) is characterised as follows:

$$\frac{\partial^2 \pi}{\partial x_i \partial x_{j \neq i}} = 0 \quad and \quad \frac{\partial^2 \pi}{\partial x_i \partial z_k} \neq 0 \quad (7)$$

Equation (7) illustrates the reductionist assumption that the performance effect of any MC(S) is independent of all other MC(S). The overall value of each MC(S) would subsequently depend only on the contingency set and the MC(S) adoption cost, i.e.:

$$\frac{\partial \pi}{\partial x_i} = V'_{x_i}(\boldsymbol{z}) - p_i \tag{8}$$

Grabner & Moers (2013) model of a reductionist approach is slightly different from the reductionist approaches covered in section 5.3. The authors focus on the implications of reductionism that appear if "only" interdependencies between MC(S) are not considered. Conflicting contingencies and performance effects, however, are considered. As visualised in figure 8, the reductionist approach differs from a systems approach by the fact that it does not account for complements and substitutes within the MCSP.

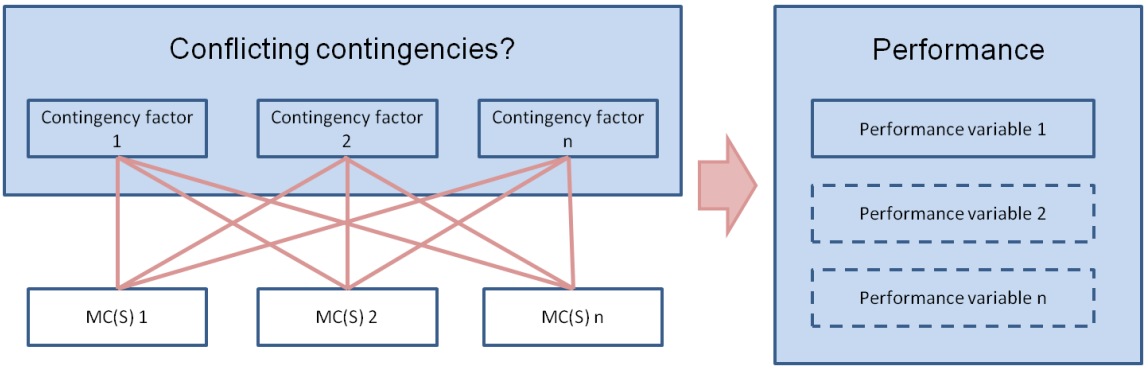


Figure 8: Reductionist approach (Grabner, Moers 2013)

7.3 Empirical implications

The analytical model is now used to derive empirical implications for MC(S) research. Grabner & Moers (2013) demonstrate two types of errors that can occur if empirical studies use a reductionist approach where a systems approach would be appropriate and vice versa.

Below, two specific functions are imposed for $V(\boldsymbol{x}, \boldsymbol{z})$ and $\vec{\boldsymbol{p}}\boldsymbol{x}$.

$$\begin{aligned} V(\boldsymbol{x}, \boldsymbol{z}) = {} & \beta_0 + \beta_{x_1} x_1 + \beta_{x_2} x_2 + \beta_{x_1 x_2} x_1 x_2 \\ & + \beta_{z_1 x_1} z_1 x_1 + \beta_{z_2 x_1} z_2 x_1 \\ & + \beta_{z_1 x_2} z_1 x_2 + \beta_{z_2 x_2} z_2 x_2 \end{aligned} \tag{9}$$

$$\vec{\boldsymbol{p}}\boldsymbol{x} = \frac{p_1}{2}x_1^2 + \frac{p_2}{2}x_2^2 \tag{10}$$

The first row in equation (9) represents the performance effect of different x_1-x_2 combinations. The interdependence between the two variables is reflected by $\beta_{x_i x_2}$. The second and third row represent the impact of the contingency factors on the performance effects of x_1 and x_2, respectively. Equation (10) represents a possible cost function.

After equation (9) and (10) are plugged into the initial maximisation problem in equation (1) and maximised with respect to x_1 and x_2, the following optimal solutions result:

$$x_1^* = \frac{\beta_{x_1}}{p_1} + \frac{\beta_{x_1 x_2}}{p_1}x_2^* + \frac{\beta_{z_1 x_1}}{p_1}z_1 + \frac{\beta_{z_2 x_1}}{p_1}z_2 \tag{11}$$

$$x_2^* = \frac{\beta_{x_2}}{p_2} + \frac{\beta_{x_1 x_2}}{p_2}x_1^* + \frac{\beta_{z_1 x_2}}{p_2}z_1 + \frac{\beta_{z_2 x_2}}{p_2}z_2 \tag{12}$$

In the case of no interdependence between x_1 and x_2, $\beta_{x_i x_2} = 0$ and the optimal solution can be re-written as:

$$x_1^* = \frac{\beta_{x_1}}{p_1} + \frac{\beta_{z_1 x_1}}{p_1}z_1 + \frac{\beta_{z_2 x_1}}{p_1}z_2 \tag{13}$$

$$x_2^* = \frac{\beta_{x_2}}{p_2} + \frac{\beta_{z_1 x_2}}{p_2}z_1 + \frac{\beta_{z_2 x_2}}{p_2}z_2 \tag{14}$$

Equations (13) and (14) also represent the optimal solution of the reductionist approach. This is the case, since the reductionist approach always assumes $\beta_{x_1 x_2} = 0$, regardless of its actual value.

7.3.1 Potential errors in measurement

Type 1 error

A type 1 error can occur in two cases. Firstly, if a reductionist approach is followed, when there is actually interdependence between x_1 and x_2 (i.e. the real $\beta_{x_1x_2} \neq 0$). It becomes obvious by looking at equation (11) that an examination of x_1 in isolation (i.e. wrongly assuming $\beta_{x_1x_2} = 0$) will bias the coefficients of the contextual factors (i.e. $\beta_{z_1x_1}$ and $\beta_{z_2x_1}$). In the worst case this could lead to the finding of a significant direct relation between a contingency factor and a MC(S) that is not existent.

Secondly, a similar error can occur if a systems approach is followed when not necessary. For example if there is no interdependence between the variables (i.e. the real $\beta_{x_1x_2} = 0$) and the coefficients have the values $\beta_{z_1x_1} > 0$, $\beta_{z_2x_1} > 0$, $\beta_{z_1x_2} < 0$ and $\beta_{z_2x_2} < 0$, several empirical methods will show (1) a negative cross-sectional correlation $\rho(x_1^*, x_2^*)$, (2) clusters of high/low and low/high x_1-x_2 combinations, and (3) opposite signs for the regression coefficients of the contingency factors for x_1 and x_2. If those results are now interpreted as a substitution effect, it also represents a type 1 error. To summarise, a type 1 error occurs if the "wrong approach" is taken (i.e. it is not measured for interdependence although there is interdependence and vice versa) and the research results suggest interdependencies that are actually not there.

Type 2 error

Another type of error can occur when the sign of $\beta_{x_1x_2}$ is opposite to the sign of $[\beta_{z_1x_1} \times \beta_{z_1x_2}]$. In this situation the interdependence between the MC(S) will be underestimated, as the cross-sectional correlation $\rho(x_1^*, x_2^*)$ is biased towards zero.

7.3.2 Test strategies to prevent errors in measurement

Grabner & Moers (2013) mention two empirical strategies that can be followed in order to adequately measure for complements and substitutes. These will be briefly discussed. The choice of statistical method is determined by whether the MCSP designer can be expected to understand and account for interdependencies between MC(S) or not.

Estimation of the pay-off function

The estimation of the pay-off function is the right statistical method if suboptimal combinations of MC(S) are likely to be found. It is therefore a recommendable strategy in cases where the MCSP designer is expected to lack understanding of the interdependencies or to have no incentive to take them into account (Grabner, Moers 2013).

Technically, a regression function is used, as represented in equation (15) below.

$$\begin{aligned} Perf = {} & \beta_0 + \beta_1 x_1 + \beta_2 x_2 + \beta_3 x_1 x_2 \\ & + \beta_4 z_1 x_1 + \beta_5 z_2 x_1 \\ & + \beta_6 z_1 x_2 + \beta_7 z_2 x_2 + \varepsilon \end{aligned} \tag{15}$$

The goal of this method is to examine whether two MC(S) lead to higher (lower) performance when adopted alone or together. If they lead to a higher (lower) performance together, it can be interpreted as proof for a complementary (substitutionary) relationship between the two MC(S).

There are, however, some limitations that need to be addressed. Firstly, a measure of performance needs to be determined that is directly related to the pay-off function $V(\boldsymbol{x}, \boldsymbol{z})$**.** Broader measures would lead to errors in a cross-sectional analysis. Additionally, Brynjolfsson & Milgrom (2012) point out the importance of finding a performance variable that is actually being maximised by the MCSP designer (see also the discussion on performance measures in

section 5.5). Secondly, Grabner & Moers (2013) mention that the method is not well suited to examine more than two MC(S), as higher-order interactions are difficult to interpret.

