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„Novel Forms of Work Arrangements for
Organizations: Analysis of the Remote Working
Potential at the Example of the Educational Services
Sector “

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Abstract

Assessing the remote working potential of an organization has become vital, especially during the Covid-19 pandemic. This very flexible work arrangement has been on the rise for some years now, nevertheless, many companies had not been prepared for its sudden execution. Alleged experts and different authors came to the rescue by offering subjective, intransparent and incomprehensible remote working potential results for whole sectors as a guideline. Despite the great relevance to evaluate the remote working potential of organizations within an industry and a sector, numbers published lacked proper foundation and a traceable analysis. The goal of this thesis is to set an example by transparently and objectively evaluating the remote working potential of an exemplary sector, being the educational services sector, and industries within and at the same time offering more detailed insights allowing to set in place measures for improvement. Remote working criteria influencing the remote working potential have been selected based on literature insights and matched to corresponding industry, occupational and work context data which yielded valuable insights on an aggregated as well as detailed level. Overall, the educational services sector has an average remote working potential of 0.71 and a best-case scenario remote working potential of 0.94 being very close to the optimum of 1.0. More detailed results, however, reveal that not all industries within are equally suited for remote working and individual value chain activities clearly point out areas for improvement and potential which has not yet been exploited.

Zusammenfassung

Die Bewertung des Fernarbeitspotenzials eines Unternehmens ist von entscheidender Bedeutung geworden, insbesondere während der Coronavirus-Pandemie. Fernarbeit, eine sehr flexible Arbeitsform, ist seit einigen Jahren auf dem Vormarsch, doch viele Unternehmen waren auf ihre plötzliche Umsetzung nicht vorbereitet. Vermeintliche Experten und verschiedene Autoren kamen zu Hilfe geeilt, indem sie subjektive, intransparente und nicht nachvollziehbare Ergebnisse zu Fernarbeitspotenzialen für ganze Branchen als Leitfaden anboten. Trotz der hohen Relevanz der Bewertung des Fernarbeitspotenzials von Organisationen innerhalb einer Branche und eines Sektors fehlte es den veröffentlichten Zahlen an einer fundierten Grundlage und einer nachvollziehbaren Analyse. Ziel dieser Arbeit ist es, eine transparente und objektive Bewertung des Fernarbeitspotenzials eines exemplarischen Sektors, des Bildungssektors, und der darin enthaltenen Branchen vorzunehmen und gleichzeitig detailliertere Einblicke zu geben, die es ermöglichen, Verbesserungsmaßnahmen zu ergreifen. Fernarbeitskriterien, die das Fernarbeitspotenzial beeinflussen, wurden auf der Grundlage von Literaturerkenntnissen ausgewählt und mit entsprechenden Branchen-, Berufs- und Arbeitskontextdaten abgeglichen, was wertvolle Erkenntnisse sowohl auf aggregierter als auch auf detaillierter Ebene lieferte. Insgesamt hat der Bildungssektor ein durchschnittliches Fernarbeitspotenzial von 0,71 und ein Bestfall-Szenario Fernarbeitspotenzial von 0,94, welches dem Optimum von 1,0 sehr nahekommt. Detailliertere Ergebnisse zeigen jedoch, dass nicht alle Branchen gleichermaßen für die Fernarbeit geeignet sind, und einzelne Aktivitäten in der Wertschöpfungskette weisen eindeutig auf verbesserungsbedürftige Bereiche und noch nicht ausgeschöpftes Potenzial hin.

1. Introduction

The global pandemic which hit the world in the beginning of 2020 changed the life and everyday routine of millions of people all around the world. Social distancing became a crucial part in fighting the spread of Covid-19 and meant to reduce interpersonal contact to the absolute minimum wherever possible. Organizations were forced to introduce new work arrangements meeting current needs. More flexible work arrangements had been on the rise for some time, however, are far from being widely established in every organization and across industries. Dingel and Neiman (2020) tried guessing the actual number of jobs in the United States that can be done from home in case the pandemic would strike as hard as virologists predicted and came up with 37% of the total workforce in the US. In July 2020 Bick, Blandin and Mertens (2020) analyzed a Real-Time Population Survey and found the actual number of people working entirely from home in the US to be 35.2% as opposed to 8.2% in February 2020. This percentage however does not hold for all employees around the globe. According to the Skills Toward Employability and Productivity survey of the World Bank Group covering 17,000 workers in low- and middle-income countries between 2012 and 2017, only 9.3% of employees can work from home and to be more specific only 1.3% of elementary jobs can be performed remotely (Gottlieb, Grobovšek, Poschke & Saltil, 2020). The potential to work from home therefor heavily varies depending on the country and type of job performed. Many companies had to apply a learning-by-doing approach when Covid-19 hit their country and were not prepared to send their entire workforce home to perform their jobs remotely. Furthermore, not all jobs that could have been done at home were actually performed at home (Bick et al., 2020), making it even harder for firms to make an accurate prediction about the number of employees which could work from home in the future.

Covid-19 accelerated the workplace transformation and got more than four times as many people to work from home as a few months before the outburst of the pandemic in the United States. However, due to the often uncoordinated and poorly planned workplace transition employees were forced to work from home even if they could no longer perform their job effectively, but also stayed at their office despite their job role having the potential to being executed remotely. The remote working

potential of an occupation or a whole industry has many times been assessed using unsubstantiated criteria or estimated by alleged experts (Greenstein, 2021; Lund, Madgavr, Manyia & Smit, 2020). So far non-transparent or subjective evaluations of remote working potential dominates research. Still “literature is mostly comprised of anecdotal evidence, personal opinions, or experience based on a single organization” (Guimaraes & Dallow, 1999, p.40). The aim of this thesis is to provide an analytics tool for remote working potential based on a summary of remote working criteria found in various field studies and in literature which are applied to real-world data to conduct a transparent and objective analysis which can be reproduced for all industries at any point in time.

In the following chapters the reader is gradually introduced to the topic to gain in-depth knowledge and to be able to reproduce the analysis if desired. First, the concept of remote working and its historic as well as current development is presented. Second, a literature and study review are conducted and based on that, a clustered summary of relevant remote working criteria presented. Third, industry and value chain analyses for an exemplary sector are performed to classify occupations accordingly in order to being able to make a statement about the remote working potential differences within a specific sector. After these steps the analytics tool can be created by merging different data sets containing remote working criteria as well as occupational data, which are going to be presented later on, in order to analyze and discuss the remote working potential for the selected sector and industries within. In the end, limitations, future research implications and a conclusion round up this thesis.

2. Remote Working Theory

In order to get a full picture of the meaning of remote working it is very helpful to take a look at its rise and historic development. The term and the concept of remote working have changed and evolved over the last decades. In the following the historic development of remote working is presented highlighting the different stages remote working has been gone through until the present day.

2.1. Historic Development

In 1975, Nilles wrote about the increasing decentralization of traditionally centralized organizations. The three factors favoring this trend are “1) the growth of the “information industry”; 2) the development of increasingly effective, relatively low-cost communications and computer technologies; and 3) the increasing magnitude and variety of forces which motivate organizations to decentralize” (Nilles, 1975, p. 1142). Being in the information industry at that time simply meant for employees to frequently work with computers, something today often is not even explicitly addressed as it is part of all industries in varying extents. Nilles (1975) research at the University of Southern California especially focused at the term *telecommuting* meaning enabling “employees of large organizations to work in offices close to (but generally not in) their homes, rather than commute long distances to a central office” (p.1143).

Gray, Hodson, Gordon and Kerrigan use the term *telework* describing a “flexible way of working which covers a wide range of work activities, all of which entails working remotely from an employer, or from a traditional place of work, for a significant proportion of work time” (as cited in in Bui, Higa, Sivakumara and Yen, 1996, p.344). As opposed to the traditional telecommuting definition of Nilles, Gray et al. include the possibility to work from home when talking about teleworking. Bui et al. (1996) base their research on the general term teleworking but describe various types “i.e., satellite offices, neighborhood work center and mobile workers” (p.344). Teleworking, therefore, is a very broad term that does not put restrictions on the remote workplace setting but is open to continuously include new modes of telework. Remote working was evolving due to the development of different technologies allowing a growing proportion of employees to participate. Within two decades, between 1980 and 2000, the number of workers having a completely home-based employment more than doubled from 1.58 million to 3.42 million (Oettinger, 2011). At that time, this was a considerable growth rate paving the way to include communications and computer technologies in peoples everyday working life. However, the Covid-19 pandemic has forced the growth rate of teleworking in 2020 to quadruple within only a few months, vastly increasing awareness of the issue and permanently changing the way work is done today. Alternative work arrangements including working remotely are no longer reserved to a sole information industry as

they were in 1975 but are part of studies conducted in a multitude of disciplines ranging from urban planning, transportation research, ethics, law, information science to organizational behavior (Bailey & Kurland, 2002; Mas & Pallais 2020).

2.2. Synonyms for Remote Working

Despite the differences explained above, the term telecommuting and teleworking are very often used interchangeably making it quite confusing when comparing different literature sources and country-specific studies (Sajoy, 2020). This is the reason why the author should always state which term is officially used and what this exactly entails. The Eurofound and the International Labour Office for example introduced ‘telework/ICT-mobile work’, short T/ICTM, which “can be defined as the use of information and communications technologies (ICT), such as smartphones, tablets, laptops and/or desktop computers, for work that is performed outside the employer’s premises” (2017, p.3). However, many new terms emerge describing work that is done in a non-traditional manner allowing researchers to choose their own definition which fits their individual context (Pratt, 1997). The list includes names like remote working, working from home (WFH), telecommuting, telework, flexiplace, distance work, cottage working, flexible working, distributed working, mobile working, homeworking, etc. (Belzunegui-Eraso & Erro-Garcés, 2020; Bloom, Liang, Roberts & Ying, 2015; Bui et al. 1996; Jackson & Wielen, 2002). A definition of telework has to be primarily based on the location where work takes place and secondly on travelling or the frequency of working remotely. The type of telecommunication, however, is completely irrelevant since all these new work arrangements rely on some kind of telecommunication means (Sajoy, 2020).

The definition used in this thesis is included in the 2002 European Framework Agreement on Telework and is applied by several EU Member States in national guidelines or national-level collective agreements (as cited in ILO, 2016). The agreement holds telework to be “a form of organising and/or performing work, using information technology, in the context of an employment contract/relationship, where work, which could also be performed at the employer’s premises, is carried out away from those premises on a regular basis” (as cited in ILO, 2016, p.3). In this thesis ‘remote working’ is the equivalent term for teleworking that is used when further discussing different

criteria influencing the potential of occupations to be performed remotely and later on when analyzing the remote working potential using real-world data.

3. Remote Working Criteria

The nature of a job or the work context play a crucial role when analyzing the suitability of specific occupations to be performed remotely (Golder & Veiga, 2005; Konradt & Hertel, 2002). The Covid-19 pandemic has forced millions of people around the world to work remotely in order to be compliant with social distancing regulations. Of course, some governments were not as strict as for example the Australian government which runs a strategy of “border closures, quarantine programmes and snap lockdowns“ (*Covid: Anger as Half of Australians in Lockdown Again*, 2021), over the course of the last two years. Nevertheless, numbers show people still had to go to their work location every day or were not able to switch completely to a remote work setting as their work context was not suitable for it. In the following, a literature analysis is conducted including studies and experiments in order to properly collect and merge criteria positively or negatively influencing the potential for different occupations to be carried out remotely.

3.1 Literature Review of Remote Working Criteria

Olson (1983) conducted an exploratory study which included 32 employees of different companies, normally working in their offices, taking part in a pilot work-at-home program. Olson was particularly interested in the kind of jobs that can be carried out remotely and interviewed not only the actual participants but also their managers. The author was able to identify six common job characteristics that were comparatively independent from the technology used by the employees. The job characteristics included 1) Minimum physical requirements, 2) Individual control over work pace, 3) Defined deliverables, 4) Need for concentration, 5) Defined milestones and 6) Relatively low need for communications (Olson, 1983). Minimum physical requirements refer to a minimum need of equipment, for instance a terminal, but also a minimum of space required for the job. The

second characteristic, according to Olson, points out the ability of workers to choose their own working pace. Third, jobs observed are output controlled as their work deliverables could be directly measured. Moreover, many participants have a high need for concentration for a significant portion of time during their workday. Fifth, employees working on long-term projects have defined milestones which can be identified and their fulfillment measured. And last but not least, participants explain that they have a low need for communication in general, communicate by phone or collect everything and talk about their issues when being in the office again.

Bloom et al. (2015) report the results of the first “randomized controlled experiment within a large firm“ (p.4) on working from home. The company of interest is a Chinese travel agency employing 16,000 people overall. Senior management was interested in the potential but also in the risks of sending their call-center employees in Shanghai home to perform their work exclusively remotely. Reducing rental costs and attrition rates but also a heavy increase in shirking were part of previous speculations. To the big surprise performance of home workers, all having decided to work remotely voluntarily, went up by 13% over the course of nine month of the experiment whereas attrition dropped by 50% (Bloom et al. 2015). When it comes to remote working the authors stated several learnings why job conditions for call-center employees are especially favorable, but far from universal. First, the equipment needed for remote workers (computer terminals, communications software and equipment) are computer and telecommunications related and can be easily provided at home, second, their job role neither requires face-to-face communication nor teamwork and third, performance (number of calls made) can be directly quantified and evaluated very easily (Bloom et al., 2015).

Wang, Liu, Qian and Parker (2021) captured the experiences of employees working remotely during the Covid-19 pandemic in a qualitative exploratory study and an empirical study thereby exploring virtual work characteristics. The authors highlighted the positive impact of job autonomy for remote workers meaning employees are free to decide when and how to accomplish their tasks which was beneficial for the overall job performance, a person’s wellbeing and work-family balance (Wang et al., 2021).

Hertel, Geister and Konradt (2005) identify tasks with a low degree of physical work and, additionally, highly information-based tasks that can be found, for example, in sales, research and development or procurement to be very suitable for remote working. Moreover, tasks with a modular structure reduce the need for coordination with others which is especially beneficial when being at different locations (Hertel et al., 2005).

Gottlieb et al. (2021) use job data of task content of developing countries and state in their paper that physically demanding jobs which, for example, include operating heavy machines, but also not using e-mail at all make it almost impossible to work from home.

In general, “most clerical and routine administrative functions can be effectively performed using commercially available computer terminals” (Nilles, 1975). Therefore, heavily depending on the task characteristic and the context it is performed in, employees can be widely independent from their traditional work place or are tied to their workplace (Pinsonneault & Boisvert, 2001). For instance, if the task can only be carried out outdoors or requires heavy machinery remote working is probably not an option. The advantages of remote working, unfortunately, arise unevenly across occupations and industries as skilled employees working at technology firms use the option of remote working everyday whereas most services have to be performed on-site (Greenstein, 2021).

