



DOCTORATE in BUSINESS ADMINISTRATION

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**BOUNDARY SPANNING IN DIGITAL TRANSFORMATION:
A MIXED-METHOD SINGLE CASE STUDY ABOUT LEARNING IN A
VOCATIONAL EDUCATION AND TRAINING DEPARTMENT**

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It has truly been a worthwhile learning journey.

Foreword

“Dream with an ambition, lead with conviction, see yourselves in a way that others may not, simply because they’ve never seen it before.”

KAMALA HARRIS, 8.11.2020

Upon winning the U.S. presidential election on Nov 3, 2020, Kamala Harris, the new U.S. Vice President-elect, uttered this quote in her first address to the American people as an advice to all children. It struck a personal chord. After more than 25 years in business, going back to university to pursue a doctoral degree has been both a dream and an ambition. It feels like a true stretch to go back to such formal learning in university which is, after all, different from the business school system where I got my academic education.

At the same time, this move reflects what learning in today’s business world is all about: a life-long endeavor. Kamala Harris did not say it was easy. The same way one might struggle through the ups and downs of writing a thesis or worry about whether others may or may not understand this move, the same way every factory worker on today’s production floor may feel when asked to learn about digitalization, robotics, artificial intelligence, or digital twins. Different stretch maybe, but similar feelings, nonetheless. And while such perceived insecurity may keep us modest and diligent with our endeavors, it should be recognized that learning can constitute a considerable individual challenge. Put differently, learning requires guts.

One of my inspirations regarding such challenge has been one of my colleagues, who, at the age of 52, finalized his master’s studies. A practitioner, trainer, and electrician by profession, he went back to university a few years ago, and it is with great respect that I can say I have been both impressed and inspired by his verve. Different stretch again, but similar challenge, certainly. Such individual learning in a training department means boundary spanning, i.e., reaching beyond the own team and the traditional mindset to get to new knowledge. Collectively speaking, this opens the door to ask how and why a learning department in a learning organization learns to learn new skills. In a corporate context, understanding how and why people reach out beyond their traditional boundaries to foster social learning and sustainability of operations is key to master transformation. Yet, let us not forget the individual’s perspective: learning remains a challenge, a journey, a quest, or a dream, depending on the interpretation.

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Managerial Summary

The empiric case of a German MNE's Vocational Education and Training (VET) department in digital transformation explores how and why boundary spanning in VET can help bridge from the old world of VET to "new work".

A Vocational Education and Training department – sometimes the little sister of a corporate learning department – operates at the bottom of the talent building echelon and typically caters for professional tertiary education. VET is considered a cornerstone of the German education system and a warrant of "Made in Germany" standards and skilled workforce. During a period of two to four years, apprentices and dual students are employed by a company and learn skills in a training center that they cannot acquire during their practical phases on the shop floor respectively in a department, or in vocational school. A VET department manages these training centers and offers an interesting personnel assembly of VET veterans, people with teaching background and recent additions from the businesses or factory floors – all of them truly dedicated to learning and teaching.

Recent developments in technical apprenticeships in Germany have added digital competencies to the vocational schools' and companies' apprenticeship training curricula. As professional education and training changes, VET trainers need to acquire new skills and, specifically, digital competencies, to adopt new VET approaches and a new mindset regarding the philosophy of VET. These digital competencies of trainers are often company specific. Intra-organizational boundaries – i.e., borders – may hinder efficient exchange of know-how and learning. Via a phenomenon called boundary spanning, such borders may be overcome.

As this thesis shows, boundary spanning propensity, along with trainers' relational abilities, leadership, and trust, significantly contributes to social learning. Propensity is defined here as the individual trainer's attitude that more boundary spanning across training centers, regions and towards internal customers should be done to proliferate information, innovative learning methods and enhance technical skills of trainers. This research also empirically proves that boundary spanning propensity significantly correlates with open learning set-ups and use-cases. Leaders should act as role models in learning and bridging across teams, while striving to create an atmosphere of openness and trust. As a qualitative result, they should also give time and room for learning. These are relevant findings for a practitioner; academically, this thesis helps to expand the academic notion of boundary spanning beyond bridging from one company to another company or beyond bridging from one corporate entity to another one: bridging can as well happen within an entity to enhance learning and improve future readiness of operations.

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As a further scientific contribution, this research adds a definition of boundary spanning propensity to the research body.

Understanding how VET teams learn to bridge skills gap, tackle anxieties, and adopt a new culture in the context of digital transformation is a worthwhile case to observe and draw practical conclusions from; it may also serve as an example for learning challenges in digital transformation of other companies or teams, such as factory floor workers or technical service personnel.

Keywords: Boundary spanning, culture change, digital transformation, learning, mixed methods, organizational resilience, vocational education and training

Introduction

Area of research

Today’s business world is not only characterized by drivers like digital transformation and big data, but it is often described as a VUCA world – VUCA being an acronym for **v**olatile, **u**npredictable, **c**omplex, and **a**mbiguous. As the companies’ external environment is recognized as being VUCA, organizational change becomes permanent and calls for agility, restructuring, a need for experimentation as well as deeper information (Bennett and Lemoine, 2014). This transformation may translate into social pain (see Figure 1) as a reaction to perceived instability that brings about a myriad of recipes on a personal, economical, sociological, and psychological level. In a corporate context, this transformation calls for answers on how to deal with change from an employee’s and from a manager’s point of view – hence, the actuality and need for change management strategies in corporate learning.

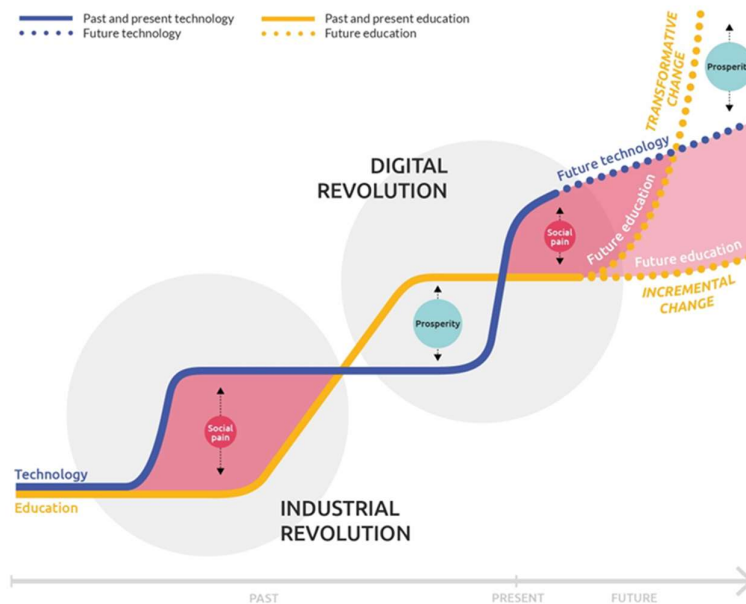


Figure 1: Goldin and Katz (2010) “The race between technology and education”, in: OECD Future of Education and Skills 2030: OECD Learning Compass 2030, OECD, 2019, p. 7.

As one of these consequences, today’s management of human resources needs to change. Whether you call it innovation, revolution or simply a facelift, vocational education and training, upskilling, and reskilling are evolving as an answer to digital transformation. The skills

required by tomorrow's employees will change and how tomorrow's employees will learn is likely to change as well. On average, the skills demand of employees is changing and estimated to increase by 10% each year, while 30% of skills of the past three years become obsolete (Gartner, 2020). These massive societal and corporate changes are reflected in the corporate world's discussions. A quote from Judith Wiese, member of the board of management of a high-tech multi-national German enterprise, illustrates this transformation:

„One of my major topics is learning ability: how can one keep people sustainably employable?¹“

**JUDITH WIESE, CHIEF HUMAN RESOURCES OFFICER, MEMBER OF THE BOARD OF
MANAGEMENT, SIEMENS AG**

For today's vocational education and training (VET), where they cater for young people entering apprenticeship and dual study programs (cooperative education program students), this topic is particularly relevant. How to prepare tomorrow's employees for digitalization, transformation, and life-long learning? As vocational education and training changes, the curricula and methods of VET will need to be adapted as well and VET trainers need to acquire new skills.

Recent developments in technical apprenticeships in Germany have added digital competencies to the vocational schools' and companies' apprenticeship training curricula. This is a strong indicator of how relevant transformation and change have become in the VET community (Bundesinstitut für Berufsbildung, 2018b), which requires trainers to develop corresponding competencies. This entails enhancing skills and methods, sometimes even the philosophy of VET. These digital competencies and methods are often impossible to be acquired externally, as they pertain to company-specific use cases. Learning from each other within an organization is therefore important and requires overcoming structural, local, and cultural boundaries to get to a new learning culture for trainers (Hollatz and Ofstad, 2021) as well as apprentices, the latter ones not in scope of this thesis. Crossing internal boundaries to create and transfer know-how effectively in learning ecosystems in times of digital transformation is also a hot topic in

¹„Eines meiner großen Themen ist die Lernfähigkeit: Wie kann man die Leute nachhaltig beschäftigungsfähig halten?“ DIE ZEIT, Interview, 31.03.2021, p. 24.

corporate education management departments (Dudézert, 2018). That is why it is worthwhile to examine boundary spanning and learning more in depth.

VET in Germany, a tradition derived from medieval artisan skilling practice that has migrated into the era of industrialization and post-industrialization, has long since proven its relevance also in modern times. Dual Apprenticeships (DA) in general consist of (1) learning periods in the company (typically, a combination of learning-in-the-training-center and shop floor learning-on-the-job is applied), regulated by Chamber of Commerce and Industry (CCI) norms and exams as well as individual company's needs, and (2a) learning periods in the vocational schools, regulated by state norms. In recent years, Dual Studies Programs (DSP) have also emerged as a form of tertiary education, combining (1) and (2b) learning periods in a university or other academic institution.

As of today, DA constitutes a mainstream tertiary education path, as about 45% of absolvents with B-level exams from school enter the dual VET arena (Autorengruppe Bildungsberichterstattung, 2020, p. 167), while almost 30% of apprentices (Geis-Thöne, W., 2021) enter with A-level exams from school. Examples for A-level exams are “Abitur” in Germany or “Baccalauréat General” in France. It does not come as a surprise then that salaries and career opportunities are comparable in Germany for people with an apprenticeship background, enriched by some upskilling as Technician or Professional Master, compared to academic backgrounds in the technical (non-commercial) occupations (Flake, Werner and Zibrowius, 2016; Hall, 2021).

Hence, VET remains a successful pathway for young people into employability. Apprenticeship constitutes a relevant alternative to studying at a university level in Germany: in 2020, 465.700 new apprenticeship contracts were signed, whereas about 490.000 beginner students were counted (Destatis, 2022). On a macro-economic level, it avoids youth unemployment, whilst attracting young talent and paving their way into the workforce (Hansjosten, 2000).

Dual Study Programs (DSP), similar to the French “*apprentissage dans l'éducation supérieure*” or the British “*degree apprenticeships*”, are defined by Graf (2014) as a “*university cooperative education program[s]*” (Graf, 2014, p. 33) which integrate academic studies and practical work in the company where the student is employed during this time. Statistical data of VET can include students that are attending a dual study program if these students are inscribed in the CCI's records as apprentices in parallel, which is not always the case. Some DSP do not include the CCI exam.

Relevance and contribution to the area

Within research on international business, the notion of „**Boundary Spanner**“ (Aldrich and Herker, 1977; Barmeyer and Grosskopf, 2020) expands on the concept of social capital and intercultural competencies (Bourdieu, 1986; Nahapiet and Goshal, 1998) to create value for society and corporations by using such social capital to effectively overcome boundaries, i.e., borders separating organizations, individuals, cultures, entities etc., notwithstanding whether these borders are national, corporate, functional, or cultural (Schotter, Mudambi, Doz and Gaur, 2017). Boundary spanning has traditionally been used to explain how to maneuver across national, inter-cultural, inter-company or inter-group barriers, and is a term typically linked to persons and roles. Only lately, boundary spanning has been enlarged to “a set of communication and coordination activities performed by individuals within an organization and between organizations” (Schotter *et al.*, 2017, p. 404) where boundary objects like knowledge are shared via processes, tools (Carlile, 2004), activities, and methods (Roberts and Beamish, 2017).

This dissertation intends to explore how the concept of boundary spanning can be used in the context of transformation of a corporate HR service unit of VET. Boundary spanning can mean inter-function and intra-function activity and/or methods for change in response to digital transformation, VUCA and lately, COVID-19. In this DBA thesis, the boundaries are not only physical, but sometimes between traditional “old-school” VET methods and roles vs. those representing the new reality. These boundaries are intangible yet can be described. The scope is intra-national, partly intra-functional and represents a new aspect in boundary spanning literature.

As Morgan puts it, a learning organization “seeks to reinvent itself and create a new business orientation”, while “the process is completely paradoxical because learning has to be guided by key operating norms that, in turn, have to be constantly challenged” (Morgan, 1998, p. 89). In other words, the quest is to see how a learning department in a learning organization learns to learn new skills. Understanding how learning occurs in such dynamic corporate VET environment via boundary spanning within the context of digital transformation is both a topic of managerial relevance and one that has received little attention in the literature.

Research question being addressed

By empirically exploring in a single business case study how and why boundary objects such as information, innovation and competencies are shared by boundary spanning actors in VET, the author of this thesis, who is also the manager of a VET department that trains more than 3.000 apprentices and dual students in Germany in average per year, makes an original contribution to organizational behavior theory. At the same time, a practical problem of trainer upskilling in a modern-day VET environment will be addressed, which otherwise may lead to serious employability issues. The doctoral candidate's work draws on concepts of boundary spanning to better understand how digital transformation occurs in VET settings to foster creativity, organizational learning, and resilience. In this context, she identifies current research gaps with regards to boundary spanning propensity (Tang, Qiu and Zhang, 2018) and ways to achieve "high quality collaboration across intra-MNE boundaries" by formal and informal mechanisms between teams (Schotter *et al.*, 2017; Schotter, Maznevski and Doz, 2019, p. 3). The author seeks to contribute to the research body by adapting models of boundary spanning to learning scaffolds (Roberts and Beamish, 2017) and leadership (Ernst and Yip, 2009a; Birkinshaw, Ambos and Bouquet, 2017) in a VET learning context.

The research question therefore is understanding how and why boundary spanning occurs between traditional VET and new forms of education in the context of digital transformation. Subquestions to support this thesis' research question will be: What are the activities, motivations and conditions of boundary spanners in this VET case? How can management support boundary spanners in VET? How does boundary spanning help an organization in times of digital transformation?

The particular caveat is that the boundaries in this case are within the same national unit and within the same corporate unit, albeit in different regions and locations. This involves horizontal spanning boundaries, across mindsets and attitudes. For a diagrammatical illustration of boundaries facing VET, please refer to Figure 2.

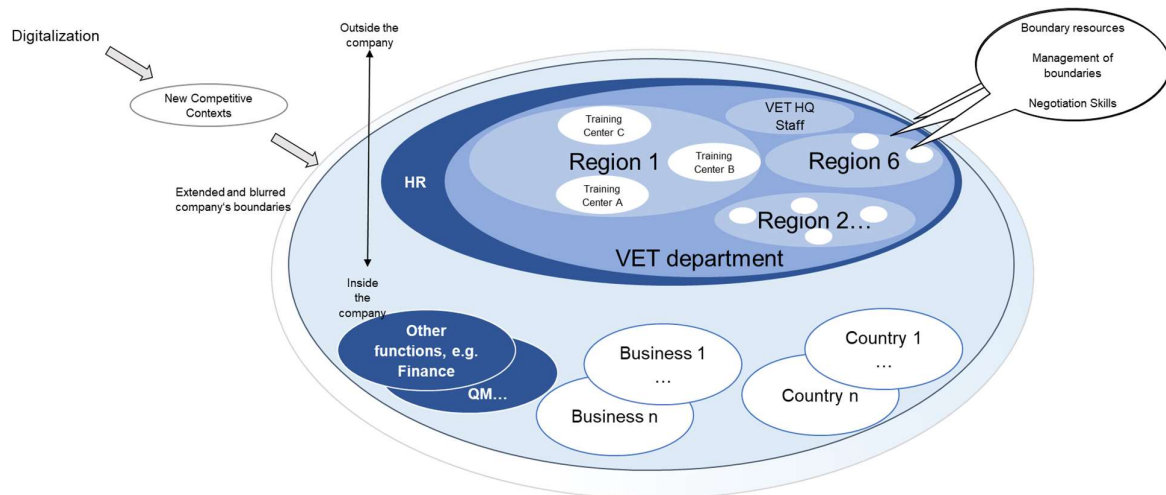


Figure 2: VET in a German MNE: Management of boundaries in times of digitalization. Adapted from Caputo, Fiorentino and Garzella, 2019, p. 404.

The scientific researcher would like to understand:

- How will extant concepts and theory in boundary spanning be enriched by this research?
- Why is the research context specific and interesting?
- Why are the research method and design suitable?

It will be this thesis' research contribution to analyze how and why boundary spanning can be taken out of the physical frontier context and applied to an intra-company, intra-function change management context, while discussing well-known concepts of management systems theory and concepts of leadership in management. Boundary spanning is not only considered in the context of roles and motivations, but also in the context of processes and methods, i.e., as “organizational level research” (Schotter *et al.*, 2017, p. 406).

This research will focus specifically on the case of a VET corporate unit of a German industrial MNE organization. Here, future talents are built up and core values are taught as part of the culture along with the development of knowledge and skills: boundary spanning in the scientifically novel context of VET in digital transformation as a special form of corporate learning will be explored, the object of which are VET trainers. This research will not focus on apprentices.

The single case study will be a German MNE in the high-tech industry. In environments like industrial automation, electrification and smart infrastructure, the repercussions of digitalization, notably of the Internet of Things (IoT), on markets, technologies and skills are most relevant, widely known and truly profound. A multinational company like the one of the

proposed case has a vast pool of apprentices, training centers and VET trainers, such that repercussions on vocational learnings can be observed qualitatively, in suitable quantities, and as a quasi-homogeneous population (same company, same country, same management). A topic of changing skills and behavioral adaption to new learning requirements via boundary spanning is complex, the subjective experience of individuals is required to understand the picture holistically. Therefore, an in-depth case study with qualitative and quantitative assessment of change is an apt methodology to pursue.

A constructive interpretive paradigm will be adopted to assess the experience of boundary spanning in VET via the eyes and feelings of various stakeholders in a VET department, thereby allowing “Shared sensemaking of experience” (Romani, Barmeyer, Primecz and Pilhofer, 2018, p. 250) and “local reinterpretation of management processes and tools [...] during the transfer of corporate values and code of conducts or knowledge management systems” (Romani *et al.*, 2018, p. 251). At the same time, potential bias will be avoided, as the thesis’ author is part of the management of the VET unit.

A case study-based mixed-method research methodology in an exploratory sequential design will be chosen to ensure validity and objectivity, as quantitative data can help alleviate potential bias, which may otherwise occur in purely qualitative research, due to the author’s single researcher position and managerial role. The two-step mixed-method approach in an exploratory sequential design can also obtain a more comprehensive understanding and to expand reliability and generalizability of the results. Qualitative research with semi-structured interviews of VET managers, trainers and stakeholders will be followed up by a second step quantitative survey with the entire VET team. Quantitative data can strengthen the findings (Eisenhardt, 1989) and potentially validate mechanisms which will help transition to new boundary spanning concepts, or amend existing concepts, in the specific area of VET. These primary data, of both qualitative and quantitative manner, will be complemented with secondary analysis encompassing documents, data, and observations, to give a holistic description of the case at hand.

The author of this thesis is part of the VET management team with first-hand contributions to the case study. In order to use this rich case for research which would otherwise not be available to the academic community, it is important to control potential bias resulting from the author’s double role as researcher-manager. To this aim, an interpretive paradigm will be chosen, thorough interview protocol adherence will be followed, the thesis supervisor will serve as a

sparring partner as needed, and qualitative and quantitative research will be combined. Several events with management are included into the research process to validate results.

For practitioners working in the fields of Human Resources and VET, the added value of this research lies in understanding whether and how boundary spanning can help social learning, digital transformation, and sustainability of operations. To this aim, activities, motivations, and consequences of successful boundary spanning will be explored. Furthermore, it will be of interest to understand how managers can fuel learning and transformation of trainers.

The thesis is structured as follows:

At the beginning, the literature review (chapter 1) will outline the current status of research regarding digital transformation and its impact on concepts in organizational and change theory, corporate learning and VET theory and practice, before thoroughly discussing the research status on boundary spanning with a particular focus on learning and change.

Chapter 2 will explain the chosen research methodology and design as well as the paradigmatic stance of the author.

This will be followed in chapter 3 by a rich contextual description of the case at hand – a German MNE in the high-tech industry undergoing change in order to prepare for the digital future.

The qualitative and quantitative research findings will be thereafter presented (chapter 4) and discussed (chapter 5).

A conclusion (chapter 6) will summarize the major findings and situate them both in the academic research context and in the managerial practices. It will also point out the shortcomings of the present dissertation and outline relevant future research avenues that can foster and expand these research results.

1. Literature review

The literature review will be structured into four different subchapters. A first subchapter will discuss **digital transformation** in the academic literature and its impact on organizational and change theory. Scientific findings concerning leadership and culture will be considered as they become relevant to the holistic assessment of the case study further on in the thesis. A special detour regarding technology adoption (stemming from information and knowledge management theory, vastly used in marketing management to explain consumer behavior) will be pursued, in order to assess whether Technology Acceptance Models (TAM) may be able to explain some VET trainer behavior and attitude towards new technologies and methodologies in the following chapters of the thesis.

A second subchapter of this literature review will focus on the current state of the art regarding **organizational learning** theories with a special focus on vocational education and training in the German context. It will furthermore analyze what digital transformation means for corporate learning and VET departments in MNE today.

The literature review will then introduce the notion of **boundary spanning** in international management and organization theory and discuss the different concepts and theories around boundary spanning.

In a final subchapter, the **research gap** in the context of intra-organization boundary spanning research will be illustrated, to make the reader understand the theoretical relevance of this DBA thesis and its contribution to research.

This dissertation follows an abductive research design, intending to build theory from case study research. However, the literature review has been led and is presented before the empirical case study, because a “priori specification of constructs can [...] help to shape the initial design of theory building research” (Eisenhardt, 1989, p. 536). With this mindset, the literature research is carried out.

1.1. Digital Transformation

Digital Transformation (DT) – in contrast to digitalization and digitization – is a notion describing intended systemic change due to the appearance and implementation of digital technologies in management and society. Gong and Ribiere (2021), in their scientific literature

review on the topic, define it as “fundamental change process enabled by digital technologies that aims to bring radical improvement and innovation to an entity [e.g., an organization, a business network, an industry, or society] to create value for its stakeholders by strategically leveraging its key resources and capabilities” (Gong and Ribiere, 2021, p. 10).

Digitization refers to the mere transfer of analogous information into digital one (Gong and Ribiere, 2021). Digitalization can be defined as “sociotechnical process of applying digitizing techniques to broader social and institutional contexts that render digital technologies infrastructural” (Tilson, Lyytinen and Sørensen, 2010, p. 749). Hence, “DT is not just an organizational issue, but it is becoming more and more an ecosystem and societal challenge and necessity” (Gong and Ribiere, 2021, p. 15).

1.1.1. Digital transformation seen through the lens of Organizational Theory

Digital transformation – such holistic change as described by Gong and Ribiere (2021), using key resources and skills to increase the value of an entire ecosystem – can be experienced in many areas of economy today. Throughout all industries, digital transformation has occurred. It can be experienced on an individual or social level as opportunity fostering innovation and creating value or, as mentioned in the introduction, as social pain, if individual skills or corporate competencies do not match today’s needs. On a corporate level, it is reflected in the corporate mission narratives, its strategy directives, and most functional operations.

Prominent scholars of modern organizational theory, having learned from the U.S. MNEs as well as from military structures and successes all over the world, taught early that structure was to follow strategy (Chandler, 1962), while “[o]rganizational design and structure require thinking, analysis and a systematic approach” (Drucker, 1974, p. 50). While structure and hierarchies were accepted to be relevant tools for effective management, it was equally understood that organizations could not only depend on them, but also needed flexible task forces and individuals to work on temporal projects, as an organization is always a “means to an end” (Drucker, 1974, p. 52). Such flexibility also allows for strategic re-assessment in case of trends like DT.

In the 1980s, the 7-S framework was introduced for organizational analysis and orchestration of change. The claim of McKinsey was “that effective organizational change is really the relationship between structure, strategy, systems, style, skills, staff, and something that is called superordinate goals” (Waterman, Peters, Phillips, 1980, p. 17). Such alignment of all elements

of management and organizational theory was simply put, yet powerful as a message, because the hard “S” – structure, strategy, systems – and the soft “S” (skills, staff, style, and subordinate goals) were brought to one level while the interdependence of these elements was underlined. More than that: “To many managers the word ‘system’ has a dull, plodding, middle-management sound. Yet, it is astonishing how powerfully system changes can enhance organization effectiveness without the disruptive side-effects that so often ensue from tinkering with structure.” (Waterman *et al.*, 1980, p. 21). In times of DT, such systems are essential for capturing the relevant myriads of data effectively, aiming to turn them into business intelligence, i.e., value-add. Taking the example of IoT, more than 10 billion of devices have already been already connected (PR Newswire US, 2020) and the market is expected to grow. In comparison to what is estimated with respect to the internet of people, connecting 4.4 billion people all around the globe via social media by 2025, IoT represents yet another dimension of data. Having systems able to process, analyze, interpret, and create value of these (machine) data will be the deal maker or breaker for high-tech corporations. It does not come as a surprise, however, that legacy systems may not always constitute a market entry barrier. To the contrary: new entrants, to speak in M.E. Porter’s terms, may very well be better equipped and overcome entry barrier by process or product innovation and “leapfrogging the industry leaders” (Porter, 1979, p. 139).

Skills, to come back to Waterman *et al.*’s (1980) concept, have sometimes been exchanged for “reSources” in later research on strategy execution and systems have been amended to “systems and processes” (Higgins, 2005, p. 5). Furthermore, “strategic performance” has been added as a second-level variable which transforms the model into the eight ‘S’s of strategy execution (Higgins, 2005, p. 5). Yet, the basic validity of the 7S-strategy and its usefulness for strategic performance and change management has prevailed and some of the “S” elements will be used to describe the case at hand in chapter 3.

Resource-based theory, among which Nahapiet and Goshal (2018) who situate their research on social capital as a competitive advantage in line with such theory, understands competitive advantage of a company to be dependent on its unique combination of resources, the latter ones specific, seldom, untradeable and not able to copied. Acedo, Barroso and Galan (2006) identify the research of Nahapiet and Goshal (2018) to integrate elements of knowledge-based theory as well. Both resource-based theory and knowledge-based theory are very suitable to explain modern organizational change and company boundaries: “If the primary resource of the firm is knowledge, if knowledge is owned by employees, if most of this knowledge can only be

exercised by the individuals who possess it” (Grant, 1996, p. 120), then such knowledge needs to be actively shared and proliferated in an organization by orchestrating strategy, systems, style, skills, staff, and superordinate goals (Waterman *et al.*, 1980).