Estimation of the demand function

The use of the demand function method builds, on the contrary to the estimation of the pay-off function method, on the assumption that the choices made by MCSP designers are optimal decisions that maximise the profit function. Therefore, it is only appropriate if it can be assumed that the MCSP designer has a good understanding of MC(S) interdependencies and no incentives to ignore them (Grabner, Moers 2013).

The empirical strategy is to investigate the MCSP design choices that were made in organisations. Unfortunately, the cross-sectional correlation $\rho(x_1^*, x_2^*)$ is not informative about interdependencies between MC(S), as it can be biased by joint determinants. However, interdependencies can be accurately determined if the covariance of MC(S) is measured conditional on the contingency set. That is if $\beta_{x_i x_2}$ is positive (negative), $E\left[\left(x_1 - E(x_1 \mid \boldsymbol{z})\right) * \left(x_2 - E(x_2 \mid \boldsymbol{z})\right) \mid \boldsymbol{z}\right]$ is also positive (negative). To apply the method, each MC(S) needs to be regressed on a set of contingency factors at first. This allows to derive a "demand function" for MC(S), which is driven by the contingency set (i.e. $x_i(\boldsymbol{z})$)**,** and to subsequently obtain estimates for $E(x_i \mid \boldsymbol{z})$**.**

Grabner & Moers (2013) mention that the choice of contextual variables on which the covariance is conditioned is essential. If there are only two relevant MC(S), the covariance needs to be conditioned only on the joint determinants. If, however, there are more than two relevant MC(S), the covariance needs to be conditioned on all observable determinants.

Dealing with heterogeneity problems

A remaining problem to both methods is posed by unobserved heterogeneity (Grabner, Moers 2013; Brynjolfsson, Milgrom 2012). There may be factors influencing the costs and benefits of specific MC(S) that are considered/observable only by/to the MCSP designer, but not the researcher (e.g. unidentified contingency factors or worker attitudes towards particular forms of MC(S)). This unobserved heterogeneity undermines the estimates of interdependence (please refer to Appendix C for details). Additionally, there might be unobserved factors that do not influence the cost and benefits of individual MC(S), but of specific MC(S) combinations. Therefore, the researcher needs to have very good knowledge of relevant contingency factors and how they influence the costs and benefits of MC(S) (combinations) (Brynjolfsson, Milgrom 2012).

Brynjolfsson & Milgrom (2012) list four possibilities to mitigate the problem of unobserved heterogeneity. Firstly, if the research is focused on homogeneous populations, some unobserved variation can be removed upfront. The approach additionally allows to use a more specified performance measure variable, since the pay-off function is going to be more similar for a homogeneous population. However, a drawback is that a homogeneous population is limiting the extent of generalisability.

Secondly, panel data can be used. This allows to increase generalisability by considering multiple industries, while still controlling for heterogeneity to some extent. Taking long time differences and including fixed effects can remove potential biases. However, the approach relies on the assumption that unobservable variables do not change over time. Thirdly, natural experiments can be used to identify an exogenous source that drives variation in observable factors. This helps to reduce the potential role of unobserved drivers.

Lastly, designed experiments are also a possibility to mitigate unobserved heterogeneity. Historically, it has been difficult for researchers to run controlled large-scale experiments, due to their high costs. Recently, however, executives in the private sector are beginning to conduct designed experiments themselves or in coordination with researchers, in order to gain insights, which they can

utilise to improve their companies' performance. This poses a great change for research, as designed experiments are particularly suitable to eliminate biases of interdependence measures (Brynjolfsson, Milgrom 2012).

7.3.3 Guidelines for MC(S) interdependence research

Grabner & Moers (2013) propose a check list that should be considered by researchers that explore MC(S) interdependencies before conducting their research.

1) What is the control problem? MC(S) are implemented in order to resolve a control problem. This control problem needs to be identified, since complementary and substitutionary relations between MC(S) can vary accordingly.

2) What MC(S) do I want to analyse? It is important to adequately define MC(S) or forms of MC(S). The classification should neither be to narrow nor to broad. Grabner & Moers (2013) note that the LOC framework is not very suitable for interdependence research, as it deals with MC(S) at a too aggregate level. The discussion in section 6 lead to the conclusion that currently the MCSP framework of Malmi & Brown (2008) is the most suitable framework for the purpose of MC(S) research. Unlike the LOC framework it includes formal and informal types of MC(S) and categorises them appropriately detailed.

3) Can all MC(S) be freely chosen?
It should be taken into consideration that some MC(S) are regulated by external authorities. Therefore, the MCSP designer cannot freely choose whether to adopt them or not, but is required to or prohibited from implementing them. Grabner & Moers (2013) suggest that MC(S) which must be implemented due to instructions of external authorities should be considered as contingency factors, not MC(S).

4) What are the proposed interdependencies between MC(S) and why?

After identifying the control problem and the relevant MC(S), the next step is to develop a theory on how the MC(S) are interdependent and why. This is an essential task, as the hypothesised relations are subject to subsequent empirical tests. It should be noted that contingency theory is only suitable to measure bidirectional relations, but not unidirectional relations.

5) What causes the optimal MCSP to vary in cross-section and/or over time?

As mentioned, MCSPs are hypothesised to vary across firms for two reasons: (1) different contingency factors and (2) different adoption costs. Therefore, all relevant contingency factors that affect the value of single MC(S) and MC(S) combinations need to be identified. Additionally, factors that influence the adoption cost across firms should be considered. This is necessary in order to be able to measure cross-sectional for interdependencies between MC(S).

6) Demand function vs. pay-off function method?

As has been argued, the ideal choice of the empirical method depends on whether the MCSP designer can be expected to understand and account for MC(S) interdependencies. If it can be assumed that decisions are optimal, the demand function is the method of choice. If, however, there are reasons to assume that they are not optimal, only the pay-off function method is appropriate (Grabner, Moers 2013).

Regarding the right choice of empirical method, it should be noted that an organisation's MCSP is usually implemented by different interest groups, in different departments, at different times. Since those groups are usually not perfectly coordinated, it is likely that some interdependencies are not taken into account (Ferreira, Otley 2009; Malmi, Brown 2008; Grabner, Moers 2013). This suggests that in most cases the pay-off function will be the preferred method for measuring interdependencies.

A general drawback of the complementarity approach discussed in this section is that only bidirectional relations are measured. However, the studies reviewed

in section 8 found unidirectional relations as well. This suggests that both bidirectional and unidirectional relations are important in order to achieve an internally consistent MCSP design.

7.4 The interdependence matrix

The interdependence matrix of Brynjolfsson & Milgrom (2012) is an easy-to-use tool, which can be utilised in order to help categorising relations between MC(S) and thereby to detect clusters of complementarities.

Practice	(1)	(2)	(3)	(4)
(1) Make frequent technical changes		+	+	+
(2) Train workers flexibly			+	
(3) Give workers discretion				+
(4) Protect workers' jobs				
(*) Frequent opportunities to upgrade technology	+			

Figure 9: Interdependence matrix (Brynjolfsson, Milgrom 2013, p. 12 mod.)

Brynjolfsson & Milgrom (2012) explain how to use the matrix by providing an example of complementary relations between organisational practices. The authors invite the reader to consider a company that is about to decide (1) whether to adopt a strategy that requires frequent technical changes, (2) whether to train their workers more flexibly, and (3) whether to give them more discretion. Brynjolfsson & Milgrom (2012) suggest complementarities between the three measures, since flexibly-trained workers can make better use of discretion, which together makes it more easy for them to adapt to frequent technical changes. This is represented by the plus symbols in cells (1,2), (1,3), and (2,3).

Since there is a system of complementarities, all three measures should be implemented. If the company was now to decide whether to implement additional practices at a later point (e.g. to protect worker's jobs - row 4), it

would check for interdependencies with the already implemented practices. The matrix additionally allows to visualise the fit of contingency factors with organisational practices. The plus sign in the last row shows that frequent opportunities to upgrade technology are hypothesised to favour the decision of making frequent technical changes. Indirectly, the contingency factor thereby also favours all other measures which are complementary to the decision of making frequent technical changes.

Brynjolfsson & Milgrom's (2012) matrix allows to provide a comprehensive overview of interdependencies and to shows in which way those are influenced by contingency factors. Since the matrix can easily be extended from organisational practices to MC(S), it can be a very useful tool for the design of internally consistent MCSPs.