3.2 Criteria Influencing the Remote Working Potential

Remote working criteria have been the center of many different studies throughout the last decades, however, have not yet been properly collected and merged in order to provide a well-structured and overarching summary of so far existing criteria. Above, numerous authors are presented all tackling individual remote working criteria which sometimes overlap, are more specific than others or just state an occupation as a whole. This section is designated to merge criteria describing the same topic, finding the right umbrella term and clustering emerging remote working criteria in Table 1 which later serves as the theoretical foundation when analyzing the specific remote working potential using real-world occupational data. Each criterion positively or negatively influences the potential to work remotely which later on will be displayed in an index ranging from 0 (no potential to work remotely) to 1 (full potential to work remotely) based on the secondary data applied.

Table 1

Summary of Remote Working Criteria and the Relationship to the Remote Working Potential

#	Remote Working Criterion	Remote Working Potential (Criterion Value ↑)	References
1	Physical Requirements	↓	Bloom et al., 2015; Gottlieb et al., 2021; Hertel et al., 2005; Olson, 1983; Pinsonneault & Boisvert, 2001
2	Face-to-face Contact	↓	Bloom et al., 2015; Greenstein, 2021; Pinsonneault & Boisvert, 2001
3	Use of Computer and/or Telecommunication Technology	↑	Bloom et al., 2015; Gottlieb et al., 2021; Pinsonneault & Boisvert, 2001
4	Job Autonomy	↑	Olson, 1983; Pinsonneault & Boisvert, 2001; Wang et al., 2021
5	Defined Deliverables	↑	Bloom et al., 2015; Guimaraes & Dallow, 1999; Olson, 1983; Pinsonneault & Boisvert, 2001
6	Mental Concentration	↑	Olson, 1983; Pinsonneault & Boisvert, 2001

3.2.1 Physical Requirements

The first criterion influencing the remote working potential which arises when analyzing studies and different literature sources is *physical requirements* (Bloom et al., 2015; Dingel & Neiman, 2020; Gottlieb et al., 2021; Hertel et al., 2005; Olson, 1983; Pinsonneault & Boisvert, 2001). During the course of this thesis physical requirements include equipment needs, space needs and other physical requirements. The ability of an employee to work remotely can be determined by special equipment he/she interacts with, for instance tools, special machines or vehicles. Special equipment can be

industry specific, for instance, medical equipment, agricultural vehicles, measuring devices, etc. Therefore, the job can only be performed on site where the equipment is found. Devices like computers, laptops or smartphones, on the other hand, do not count as special equipment. They have become increasingly affordable over the years and can be easily provided at home (Bloom et al., 2015). Moreover, space needs, which come naturally with vehicles or large machines that have to be used, also include activities that are performed outdoors and therefore cannot be transferred to a home setting. Working in close physical proximity to other people is another indicator for little or no possibility to work from somewhere else since this holds true for e.g. close contact services. The first row in Table 1 shows the impact of physical requirements on the remote working potential. In general, the more often an employee's job has physical requirements, the lower the potential for remote working gets.

3.2.2 Face-to-face Contact

The second criterion which emerges is *face-to-face contact* (Bloom et al., 2015; Greenstein, 2021; Pinsonneault & Boisvert, 2001). Face-to-face contact or in-person face time includes time an individual spends with, for example, individual coworkers, superiors, customers, suppliers, patients, a whole team, etc. where all parties involved are physically present at the same location. Especially when the job role implies, for instance, serving, advising or caring for other people on site, face-to-face contact can only be replaced in very few cases. Of course, a quick office chat can be done via phone or a collaboration tool, but frequently interacting face-to-face with others implies a necessity rather than a matter of taste. The question remaining is, how to distinguish necessary face-to-face contact from unnecessary face-to-face contact. An office worker who usually attends a daily team meeting with his coworkers and team leader on site was able to easily switch to a remote setting in 2020 when the Covid-19 pandemic hit the world using a collaboration tool. The situation, however, is quite different for e.g. a nurse who has daily face-to-face contact with patients and is simply unable to perform her job remotely without face-to-face contact. The answer is by creating an index containing different remote working criteria which as a sum represent the overall potential. Taking for example the two criteria *Physical Requirements* and *Face-to-face Contact* into consideration

when analyzing the remote working potential of an office worker and a nurse, the difference becomes evident. People in both job roles might declare having daily face-to-face contact with others, however only the nurse is dependent on specialized equipment like medical devices, whereas the office worker simply needs his laptop. The index, therefore, shows a very much lower remote working potential for a nurse. Table 1 indicates the relationship between face-to-face contact and the remote working potential of a job role. The more frequent a person interacts face-to-face the lower the remote working potential gets.

3.2.3 Use of Computer and/or Telecommunication Technology

The third criterion is *use of computer and/or telecommunication technology* (Bloom et al., 2015; Dingel & Neiman, 2020; Gottlieb et al., 2021; Pinsonneault & Boisvert, 2001). As outlined by e.g. Bloom et al. (2015) employees using telecommunications means and or a computer when performing their daily work in the office, relocating them home does not negatively influence their performance. Communication, for instance, can be still conducted the same way since the employee always used e-mail, telephone or videocalls even when being in the office. The job includes working with a computer that thanks to technological development has become relatively affordable and can be provided at home as well. Often employees have their own laptops which they can bring home and which does not need a lot of space. In case a person does not use computers or general telecommunication technology in his/her daily work life, the possibility to switch to a remote setting becomes much more complicated. Either, the company has not yet implemented their use which means theoretically the person performing the job could do so remotely by using a e.g. laptop but has not yet been provided with the device or their use is not feasible in general and providing a device with a specific technology would not increase the potential to work remotely. The interaction with other remote working criteria can reduce this uncertainty. In the event the job does not allow to work with standard technology and devices, which could be provided in a remote setting, the job role might for example also involve a lot of physical interactions which is depicted in the final remote potential score when combining all criteria. Table 1 depicts how the use of computer and/or telecommunication technology influences the potential to work remotely. In case a person uses

computer and/or telecommunication technology a lot of the time the potential of the job to be performed e.g. at home becomes much higher.

3.2.4 Job Autonomy

The fourth criterion is *job autonomy* (Olson, 1983; Pinsonneault & Boisvert, 2001; Wang et al., 2021). The criterion states how free an individual is to make his/her own decision. This implies that the person is not continuously supervised, can freely decide how to accomplish different tasks and has control over his/her own work pace. In an office setting job autonomy is not as influential as in a remote setting. The need for supervision, for example, suggests that the continuation of work is hindered, if the person accountable cannot evaluate the work result properly. If, however, a person can freely decide how to perform a task and also when to perform it, he/she is independent from others and can work unobstructed. Table 1 shows how job autonomy and the remote working potential are related. In the event someone is highly autonomous in his/her job the ability to work remotely increases as well.

3.2.5 Defined Deliverables

The fifth criterion is summarized as *defined deliverables* (Bloom et al., 2015; Guimaraes & Dallow, 1999; Olson, 1983; Pinsonneault & Boisvert, 2001). This criterion aims to identify if a job role has well defined objectives. The term defined deliverables means that the quantity and quality of a person's performance can be measured and evaluated. "Managers can learn to judge employees on actual work produced, and not on presence, engaging personalities, or just looking busy" (Guimaraes & Dallow, 1999, p.42). Table 1 highlights how defined deliverables influence the potential to work away from the traditional office spaces. If for example, supervisors have defined and communicated duties and goals which have to be fulfilled by their employees the remote working potential increases.

3.2.6 Mental Concentration

The sixth criterion is *mental concentration* (Olson, 1983; Pinsonneault & Boisvert, 2001). The last criterion targets the need of a person carrying out the task to be mentally concentrated for a better

part of the time. Research shows the necessity of high mental concentration for longer periods of time on the job also favors working in a remote work setting (Olson, 1983; Pinsonneault & Boisvert, 2001). In an extremely busy, loud, disturbing, or unstable work environment an individual might not be capable of doing the task correctly or might need much more time to do so. In a remote setting, when being for instance at home, very complex tasks can be performed without being constantly distracted by external disturbance factors similar to, for example, working in a single office. The need for mental concentration can indicate a work context where a person has to isolate himself/herself from others in order to being able to work. Table 1 shows how mental concentration and the potential to work remotely are related. If the need to concentrate is high the potential to work in a remote setting becomes higher as well.

4. Educational Services Sector Value Chains

Section four aims to provide additional theoretical knowledge needed in order to later on analyze and interpret real-world occupational and industry data. This part of the thesis explains the purpose and content of Porters Value Chain which can be used to display customized value chains of many different industries. Thereafter, the educational services sector is presented as this sector and the most important industries within this sector are taken as an example to analyze the remote working potential of a whole industry including various occupations which are sorted by their affiliation to the different value chain activities.

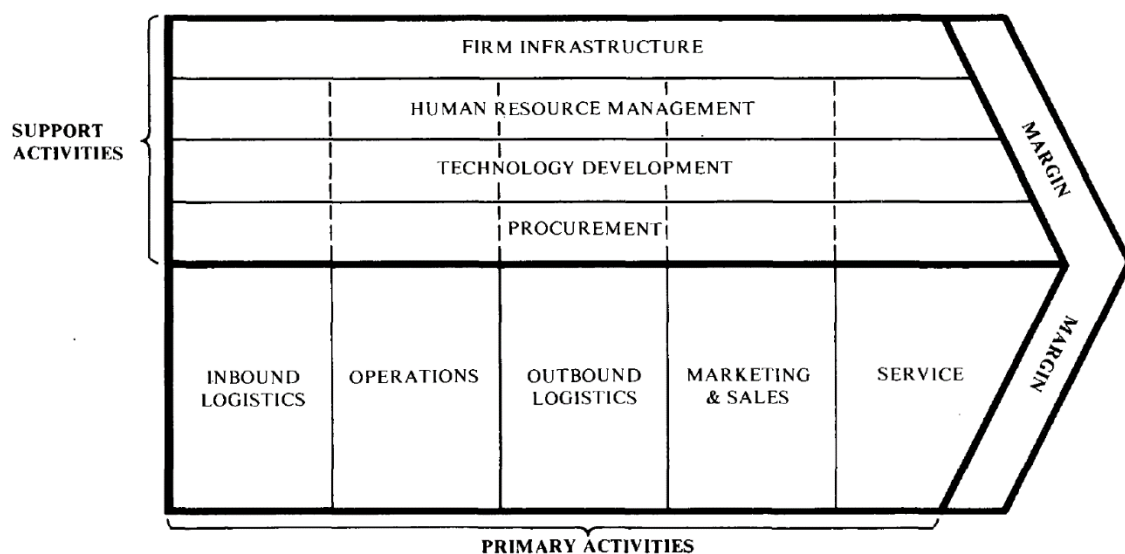
4.1 Value Chain Theory

In his book *Competitive Advantage: Creating and Sustaining Superior Performance* firstly published in 1985, Porter introduces a framework, called the generic value chain, which is highly relevant and popular until today. Figure 1 shows Porter's generic value chain including different value adding activities that can be applied to all kind of firms no matter of the revenue, product or service offering, number of employees, etc. Moreover, the value chain can be applied to analyze a business unit, a

firm, an industry or a whole sector (Zamora, 2016). The purpose of the value chain, according to Porter (1998), is to disaggregate all strategically relevant activities, for instance of a specific firm, allowing to better understand the specific costs as well as already existing or not yet used sources of differentiation. It is not enough to look at a firm as whole to identify its competitive advantage but essential to look at activities separately and to analyze the series of activities performed (Ensign, 2001; Kumar & PV, 2016). In order to gain competitive advantage these critical activities need to be performed at a lower cost or simply better compared to other players operating in the same market (Porter, 1998). “The nature of Value Chain depends on the nature of the industry, thus the nature of a Value Chain for a manufacturing company, a service company, and a nonprofit organization will each be different” (Simatupang, Piboonrungrroj & Williams, 2017, p.5).

Figure 1

Porter’s Generic Value Chain



Note: Primary activities and support activities of the generic value chain. Reprinted from *Competitive Advantage : creating and sustaining superior performance; with a new introduction* (p. 37), by M. E. Porter, 1998, Free Press. Copyright [1985] by Michael E. Porter.

Later on, the adapted value chains within the educational services sector will be described. Nevertheless, in order to properly understand the value chains of the educational sector, the generic

value chain, as it was firstly introduced by Porter, has to be explained since this framework is the basis for all other more specific value chains. According to Porter value chain activities can be classified into two separate types which are 1) *Primary Activities* and 2) *Support Activities*. In general, “identifying value activities requires the isolation of activities that are technologically and strategically distinct” (Porter, 1998, p.39). The following two sub-sections outline how Porter divided and grouped these activities to be generally applicable for future research.

4.1.1 Primary Activities

The distinction between primary and support activities can be achieved by examining the way how activities add value. Primary activities directly contribute to value adding when producing goods or providing a service (Kumar & PV, 2016). Porter (1998) states five generic categories included in the primary activities of any firm which in turn contain distinct activities depending on the specific firm strategy and industry. The generic categories, shown in Figure 1, are 1) inbound logistics, 2) operations, 3) outbound logistics, 4) marketing & sales and 5) service.

Inbound logistics include activities necessary to receive, store and disseminate inputs to the final product which can be for example handling of material, warehousing, controlling inventory, scheduling vehicles and making returns (Porter, 1998). The first category is especially important for manufacturers and less important for service firms as a service in the end is not a tangible product made out of materials and stored in a warehouse (Simatupang et al., 2017).

Operations refer to activities that transform inputs into the final product like “machining, packaging, assembly equipment maintenance, testing, printing, and facility operations” (Porter, 1998, p.40).

Outbound logistics refer to everything ranging from collection, storage and distribution, meaning the flow of products from the company to the customer (Ernst & Kamrad, 2000). Possible activities include the warehousing of finished goods, handling of material, operations of delivery vehicles, order processing or scheduling (Porter, 1998). Nowadays strategic planning does not only mean to improve manufacturing or marketing but an essential part is to recognize efficiencies possible in logistics (Ernst & Kamrad, 2000).

The fourth category marketing and sales refers to all activities resulting in the provision of a means for a buyer to purchase the product or service and triggering him/her to really go through with the purchase. Activities falling in this category are “advertising, promotion, sales force, quoting, channel selection, channel relations, and pricing” (Porter, 1998, p.40).

The last category mentioned by Porter is service. Activities included in service aim to maintain or enhance the value of the final product or service (Dubey et al., 2020). Examples of service activities are: installing or repairing a product, conducting a training, supplying parts, product adjustment or customer service (Dubey et al., 2020; Porter, 1998).

Depending on the industry the importance of these five different primary activities can vary heavily (Armistead & Clark, 1993). “For a service firm providing the service on its premises such as a restaurant or retailer, outbound logistics may be largely nonexistent and operations the vital category” (Porter, 1998, p.40). When looking at the educational sector which is analyzed later on in this thesis, this is an important insight.