Another approach to systems in organizational theory lies in the conceptualization of loosely coupled systems (LCS). One of its first contextualizations was in educational organizations (Weick, 1976). LCS can be used to explain organizational relationships between organizations or between activities, between hierarchical levels, between an organization and its environment. It is defined as a “situation in which elements are responsive but retain evidence of separateness and identity” (Orton and Weick, 1990, p. 203). The LCS model is characterized by its dialectical interpretation: “If there is both distinctiveness and responsiveness, the system is loosely coupled” (Orton and Weick, 1990, p. 205). According to Orton and Weick (1990), LCS can be considered a management theory. Its demand for flexibility corresponds to the findings of Drucker (1974) and Waterman *et al.* (1980) in that organizations need a certain amount of flexibility, i.e., loose coupling, to enable excellent performance. Orton and Weick (1990) specifically mention Peters and Waterman (1982) in their paper. For these reasons, LCS lends itself to explain mechanisms in an ecosystem.

The observed need for flexibility in organizations is also reflected by Mintzberg’s adhocracy organization type (Mintzberg, 1979; Morgan, 1998). As environments become complex and uncertain and VUCA prevails, simple structures and adhocracy are most likely to be successful. Simple structures can rather be found in a start-up company environment. Traditional companies may mimic such simplicity by a phenomenon called adhocracy. As Morgan points out: “‘Adhocracies’, ‘virtual teams’, and ‘virtual organizations’ now abound in innovative firms in the electronic and other high-tech and rapidly changing industries. [...] This form of organization also sometimes emerges as a differentiated unit of a larger organization: for example, an ad hoc task group or project team performing a limited assignment” (Morgan, 1998, p. 52).

Organizations, as illustrated in this subunit, allow for new phenomena, by designing the required flexibility into their systems, structures, and methods. The soft “S” will be picked up again in 3.1.3, when leadership, culture and corporate learning in DT are discussed.

Beyond flexibility, “[organizational] resilience as the maintenance of positive adjustment under challenging conditions such that the organization emerges from those conditions strengthened and more resourceful”, which values “past learning and fosters future learning but exists

independently of learning activities in that resilience represents a broader store of capabilities” (Vogus and Sutcliffe, 2007, p. 3418) is a relevant concept of what it takes for an organization to undergo digital transformation, and lately, the COVID-19 pandemic, successfully.

1.1.2. Digital Transformation seen through the lens of Change Theory

As Gareth Morgan (1998, p. 35) puts it, organizations are like organisms constantly “seeking to adapt and survive in a changing environment”. Such contingency is obviously visible in times of DT. In academic theory, this is reflected by change theory. To complement organizational theory (as discussed in chapter 1.1.1) current literature about change management theory will be analyzed in more depth, with a special caveat focusing on technology adoption.

As organizations, environments and people change, managing change has long since been a process under scrutiny. When the beginnings of management theories and Taylorism were optimizing labor, systems and structures under perceived stable conditions, contingency models explored business and management under varying conditions.

Change management and system theory exemplified by metaphors like organizations as brains or as organisms were better equipped to explain change: “When you view organizations as brains, you find yourself thinking about information processing systems, learning capacities and disabilities” (Morgan, 2011, p. 468). This metaphor will be retained for the present research, as it allows organizations to be considered open systems, with managers as connecting agents and information processing as source for intelligence and success. In this context, it is also worthwhile to point out that learning capabilities of an organization translate into organizational learning, which is the essence of a VET department and strategy orchestrating the competencies of the future talent pipeline.

Today’s changes in the corporate world – Internet of things, digitalization, social media, VUCA, lately, COVID-19 – are vast and all-incumbent, and often related to technology adoption. Although digitalization and digital transformation are not the same as technology, they are closely linked.

One of the standard theories for technology adoption modelling (TAM) was developed by Davis (1989). It states that user adoption of technology is positively influenced by the ease of use and perceived benefit, whereas ease of use is deemed less important (and partly offset by a learning curve) if the perceived benefit is high enough (Davis, 1989). This very robust model was confirmed by its replicability and generalization capacity as well as its predictive validity

(Venkatesh, David and Morris, 2007). Other technology adoption theories have emerged since then (Oliveira and Martins, 2011), but its generalization capability differentiates it from other models.

While Davis (1989) initially focuses his model on the individual user, other models (Oliveira and Martins, 2011) expand technology adoption modelling to align technology with the organization and the environment.

TAM was also enlarged to include other antecedent variables. Along with other models, unified theories of acceptance and use of technology followed, one of which will be mentioned here. UTAUT2 – unified theory of acceptance and use of technology 2 – was developed by Venkatesh, Thong and Xu (2012). This approach integrated performance and effort expectancy elements as well as behavioral intentions and social influence into one single model of technology adaptation for explanation of technology use by employees.

TAM2 (Venkatesh and Davis, 2000) – which includes social influence factors (subjective norm, voluntariness, and image) and “cognitive instrumental processes” (job relevance, output quality, result demonstrability, ...) to explain effects on user acceptance – may be an equally relevant concept to consider in this thesis, because it is widely accepted and used and it takes into consideration a variety of psychometric values of use as well as – indirectly – the organizational expectations (via subjective norm, image, output quality). It is illustrated in Figure 3.

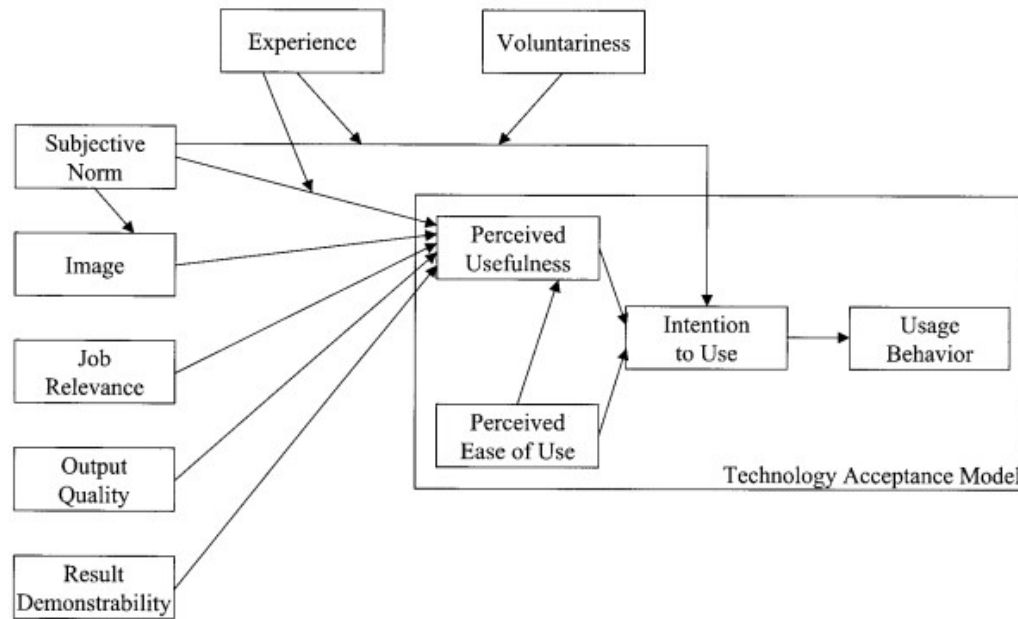


Figure 3: TAM 2 (Venkatesh and Davis, 2000, p. 188)

Furthermore, current research considers the increasing dynamics of technology and environmental conditions. Technology changes in organizations today cannot be managed by applying classical models where change is to be planned, executed and afterwards, the organization aims for stability again (Lewin, 1947; cited by Orlikowski and Hofman, 1997, p. 265). “Predefining the technological changes to be implemented [...] is not feasible” (Orlikowski and Hofman, 1997, p. 266); hence, Orlikowski and Hofman (1997) suggest an improvisation model for managing technological transformation and state that technology implementations can be considered as ongoing processes rather than events. They differentiate three types of change, i.e., anticipated change, emergent change, and opportunity-based change, due to experimenting with new technology. In the case study presented by Orlikowski and Hofman (1997), methods of opportunity-induced changes include setting up pairs of junior-senior specialists to leverage opportunities, as well as a new role of intermediary for these pairs. It may also be worthwhile to pay attention to the age groups at work, as digital natives (those growing up with digital technologies) and digital immigrants (those who did not) collaborate and mitigation for leveraging digital fluency or managing variance in digital fluency may be useful (Colbert, Yee and George, 2016).

1.1.3. Digital Transformation seen through the lens of Leadership and Culture

Another aspect of Orlikowski and Hofman's (1997) research contribution is the recommendation to align a company's adjustment process with its strategy and organization to make change effective. According to them, this also includes appropriate mechanisms and authority levels to implement ongoing changes. Such required convergence of soft and hard elements of corporate artefacts resembles to what Waterman *et al.* (1980) published about their 7S-Strategy.

Digital transformation as yet another change? Its definition as "fundamental change process enabled by digital technologies that aims to bring radical improvement and innovation to an entity [e.g., an organization, a business network, an industry, or ecosystem] to create value for its stakeholders *by strategically leveraging its key resources and capabilities*" (Gong and Ribiere, 2021, p. 10) explains it to be a paradigm shift and a source of competitive sustainability, if done well, rather than just another trend to obey to. This definition further implies that leadership and culture play an important role as carriers of messages and of learnings regarding these key resources and capabilities. This is confirmed by Schwarzmüller, Brosi, Duman and Welpé (2018). In their qualitative expert interviews, they identify the implications of DT for key resources and capabilities, ranging from (a) "work life and health", (b) "information and communication technology use", (c) "performance and talent management" to (d) "organizational hierarchies" (Schwarzmüller *et al.*, p. 122). As to leadership in DT, their research shows an "increased importance of relationship-based leadership" (Schwarzmüller *et al.*, 2018, p. 130), to see the person behind the employee, who is assumed to be able to problem-solve independently of hierarchy. At the same time, such person should be supported by a leader apt at networking and teambuilding in an environment where information is transparent. Effective leadership styles in times of digital transformation aim at building cohesive teams.

"It has now become imperative for leaders leading in this new digital era to improve the vision, communicate effectively, and include ideas from both team members and all stakeholders across the organization" (Kazim, 2019, p. 31). Snow, Fjeldstad and Langer (2017) even advocate for an "actor-oriented organizational architecture" since they deem hierarchical management styles unfit for a digital organization. Reducing hierarchy to the minimum means in return that every actor requires work skills like those of a leader: sense-making, social intelligence, cross-cultural competency, and virtual collaboration among others (Snow *et al.*, 2017, p. 5).

This resonates well with Gong and Ribiere (2021) who, when defining DT, added resources and capabilities to reflect the human and leadership aspects as vital parts of the DT phenomenon. With their definition on DT to “create value for its stakeholders by strategically leveraging its key resources and capabilities”, they indeed pick up on those two soft “S” again, i.e., staff and skills, mentioned by Waterman *et al.* (1980, p. 17), to serve value in an ecosystem.

DT and its challenges, e.g., the abovementioned hierarchy-less or actor-oriented organizational architecture, but also mind-set shifts, new business models and cross-cultural collaboration bring about changes in organizational culture (Snow *et al.*, 2017; Kazim, 2019).

Managing boundaries in this new game becomes a specific skill to succeed (Caputo, Fiorentino, Garzella, 2019). This new arena (see Figure 4) is characterized by the notion of ecosystems, that bring external and internal partners’ value chains together for joint value creation for the customer. It may even require a reconsideration of boundaries or, as Caputo *et al.* (2019, p. 391) put it: the focus shifts “from the boundaries of management to the management of boundaries”. This may give new angles to future research on boundary spanning, corporate culture, and leadership skills. Put differently, in an ecosystem where external and internal players act, the boundaries between organizations blur and need to be understood in an ecosystem context.

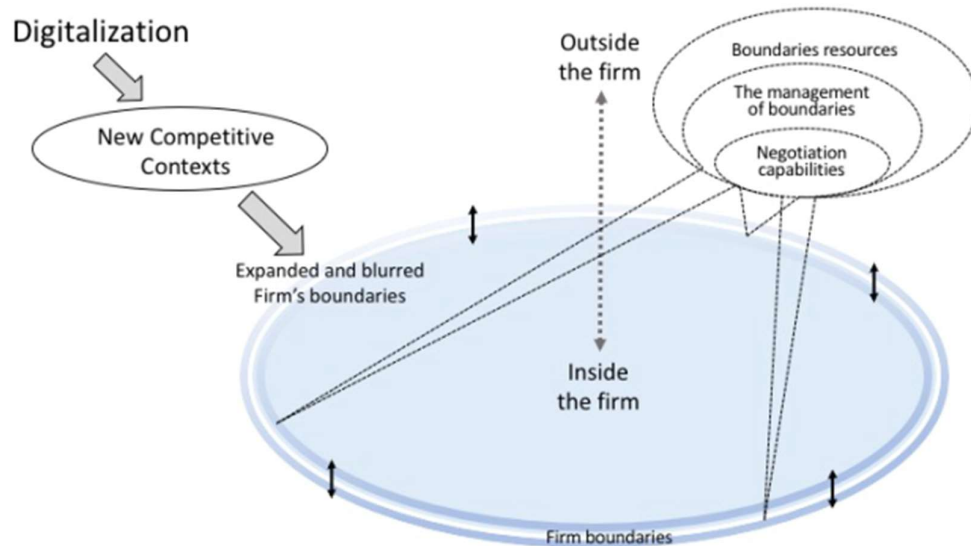


Figure 4: Management of boundaries in times of digitalization (Caputo, Fiorentino and Garzella, 2019, p. 404).

Culture as defined by Schein (1990) – characterized by its group-inherent learning aspects as to problem-solving approaches – is considered a theoretical concept that can facilitate perception, thoughts, and feelings around these rather rigid management tools.

Weick and Sutcliffe (2015), in their book “Managing the Unexpected”, refer to culture and to Peters and Waterman (1982), stating that “the possibility that culture can simultaneously produce stability and flexibility was one of the important contributions to theory [...]. Loose tight was a summary phrase that stood for the idea that firms should tightly couple their employees to a small number of values that must be followed (usually no more than three) but allow discretion on everything else” (Weick and Sutcliffe, 2015, pp. 132-133). Hence, culture can be the bracket to hold a company together by shared values, even though boundaries start to blur.

1.2. From digital transformation to corporate learning: change as a challenge for Human Resources Management and Vocational Education and Training

1.2.1. From Human Resources specialist operator to change agent

As corporate culture changes and boundaries blur, triggered by DT, so are the roles and the self-understanding of HR. Due to DT, Robotic Process Automation (RPA) has entered HRM and automated standard and repetitive activities in HR whilst reducing process time. RPA can be used for candidate pre-selection in recruitment, management of recruitment documents, onboarding, and training, respectively training management. This leads to changing roles in HRM, since tasks of the HR specialist operator are automated. At the same time, new roles in HR emerge, e.g., change agents, RPA project managers, Data Analysts, and HR consultants to the line functions (Rotter, 2021; Saukkonen, Kreis, Obermayer, Rodriguez and Haaranen, 2019).

1.2.2. From individual, initial learning to continuous organizational learning

Digital transformation (DT) puts different demands on corporate learning, corporate training and vocational education and training. In chapter 1.1.3 it was illustrated that due to changes in information and communication technology use, talent management changes as well (Schwarz Müller *et al.*, 2018).

Referring to the images of organizations as brains (Morgan, 1998) or open systems, information processing as source for intelligence and success needs to be adapted when the environment changes. Morgan further comments that “the idea of developing capacities for individual and organizational learning has established itself as a key priority in designing and managing organizations that can deal with the challenges of a turbulent world” (Morgan, 1998, p. 79).

Different stages of learning can be differentiated in research, which are often described as single-loop or double-loop learning. Single-loop learning is typically done by one or few members of the organization and may result in a change of procedure or routine (Morgan, 1998; Argyris, 2002; Bartel-Radic and Paturel, 2006; Seufert, Schuchmann, Meier, and Fandel-Meyer, T., 2016b). While “single-loop learning” describes organizational learning without questioning the underlying values, double-loop learning also reestablishes the appropriateness of these conscient or subconscious corporate values or rules before execution of suitable responses (Morgan, 1998). Organizational learning leads to organizational competency: “When learning is “embedded” within the organization through routines or shared mental models, it is considered to be OL from which organizational competence may arise” (Bartel-Radic, 2013, p. 241). OL has shown to happen in three phases: a top-level management phase, a management phase and finally, a phase where many levels of the organization learn which represents a change in the organizational culture (Bartel-Radic, 2013). As Vogus and Sutcliffe (2007, p. 3421) put it, efficient learning to “continuously refine and update [...] understanding of the status of ongoing operations and the environment” becomes vital for resilient organizations.

Learning is also considered an organizational capability by Kusunoki, Nonaka and Nagata (1998), and such organizational capability can constitute a barrier of entry as well as a source of sustainable competitive advantage. It consists of multilayered knowledge that can be local (object-based), architectural (function-based) or process-oriented (interaction and communication across boundaries). The more knowledge becomes architectural and process oriented, the less it can be described as individual knowledge, and the more it becomes dynamic and firm specific. Organizational learning is dependent of corporate culture (Flores, Zheng, Rau and Thomas, 2012). Other research streams characterize organizational ambidexterity – i.e., striving for exploiting the present while exploring the future regarding alignment and adaptability – as a concept to explain why learning is so important for organizational effectiveness (Gibson and Birkinshaw, 2004).

Schuchmann and Seufert (2015), in their research contribution about organizational development and innovation in the banking sector, put it bluntly: “Ultimately, the

organization’s continuous learning is the essential precondition for its capability to be innovative” (Schuchmann and Seufert, 2015, p. 31). They advocate for managers’ and organizations’ competency development to enable employees’ ability to change. Their four levels of organizational learning (see Table 1) aim for “continuous learning and development” with the “objective of innovation” (Schuchmann and Seufert, 2015, p. 33) while pointing out the different goals on an individual, team level, organizational and global level of learning.

Global Level	<ul style="list-style-type: none"> - Connect the organization to its environment - Motivate actors to share the same vision
Organizational Level	<ul style="list-style-type: none"> - Ensure to take learning impulses into account - Ensure to generate, use, and share knowledge
Team Level	<ul style="list-style-type: none"> - Afford collaboration and “learning to learn”
Individual Level	<ul style="list-style-type: none"> - Encourage the actors for trial, asking questions and discussions - Afford continuous learning (create learning infrastructures and appropriate working conditions) - Foster employees’ intrinsic motivation

Table 1: Four levels of organizational learning (Schuchmann and Seufert, 2015, p. 33)

On a team level, “learning to learn” and advocating collaboration is important. On an organizational level, awareness to generate use and share knowledge is essential, while learning impulses can be given by, e.g., encouraging and embracing taking time to learn, by goals, metrics, and role models:

As per Figure 5, their organization learning framework posits strategy, structure, and culture as the core of a learning organization. A learning organization depends on a learning-/innovation-oriented leadership development. Individual competency development to promote innovative behavior is equally part of the framework of a learning organization. The design of infrastructure able to promote learning and development should not be forgotten, e.g., tools like social networking systems (SNS) to promote virtual learning communities (Karoui, Dudézert and Leidner, 2015). A final action area of a learning organization are innovative forms of work and networking, sometimes referred to as new work. This framework of four pillars is dependent on human resource development and organizational development (Seufert *et al.*, 2016b, p. 290).

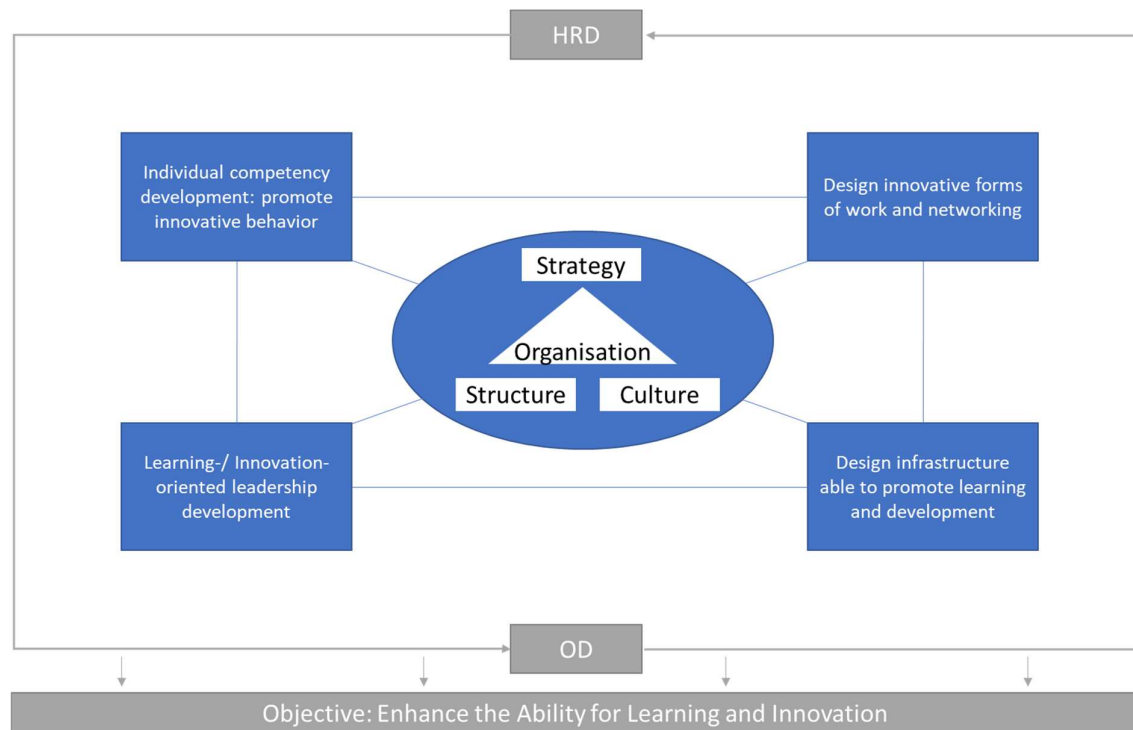


Figure 5: Four action areas for a learning organization (Seufert et al., 2016b, p. 290)

Designing such a learning organization requires continuous learning for employees, managers, and the organization. This way, an organization can cope with substantial changes such as DT, i.e., be resilient, because it realizes that this transformation is more about human resources than technological resources (Moehrle, 2020).

In a systematic literature review, Widmann, Messmann and Mulder (2016) identify leaders' possibilities to encourage and facilitate innovative work behavior by team learning behaviors: by providing social interaction, by allowing for visibility of teams' progress and by creating a work environment that clearly allows for structures and goals whilst stimulating safety and trust. Team learning behaviors, e.g., knowledge sharing and team reflexivity and, at later stages of innovation creation, boundary spanning (i.e., reaching beyond the team's knowledge) can foster innovative work behavior, while remaining an unstructured and dynamic process (Widmann, Mulder and König, 2019). As this study from 2019 was conducted in a VET teachers' vocational school context, it makes it particularly relevant for this thesis.

1.2.3. From classroom training to self-guided training

Since “the entire workforce must be mobilized and prepared for a decade of reskilling and upskilling [...], concepts such as life-long learning and adaptive personalized learning have to be turned from idea into reality” (Moehrle, 2020, p. 50). The author mentions examples from Novartis, Shell and Siemens who deploy major campaigns and funds to close the digital skills gap, while also promoting agility and engaging leadership in such endeavor for holistic corporate learning approaches.

With the possibilities of digital learning platforms (DLP) and new learning providers entering the corporate learning arena, corporate learning becomes more flexible and more individual. In the past, scheduled classroom trainings were part of regular corporate trainings. Today, corporate training comes to the users who, enabled by individualized learning platforms, can set up personal learning interests and learning paths (fueled by individually set preferences or artificial intelligence –AI– based suggestions), assess individual competencies and development vectors, monitor, and control individual learning progress and furthermore select time and location of their learning journey (Mehta, Chauhan, Gupta and Jaiswal, 2021). This can put responsibility for learning on the employee as much as on the manager.

The COVID-19 pandemic situation has furthermore accelerated use of DLP in corporate learning environments (Mehta *et al.*, 2021). Both ongoing learning (upskilling, reskilling) as well as initial learning (dual VET, dual study programs) have been turbo-digitalized and turbo-individualized due to the environmental constraints following the shut-down because of COVID-19.

As Seufert and Meier (2016a) recommend to education providers, the portfolio of education offers needs to be expanded beyond classical classroom trainings and transfer oriented formats (see Figure 6). Curation of content on the one hand, but also moderated learning processes in the work environment (e.g., peer coaching, case studies) as well as dynamic exchange and learning in ecosystem-like networks are part of today’s palette of learning offers with the aim to foster empowerment and innovation.

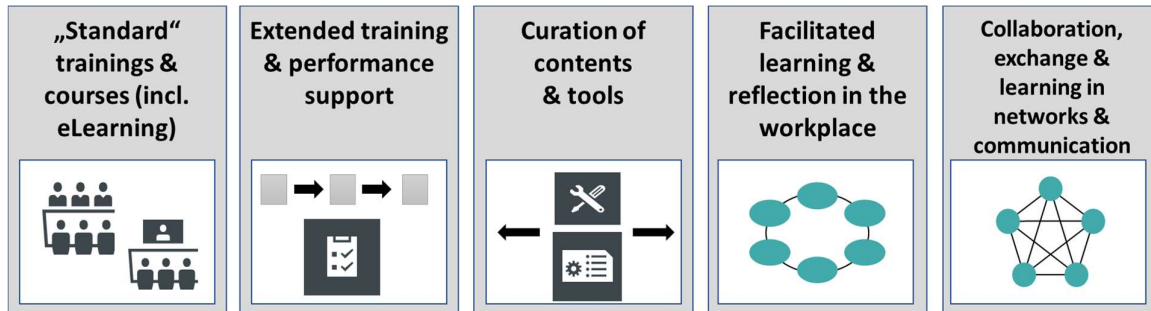


Figure 6: Extended portfolio of offerings for education providers (Seufert and Meier, 2016a, p. 30).

New learning models like dynamic exchange (Widmann *et al.*, 2016) and learning in communities (Seufert and Meyer, 2016a) appear less formal, more individually steerable and more learner-centric, but nonetheless constitute forms of team learning.

1.2.4. From VET trainer to coach

DT provides changes for HRM and corporate learning. Furthermore, it also transforms how, when, and where individual learning in corporate contexts takes place. As the requirements of corporations are different in today's times of DT, the national regulations on VET also undergo changes. VET is culturally woven into the national education systems, which makes local and national politicians and administrations to stakeholders in the VET ecosystem. Yet, it is important to state that it is not unilaterally praised around the globe. A recent feature in the Harvard Business Review from a U.S.-American professor in higher education gives a passionate vow regarding the benefits of higher education vs. skills training (Kuh, 2019).

Having said this, in Germany there is still a broad acceptance for dual VET as a relevant and resilient path for employment and skilled labor. Metal and electrical VET in Germany has recently been modernized. Since August 2018, for each of the 11 occupations in the metal and electronic fields, the topics of digitalization of work, data and information security have become a requirement of the legally binding occupational curricula. Furthermore, a number of additional qualifications (e.g., additive manufacturing, process integration) can be acquired via an optional CCI certificate, allowing companies to specifically build up competencies for DT (Bundesinstitut für Berufsbildung, 2018a). The optional CCI certificates can also be used for upskilling.