7.5 Difficulties in changing internally consistent MCSP

This section attempts to extend Brynjolfsson & Milgrom's (2012) general hypotheses about the difficulties of changing internally consistent systems of organisational practices to MC(S) research. The authors note that it is difficult to change a system of complementarities (i.e. a system in which several pairs are complementary), since changing only one or a few components at a time is likely to initially result in an unwanted performance decrease. This indicates that when changing internally consistent MCSPs, all relevant MC(S) components should be changed at once, in order to avoid a decrease in performance.

However, a simultaneous change of all relevant MC(S) is difficult to accomplish for various reasons. Firstly, it poses a coordination problem. Since the outcome of MC(S) change remains partially unpredictable, not only the initial change, but also subsequent adjustments need to be tightly coordinated (Brynjolfsson, Milgrom 2012). Secondly, some forms of MC(S) take longer to be adjusted than others (e.g. implementation of clan controls vs. implementation of simple rules), which makes it impossible to change them simultaneously (Brynjolfsson, Milgrom 2012; Grabner, Moers 2013).

Thirdly, there may be MC(S) within the MCSP which are not recognised as such by the MCSP designer (e.g. forms of cultural controls). In this case, even if all known MC(S) are successfully changed as intended, undetected MC(S) could harm the performance of the new MCSP if they remained unchanged. Since MCSPs tend to become more complexly interdependent over time, a change of the package becomes more difficult as a firm matures (Brynjolfsson, Milgrom 2012).

8 Contingency-based research on MCSP design

Contingency-based research has been able to provide some insights on how MCSPs work (Fisher 1998). Chenhall (2003) provides an overview of the found relations between MC(S) and contingency factors. He concludes that while the body of literature is not without imperfections in methodology, it still provides a basis for generalisable propositions.

However, many scholars criticise that empirical and theoretical results from contingency-based research have not been definitive enough (Fisher 1995; Grabner, Moers 2013; Dent 1990). This is due to various reasons: (1) A reductionist approach to fit was followed, which did not account for MC(S) interrelations, nor performance effects (Otley 1980; Fisher 1995; Flamholtz et al. 1985; Malmi, Brown 2008; Grabner, Moers 2013; Merchant, Otley 2006; Chenhall 2003; Drazin, van de Ven 1985). (2) A lack of a clear definition of MC(S) (Flamholtz et al. 1985; Malmi, Brown 2008; Fisher 1995; Grabner, Moers 2013). (3) A lack of a clear definition of contingency factors (Otley 1980; Fisher 1995).

Otley (1980) noted that it will require "painstaking work over considerable periods of time" (p. 426) to develop a comprehensive contingency theory that takes all interrelations between relevant variables as well as performance

effects into account. A lot of the "painstaking work" still remains to be done. Contingency-based research is called upon to conduct longitudinal case studies in order to further develop MC(S) theory and ultimately provide guidelines on how to design optimal MCSPs (Otley 1980; Merchant, Otley 2006; Fisher 1995; Malmi, Brown 2008). Those case studies need to be conducted while accounting for all interrelations within the MCSP as well as between MC(S) and contingency factors (Otley 1980; Fisher 1995; Malmi, Brown 2008; Grabner, Moers 2013). Additionally, performance effects need to be appropriately measured (Otley 1980; Fisher 1995; Chenhall 2003).

Out of the many research papers that were reviewed in preparation to write this thesis, none could be identified that was able to comply with these ambitious standards. However, a selection of influential and (mostly) recent papers which document interrelations between MC(S) is going to be presented in sections 8.1 to 8.4. A summary of the respective key findings and shortcomings is provided at the end of each section (as well as in Appendix F.I and F.II) and a reflection on those follows in chapter 8.5. While, unfortunately, the integration of results proved difficult, due to the different settings, variables and definitions that were used by the authors, some new implications for theory could be derived.

8.1 MCSP and the institutional environment

Abernethy & Chua (1996) conducted a longitudinal case study in an Australian teaching hospital. The authors were interested in two questions: Firstly, how does a change in the organisation's institutional environment[9] influence MCSP design and secondly, are accounting control systems complemented or substituted by other MC(S)? Their study focused primarily on three MCSP elements: (1) the governance structure, (2) accounting controls, and (3) management culture.

[9] The institutional environment was defined as "the elaboration of rules, practices, symbols, beliefs, and normative requirements to which individual organisations must conform to receive support and legitimacy" (Abernethy, Chua 1996, p. 574).

In 1979, the beginning of the case study, the hospital had too less personnel, was politically not well connected, and very weak in fund raising. The board consisted mainly of senior physicians without financial and administrative training. It relied on a manager whose moderate skills had led the hospital to face impending closure. MC(S) towards the medical staff were informal, qualitative, and nonbureaucratic.

However, there was a paradigm change towards management improvement in the public sector at that time. A health commission was established, which intended to increase the accountability of public health organisations. The institutional environment subsequently changed in a way that no longer allowed poor financial management and became more "businesslike".

To "fix" the problems of the hospital, an interim manager and two consecutive CEOs were appointed by the government over the next 11 years. Abernethy & Chua (1996) could observe how the MCSP was adapted due to the change in the institutional environment. Firstly, the new management changed the government structure, in order to reduce the power of medical staff in strategic decision-making. This was done by establishing a businesslike nonrepresentational board, which should redistribute power amongst stakeholders (management, medical staff, and sponsors) more equally. Additionally, the dual line of hierarchy was restructured to a single one and formal lines of accountability were introduced. This was supported by the implementation of a divisional organisation structure, whose heads were physicians that reported to the management. Secondly, the compensation system for physicians was changed in a way that made them perceive their status within the hospital less as contractors and more as employees. This measure decreased the physicians bargaining power and increased the effectiveness of administrative MC(S) to direct their behaviour.

In 1984, while planning for a new hospital building, the management identified the need for a new computerised system. The funds for a new computer where obtained from the government under the condition to develop a "clinical costing system" prototype. While considerable effort was put in the development of new

accounting reports between 1986 and 1991, those were not routinely distributed, nor used to increase the hospital's efficiency. However, the clinical costing project had a strong influence on the hospital's culture, since the CEO's personal involvement signalled that resource management was a top priority.

Together with the reorganisation of the governance and organisation structure the clinical costing system lead through the transformation of values to a resource management culture that was dominated by management interest. Within the 12 years of the case study, the MC(S) shifted towards a mix of formal, bureaucratic forms of controls. Abernethy & Chua (1996) stress that the change in the MCSP was not simply a result of economic conditions that the hospital faced. Instead, it was triggered by fundamental changes in the institutional environment.

Regarding the question whether accounting control systems can be complemented or substituted by other MC(S), the authors found that budgets can indeed work as a substitute for elaborate accounting systems if the mix of other elements in the MCSP (e.g. governance and values) ensures that stakeholder demands are met. Therefore, it might not be necessary to invest in sophisticated accounting systems to meet stakeholder demands for legitimacy and efficiency.

It is also noteworthy that the governance and organisation structure were changed and a culture of resource management promoted before changes in the accounting system occurred. This is described by Abernethy & Chua (1996) as a rational approach, as resources were scarce at first and the prior measures could be accomplished easier given the circumstances.

Findings

- Change in institutional environment (institutional pressure) leads to change in the MCSP
- Budgets can work as substitute for more sophisticated formal controls if combined with informal controls
- Change in culture before change in accounting system, due to lower cost of implementation

Shortcomings

- Individual framework for MC(S) and individual contingency factor terminology
- Little control for other contingency factors
- No measurement of performance effects

8.2 MCSP in a growth firm context

Sandelin (2008) observed in his empirical case study how growth influenced a firm's MCSP. He utilised the OOC framework to categorise forms of control and paid particular attention to the links between MC(S). Between the first and the second time the firm's MCSP was analysed, the firm grew substantially, while the contingency setting remained relatively stable. For an overview of the timeline and the identified contingency factors please refer to Appendix D.

The firm was founded out of a merger in 1998. The first MCSP analysis took place between then and mid 2000 when it went public. During that period an ownership culture was prevalent, as employees were in possession of shares and/or share options. Sandelin (2008) states that a intra-entrepreneurship culture replaced the need for detailed task descriptions and pre-action planning. Management placed a high value on innovation and growth which encouraged employees to engage in research and development activities. Personnel controls were used to hire people with an intrinsic technological motivation and

a good fit to the firm's unstructured organisational setting. Additionally, open-plan offices facilitated action controls in the form of personal supervision and peer control. Budgeting was used as well, but since the degree of participation and accountability was low, it had little significance as a control device. Financial results were obtained by senior managers for decision-support only. Reciprocal linkages could be observed between cultural, personnel, and action controls. The MCSP allowed for technology-driven product development. This was considered essential in order to accomplish profitable growth.

After the firm went public in 2000 it started internationally expanding. However, it soon drifted into financial distress, due to problems with acquisition activities abroad. In 2001 a crisis management team replaced the old management and could secure the survival of the firm through negotiations that lead to a voluntary debt-restructuring.