4.1.2 Support Activities

Support activities, in contrast to primary activities, have indirect effects on the value of the final product (Kumar & PV, 2016). The four support activities, shown in Figure 1, are 1) procurement, 2) technology development, 3) human resource management and 4) firm infrastructure.

Procurement, when it comes to support activities, is the function that purchases inputs like raw materials or supplies, but also assets like machines, equipment and buildings (Porter, 1998). Procurement can be found in different parts of a firm depending on the item that needs to be procured. While the traditional purchasing department might be responsible for raw materials, a plant manager acquires a special machine, an office manager selects temporary help and the CEO procures strategic consulting (Porter, 1998).

Technology development includes various activities that can be aggregated into efforts to improve the product or service and the process. Possible activities range from “basic research, product design to media research, process equipment design, and servicing procedures” (Porter, 1998, p.42).

Human resource management evolves around all types of activities concerning personnel and include recruiting and hiring as well as training, development and compensation according to Porter.

The last support activity describes firm infrastructure. This category occurs many times at both corporate and business unit level and, unlike other support activities, supports the entire chain rather than individual activities (Porter, 1998). More concrete examples are activities such as finance, accounting or general management (Flanagan, Lepisto & Ofstein, 2018).

The margin, finally, is the difference between the total value added by performing all activities and the costs which occur in the process (Feller, Shunk, & Callarman, 2006).

4.2 Educational Services Sector

This thesis takes the educational services sector as an example to later on analyze the remote working potential of different industries. The North American Industry Classification System (NAICS) groups establishments with similar production process into industries, thereby covering all economic activities and creating overall 20 sectors and 1,057 different industries (U.S. Census Bureau, 2017). According to the NAICS definition “the Educational Services sector comprises establishments that provide instruction and training in a wide variety of subjects. This instruction and training is provided by specialized establishments, such as schools, colleges, universities, and training centers” (U.S. Census Bureau, 2017). The service is usually delivered by instructors or teachers. The instruction itself can be imparted in diverse settings, such as the workplace, the home, or educational institutions and through different means. Industries within the educational services sector are among others elementary and secondary schools, junior colleges and colleges, universities, and professional schools.

4.2.1 Literature Review of Educational Services Sector Value Chains

Porter’s generic value chain requires activities to be segregated into discrete elements which interferes with the service sector at times being characterized as intangible, inseparable, inconsistent and non-inventory (Pathak & Pathak, 2010). Some studies and earlier research rejected Porter’s value chain and propose alternative chains for the educational services sector due to these four

characteristics and the argument that inbound and outbound logistics are components which cannot be applied (Makkar, Gabriel & Tripathi, 2008). However, the educational services sector is facing a changing environment due to an increase in international competition and is under intense pressure to create value (Dorri, Yarmohammadian, & Nadi, 2012; Pathak & Pathak, 2010; Sison, Pablo, & E-college Team, 2000). This recent trend facilitates to “unbundle the academic process into discrete activities (which have well developed measures); to distinguish between value driving and other activities; to configure the value chain as per the Porter’s model; and to explore critical linkages between activities” (Pathak & Pathak, 2010, p.167).

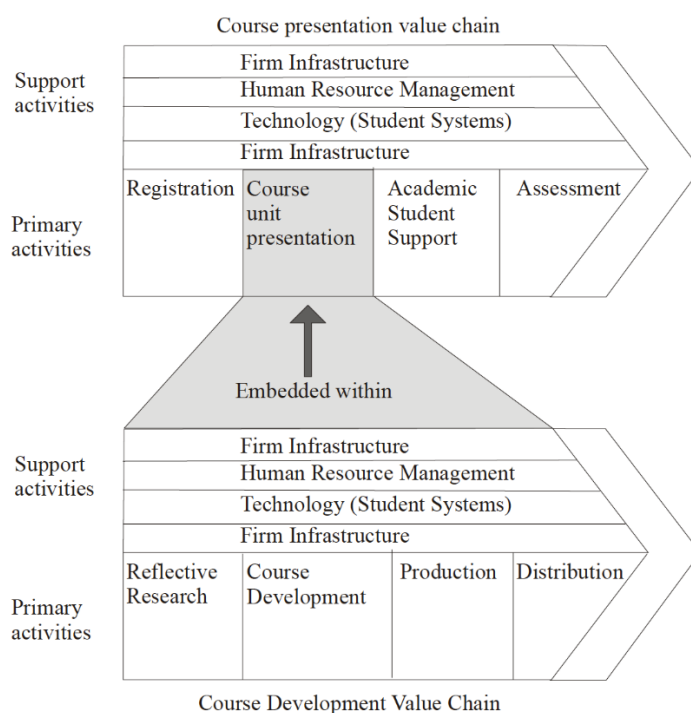
Figure 2 displays the educational value chain determined by Van der Merwe and Cronjé (2004) including the two possible outcomes of the educational environment, course development and course presentation. According to the two authors, the course development and presentation value chain both consist of Porter’s support process. The primary activities of course development are reflective research, course development, production and distribution. Moreover, this value chain is directly embedded within the course presentation value chain, consisting of again four primary activities, registration, course unit presentation, academic student support and assessment (Merwe & Cronjé, 2004).

However, the changing external environment stretched education beyond the mere exchange of value, for instance course development and course presentation, between teacher and taught. “A large chunk of the academic’s role has been disintegrated and the thrust on teaching and learning has been replaced by other value-creating activities” (Pathak & Pathak, 2010, p.167). Student enrolments, funds, assessments, research & development, trainings, alumni support, or technology significantly contribute to the value creation (Hutaibat, 2011; Pathak & Pathak, 2010; Sison et al., 2000; Xuan, & Yunchen, 2015).

Not only universities are affected by this change. When looking at different ratings of elementary and secondary schools, criteria such as reputation, course selection, success, partners, alumni programs, etc. play here an important role as well (EWS, 2021; TBS, 2021; The New School, 2021; Xuan, & Yunchen, 2015).

Figure 2

Course Development and Course Presentation Value Chain



Note: Course development value chain being embedded within the course presentation value chain.

Reprinted from *The educational value chain as a modelling tool in re-engineering efforts* (p.8), by A. V. Merwe and J. C. Cronjé, 2004, ISICT. Copyright [2004] by Alta van der Merwe and Johannes Cronjé.

Educational services can be counted to an “internationally competitive sector, which requires identifying, acquiring and focussing resources in order to maintain a top research and education position in the global market” (Hutaibat, 2011, p.210). While educational design and delivery clearly add most value expanding relationships with other parties such as parents, schools from which students come or to which students will go, employers or alumni are becoming more and more important (Sison et al., 2000). In the following the adapted value chains are presented.

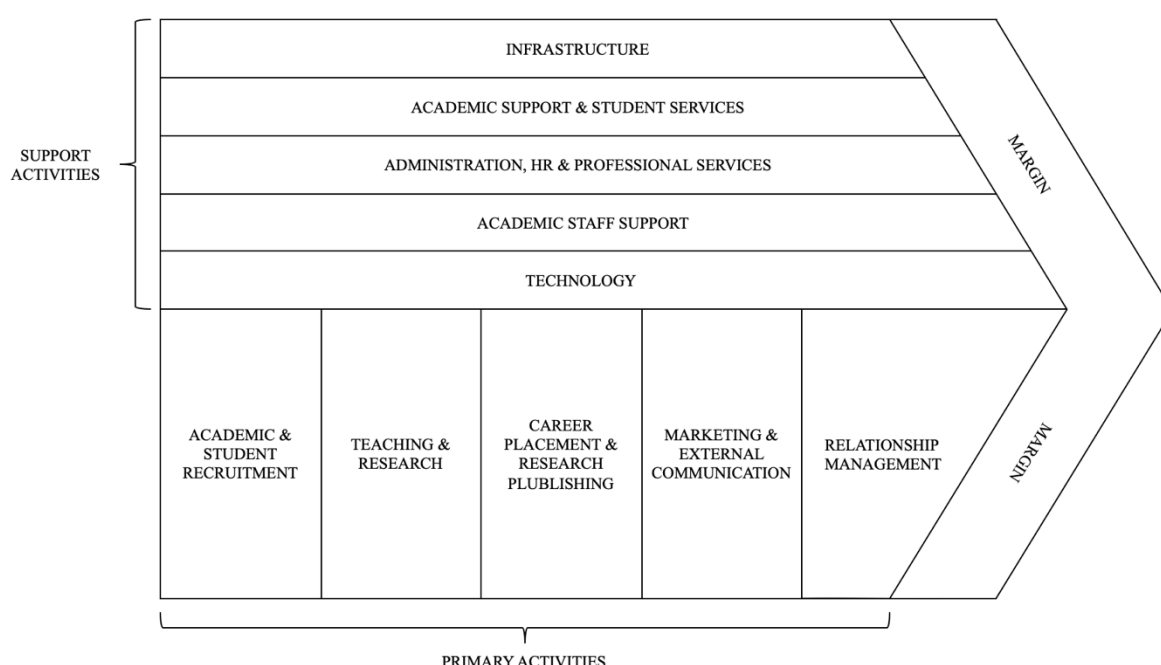
4.2.2 Adapted Value Chains within the Educational Services Sector

Due to the fact that the sector of interest is a service sector, Porter’s generic value chain needs to be adjusted in terms of content since, for example, classical input factors like raw materials cannot be

applied here. Nevertheless, the value chains within the educational services sector have been the center of attention of many different studies and authors make it possible to merge their findings into applicable value chains which later on can be used when focusing on the remote working potential of this specific sector. Figure 3 displays the value chain for colleges, universities and professional schools including five primary activities and five support activities.

Figure 3

Value Chain for Colleges, Universities, and Professional Schools



Note: The value chain includes five primary activities and five support activities. Adapted from *A Critical Appreciation of the Uses for Strategic Management Thinking, Systems and Techniques in British Universities* (p.304), by R. E. Groves , M. Pendlebury and D: Stiles, 1997; *Value Chain for Strategic Management Accounting in Higher Education* (p.218), by K. Hutaibat, 2011; *Reconfiguring the higher education value chain* (p.170), by V. Pathak and K. Pathak, 2010.

Primary activities include 1) *Academic and Student Recruitment*, 2) *Teaching and Research*, 3) *Career Placement and Research Publishing*, 4) *Marketing and External Communication* and 5)

Relationship Management, whereas support activities are composed of 1) *Infrastructure*, 2) *Academic Support and Student Services*, 3) *Administration, Human Resources (HR) and Professional Services*, 4) *Academic Staff Support* and 5) *Technology* (Groves, Pendlebury & Stiles, 1997; Hutaibat, 2011; Pathak & Pathak, 2010). Due to the fact that value chain activities within the industries of interest in this thesis differ only in some areas the value chain of colleges, universities and professional schools is going to be explained in more detail, whereas for the other industry only the deviating activities are highlighted.

The first primary activity, academic and student recruitment, represents Porter's inbound logistics where inputs to the final product are received. As mentioned above, this sector is a service sector and does not follow the same processes as traditional manufacturing company in the manufacturing sector. Intellectual capital being the core competence here has the consequence that the recruitment of teaching and research staff as well as student enrolment replace activities being found in the traditional inbound logistics. The second cluster of activities, known as operations, is replaced by teaching and research. The transformation of inputs to the final product can here be seen as for instance, student learning, development of teaching and research skills, topic identification, funding arrangements, tutoring and supervision, etc. (Groves et al., 1997; Hutaibat, 2011; Pathak & Pathak, 2010). This is followed by the third cluster career placement and research publishing, referred to as outbound logistics in Porter's generic value chain. The goal here is to place the final product in the market in the best possible manner at the least cost and time so that the return on investment is maximized meaning that for example publications need to be achieved fast and in the best academic journals possible (Pathak & Pathak, 2010). This part of the value chain is influencing the rankings between institutions therefore becoming increasingly important and placing the focus on, for instance, network development. The fourth primary activity is marketing and external communication encompassing brand and market development which can be achieved by hosting open days, advertising the institution in print or social media or having agents promote overseas (Groves et al., 1997; Pathak & Pathak, 2010). Finally, relationship management with existing and future clients, recruiters and alumni is becoming part of the value chain since this maintains and enhances the value of the service.

Support activities have been adopted as well, in order to properly reflect the specific conditions in the educational services sector. First, infrastructure exists to support the entire value chain and includes for instance general management, finance or accounting services all rendered by the center (Hutaibat, 2011). Second, academic support and student services which can be the library, IT services, student accommodation, academic training courses, etc. (Hutaibat, 2011; Pathak & Pathak, 2010). Third, administration, human resource and professional services, activities performed by non-academic staff, address admissions, HR policies, contract creation, estates, etc. Fourth, academic staff support can be for example a mentoring system for research and teaching but also learning and teaching trainings (Hutaibat, 2011). And fifth, technology no longer being a mere support service enables innovation and increased flexibility in academic delivery (Pathak & Pathak, 2010). “Through connecting to different educational technology platforms using a range of networks, hardware, and software applications, people are now able to study their chosen educational programmes anytime, anywhere” (Poon, 2006, p.86).

The value chain of elementary and secondary schools resembles the value chain presented above, however, deviates in some activities (see Appendix A). Adoptions need to be made in primary and support activities. When it comes to elementary and secondary schools services are not only offered to students, but parents as well. The support activity academic support, student and parent counseling accounts for this. Moreover, in elementary and secondary schools focus is not that much on research, which is why the second primary activity needs to be altered to teaching and special education. Lastly, the third primary activity in the industry elementary and secondary schools is preparation for later grades and career placement also due to the fact that research is not a driving force when it comes to value creation in this industry, but mostly succeeding to advance in higher grades and making a successful start in the job market. (Groves et al., 1997; Hutaibat, 2011; Pathak & Pathak, 2010; TBS, 2021; The New School, 2021)

5. Methodology

The fifth section of the thesis explains the methods used to conduct the research, thereby allowing the reader to properly evaluate the reliability and validity of the research itself. Since the aim of this thesis is to objectively evaluate the remote working potential of a whole sector methods applied in the thesis need to be thoroughly explained. Alleged experts working at McKinsey, for example, analyzed the remote working potential of different sectors by evaluating different activities within occupations at their own discretion and state that people within the education sector can perform their jobs only 33% – 69% of the time remotely (Lund, Madgavr, Manyia & Smit, 2021). Another attempt was made by authors who “made an educated guess at the start of the pandemic about how remote work would affect some occupations and not others” (Greenstein, 2021, p.111). This was based on closely reading the Occupational Information Network and, here as well, evaluating occupations by defining a set of conditions and knock-out criteria themselves which led to 83% of jobs in the educational sector which can be done at home (Dingel & Neiman, 2020).

For this thesis secondary occupational data has been carefully selected in order to objectively and transparently evaluate the remote working potential of the educational services sector. The theoretical foundation has been laid in previous sections of this thesis and a summary table of remote working criteria has been established. In order to investigate the remote working potential of the selected sector, the most suitable approach was the use of secondary quantitative data to generalize results to a wider population compared to limited generalizability when, for instance, conducting a defined number of interviews. Furthermore, the research approach needs to be applicable to any type of industry, as the educational services sector is an example of how the analysis can be done, and executed by someone else thereby fostering the use of data which has been collected for all industries in the same way. Reproducibility and applicability to other industries is key when aiming to objectively evaluate the remote working potential.