VET needs to prepare learners for day-one readiness in the corporate world. When corporate learning becomes digitalized and self-organized and the learner is responsible for progress, this needs to be practiced during apprenticeship to prepare for life as a normal employee. Hence, the entry of modern learning methods in VET is so important (Hollatz and Ofstad, 2021).

Besides the curricular changes following DT, the role of the VET trainer adapts as well. Modern methods and didactics which emerge in corporate learning (see 1.2.3.) do not stop at the doors of VET training centers: more learner-centric approaches appear, digitalized (virtual/hybrid) learning formats and contents become popular in the vocational education and training arena. Bitkom, Germany's Digital Association, requires offers for upskilling teachers and VET trainers to enhance the possibilities of digital offerings (Bitkom, 2018). Corporate VET trainers, along with all other employees, can benefit from corporate learning programs and DLPs. Furthermore, life-long learning concepts and DT change the role of the VET trainer and what and how they need to learn (Hollatz and Ofstad, 2021).

Under COVID-19 induced pandemic conditions, digital literacy became mandatory for each VET trainer literally overnight to avoid short-time work for both VET staff and VET learners, let alone to avoid suboptimal learning for the young apprentices and dual students. A climate of trust under these virtual circumstances (Brahm and Kunze, 2012) as well as individual coaching and learning methods were the logical consequence in many companies and VET settings.

1.3. Research on boundary spanning

DT requires organizations with their structure and strategy and their built-in change and flexibility potential (Weick, 1976; Orton and Weick, 1990; Morgan 1998; Orlikowski and Hofman, 1997) to think of themselves as parts of “ecosystems” (Gong and Ribiere, 2021, p. 15; Caputo *et al.*, 2019) where collaboration across and management of boundaries (Kazim, 2019) are relevant for success, while new learning models such as dynamic exchange and learning in ecosystems or communities appear less formal, more individually steerable and more learner-centric (Schuchmann and Seufert, 2015; Widmann *et al.*, 2016).

It will be the quest of this thesis to understand why and how boundary spanning occurs between traditional VET and new forms of education and training in the context of digital transformation and learning ecosystems. In the previous section of the literature review, digital transformation, and its implications on research on organizational theory, in particular leadership and culture

have been defined. Boundary spanning as a relevant skill in building ecosystems, has also been touched on. Furthermore, it has been discussed how DT impacts corporate learning, shifts the boundaries between what is deemed external and internal in an ecosystem, and the role of VET trainers in learning ecosystems.

The following part of the literature review will focus on the notion of boundary spanning and whether and how concepts of boundary spanning in international management and intercultural management can help to describe and understand transformation of traditional VET into new forms of education and training.

1.3.1. History of the boundary spanning notion

The notion of organizational boundaries spanning roles goes back to the seventies. Then, research in organizational behavior started to focus on the role of boundary spanners, where “boundaries are a defining characteristic of organizations” (Aldrich and Herker, 1977, p. 217) and boundary roles are defined as bridging from within the organization to the outside with the explicit role of information processing and outside representation (Aldrich and Herker, 1977; Joshi, Pandey and Han, 2009). In their conceptualization of the interface of an enterprise vs. the environment, Aldrich and Herker formulate the hypothesis that the need for boundary spanners in rapidly changing environments is higher than in environments characterized by stability. A second hypothesis at that time consists of the power of boundary spanners being dependent of routinization and own expertise of the person fulfilling the boundary spanner role.

Other streams of research position boundary spanning in the broader context of sociological studies, naming Marx, Weber and Bourdieu and their quest for understanding “social and economic processes” also a research journey along boundaries and status, while resuming that “this broad view may, however, complicate a precise understanding of the boundary phenomenon itself” (Jaeger and Pedersen, 2020, p. 3).

In 1976, Leifer and Delbecq, presented a model of boundary spanning activities where boundary spanners observe the environment and filter select information for their organization, thereby acting as an influencing “variable” (Leifer and Delbecq, 1976, p. 48) between the organization and its environment.

In their review of inter-organizational boundary-spanning literature of 10 top journals (Financial Times ranking), Tang *et al.* (2018) systematically analyze whether boundary spanning is more than just an organizational phenomenon. They classify the roles of boundary

spanning and summarize their effects on organizations, including both positive and negative effects. Their findings show that boundary spanning literature can be classified into three phases: it started in the 1970s, with slow increase of research activities in the 80s and 90s. After the millennial, Boundary Spanning became a study subject of higher concern, illustrated by two calls for research in 2014 and 2019 by the Journal of Management Studies.

Tang *et al.* (2018) do not consider boundary spanning as a unified theory yet. From their point of view, research gaps exist as to collective effects of boundary spanning on management, organizations, and performance. Despite this, they include select studies that articulate the double-edged sword of boundary spanning activities that may have bottleneck effects if not done well (e.g., Kane and Levina, 2017). They furthermore ask for more research “on B[oundary] S[panning] propensities, suggesting that the extant literature does not present clearly how well the B[oundary] S[panning] roles are played in the organization. Therefore, research on the measurement scale of ‘level of boundary spanning (propensity)’ is called for attention to extend our understanding of [...] roles” (Tang *et al.*, 2018, p. 24).

Tang *et al.* (2018) also comment that the proliferation of knowledge as well as learning aspects have become more interesting for research on boundary spanning than just information and knowledge, which will be illustrated in the next subchapter.

1.3.2. From inter-organizational boundary spanning to intra-organizational boundary spanning

Within multi-national corporations (MNCs) across national boundaries, social boundaries and cultural boundaries get more research attention, as globalization requires people of different backgrounds working together (Yagi and Kleinberg, 2011).

With individual boundary spanning being explored towards intra-company aspects, intercultural communication research becomes a more relevant research stream in international business and organizational behavior. Cultural and language skills (Barner-Rasmussen, Ehrnrooth, Koveshnikov and Mäkelä, 2014) may positively influence an individual’s boundary spanning capability, whose activities consist mainly of information exchanging, as Aldrich and Herker (1977) already defined. However, Barner-Rasmussen *et al.* (2014) drop the concept of representation (relevant in a company vs. environment setting) in return for linking, facilitating, and intervening (as needed in an inter-group intra-company setting). They also discuss

organizational culture as a different facet of culture which may require separate analysis as to its characteristics.

In their research on communication across ethnic cultures, Barmeyer and Grosskopf (2020) present the intercultural competence and intelligence of migrants to be a social capital, more specifically, an intercultural capital, which makes these individuals with a migration background particularly effective intercultural boundary spanners within social networks or organizations.

In the context of intra-company boundary spanning, leadership across intra-organizational boundaries is subject of IM research. Ernst and Yip (2009a) examine effective behavior of leaders bridging “social identity boundaries” of their staff and identify “suspending, reframing, nesting and weaving” (Ernst and Yip, 2009a, p. 16) as leadership tactics as per Figure 7, that get people within a company to work successfully across social and cultural borders.

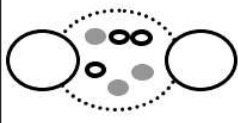
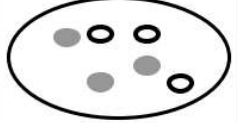
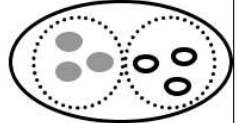
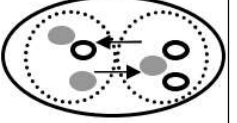
	SUSPEND <i>Create a Third Space</i>	REFRAME <i>Activate a Shared Identity</i>	NEST <i>Embed Groups Within Larger Whole</i>	WEAVE <i>Cross-Cut Roles and Identity</i>
Action	Create a neutral zone where social interaction is person-based rather than identity-group based	Activate a shared or superordinate identity that is inclusive across social groups	Embed and affirm groups within large wholes so that groups have both distinct and interdependent identities	Cross-cut work group roles with social group membership in a systematic way
Schematic				

Figure 7: Boundary Spanning leadership tactics (Ernst and Yip, 2009a, p. 16)

They point out that boundary spanning means shifting from a “bounded, within-group mindset to a [...] cross-group mindset” and represents both quests and opportunities for leaders (Ernst and Yip, 2009b, p. 13).

In their research on corporate headquarters’ executives, Birkinshaw *et al.* (2017) confirm the “spearheading”, i.e., initializing interaction, and “reconciling” with external actors, besides “lubricating” and “facilitating” internally as leadership tactics.

However, boundary spanning is not only done by leaders. Expanding research along the lines of inter-unit interaction of MNCs, Barner-Rasmussen *et al.* (2014, p. 887) define boundary spanners as “individuals who are perceived by other members of both their own in-group and/or relevant out-groups to engage in and facilitate significant interactions between the two groups” and resume previous research to conclude that boundary spanners effectively contribute to “knowledge sharing and collective social capital”. As Nahapiet and Goshal (1998) show in their research, such social capital – initially explored by Bourdieu (1986) – will contribute to corporate value creation by allowing for creativity, learning and innovation. Karoui *et al.* (2015, p. 39) point out the value of digital tools like social network systems in the context of social capital and boundary spanning, where “cross-boundary interactions are viewed as favorable in an organization and lead to the accrual of social, and symbolic, capital”. Modern software tools have the potential to engage and maintain virtual communities of practice to facilitate boundary spanning across companies in order to foster learning and innovation (Arzumanyan and Mayrhofer, 2016).

Other scholars talk about the need to use “cultural brokers” (Casciaro, Edmondson and Jang, 2019, p. 133) arching towards the other side or acting as glue to help construct lasting connections with the aim to overcome silos.

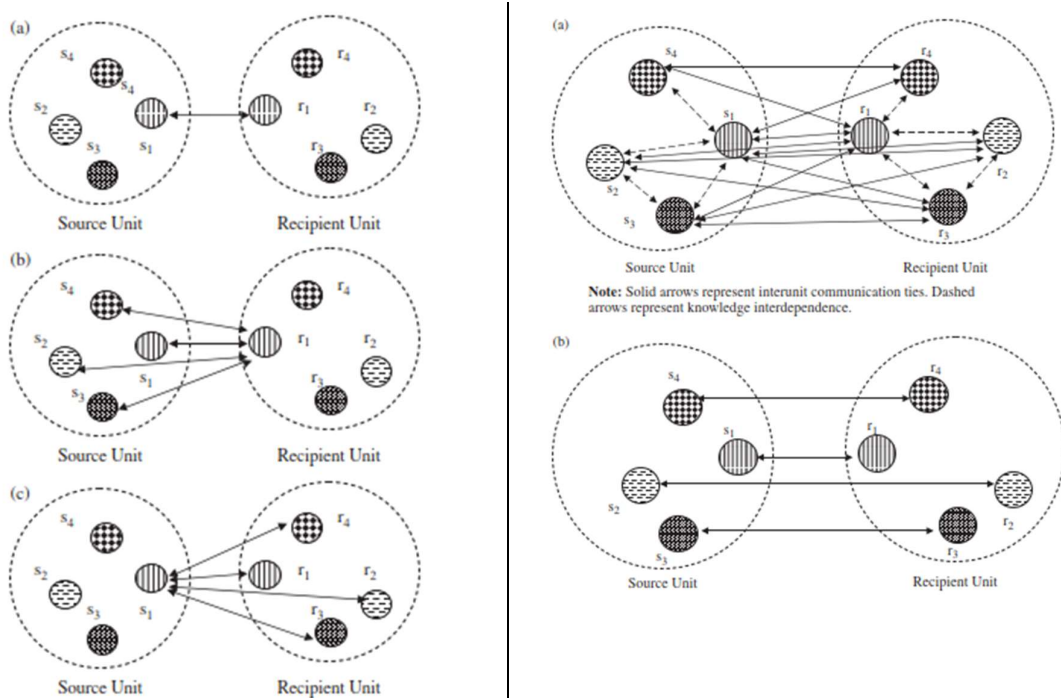
Subsequent work of Mäkelä, Barner-Rasmussen, Ehnrooth and Koveshnikov (2019) analyzes boundary spanners from the angle of how they are perceived by others, defining recognized boundary spanning roles as “facilitating or positively impacting inter-group transactions and relations” (Mäkelä *et al.*, 2019, p. 336) and corroborates that power positively correlates with effective boundary spanning as “it is still amenable to hierarchy and structure” (Mäkelä *et al.*, 2019, p. 347).

The role of knowledge transfer across functional boundaries has been researched by Carlile (2002, 2004). He defines knowledge as function-specific, often “embedded and invested” (Carlile, 2002, p. 442), which makes its transfer difficult. He shows that boundary objects (such as a common framework, design specs, dictionaries, definitions, computer models) can help exchange knowledge more effectively for the purpose of fostering innovation. The exchange process happens on three levels, i.e., (1) simple “transfer”, (2) more complex “translation”, and (3) pragmatic or politically motivated “transformation” (Carlile, 2004, p. 555), should a negotiation of conflicting interests be needed. More importantly, such objects of knowledge can pass boundaries without corruption of information, without detriment to the boundary, or

object itself. They constitute a vehicle of communication across entities of people (Jaeger and Pedersen, 2020).

Besides such communication and translation – or deciphering – skills, Caputo *et al.* (2019) consider negotiation capabilities, linkage skills based on trust-building, infrastructural and organizational building capacities to be characteristics of management of boundaries in the digital age in view of new business models and ecosystems with blurred boundaries and synergetic value creation inside and outside the company.

In the context of knowledge transfer as described by Carlile (2002, 2004), knowledge can be further classified. Zhao and Anand (2013) show in their research on knowledge sharing and learning that the effectiveness of knowledge sharing depends on the complexity of this knowledge. If the knowledge is complex, a knowledge bridge may be more effective than the use of boundary spanners. They suggest a contingency framework for knowledge transfer in form of a “collective bridge” (Zhao and Anand, 2013, p. 1521), which they define as an informal gateway to transfer knowledge among individuals from different teams.



- (a) One-to-one interunit boundary spanning.
- (b) Many-to-one interunit boundary spanning.
- (c) One-to-many interunit boundary spanning

- (a) Interunit collective bridge for transferring collective knowledge.
- (b) Interunit collective bridge for transferring individual knowledge.

Figure 8: Boundary spanning activity types vs. collective bridge types (Zhao and Anand, 2013, p. 1518 and 1521).

A scheme of this model vs. boundary spanning can be seen in Figure 8.

Such collective bridge could incur more costs as more actors may be involved, which can be partly offset by suitable IT support. The authors also discuss the adverse side effects of proliferation of confidential information, as such networks invite for – sometimes unwanted – transparency.

1.3.3. From boundary spanning roles to boundary spanning processes and methods

Most research endeavors around boundary spanning discuss the individual role of boundary spanners or, as seen in 1.3.2., on the boundary objects. Schotter *et al.* (2017) state that boundary spanning has become “an umbrella term encompassing considerable diversity” in describing activities and individuals in global organization (Schotter *et al.*, 2017, p. 404). They conclude that there is a research gap regarding boundary spanning theory and ask for more “organizational level research” (Schotter *et al.*, 2017, p. 406). They define boundary spanning as a multi-level paradigm that includes individual and organizational levels of analysis (see Table 2).

		<i>Paradigm</i>	
		<i>Economics</i>	<i>Sociology</i>
Level of analysis	Organization – <i>Boundary spanning function</i>	Systems, Processes and Routines	Boundary Objects; Socialization
	Individual – <i>Boundary spanning manager</i>	Human Capital; Motivation; Experience	Identity and Belonging; Bi-culturalism

Table 2: Multi-level boundary spanning paradigm (Schotter *et al.*, 2017), p. 417.

On an organizational level, boundary spanning in an economics paradigm comprises systems, processes, and routines (Table 2), but also corporate culture and “informal norms” (Schotter *et al.* 2017, p. 410). They advocate for a “rubber band model” to interconnect between units. Such rubber band illustrates the organizational flexibility needed for boundary spanning. This construct reflects on the organizational systems theory of “loose coupling” (Orton and Weick, 1990), the agents of which can be described as boundary spanners.

It is of relevance in this discussion that boundary spanning is dependent not only on the distance metrics between groups (Beugelsdijk, Kostova and Roth, 2017; Schotter *et al.* 2017), but also on the bounding ties within groups. This must be taken into account when designing inter-group boundary spanning research and will be discussed later in the case study.

When studying boundary spanning between headquarters and subsidiary of an MNE in a Scandinavian institutionalism approach, another aspect of boundary spanning comes to light: conceptionally, Gutierrez-Huerter, Moon, Gold and Chapple (2019) claim that the process of translation of knowledge or practices, which is the object of their study, is done by the role of the translator, who is hierarchically in charge; the boundary spanners may complement translation on an individual level by specific bridging skills, “because they gather and exchange knowledge, and facilitate connections inside and outside the MNE, they are likely to be exposed to a variety of important social interactions through which they develop their understanding and interpretation of new knowledge” (Gutierrez-Huerter *et al.*, 2019, p. 393). Their managerial suggestion is to provide opportunities for local executives and boundary spanners to meet in order to create the social capital needed to effectively manage change in the subsidiaries.

A recent call for more research on boundary spanning (Schotter *et al.*, 2019) reflects on the agility found in organizational theory and practice and demands to know “how organizations can achieve high quality collaboration across intra-MNE boundaries” (Schotter *et al.*, 2019, p. 3). It asks for formal and informal mechanism research, but also calls for research on fostering horizontal collaboration. This dissertation will pick up on this call for research upon describing the current research endeavor in the next chapter.

1.3.4. Boundary spanning in learning

Indeed, boundary spanning has not only been discussed in the business context, but also in the context of (higher) education. Boundary spanning can improve organizational effectiveness and stakeholder management of universities, especially when it comes to dual study programs and “work-integrated learning” (Peach, Cates, Jones and Lechleitner, 2011, p. 1). Widmann *et al.* (2019) refer to boundary spanning in the context of team learning of VET teachers across internal and external borders. Burkhardt (2002) discusses boundary spanning between academic institutions and society and advocates for professional leadership development for managers acting across these borders. Fougère, Solitander and Maheshwari (2019) explore reciprocal

learning of external students and managers in the context of service learning and management studies, where students work out a certain project for a company.

This dissertation aims at exploring why and how boundary spanning occurs within a corporate VET department. Therefore, research work at the boundaries between higher education institutions and its environment is another perspective than what this dissertation aims at, i.e., the inner-organizational boundaries of a learning department learning to learn new things. It is only partly relevant here, as these boundaries do not constitute the internal boundaries of focus of this thesis.

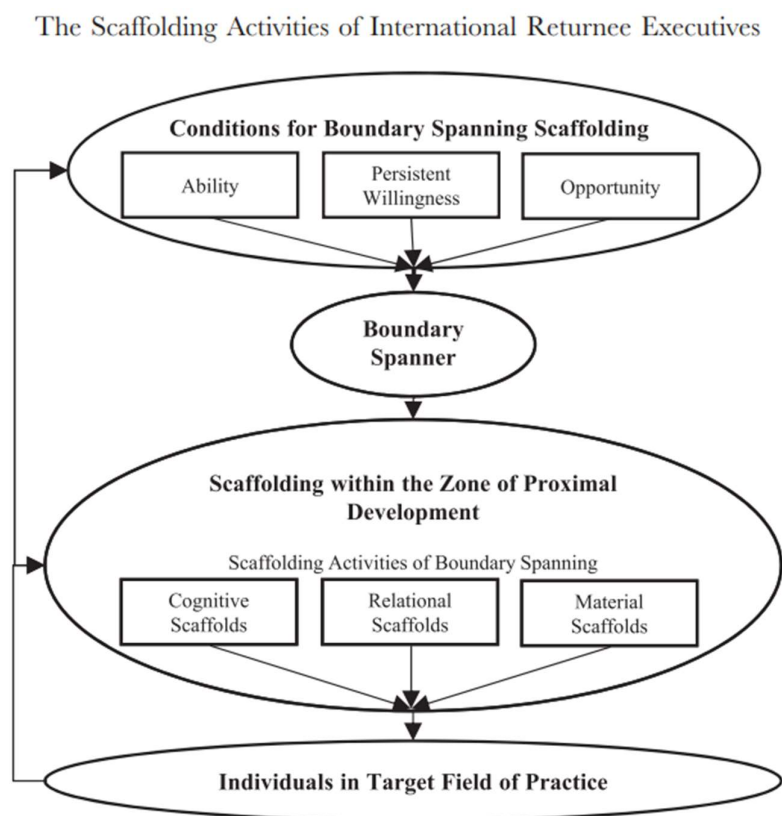


Figure 9: Support for Learning through boundary spanners: conditions and activities illustrated in the scaffolding model of boundary spanning (Roberts and Beamish, 2017, p. 531).

Roberts and Beamish (2017) investigate global boundary spanning in the context of corporate learning and educational theory in a study of international returnees to Korea. They illustrate learning via the boundary spanners by referring to the scaffolding concept used in learning. Scaffolding means giving support to the learner such that his or her personal competency

development (or learning) may occur (Wood, Bruner and Ross, 1976). Within this scaffolding context, Roberts and Beamish (2017) identify individuals' conditions for boundary spanning to be effective and dimensions of such support, namely cognitive scaffolds, relational scaffolds, and material scaffolds (see Figure 9). The authors conclude that "boundary spanners enable other individuals to integrate new knowledge practices" (Roberts and Beamish, 2017, p. 535). They introduce the "Zone of proximal Development" in the boundary spanning discussion (Roberts and Beamish, 2017, p. 515) as a learning concept borrowed from Vygotsky (1978, p. 86, as cited by Wass, Harland and Mercer, 2011, p. 318): "the distance between the actual developmental level, as determined by independent problem solving, and the level of potential development, as determined through problem solving under adult guidance or in collaboration with more capable peers" (Vygotsky, 1978, p. 86). Hence, Vygotsky's idea of scaffolding learning is a facet of learning in teams.

The zone of proximal development describes how, through the aid of another person as teacher or mentor, students can achieve more learning than if they were alone. Roberts and Beamish illustrate the learning scaffolding done by a boundary spanner as a "persistent commitment to the processes and to the people who will be involved in the knowledge practices that result from the boundary spanning" (Roberts and Beamish, 2017, p. 535), thereby contributing to others' learnings as a master teacher who understands boundary spanning as a dynamic and incremental process.

Other sources situate Vygotsky's idea in the context of teacher education. They discuss that the zone of proximal development might ignore other auxiliary elements in teachers' learning such as books, demos, or videos, and acknowledge that teachers' self-scaffolding is seen as the first step of proximal teacher development (Fani and Ghaemi, 2011).

1.4. Can the concept of boundary spanning help understand and foster intra-organizational transformation?

1.4.1. Research gap and intended theoretical contribution of this DBA research

Upon analyzing the current literature on digital transformation, corporate learning, and boundary spanning, one can conclude that while there has been ample research on inter-organizational boundary spanning in MNCs, the specific aspect of learning and learning organizations in intra-organizational boundary spanning has only recently received attention in

management research. In this context, Roberts and Beamish (2017) suggest further research to investigate:

- The “how”: the concept of a collective bridge (Zhao and Anand, 2013) vs. boundary spanning in the realm of learning
- The “why”: the willingness of individuals to act as boundary spanners.
- The “how much”: evidence regarding boundary spanning scaffolding activities as a predictor of performance and success.

As Table 3 shows, extant research on boundary spanning can be classified by whether boundary spanning between companies or within companies is discussed. One can also distinguish whether boundary spanning is observed between different functions or within different functions. Most extant research focuses on inter-company/inter-function or intra-company/inter-function research. Only few application examples for inter-company/intra-function research in boundary spanning, other than in occupational associations or in formal benchmarking projects, were able to be found. There seems to be little field research pertaining to intra-company intra-function research on boundary-spanning within a context where culture is changing (e.g., due to DT), although one may assume that intangible boundaries could as well exist on an intra-group level in such a situation.

Boundary spanning research	Inter-function	Intra-function
Inter-company	Classical management problems in IM, e.g., Joint Ventures, Alliances	Specific contexts such as benchmarking or occupational associations
Intra-company	Headquarters-subsidary relationships in MNEs or liaison between R&D and Marketing	Departmental transformation, e.g., culture change due to DT or new forms of VET learning

Table 3: Boundary types

Boundary spanning between traditional VET and new forms of VET learning in times of digital transformation and learning ecosystems therefore constitutes a relevant novel research contribution to the area of intra-company, intra-group research. It helps answer a research gap.

Management systems research calls for tools and processes to be consistent and coordinated with structure, strategy, goals, skills, and other soft factors. Management systems theory has

explored contingency and change; the concept of loosely coupled systems has been proven to be a useful concept to apply and explore in an educational setting, while the special caveat of VET exploration will be novel. TAM theories are part of the literature review because initially, it was pondered to consider this model as a relevant framework to study this topic. Meanwhile, qualitative research (see chapter 4) showed that the focus of the respondents in this thesis was put on organizational and management issues, rather than on software and technology acceptance.

1.4.2. Research question

Taking into consideration the research gap, the research question is articulated around **understanding how and why boundary spanning occurs between traditional VET and new forms of education in the context of digital transformation.**

Subquestions to support this thesis' research question will be:

- What are the activities, motivations, and conditions of boundary spanners in this VET case?
- How can management support boundary spanners in VET?
- How does boundary spanning help an organization in times of digital transformation?

These questions will be explored by analyzing both ambitions and methods of boundary spanners and interaction with management in such learning department. In the literature review above, it was already established that there seems to be little field research pertaining to intra-company, intra-function research on boundary-spanning in digital transformation and that intangible boundaries due to a changing corporate culture could as well exist on an intra-function level, which needs to be understood and managed. It is important to point out that the first two subquestions address boundary spanners on an individual level, whereas the third subquestion deals with the general phenomenon of boundary spanning as it pertains to value-add such as innovations, learning, or organizational resilience.

In the next chapters, the research design will be justified (chapter 2) and the context of the case study will be explained (chapter 3), before discussing results (chapter 4) and situating these in the scientific body of research (chapter 5).

2. Research Design

*Not everything that can be counted counts,
and not everything that counts can be counted.*

ALBERT EINSTEIN (AS PER GIOIA, CORLEY AND HAMILTON, 2013, P. 16)

This chapter will present the epistemological background and methodology of this research. It will explain how the chosen research design is embedded in science theory and with which research philosophy the researcher goes about her task.

It will then focus on the case study design and discuss why and how this research method will be used, while also discussing possible biases and limitations which may become obvious in the case study construction, both for the qualitative and the quantitative parts of the study.

2.1. Epistemological stance, paradigm, and methodology

As Popper claims, a realistic view of the world along with the idea of approaching truth seems indispensable for his understanding of science. Science as a product of human ideas (Popper, 2004) means putting ideas into concepts, concepts constructing theories.

Researchers contributing to social science should know where they stand from an epistemological stance: the reader should know how they define their stance of truth, their understanding of knowledge and what they aim to contribute to knowledge generation, because “the goal of theory-building and the form of research results depend on the research’s epistemological framework, and [...] the validity of research results can only be justified in reference to a certain vision of what is knowledge, i.e. in reference to an epistemological framework” (Avenier and Thomas, 2015, p. 89).

2.1.1. Overview of paradigms in social sciences

There is no straight-forward way to classify epistemological frameworks, as there are many (Avenier and Thomas, 2015; Welch, Piekkari, Plakoyiannaki and Paavilainen-Mäntymäki, 2011; Walsh, 2017).