In 2002 the new senior management team took over after the interim management left. This was when the second analysis of the MCSP started. Sandelin (2008) points out that there was very little administrative infrastructure in place, as in the first analysis. The new primary goal of the management was to secure liquidity and profitability by making operations as efficient as possible. The strategic focus of the organisation shifted away from innovation to an efficient delivery of the core products.

The core of the new MCSP was built around a cybernetic budgeting and financial results system that held employees accountable for results down to the operative management level. Participative budgeting was implemented in order to build commitment towards performance targets. Action-plans and payback calculations were used as forms of ex-ante controls. Action planning visualised the need for specific skills and specified the personnel selection and placement criteria. In order to further develop a results-orientated culture, company-wide meetings were arranged for interim reports. Sandelin (2008) points out that the focus on financial results guided planning, personnel, and cultural controls. A reciprocal link was, however, only observable between financial results and planning controls.

The author concluded that the two observed MCSPs resulted in an equally good final state (equifinality), as both were able to achieve growth and profitability.[10] Therefore, he argues that internally consistent informal cultural, personnel, and action controls can work as a substitute for more formal forms of control.

Sandelin (2008) stresses that internal consistency was reached within both MCSPs by prioritising a certain form of control - cultural control in the first and results control in the second MCSP. He states that "Only this primary form of control was aimed at facilitating success in the prioritized functional demand. The design of other control elements was affected by the primary mode of control, whereas their use reinforced the particular control orientation." (p. 338). Therefore, he argues that an optimal MCSP is based on a combination of MC(S) that is able to support a particular control orientation or management philosophy.

Sandelin (2008) notes, that the contingency set was very similar and could therefore not explain for differences between the MCSPs. For this reason, he perceived the different constitution to be caused by conflicting functional demands, which were innovation and efficiency[11], respectively. However, none of the two demands was dominant enough to dictate one optimal control form for the MCSP. While in the first case growth and profitability were sought by protecting the innovative core of the organisation, in the second case, cost-efficiency was thought to be the necessary precondition.

One of the main findings of this study is that MCSP design is substantially determined by how management prioritises between conflicting functional

[10] Is should be noted, that the MCSPs were evaluated against overall goal attainment instead of performance. Additionally, it is important to recognise that the first MCSP turned out not to be optimal for an internationalisation strategy, as it was not designed to be efficient at distance. This suggests that geographical dispersion induces the need for rather formal MC(S) (Sandelin 2008).

[11] Sandelin (2008) notes that he observed other functional demands as well, but concentrated for the sake of simplicity only on the two most dominant ones.

demands. Both MCSPs were designed accordingly to the functional demands which were considered more important by the incumbent management.

Findings

- Growth leads to change in the MCSP
- Internally consistent informal cultural, personnel, and action controls can work as a substitute for formal forms of control
- Complementarities between forms of control depend on contingency factors
- Optimal MCSP design is based on a combination of MC(S) that are able to support a particular control orientation or management philosophy
- MCSPs were designed accordingly to the functional demands considered most important by the incumbent management

Shortcomings

- Little control for other contingency factors than growth; while the authors note that other contingency factors besides size remained relatively stable, they documented a change in strategy and scope of operations; it is not obvious that growth was (solely) responsible for the change of the MCSP
- Insufficient measurement of performance effects; the authors describe an equifinal state of the two MCSPs; the first MCSP, however, might have contributed to financial distress

8.3 MCSP and lean manufacturing I

Kennedy & Widener (2008) conducted a case study in order to investigate the implications of a lean manufacturing strategy on MCSP design. They studied firm undertook two successive initiatives: (1) in 2001 it implemented lean

manufacturing[12], and (2) in 2002 it implemented lean accounting and control practices[13].

The authors first developed an ex-ante model of how they expected the strategic initiative to influence a number of MC(S). The model was based on existing contingency-based literature and can be found in Appendix E.I. Subsequently, Kennedy & Widener (2008) observed the actual changes in the constitution of the MCSP as well as many unidirectional and bidirectional relations between the MC(S). After the case study was completed they contrasted their findings (please refer to Appendix E.II) with the ex-ante model and developed a revised theoretical framework, which is depicted in figure 10. In the ex-post framework, the observed changes were put into context and represented at a theoretical level. This was done in order to allow an extension of the model to other cases, where firms that implement lean manufacturing, lean accounting, and lean controls.

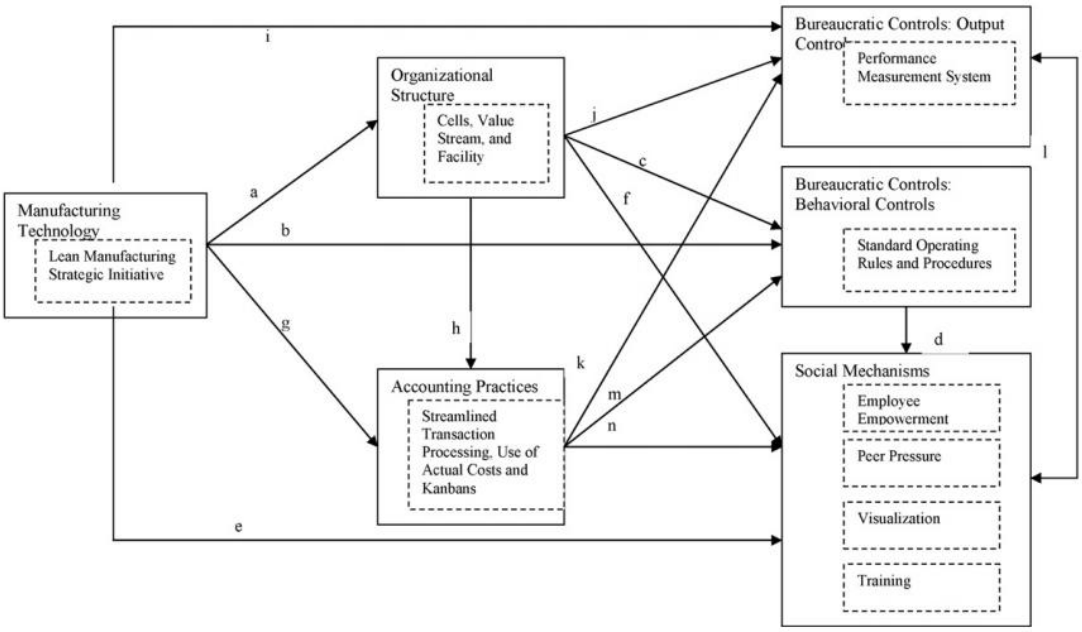


Figure 10: Ex-post framework (Kennedy, Widener 2008, p. 313)

[12] Lean manufacturing combines techniques from total quality management, just-in-time production, and total preventive maintenance (Kennedy, Widener 2008).

[13] Lean accounting practices seek to reduce the steps in transaction processing, replace standard costs by actual costs, and discontinue cost allocation, while lean control practices re-focus performance measurement systems and particularly utilise social controls (Kennedy, Widener 2008).

There were many changes in the MCSP that followed from the lean manufacturing strategic initiative, as can be seen in figure 10. The first paths (a,b,c,d) are going to be briefly described, in order to demonstrate how Kennedy & Widener (2008) visualised their findings. For a full description of all causal relations please refer to the authors' original work.

Lean manufacturing requires a firm's employees to take cross-functional responsibility. Therefore, the organisational structure was altered accordingly from a vertical hierarchy with functional responsibility centres to five "cells" of which each was responsible for various functions regarding one product family (path a, fig. 10). Since workers were now assigned multiple tasks within their cells, standard operating procedures were needed (path b, fig. 10). Additionally, the new cell structure created a demand for standard operating procedures (path c, fig. 10). These procedures functioned as decision aids for the workers and facilitated employee empowerment (path d, fig. 10).

Organisational structure and accounting practices turned out to be important intervening variables between the strategic initiative and the MCSP. This means that they influenced the selection and reliance of MC(S) additionally to the direct impact of the lean manufacturing initiative. This was an interesting finding, as so far contingency-based research predicted only organisational structure as an intervening variable. Please refer to Appendix E.III for a visual representation of the many unidirectional und bidirectional relations between MC(S) that the authors documented.

Kennedy & Widener (2008) found that the implementation of the strategic initiative shifted the overall focus of the MCSP from behavioural control to a portfolio of MC(S) that emphasised output, behavioural, and social controls. The authors argue that the changes of individual MC(S) fitted together to produce a change in the overall MCSP, which allowed for performance improvement. They stress that all MC(S) variables are key and, thereby, once more the importance to investigate MCSP holistically.