5.1 Data Collection

Data collection was therefore done by searching suitable data sets including components such as industry classification, occupations and data providing information about the remote working potential. In the following the data sets used to create the analytics tool to calculate the remote working potential are presented. All data sets are freely accessible, additionally enabling reproducibility of results at any point in time.

5.1.1 Occupational Employment and Wage Statistics

The U.S. Bureau of Labor Statistics publishes an Occupational Employment and Wage Statistics (OEWS) survey every year in May that includes, among other things, the NAICS code for the given industry, the 6-digit Standard Occupational Classification (SOC) code or OEWS-specific code for the occupation and the estimated total employment rounded to the nearest 10 (excludes self-employed). The OEWS program conducts a survey every six months, including approximately 180,000 establishments, to generate data on employment and wages for about 800 occupations and for 415 industry classifications at the U.S. national level. For this thesis the latest survey has been used being the OEWS data of May 2020.

5.1.2 Work Context

The Occupational Information Network (O*NET) provides a database containing various files which include variables describing work and worker characteristics covering the entire U.S. economy. The O*NET data collection program makes quarterly updates on the worker and job-oriented data categories. The O*NET Work Context file holds information on physical and social factors that influence the nature of work. These factors, or work context categories, will later on be matched to the criteria found in literature influencing the remote working potential of an occupation and therefore of a whole industry. The various work context categories are given for each occupation and rated by people performing the specific occupation. This creates an extensive data set including the ratings for every work context category and every O*NET-SOC occupation. Moreover, the

percentage distribution of the respondents' answers is available for each category as well. The sample size varies between 12 and 82 participants depending on the occupation.

5.1.3 Work Context Categories

Additionally, the O*NET Work Context Categories file gives valuable insights on the scale used to evaluate the physical and social factors and the specific response options. The work context categories used to match the criteria found in literature all have five possible responses which are also given a numerical score in order to analyze the data (see Appendix Table B1 for exemplary work context categories).

5.1.4 Content Model Reference

The O*NET Content Model Reference file offers the concrete formulation of the questions that have been posed to the individual survey participants when evaluating their specific work context. The more detailed description has to be considered to evaluate the suitability for a work context category to be matched to a literature criterion to avoid mismatching (see Appendix Table B2 for the content model references of exemplary physical factors).

5.1.5 Task Statements

The Task Statements file provided by the O*NET program contains the different tasks associated with each O*NET-SOC occupation. Furthermore, the individual tasks of an occupation are sorted by relevance allowing to use the task statements to assign an occupation to the correct value chain activities. The file holds information on core tasks and supplemental tasks. The relevance of the supplemental tasks is however extremely low, which makes the core tasks the basis for evaluating the classification in the value chain (see Appendix Table B3 for the task statements of an exemplary occupation).

5.2 Method of Analysis

This section highlights how the collected data has been processed and analyzed. After finding all necessary data to map the remote working potential, the data sets needed to be filtered and merged to derive the remote working potential for the specific sector. As an example of how the analysis can be performed for diverse sectors, the educational services sector has been chosen. For the purpose of the thesis, Microsoft Excel serves as the software to build an analytics tool to evaluate the remote working potential of the educational services sector.

The overall goal was to create a summary table for the educational services sector which displays the specific remote working potential for the individual value chain activities within the sector and a combined score to verify or falsify the estimates done by the parties mentioned above. According to the Occupational Employment and Wage Statistics provided by the U.S. Bureau of Labor Statistics the educational services sector, represented by the NAICS code 61, consists of seven industries and employs a total of 12,740,960 people. For the analysis done in this thesis the industries with the biggest total employment were taken in order to avoid a disproportionately high workload but at the same time to guarantee generalizability as far as possible. Elementary and secondary schools, NAICS code 6111 with a total employment of 8,243,290, and colleges, universities, and professional schools, NAICS code 6113 with a total employment of 3,033,530, make up 89% of the whole sector (see Appendix Table B4) and will thereafter represent sector 61.

All occupations included in these two industries had to be sorted into the respective value chain activities which is why occupations with a very small total employment were filtered out intending to reduce effort but still getting accurate results when calculating the remote working potential weighted by total employment. For this analysis, 134 occupations for elementary and secondary schools, resulting in 92% of the original total employment, and 140 occupations for colleges, universities, and professional schools, resulting in 87% of the original total employment, were taken into account (see Appendix Table D1 and D2). For each industry individually, occupations were sorted into the particular value chain activities using the O*NET task statements. Occupations can be mapped to more than one value chain activity depending on the listed core tasks. A successful

merging of data sets could be achieved due to the fact that the U.S. Bureau of Labor Statistics as well as the Occupational Information Network use the 6-digit Standard Occupational Classification code. The O*NET work context categories, being physical and social factors that influence the nature of work, were selected and merged to represent the remote working criteria that are based on literature insights (see Appendix Table B5 for the content model reference descriptions of the work context categories used). Overall, 18 work context categories could be matched and merged into the six remote working criteria. Due to the fact that secondary data was used, the questions posed in the O*NET survey were not always completely suited for one work context category to represent a criterion alone. This is the reason why all data categories fitting into one of a literature-based criteria were taken and merged to create a value as representative as possible. Table 2 shows the 18 O*NET work context categories used. Depending on the suitability of O*NET categories one to nine categories could be matched to each of the six remote working criteria indicating the remote working potential of an occupation.

Each occupation within the industry 6111 and 6113 was allocated to one or more value chain activities and furthermore connected to 18 work context categories in order to calculate the remote working potential resulting of the mean values of the different work context categories for the specific occupation. Depending on the positive or negative impact of the category on the remote working potential, the mean values were inverted or kept with their original values. Since all categories used follow a five item scale, the mean values could be taken without having to be altered to be comparable when it comes to their degree of influence on the remote working potential of an occupation. Every item is assigned with a value ranging from one to five. The final average value resulting from the answers of survey participants was converted into a key figure that ranges between the values zero, no potential to work remotely, and one, full potential to work remotely. This conversion allows for a direct comparison of results since it is the scale used in reports which are supposed to be challenged.

Table 2*O*NET Work Context Categories matching Remote Working Criteria based on Literature*

#	Remote Working Criteria based on Literature	Matching Work Context Categories
1	Physical Requirements	Indoors, Not Environmentally Controlled; Outdoors, Exposed to Weather; Outdoors, Under Cover; In an Open Vehicle or Equipment; In an Enclosed Vehicle or Equipment; Physical Proximity; Spend Time Using Your Hands to Handle, Control, or Feel Objects, Tools, or Controls; Wear Common Protective or Safety Equipment such as Safety Shoes, Glasses, Gloves, Hearing Protection, Hard Hats, or Life Jackets; Wear Specialized Protective or Safety Equipment such as Breathing Apparatus, Safety Harness, Full Protection Suits, or Radiation Protection
2	Face-to-face Contact	Face-to-Face Discussions
3	Use of Computer and/or Telecommunication Technology	Telephone; Electronic Mail
4	Job Autonomy	Freedom to Make Decisions; Structured versus Unstructured Work
5	Defined Deliverables	Importance of Repeating Same Tasks; Time Pressure
6	Mental Concentration	Importance of Being Exact or Accurate; Degree of Automation

In an effort to not only analyze the average remote working potential of an industry but also a more optimistic outcome, a best-case scenario was calculated for the two industries within the educational services sector. Of course, taking the mean values creates a more realistic picture, however, looking at the minimum and maximum values, depending on the impact, can produce interesting results

helping to, for instance, identify opportunities for improvement. The remote working potential for the best-case scenarios was calculated by considering the most favorable answer given by any of the respondents of the occupation in question. To test for extreme outliers significantly distorting the results a five, as well as a ten, percent threshold was included ensuring to take the most optimistic answer given by at least five or ten percent of respondents respectively. Since the test results did only vary by a few percentage points, the actual most optimistic answers were included in the final best-case scenario analyses.

In general, this methodology offers a highly transparent, data-driven and freely accessible way to analyze the remote working potential of diverse industries. The work context categories display survey results of people performing the occupation of interest, thereby creating a remote working potential not based on subjective assessments and personal opinions, but based on a data-driven objective evaluation of criteria found in literature and different studies.

6. Results

After the collection and analysis of data the most important findings regarding the remote working potential, also referred to as RWP, are being displayed in this section of the thesis. In order to illustrate the main findings different tables were created allowing to concisely report results. First, the weighted remote working potential of industry 6111 and 6113 are presented including the average as well as the best-case scenario. Second, breaking up the average remote working potential into the six components allows to study specific opportunities for improvement more closely. Third, the combined remote working potential for the educational services sector is displayed.

6.1 Remote Working Potential for Industries Presented Separately

As Table 3 indicates the average weighted remote working potential for industry 6111, elementary and secondary schools, is 0.70. The lowest potential to work remotely have occupations within the support activity administration, HR & professional services with only 0.68. In addition, the standard

deviation in this support activity is highest compared to all others in the industry. This means that the RWP of individual occupations in the activity lies on average 0.058 from the mean value. The variability in this case is much higher than, for instance, for the primary activity relationship management which has the lowest standard deviation of only 0.012. In the industry 6111 the average RWP ranges from 0.68, as already mentioned above, up to 0.76 being the support activity infrastructure. The minimum as well as maximum potential, therefore, both appear in support activities.

Table 3

Weighted Remote Working Potential for Elementary and Secondary Schools (NAICS 6111)

Value Chain Activities		6111 Average RWP/ Standard Deviation	6111 Best-Case RWP
Primary Activities	Academic & Student Recruitment	0.74 / 0.016	0.96
	Teaching & Special Education	0.70 / 0.037	0.96
	Preparation for later Grades & Career Placement	0.70 / 0.014	0.95
	Marketing & External Communication	0.75 / 0.016	0.94
	Relationship Management	0.74 / 0.012	0.96
Support Activities	Infrastructure	0.76 / 0.015	0.90
	Academic Support, Student & Parent Counseling	0.70 / 0.028	0.95
	Administration, HR & Professional Services	0.68 / 0.058	0.94
	Academic Staff Support	0.73 / 0.015	0.95
	Technology	0.74 / 0.015	0.93
Total Average RWP		0.70	0.94

Note: RWP = Remote Working Potential; weighted by total employment.

When looking at primary and support activities separately the range becomes much smaller for the former. Within primary activities the potential only varies from 0.70 to 0.75. Within all primary

activities the RWP standard deviation for teaching and special education occupations is highest and lies on average 0.037 from its mean of 0.70. This as well indicates a higher variability revealing a larger gap among teaching and special education occupations. Among these primary activities teaching and special education as well as preparation for later grades and career placement, both yield the lowest RWP of 0.70. By contrast, all other primary activities have a RWP of at least 0.74. The best-case scenario offers an optimist view on the potential to work remotely in this industry. The overall RWP is 0.94, thus pointing out a 0.24 potential improvement. In this scenario every activity was heavily boosted, nevertheless, the biggest improvement would be for teaching and special education and administration, HR & professional services since both increased by 0.26.

Table 4 presents the weighted RWP for colleges, universities, and professional schools, NAICS code 6113. Here as well, the total employment within an occupation determined the weighting when it comes to the calculation of the average activity RWP. The colleges, universities, and professional schools RWP is higher compared to the industry 6111, presented above, and amounts to 0.73. Furthermore, the RWP difference between activities decreased to 0.05. Again, the lowest RWP and highest standard deviation has the support activity administration, HR and professional services with 0.71 and 0.060 respectively. The highest potential and at the same time lowest standard deviation has the primary activity marketing and external communication with 0.76 and 0.012. Occupations within infrastructure yield again a very high RWP of 0.75 and on average do not vary a lot when looking at the standard deviation of 0.013. Teaching and research occupations on the other hand have a relatively high standard deviation of 0.023. Although less than above, support activities vary again more when it comes to the RWP compared to primary activities.

The best-case scenario with an average RWP of 0.93 is slightly worse compared to industry 6111, however still offers a 0.20 potential improvement. Marketing and external communication as well as infrastructure yield only a maximum of 0.89 which is far below average, however still an indication for great future improvement opportunities. Administration, HR and professional services have a prospect of 0.23 increase in the activities RWP. In an optimistic calculation both industries have a remote working potential above 0.90 being very close the optimum of 1.0, a full remote working potential.

Table 4

*Weighted Remote Working Potential for Colleges, Universities, and Professional Schools
(NAICS 6113)*

Value Chain Activities		6113 Average RWP / Standard Deviation	6113 Best-Case RWP
Primary Activities	Academic & Student Recruitment	0.74 / 0.016	0.93
	Teaching & Research	0.73 / 0.023	0.95
	Career Placement & Research Publishing	0.74 / 0.022	0.95
	Marketing & External Communication	0.76 / 0.012	0.89
	Relationship Management	0.74 / 0.019	0.95
Support Activities	Infrastructure	0.75 / 0.013	0.89
	Academic Support & Student Services	0.74 / 0.019	0.95
	Administration, HR & Professional Services	0.71 / 0.060	0.94
	Academic Staff Support	0.73 / 0.013	0.94
	Technology	0.74 / 0.021	0.95
Total Average RWP		0.73	0.93

Note: RWP = Remote Working Potential; weighted by total employment.

6.2. Comparison Between Criteria

Table 3 and 4 already give first insights into the differences between activities. Nevertheless, a more detailed analysis is needed in order to properly evaluate the remote working potential of both industries. Only when looking at the individual remote working criteria separately opportunities for improvement and disruptive factors can be revealed.

Table 5 shows the weighted remote working potential matrix for elementary and secondary schools, NAICS code 6111. The table includes all value chain activities, sorted by primary and support

activities, and all remote working criteria listed separately. Isolating criteria allows a much deeper insight into the vast RWP differences within activities themselves.

When looking at the average remote working potential of occupations sorted by criteria for elementary and secondary schools face-to-face contact with on average 0.26 RWP for all occupations has by far the lowest potential whereas the criterion use of computer and/or telecommunication technology with an average RWP of 0.90 for all occupations surpasses all other criteria in this industry. The other four do not vary as heavily from each other as the two mentioned before. The criterion physical requirements has an average RWP of 0.84 for all occupations, job autonomy of 0.84, defined deliverables of 0.69 and mental concentration of 0.81. Diving into face-to-face contact a bit deeper, activities differ not insignificantly. The support activity administration, HR and professional services has the highest RWP within the criterion, being 0.30, whereas the primary activity preparation for later grades and career placement displays only a RWP of 0.23. With regard to the use of computer and/or telecommunication technology the value chain activity administration, HR and professional services here reaches the worst RWP, being 0.72, and is therefore 0.18 below average. The primary activities academic and student recruitment as well as relationship management are second best and only slightly behind the support activity infrastructure with an extremely high RWP of 0.98 in this criterion. The RWP of the other four criteria also varies when comparing the different value chain activities, however, do not influence the overall RWP of the individual activity as much as the two described above. Administration, HR and professional services is lowest for both physical requirements and job autonomy. Looking at defined deliverables the RWP of teaching and special education is lowest, whereas for mental concentration the support activity technology has the smallest RWP.