While the **positivist** philosophy adopts a natural science model for social sciences, striving to document how reality functions via variables and quantitative data with an outside – objective – researcher’s point of view (Walsh, 2017), **post-positivist** researchers are more cautious in asserting reality (Avenier and Thomas, 2015). They consider that observation cannot lead to generalization – so-called induction (Welch *et al.*, 2011) – but only to theories as causal relationships, which may prevail until there are better theories [or different case studies], and that a scientific theory must be falsifiable (Avenier and Thomas, 2015). Even by learning why a theory is false, the researcher gets new insights, i.e., newer, or sharper problem statements. This is how scientific learning occurs according to the positivist philosophy (Popper, 2004). Collien (2021) analyzed power in positivist boundary spanning research and cites researchers like Barner-Rasmussen *et al.* (2014) and Aldrich and Herker (1977) who consider power in boundary spanning as a resource.

Constructivist or Interpretivist philosophy, to the opposite, does not claim a truth, but rather points at the social context under which multiple realities are constructed and interpreted by a researcher who is not only an observer but also acts as an interpreter (Walsh, 2017) in search of “understanding of actors’ subjective experiences” (Welch *et al.*, 2011, p. 745). Validity is given to research by rich contextual descriptions. In this context, researchers on boundary spanning like Kane and Levina (2017) or Ernst and Yip (2009a) consider power to boundary span an empowerment. As put by Collien (2021, p. 452), “these interpretive approaches frequently adopt a managerial perspective and seek to maintain or improve the existing organizational order”.

Radical constructivism goes one step further and aims at deriving actionable models and propositions from the research, while also admitting that the researchers, by inquiring, influence the experience of the situation/phenomenon under scrutiny and are subjective (Avenier and Thomas, 2015). Discourse-oriented perspectives of power in boundary spanning as classified by Collien (2021) could be cited here as examples of “reality-constituting, objectifying power effects of discourses on boundary spanning” (Collien, 2021, p. 455).

Critical realism accepts the relativism of knowledge, which is socially and historically constructed, but still able to be investigated, measurable and empirically testable (Avenier and Thomas, 2015). This allows for a “subjective search for causes” (Welch *et al.*, 2011, p. 745), yet “with limited generalizations” (Welch *et al.*, 2011, p. 745). In the context of boundary spanning research, Collien (2021) derives different ideology-critical research streams regarding power relationships in boundary spanning, aiming either at domination or emancipation, typically in a cross-cultural or international context.

2.1.2. Discussion and selection of the paradigm of this thesis

This doctoral thesis aims at understanding how and why boundary spanning occurs between traditional VET and new forms of education in the context of digital transformation. It will be a single case study of an MNE VET department in its individual and collective journey(s) towards a learning ecosystem and organizational resilience of VET operations in the context of digital transformation. The case in question, i.e., a complex MNE context of a German high-tech company, offers multiple layers of boundaries inside and outside the department and the company is therefore an interesting case to be studied. With 20 training centers and 6 regions, the setting is both specific enough and vast enough to allow for ample intra-organizational complexity.

The question of the research paradigm should be discussed in view of the aim of the study – understanding – and in view of the guidelines supporting scientific validity, reliability, and objectivity in this context. Understanding how people make sense of their environment and engage in activities is the goal of this thesis’ knowledge generation process. This is in line with the paradigm classification of boundary spanning according to Collien (2021), which is drawing scholars’ attention to the conditions of “collaboration and knowledge-sharing” (Collien, 2021, p. 453), which can entice all participants to “building and maintaining shared boundary spanning platforms” (Collien, 2021, p. 453), while also acknowledging counteracting processes like withdrawal or quietness (Collien, 2021). This dissertation seeks to find “plausible interpretations that fit lived experience” (Avenier and Thomas, 2015, p. 71). It will be written with an interpretive stance, while considering that rich description is needed to prove to the reader the credibility of the achieved conclusions. Generalizations must be carefully pondered, if not avoided (Avenier and Thomas, 2015). Furthermore, rules of validity (Klein and Myers, 1999) should be obeyed to demonstrate how the suggested truth was derived within the research process with due focus on how interpretations were controlled and checked.

The appropriateness of case study method will be argued in the following. The case study design with both qualitative and quantitative exploration in a mixed method sequential design will be detailed in chapter 2.2. In order to increase the internal validity of the research findings beyond the interpretation and careful modeling indicated above, a quantitative study will further explore findings of the qualitative study. Therefore, this research project will be carried out in an exploratory sequential design. As the quantitative part further explores the inductive qualitative findings while referring to and amending additional literature, it will be characterized as abductive/explorative. External validity (generalizability) of this quantitative data will be discussed in chapter 2.2.2.5., respectively in the discussion (chapter 5) of results and their shortcomings (chapter 6.3).

2.1.3. Discussion and selection of methodological framework and research design

The case study is well established in the social science research community to gain insights in real-life situations. It allows for in-depth description and exploration of a smaller number of phenomena (Bartatier, 2019). In this philosophical stance, a single case study is the appropriate method, which can show the uniqueness of the research findings. Hence, uniqueness rather than generalizability is not a compromise, but the aim (Avenier and Thomas, 2015).

In this case, access to the German high-tech company is given via the author, which allows for interviews with numerous players and in-depth analysis as to managerial practice in VET. Such view from the insight out can yield new knowledge for the research and managerial community and can hardly be achieved from the outside. The author will strive for rich contextualized explanation, looking for “subjective search for meaning”, whilst knowing that “particularization”, rather than generalizations might be possible (Welch *et al.*, 2011, p. 745). Such “interpretive sense-making” is suitable if the focus of research is on contextualization whereas the causal explanations are not a primary research aim (Welch *et al.*, 2011, p. 750). In such cases, mixing deductive and inductive methods is often used.

This research will take on an interpretive paradigm posture as discussed in the previous chapter. This mandates the researcher to explore without judgement and via abductive research design to analyze the relevant topics and concepts, which is particularly important when it comes to exploring culture change. Systematically combining induction and deduction in an abductive logic allows for “developing theory over time” and has been built into the case study design as per chapter 2.2. “The researcher’s objective is to discover new things — other variables and

other relationships. Even during this process, the researcher must consider phenomena in the light of a theoretical framework. The researcher should not be unnecessarily constrained by having to adhere to previously developed theory” (Dubois and Gadde, 2002, p. 559).

Following the guidelines given by prominent case study researchers like Kathleen M. Eisenhardt (1989) and Dubois and Gadde (2002), no pre-fixed ideas or constructs are recommendable, and the data lead the way to shaping theory, while “enfolding literature” to create “internal validity” at a theoretical level (Eisenhardt, 1989, p. 533). For more detail on such guidelines, please refer to Table 4.

STEP	ACTIVITY	REASON
Getting Started	Definition of research question Possibly a priori constructs	Focuses efforts Provides better grounding of construct measures
Selecting Cases	Neither theory nor hypotheses Specified population Theoretical, not random, sampling	Retains theoretical flexibility Constrains extraneous variation and sharpens external validity Focuses efforts on theoretically useful cases – i.e., those that replicate or extend theory by filling conceptual categories
Crafting Instruments and Protocols	Multiple data collection methods Qualitative and quantitative data combined Multiple investigators*	Strengthens grounding of theory by triangulation of evidence Synergistic view of evidence Fosters divergent perspectives and strengthens grounding
Entering the Field	Overlap data collection and analysis, including field notes Flexible and opportunistic data collection methods	Speeds analyses and reveals helpful adjustments to data collection Allows investigators to take advantage of emergent themes and unique case features
Analyzing Data	Within-case analysis Cross-case patterns search using divergent techniques*	Gains familiarity with data and preliminary theory generation Forces investigators to look beyond initial impressions and see evidence thru multiple lenses
Shaping Hypotheses	Iterative tabulation of evidence for each construct Replication, not sampling, logic across cases* Search evidence for „why“ behind relationships	Sharpens construct definition, validity, and measurability Confirms, extends, and sharpens theory Builds internal validity
Enfolding Literature	Comparison with conflicting literature Comparison with similar literature	Builds internal validity, raises theoretical level, and sharpens construct definitions Sharpens generalizability, improves construct definition, and raises theoretical level
Reaching Closure	Theoretical saturation when possible	Ends process when marginal improvement becomes small

*N/A in this dissertation

Table 4: Process of Building Theory from Case Study Research (Eisenhardt, 1989, p. 533)

2.2. Mixed-Method Case Study Design

This DBA thesis will contribute to research by exploring the above-mentioned research questions via a single exploratory mixed-method case study of a German MNE training department for vocational education and training (VET). The case will be described in detail, as to the corporation, function, and strategy, in chapter 3. Here, it will be argued why the chosen single exploratory mixed-method case study is appropriate for answering the research question, and which methods and techniques will be applied to warrant objectivity, reliability, and validity.

The case of a VET department with 20 training centers, about 280 employees and three levels of hierarchy is big enough to lend itself to both qualitative and quantitative investigations. The VET department studied has established its leading position as a VET provider in DT and is therefore an interesting case given the research questions. It is complex in hierarchical structure and boundaries – inside and outside the department. It is rather unique in its size, regional distribution, and industrial domain. Because of this uniqueness, its complexity, size and hierarchical breadth and depth, it is considered suitable for a single case study and a good example to study boundary spanning in VET in the context of digital transformation.

To ensure validity and objectivity and to expand reliability of the results, research is carried out using a two-step mixed-method approach in an exploratory sequential design. Quantitative and qualitative research allows for a more comprehensive understanding and integration of data. Semi-structured interviews with 21 individuals of the VET department lead to new insights on boundary spanning scaffolding motivations and methods and can be complemented by a quantitative online survey with 175 VET department participants, thereof 104 trainers. For a schematic view on the research design phases, please refer to Figure 10.

The schematic overview in Figure 10 shows three phases. In the qualitative research phase, the semi-structured interviews are carried out, transcribed, coded – in three iterations indicated here as 1a, 1b, and 1c. – and analyzed. This analysis is the essential input for the second, quantitative, research phase. This survey is based on the findings of phase 1. A third phase called integration, where qualitative and quantitative data are combined for synthetic sensemaking, is indispensable in order to truly mix (and not just combine) methods (Creswell, 2015).

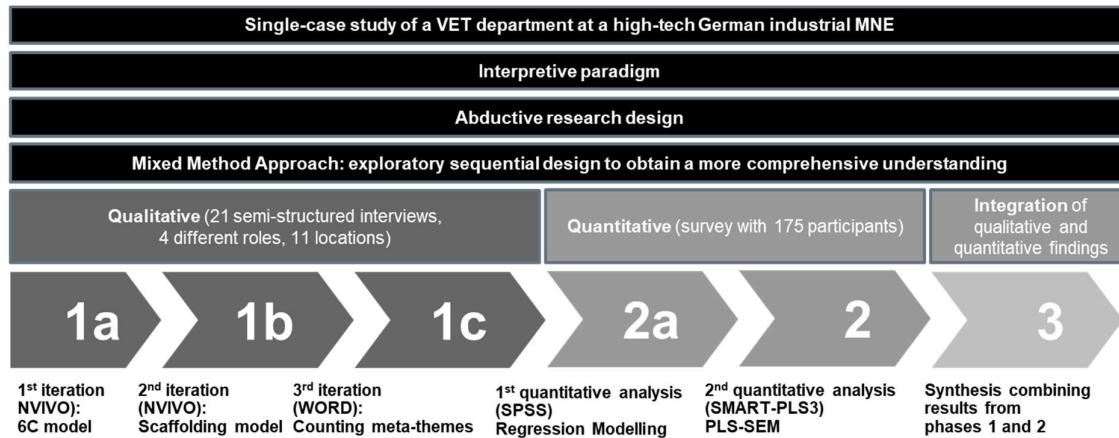


Figure 10: Schematic Overview of Research Design phases

Prior to the empirical qualitative research in step 1a, a literature review was done which helped shape the interview protocol. After step 1a and the establishment of the 6C model, more literature was enfolded. At that time, the scaffolding model (Roberts and Beamish, 2017) was identified to be used as a framework to structure the second iteration of coding. That resulted in step 1b. Seeking to manifest consequences of boundary spanning out of the data such as innovation and learning, the notion of “sustainability” was able to be derived in step 1c by the explorative quantitative analysis of qualitative data. Rather than finding code referencing innovation as a consequence of boundary scaffolding as literature indicated, code referencing “sustainability of VET operations” was identified instead. That had to be situated in literature again. Step 2a took up the meta-themes identified in steps 1a through 1c and aimed to solidify the scaffolding model. Furthermore, aiming to quantify and relate the different concepts and constructs around boundary spanning in learning to contribute to theory, different types of quantitative modelling was applied. Regression modelling both linear and according to Poisson helped find some explanation as to the how and why of boundary spanning in VET learning. PLS-SEM modelling helped further understand the interrelationship (or not) of concepts like boundary spanning, sustainability of VET operations, digital transformation, and social learning. A graphical representation of this abductive process can be seen in Figure 11.

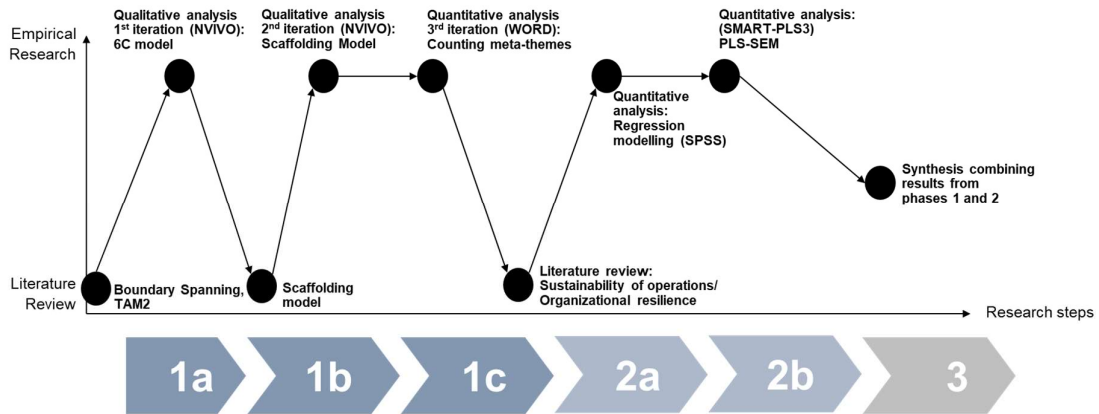


Figure 11: Systematic combination of inductive and deductive for an abductive logic (according to Dubois and Gadde, 2002)

Carrying out a quantitative survey setting in an interpretive paradigm posture may have its challenges. Operationalization of the survey with a fair share of open-ended survey questions on the one hand, and the research posture of the manager-author on the other hand, stand for its feasibility. The author is fully aware of the diversity of individual’s characters and mindsets in the VET department, which make an interpretive posture the only possible stance, as it allows for said diversity-based subjective views.

2.2.1. Qualitative exploration procedure

2.2.1.1. Interview protocol

In order to explore boundary spanning in VET between traditional and new forms of education, 21 semi-structured interviews with various members of the department were carried out between January 4 and June 22, 2021. Semi-structured interview protocols are used to adopt a systematic and similar structure of the interviews. Attitudes, behaviors, observations, and narratives of interviewees are explored around six key topics: challenges, methods, (changes in) leadership, culture change, key people in transformation, role models as well as g) possible identification of further interviewees. Figure 12 shows the semi-structured interview protocol for interview partners 1 through 10.

Control Variables

STATISTICS
 Name
 Training Center/Location
 Role
 Age
 Education: Tech/Commercial
 highest Diploma: Apprenticeship/Studies/Other
 Hierarchical level: Mgr/Trainer/Other
 Region

Methods

INTRO
 What?
 Processes?
 Systems?
 Apprenticeships?
 Continuous Training (Upskilling, Reskilling)?
 Train-the-trainer?
 Barriers

WHAT

Culture Change

INTRO
 Who?
 What?
 How?
 Values? Norms?
 Symbols?
 Where to - objectives?
 Skills? Competencies?
 Why? (Image, Job relevance) Venkatesh et al, 2000
 Subjective Norm, Experience, vol1 Venkatesh et al, 2000

HOW

Key roles in culture change

FOLLOW-UP
 Role Trainer
 Role Training Center Manager
 own role
 Role models? Why?
 Enablers/Facilitators? How? Why Ernst and Yip, 2009
 Suspending/reframing/nesting/weaving aka create a third space,
 activate a shared identity, embed groups within larger whos, cross-cut roles and identity

WHY

Challenges in VET

ICEBREAKER
 Digital transformation? (Work Life and health, Information and Communication technology use, performance and talent mgmt, hierarchy)
 Learning? Schwarz Müller et al., 2018
 new VET philosophy (project "COPEd" - competency and project-oriented education?)
 What worked well last year?
 What are topics for this year?
 What was different in the past?

WHAT

How does leadership change?

INTRO
 Diversity
 Inclusion
 Resistance
 Initializing interaction and "reconciling" with external actors Birkinshaw, 2017
 Oil and facilitate Birkinshaw, 2017
 Promotion of lateral collaboration Schotter et al., 2019
 Flexibility vs. Control, VUCA, Loosely coupled systems Orton, et al., 1990

HOW

Who is such a boundary spanner between old culture and new methods?

FOLLOW-UP NEW INTERVIEWEES
 Interaktion von welcher zu welcher Gruppe? Schotter et al., 2017
 Interaktion von welchem/r zu welchem/r System/Methode/Ausbildungsphilosophie?
 Perception by others? Mäkelä et al., 2019

HOW

Role models

FOLLOW-UP
 How would you describe someone like this? C.F. Jung/Meyer-Briggs
 What does he/she do particularly well? Why?
 How does he/she learn? Why? McGregor X-Y-Theory
 How does he/she teach? Why?
 What is the benefit for the company? Why?
 How does a role model inspire others? Why?
 Knowhow Technology? Innovation? Lisak et al., 2016
 Kommunikation? Interaction? How and why? Barner-Rasmussen et al., 2014
 Share know-how Nahapiet and Ghoshal, 1998
 Create purpose for the company? Why? Nahapiet and Ghoshal, 1998
 Interaction from which to which group? Mäkelä et al., 2019
 Lateral cooperation? Schotter/Maznevski/Doz, 2019

WHY

Figure 12: Semi-structured interview protocol, interviewees P1-P10.

As the empiric research part was carried out abductively, it was after the analysis that relevant findings were compared with theoretical concepts. After carrying out the first half of the interviews, the model of learning scaffolding through boundary spanning by Roberts and Beamish (2017) turned out to be a valuable theoretical asset to describe the phenomenon of boundary spanning in VET, i.e., conditions (ability, persistent willingness, and opportunity) as well as activities (cognitive, relational, and material). The interview protocol used for the second half of the interviews is shown in Figure 13. It picked up and explored this boundary spanning learning model further, thereby striving to amend the extant boundary spanning learning literature.

Control Variables

STATISTICS
 Name
 Training Center/Location
 Role
 Age
 Type of education: Commercial/Technical/Other
 Highest degree: Apprenticeship/Studies/Other
 Hierarchy level: Mgr/Trainer/Other
 Region

Challenges in VET

ICEBREAKER
 Digitalization? (*Work Life and health, Information and Communication technology use, performance and talent mgmt, hierarchy*)
 Learning? *Schwarz Müller et al., 2018*
 new VET philosophy?
 What went well last year?
 What are the hot topics this year?
 What has changed over the years?

Key persons in learning

FOLLOW-UP
 Role Trainer
 Role Training Center Manager
 own Role
 Role models? Why?
 Boundary spanners? Why? How?
Suspending/reframing/nesting/weaving

How do VET trainers learn?

Who or what inspires them to learn?
 How do they learn?
 alone
 via others
 via classes (internal or external)
 via Learning-by-doing
 via manager
 Employability
 role models
 because it is fun/gamification

WHO

WHAT

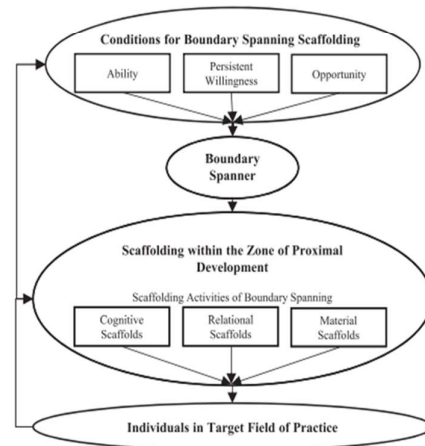
HOW

WHY

Conditions for Boundary Spanning scaffolding?

How can boundary spanners provide learning scaffolds for others?
 Competencies/Skills/KnowHow/Pedagogics - ABILITY
 Motivation/"Teaching DNA"/Communication - WILLINGNESS
 opportunity/virtual and physical classrooms - OPPORTUNITY

The Scaffolding Activities of International Returnee Executives



Boundary spanning

What types of boundary spanning are there?
 Who are the boundary spanners?
 How can we nurture boundary spanning?
 What do they do?
 Why do they become boundary spanners?

WHAT HOW WHY

Scaffolding activities

Cognitive scaffolds (Concepts, Documents, didactics, methods, artifacts related to learning)?
 Relative Scaffolds (Colleagues, friendships, relationship to learners, to customers...)
 Practical/mechanical scaffolds (access to technology and trainings, classroom equipment, tandem teaching?)
 Cultural scaffolds (trust, openness, learning culture, culture that pardons mistakes?)
 Psychological scaffolds (counteracting anxiety)?
 Other?

Roberts and Beamish, 2017

Figure 13: Semi-structured interview protocol, interviewees P11-P20.

2.2.1.2. Interview setup

In order to explore boundary spanning in VET between traditional VET and new forms of education, the author conducted 21 semi-structured interviews in Germany with various members of the department. This resulted in 290 pages of transcriptions.

The author explained in a management meeting on Dec 18, 2020, that she intended to conduct a DBA thesis as a three-year project and would like to interview members of the team (Interview partners 1-10, abbreviated as P1-P10) regarding the topic in question, which she generally introduced as "Culture change in VET". All interviewees were interested in participating in the

interviews and agreed to the procedure. These interview partners were interviewed in January of 2021. They suggested another eleven interview partners (Interview partners 11-21, abbreviated as P11-P21) from various functions and hierarchy levels in the VET department to be interviewed because of their subject matter expertise, practical experience with boundary spanning, or with learning ecosystems. P11-P21 were interviewed between April 15, 2021, and August 11, 2021; they were informed by their managers about the study and asked if they wanted to participate. Again, all people who were asked to participate, agreed to participate. Then, they were called by the author who explained the whereabouts of the study, namely that it would be an interview about an hour long, that it would be recorded and that they were asked to give prior consent to have their data processed, while being treated anonymously. P11-P21 agreed to the procedure.

A few days prior to the interview, each potential interviewee received a written request for consent for using the data of the interview for academic research in an anonymous manner. The interviewees were also asked in writing for agreement to save a .mp4 copy of the interview with MS Teams for later transcription. All documents but two (P9 and P20) were signed and sent back prior to the interview. In these two cases, it was agreed that the interview could be recorded and, upon receiving the signed consent sheet (which was shortly after the interview), the interviewer was allowed to use the respective interview.

At the set time, each interviewee was told that the interview would be semi-structured, i.e., that the interviewer would only ask a few questions where necessary, and that it was the interviewees' freedom to elaborate on topics they felt necessary to address in the context of cultural change.

2.2.1.3. Control variables

Control variables (see Table 5) were age group, location, (highest) level of education (which was later coded according to the EQR level), gender, role/hierarchical level (Regional Manager, Headquarters staff, Local (Training Center) Manager, Trainer/Coach) and whether the interviewee was a direct report of the researcher-manager

Proband No.	Age Group	Direct Report	Gender	Level of Education	Region	Headquarters Manager
P01	60+	No	m	6	1	Regional Manager
P02	50-59	Yes	m	7	2	Regional Manager
P03	50-59	Yes	m	6	3	Regional Manager
P04	50-59	Yes	m	8	4	Headquarters Manager
P05	40-49	Yes	m	6	4	Headquarters Manager
P06	40-49	Yes	m	7	7	Regional Manager
P07	40-49	No	m	6	6	Headquarters Manager
P08	50-59	No	m	7	1	Regional Manager
P09	50-59	Yes	f	7	1	Regional Manager
P10	40-49	Yes	m	6	5	Local Manager
P11	30-39	No	m	7	4	Local Manager
P12	40-49	No	m	7	5	Local Manager
P13	40-49	No	m	7	2	Trainer
P14	20-29	No	f	7	2	Local Manager
P15	40-49	No	f	7	4	Headquarters Manager
P16	40-49	No	f	6	4	Local Manager
P17	40-49	No	m	6	1	Trainer
P18	40-49	No	m	6	3	Trainer
P19	50-59	No	m	7	2	Local Manager
P20	40-49	No	m	7	1	Headquarters Manager
P21	40-49	No	f	6	7	Headquarters Manager

Table 5: Control variables P1-P21

In addition, the region any interview partner belongs to is shown (regions were numbered from 1-7). To ensure anonymity, the cross-regional service unit is also identifiable as one region. Since one regional manager has currently been responsible for two regions, these two regions were given the same number.

A summary table of the interviewee control variables can be seen in Table 5. As to the relative distribution of roles among the interviewees, please refer to Figure 14. A third or the interviewees were VET Regional managers and another third VET Training Center Managers; the remaining third consisted of VET trainers (10%) and VET Headquarters staff (24%).

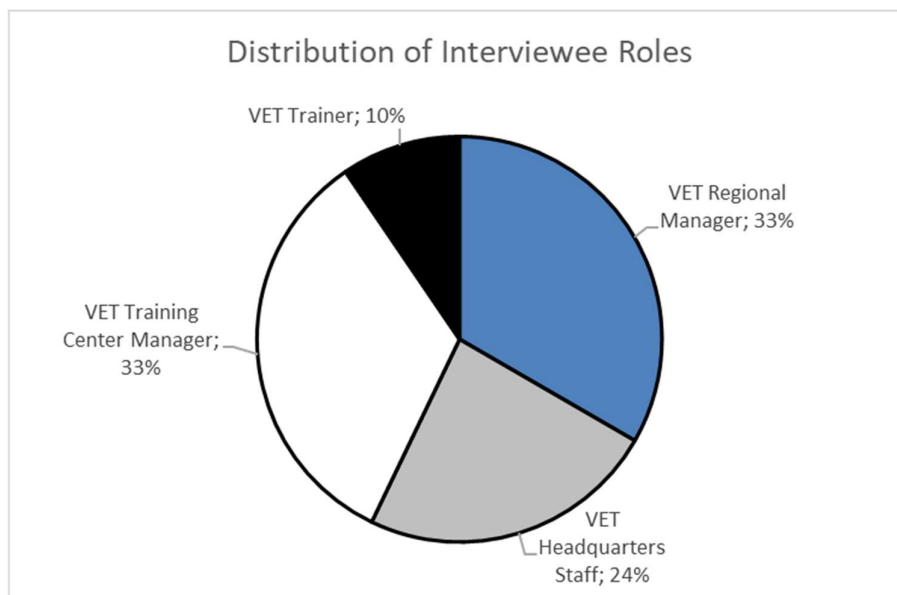


Figure 14: Distribution of Interviewee Roles

The distribution of interviewees in terms of age and level of education (according to the European Qualification Framework, EQF) can be seen in Figure 15. An EQR level 7 corresponds to a master's degree, EQR level 6 equals a bachelor or certified technician, EQR level 8 corresponds to a PhD. It is noteworthy that all training center managers (▲) are 43 years and younger, whereas the next higher management level, i.e., the regional managers (●), are all 42 and older. Headquarters staff and trainers are evenly spread across the age groups.