Kennedy & Widener (2008) illustrate their argument for the importance of a holistic MCSP perspective by considering what would have happened if employee empowerment was removed from the MCSP. Firstly, it would have lead to a reduction of peer pressure power. Secondly, there would have been less information in the performance measurement system, as workers were not allowed to collect and report. Thirdly, command and responsibility would have needed to be reverted to line management. As a consequence, the detailed accounting practices could not have been reduced and the cell structure would not have worked. To summarise, Kennedy & Widener (2008) argue that the removal of one MC(S) (i.e. employee empowerment in their example) from the MCSP would have likely led to a failing of the overall initiative, unless its functions could have been substituted by other MC(S).

Findings

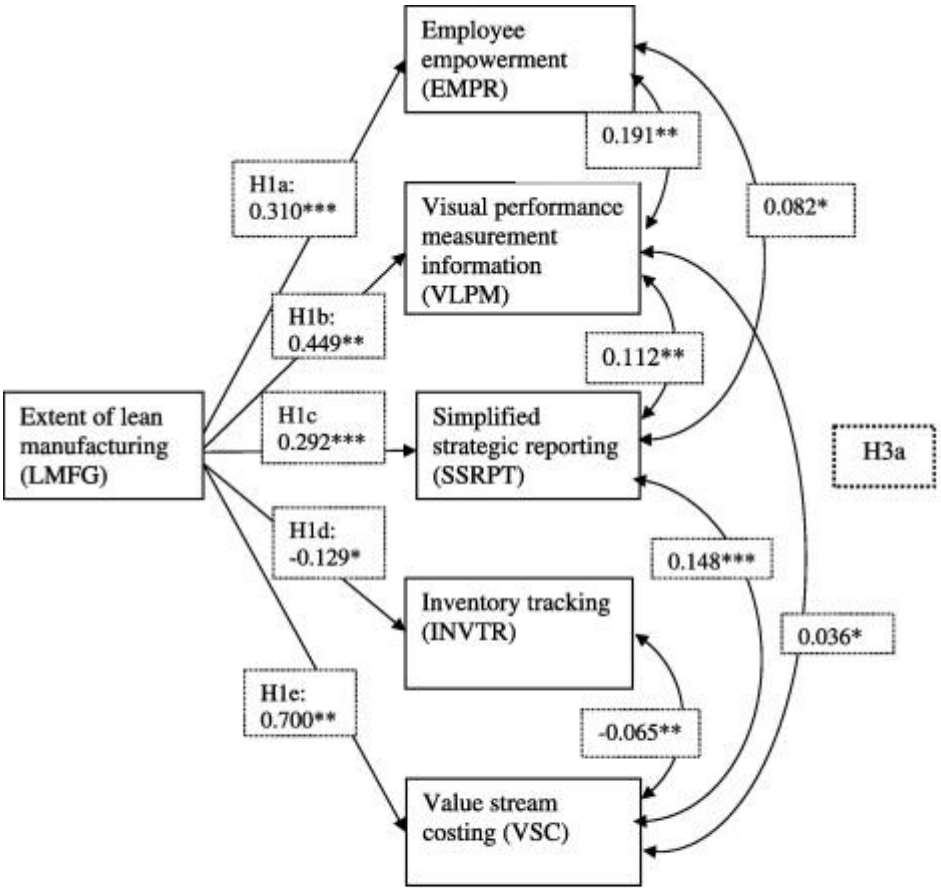
- Lean manufacturing leads to change in the MCSP
- Many unidirectional and bidirectional relations exist within the MCSP
- Strategic initiative leads to focus of the MCSP on a portfolio of MC(S) that emphasise output, behavioural, and social controls
- Organisational structure and accounting practices turned out to be important intervening variables between the strategic initiative and the MCSP; in other words, they influenced the selection and reliance of MC(S) additionally to the direct impact of the lean manufacturing strategy initiative

Shortcomings

- Individual framework for MC(S) and individual contingency factor terminology
- Little control for other contingency factors
- No measurement of performance effects

8.4 MCSP and lean manufacturing II

Based on the case study of Kennedy & Widener (2008), Fullerton et al. (2013) used a structural equation model to provide empirical evidence on the relation between a lean manufacturing strategy implementation and a selection of MC(S) and accounting practices. The MC(S) considered were employee empowerment (EMPR) and visual performance measurement (VLPM); the included accounting practices were simplified strategic reporting (SSRPT), inventory tracking (INVTR), and value stream costing (VSC). By applying a survey instrument and using the responses of 244 US companies, they were able to derive the findings depicted in figure 11 below.



Notes:
***,**,* indicates the significance of the *p*-value at <0.01, 0.05, and 0.10, respectively.
We report one-tailed *p*-values.
We are only depicting the results of the structural model.

Figure 11 (Fullerton et al. 2013, p. 62)

Regarding MC(S) they found that the extend of lean manufacturing strategy positively correlated with the use of employee empowerment (path H1a, fig. 11) and visual performance measurement information (path H1b, fig. 11). This was expected by the authors, as both employee empowerment and visualisation of performance measurement information were theorised to increase efficiency if a lean manufacturing strategy was implemented (Kennedy, Widener 2008; Fullerton et al. 2013). More interesting was that MC(S) and accounting practices were observed to work as a package as well. EMPR, VLPM, SSRPT, and VSC had positive associations with each other and negative associations with INVTR. The six paired associations that were statistically significant are visualised by the paths which connect the individual components of the controlling-accounting mix in figure 11.

Findings

- Lean manufacturing leads to a change in MC(S) and accounting practices
- Interrelations between accounting practices and MC(S)

Shortcomings

- Individual framework for MC(S) terminology
- Only two MC(S) considered
- Little control for other contingency factors
- No measurement of performance effects
- Survey instrument as methodology

8.5 Reflection on findings and shortcomings

While many interrelations between MC(S) were found in the reviewed studies, it is still challenging to integrate the results into generalisable propositions. One reason being that each study used different MC(S) frameworks and different contingency factor terminologies. Another reason being that the settings were

just too diverse. Nevertheless, two findings have interesting implications for the theories introduced in sections 5 and 7.

Implications for theory

Abernethy et al. (2004) observed that the hospital changed its governance and organisation structure and promoted a culture of resource management before implementing an accounting system. They assume that the sequence of implementation was driven by a constraint of financial resources. This implicates that a budget constraint needs to be considered for equation (1) in the analytical model of Grabner & Moers (2013). The constraint could be expressed as $\boldsymbol{p} \leq c$; with $\boldsymbol{p}$ representing the total cost of implementations and c representing the available budget for MC(S).

Both Kennedy & Widener (2008) and Fullerton et al. (2013) found interrelations between MC(S) and accounting practices. This indicates that accounting practices need to be considered in MCSP design. Additionally, it implies that the MCSP framework of Malmi & Brown (2008) is on its own not sufficient to capture all relevant interrelations, as it explicitly excludes management accounting systems which are used solely for decision support. Therefore, such systems need to be either (re)integrated in the framework or considered in additional frameworks.

Shortcomings

Unfortunately, individual MC(S) frameworks were used in three out of four reviewed papers which makes the integration of study results difficult. Moreover, none of the studies did measure for performance effects, which prevents an objective judgement on MCSP effectiveness. Additionally, there was little control for contingency factors, as only a small range of the contingency set has been considered in each study. Thus, while controlling for interrelations between MC(S), most of the suggestions to MCSP research (see introduction of section 8) were not followed.

Due to the high complexity of a systems approach to fit, MC(S) research has difficulties to simultaneously comply to all suggestions on study design. The whole of MC(S) choices and contingency variables as well as interrelations between and within them are difficult to capture at the same time. Abernethy et al. (2004) note that "No empirical study can investigate all organisational design choices at the same time." (p. 563). The same is true for the case studies discussed in this thesis. However, while findings from contingency-based research remain piecemeal, they still offer building blocks for theory and help to expand our knowledge on MCSP design.

9 Conclusion

This thesis aimed to provide guidance on the issue of interrelations within the MCSP. Since contingency theory is the most dominant concept in MC(S) research (Fisher 1995; Dent 1990; Chenhall 2003), it was thoroughly explained how MCSP design is hypothesised to work from a contingency-based view. Subsequently, after providing a categorisation of approaches to fit, the systems approach was identified as the only approach that accounts for all relevant relationships between the contingency set and the MCSP as well as interrelations within the MCSP. By integrating suggestions on study design a call to contingency-based research was derived: Longitudinal case studies should be conducted while following a systems approach to fit and measuring performance in accordance with the companies stated goals (Fisher 1995; Merchant, Otley 2006; Malmi, Brown 2008).

In order to be able to integrate study results and to extend theory, it is essential that a consistent terminology is used to document interrelations between (forms of) MC(S) (Fisher 1995; Malmi, Braun 2008). Therefore, the most prominent MC(S) frameworks were introduced and briefly evaluated with regard to their usefulness for MC(S) research. The MCSP framework of Malmi & Braun (2008) was identified as the most promising one, as it provides the most comprehensive view of MC(S).