Table 5

Weighted Remote Working Potential Matrix for Elementary and Secondary Schools (NAICS 6111)

Remote Working Criteria Value Chain Activities		Physical Requirements	Face-to-face Contact	Computer/Communication Technology	Job Autonomy	Defined Deliverables	Mental Concentration
Primary Activities	Academic & Student Recruitment	0.84	0.24	0.97	0.90	0.70	0.81
	Teaching & Special Education	0.84	0.25	0.82	0.83	0.63	0.81
	Preparation for later Grades & Career Placement	0.84	0.23	0.86	0.81	0.64	0.79
	Marketing & External Communication	0.84	0.28	0.92	0.85	0.76	0.86
	Relationship Management	0.83	0.24	0.97	0.89	0.69	0.82
Support Activities	Infrastructure	0.87	0.28	0.98	0.84	0.77	0.79
	Academic Support, Student & Parent Counseling	0.83	0.24	0.86	0.83	0.64	0.80
	Administration, HR & Professional Services	0.76	0.30	0.72	0.77	0.71	0.80
	Academic Staff Support	0.84	0.24	0.96	0.87	0.68	0.82
	Technology	0.86	0.27	0.96	0.85	0.72	0.77
Average RWP		0.84	0.26	0.90	0.84	0.69	0.81

Note: Weighted by total employment; RWP = Remote Working Potential.

Table 6 shows the weighted remote working potential matrix for colleges, universities, and professional schools, NAICS code 6113. Here as well all value chain activities and remote working criteria are listed separately in order to compare individual results. Similar to industry 6111 the lowest average RWP can be found when looking at the industry average RWP of occupations for face-to-face contact with 0.28. Nevertheless, for colleges, universities, and professional schools the value chain activities infrastructure, academic support and student services and academic staff support all yield a RWP of 0.30 or more in this criterion. The lowest result has the primary activity academic and student recruitment with a RWP of only 0.24. In this industry occupations clustered by the criteria physical requirements, job autonomy and the use of computer and/or telecommunication technology have the highest average RWP with 0.87, 0.88 and 0.91 respectively. In all of these three criteria the support activity administration, HR and professional services has the lowest RWP again. The most promising remote working potential, when looking at physical requirements, have the primary activities career placement and research publishing and relationship management with 0.89. Switching to the use of computer and/or telecommunication technology the highest RWP have the value chain activities marketing and external communication and infrastructure, whereas for the criterion job autonomy the primary activity academic and student recruitment yields the best RWP. Compared to industry 6111 the criteria defined deliverables and mental concentration have a little lower than average RWP of 0.68 and 0.80. Regarding defined deliverables, the primary activity teaching and research has the lowest RWP of 0.63. By contrast, marketing and external communication and administration, HR and professional services both yield a RWP of 0.75 in this criterion. When it comes to mental concentration academic staff support has the smallest RWP, whereas marketing and external communication again is highest among activities.

Table 6

Weighted Remote Working Potential Matrix for Colleges, Universities, and Professional Schools (NAICS 6113)

Remote Working Criteria Value Chain Activities		Physical Requirements	Face-to-face Contact	Computer/Communication Technology	Job Autonomy	Defined Deliverables	Mental Concentration
Primary Activities	Academic & Student Recruitment	0.88	0.24	0.91	0.93	0.64	0.82
	Teaching & Research	0.87	0.28	0.86	0.90	0.63	0.81
	Career Placement & Research Publishing	0.89	0.29	0.89	0.92	0.64	0.80
	Marketing & External Communication	0.84	0.27	0.96	0.88	0.75	0.83
	Relationship Management	0.89	0.28	0.90	0.92	0.64	0.81
Support Activities	Infrastructure	0.88	0.30	0.96	0.84	0.72	0.79
	Academic Support & Student Services	0.88	0.30	0.89	0.91	0.68	0.80
	Administration, HR & Professional Services	0.77	0.28	0.85	0.78	0.75	0.82
	Academic Staff Support	0.88	0.31	0.90	0.88	0.64	0.75
	Technology	0.87	0.28	0.95	0.82	0.73	0.77
Average RWP		0.87	0.28	0.91	0.88	0.68	0.80

Note: Weighted by total employment; RWP = Remote Working Potential.

6.3. Educational Services Sector Remote Working Potential

After having displayed the remote working potential of the two industries 6111 and 6113 within the educational services sector, NAICS code 61, as well as the individual results when listing all criteria separately, the RWP of the whole sector can be presented. Table 7 shows the weighted remote working potential and the best-case scenario RWP for the educational services sector.

Table 7

Weighted Remote Working Potential for the Educational Services Sector (NAICS 61)

Value Chain Activities		61 Average RWP	61 Best-Case RWP
Primary Activities	Academic & Student Recruitment	0.74	0.94
	Teaching, Special Education & Research	0.70	0.95
	Career Placement, Preparation & Research Publishing	0.71	0.95
	Marketing & External Communication	0.76	0.92
	Relationship Management	0.74	0.95
Support Activities	Infrastructure	0.75	0.89
	Academic Support, Student & Parent Counseling/ Services	0.70	0.95
	Administration, HR & Professional Services	0.69	0.94
	Academic Staff Support	0.73	0.94
	Technology	0.74	0.94
Total Average RWP		0.71	0.94

Note: RWP = Remote Working Potential; weighted by total employment.

The total average RWP for sector 61 is 0.71. The primary activity marketing and external communication has the highest RWP, being 0.76, among all value chain activities, followed shortly after by the support activity infrastructure having a RWP of 0.75. The aggregated values shown in Table 7 are weighted by total employment as well, therefore reflecting the RWP of the individual industries within these activities. The lowest RWP, being 0.69, has again the support activity

administration, HR and professional services. The average sector RWP in this activity deviates only slightly from the individual results of industry 6111 and industry 6113 already. The three activities teaching, career placement and academic support for students or parents, having a sector average RWP of 0.70, 0.71 and 0.70, do not display the individual industry potentials equally accurately. Industry 6111 has a RWP of 0.70 for all three activities, whereas industry 6113 has a not negligibly higher RWP for these activities of 0.73, 0.74 and 0.74 respectively (see Table 3 and 4). The sector RWP, in some cases, covers up deviating individual industry results. The remaining two primary activities academic and student recruitment and relationship management, both having an average sector RWP of 0.74, as well as the two support activities academic staff support and technology, yielding an average sector RWP of 0.73 and 0.74, reflect the individual results of industries appropriately. Looking at the best-case scenario of sector 61 the overall remote working potential is 0.94 which opens a gap of 0.23 when comparing it to the sector average. Value chain activities vary in this scenario from a minimum value of 0.89 for infrastructure to maximum values of 0.95 for teaching, career placement, relationship management and academic support for students or parents. The primary activity concerning teaching and the support activities academic support for students and parents and administration, HR and professional services have the highest possible improvement of 0.25. Marketing and external communication and infrastructure can only improve by 0.16 and 0.14. Nevertheless, the best-case scenario points out a significant increase in RWP for all value chain activities and presents a near-optimum remote working potential for the educational services sector.

7. Discussion

The aggregated results for both industries and the educational services sector presented above can only provide a very general view. Many interesting and important insights get lost merging criteria to display a summary. Of course, the primary goal is to compare aggregated results to the remote working potential analysis of other authors who did not disclose their approach or made a subjective evaluation in order to contrast this with a sound analysis. Nonetheless, this thesis is supposed to set an example how to evaluate the remote working potential of a whole sector properly and at the same

time to give valuable insights on a more detailed level to avoid mismatching. This is the reason why the more detailed Tables 5 and 6 have been included as well. Looking at value chain activities and remote working criteria separately allows to point out differences instead of falsely generalizing the remote working potential even when it does not hold for every value chain activity, let alone occupation within the sector, the same way.

The first step, however, is to compare the aggregated remote working potential calculated in this thesis with the ones published in reports and other papers. The strategy consultancy McKinsey, for instance, claims in their report that jobs within the education sector can only be performed 33% of the time remotely, 69% of the time at maximum (Lund, Madgav, Manyia & Smit, 2021). The two authors Dingel and Neiman (2020), by contrast, assume that 83% of these jobs can be done at home thereby raising the bar substantially. Even though percentage share of time and percentage share of jobs are different units of measurement these percentages indicate different remote working potentials for the sector. McKinsey states that on average all jobs within the sector can be done 33%-69% of the time at home which can be considered low to medium overall potential. This implies that in case of emergency, as for instance a global pandemic, the sector would not be able to switch to a remote setting since one to two third of the time people would have to return to their official workplace location in order to perform their jobs. The other proposed figure from Dingel and Neiman says that 83% of jobs can be fully performed remotely, whereas 17% of jobs cannot be performed at home at all. This extreme point of view would mean a 0.83 remote working potential for the whole sector, however, consisting of individual remote working potentials of either 0, not being able to work remotely at all, or 1, being able to work remotely completely. This analysis displays an unrealistic picture and disguises opportunities for improvement. Thresholds, determining whether occupations can be performed remotely or not, were chosen by the authors and not based on prior studies or theory.

The approach taken in this thesis aims to assess the suitability of occupations to be performed remotely not subjectively, by alleged experts or authors evaluating occupation at their own discretion, but objectively, by survey participants performing the occupation of interest who rated the specific work context themselves. Intentionally knock-out criteria have not been included in order

to avoid subjective interference with results. A key figure indicating the remote working potential which can be interpreted has been derived. This resulted in an average weighted remote working potential for the educational services sector of 0.71 and a best-case remote working potential of 0.94. This means that the work context of people fulfilling occupations within this sector is on average suitable at 71%, at 94% in the best-case, in order for the tasks to be performed remotely. Especially, when looking at the best-case scenario the remote working potential calculated in this thesis is higher than the two other findings presented above.

Considering the impact of the Covid-19 crisis on teaching at schools and universities a medium to high remote working potential appears to be a valid evaluation. In the most critical phases of the pandemic the value chain activity teaching switched to a remote setting. According to the U.S. Census Bureau “nearly 93% of households with school-age children report some form of distance learning during COVID-19” (McCelrath, 2020, para. 1). Especially in higher education “online learning became the default in 2020” (Gallagher & Palmer, 2020, para. 6). However, the two industries are not equally suited for remote working. When considering the industries separately, elementary and secondary schools (6111) just have a RWP of 0.70 for occupations within teaching and special education and a relatively high standard deviation of 0.037. Colleges, universities and professional schools (6113) show a RWP of 0.73 and a lower standard deviation of 0.023 when it comes to teaching and research. At first glance the difference seems to be not that big, but these aggregated results are covering up important facts.

Going into more detail, it becomes apparent that colleges, universities and profession schools have fewer physical requirements, less face-to-face contact, a higher use of computer and/or communication technology and very high job autonomy in this value chain activity compared to elementary and secondary schools. These circumstances render teaching and research activities at colleges, universities and profession schools much more likely to be successfully conducted in a remote setting too. The UNESCO Institute for Statistics, publishing internationally-comparable data on education, revealed that from March 2020 to November 2021 elementary and secondary schools were partially closed for 71 out of 92 weeks meaning distance learning strategies were applied in most cases (“Total Duration of School Closures”, 2021). Even though the overall average remote

working potential for elementary and secondary schools is 0.70, switching to remote working is still a great challenge when it comes to teaching. In reality this industry mixes distance learning with complete school closings since the beginning of the Covid-19 pandemic. In order to increase actual remote working the individual remote working criteria have to be further analyzed and decomposed to develop concrete recommendations for action in this value chain activity. Especially physical requirements, face-to-face contact, the use of computer and/or communication technology and job autonomy should be taken into account since these criteria are below sector average. Studying occupations within this primary activity which is also biggest when it comes to total employment is crucial since the best-case scenario for elementary and secondary schools in this activity indicates a RWP of 0.96. Increasing the average RWP by analyzing individual criteria and then introducing concrete measures to improve the work context of occupations within this activity is crucial. This detailed analysis offers valuable insights and sheds light on areas which can be definitely improved according to the best-case scenario. The full potential has not yet been exploited in reality for neither industry. Even though, colleges, universities and profession schools have a higher average RWP in this activity the best-case scenario indicates a huge potential improvement here as well which should not be ignored either.

Even though value chain activities concerning teaching have the highest total employment in both industries, therefore being most influential, it is worth looking into the value chain activities with the highest and lowest RWP as well to gain a deeper understanding. The support activity administration, HR and professional services has the lowest RWP of the sector being 0.69. The results of the individual remote working criteria point out the cause. Both industries show less face-to-face contact in this activity than in some other, however, have more physical requirements, a lower use of computer and/or communication technology and less job autonomy. The standard deviation of the RWP in both industries is highest for this activity. Considering the individual occupations, it becomes apparent that professional services occupations, as for example landscaping and groundskeeping workers with a RWP of 0.52 or maintenance workers with a RWP of 0.57, are having a strong negative influence. Mere administrative occupations, however, have a much higher RWP.

Displaying detailed results therefore greatly matters since a low RWP of one value chain activity, negatively influences the RWP of the whole industry and sector. After being able to point out the individual value chain activities and occupations lowering the average sector and industry RWPs these can be carefully analyzed using the individual remote working criteria and improvements can be put into place. Additionally, occupations within value chain activities can be clustered separately when seeing discrepancies to avoid wrong interpretations. In this case administration and HR could be further separated from professional services as the RWP of the two former is much higher when not combined with the latter. The individual RWPs then are in line with the literature and study insights presented in the beginning of the thesis (Bloom et al. 2015; Gottlieb et al. 2021; Hertel et al. 2005; Nilles, 1975).

Both marketing and external communication as well as infrastructure score the highest RWP in sector 61. Occupations in marketing and external communication at colleges, universities and professional schools yield an above average RWP for the three remote working criteria use of computer and/or communication technology, defined deliverables and mental concentration. Occupations within the support activity infrastructure are strongly noticeable due to their extensive use of use of computer and/or communication technology. Even though standing out positively the RWP of value chain activities as, for example, marketing and external communication, infrastructure, academic and student recruitment, relationship management and technology can be further increased according to their individual best-case scenarios and some potentially even completely outsourced in the future.

8. Limitations and Future Research

Explaining limitations and different options for further research conducted in the future is essential. Limitations reveal to what extent results can be generalized, how they can be interpreted and what cannot be concluded. This thesis used secondary data covering the U.S. workforce and U.S. industry data. Hence, results presented in this thesis only reflect the remote working potential of U.S. occupations, industries and sectors. It is not possible to generalize results beyond therefore external validity is limited to the U.S. However, the results can be seen as a starting point for studies in sectors

and industries of countries with similarly developed economies and workforces. A recommendation for future research is to replicate the analysis for other countries to extent validity or explore deviations depending on size, degree of digitalization, economic focus, etc.