It is also categorized whether the current training center the person works in is small (up to 4 trainers), medium size (5-15 trainers) or big (>15 trainers). For regional managers who are responsible for more than one training center, the value corresponds to the training center where the person has formally been hired at, assuming that this reflects mostly in the answers. 33% of the interviewees currently work in small training centers, 48% in medium training centers and 19% work in big training centers.

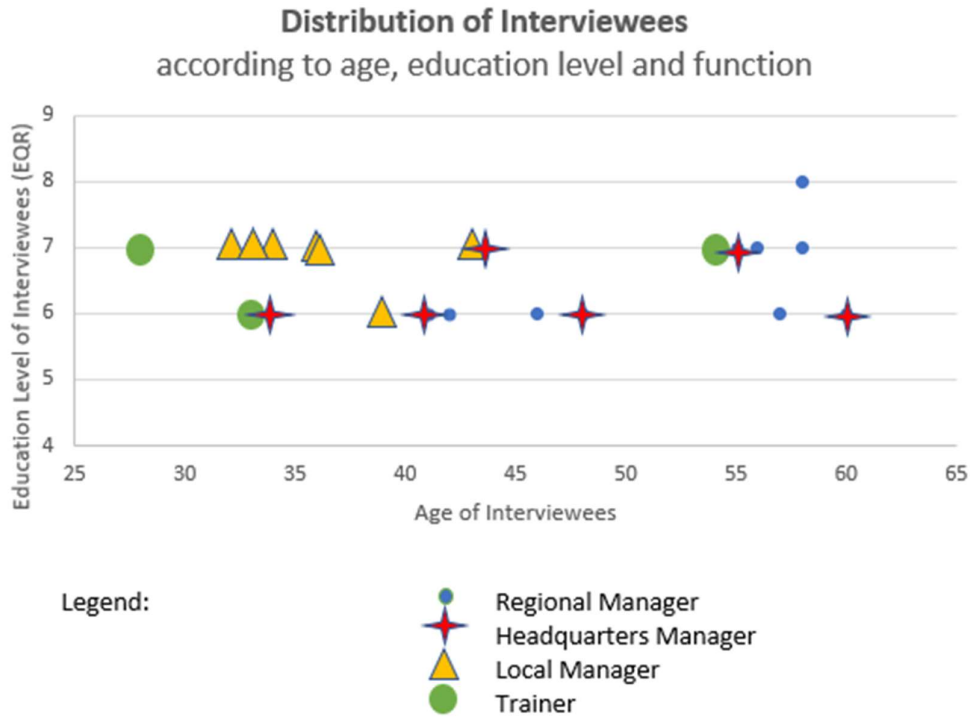


Figure 15: Distribution of interviewees in terms of age and education level

Furthermore, each interview partner was categorized according to how many different VET training centers he or she has already worked in (1, 2, >2). 48% of the interviewees have worked in two training centers and 14% of the interviewees have worked in more than two training centers. That leaves 38% of the interviewees with work experience in only one location. For more details, please refer to Table 6.

Interviewee No.	Experience in # of Training Centers	Training Center Size
P01	1	Small
P02	2	Medium
P03	>2	Small
P04	>2	Medium
P05	2	Medium
P06	1	Big
P07	2	Medium
P08	2	Medium
P09	1	Big
P10	2	Small
P11	2	Big
P12	1	Small
P13	2	Medium
P14	1	Medium
P15	2	Small
P16	2	Medium
P17	1	Big
P18	2	Small
P19	>2	Medium
P20	1	Small
P21	1	Medium

Table 6: Control variable training center size, experience of experience in number of training centers

2.2.1.4. *Transcription*

Following the interviews which were recorded in MS Teams, the .mp4-files were imported in MS Word and auto-transcribed. Then, all interviews were reviewed, and auto-transcription was corrected as needed. All transcriptions are done in German. Furthermore, during the manual reviews, the following rules apply:

- Word doubling is eliminated.
- All references to names are eliminated. If necessary, colleagues are referenced as K1-Kx. If the referenced colleague is also an interviewee, he or she is referenced by his or her alias name: P1-Px.
- All references to training center sites and region names are eliminated. Training center sites are coded from A-Z randomly, not in alphabetical order.
- All references to female colleagues are changed into the masculine form to ensure anonymity. The number of female trainers is too low to guarantee anonymity otherwise.

- All company-internal acronyms are replaced by generic terms, indicated by [brackets]. Example: “department XZY” would be transcribed as [VET department], should XZY be the acronym for the company internal VET department.
- The original video files are preserved for future reference and validity/credibility and potential future rounds of analysis.

The cleaned-up German word files were imported into NVivo.

2.2.1.5. Open Coding Process

Grounded theory elements of Corbin and Strauss (1990) are used to analyze the data, as it has shown to be a pragmatic method to get a general overview of such new inductive empiric results. Coding using NVivo data analysis software was carried out first according to an open coding process, then by axial coding and selective coding (Corbin and Strauss, 1990) according to the 6C coding family (MacDonald, 2001).

In a grounded theory approach, an iterative process between interviewing and analyzing is indispensable (Corbin and Strauss, 1990). In a first round of coding in February and March 2021, the coding of the first ten interviews was done with the aim of gaining insights which help refining the research process. This “open coding” approach allows for both in-vivo coding and generic codes.

Example for generic codes:

- “Boundary Spanning”
- “Barrieren” [In English: “barriers”]
- “Angst” [In English: “fear, anxiety”]
- “Digitalisierung” [In English: „digitalization“]

Examples for in-vivo coding:

- *“This has been a discussion for the last six, seven, eight years already, to finally allow for better exchange among the locations and I think this is still an issue.”* (Interview partner Nr. 6)
- *“There exists a certain pressure. As the employees – and that is the difference to other employees in other business units or other companies – the employees in the VET department see the future coming. That means they know there will be changes. And*

therefore, they know that they need to get moving and learn.” (Interview partner No. 19)

After the first open round of coding of the 10 interviews, axial codes were identified. Later on, interviews 11-21 were coded accordingly; whenever applicable, open codes and axial codes were grouped to already existing codes identified in the round of the first 10 qualitative interviews. As a cross-check, the author compared the theme to the initial quoted text once again to avoid accidental misinterpretations.

2.2.1.6. Axial and selective coding process

In a next step, codes were cleaned up according to the following rules:

- Duplicates were eliminated (e.g., “Korsetts” and “Korsett”).
- The in-vivo codes were put into other codes, whenever it makes sense. (e.g., „*That has been a discussion for the last six, seven, eight years already, to finally allow for better exchange among the locations and I think this is still an issue.*” → “Boundary Spanning”) (Interview partner 6)
- Codes with low mentioning were analyzed. Some were organized into other codes which became concepts (e.g., “digitalization” → challenges [In German: “Herausforderungen”]); some others remain separate concepts (e.g., “Kulturwandel” [In German: culture change in English]). Although it could have been placed under “challenges”, the phenomenon seemed specific and relevant enough not to be subsumed. In order to ensure relevance in a final construct, all hypothetical interrelations (Figure 16, after 10 interviews) were verified with at least three references from interview partners.
- Some relevant topics were then grouped into other codes (preliminary categories or meta-codes).

Then, the selective coding process was initiated, grouping all findings around the central category of “boundary spanning”.

Among the possibilities offered by Grounded Theory, we chose the 6C “coding paradigm” (Corbin and Strauss, 1990, p. 423). This coding hierarchy, via identifying conditions, context, concept and consequences, cause, and contingency, fits well our objective of discovering first

answers to the *how* (conditions, context, contingency) and *why* (cause, consequence) of the research question.

Coding according to Corbin and Strauss (1990) resulted in 946 coded references in several hierarchy levels (Table 7). These C-codes came about after careful re-examination not only of the open codes, but also of the original texts. The detailed coding structure can be seen in Appendix 1: Qualitative study.

Name of code	#Interview partners	#References
	21	946
CAUSE - Need to secure competencies	2	2
CAUSE - Self-conception is changing	9	37
CAUSE - Transformational Challenge	18	263
CONCEPT - Boundary Spanning	21	207
CONDITION – Leadership	18	169
CONDITION – Mindset	11	36
CONDITION - Flexibility and trust	2	5
CONDITIONS – Values	7	19
CONSEQUENCE - Culture and Mindset Change	12	48
CONSEQUENCE - Value-add for the company	11	29
CONTEXT	18	123
CONTINGENCY	7	8

Table 7: 6C codes

This 6C first analysis was done as part of an interrelated process of data collection and analysis (Corbin and Strauss, 1990) after 10 interviews (Figure 16). It gave orientation as to some preliminary concepts, although additional sampling (of data and concepts) was required as part of the interrelated process and selective coding. After more interviews, a slightly changed interview protocol and a more selective coding iteration, empirical findings of all 21 qualitative interviews can be found in the results. Figure 16 is shown here to document due process and thorough development of analysis.

The subjective perception of causes by the interview partners was sharpened and structured between Figure 16 (Interview partners 1-10) and Figure 21 (Interview partners 1-21) to reflect more precisely what the interview partners articulated. For example, “Corset” was partly subsumed under “Laws and regulations” in a process of abstraction (Corbin and Strauss, 1990). (The original code “corset” was split because it is also relevant as a challenge which *causes* a VET department to boundary span.). “Role modeling” and “self-awareness” were abandoned as poorly developed categories and subsumed under leadership and mindset, respectively.

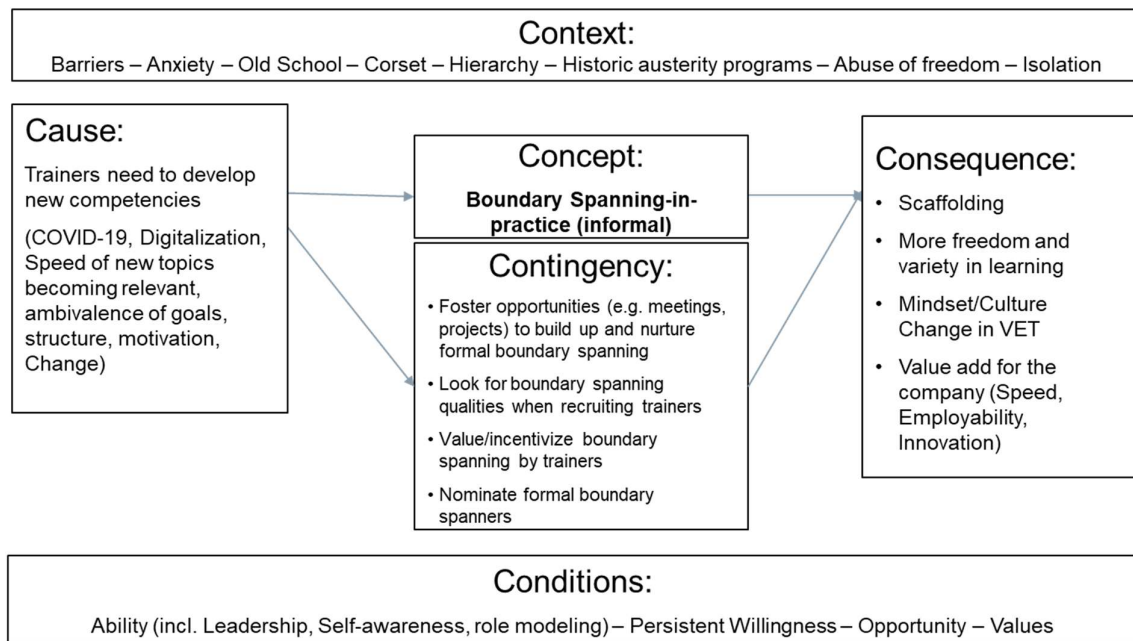


Figure 16: Hypothetical relationships: Understanding how and why boundary spanning occurs, first 10 interviews (Corbin and Strauss, 1990; MacDonald, 2001; Roberts & Beamish, 2017)

2.2.1.7. Second iteration of coding

In a second iteration, all interviews and open codes were revisited. This time, the coding was done according to Gioia, Corley and Hamilton (2013), such that one talks about 1st order codes rather than open codes. The Gioia method was used by Roberts and Beamish in 2017 to establish the boundary spanning scaffolding model which turned out to be a relevant model for this research. Therefore, it was the logical choice for a second iteration of coding. It is worth noting that although one feels getting lost at this stage due to the sheer number of 1st order codes, the feeling of being lost is intended (Gioia *et al.*, 2013).

With the boundary spanning scaffolding model (Roberts and Beamish, 2017) in mind, 2nd order categories were established with careful consideration as to the original concepts, themes, dimensions of the model. In particular, the dimension whether something was a condition for boundary spanning or a type of activities or mere examples of boundary spanning was examined. After prudent back and forth analysis, these *conditions*, and *activities* fit very well into the current analysis as dimensions. As to first-order constructs, these have a completely different appearance than in adjacent literature. This is entirely plausible for a grounded approach. In chapter 5, the discussion will focus on comparing these findings at hand with findings in the literature.

As illustrated in Table 8, text was coded by 21 Interview partners' interviews via 181 references around second-order categories related to Roberts and Beamish (2017).

Name of code	#Interview Partner	#Coding references
BOUNDARY SPANNING SCAFFOLDING	21	181
1-Ability	15	38
2-Persisting Willingness	16	47
3-Opportunity	11	28
A-Cognitive Scaffolding	7	15

B-Relational Scaffolding	10	34
C-Material Scaffolding	8	19

Table 8: Results of Coding regarding boundary spanning scaffolding; second order constructs (1-3 and A-C) for the dimensions conditions and activities

All coding was done in German. Translation was done in the end in order not to confuse the language perception.

2.2.1.8. Limitations and biases

Limitations resulting from a single case study are its specificity, and, therefore, potential lack of generalizability. Having said this, it can still be a valid research contribution to manifest a concept or a theory via a case study or to expand a concept or theory for a specific case, while carefully discussing its applicability in other settings. If “the problem is directed towards analysis of a number of interdependent variables in complex structures, the natural choice would be to go deeper into one case instead of increasing the number of cases” (Dubois and Gadde, 2002, p. 558).

Objectivity is also possible in an exploratory interpretive approach. Objectivity, in this case, will be obtained by the “organization of data collection and analysis around core concepts of critical social theorists as well as [...] bringing to light inconsistent and even conflicting findings” (Avenier and Thomas, 2015, p. 86). Hence, strict application of research protocols, coding guidelines, interim and final well-grounded result documentation are mandatory to maintain research quality and transparency. Multi-method data collection for the qualitative and quantitative part add to the internal validity by triangulation.

Intersubjectivity is usually given by working in researcher teams (Eisenhardt, 1989). In this particular case, the DBA thesis has only one author; hence, different presentations to management and scientific reviews with professors must serve as quality gates. The author presented and discussed findings of her empiric project with her management team as “knowledgeable agents” (Gehman, Glaser, Eisenhardt, Gioia, Langley and Corley, 2018, p. 291); the methodology was furthermore discussed during two scientific conferences: EDBAC (Executive DBA council)’s EMS symposium 2021, in Miami, and the ATLAS-AFMI conference in Nizza in 2022.

As to the potential biases of the proposed case study design, the thesis author is the manager of the VET department and the interviewer. This must be pointed out clearly, in order to understand a potential drift towards hypothetically painting the picture brighter than it is, supposed some team members want to spare their manager some hoarse truths. However, as will be discussed later, the axial coding brings out a context which is certainly not painted too brightly. Critical notions like “barriers, fear, corset, historic austerity programs, isolation” are brought up verbatim, coded in NVivo, and analyzed to characterize the context of the study by the interviewees (chapter 4.1.1, Figure 21), although that may shed an unfavorable light on management and leadership. The quantitative study will also help counteract potential bias. In all steps of the study, proper precautions (semi-structured interviews, interview protocols, cautious documentation, and open discussion of conflicting findings, also conflicting in a political sense) are set up to avoid potential bias.

2.2.2. Quantitative exploration

Once the results of the qualitative exploration have been established, a quantitative study was set up. According to Eisenhardt (1989, p. 538), “quantitative evidence can indicate relationships which may not be salient to the researcher. It also can keep researchers from being carried away by vivid, but false, impressions in qualitative data, and it can bolster findings when it corroborates those findings from qualitative evidence”.

The quantitative study incorporates some of the findings (and correspondent theoretical models) to explore these further, in an abductive manner, as models are amended. By doing an on-line survey with all 286 VET department members, the findings can be questioned and understood on a larger scale. This can feed into the assessment of the inter-subjectivity of the empirical findings of the qualitative exploration. “When testing hypotheses derived from a grounded theory, the investigator should specify the test conditions under which the hypothesis(es) was being tested and make adjustments in the theory to fit those conditions” (Corbin and Strauss, 1990, p. 424).

The author kept an interpretive paradigm posture. She studied the conditions of boundary spanning as well as the cognitive and relational activities experienced by boundary spanners in learning towards “individuals in the target field of practice” (Roberts and Beamish, 2017) in the sense of a why, what, and how. She added questions about aspects of trust, leadership, and culture change, which came up in the qualitative research. Test conditions will be described in

the next chapter. The interpretive paradigm posture in a quantitative survey setting is challenging, yet not insurmountable. To this aim, approximately one third of the survey questions remained open-ended.

2.2.2.1. Concepts and Hypotheses

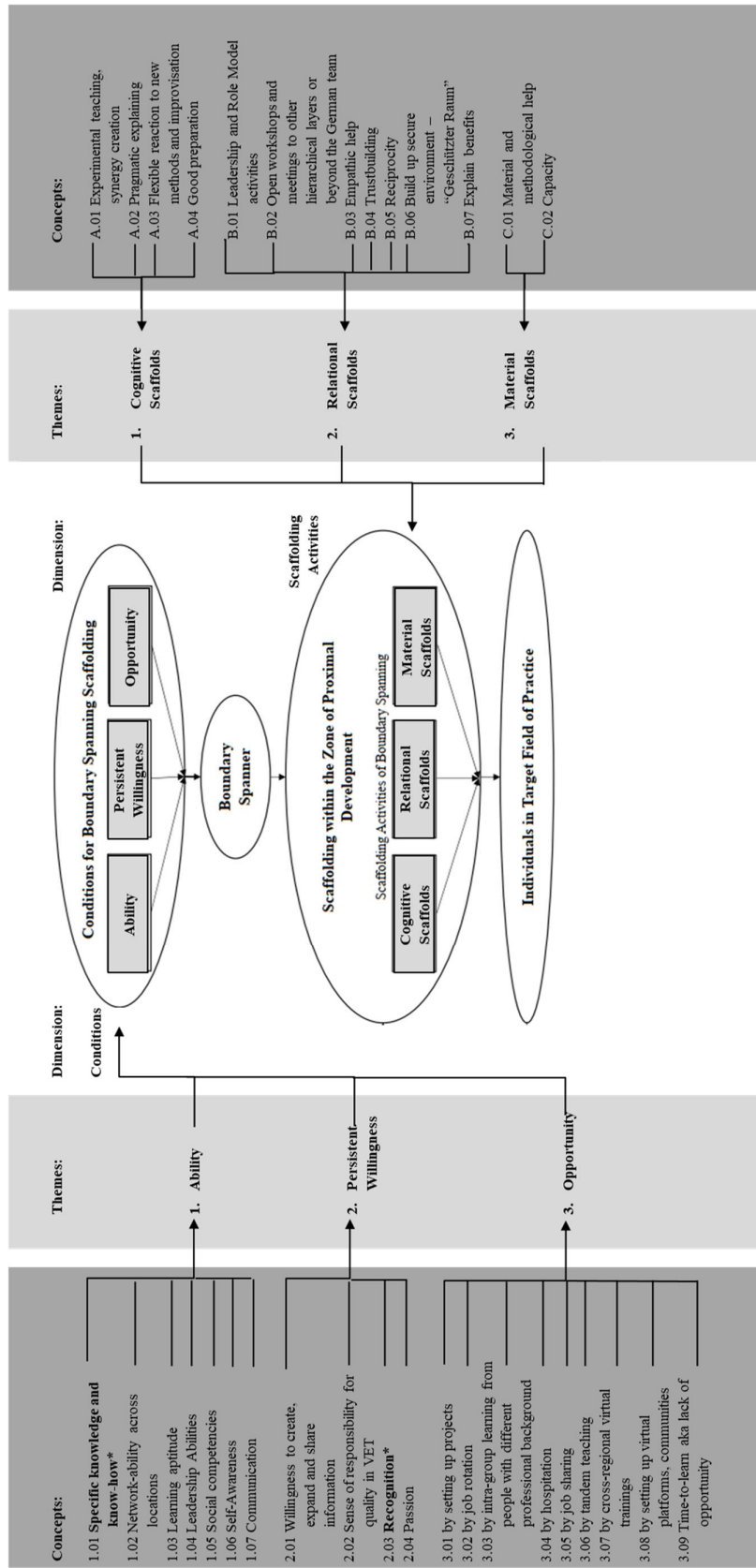
The main objective of the quantitative study resided in further exploring how and why boundary spanning can help learning, transformation and long-term performance of the VET department's operations.

Based on the qualitative analysis outlined in chapter 4, the propositions

- Leadership (and Trust) contribute to culture change,
- Culture change positively impacts boundary-spanning-in-learning,
- Boundary-spanning-in-learning positively impacts perceived organizational resilience of VET operations,

were included into the quantitative analysis hereinafter.

Figure 17 illustrates the concepts, themes and dimensions identified in the qualitative analysis, according to the boundary spanning scaffolding model by Roberts and Beamish (2017). These were also operationalized in the survey. All themes and concepts are taken up and discussed in detail in chapter 4. Figure 17 is meant to give an overview only. On the left side of the model, the construct order for conditions is illustrated; on the right side of the model, the construct order for activities is illustrated.



Source: Adapted from Roberts, Beamish (2017), *The Scaffolding Activities of International Returnee Executives: A Learning Based Perspective of Global Boundary-Spanning*, Journal of Management Studies, p. 531.

*Roberts and Beamish have a similar concept called „External Motivation“ for Recognition. They also refer to knowledge (of foreign practice) as a concept for ability.

Figure 17: Concepts, Themes and Dimensions of this study compared to the original Roberts and Beamish scaffolding model (2017)

As the quantitative research is carried out in an abductive, interpretive posture, it was tested against a rudimentary model (see Figure 18) which the author drew from her qualitative research.

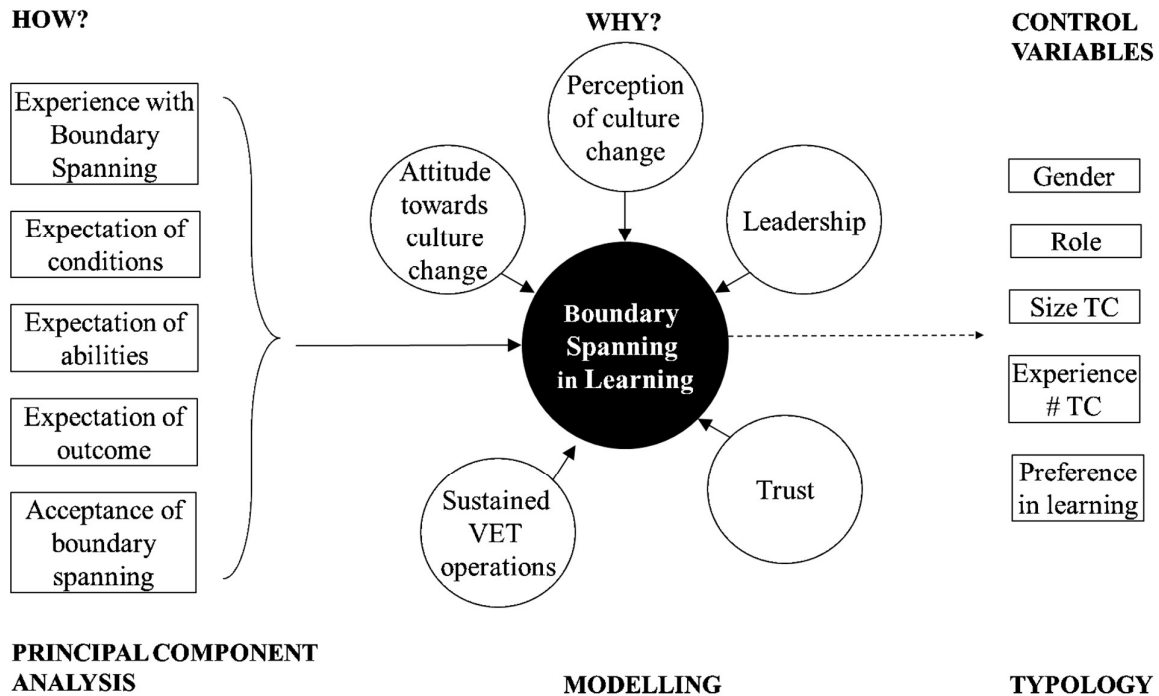


Figure 18: Rudimentary model to draw up quantitative survey

2.2.2.2. Survey setup

The survey was developed as an online survey in Microsoft Forms between September 20 and October 22, 2021, and is shown in Appendix A2. The VET team of the studied MNE has experience with answering online surveys in Microsoft Forms format. The survey, in German, was prepared based on the findings of chapter 4.1, then reviewed by the responsible person for surveys in the VET team’s headquarters and passed on to the workers’ council committee that must approve all surveys carried out with employees. It was positioned as part of the validation of the department’s new philosophy of learning, with special focus on the learning activities planned for 2022 and on learning from colleagues, which is the operationalized layperson’s explanation for boundary spanning scaffolding in learning. All employees of the German VET department were surveyed. The team responsible for international operations, of which some

members also reside in Germany, was not included into the survey. The complete survey in English translation is enclosed as Appendix A2: Quantitative Survey.

After the control variables section and the introductory part, survey participants were asked for their opinion as to learning from colleagues on a five-point Likert scale (Moscarola, 2019). Then, select points of the qualitative findings were developed into questions, again on a five-point Likert scale. These questions focused on conditions for boundary spanning in learning in terms of ability and willingness as well as any active role as boundary spanner in learning. The survey furthermore incorporated questions and expectations associated with this boundary spanning role. To grasp the answers holistically, comment fields were included for allowing the survey participants to include further explanations. Upon suggestion of the company-internal survey specialists, an additional field “I don’t have an opinion” was also added to each Likert scale answer, should the respondent not feel concerned by the question at hand.

Afterwards, the survey focused on activities and asked what made a “good” training by colleagues. This allowed confirmation of the cognitive and relational activities identified in the qualitative part. Specific questions as to intra-team boundary spanning in learning as well as boundary spanning from other internal and external stakeholders outside the department were put towards the end of the survey, such as not to taint the neutral questions asked beforehand.

Finally, there were questions whether managers acted as role models in boundary spanning across training center locations, if trust were perceived, and how strongly the participants have experienced culture change in their VET department in the last five years (all five-point Likert scales). A last question aimed at the aspect of perceived long-term performance of the VET department’s operations [in German: “Zukunftsfähigkeit”] which was one of the relevant qualitative outcomes as described in chapter 4. With these questions, select qualitative findings were able to be asserted as to what, how and why.

2.2.2.3. Control variables

This survey was conducted with 286 participants of a German MNE vocational education and training department, 190 of which were VET trainers. 61% (175 participants) answered to the survey in total, thereof 104 trainers.