Optimal MCSP design is characterised by two factors. Firstly, the MCSP needs to match the contingency set of the organisation and secondly, it needs to be internally consistent (Drazin, van de Ven 1985). Grabner & Moers (2013) propose that internal consistency is defined by a complementary relation between MC(S). Their analytical model of MCSP design was introduced and guidance on research issues regarding the measurement of MC(S) interdependence was provided. Additionally, the interdependence matrix of Brynjolfsson & Milgrom (2012) was presented as a simple-to-use tool to identify clusters of complementarities. Subsequently, difficulties in changing internally consistent systems were discussed.

Four prominent studies on MCSP design were reviewed in this paper. While many interrelations within the MCSPs were found, the study results could not be integrated, since different MC(S) frameworks and contingency factor terminologies were used. Additional shortcomings were little control for contingency factors and the lack of performance measurement. MC(S) research obviously has difficulties to simultaneously comply to all suggestions on study design, due to the high complexity of a systems approach to fit.

To understand the relations between contingency factors and MC(S) as well as the interrelations within the MCSP is of high relevance in order to be able design MCSPs which are efficient and effective. Therefore, there are two important opportunities for further research. Firstly, the call to conduct longitudinal case studies while following a systems approach to fit and measuring performance in accordance with the goals stated by the respective companies remains (Fisher 1995; Merchant, Otley 2006; Malmi, Brown 2008). Secondly, it needs to be tested whether complementary theory provides the answer on how to design internally consistent MCSP or if there are additional forms of (bidirectional) interrelations that need to be controlled for.

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Appendices

Appendix A - Contingency control variables

1) External environment

- uncertain vs. certain
- static vs. dynamic
- simple vs. complex
- turbulent vs. calm

2) Competitive strategy and mission

- Porter: low-cost, differentiation
- Miles & Snow: defender, prospector
- Product life cycle: build, hold, harvest, divest

3) Technology

- Woodward: small batch, large batch, process production, mass production
- Perrow: number of exceptions, nature of search process
- Interdependence: pooled, sequential, reciprocal

4) Unit, firm and industry variables

- Firm size
- SBU (profit center) size
- Firm diversification: single product, related diversified, unrelated diversified
- Firm structure: u-form, m-form
- Industry variables

5) Knowledge and observability factors

- Knowledge of the transformation process
- Outcome (output) observability
- Behaviour (effort) observability

Source: Fisher (1995) p. 30

Appendix B - Choice of control form

The matrix below demonstrates four cases, each varying with regard to the management's knowledge of the transformation process and its ability to measure outputs.

Conditions Determining the Measurement of Behavior and of Output

		Knowledge of The Transformation Process	
		Perfect	*Imperfect*
Ability to Measure Outputs	*High*	Behavior or Output Measurement (Apollo Program)	Output Measurement (Women's Boutique)
	Low	Behavior Measurement (Tin Can Plant)	Ritual and Ceremony, "Clan" Control (Research Laboratory)

Source: Ouchi (1979) p. 843

If the management's knowledge of the transformation process is perfect and outputs can easily be measured, either behaviour control or output control can be used. If the output cannot be measured, but the transformation process is known, management can simply direct employees' behaviour. Otherwise, if there is little knowledge about the transformation process but output can be measured, output control is the favoured form of control. More interestingly is the case when the output cannot be measured and additionally the transformation process is unknown. Ouchi (1979) mentions the example of a research laboratory where a new technology is developed for such a situation. Since behaviour or output control do not work for the above-mentioned reasons, management has to rely on clan controls. By ensuring a strict recruiting process, only selected individuals with the right skill and mind set are employed and through a schooling and professionalisation process taught to internalise clan values. Rituals and ceremonies which reward the "right" attitudes, values, and beliefs are performed, since only those can be perceived and evaluated by the other clan members. Thereby, the organisation ensures to have a committed set of employees who display the attitudes and values that are most likely to lead to organisational success (Ouchi 1979).

Appendix C - Unobserved heterogeneity

Brynjolfsson & Milgrom (2012) demonstrate how unobserved heterogeneity can lead to a bias of both performance tests and correlation tests[14]. Two MC(S) (y_1, y_2) are considered which vary independently and exogenously and are assumed to be binary, so $(y_1, y_2) \in \{0, 1\}$. Thereby, four pairs of MC(S) choices result: (0,0), (1,0), (0,1), and (1,1). The performance test statistic suggested by Brynjolfsson & Milgrom (2012) to detect complementarities is:

$$Perf\Delta = f(1,1) + f(0,0) - f(1,0) - f(0,1) \quad (16)$$

If the change in overall performance of both MC(S) implemented together is greater than the sum of the individually implemented MC(S) (i.e. $Perf\Delta > 0$), it suggests complementarities; if it is lower than zero (i.e. $Perf\Delta < 0$), it suggests substitutes.

As discussed in section 7.1, the adoption of MC(S) is determined by their costs and benefits. However, while the MC(S) designer may consider many exogenous variables that affect those costs and benefits, others may not be observable by the econometrician who is measuring for interdependencies. This can cause biases. Assume that X is a practice-specific exogenous variable that affects returns.[15] This variable is now divided into an observable component, x_j, and an unobservable component, χ_j, as demonstrated below for the example of a computer system implementation.

Variable	Observable	Unobservable
X	x_j (e.g. years of experience and education)	χ_j (e.g. home use of computers and user-friendlyness of software)

Source: Brynjolfsson & Milgrom (2013), p. 36 mod.

[14] Performance tests and correlation tests closely resemble the 'estimation of the pay of function' and the 'estimation of the demand function' (as introduced in section 7.3.2), respectively.

[15] For the sake of simplicity, practice-specific exogenous variables that affect only adoption(costs) are left out.

The performance effects of the different pairs of MC(S) choices in equation (16) are subsequently characterised by the following estimation equation:

$$f(i,j) = \beta_1 x_1 y_1 + \beta_2 x_2 y_2 + \theta_{ij} + \xi \tag{17}$$

The variable y_i is 1 if the firm adopts the corresponding MC(S) or otherwise 0. θ_{ij} represents the interaction effect, while the corresponding subscript indexes whether the first and the second MC(S) are implemented or not (0 or 1). ξ is a firm-specific error which consists of the variables shown in equation (18).

$$\xi = \chi_1 y_1 + \chi_2 y_2 + \varepsilon \tag{18}$$

While the observable components are incorporated into the estimation equation, the unobservable components can bias the measure for interdependence.

The expected value of the test statistic[16] is

$$\begin{aligned} E\left[\widehat{Perf\Delta}^{OLS}\right] = Perf + E\left[\chi_1 \middle| ij = (1,1)\right] + E\left[\chi_1 \middle| ij = (1,0)\right] \\ -E\left[\chi_2 \middle| ij = (1,1)\right] - E\left[\chi_2 \middle| ij = (0,1)\right] \end{aligned} \tag{19}$$

If the last four terms do not add up to zero - they only do if Perf=0 and χ_1 and χ_2 are uncorrelated or zero - there is a bias. Below, the bias effects are explained for the performance test and the correlation test.

Rejection of complementarities in the performance test

Assumptions:

- χ_1 and χ_2 do not correlate
- The two practices are truly complements ($Perf\Delta > 0$)

[16] Two test statistics are being referred to in Appendix C. These are ordinary least square estimates and two-stage least square estimates, which are denoted by the superscripts ^{OLS} and ^{SLS}, respectively.

When the organisational designer is confronted with practice-specific productivity shocks, but the econometrician does not observe them, the test statistics are biased downwards. This happens as the sum of the last four terms in equation (19) is negative in this case. Therefore, practices which are truly complements can be erroneously identified as substitutes by the test statistics (i.e. $E\left[\widehat{Perf\Delta}^{OLS}\right] < Perf\Delta$ and $E\left[\widehat{Perf\Delta}^{SLS}\right] < Perf\Delta$).

Finding complementarities that are not there in the correlation test

Assumptions:

- χ_1 and χ_2 are positively correlated
- The two practices are truly independent ($Perf\Delta = 0$)

If χ_1 and χ_2 are positively correlated, it can lead the econometrician to find complementarities although there are none (i.e. $E\left[\widehat{Perf\Delta}^{OLS}\right] > 0$ and $E\left[\widehat{Perf\Delta}^{SLS}\right] > Perf\Delta$) (Brynjolfsson, Milgrom 2012).