Moreover, due to the fact that secondary data was used the work context categories did not match the remote working criteria found in literature in every case to the full. Using multiple work context categories to map criteria reduces this gap as far as possible and increases the degree of matching. Nevertheless, using secondary data was much more advantageous compared to collecting own data since surveying the same number of suitable people for each of the hundreds of different occupations would not have been possible within the scope of this thesis due to financial and time aspects. Future research needs to increase accuracy for matching literature criteria with data. One option is to include additional categories in existing surveys to close those gaps. Another option would be to collect own data and introduce categories specially designed to reflect literature criteria.

The value chains within the educational services sector are based on literature. The sorting of occupations into the different value chain activities is based on the core tasks performed in the specific occupation, however not additionally verified by people executing them. Future research can include additional control mechanisms, besides task statements, in order to sort occupations into value chain activities and possibly also fine tune the breakdown of activities since strategically relevant activities can change over time.

Remote working criteria derived from literature were carefully selected. Nevertheless, the recent increase in remote working caused by the Covid-19 pandemic directed the focus of research on this topic. Increased data collection and new studies in this area continuously produce new insights. Therefore, complementary remote working criteria have to be continuously added in order to properly reflect the remote working potential of occupations and industries.

9. Conclusion

The overall goal of this thesis was to evaluate the remote working potential of an exemplary sector which resulted from a truly transparent analysis. The assessment is based on remote working criteria

found in literature that have been applied to real-world occupational data in order to challenge approaches and results of authors fobbing off readers by referring to alleged experts or ground their findings on unsubstantial subjective evaluations. Of course, the remote working potential analysis of other sectors need to be adapted since value chain activities differ and literature insights need to be continuously updated. Nevertheless, the approach offers guidance when it comes to maximizing transparency, minimize subjective interference and securing reproducibility. The educational services sector having an average remote working potential of 0.71, 0.94 in the best-case scenario, exceeds the results presented by McKinsey experts (2021) and challenges the findings of Dingel and Neiman (2020) by creating a RWP index not based subjectively selected knock-out criteria. Getting to the bottom of a cause by going deeper into the details of any conspicuousness in regard to the remote working potential is extremely relevant in order to make correct assessments about the remote working potential of occupations which then can be outsourced or not. Displaying industries separately already gives valuable insight and allows to explain sector results. Nevertheless, being able to display value chain activities and remote working criteria separately greatly adds value since activities and occupations lowering the overall remote working potential can be detected and improvements made where most needed or impactful.

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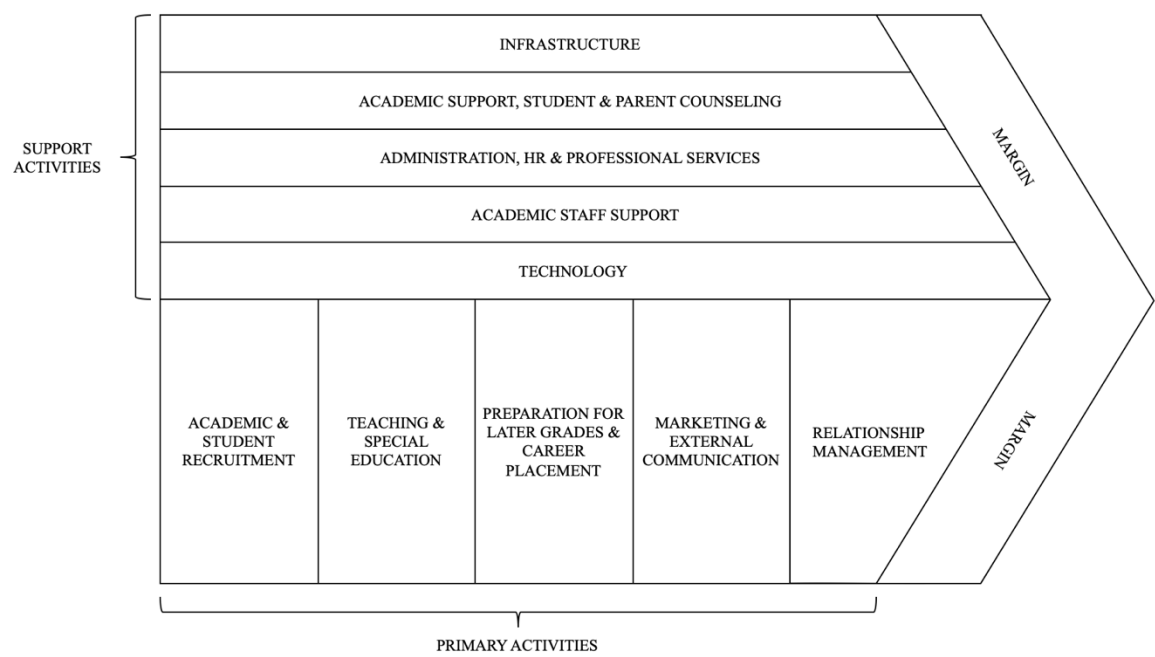
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Appendix A. Value chain for Elementary and Secondary Schools

Value Chain for Elementary and Secondary Schools (NAICS 6111)



Note: Adapted from Groves et al., 1997; Hutaibat, 2011; Pathak & Pathak, 2010; TBS, 2021; The New School, 2021.

Appendix B. Data Extracts of Secondary Data

Table B1

Work Context Category Examples

Element ID	Element Name	Scale ID	Scale Name	Category	Category Description
4.C.1.a.2.1	Face-to-Face Discussions	CXP	Context (Categories 1-5)	1	Never
4.C.1.a.2.1	Face-to-Face Discussions	CXP	Context (Categories 1-5)	2	Once a year or more but not every month
4.C.1.a.2.1	Face-to-Face Discussions	CXP	Context (Categories 1-5)	3	Once a month or more but not every week
4.C.1.a.2.1	Face-to-Face Discussions	CXP	Context (Categories 1-5)	4	Once a week or more but not every day
4.C.1.a.2.1	Face-to-Face Discussions	CXP	Context (Categories 1-5)	5	Every day
4.C.2.a.1.e	In an Open Vehicle or Equipment	CXP	Context (Categories 1-5)	1	Never
4.C.2.a.1.e	In an Open Vehicle or Equipment	CXP	Context (Categories 1-5)	2	Once a year or more but not every month
4.C.2.a.1.e	In an Open Vehicle or Equipment	CXP	Context (Categories 1-5)	3	Once a month or more but not every week
4.C.2.a.1.e	In an Open Vehicle or Equipment	CXP	Context (Categories 1-5)	4	Once a week or more but not every day
4.C.2.a.1.e	In an Open Vehicle or Equipment	CXP	Context (Categories 1-5)	5	Every day
4.C.2.a.3	Physical Proximity	CXP	Context (Categories 1-5)	1	I don't work near other people (beyond 100 ft.)
4.C.2.a.3	Physical Proximity	CXP	Context (Categories 1-5)	2	I work with others but not closely (e.g., private office)
4.C.2.a.3	Physical Proximity	CXP	Context (Categories 1-5)	3	Slightly close (e.g., shared office)
4.C.2.a.3	Physical Proximity	CXP	Context (Categories 1-5)	4	Moderately close (at arm's length)
4.C.2.a.3	Physical Proximity	CXP	Context (Categories 1-5)	5	Very close (near touching)

Note: Reprinted from Work Context Categories, 2021. Occupational Information Network.

Table B2

Content Model Reference Descriptions for five Exemplary Physical Work Conditions

Element ID	Element Name	Description
4.C.2	Physical Work Conditions	This category describes the work context as it relates to the interactions between the worker and the physical job environment
4.C.2.a	Work Setting	Description of physical surroundings that the worker will face as part of this job
4.C.2.a.1	Frequency Required to Work:	How frequently does this job require the worker to work:
4.C.2.a.1.a	Indoors, Environmentally Controlled	How often does this job require working indoors in environmentally controlled conditions?
4.C.2.a.1.b	Indoors, Not Environmentally Controlled	How often does this job require working indoors in non-controlled environmental conditions (e.g., warehouse without heat)?
4.C.2.a.1.c	Outdoors, Exposed to Weather	How often does this job require working outdoors, exposed to all weather conditions?
4.C.2.a.1.d	Outdoors, Under Cover	How often does this job require working outdoors, under cover (e.g., structure with roof but no walls)?
4.C.2.a.1.e	In an Open Vehicle or Equipment	How often does this job require working in an open vehicle or equipment (e.g., tractor)?

Note: Reprinted from Content Model Reference, 2021. Occupational Information Network.

Table B3*Task Statements for Geography Teachers, Postsecondary*

O*NET-SOC Code	Title	Task ID	Task	Task Type
25-1064.00	Geography Teachers, Postsecondary	6011	Prepare course materials, such as syllabi, homework assignments, and handouts.	Core
25-1064.00	Geography Teachers, Postsecondary	6006	Prepare and deliver lectures to undergraduate or graduate students on topics such as urbanization, environmental systems, and cultural geography.	Core
25-1064.00	Geography Teachers, Postsecondary	6017	Conduct research in a particular field of knowledge and publish findings in professional journals, books, or electronic media.	Core
25-1064.00	Geography Teachers, Postsecondary	6007	Evaluate and grade students' class work, assignments, and papers.	Core
25-1064.00	Geography Teachers, Postsecondary	6008	Compile, administer, and grade examinations, or assign this work to others.	Core
25-1064.00	Geography Teachers, Postsecondary	6012	Keep abreast of developments in the field by reading current literature, talking with colleagues, and participating in professional conferences.	Core
25-1064.00	Geography Teachers, Postsecondary	6009	Initiate, facilitate, and moderate classroom discussions.	Core
25-1064.00	Geography Teachers, Postsecondary	6010	Maintain student attendance records, grades, and other required records.	Core
25-1064.00	Geography Teachers, Postsecondary	6013	Supervise undergraduate or graduate teaching, internship, and research work.	Core
25-1064.00	Geography Teachers, Postsecondary	6014	Plan, evaluate, and revise curricula, course content, course materials, and methods of instruction.	Core
25-1064.00	Geography Teachers, Postsecondary	6015	Maintain regularly scheduled office hours to advise and assist students.	Core
25-1064.00	Geography Teachers, Postsecondary	6016	Supervise students' laboratory and field work.	Core
25-1064.00	Geography Teachers, Postsecondary	6021	Serve on academic or administrative committees that deal with institutional policies, departmental matters, and academic issues.	Core
25-1064.00	Geography Teachers, Postsecondary	6020	Advise students on academic and vocational curricula and on career issues.	Core
25-1064.00	Geography Teachers, Postsecondary	6018	Collaborate with colleagues to address teaching and research issues.	Core
25-1064.00	Geography Teachers, Postsecondary	6028	Perform spatial analysis and modeling using geographic information system techniques.	Core
25-1064.00	Geography Teachers, Postsecondary	6026	Write grant proposals to procure external research funding.	Core
25-1064.00	Geography Teachers, Postsecondary	6022	Participate in student recruitment, registration, and placement activities.	Core
25-1064.00	Geography Teachers, Postsecondary	6019	Select and obtain materials and supplies, such as textbooks.	Core

Note: Reprinted from Task Statements, 2021. Occupational Information Network.

Table B4*Total Employment of Industries within the Educational Services Sector*

NAICS	NAICS_TITLE	I_GROUP	OWN_C	OCC_C	OCC_TITLE	D_GRP	TOT_EMP
61	Educational Services	sector	235	00-0000	All Occupations	total	12.740.960
611100	Elementary and Secondary Schools	4-digit	235	00-0000	All Occupations	total	8.243.290
611200	Junior Colleges	4-digit	235	00-0000	All Occupations	total	682.250
611300	Colleges, Universities, and Professional Schools	4-digit	235	00-0000	All Occupations	total	3.033.530
611400	Business Schools and Computer and Management Training	4-digit	235	00-0000	All Occupations	total	70.600
611500	Technical and Trade Schools	4-digit	235	00-0000	All Occupations	total	125.230
611600	Other Schools and Instruction	4-digit	235	00-0000	All Occupations	total	400.820
611700	Educational Support Services	4-digit	235	00-0000	All Occupations	total	185.230

Note: Reprinted from All May 2020 data, 2022. Bureau of Labor Statistics.

Table B5*Work Context Categories*

Element ID	Element Name	Description
4.C.1.a.2.f	Telephone	How often do you have telephone conversations in this job?
4.C.1.a.2.h	Electronic Mail	How often do you use electronic mail in this job?
4.C.1.a.2.l	Face-to-Face Discussions	How often do you have to have face-to-face discussions with individuals or teams in this job?
4.C.2.a.1.b	Indoors, Not Environmentally Controlled	How often does this job require working indoors in non-controlled environmental conditions (e.g., warehouse without heat)?
4.C.2.a.1.c	Outdoors, Exposed to Weather	How often does this job require working outdoors, exposed to all weather conditions?
4.C.2.a.1.d	Outdoors, Under Cover	How often does this job require working outdoors, under cover (e.g., structure with roof but no walls)?
4.C.2.a.1.e	In an Open Vehicle or Equipment	How often does this job require working in an open vehicle or equipment (e.g., tractor)?
4.C.2.a.1.f	In an Enclosed Vehicle or Equipment	How often does this job require working in a closed vehicle or equipment (e.g., car)?
4.C.2.a.3	Physical Proximity	To what extent does this job require the worker to perform job tasks in close physical proximity to other people?
4.C.2.d.1.g	Spend Time Using Your Hands to Handle, Control, or Feel Objects, Tools, or Controls	How much does this job require using your hands to handle, control, or feel objects, tools or controls?
4.C.2.e.1.d	Wear Common Protective or Safety Equipment such as Safety Shoes, Glasses, Gloves, Hearing Protection, Hard Hats, or Life Jackets	How much does this job require wearing common protective or safety equipment such as safety shoes, glasses, gloves, hard hats or life jackets?
4.C.2.e.1.e	Wear Specialized Protective or Safety Equipment such as Breathing Apparatus, Safety Harness, Full Protection Suits, or Radiation Protection	How much does this job require wearing specialized protective or safety equipment such as breathing apparatus, safety harness, full protection suits, or radiation protection?
4.C.3.a.4	Freedom to Make Decisions	How much decision making freedom, without supervision, does the job offer?
4.C.3.b.2	Degree of Automation	How automated is the job?
4.C.3.b.4	Importance of Being Exact or Accurate	How important is being very exact or highly accurate in performing this job?
4.C.3.b.7	Importance of Repeating Same Tasks	How important is repeating the same physical activities (e.g., key entry) or mental activities (e.g., checking entries in a ledger) over and over, without stopping, to performing this job?
4.C.3.b.8	Structured versus Unstructured Work	To what extent is this job structured for the worker, rather than allowing the worker to determine tasks, priorities, and goals?
4.C.3.d.1	Time Pressure	How often does this job require the worker to meet strict deadlines?