In order not to divulge explicitly the topic of the study, i.e., boundary spanning, the questions were combined with general questions about new forms of learning (e.g., learning format preferences, opinions about how the new philosophy is being implemented, etc.). Consequently,

not all questions are relevant to this DBA thesis, the research topic of the latter centering around how and why boundary spanning occurs in VET in the context of digital transformation.

Comparable to the qualitative study, control variables were age group, role, size of current training center and experience in different training centers. The age of the interviewee and the size of the location were categorizable in equi-distant steps, along with the information whether the survey participant had work experience in 1, 2 or >2 training centers of the VET department in the past.

Location, gender, (highest) level of education (according to the EQR level) and whether the interviewee was a direct report of the author-researcher could not be controlled, because of company rules and/or German data privacy laws.

The different roles served as control variables, i.e., the roles identified during the qualitative interviews (managers MGR, trainers T, headquarters staff HQ). In addition, another role M was added, i.e., teacher/mentor/learning coach [in German: “Lernprozessbegleiter”], the latter one a role only for dual students. Teachers can be found in the MNE-owned vocational schools. A further role called “Miscellaneous” was created, subsuming adjacent positions as assistants, temp workers etc.

This way, clusters can be filtered and examined separately. For instance, trainers, mentors, and teachers were subsumed in the last line (Table 9) via a compound variable into one group Trainer, vs. managers and headquarters staff constituting the alternative group MGR/HQ (in this compound variable, MISC were left out).

Other control variables were size of training center and number of training centers a survey participant had worked in (including the current one) as an operationalized indicator for having experienced different structural boundaries (see Table 9).

The descriptive statistics of the control variables can be found in Table 9.

Descriptive Statistics									
	N	Minimum	Maximum	Mean	Std. Deviation	Skewness		Kurtosis	
	Statistic	Statistic	Statistic	Statistic	Statistic	Statistic	Std. Error	Statistic	Std. Error
Which age group do you belong to? 1=<30yrs; 2=30-39; 3=40-49; 4=50-59; 5>59	175	1	5	2,99	1,009	,046	,184	-,723	,365
How big is the training center where you currently work? 1:<5 employees; 2:5-15; 3:>15	175	1	3	2,44	,621	-,643	,184	-,529	,365
How many training centers have you worked at as part of regular staff (including the current one)? 1: 1; 2: 2; 3: >2	175	1	3	1,43	,682	1,308	,184	,359	,365
1=T; 2=M; 3=HQ; 4=MGR; 5=MISC	175	,00	4,00	1,7429	1,25814	,550	,184	-,833	,365
1 = Trainer; 2 = MGR/HQ	153	1,00	2,00	1,3203	,46811	,778	,196	-1,413	,390
Valid N (listwise)	153								

Table 9: Descriptive statistics of control variables, quantitative survey

2.2.2.4. Survey conduction

Survey participation was voluntary and sent out via email. A short introduction explained to the survey candidates that the survey aimed at assessing the continuous education, more specifically, learning from each other, learning across training center sites and boundary spanning with other units and partners. It furthermore indicated that some of the results were to be analyzed and re-used in a scientific context. Data were handled anonymously. The survey was not used to assess employee performance. Therefore, individual's answers should not include names or descriptions that could be used to identify individuals.

The complete survey in English translation can be found in Appendix 14.2.

The results were reported in Excel, imported into SPSS software, and analyzed there. A complete description of the steps of the analysis in SPSS can be found in Appendix 14.3.

2.2.2.5. Limitations and biases

This abductive quantitative approach does not aim at confirming or rejecting specific hypotheses deeply rooted in scientific literature. Rather, it is the data which guide the way to any concepts and theories. This makes the questionnaire appears as an exploratory tool to confirm (or not) the qualitative findings while further exploring others. This, in return, may limit generalizability of the results to the case at hand, although in-case validity can be shown (see chapter 4.3.5.4.).

While all relevant dimensions of boundary spanning in learning were addressed (conditions, activities, scope of boundary spanning and leadership/culture change), the level of questions had to be formulated in an empirical way that may sound somehow superficial with regards to boundary spanning, as the respondents were supposed to not be familiar with boundary spanning theory, nor were they all informed about the prior qualitative study. The exception hereby were managers and select trainers, some of whom were involved in the qualitative research part.

As to possible bias, this was strictly controlled by pre-testing the survey with subject matter specialists who normally do surveys in this VET department, and who were also used to the qualitative study. Their job was to do a pre-assessment for clarity, neutral tone, practical relevance, and context as well as feasibility regarding workers' council permission. In some questions, additional explanation was offered prior to the question to clarify the context or the specific purpose. This was added based on feedback of the departmental subject matter experts.

Further quality gates were the following:

- A pre-test with one of the interviewed VET trainers, which took place on October 28, 2021, to ensure clarity and understanding from a peer group perspective.
- A discussion regarding the quantitative research findings in the management team on January 26, 2022, and the worker's council apprenticeship committee on February 1, 2022.

3. Context of the case study: VET in a high-technology MNE

In the previous chapter, it was established why a case study design was chosen to explore the research question of this thesis. This chapter presents the single case study and discusses what makes it special as well as suitable in this research context, and how to describe the context of the case study for the reader to follow and to relate to the empirical data of the qualitative and quantitative studies.

The company in the focus of this thesis is a high-tech multi-national enterprise of German origin.

Why German? In Germany, the dual vocational education and training system with dual apprentices and, nowadays, dual study programs (DSP), has a long-standing tradition, as explained in the introduction. The company which is the object of this study, trains apprentices and dual students in high numbers each year (in average 3.600 learners p.a.) and has experience with VET operations while managing a large staff of VET trainers. Due to the size of its VET operations in Germany, there is a sufficiently large research population (ca. 150 VET trainers, ca. 30 managers) and there is relevant organizational breadth and depth of the team to be studied, whereas there are only a few if any truly comparable VET organizations in Germany and worldwide.

Why an MNE? The size of the operations of the MNE as well as the VET department itself warrant many organizational boundaries, as illustrated in Figure 2.

Why a high-tech company? The company has been undergoing deep-rooted changes in terms of digital transformation and learning, as will be outlined hereinafter. There is relevant occurrence of digital transformation-induced creativity, learning and innovation throughout the organization.

Why this particular company? As already detailed in the previous chapters, the researcher-author is the manager of the German VET department and therefore has access to data, players, and other insights. Such detailed empirical data are relevant to a DBA thesis that strives to establish practice-oriented knowledge deeply rooted in research theory, thereby contributing to management theory and practice.

For organizational analysis of the case, the 7-S-framework introduced in chapter 1.1.1. is used in the following.

3.1. Structure

The VET department is set up as a global entity situated in the HR department, with a German and an international department as well as a Global Strategies and Processes Team supporting both departments. As per the fiscal numbers in 2021, the German VET department has by far the largest operations (~250 department members), compared to other countries the MNE operates in. It provides training and education for approx. 3.600 apprentices and dual students in average per year in 20 training centers throughout Germany. Due to the refugee crisis in 2015, the German VET department has also provided special six months training classes for young refugees, to prepare them for industrial apprenticeships (Ofstad and Wolf, 2017), since 2016.

The 20 training centers act as loosely coupled systems (see chapter 1.1.1) because of their both separate and joint characteristics. Each training center has its own history and vocational focus and slightly different culture.

„This is something I have realized as I lived in different locations myself – each region stands for its own identity. And personally, I appreciate to have and to hold up and preserve an own culture. Therefore, I would not like it if a shared culture led to a shared identity.” (Interview partner P10)

The training centers are organized into seven regions (Figure 19).

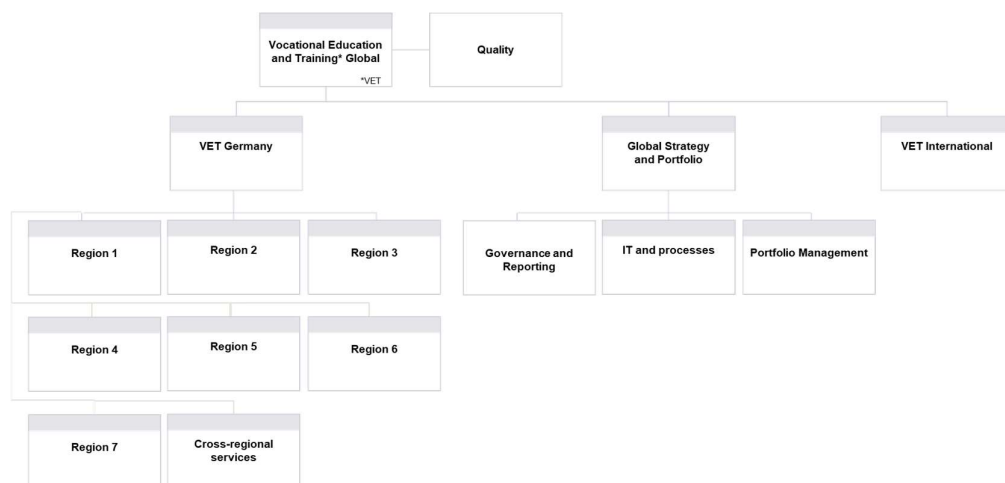


Figure 19: Organizational structure, VET department, case study

Each regional manager has between two and six training centers to manage, offering training for occupations such as electrician, fitter, IT operators for system integration (in German: “Fachinformatiker für Systemintegration”), etc., in each training center. There is a strong focus on mechanical and electrical trades. Dual study programs include, for example, Bachelors in Engineering, IT, and Digital Business Management.

Customers are mostly internal, i.e., these are managers in the regional entities, e.g., in the factories, sales or service organizations, in accounting or HR, who have apprentices and dual students as part of their team members. The latter spend part of their time in the VET training centers, such that training lessons can be scaled effectively and skills can be taught and practiced without negatively affecting productivity in the departments. Some customers are also external customers who pay the company for the service of training their apprentices when they are not at vocational school or scheduled to work in the customers’ departments.

A cross-regional shared-services team within the German VET department is responsible for all cross-regional processes, such as apprentice marketing, recruiting, sales, and growing activities in technical upskilling and reskilling for – mostly blue-collar – employees.

Apprentices and dual students report to their respective business departments’ managers (e.g., production team x, or accounting team y). They are sent to the VET department for training. They spend about one third of their time in the VET department, one third of their time in vocational school or universities of applied sciences, and another third of their time in practice in their respective business departments. The VET department coordinates most VET activities for the apprentices and DS. This includes vocational school arrangements, schedule of practice phases in the business (e.g., shop floor), feedback loops and performance evaluation for the practical work in the training centers. During the time when they work in the respective business departments side-by-side with their future colleagues, they are under the responsibility of the respective business line managers, who also pay the apprentices’ wages during the 2 through 3.5-year apprenticeship (dual studies up to 4 years) duration.

3.2. Strategy

Prior to 2015, the VET department regions and training centers were organized as profit centers. Sometimes, they competed for the same (internal or external) customer. As an example, some managers from North-Rhine Westphalia wanted a dual student from the Duale Hochschule

Baden-Württemberg (DHBW) rather from a North-Rhine Westphalia university, because they preferred the setup, length, or specialty of the DHBW offering. A training center, however, would offer collaborations with regional universities to reduce complexity and limit travel costs. It took careful negotiations among the training centers and customers to balance out customers interests with those of the profit-center driven training centers at the time, because internally, the regional structure defined which training center was teaching the apprentices.

Prior to 2015, the number of average learners per year was almost double compared to 2020. The number and size of the training centers and regions as well as a quasi-competitive structure made co-operation across boundaries simply not practical.

„ ... many of us, i.e., those who have been here for a long time, have been socialized in a certain way. In other words: in the regions, we tried to secure our business, our own business; hence, we did not think in training center locations, but in regions, well, if I am honest, as a bigger region with many locations, we actually primarily looked at our location, secondly at our region, and afterwards came the focus on us as a country-wide team.”

(Interview partner 10)

In 2016, a strong focus was put on digitalization topics as well as on internal customers' needs and demand-driven apprenticeship numbers. This means, numbers as predicted by the businesses during their long-term personnel management process, and no surplus apprentices who might not remain with the company after the end of the apprenticeship, are hired. This changed the management framework and required a downsizing of VET operations in Germany. Prior to 2016, about one third of the VET operations had been carried out for external customers, respectively external apprentices. With focus on internal customers' needs, the external business was also consequently scaled back.

Throughout 2021, almost half of the jobs in the VET department were carved out to spin-offs, reduced-in-force or re-organized. This put a rift between management and trainers because the new strategy was perceived as something which was implemented against the staff, leading to downsizing, early retirements, and spin-offs, effectively reducing capacity.

This reduced capacity makes cooperation across regions and training centers vital for success and provides for a more flexible setup of training centers, while focusing on overall goals and profit, rather than on profit and goal achievement on a training-center level. The profit goals of the regional managers are consequently adapted and set up as shared goals, aiming for collective

performance achievements vs. regional optima to the detriment of overall cost savings. As an example, it is positively acknowledged nowadays if trainings centers pool resources and/or occupations to economize on resources, rather than jealously counting that the neighboring training center does not have more apprentices than the own one.

Two examples will underline such co-operational strategies on an operative level:

(1) The need to invest in new equipment to provide adequate training facilities increased, but some equipment had to be shared across regions because of the cost. Again, more cooperation was needed across training centers, which required boundary spanning. For specific classes, equipment is sent to the training center, or apprentices go to another training center, if equipment is not shippable.

„Well, we closed our metal workshop. That means that a part of the mechanical systems, as a [teaching] topic, was eliminated. We have no equipment, no trainer any longer. That is just that. Well, ok, and then I asked the whole region: “Does anyone still have trainers who can teach this, and the relevant equipment?” And the colleague who had asked [me], “Attention here, we need this in the mechatronics area, can we just buy this?” He realized by himself that this did not make sense, because that would have meant 35k€ times x for class equipment. And say, for teaching this topic two weeks a year, this does not sound efficient to me. Then we simply asked other locations and voilà, it works, but it is not common [...], but probably it is not in people’s heads because we can go a long way by ourselves, about 80%-90% we can do ourselves, and for the remaining 10% it is [about asking others to cooperate]...!” (Interview partner P11)

(2) Not every training center can offer the variety of occupations needed to satisfy customer needs. Hence, cooperation is needed to maintain the offer for internal customers. As an example, the commercial apprenticeships were re-organized in one single group consisting of apprentices from different training centers and regions, who are all trained in one training center, with certain virtual vocational school elements. This allows them to spend a relatively large amount of VET weeks in their home base, without incurring excessive travel costs. As the company maintains a few private vocational schools itself, such curriculum and scheduling optimization is possible.

Similarly, a regional class with distance education was set up for IT specialists.

„... such a model like IT specialists carried out as distance education like the setup in M would have been torpedoed 10 years ago.” (Interview partner P10)

3.3. Superordinate Goals

“The VET department as partner of the business lines strives to provide strong dual VET with high quality, competency-orientation, and the right mindset, in order to guarantee the pipeline of young talents for the company in Germany.” This mission statement of the VET department of 2019 has been amended a year later, reflecting pandemic conditions and the potential new normal corporate world afterwards, to include *Virtualization in VET offers a significant contribution to self-oriented learning of tomorrow’s employees* (Internal document, 2020).

In recent years and months, the topic of employability has become a company priority and an integral part of its corporate social responsibility. This concerns initial corporate learning (i.e., dual VET) as well as continuous corporate learning (upskilling, reskilling). In this context, digital learning platforms play an increasingly important role (see chapter 1.2.2.), not just in pandemic times, but also from a strategic corporate learning perspective. The company has its own global DLP with more than 60,000 learning nuggets. Learning nuggets are micro-credentials, lasting between 5-10 minutes sometimes, to facilitate and fit learning elements into the daily agenda of employees.

One of the management board’s objectives, i.e., increasing digital learning hours per employee, has been implemented since 2020. Consequently, goals, implementation and reporting of learning activities have gained significantly more importance throughout the company. Until 2025, the amount of digital learning hours per employee worldwide is to be doubled.

Currently, the VET department takes on increasing responsibility in the upskilling and reskilling arena, to train skilled and un-skilled, notably blue-collar workers concerning technical and digitalization topics to counteract future employability problems. These endeavors need to be balanced out against capacities needed for dual VET. The VET department also puts suitable content onto the internal DLP for technical upskilling training (Bundesvereinigung der deutschen Arbeitgeberverbände, 2021). Here, synergies are possible with dual VET contents, which are hosted on a separate platform.

When it comes to the learners in the VET department – apprentices and dual students – the VET leadership team has been carrying out satisfaction surveys since 2019 with the entire cohort of

absolvents each year. Raising the motivation of learners was a topic of focus and a departmental collective goal in 2020 and 2021, as the average score was 2,5 (with 1 being best and 5 being worst) in 2019 and 2,6 in 2020. In 2021, thanks to collaborative efforts of the entire VET team, a modernized curriculum with enhancements regarding digital technologies, process changes and better cooperation of all stakeholders involved in VET, the score could be significantly improved to 2,3. In addition, the voice of the learners was solicited in two surveys regarding digital learning following the pandemic-induced virtualization of apprenticeships.²

3.4. Systems and Processes

When the company made digitalization an explicit part of the company strategy in 2014, the VET department reassessed and amended the curricula and reformulated its mission: customer focus. This so-called digitalization roadmap was started in 2015 with an assessment of which topics will be required in future curricula, together with internal and external stakeholders. All occupations were analyzed and amended in the following years. The department has a product lifecycle management (PLM) team, which develops new learning products for VET training. The PLM process with innovation radar, product development process and roll-out was adapted in the following and new and amended curricula were launched with the 2017 intake of apprentices (Hollatz and Ofstad, 2021). Since 2017, every two years a reassessment of innovation radar activities and, consecutively, of the VET product development activities, is being carried out. Regular customer panels provide for intermediate input, so that relevant trends can be implemented as needed. As an example of internal customer voice being heard, a special focus in one occupation in the electronical field was introduced by 2021, i.e., “Electronics technician IT/IoT for Building Technologies”.

Systems have also been actively changed: the backbone VET enterprise resource planning (ERP) had been provided by a proprietary system until 2019, when the decision was taken to exchange it for software-as-a-service off-the shelf standard VET solutions. This again counts as self-induced change, which is perceived by some as cumbersome. It certainly asks for additional energy because trainers and planners must get adapted to a new system. Rolling out these new education management solutions in an agile manner, i.e., with somewhat flexible

² see <https://www.linkedin.com/feed/update/urn:li:activity:6790285305833373696/> (published on April 20, 2021) and <https://www.linkedin.com/pulse/offering-outstanding-learner-experience-newwork-dual-education/> (published on July 9, 2020)

deadline and functionality packages, poses an additional communication and acceptance challenge. Such changes may lead to uncertainty and dissatisfaction for some who ask:

“What do you do with our beautiful organization?” (Interview partner P4)

3.5. Staff and skills

Turnover, i.e., natural attrition in the department has traditionally been at < 3%; hence, teams were rather stable. Besides, German labor laws allow lay-offs only if there is personal fault or adverse corporate financial conditions that make lay-offs inevitable.

Train-the-trainer activities were mostly classroom teaching affairs, sometimes lasting a week, often centrally organized by the VET department’s headquarters staff. Roll-out of a new product (aka, a new occupation) or simply adding skills to the occupation’s curriculum based on internal customer input, means providing for the right equipment and, more importantly yet, training the trainer concerning the new topics. This has proven to be an on-going activity, which the VET management team continues to put a lot of focus on.

“People stay in VET for a long time, i.e., as a VET trainer, I am not doing a new job after three years, [...] if I look how long VET trainer colleagues stay with us, then we talk about a two-digit number of years and many of those grew up in the old world. Where regulations did not constantly change, but where one actually could teach the same stuff for years. These times are simply gone. And this is, in my point of view, the biggest challenge, to bring the VET trainers into the boat respectively, to smarten them up, such that they can transfer new know-how to young apprentices accordingly.” (Interview partner P7)

The speed of digital transformation requires train-the-trainer efforts far beyond what was needed previously. For most of the innovative topics, classroom training does not exist yet. Therefore, learning-by-doing, learning-by-job-shadowing, and learning from internal experts-increased. All these facets require boundary spanning capacities. To foster learning from each other, every other Wednesday a virtual *New Normal Great Teaching* session has been organized by VET headquarters: the various trainers from various training centers presented content or methods. This was so successful that it has been set up for the international VET operations a year later. Starting in October 2021, half-day *learning day* appointments were established and

offered to the entire German trainer community as an action research element, where the author-department manager reflected on one of the qualitative outcomes that indicated a lack of time for training.

Due to the scarcity of trainers in some expert fields and training centers because of the reduction in force, trainers-specialists work across regions more than before. This required boundary spanning to bridge across the different training center cultures and mindsets because each training center mentality is different. Another reason for more learning of VET trainers lies in a changed VET philosophy and systematics: the local trainers are supposed to teach more holistic competency fields including new topics – and new values – starting in 2021. Examples here are “Lean Management” or “Introduction into Digitalization and Networking” topics, which are supposed to be trained by all trainers, even though it might not be their specialty. The following quote illustrates the change in values:

„When training started at 7 a.m. in the morning and ended at 3:45 p.m., then it really ended at 3:45 p.m. Rather, there was a problem if anyone was still present after 4:00 p.m. And this is for me a great example regarding mindset, which cannot hold up today. Well, because finally eventually, this is about finding solutions in every function and the working day should be aiming at finding solutions. And this is why this example with working time is so striking, where I say, there is culture change noticeable, because we want to use our new VET philosophy, which we just defined, to consciously create more freedom for autonomous learning, specifically for the year two apprentices. Project-based learning, overarching learning as well. And this is, to my belief, exactly the culture change we need here, because a young person who gets into his first job and thinks, it starts at 8:00 a.m. sharp and in the evening, it doesn't go longer than eight hours, and counts down, will have a general problem. And in parallel to “how do I go about work?”, this has to be about “how to acquire the competences needed for problem-solving?” We must pass on this mindset to our boys and girls.”

(Interview partner 6)

Given the rather recent experience of down-sizing activities, employees realize how relevant it is for their jobs to continue to learn new topics, technologies, and methods. However, due to the same activities, capacity load is high, and finding time for learning can be seen as a challenge for some.

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It is also worthwhile to note that VET management stresses the importance of networking beyond VET to the business lines (which are internal customers). Therefore, trainers may feel coerced and stressed by subjective norms, job relevance, output quality and result demonstrability without realizing that learning side-by-side with the learners is possible and it is about methods, problem-solving and creativity, not knowledge alone.

“The main problem is the whole new know-how which needs to be taught now, which is, in some phases, not done by the VET trainers any longer.

This concerns many VET trainers, who say: “Man, I do not know any longer what to teach these apprentices.” So, you see again, that methods of teaching have fundamentally changed. I teach occupational groundwork, say, until the part 1 exam, where the basics are set, and then actually this moves into the development phase, where one must really motivate the learners to tackle new technologies. The VET trainer must realize that it is absolutely no longer necessary to master, say 100%.” (Interview partner 1)

To some extent, this may lead to fear regarding change:

“Certainly, fear of change is present. Not for everybody.”

(Interview partner P15)

Managers realize that this implies a task for them:

“... there is a lot of fear playing out and yes, I believe that can be managed by leadership, that can one do with many talks, I believe, here and there it is really a very personal level which needs to be addressed, but fear is certainly a big factor, yes.” (Interview partner P14)

3.6. Style and culture

In recent years, not only has the content been regularly adapted and amended, but in 2020, a project was also started to reassess the didactic foundations of the corporate dual VET activities. How to teach VET contents? How can trainers support learners? How to prepare learners best for a career in the company?

The project’s name – COPED (acronym for **co**mpetence and **p**roject-oriented **e**ducation) – gives an indication of what will be relevant in the future. While project-oriented VET learning remains a central pillar of the future, this new VET philosophy puts the individual competencies

and needs of the learners in the focus more than before. It also gives the trainer more flexibility as to the schedule and duration of the learning units. Another important change concerns the overall responsibility of the VET trainer for a competency field (> 15 weeks), where he or she is now fully responsible. In former times, many VET trainers were only in apprentice groups for a few days or weeks, focusing on their respective specialties (e.g., hydraulics, network security, lean management). At the same time, COPED emphasizes the young learners' responsibility for their own learning success, and the road to self-oriented learning will be paved, in order to prepare them for their future as a full-time employee, ready for upskilling and digital learning platforms.

For a summary illustration, which was shown during an all-VET employee meeting in Germany in February 2021, please refer to Figure 20.



Figure 20: New VET philosophy (internal document, 2021).

It is worthwhile to note that the VET department deals with the many changes (re-dimensionalization, digitalization roadmap, refugees' classes, COPED, blue collar upskilling) by setting up virtual project teams (refer to chapter 1.1.1.).

“And we have a culture change, we have a transformation process within the company and I, personally, like the notion of ‘change concerned people into involved people’ in this context.” (Interview partner P10)

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The communication style has become rather open, and leadership strives to be participative, to help alleviate the capacity load and nurture willingness to change on all levels. Many projects are done in an agile manner without knowing the output (when, what specifically, and how) completely, and teamwork is the predominant way of working to deal with what the organization sees as challenges: DT-induced paradigm shift in VET, which corresponds to constant change, in a VUCA environment. Volatility such as re-dimensionalization or increased activities in upskilling and reskilling; unpredictability, such as future intake of apprentices or breadth and depth of upskilling needs; complexity, because many projects overlap and depend on each other, as well as ambiguity, as the future cannot be easily anticipated, and pandemic conditions prevent a clear-cut roadmap for going back to normal or proceeding to what the company management team refers to as the *New Normal*.

Having illustrated the case at hand in times of digital transformation and cultural change, the next chapter will be dedicated to the specific findings of the case study carried out with employees in the abovementioned case. How and why does boundary spanning occur between traditional VET and new forms of education in the context of digital transformation and new learning ecosystems?

4. Research findings

Mixed methods research findings are presented as they occurred during the research phases. Research started qualitatively, with 21 semi-structured interviews. Results of the qualitative analysis are presented in chapter 4.1. A survey with 175 answers followed. Results thereof are presented in chapter 4.2. Integrating both qualitative and quantitative findings will be discussed in the mixed methods result section in chapter 4.3.

4.1 Qualitative findings: What to find in this case on boundary spanning?

4.1.1. 6C analysis

Among the possibilities offered by Grounded Theory, the 6C “coding paradigm” (Corbin and Strauss, 1990, p. 423) was chosen because it was an apt approach to get an overview of the general concept via open coding of qualitative data. The two most relevant references per category or subcategory can be found in the appendix A1. Figure 21 illustrates the model.