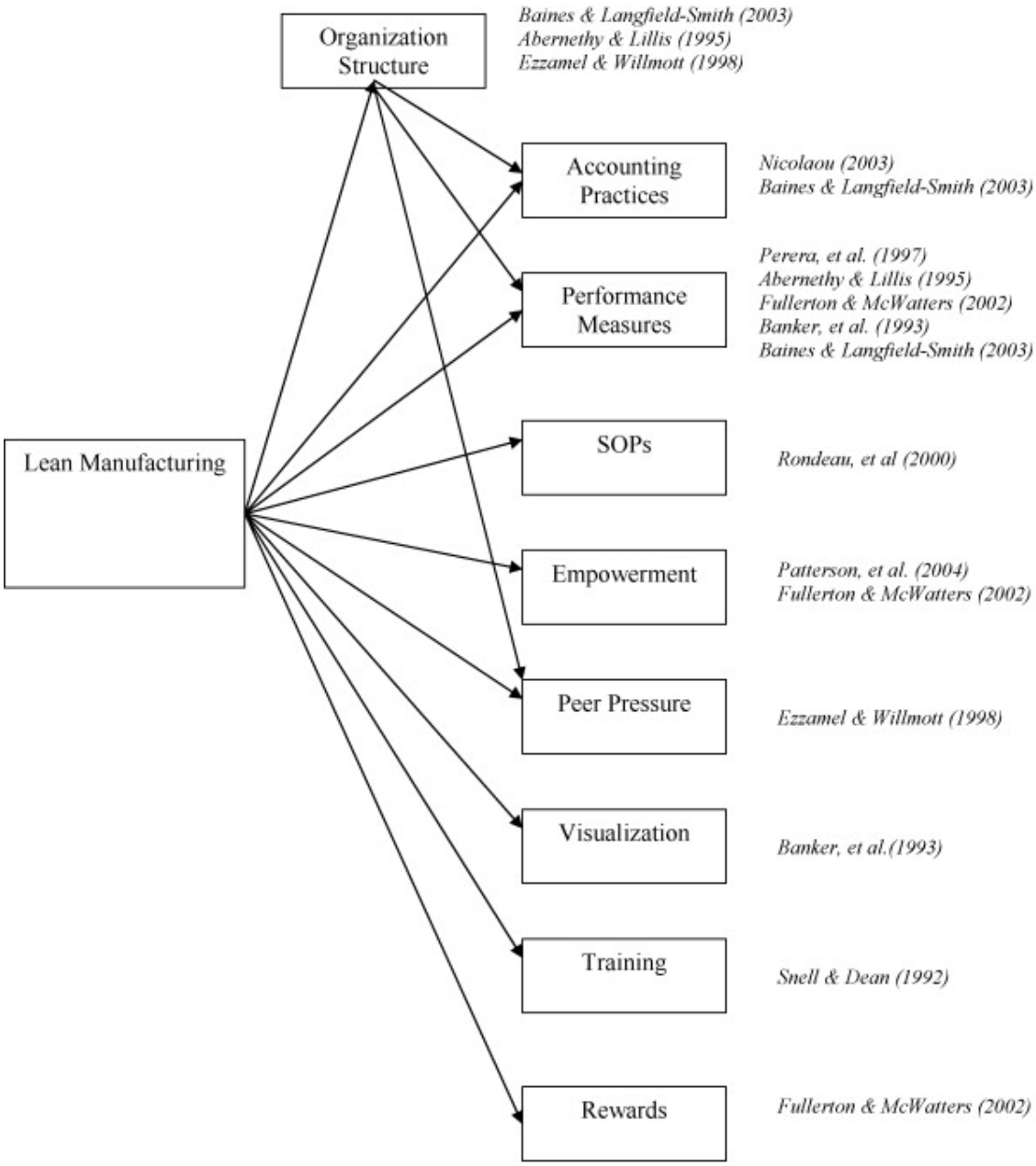
Appendix D - Timeline and contingency factors

Events	Telecom deregulation		IPO	Crisis			New Communications Market Act
Appointments	CEO 1	CFO 1		CEO* CFO*	CEO 2	CFO 2	
	1998	*1999*	*2000*	*2001*	*2002*	*2003*	*2004*
	← CASE 1 →				← CASE 2 →		
Financials (M€)							
- Turnover	0.4	4.9	13.3		30	30	70
- EBITDA	-0.6	-1.1	1.26		0.7	5.3	11
- Operating profit	-0.7	-1.7	0.23		-4	1.3	5
Ownership %							
- Employees	N/A	34	16.8		7	14.2	19.5
- External parties	N/A	66	83.2		93	85.8	80.5
Contingencies							
- Technology	Information technology, automation, knowledge				Information technology, automation, knowledge		
- Environment	Uncertainty due to technological advancement and opportunism				Uncertainty due to technological changes		
	Deregulation driven tightening competition				Tightening price competition, customer mobility		
- Strategy	Lowest price / growth + profitability				Lowest price / efficiency + growth		
- Size (employees)	110	160	200		250	190	220
- Scope	Domestic operations			Internationalization	Domestic + international operations		
- Board of Dir:s	External				External		
- Cash balance	Tight				Tight		

** CEO and CFO were hired only for the crisis time.*

Source: Sandelin: (2008) p. 341

Appendix E.I - Ex-ante model



Source: Kennedy & Widener (2008) p. 307

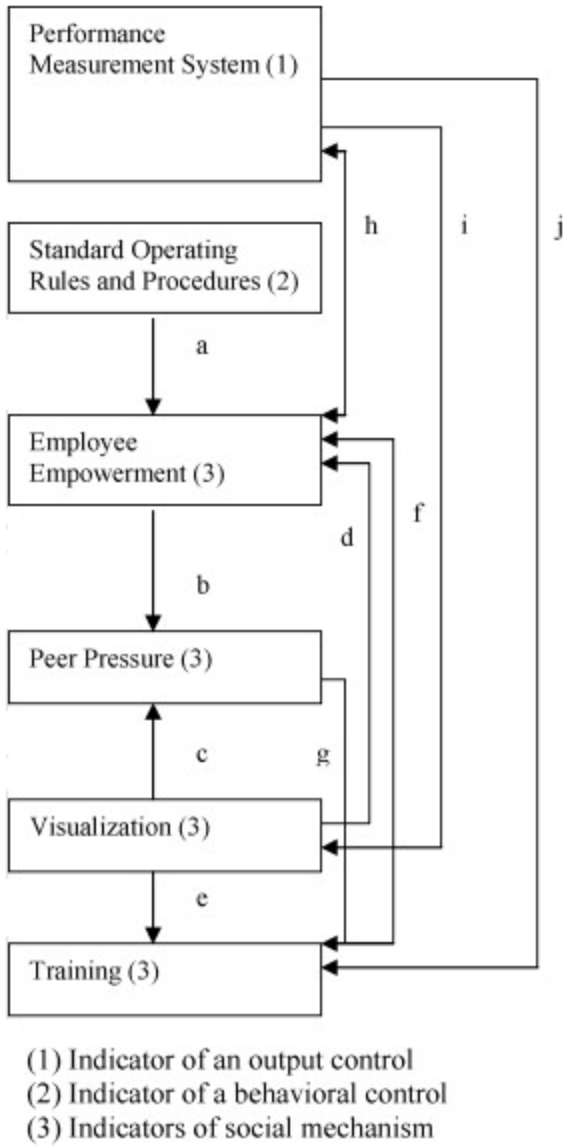
Appendix E.II - Description of variables

This figure presents a brief summary of the before and after state of each variable in the theoretical framework. The evidence is documented as follows: photo=P; archival record=A; interview=I; observation=O.

Variables	Before Initiatives	After Initiatives
Strategic Manufacturing Technology	Batch-and-Queue Manufacturing • Produced to forecast (I, O) • Separate functional areas (A, I) • Ad hoc teams to increase quality (I) • Employees are single tasked (I)	Lean Manufacturing • One piece flow (O, P) • Produces to customer order (O, A, I) • Manages bottlenecks to optimize flow (I) • Produces in teams (O, I, P) • Quality built into process (O, I, A, P)
Organizational Structure	Vertical Structure • Vertical reporting (A) • Functional (departmental) responsibility centers (A) • Employees are single tasked (I)	Cell Structure • Flatter with cell and value stream teams (P, O, A) • Value stream team with multi-functional members (P, I, A) • Employees responsible for entire production process (multiple machines and tasks) (P, I, O)
Accounting Practices	See Figure 3	See Figure 3
Output Controls (Performance Measurement)	Traditional Variance Measures • Traditional manufacturing variances (A, I) • Low margin exception reports (A, I) • Facility measures included traditional accounting measures (A, I) • Accounting group tracked performance measures (I) • Information provided to manager and supervisor (I)	Non-traditional Operational Measures • Operational measures (refer to Figure 4) (P, A, I, O) • No variance analysis (P, A, I) • Posted throughout facility and shop floor (P, A, I) • Generated from the bottom-up on a frequent basis (P, A, I)
Behavioral Controls	Absent • Technical process documents located in supervisor and engineering offices (I)	Standard Operating Procedures • SOPs visible in cell and includes pictures of each part of the process (O, P, I) • Yellow floor markings indicate flow of material and finished goods (O, P, I)
Social Controls	Absent • Empowerment: supervisors & managers only (I) • Peer Pressure: none (individual contributors) (I) • Visualization: none; paper reports only to manager and supervisor (I) • Training: single process only (I)	Heavy Reliance • Empowerment: (1) formation of Cell and VS teams; self-selection of cell team members (I), (2) vacation and work schedules; TPM (A,P, I, O), (3) production scheduling (P, A, I, O), (4) quality assurance (P, I, O, A); (5) request training (I, O), (6) tracking own measures (I, O, P, A) • Peer Pressure: (1) cell members pressure one another to perform (I), (2) cell members pressure one another to gain additional training and skills (blue dots) (I, O, A, P), (3) posted responsibility for action items (O, P, I) • Visualization: (1) Yellow marking on the floor indicating layout of machines, tools, and inventory (O, P, I); (2) cell and value stream metric boards (O, P); (3) flip charts (O, P) • Training: (1) skills matrix (I, O, A, P); (2) intranet training (I, O)