Note: 18 work context categories were used to represent remote working criteria found in literature.

Reprinted from Content Model Reference, 2021. Occupational Information Network.

Appendix C. Additional Results

Table C1

Non-weighted Remote Working Potential Matrix for Elementary and Secondary Schools (NAICS 6111)

Remote Working Criteria Value Chain Activities		Physical Requirements	Face-to-face Contact	Computer/ Communication Technology	Job Autonomy	Defined Deliverables	Mental Concentration
Primary Activities	Academic & Student Recruitment	0.86	0.25	0.98	0.87	0.77	0.79
	Teaching & Special Education	0.80	0.27	0.81	0.83	0.64	0.81
	Preparation for later Grades & Career Placement	0.83	0.26	0.84	0.84	0.61	0.79
	Marketing & External Communication	0.85	0.29	0.93	0.86	0.75	0.85
	Relationship Management	0.84	0.25	0.98	0.83	0.71	0.80
Support Activities	Infrastructure	0.87	0.27	0.98	0.86	0.75	0.79
	Academic Support, Student & Parent Counseling	0.82	0.24	0.90	0.84	0.67	0.79
	Administration, HR & Professional Services	0.71	0.29	0.76	0.78	0.72	0.80
	Academic Staff Support	0.83	0.25	0.96	0.85	0.69	0.80
	Technology	0.87	0.29	0.94	0.81	0.74	0.77

Table C2

Non-weighted Remote Working Potential Matrix for Colleges, Universities, and Professional Schools (NAICS 6113)

Remote Working Criteria Value Chain Activities		Physical Requirements	Face-to-face Contact	Computer/Communication Technology	Job Autonomy	Defined Deliverables	Mental Concentration
Primary Activities	Academic & Student Recruitment	0.87	0.24	0.91	0.92	0.65	0.81
	Teaching & Research	0.86	0.28	0.85	0.91	0.63	0.82
	Career Placement & Research Publishing	0.88	0.29	0.86	0.93	0.62	0.82
	Marketing & External Communication	0.84	0.26	0.96	0.87	0.76	0.84
	Relationship Management	0.88	0.28	0.88	0.92	0.62	0.82
Support Activities	Infrastructure	0.88	0.28	0.96	0.85	0.74	0.79
	Academic Support & Student Services	0.86	0.27	0.88	0.89	0.66	0.81
	Administration, HR & Professional Services	0.71	0.28	0.79	0.78	0.73	0.81
	Academic Staff Support	0.86	0.29	0.92	0.84	0.64	0.77
	Technology	0.86	0.28	0.97	0.85	0.72	0.77

Appendix D. Job Roles

Table D1

Job Roles and Value Chain Allocation (NAICS 6111)

1	OCC_CODE	OCC_TITLE	O_GROUP	TOT_EMP	A_MEAN	1_VCA	2_VCA	3_VCA	4_VCA	5_VCA	6_VCA	7_VCA	8_VCA	9_VCA	10_VCA
2	11-3121	Human Resources Managers	detailed	3.940	120.400	1					1				
3	13-1071	Human Resources Specialists	detailed	11.220	61.970	1									
4	13-1141	Compensation, Benefits, and Job Analysis Specialists	detailed	2.060	63.310	1									
5	43-4111	Interviewers, Except Eligibility and Loan	detailed	1.360	45.880	1									
6	43-4161	Human Resources Assistants, Except Payroll and Timekeeping	detailed	3.590	44.360	1									
7	11-9031	Education and Childcare Administrators, Preschool and	detailed	3.910	73.250	1	1					1		1	
8	11-9032	Education Administrators, Kindergarten through Secondary	detailed	256.600	103.010	1	1			1		1		1	
9	25-2011	Preschool Teachers, Except Special Education	detailed	72.630	50.520		1								
10	25-2012	Kindergarten Teachers, Except Special Education	detailed	116.680	61.630		1	1				1			
11	25-2021	Elementary School Teachers, Except Special Education	detailed	1,356.460	65.470		1	1				1			
12	25-2022	Middle School Teachers, Except Special and Career/Technical	detailed	596.730	64.970		1	1				1			
13	25-2031	Secondary School Teachers, Except Special and Career/Technical	detailed	979.330	67.360		1					1			
14	25-2032	Career/Technical Education Teachers, Secondary School	detailed	70.180	66.100		1								
15	25-2051	Special Education Teachers, Preschool	detailed	12.710	65.590		1					1			
16	25-2051	Special Education Teachers, Kindergarten and Elementary	detailed	186.300	64.690		1					1			
17	25-2057	Special Education Teachers, Middle School	detailed	79.390	66.300		1					1			
18	25-2058	Special Education Teachers, Secondary School	detailed	136.960	66.790		1								
19	25-2059	Special Education Teachers, All Other	detailed	22.190	68.260		1								
20	25-3011	Adult Basic Education, Adult Secondary Education, and	detailed	15.380	64.640		1	1							
21	25-3021	Self-Enrichment Teachers	detailed	14.540	52.760		1	1							
22	25-3041	Tutors and Teachers and Instructors, All Other	detailed	112.480	52.430		1					1			
23	25-9044	Teaching Assistants, Except Postsecondary	detailed	1,067.040	30.970		1								
24	27-2022	Coaches and Scouts	detailed	49.910	41.580		1								
25	27-3091	Interpreters and Translators	detailed	8.970	49.480		1								
26	29-9091	Athletic Trainers	detailed	3.140	62.500		1								
27	39-9011	Childcare Workers	detailed	105.780	30.280		1					1			
28	39-9032	Recreation Workers	detailed	9.660	29.730		1								
29	21-1012	Educational, Guidance, and Career Counselors and Advisors	detailed	144.850	68.770			1							
30	13-1161	Market Research Analysts and Marketing Specialists	detailed	1.350	60.410				1						
31	27-2041	Music Directors and Composers	detailed	1.390	59.340		1								
32	27-2042	Musicians and Singers	detailed	2.230	*		1								
33	27-4011	Audio and Video Technicians	detailed	2.140	46.710				1						
34	13-1131	Fundraisers	detailed	3.040	67.160					1					
35	27-3031	Public Relations Specialists	detailed	6.340	60.200					1					
36	43-4051	Customer Service Representatives	detailed	2.310	36.710					1					
37	11-1011	Chief Executives	detailed	9.540	156.150						1				
38	11-1021	General and Operations Managers	detailed	12.410	131.620						1				
39	11-3031	Financial Managers	detailed	7.840	122.670						1				
40	13-1111	Management Analysts	detailed	1.820	95.150						1				
41	13-1199	Project Management Specialists and Business Operations	detailed	20.830	66.820						1				
42	13-2011	Accountants and Auditors	detailed	13.110	72.180						1				
43	13-2031	Budget Analysts	detailed	1.130	70.150						1				
44	13-2099	Financial and Investment Analysts, Financial Risk Specialists	detailed	1.490	70.590						1				
45	43-3031	Bookkeeping, Accounting, and Auditing Clerks	detailed	34.550	44.360						1				
46	43-3051	Payroll and Timekeeping Clerks	detailed	7.560	48.890						1				
47	43-6011	Executive Secretaries and Executive Administrative Assistants	detailed	22.530	60.570						1				
48	15-1232	Computer User Support Specialists	detailed	34.080	50.550							1			1
49	19-3034	Clinical, Counseling, and School Psychologists	detailed	44.970	80.960							1			
50	21-1011	Substance Abuse, Behavioral Disorder, and Mental Health	detailed	11.130	58.670							1			
51	21-1014	Counselors, All Other	detailed	2.300	54.620							1			
52	21-1021	Child, Family, and School Social Workers	detailed	45.960	65.080							1			
53	21-1093	Social and Human Service Assistants	detailed	6.870	39.260							1			
54	21-1094	Community and Social Service Specialists, All Other	detailed	4.910	52.210							1			
55	21-2011	Clergy	detailed	1.900	55.680							1			
56	21-2021	Directors, Religious Activities and Education	detailed	1.450	49.130							1			
57	25-4022	Librarians and Media Collections Specialists	detailed	48.210	65.230							1			
58	25-4031	Library Technicians	detailed	12.560	37.590							1			
59	29-1031	Dietitians and Nutritionists	detailed	1.300	57.750							1			
60	29-1122	Occupational Therapists	detailed	15.560	78.890							1			
61	43-4121	Library Assistants, Clerical	detailed	9.850	31.690							1			
62	11-3012	Administrative Services and Facilities Managers	detailed	12.430	99.550								1		
63	11-3071	Transportation, Storage, and Distribution Managers	detailed	1.940	86.800								1		
64	11-9051	Food Service Managers	detailed	4.380	69.390								1		
65	13-1023	Buyers and Purchasing Agents	detailed	2.900	60.900								1		
66	13-1041	Compliance Officers	detailed	3.020	67.000								1		
67	29-1123	Physical Therapists	detailed	5.910	82.970								1		
68	29-1127	Speech-Language Pathologists	detailed	58.530	75.670								1		
69	29-1141	Registered Nurses	detailed	54.500	62.170								1		
70	29-2061	Licensed Practical and Licensed Vocational Nurses	detailed	10.070	43.690								1		
71	29-9093	Health Information Technologists, Medical Registrars, and	detailed	2.470	46.940								1		
72	31-1121	Home Health and Personal Care Aides	detailed	4.770	30.410								1		
73	31-1131	Nursing Assistants	detailed	6.330	30.480								1		
74	31-2011	Occupational Therapy Assistants	detailed	1.740	52.790							1			
75	31-9092	Medical Assistants	detailed	1.100	31.000								1		
76	31-9099	Healthcare Support Workers, All Other	detailed	8.240	43.520								1		
77	33-3051	Police and Sheriff's Patrol Officers	detailed	6.210	58.860								1		
78	33-9032	Security Guards	detailed	32.980	38.540								1		
79	33-9091	Crossing Guards and Flaggers	detailed	8.510	28.870								1		

1	OCC_CODE	OCC_TITLE	O_GROUP	TOT_EMP	A_MEAN	1_VCA	2_VCA	3_VCA	4_VCA	5_VCA	6_VCA	7_VCA	8_VCA	9_VCA	10_VCA
80	33-9092	Lifeguards, Ski Patrol, and Other Recreational Protective Workers	detailed	3.040	27.400								1		
81	33-9099	School Bus Monitors and Protective Service Workers, Except Janitors	detailed	60.250	31.350								1		
82	35-1012	First-Line Supervisors of Food Preparation and Serving Workers	detailed	34.200	38.520								1		
83	35-2012	Cooks, Institution and Cafeteria	detailed	122.290	27.610								1		
84	35-2021	Food Preparation Workers	detailed	22.560	31.070								1		
85	35-3023	Fast Food and Counter Workers	detailed	126.670	26.670								1		
86	35-3041	Food Servers, Nonrestaurant	detailed	3.340	26.210								1		
87	35-9011	Dining Room and Cafeteria Attendants and Bartender Helpers	detailed	19.650	27.850								1		
88	35-2021	Food Preparation and Serving Related Workers, All Other	detailed	3.440	28.330								1		
89	37-1011	First-Line Supervisors of Housekeeping and Janitorial Workers	detailed	12.300	47.580								1		
90	37-1012	First-Line Supervisors of Landscaping, Lawn Service, and Janitorial Workers	detailed	1.060	58.490								1		
91	37-2011	Janitors and Cleaners, Except Maids and Housekeeping Cleaners	detailed	294.420	34.300								1		
92	37-2012	Maids and Housekeeping Cleaners	detailed	1.220	32.220								1		
93	37-3011	Landscaping and Groundskeeping Workers	detailed	13.450	38.410								1		
94	39-1022	First-Line Supervisors of Personal Service and Entertainment Workers	detailed	4.000	46.980								1		
95	39-3091	Amusement and Recreation Attendants	detailed	1.000	27.030								1		
96	41-2011	Cashiers	detailed	4.520	27.680								1		
97	43-1011	First-Line Supervisors of Office and Administrative Support Workers	detailed	18.370	61.090								1		
98	43-4071	File Clerks	detailed	2.430	36.690								1		
99	43-4171	Receptionists and Information Clerks	detailed	12.840	32.270								1		
100	43-5032	Dispatchers, Except Police, Fire, and Ambulance	detailed	1.960	43.260								1		
101	43-5061	Production, Planning, and Expediting Clerks	detailed	1.290	56.180								1		
102	43-6014	Secretaries and Administrative Assistants, Except Legal, Medical, and Executive	detailed	232.600	39.520								1		
103	43-9021	Data Entry Keyers	detailed	5.840	34.890								1		
104	43-9022	Word Processors and Typists	detailed	8.560	42.810								1		
105	43-9061	Office Clerks, General	detailed	111.640	35.840								1		
106	47-1011	First-Line Supervisors of Construction Trades and Extraction Workers	detailed	1.230	74.230								1		
107	47-2031	Carpenters	detailed	2.730	50.220								1		
108	47-2111	Electricians	detailed	3.020	55.340								1		
109	47-2141	Painters, Construction and Maintenance	detailed	1.780	47.870								1		
110	47-2152	Plumbers, Pipefitters, and Steamfitters	detailed	2.430	59.200								1		
111	49-1011	First-Line Supervisors of Mechanics, Installers, and Repairers	detailed	8.330	65.540								1		
112	49-3031	Bus and Truck Mechanics and Diesel Engine Specialists	detailed	9.090	48.020								1		
113	49-9021	Heating, Air Conditioning, and Refrigeration Mechanics and Installers	detailed	4.010	55.170								1		
114	49-9071	Maintenance and Repair Workers, General	detailed	65.400	45.870								1		
115	51-8021	Stationary Engineers and Boiler Operators	detailed	1.210	51.560								1		
116	53-1043	First-Line Supervisors of Transportation and Material Moving Workers	detailed	4.970	59.360								1		
117	53-3031	Driver/Sales Workers	detailed	1.240	41.920								1		
118	53-3032	Heavy and Tractor-Trailer Truck Drivers	detailed	1.090	48.560								1		
119	53-3033	Light Truck Drivers	detailed	2.050	38.190								1		
120	53-3052	Passenger Vehicle Drivers, Except Bus Drivers, Transit and Taxicab	detailed	196.100	34.450								1		
121	53-7062	Laborers and Freight, Stock, and Material Movers, Hand	detailed	2.590	36.360								1		
122	53-7065	Stockers and Order Fillers	detailed	1.840	38.840								1		
123	11-9151	Social and Community Service Managers	detailed	1.120	92.520								1	1	
124	13-1151	Training and Development Specialists	detailed	6.860	69.300									1	
125	25-9031	Instructional Coordinators	detailed	83.400	72.070									1	
126	39-9041	Residential Advisors	detailed	4.850	36.050							1		1	
127	11-3021	Computer and Information Systems Managers	detailed	7.010	111.160	1									1
128	15-1211	Computer Systems Analysts	detailed	3.440	80.580										1
129	15-1231	Computer Network Support Specialists	detailed	8.020	61.870										1
130	15-1244	Network and Computer Systems Administrators	detailed	12.510	74.620										1
131	15-1242	Database Administrators and Architects	detailed	2.520	76.520										1
132	15-1251	Computer Programmers	detailed	1.120	75.730										1
133	15-1253	Software Developers and Software Quality Assurance Analysts and Testers	detailed	2.020	86.910										1
134	15-1254	Web Developers and Digital Interface Designers	detailed	1.530	73.970										1
135	15-1299	Computer Occupations, All Other	detailed	3.830	63.680										1

Note: 1_VCA = academic & student recruitment; 2_VCA = teaching & special education; 3_VCA = preparation for later grades & career placement; 4_VCA = marketing & external communication; 5_VCA = relationship management; 6_VCA = infrastructure; 7_VCA = academic support, student & parent counseling; 8_VCA = administration, HR & professional services; 9_VCA = academic staff support; 10_VCA = technology.