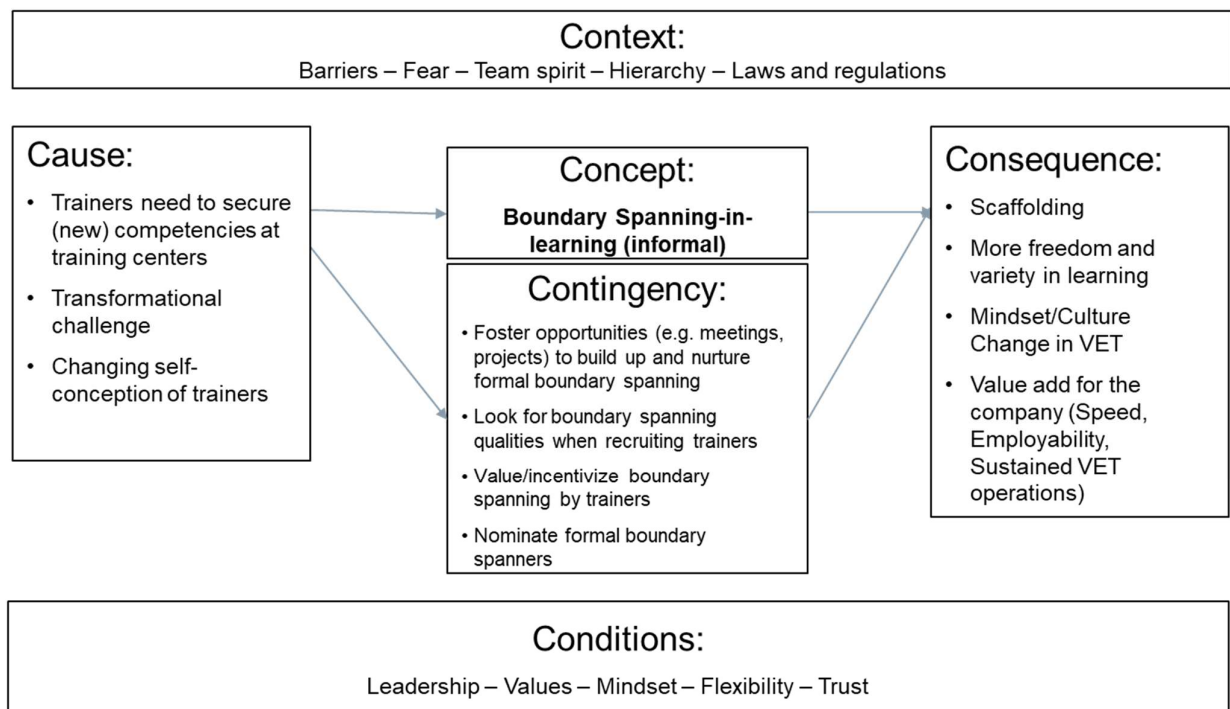


Figure 21: Understanding how and why boundary spanning occurs, 21 interviews (Corbin and Strauss, 1990; MacDonald, 2001)

In the following, the 6C categories will be presented. For all categories there is an extensive list of all categories, topics within the categories and two typical quotes in Appendix A1.

4.1.1.1. 6C – Causes

In terms of *causes* of boundary spanning in VET, extrinsic and intrinsic causes (motivations) could be found.

- VET Trainers need to *secure (new) competencies* at training centers to ensure the training center can be run, and because they have an intrinsic need to do life-long learning. New competencies include for example technologies such as robotics, additive manufacturing, digital automation, edge, cloud, but also methodic knowledge about virtual and hybrid learning formats, gamification software, with creative formats such as reverse teaching (apprentices teach trainers) or common exploration of topics without the trainer having the solution ready. This is a comment specifically relating to small training centers, who do not have the personnel capacity of bigger training centers. Therefore, every trainer needs to be a generalist rather than cultivating a specialty (e.g., in hydraulics, or embedded systems).

“Even in their free time they do continuous education. This life-long learning for them is not just a flowery phrase, this is life for them.”

(Interview partner P3)

- Their *self-conception* changes due to the new role required from them externally to convey new competencies as coaches in a holistic manner and, internally, because their self-confidence and courage increases.

“Life of a VET trainer changes, in my opinion, respectively, has already changed substantially. Isolated („Island“) competency is something we do not need any longer. A VET trainer must be able to convey comprehensive knowhow, and even sometimes has to admit, if he is not the expert in one special area, exactly that. Maybe he teaches together with a colleague, maybe he searches for solutions or asks colleagues. Those may be experts in this domain [...] Without saying that this lesson cannot be taught by me.

That can serve as an example for the boys and girls how to come to a solution without trying to dodge the responsibility.”

(Interview partner P6)

- *Transformational changes* on the meta-level are referred here. Interview partners speak about a “balancing act” of all these changes which are challenging to manage. These include digitalization, COVID-19, speed of operations, or the conflict of a rigid VET law facing dynamic conditions in a modern high-tech MNE (all external changes). Interviewees also mention the different expectations that a VET department faces today in such a MNE (i.e., to convey training not only for apprentices and dual students, but also to employees in need of upskilling/reskilling). These would be internal changes.

These causes cannot be answered by traditional learning units but need new, sometimes improvised, often spontaneous learning by boundary-spanning.

4.1.1.2. 6C – Context

The *context*, in which this happens, can be characterized as follows. The context is highly dependent on the perceived situation of the interview partners at the different training centers.

- *Barriers* are mentioned by 18 out of 21 interview partners. Hierarchy can be perceived as a barrier. On numerous occasions, the lack of time was perceived as a barrier, which did not allow for new knowledge and competencies.
- *Fear* is expressed by many interview partners (13/21), with various facets: fear about being laid off, fear about making mistakes and losing face, learning new things, about not being accepted by the learners any longer due to age, and fear about getting additional tasks.
- *Team Spirit* is voiced to be dependent of group constellation and size. If the team spirit is good and there is trust, boundary spanning in learning seems easy. On the other side, team members not open to change may have an effect on the total team. As P13 puts it:

„You are always as open to change as the people in your environment.”

(Interview partner P13)

- *Hierarchy* power and structures are described to have decreased by importance in the last years and replaced by trust.
- *Laws and regulations* refer to the legislative framework of VET in Germany, but also is perceived by some as a safe framework in which to operate, while flexibility and freedom in learning is seen as risk.

4.1.1.3. 6C – Concept

The *concept* of boundary spanning-in-learning is described in ample words by all interview partners. This central phenomenon is a result of selective coding asking for the “core category” (Corbin and Strauss, 1990, p. 424).

- Boundary spanning in learning can happen *informally* or *formally*. During the pandemic, informal boundary spanning in learning situations often had to be formalized due to the lack of opportunity to meet.
- It can happen *within a site* or *across different sites* or *between a site and headquarters*.
- There is also boundary spanning in learning *towards the businesses*.

The core concept has been defined as boundary-spanning-in-learning. Albeit the focus is here on informal (spontaneous) boundary spanning, the frontier between informal and formal is somewhat blurry. Informal boundary spanning has had to be formalized because of pandemic home office conditions for instance. In other examples, one training center manager invokes formal boundary spanning situations where employees of one training center meet to learn together, and after some efforts this endeavor becomes routine and easiness that allows for it to be described as informal:

“We talk a lot about it, we are in a dialogue, that I strive to keep up continuously. With regards to learning it is the path I took: I started with little nuggets, really, did not paint the whole picture because that might have been depressing, but rather tried a bit to visualize the dialogue together. What are the next little steps? And then aim at small success stories, say, this is a tool I have learned to master, and it works. In the next step, I will deep-dive into 3D printing, and then I share this. We had such nuggets. One of the team members is really fit in terms of robotics. And then we said „OK, this one does a two-hour training in the afternoon”, while the apprentices were tied up with some safety training. This time we use, even the team assistant participated, such that really everybody knew what this was about. And everyone participated. Then there was another part where we said: „Ok, and now we do 3D printing.” And not just this „I got it“, but rather this successful feeling of “I could teach this.”. That was the value-add.” (Interview partner P15)

4.1.1.4. 6C – Contingency

Contingency actions include:

- *Formal opportunities to build up and nurture formal boundary spanning*, As P18 puts it:

“We have the transfer of knowledge of managers as a fixed appointment in the regional meeting. That is where you exchange, of course the experts also exchange [information] and managers as well, via MS Teams, via projects.” (Interview partner P18)

- *Looking for boundary spanning qualities when recruiting trainers*. According to P6, social competencies are deemed as important as technical expertise.
- *Value/incentivize boundary spanning by trainers* is not done a lot. P21, a junior manager driving a cross-regional project, described what made the project successful and how he got everyone to interact and contribute:

“We really took notes and documented every best practice (no matter how weird I might have personally judged those practices), simply because we wanted to express appreciation.” (Interview partner P21)

- *Nominate formal boundary spanners*.

The valuing and incentivizing of boundary spanning examples by trainers has not been mentioned a lot. Although we are aware of the fact that boundary spanning is indeed welcome and such qualities are entirely relevant when considering individuals' promotions, it was neither a spontaneous, widely discussed topic of the interviews, nor did the interview protocol convey a question around incentivizing/valuing it specifically. The remuneration issue, i.e., promotion or public praise for people who venture out and boundary span across teams or regions is added here explicitly as a research-in-action element, based on the experience of the author.

4.1.1.5. 6C – Conditions

As to **conditions** in which boundary spanning in learning can be achieved, *leadership, values, mindset, and flexibility & trust* are the subcategories identified after conducting all interviews. Flexibility and trust seem interrelated with interviewees of a small size training centers (see Table 10). Therefore, it is mentioned despite a low number of comments. Within leadership,

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role models, openness, empathy and the respectful relationship between manager and team member were mentioned most often. to characterize what makes a difference in leadership. As P7 and P8 put it, leadership is more at eye level and culture is open, with managers acting as role models:

“Fundamentally, I can state that managers today are striving much more to act at eye level with their staff.”

(Interview partner P7)

“Culture has definitely changed. It became more open, what, I think, is appreciated by everyone. And this open culture, that is, I think, the same for all. That is fun. That raises or keeps up motivation. [...] I think managers should live this topic [as a role model] and ask for it.”

(Interview partner P8)

In terms of mindset, it is interesting to see how P19 describes the absence of jealousy and the value of learning to be special in this department:

“I have never experienced in VET that anyone would block. To the opposite: in VET, you always motivate. Here is a group. Here is the opportunity. Either in small, simple courses or in job shadowing, in a bigger setting, if you say, one really wants to attain another level of education, a continuous education type of qualification, which allows someone to continue to be employable in the everyday work environment. I must say, this is different in this VET department compared to other departments where I worked.” (Interview partner P19)

A central value of this department is quality-orientation and a sense of responsibility for the cause:

“I think the trainer who says I ultimately stand in front of my group, and I do this in a formal classroom setting and I wait until headquarters gives me a VET curriculum how to convey my topics in a project setting or in a MS Teams setting... because I do not have ideas how to do online VET training... I think this type of person, who, as matter of fact, acts like a first-year apprentice (I am a bit catty now), that this type of person will not have

a home in VET, because we have this quest for quality for our businesses. Sounds brutal, but I am convinced of that.” (Interview partner P6)

4.1.1.6. 6C – Consequences

Consequences of boundary-spanning in learning are defined as:

- *Scaffolding*, i.e., bridging the skills gap with the help of other colleagues

“I must build coalitions, I must accept to a much further extent that I do not know everything, Instead, I must [...] find someone suitable[...]. I must consider this for the sake of the company. And the company benefits because this network thinking, this systemic thinking provides a value-add.”

(Interview partner P3)

- *More freedom and variety in learning*
- *An individual mindset / collective culture change in VET*
- *Value add for the company* in terms of speed of implementation, employability of apprentices, dual students and employees undergoing technical upskilling and reskilling. It will also potentially lead to sustainability of future operations which is important for managers: .

“We really want to [...] secure the future of our employees.” (Interview partner P17)

Another topic is speed of implementation of new technological know-how:

“In the past we would have done it in a way that we would have set up a product team and then we would have created ideas how to get these VET things done ourselves. Of course, we would have looked left and right, who could be our partners, professional didactic suppliers, but it does not work this way [any longer]. You need to look faster: how is the topic positioned in our business? Where can I get content from fast? Which options do I have to assess content where everyone agrees that this would be relevant for all learners, vs. content which must be customized for technicians or commercial clerks? And that is something where you would involve the business, or the technology teams, because they have the contacts into the

business, to play this network completely. On the other side you need to watch out what others have done already, because you never start at zero.

We follow the business. Hence, what exists in the business, what exists outside the business, in order not to start at zero? Well.” (Interview partner

P5)

It is worthwhile to note that there are no big differences as to size of training center and number of perceptions uttered (refer to Table 10).

Training Center size	small (n=7)	medium (n=9)	big (n=3)	Total (19)
CAUSE - Need to secure competencies	2	0	0	2
CAUSE - Self-conception is changing	3	4	1	8
CAUSE - Transformational Challenge	6	8	3	17
CONCEPT - Boundary Spanning	7	9	3	19
CONDITION - Flexibility and Trust	2	0	0	2
CONDITION - Leadership	6	7	3	16
CONDITION - Mindset	1	7	1	9
CONDITIONS - Values	2	3	1	6
CONSEQUENCE - Culture and Mindset Change	5	5	2	12
CONSEQUENCE - Value-add for the company	3	5	2	10
CONTEXT	6	9	2	17
CONTINGENCY	4	2	1	7
Total	7	9	3	19
Distribution of probands in training centers (size)	33%	48%	19%	
Distribution of comments across training centers (size)	37%	47%	16%	

Table 10: 6C Model depending on training center size

4.1.2. Boundary Spanning Scaffolding Analysis

This analysis was not done without knowledge of current literature, in particular, Roberts and Beamish’s (2017) Boundary Spanning Scaffolding Model. The Boundary Spanning Scaffolding Model of Roberts and Beamish (2017) frames the conditions of boundary spanning in learning as well as the activities towards the object of boundary spanning, i.e., the learner as main dimensions of boundary spanning. Among conditions, abilities, persisting willingness and opportunities are shown as themes. Activities are subdivided into cognitive learning scaffolding, relational learning scaffolding and material learning scaffolding.

This was used as framework for the following qualitative analysis.

The model which can be established based on the qualitative interviews looks as follows:

4.1.2.1. *Conditions*

4.1.2.1.1. *Ability*

Ability as a second order construct as a **condition** of boundary spanning. It includes knowledge and know-how, networkability across locations, learning aptitude, leadership abilities, social competencies, self-awareness, and communication skills.

The deep-domain technical knowledge is valued highly by the interviewees, yet to be successful in VET that is not deemed enough by the interviewees. Rather, didactical skills and interpersonal skills are important to be a successful VET trainer. The interviewees admit that in the past, the focus was often on technical skills. With the digitalization-induced topics and learning entering the VET arena, the competency to interact and collaborate with colleagues to enhance common knowledge in a team’s learning approach, has gained importance.

“...if I cannot establish a bridge in order to initiate exchange which can afterwards be continued via collaboration tools [like MS Teams], I cannot reach this cross-fertilization.” (Interview partner P6)

Further quotes for this theme of ability can be found in Table 11.

BOUNDARY SPANNING SCAFFOLDING	Quote
1-Ability	
1.01 Knowledge and Know-how	<p>Boundary spanners are persons with a certain background or experience and know-how and knowledge to bring things together. (P5)</p> <p>Either you are really a pro and deep into the domain details which can be trained as an expertise, or else, you are didactically and methodologically so fit – this is the answer then – then you need exactly this to take the other person’s hand. Maybe one does not know better oneself but has experience or problem-solving strategies which can be taught to others. In summary, really deep domain knowledge or exactly the opposite, well not the opposite, but rather didactics, methods, and coaching [knowledge]. (P21)</p>
1.02 Networkability across locations	<p>The relationship level is often present in locations, their environment, but because of the geographical distance not across locations. And if I cannot establish a bridge in order to initiate exchange which can afterwards be continued via collaboration tools [like MS Teams], I cannot reach this cross-fertilization. (P6)</p> <p>These days, one has to value communication skills, this ability to talk, to network and the ability to combine this, to lead and network... this is maybe more important than the last technical aspect. (P3)</p>

BOUNDARY SPANNING SCAFFOLDING		Quote
1.03	Learning aptitude	<p>Boundary spanners can acquire know-how independently, use modern media. (P6)</p> <p>The IT guy, K13, does a lot via chats, via groups, via the internet, be it on Yammer or Facebook-groups or any type of techie group, and he gets his info this way... or whatever blogs, sometimes in English. He acquires the info this way and then exchanges it with others. And if he has a problem he might discuss it in such groups. (P12)</p>
1.04	Leadership abilities	<p>Boundary Spanners can act in the background/in second row successfully, while setting the right direction and creating the right environment. (P4)</p> <p>Actually, the social competency as “pusher” [German: der Treiber] to interact and engage others, must be present. (P8)</p>
1.05	Social competencies	<p>These days, one has to value communication skills, this ability to talk, to network and the ability to combine this, to lead and network... this is maybe more important than the last technical aspect. (P3)</p> <p>I think he has – how to say it – the required subtlety and sensitivity [German: Fingerspitzengefühl]. With most people, I dare say, he knows how they are doing: a certain empathy – can I challenge him a little more? Should I ask first and use scaffolding [German: den darüber irgendwo hinführen]? He observes very well, he listens, he is very structured. (P12)</p>
1.06	Self awareness	<p>The main pillar is first and foremost that I know myself to some extent, that I am in principle able to build up a network on a relational level. (P6)</p> <p>They know that they have knowledge and that it is sensible to work on this continuously and to take others along. (P3)</p>
1.07	Communication Skills	<p>Once, there was a low point and we addressed this openly. We did a workshop and analyzed why it did not work. What do we need to change and adapt? And we changed the rules of the game a bit and that helped. This turned out to be the call for action [German: Ruck] and a reassessment of priorities... well, what do we really want, do you all want to still be part of the team? That helped. (P21)</p> <p>...the colleagues who are really good - and this takes me back to the topic of “talking” that I addressed before – well, good at talking, not only in their own organization, but also across interface partners. (P6)</p>

Table 11: Boundary Spanning Scaffolding – Abilities

4.1.2.1.2. Persistent willingness

In addition to ability, *persistent willingness* is deemed a quality of a successful boundary spanner (Roberts and Beamish, 2017). This second order construct is of particular interest for this thesis, as it touches on the *why* of the research question. Why is someone willing to span boundaries in learning?

The answers are somewhat more subtle than the causes indicated in 4.1.1. and relevant quotes are shown in Table 12. This research shows that *persisting willingness* is characterized by the willingness to create, expand, and share knowledge, and a passion for education because “it is important for them” (Interview partner P3). Recognition is an extrinsic motivation. A sense of responsibility for the quality of education is another, yet, intrinsic, motivation. One proband stresses the learning community thought in the sense of a learning ecosystem where everyone gives and takes:

“I did not have an order; I gave myself the order. I had the order to implement and unify this topic in [training center] M. That was my order and then I found myself the project topic. [...] It just happened this way. In the beginning I imagined an ecosystem that functions just like this, which works by itself, but that did not work. There was always someone, i.e., they needed me in this role to actively build these bridges again and again and pick up and create trust and show interest...” (Interview partner P21)

BOUNDARY SPANNING SCAFFOLDING	Quote
2-Persisting Willingness	
2.01 Willingness to create, expand and share knowledge	<p>Boundary spanners expand their knowledge. It is important for them to let others participate in their knowledge (pedagogical streak) [...] Boundary spanners network with PLM organization and other regions, then multiply it in the local training center. (P3)</p> <p>To pick up this community thought and to claim that if we share things, we can move along together. (P8)</p>
2.02 Sense of responsibility for quality in VET	<p>This consciousness that I want high quality, that I want to do things well and right. I think this is the main driver. (P11)</p> <p>Exactly, question of personality and maybe also background. How has someone succeeded in this professional life so far? Were you ever productive and driven by</p>

BOUNDARY SPANNING SCAFFOLDING	Quote
	<p>deadlines? Have you realized at any given point in time, for instance for people working on the shop floor – well, even then you have differences, some production lines are so-so, some are really tough. You realize this background when they do their new job as VET trainer. How do they work? How are they driven to deliver, and how have they realized the importance of deadlines and internalized the challenging attitude? Or are they easy going and think one way or another this will clear out... That represents attitude and of course that resides in their personal biography. (P17)</p>
2.03 Recognition	<p>If you are now in a position to help other people, then your personal rank, the social rank, increases, because the knowing part is... has a certain power or function or whatever. (P17)</p> <p>Because he could put himself onstage. For instance, he takes a video of this topics and invites the managers [...] Partly, this is about recognition. (P13)</p>
2.04 Passion	<p>I did not have an order; I gave myself the order. I had the order to implement and unify this topic in [training center] M. That was my order and then I found myself the project topic. [...] It just happened this way. In the beginning I imagined an ecosystem that functions just like this, which works by itself, but that did not work. There was always someone, i.e., they needed me in this role to actively build these bridges again and again and pick up and create trust and shows interest...(P21)</p> <p>This urge, this can also be loud enthusiasm. Enthusiasm, which I carry to the outside. (P4)</p>

Table 12: Boundary Spanning Scaffolding - Persistent Willingness

4.1.2.1.3. Opportunities

Opportunities for learning exist and are typically triggered by managers. As these are examples that may be relevant in terms of managerial recommendations in chapter 5, the author makes an explicit exception to the rule described in chapter 2.2.1.6. that there should be two quotes each for a first order construct. Rather, these are seen as examples-of-practice worthwhile being mentioned here.

The interview partners mentioned many opportunities for boundary spanning in learning. From their managerial practice, they talked about many occasions where learning from colleagues was possible and effective. For instance, they mentioned learning in situations of:

- Setting up projects, or expert teams. This can be useful when a new topic or occupation must be filled with learning content, as P3 describes:

“There are those whom I mentioned, who do this [boundary spanning] in the region, no question, in all regions, in all training centers. But cross-regional – then they must have actively been involved in projects, in PLM or in sub-ordinated projects, where they cooperate.” (Interview partner P3)

- Job rotation, i.e., switching places for trainers by assigning them for a certain time in a different training center.
- Intra-group learning from people with different professional backgrounds, e.g., trainers with an academic background learn from trainers with a factory background or vice versa.
- Job shadowing, i.e., following a colleague during a specified timeframe (e.g., 2 days) through everything he or she does.
- Job Sharing, i.e., doing a job together for instance in phases of transition from active to passive work and for onboarding new employees.
- Tandem teaching, i.e., teaching a class together.

This attitude of expectation – „I take a course for a week and then I know it and can teach this a week after”– this does not work. I wish that there were tandems that formed, such that one would not need to go into a new [training] situation alone. Instead, tandems form, maybe across locations, and certain curricula can be taught in a team. Just implement it. Well, it does not work this way in this VET department, I must say. (Interview partner P14)

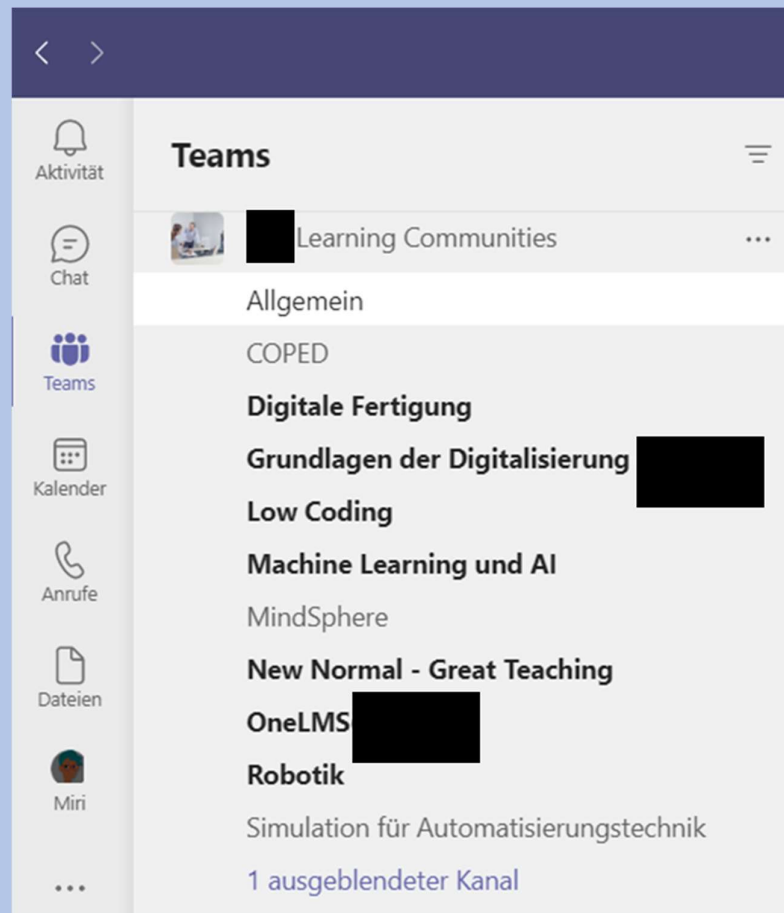
- Cross-regional virtual trainings, i.e., setting up opportunities for trainers in two or more regions.
- Setting up virtual platforms/communities. Here DLPs or communities-of-practice-oriented SNS solutions are useful.

A lack of opportunity is explicitly mentioned in some interviews as a hindrance to boundary spanning in learning. This lack translates to a lack of free time. All relevant quotes on opportunities can be seen in Table 13.