Source: Kennedy & Widener (2008) p. 310

Appendix E.III - Relations among the MC(S)



Source: Kennedy & Widener (2008) p. 314

Appendix F.I - Findings from MCSP research

Abernethy & Chua (1996)	Sandelin (2008)	Kennedy & Widener (2008)	Fullerton et al. (2013)
• Change in institutional environment (institutional pressure) leads to change in the MCSP • Budgets can work as substitute for more sophisticated formal controls if combined with informal controls • Change in culture before change in accounting system, due to lower cost of implementation	• Growth leads to change in the MCSP • Internally consistent informal cultural, personnel, and action controls can work as a substitute for more formal forms of control • Complementarities between forms of control depend on contingency factors • Optimal MCSP design is based on a combination of MC(S) that is able to support a particular control orientation or management philosophy • MCSPs were designed accordingly to the functional demands considered most important by the incumbent management	• Lean manufacturing leads to change in the MCSP • Many unidirectional and bidirectional relations exist within the MCSP • Organisational structure and accounting practices are important intervening variables between lean manufacturing and the MCSP • Strategic initiative leads to a focus of the MCSP on a portfolio of MC(S) that emphasize output, behavioural, and social controls	• Lean manufacturing leads to a change in MC(S) and accounting practices • Interrelations between accounting practices and MC(S)

Appendix F.II - Shortcomings in MCSP research

Abernethy & Chua (1996)	Sandelin (2008)	Kennedy & Widener (2008)	Fullerton et al. (2013)
• Individual framework for MC(S) and individual contingency factor terminology • Little control for other contingency factors • No measurement of performance effects	• Little control for other contingency factors • Insufficient measurement of performance effects	• Individual framework for MC(S) and individual contingency factor terminology • Little control for other contingency factors • No measurement of performance effects	• Individual framework for MC(S) terminology • Only two MC(S) considered • Little control for other contingency factors • No measurement of performance effects • Survey instrument as methodology

Individual framework for MC(S):	3 out of 4 papers
Little control for other contingency factors:	all 4 papers
No or insufficient measurement of performance effects:	all 4 papers

Appendix G - Summary in German

Es wurde festgestellt, dass die Gesamtheit der Unternehmenssteuerungspraktiken und/oder -systeme (UP(S)) welche in einem Unternehmen Verwendung findet ein Paket bildet (Otley 1980; Fisher 1995; Abernethy, Chua 1996; Malmi, Brown 2008). Die vorliegende Masterarbeit beschäftigt sich mit den wechselseitigen Beziehungen zwischen den verschiedenen UP(S) innerhalb dieses Unternehmenssteuerungspaketes.

In der Arbeit wird aufgezeigt, dass Wechselbeziehungen innerhalb des Unternehmenssteuerungspaketes zu beachten sind, um keine Fehlschlüsse über die Verbindung zwischen bestimmten Unternehmenscharakteristiken und UP(S) zu ziehen. Eine Aufarbeitung verschiedener theoretischer Ansätze zur Messung dieser Wechselbeziehungen sowie der daraus resultierenden Leistungseffekte legt nahe, dass die Forschung einen "Systems Approach" verfolgen soll, um keine Verzerrungen in den Messergebnissen zu erhalten. Darüber hinaus sollen Langzeitfallstudien durchgeführt sowie die Leistungsmessung auf die jeweiligen Unternehmensziele abgestimmt werden.

Um Forschungsergebnisse konsolidieren und generalisieren zu können, besteht die Notwendigkeit eine einheitliche Terminologie für UP(S) zu verwenden. Nachdem die wichtigsten Rahmenwerke diskutiert und verglichen wurden, konnte das "MCSP Framework" von Malmi & Braun (2008) als das bestgeeignetste Rahmenwerk zur Kategorisierung identifiziert werden.

Unternehmenssteuerungspakete müssen in sich konsistent sein, um eine optimale Leistungsfähigkeit zu erreichen (Drazin, van de Ven 1985). Grabner & Moers (2013) definieren diese interne Konsistenz als Komplementarität der UP(S) im Unternehmenssteuerungspacket.

In der Arbeit wird das entsprechende analytische Modell vorgestellt und nachdem empirische Implikationen aufgezeigt wurden, werden Empfehlungen zur Messung von Interdependenzen zwischen UP(S) gegeben. Des weiteren wird mit der Interdependenzmatrix von Brynjolfsson & Milgrom (2012) ein einfach zu benützendes Werkzeug präsentiert, um Cluster von komplementären Systemen zu erkennen.

Im letzten Abschnitt der Masterarbeit werden die wichtigsten Erkenntnisse sowie die Mängel im Studiendesign von vier einflussreichen Forschungsarbeiten zu UP(S)-Wechselbeziehungen herausgearbeitet. Es wurde eine Vielzahl von gegenseitigen Wechselbeziehungen innerhalb des Unternehmenssteuerungspaketes gefunden. Allerdings muss festgestellt werden, dass die Studienergebnisse zum Großteil nicht konsolidierbar sind, da sich die jeweiligen Studien mit verschiedenen Unternehmenscharakteristiken und UP(S) beschäftigten sowie individuelle Terminologien und Rahmenwerke verwendet haben. Darüber hinaus wurde vorwiegend nur eine Unternehmenscharakteristik berücksichtigt und es wurden keine Leistungsmessungen durchgeführt. Es wird daher weiter aufgefordert Forschungsergebnisse unter Berücksichtigung des Systems Approach zu generieren.

Appendix H - Curriculum Vitae

Curriculum Vitae

Peter Gschaider

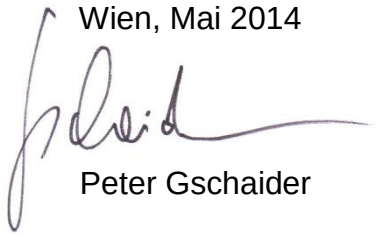
Ausbildung:

03/2012 - 05/2014	**Masterstudium Betriebswirtschaft**
Schwerpunkte:	Controlling und Corporate Finance
Masterarbeit:	"Interrelations within the Management Control Systems Package"
	Universität Wien
10/2011 - 02/2012	**Masterstudium Finanzwirtschaft und Rechnungswesen**
	Wirtschaftsuniversität Wien
03/2008 - 06/2011	**Bakkalaureatsstudium Betriebswirtschaft**
Schwerpunkt:	Controlling (Unternehmensrechnung und Budgetierung)
Auslandsaufenthalt:	Zwei Semester an der University of Exeter
Bakk.-Arbeit:	“Stock Option Compensation and Managers’ Choices”
10/2007 - 02/2008	KF-Universität Graz
	Bakkalaureatsstudium Umweltsystemwissenschaften
09/2003 - 07/2005	KF-Universität Graz
	Berufsreifeprüfung
09/1999 - 08/2002	WIFI Salzburg
	Lehrausbildung zum Großhandelskaufmann
	mit Auszeichnung abgeschlossen
	Carl Steiner GmbH

Berufserfahrung:

08/2013 - 02/2014	**Junior Consultant / Assistant bei der TCI Consult (Teilzeit)**
03/2011 - 08/2011	**Praktikant bei der TPA Horwath Unternehmensberatung**
08/2010 - 08/2010	**Praktikant bei der Raiffeisen-Holding NÖ-Wien**
11/2005 - 01/2007	**Großhandelskaufmann bei Würth Hochenburger**
09/2004 - 10/2005	**Verkaufsmitarbeiter bei Pagro (Teilzeit)**
09/2002 - 03/2003	**Großhandelskaufmann bei Carl Steiner**

Wien, Mai 2014



Peter Gschaider