Table D2

Job Roles and Value Chain Allocation (NAICS 6113)

1	OCC_CODE	OCC_TITLE	O_GROUP	TOT_EMP	A_MEAN	1_VCA	2_VCA	3_VCA	4_VCA	5_VCA	6_VCA	7_VCA	8_VCA	9_VCA	10_VCA
2	11-3121	Human Resources Managers	detailed	4.270	125.150	1					1				
3	13-1071	Human Resources Specialists	detailed	16.010	66.880	1									
4	43-4111	Interviewers, Except Eligibility and Loan	detailed	8.900	43.470	1									
5	11-9033	Education Administrators, Postsecondary	detailed	112.250	119.190	1	1	1		1					
6	19-1029	Biological Scientists, All Other	detailed	4.150	71.140		1								
7	19-1042	Medical Scientists, Except Epidemiologists	detailed	22.180	77.380		1								
8	19-2099	Physical Scientists, All Other	detailed	3.840	68.760		1								
9	19-4021	Biological Technicians	detailed	17.800	47.280		1								
10	19-4061	Social Science Research Assistants	detailed	13.840	50.330			1	1						
11	19-4099	Life, Physical, and Social Science Technicians, All	detailed	17.480	51.780		1								
12	25-1011	Business Teachers, Postsecondary	detailed	61.800	113.110			1	1		1				1
13	25-1021	Computer Science Teachers, Postsecondary	detailed	21.370	103.140	1		1							
14	25-1022	Mathematical Science Teachers, Postsecondary	detailed	27.290	87.600			1			1				
15	25-1031	Architecture Teachers, Postsecondary	detailed	6.200	102.470	1	1	1			1				
16	25-1032	Engineering Teachers, Postsecondary	detailed	33.590	117.320	1	1	1							
17	25-1041	Agricultural Sciences Teachers, Postsecondary	detailed	6.850	101.260	1	1	1			1		1		
18	25-1042	Biological Science Teachers, Postsecondary	detailed	35.720	100.700	1	1	1			1		1		
19	25-1051	Atmospheric, Earth, Marine, and Space Sciences	detailed	8.500	105.190		1	1			1				
20	25-1052	Chemistry Teachers, Postsecondary	detailed	16.860	96.000		1	1			1				
21	25-1053	Environmental Science Teachers, Postsecondary	detailed	4.990	94.940		1	1					1		
22	25-1054	Physics Teachers, Postsecondary	detailed	11.560	104.470		1				1		1		
23	25-1061	Anthropology and Archeology Teachers, Postsec	detailed	4.830	98.550			1	1						
24	25-1062	Area, Ethnic, and Cultural Studies Teachers, Posts	detailed	8.680	90.160			1			1		1		
25	25-1063	Economics Teachers, Postsecondary	detailed	11.430	128.050		1	1					1		
26	25-1064	Geography Teachers, Postsecondary	detailed	3.140	85.770			1	1		1				
27	25-1065	Political Science Teachers, Postsecondary	detailed	13.170	103.660			1	1				1		
28	25-1066	Psychology Teachers, Postsecondary	detailed	29.260	89.850	1	1	1			1				
29	25-1067	Sociology Teachers, Postsecondary	detailed	9.940	87.720			1	1		1				
30	25-1071	Health Specialties Teachers, Postsecondary	detailed	165.470	130.490			1			1				
31	25-1072	Nursing Instructors and Teachers, Postsecondary	detailed	36.130	84.320			1							
32	25-1081	Education Teachers, Postsecondary	detailed	50.390	74.390			1	1		1		1		
33	25-1082	Library Science Teachers, Postsecondary	detailed	3.530	74.850			1			1				
34	25-1111	Criminal Justice and Law Enforcement Teachers,	detailed	7.300	72.420			1			1				
35	25-1112	Law Teachers, Postsecondary	detailed	13.980	137.430			1	1		1				
36	25-1113	Social Work Teachers, Postsecondary	detailed	12.630	78.620			1	1		1				
37	25-1121	Art, Drama, and Music Teachers, Postsecondary	detailed	69.360	84.590			1			1				
38	25-1122	Communications Teachers, Postsecondary	detailed	20.990	78.470	1	1						1		
39	25-1123	English Language and Literature Teachers, Posts	detailed	39.490	78.410			1	1				1		
40	25-1124	Foreign Language and Literature Teachers, Posts	detailed	16.740	76.950			1	1		1				
41	25-1125	History Teachers, Postsecondary	detailed	15.320	87.050			1	1		1		1		
42	25-1126	Philosophy and Religion Teachers, Postsecondary	detailed	19.950	87.880			1	1		1		1		
43	25-1193	Recreation and Fitness Studies Teachers, Postsec	detailed	9.600	68.880			1			1		1		
44	25-1194	Career/Technical Education Teachers, Postsecon	detailed	9.200	66.370			1	1				1		
45	25-1192	Postsecondary Teachers, All Other	detailed	143.680	86.510			1	1		1		1		
46	25-3021	Self-Enrichment Teachers	detailed	3.790	51.570			1	1						
47	25-3041	Tutors and Teachers and Instructors, All Other	detailed	24.420	39.920			1					1		
48	25-9021	Farm and Home Management Educators	detailed	5.060	60.980			1			1				
49	25-9044	Teaching Assistants, Postsecondary	detailed	123.030	39.760			1							
50	25-9044	Teaching Assistants, Except Postsecondary	detailed	6.950	33.700			1							
51	27-2022	Coaches and Scouts	detailed	45.170	62.610			1							
52	29-9091	Athletic Trainers	detailed	5.760	53.870			1							
53	39-9032	Recreation Workers	detailed	10.160	28.480			1							
54	21-1012	Educational, Guidance, and Career Counselors an	detailed	70.400	55.060				1						
55	11-2021	Marketing Managers	detailed	3.570	119.720					1		1			
56	13-1121	Meeting, Convention, and Event Planners	detailed	8.200	54.280					1					
57	13-1161	Market Research Analysts and Marketing Specie	detailed	9.750	65.690					1					
58	27-1024	Graphic Designers	detailed	3.940	54.490					1					
59	27-2012	Producers and Directors	detailed	3.420	67.170					1					
60	27-3041	Editors	detailed	3.530	68.280					1					
61	27-4011	Audio and Video Technicians	detailed	3.910	49.330					1					
62	13-1131	Fundraisers	detailed	14.910	72.070						1				
63	27-3031	Public Relations Specialists	detailed	20.160	65.250						1				
64	43-4051	Customer Service Representatives	detailed	14.120	38.850						1				
65	11-1021	General and Operations Managers	detailed	12.620	136.000							1			
66	11-3031	Financial Managers	detailed	12.490	135.640							1			
67	13-1111	Management Analysts	detailed	10.210	78.720							1			
68	13-1199	Project Management Specialists and Business Op	detailed	58.430	70.450							1			
69	13-2011	Accountants and Auditors	detailed	22.710	69.110							1			
70	13-2031	Budget Analysts	detailed	3.490	72.100							1			
71	13-2071	Credit Counselors	detailed	7.100	50.660							1			
72	13-2099	Financial and Investment Analysts, Financial Risk	detailed	15.450	75.140							1			
73	43-3021	Billing and Posting Clerks	detailed	4.940	42.880							1			
74	43-3031	Bookkeeping, Accounting, and Auditing Clerks	detailed	19.590	45.000							1			
75	43-6011	Executive Secretaries and Executive Administrati	detailed	44.900	61.320							1			
76	15-1232	Computer User Support Specialists	detailed	27.520	55.960								1		1
77	19-3034	Clinical, Counseling, and School Psychologists	detailed	3.970	75.750								1		
78	21-1011	Substance Abuse, Behavioral Disorder, and Ment	detailed	3.440	57.780								1		
79	21-1093	Social and Human Service Assistants	detailed	3.500	36.820								1		
80	25-4022	Librarians and Media Collections Specialists	detailed	19.310	69.070								1		
81	25-4031	Library Technicians	detailed	11.600	42.940								1		
82	43-4121	Library Assistants, Clerical	detailed	9.070	34.740								1		
83	11-3012	Administrative Services and Facilities Managers	detailed	19.900	102.730							1		1	
84	11-9111	Medical and Health Services Managers	detailed	6.300	125.340							1		1	
85	13-1023	Buyers and Purchasing Agents	detailed	5.100	65.500									1	

1	OCC_CODE	OCC_TITLE	O_GROUP	TOT_EMP	A_MEAN	1_VCA	2_VCA	3_VCA	4_VCA	5_VCA	6_VCA	7_VCA	8_VCA	9_VCA	10_VCA
86	13-1041	Compliance Officers	detailed	6.210	70.520								1		
87	29-1071	Physician Assistants	detailed	4.930	108.010								1		
88	29-1141	Registered Nurses	detailed	30.330	81.710								1		
89	29-1171	Nurse Practitioners	detailed	6.970	108.060								1		
90	29-1229	Physicians, All Other; and Ophthalmologists, Except	detailed	12.610	107.860								1		
91	29-2011	Clinical Laboratory Technologists and Technicians	detailed	13.890	54.720								1		
92	29-2056	Veterinary Technologists and Technicians	detailed	3.480	43.600								1		
93	29-2061	Licensed Practical and Licensed Vocational Nurses	detailed	4.780	46.410								1		
94	31-1131	Nursing Assistants	detailed	5.560	44.870								1		
95	31-9091	Dental Assistants	detailed	3.110	41.660								1		
96	31-9092	Medical Assistants	detailed	8.670	39.750								1		
97	31-9096	Veterinary Assistants and Laboratory Animal Care	detailed	3.270	39.690								1		
98	33-1012	First-Line Supervisors of Police and Detectives	detailed	3.390	84.450								1		
99	33-3051	Police and Sheriff's Patrol Officers	detailed	14.960	59.790								1		
100	33-9032	Security Guards	detailed	18.820	38.160								1		
101	35-1012	First-Line Supervisors of Food Preparation and Serving	detailed	3.520	46.410								1		
102	35-2012	Cooks, Institution and Cafeteria	detailed	6.990	36.130								1		
103	35-3023	Fast Food and Counter Workers	detailed	10.210	29.870								1		
104	35-9011	Dining Room and Cafeteria Attendants and Bartenders	detailed	4.330	31.770								1		
105	37-1011	First-Line Supervisors of Housekeeping and Janitorial	detailed	4.880	48.110								1		
106	37-2011	Janitors and Cleaners, Except Maids and Housekeeping	detailed	67.410	34.260								1		
107	37-2012	Maids and Housekeeping Cleaners	detailed	3.480	31.020								1		
108	37-3011	Landscaping and Groundskeeping Workers	detailed	12.860	36.450								1		
109	39-1022	First-Line Supervisors of Personal Service and Entertainment	detailed	3.190	55.510								1		
110	39-3031	Ushers, Lobby Attendants, and Ticket Takers	detailed	3.240	24.700								1		
111	39-3091	Amusement and Recreation Attendants	detailed	4.620	27.060								1		
112	41-2011	Cashiers	detailed	4.160	28.610								1		
113	43-1011	First-Line Supervisors of Office and Administrative	detailed	38.100	64.530								1		
114	43-4171	Receptionists and Information Clerks	detailed	7.260	33.100								1		
115	43-5061	Production, Planning, and Expediting Clerks	detailed	3.940	54.360								1		
116	43-6013	Medical Secretaries and Administrative Assistants	detailed	6.610	42.330								1		
117	43-6014	Secretaries and Administrative Assistants, Except	detailed	111.900	41.540								1		
118	43-9051	Mail Clerks and Mail Machine Operators, Except	detailed	3.010	36.060								1		
119	43-9061	Office Clerks, General	detailed	115.050	35.550								1		
120	47-2031	Carpenters	detailed	4.050	57.830								1		
121	47-2111	Electricians	detailed	5.590	65.530								1		
122	47-2152	Plumbers, Pipefitters, and Steamfitters	detailed	4.140	66.460								1		
123	49-1011	First-Line Supervisors of Mechanics, Installers, and	detailed	6.580	69.960								1		
124	49-9021	Heating, Air Conditioning, and Refrigeration Mechanics	detailed	5.780	56.490								1		
125	49-9071	Maintenance and Repair Workers, General	detailed	32.650	45.970								1		
126	51-8021	Stationary Engineers and Boiler Operators	detailed	3.010	65.620								1		
127	53-3052	Passenger Vehicle Drivers, Except Bus Drivers, Tr	detailed	3.240	36.600								1		
128	53-7062	Laborers and Freight, Stock, and Material Mover	detailed	6.880	32.890								1		
129	13-1151	Training and Development Specialists	detailed	7.870	64.120									1	
130	25-9031	Instructional Coordinators	detailed	29.620	67.060									1	
131	39-9041	Residential Advisors	detailed	12.660	36.240							1			
132	11-3021	Computer and Information Systems Managers	detailed	12.800	126.820						1				1
133	15-1211	Computer Systems Analysts	detailed	15.620	82.680										1
134	15-1231	Computer Network Support Specialists	detailed	7.330	64.200										1
135	15-1241	Computer Network Architects	detailed	4.260	88.540										1
136	15-1244	Network and Computer Systems Administrators	detailed	14.680	81.530										1
137	15-1242	Database Administrators and Architects	detailed	5.340	83.490										1
138	15-1251	Computer Programmers	detailed	7.520	79.550										1
139	15-1253	Software Developers and Software Quality Assurance	detailed	10.990	88.680										1
140	15-1254	Web Developers and Digital Interface Designers	detailed	5.890	70.450										1
141	15-1299	Computer Occupations, All Other	detailed	8.880	79.490										1

Note: 1_VCA = academic & student recruitment; 2_VCA = teaching & research; 3_VCA = career placement & research publishing; 4_VCA = marketing & external communication; 5_VCA = relationship management; 6_VCA = infrastructure; 7_VCA = academic support & student services; 8_VCA = administration, HR & professional services; 9_VCA = academic staff support; 10_VCA = technology.