BOUNDARY SPANNING SCAFFOLDING	Quote
3-Opportunity	
3.01 by setting up projects	<p>There are those whom I mentioned, who do this [boundary spanning] in the region, no question, in all regions, in all training centers. But cross-regionally – then they must have actively been involved in projects, in PLM or in sub-ordinated projects, where they cooperate. (P3)</p> <p>We had worked ourselves into the details, I did half a year of product development [curricula development]. I worked with the manufacturing plant and had the background. I did not know everything 100%, because this was a very complex plant [...] what we knew we got across, we taught him [the colleague] and yes, then he got on very well in the project and the second time, during the job shadowing, it went relatively well. Almost everything that was needed he could already do by himself. This worked well and he learned the ropes quickly. I think this is simply a value-add to have someone else to ask, different from what to expect in an official training course [by an external provider]. (P20)</p> <p>These are our visionaries, they think it through, they develop the course material, and they have the task to multiply their knowledge in the VET community and to transfer it among their colleagues at the same local site and at other sites. (P16)</p>
3.02 by job rotation	<p>I would favor such exchange beyond the VET department. Of course, I cannot decide this beyond my own area of responsibility. I cannot say, you on the factory floor, you take a VET trainer now, but it would be a great thing, if a VET trainer, for instance, could work together with automation engineers for three months, such that they could conceptualize a real plant. And maybe take responsibility for programming one unit, or something like that? As we are more on a basic level, it would be a good think to work with the pros under real conditions. In my opinion, that should be done in all functions in our region... Electronics, development, R&D. We have engineers that do commissioning... We should be able to find a suitable functional department for all facets of VET. (P11)</p> <p>One variant of job rotation, if you see it this way, is to see how we teach the same thing in other local training centers. It may be another application, another manager, whatever, but in principle, there is nothing worse than doing the same thing 15-20 years. Therefore, job exchange or something like this? (P11)</p>
3.03 by intra-group learning from people with different professional background	<p>Boundary spanning can happen at the same training center. Colleagues with factory and academic backgrounds learn from each other. (P1)</p> <p>In the beginning [...], we started to establish that we identified even the small things that we needed someone to look into. And then, that person would offer half an hour to teach others. This was meant to establish a learning from each other of certain knowhow in everyday situations. Sometimes we did it via MS Teams, sometimes via MS Planner or whatever [...] whatever is needed in a daily context, such that one person makes a deep-dive and conveys his knowledge to others in a structured order. (P15)</p>

BOUNDARY SPANNING SCAFFOLDING	Quote
3.04 by job shadowing [in German: “Hospitation”]	<p>I must say, we have now two younger colleagues, that was by coincidence. Truly, I must be careful to say, this was the reason. But with these two the topic of job shadowing got started because they started to sit in other trainers’ courses. Then, of course, other colleagues picked up the idea “Great, then I go and see how one teaches different topics, whatever, “single phase alternating current techniques or else.” (P11)</p> <p>Well, as I said, this job shadowing across locations is ok. (P19)</p> <p>Why we do this? [...] Maybe sometimes it is because one says there is someone whom we could help by asking him to adopt this role of helping someone else. (P16)</p>
3.05 by job sharing	<p>Well, this job sharing would be interesting, even if one must clearly say that one is not willing to go to work somewhere else once one has a certain age. OK, maybe we take age out of the equation. We have people with local roots, they have obligations, they do not want to go to M four, five weeks or change from M to W or just don’t want to get to know new conditions. (P19)</p> <p>But analogous to how you say, “travelling instructs”, where you get new impressions, in my experience no matter in which area or company where I worked, no matter in which department, which training center, you always get new impulses. Potentially, because something is new, where one says „OK, I don’t know this. This is interesting. Or I can do better...” This way, I keep my knowledge up to date, such that what I do and the way I do it is good. That can be the realization. (P19)</p>
3.06 by tandem teaching	<p>This attitude of expectation – „I take a course for a week and then I know it and can teach this a week after”– this does not work. I wish that there were tandems that formed, such that one did not need to go into a new [training] situation alone. Instead, tandems form, maybe across locations, and certain curricula can be taught in a team. Just implement it. Well, it does not work this way in this VET department, I must say. (P14)</p> <p>There are these tandems you mentioned, young and old, this is used for continuous education of elderly people... the one who will leave teaches the young one. One always says: new brooms sweep clean, but the old ones know the corners. Exactly this old knowhow, those corners, must be transferred to the young colleagues, I think this is important. In contrast, transferring the new brooming technique [to remain in this picture] to the older colleagues – look, here is something new. That is also important, and this is why such a tandem between old and new is so interesting. I also think it is interesting to do something across domains, which may not be job-related. (P19)</p>
3.07 by cross-regional virtual trainings	<p>In the commercial faculty that works outstandingly. They all know each other somehow, because in the past, they crossed paths at some training course or other. Of course, not the young ones. They, and all others, must be nudged a bit, i.e., in the technical faculty they must be nudged. (P10)</p>

BOUNDARY SPANNING SCAFFOLDING	Quote
	<p>Well, and now we proceed virtually and not in reality. And that is perhaps another impulse for the upcoming years. Maybe it will be that we will teach in courses [...] and still be able to motivate our people to say, “Watch out, you need to be able to reach this and that in three and a half years from now”, or as employee “Here is a training course and you can dial in from wherever in Germany and there is no fixed time, do as it works for you”. As a VET trainer, one must maybe say “Just do this virtual class”. The class is done by training center F. Why can’t the nice colleague or apprentice from M just participate?” I am aware that I tear down walls here. (P19)</p>
<p>3.08 by setting up virtual platforms, communities</p>	<div style="border: 1px solid #ccc; padding: 10px; background-color: #f9f9f9;"> <p>Guten Morgen,</p> <p>hat jemand von uns/euch Erfahrungen mit dem Simulationslehrsatz der Klimatechnik von der Firma [REDACTED]?</p> <p>Falls ja... ich würde mich gerne wegen diversen Herausforderungen mal drüber unterhalten wollen :-).</p> <p>Habt einen tollen Tag.</p> <p>[REDACTED]</p> <p> Gefällt mir v  Kommentar Seien Sie der erste, dem dies gefällt</p> </div> <p>Via the platform Yammer, a company-SNS, a special chat group for VET has been set up.</p> <p>“Good morning,</p> <p>Has anyone of us/you experience with simulation theorem of clima technology of company x?</p> <p>If yes, I would like to talk to you regarding diverse challenges.</p> <p>Have a great day.</p> <p>Name”</p>



Furthermore, MS Teams based Learning Communities and Expert Teams structure collaboration virtually.

Learning Communities:

General

New VET philosophy

Digital Factory

Digitalization Basics

Low Coding

Machine Learning and Artificial Intelligence

Cloud

New Normal – Great teaching [Methodology and Didactics]

One Learning Management System

Robotics

Simulation for Automatization

BOUNDARY SPANNING SCAFFOLDING		Quote
3.09	Time-to-learn/lack of opportunity	<p>I think one has the possibility to create a time window if one wishes. As they are sufficient freedom to let the learners work in a self-learning phase. During this time, the trainer can learn himself. It is even possible to do a self-learning unit if the apprentices' group is present. Or one can learn together with the group. This is why I think if one wants to learn, then he has the opportunity to do so, but he has to take initiative to seize the opportunity. This is not something that is served to you. [In German: Die [Möglichkeit] bekommt er nicht serviert.] (P21)</p> <p>Self-Learning – this means increasing your own responsibility. This must be emphasized with trainers, such that they understand the necessity for them to start self-learning phases. In the past, it was more like “send me to a course”, the course lasted for five days, easy practice, and one knew: “now I show my willingness to get training and go there, but there is 90% likelihood that this training won't happen because of scheduling issues with the apprentices' groups and there are 1000 excuses why it did not happen.” Therefore, I am happy that these five-day training blocks do not exist any longer. But that whenever there is a free window of time to learn, [it is your responsibility to use it]. This freedom must be illustrated to a trainer because he will not see it this way. A VET trainer has lots of things to do and no time. This perceived capacity overload should be tackled such that trainers' responsibility for his own learning can be nurtured and built up. In younger teams that works well mostly. (P1)</p> <p>Where I sense my colleagues' extreme bitterness: the overload of learning offers. In other words, just by offering online learning and curated content, which is sometimes really nicely done, that does not mean that colleagues accept it [...] then they realized these courses exist, these courses are available in half-day steps, these courses are able to be integrated into my daily work as a VET trainer, then they adopted them. (P13)</p>

Table 13: Boundary Spanning Scaffolding – Opportunity

In general, there is dissent in the VET team of the case study whether the opportunities for learning in general are sufficient or not. This underlying conflict seems to create a resistance to learning for some who do not feel comfortable with being asked to spend time to learn, whereas they do not see this time during their working hours.

“Where I sense my colleagues' extreme bitterness: the overload of learning offers. In other words, just by offering online learning and curated content, which is sometimes really nicely done, that does not mean that colleagues accept it [...] then they realized these courses exist, these courses are available in half-day steps, these courses are able to be integrated into my

daily work as a VET trainer, then they adopted them.”

(Interview partner P13)

4.1.2.2. Boundary Spanning Scaffolding Activities

4.1.2.2.1. Cognitive Scaffolding

Regarding the **activities** dimensions that make boundary spanning successful in a learning context, the grounded approach brought out the second order constructs of cognitive, relational, and material scaffolding, i.e., means of helping others to learn. Again, while the second-order constructs were the same in comparison to Roberts and Beamish’s (2017) model, first-order concepts in the *activities* dimensions were mostly different.

Cognitive scaffolding (see Table 14) subsumes experimental teaching, pragmatic explaining, flexible reaction to new methods and improvisation as well as good preparation. These turned out to be first order constructs. It is worthwhile to note how relevant good examples – often referred to as use cases from the businesses – are to make new technologies understood:

“Practical examples are important, real use cases, really showing how to use it concretely. What concretely is the task? Which real project did I task my learners with, for instance, not on a theoretical level, but in a real-life context, for practical implementation? [...] For instance, when it concerns automation technology. To illustrate a pragmatic example, we built a LEGO roboteer and we made it drive over a slit. And what happened? The learners were able to visualize this. To show in practice how to apply this:

How can I experience this in apprenticeship settings?”

(Interview Partner P16)

BOUNDARY SPANNING SCAFFOLDING		Quote
A-Cognitive Scaffolding		
A.01	Experimental teaching	I had a young VET trainer four years ago, this was a jack-of-all-trades, he really lived this and all others were baffled about what he does, really. Yet, it was not really that the spark carried over, i.e., I will teach this way as well. He worked very

		<p>experimentally, with dual students in particular. He connected different fields, built bridges and integrated academic content and so on. He did this tremendously well. But unfortunately, others did not pick this up. (P2)</p> <p>Some sit down and simply exercise. They practice and try and try. [...] you have to be that kind of learning type. But I think this is still a suitable method and then there are those who transfer their knowledge to others, who really go into this technical specialist direction. At least in my experience. (P15)</p>
A.02	Pragmatic explaining	<p>For me he still has this down-to-earthiness [in German: Bodenhaftigkeit], he stands in front of groups and continues to be a trainer. He is not condescending but does it on eye-level. (P16)</p> <p>Practical examples are important, real use cases, really showing how to use it concretely. What concretely is the task? Which real project did I task my learners with, for instance, not on a theoretical level, but in a real-life context, for practical implementation? [...] For instance, when it concerns automation technology. To illustrate a pragmatic example, we built a LEGO roboter and we made it drive over a slit. And what happened? The learners were able to visualize this. To show in practice how to apply this: How can I experience this in apprenticeship settings? (P16)</p>
A.03	Flexible reaction to new methods and improvisation	<p>Cognitively, yes. I think that you have to keep fit in your head. It starts with improvising solutions. It starts with sudden disturbances, which are to be considered, parallel to new know-how. If I have done something in a certain way for the last ten years... Suddenly there is new knowledge, new methods to incorporate. (P18)</p> <p>He accepts the topic to be considered done. Even fixes it in a written manner somehow and searches for information: how could I do it? [...] But if he realizes, man, something is different, then he turns things around, depending on the situation. (P12)</p>
A.04	Good preparation	<p>This course called “Digitalization basics”, it is perfect, very simple level and well prepared, honestly, that is not often the case that courses and technologies in VET are so well prepared. Quite candidly. (P17)</p> <p>Well, these colleagues are characterized by the fact that they really well prepared for the topic. They are somewhat experts in this field. (P14)</p>

Table 14: Boundary Spanning Scaffolding – Cognitive Activities

4.1.2.2.2. Relational Scaffolding

First-order constructs identified as *relational scaffolding* are leadership and role model activities.

“The local training center manager has an interesting approach, if I take into account the last years in F. They took on one bigger topic every year;

rather, he chose it and took it to the team and acted as a role model, lived it, and that way, forced them somewhat... positively put, he challenged them, ok? To take on this topic..." (Interview partner P2)

Furthermore, opening of workshops to multiple hierarchical layers and countries beyond Germany, empathic help, trust building, reciprocity, building up and operating (i.e., learning) in secure environments were deemed important. As P21 puts it:

"Exactly these are people who are down to earth, where you are not frightened to be lectured or criticized or they won't roll their eyes upon you because you know less than them. Simply a question of appreciation."
(Interview partner P21)

Finally, a crisp explanation of why learning makes sense from the point of view of the learner gave relevance to the learning process. This resembles the "direct involvement in relationship development" and "Hosting Foreign partners" first order constructs of Roberts and Beamish (2017, p. 42). Again, P21 is quoted for illustrating how important it is to show relevance of the topic to others:

"For me it was passion, I simply wanted to know whether what I did here for them, could work on a national level. And to show this relevance to others. Why should this be interesting for this other location? Why do we all sit in the same boat? What is your personal benefit, not only from a training center perspective, but also as an individual if we implement this together?" (Interview partner P21)

More relevant quotes as to relational scaffolding can be found in Table 15.

BOUNDARY SPANNING SCAFFOLDING		Quote
B-Relational Scaffolding		
B.01 Leadership and Role Model activities	I have never experienced in VET that anyone would block. To the opposite: in VET, you always motivate. Here is a group. Here is the opportunity. Either in small, simple courses or in job shadowing, in a bigger setting, if you say, one really wants to attain another level of education, a continuous education type of qualification, which allows	

	<p>someone to continue to be employable in the everyday work environment. I must say, this is different in VET compared to other departments where I worked. (P19)</p> <p>The local training center manager has an interesting approach, if I take into account the last years in F. They took on one bigger topic every year; rather, he chose it and took it to the team and acted as a role model, lived it, and that way, forced them somewhat... positively put, he challenged them, ok? To take on this topic... (P2)</p>
<p>B.02 Open workshops and meetings to other hierarchical layers or beyond the German team</p>	<p>He rather uses the official work groups or workshops to get ideas. He takes from there and then tries to adapt and deepen it to our needs or to his needs. (P12)</p> <p>This boundary spanning across hierarchies. Concretely put: our manager workshop in October, ok. But maybe we should envision this with another type of participants. Leadership Meeting? Another point where I say: we should architect that such that we can bridge across hierarchies. At least, we incorporated the foreign German speaking sites, that was great. (P10)</p>
<p>B.03 Empathic help</p>	<p>He knows, I would say, how most people are doing. Well, he has a certain empathy. Can I challenge him a bit more? Must I first ask and listen and tease him on? He really observes well, listens well, is very structured. (P12)</p> <p>And [...] in any case there is empathy. If I cannot really feel the other person, if I don't know where he is, that is bad. And next step after empathy: tactics, i.e., if I know where the other person is, can I pick things up or not, depending on the right moment to act [...] And then there is – I don't know how to describe it – maybe this is undervalued, I don't know, a certain type of funniness, situational comic, charm, charisma or something which touches people emotionally, I'd say, a story sometimes... (P17)</p>
<p>B.04 Trust building</p>	<p>Exactly these are people who are down to earth, where you are not frightened to be lectured or criticized or they won't roll their eyes upon you because you know less than them. Simply a question of appreciation. [...] Well, this is it. Coordinated, but never backstabbing, that has always been important for me, that you play with an open deck of cards ... everybody in the community knew if I had an appointment with their training center manager and everybody had the offer to join in, because I never wanted them to think we did politics clandestinely. And if I had to present in the management circle or onstage, everyone was informed beforehand: we will report this, anyone has a topic which we should take along? These are the slides...There was transparency. Wasn't especially acknowledged but wasn't not acknowledged [either]. It was ok that way. (P21)</p> <p>From my personal experience, I sometimes prefer if you do not know the others well. Yet, I know friends, privately, and colleagues with whom I have been working for a long time, who give me very honest feedback and I can accept that well. (P14)</p>
<p>B.05 Reciprocity</p>	<p>You like to learn from those, of course, that is human, you like to learn from those whom you think are nice, and who are close by, geographically or from a technical</p>

	<p>background. Of course. Or from those where you get the feeling I can give something back. I know this from myself, it is easier to ask someone to help me if I have something to offer. Give and take. I believe this is very important. (P21)</p> <p>These two! On the one hand [the new colleagues] K2 from the factory, on the other side the scientific education of K1, and both combined. This is – for me – a dream-team combination. K2 benefits from K1, i.e., from the scientific aspects, and K1 benefits from K2, because K1 is not so deep into the processes on the shopfloor. (P1)</p>
<p>B.06 Build up secure environment – “Safe rooms”</p>	<p>That was also a challenge, and actually this boundary spanning into the direction of not to show a weakness. I may state as a training center location that something here does not work out so well without getting a negative smiley and without anyone taking note of our supposed failure. Rather, I can really disclose our weaknesses and that felt a bit artificially initiated in the beginning. Really. I never wanted to say, for instance, here in M., everything works out perfectly. I consciously threw examples into the rink where it did not run smooth here in M., even though we learnt to live with it, and I asked: „Can you help me here?“ And I think it was good to build this bridge and to say, we learn from each other, and I do not want to correct you and lecture you to accept anything I imposed. (P21)</p> <p>For instance, if I realize that someone still has difficulties with a topic, if he struggles with the topic and I could share my experience or simply suggest that he may try out this or that. I’d rather do this in a one-on-one instead of in front of the whole group. (P14)</p>
<p>B.07 Explain benefits</p>	<p>For me it was passion, I simply wanted to know whether what I did here for them, could work on a national level. And to show this relevance to others. Why should this be interesting for this other location? Why do we all sit in the same boat? What is your personal benefit, not only from a training center perspective, but also as an individual if we implement this together? (P21)</p> <p>Many colleagues must still be caught on, must be convinced to a certain degree. Even with simple arguments. (P1)</p>

Table 15: Boundary Spanning Scaffolding – Relational Activities

4.1.2.2.3. Material Scaffolding

Finally, **material scaffolding** as a second-order construct can be identified (see Table 16). It can be split up between material and methodological help on one side, and capacity deployment on the other side. Rather than an activity of helping trainers to learn, it is a lack of activity (similar to the lack of opportunity identified in the conditions dimension) due to time-for-learning, which hinders boundary spanning. In other words: in this case study, the individual

capacity of VET trainers proves to be a limiting factor affecting learning for some interviewees. From the point of the view of a trainer, the situation is explained as follows:

“Then we need to get people, pros, on board, product development etc. I really like them all, ok? And they do a good job, but they have, I guess, few resources and capacities and that is stupid and somehow that just does not work out very well. It is a pity for them because they end up being demotivated.” (Interview partner P17, trainer)

Whether this is actual or perceived lack of time, cannot be proven in vivo. However, restructuring and downsizing issues of the department a few years ago were described in chapter 3 and the consequences of these are certainly perceived today. The regional managers have a different view on the situation:

I am actually quite happy that we do not have these week-long training blocks any longer, but that [learning is possible in small nuggets] whenever there is some free time. The trainer must be made aware of these liberties because he does not see it himself this way. A trainer feels he has always work to do and never time...“ (Interview partner P1, regional manager)

As an interpretive researcher, the author strives to represent the different realities and perceptions, rather than judging or presenting one reality. In this sense, the ambivalence of interviewees opinion is worthwhile taking note of, and rather a reflection of quality than of shortcomings.

BOUNDARY SPANNING SCAFFOLDING	Quotes
C-Equipment	
C.01 Material and methodological help	To step up to people? This is exactly what he did. Consequently, we got offers, especially from the production/shopfloor area. We got equipment and suggestions how to integrate this technology into apprenticeship processes. [...] We got offers from production regarding old equipment which otherwise would have been scrapped, and suggestions regarding how to integrate it into our VET courses. (P7)

	<p>He allows people to go to the plant equipment. [...] Even if there is a risk that something gets out of order, he is courageous in this way, because he himself is also very creative and he just lets people do. (P9)</p> <p>Let us simply do a video for the intro week. (P12)</p>
<p>C.02 Capacity</p>	<p>Then we need to get people, pros, on board, product development etc. I really like them all, ok? And they do a good job, but they have, I guess, few resources and capacities and that is stupid and somehow that just does not work out very well. It is a pity for them, because they end up being demotivated if they realize that by their colleagues. And for the colleagues it is also a pity, somehow we must... We have big plans. We really should stand there proudly and ensure our future, but this is not enough. That's what I would like to convey here. (P17)</p> <p>Sometimes you need to consider this carefully, I discuss this tomorrow with my boss as well. It is just an overload, which plays along here, an overburdening. (P13)</p> <p>In this case you are notably absent and do it yourself, rather than having to synchronize and get central orders to carry out. Or rather than taking on responsibility. Maybe this sounds a bit harsh now. (P13)</p> <p>This is the big challenge, I guess, for our trainers, especially due to scarce timing. We have charged our trainers extremely, they are fully booked, they spend a lot of time in front of apprentices' groups, and in all these new topics [...] The pivotal point is the following: if you tell them to learn by themselves, to take care of their learning, this can only be carried out with exertion of power and with prescribing learning time. And I see it fail... In other words, people do not want to do it. (P13)</p> <p>Where I sense my colleagues' extreme bitterness: the overload of learning offers. (P13)</p> <p>I am actually quite happy that we do not have these week-long training blocks any longer, but that [learning is possible in small nuggets] whenever there is some free time. The trainer must be made aware of these liberties because he does not see it himself this way. A trainer feels he has always work to do and never time..." (P1)</p>

Table 16: Boundary Spanning Scaffolding – Material Scaffolding

4.1.3. Other findings

Upon analyzing the different aspects of the 6C, the notion of “fear” aka, the German “Angst”, merits some more observations. During the first batch of interviewees (P1-P10), fear was mentioned by half, trust was mentioned by 70%, time constraints in learning by 50% and future by 80% of the interviewees. In all cases, the interviewer did not mention the notion in any of the questions first (unprompted answers). This led the author to further exploration. In order to

illustrate the hypotheses of interrelatedness between fear, leadership, trust, culture change and boundary spanning in learning, please refer to Figure 22.

There are different components of fear, namely fear of lay-offs, fear of colleagues and managers and fear of new tasks. “Fearing new tasks” is influenced by the independent variables of trainer age and perceived stress level. “Perceived stress level” is felt if trainers’ time foresees holding classes, which is perceived as a lack of time for learning. The conditional elements of trust and leadership counteract fear.

„Empathy means for me [...] the capability to understand colleagues in certain points. [...] Without this capability there will always be a fear bias, the colleague is afraid because the manager might react in a drastic manner. In principle, this prevents a culture of self-learning, to come back to this issue.” (Interview partner 6)

„This basic trust in colleagues, they realize that this is particularly good and that backs them if they go to other regions and sites, in cross-regional teams so-to-speak.” (Interview partner 18)



Figure 22: Understanding “Fear”

The hypotheses are that trust and leadership contribute to culture change and that culture change contributes to boundary-spanning-in-learning, which, in return, contributes to organizational resilience of VET operations. As two interviewees put it:

„We really want to present ourselves well and secure the future of the employees somehow.” (Interview partner P17)

„Employees [in the VET department] see the future coming closer. That means they know there will be changes, there will be new technologies, new processes. And therefore, they know they need to move and learn. [...] Those who have knowledge in the future, have power. And the potential is there – with or without the specific technical knowhow, or maybe product knowhow – to establish an exchange, for instance.” (Interview partner P19)

While the German word “Zukunftsfähigkeit” cannot be translated easily, throughout the initial research, the translation in English remained “Sustainability” (of operations). A further literature analysis resulted in a translation into “organizational resilience” (Vogus and Sutcliffe, 2007, p. 3418) which best explains the department’s ability to prepare for the future challenges.

These hypotheses could be studied via a quantitative analysis hereinafter. However, the author decided that the topic of fear, albeit strongly corroborated by the first part qualitative analysis, does not lend itself to a quantitative survey because of the very likely objections of the workers council regarding such survey, while questions about culture change, leadership, trust, and organizational resilience were included into the online survey to further explore the construct illustrated in Figure 22.

No.	Role	Control Variables	Topics									
		Training Center Size	Sustainability	Time	Trust	Fear	Digitalization	Learning from others	Leadership	Culture	Innovation	Boundary Spanning
P1	Headquarters Manager	Small	x	x	x	x	x	x	x			
P2	Regional Manager	Medium		x	x		x			o		o
P3	Regional Manager	Small	x	o			x	o	o			
P4	Regional Manager	Medium						x	o	o		
P5	Headquarters Manager	Medium	x	x	x				x	x		x
P6	Headquarters Manager	Big	x	o		x		x	o	x		o
P7	Regional Manager	Medium	x		x	x	x	x	o	x		x
P8	Headquarters Manager	Medium	x	x	x	x	o	o	x	o		
P9	Regional Manager	Big	x	x	x	x						
P10	Regional Manager	Small	x		x			o	o	o		o
P11	Local Manager	Big		x		x		o	o	o		
P12	Local Manager	Small		x								
P13	Local Manager	Medium	x	x		x	x	x		x		o
P14	Trainer	Medium		x		o		o	x	o		
P15	Local Manager	Small	x	x		o		x	o	x		
P16	Headquarters Manager	Medium	x	x				o	x			
P17	Local Manager	Big	x	o			x	o	x			o
P18	Trainer	Small	x	o	x	o	x	o	o			x
P19	Trainer	Medium	x	x		x	o	o	x	x	x	
P20	Local Manager	Small		x		x		o	x			
P21	Headquarters Manager	Medium		x	x	x		o	o			o
			x = unprompted, o = prompted mentionings during the interview									

Table 17: Theme analysis: x = unprompted; o = prompted mentioning

A quantitative exploration of the qualitative interviews was then carried out. The author went back to the original interviews and counted the unprompted (and prompted) mentioning of basic notions like organizational resilience (of VET operations), time constraints, trust, fear, digitalization, learning from others, leadership, culture, innovation, and boundary spanning. This is illustrated in Table 17. “Prompted” in this context means that the interviewer used the word before the interviewee used it as well.

Time constraints and organizational resilience of VET operations score highest in terms of spontaneous (unprompted) topics brought up by the interviewees. This score is insofar logical

as no questions on the two topics of time/capacity shortages and future had been designed into the semi-structured interview protocol. While the author was not surprised about the capacity shortages given the recent restructuring (see chapter 3.2.) the frequently uttered concern for the future relevance of the VET department – i.e., organizational resilience or sustainability of operations – was noteworthy. It should be noted that this notion of sustainability has nothing to do with green skills or ecological sustainability.

	Sustainability	Time	Trust	Fear	Digitalization	Learning from others	Leadership	Culture	Innovation	Boundary Spanning
Unprompted answers:	14	14	9	10	7	6	8	6	1	3
Prompted answers:	0	4	0	3	2	11	9	6	0	6
Total times answered:	14	18	9	13	9	17	17	12	1	9
For unprompted answers, see distribution by control variables as follows:										
Big	3	2	1	3	1	1	1	1	0	0
Medium	6	8	5	5	3	3	5	4	1	2
Small	5	4	3	2	3	2	2	1	0	1
Headquarters Manager	5	5	4	4	1	2	4	2	0	1
Regional Manager	4	2	4	2	3	2	0	1	0	1
Local Manager	3	5	0	3	2	2	2	2	0	0
Trainer	2	2	1	1	1	0	2	1	1	1

Table 18: Control variables and notions

Fear is a prominent topic (10/21 unprompted answers in total), while the most frequently addressed topics were time constraints (14/21 unprompted) and sustainability of operations in VET (14/21 unprompted). Fear is mentioned by two thirds of headquarters managers (see Table 18), while regional (33%) and local managers (50%) mention it to a lesser extent. It seems not to be a topic of high urgency in small training centers.

Leadership is mentioned most often by headquarters staff and trainers, and not by managers.

Hence, sustainability of VET operations is added to the quantitative study topics, while its focus continues to be on the concept of boundary spanning scaffolding (as per chapter 4.1.2.). Via

quantitative confirmation of the qualitative concepts of conditions and activities, a relevant research contribution to the why and how of boundary spanning scaffolding in a VET context can be fostered. Time constraints are not added as a question, yet a third of the answers are designed as open text answers, where the topic could be addressed by the survey respondents.

The qualitative findings can be summarized as follows: boundary spanners in VET need abilities, persisting willingness and opportunity as conditions to execute scaffolding activities towards their fellow colleagues in the target field of practice. Abilities are mostly non-functional skills such as social competencies, networkability, and self-awareness. Activities include cognitive and relational support to learning colleagues with a special focus on use cases, experiments (cognitive activities) as well as trust building, open and voluntary workshops in a secure and trusted environment (relational activities). Boundary spanning leads to scaffolds supporting those who learn, to more freedom and variety in training, i.e., creativity, enhanced employability of VET trainers and thereby, on an organizational level, to sustained VET operations that are well prepared for future challenges. It also changes the individual mindset of trainers and the culture in the department. One of the most relevant barriers to overcome is the lack of time to undertake activities.

4.2 Quantitative exploration: how to use regression modelling and PLS-SEM to foster understanding of this case?

A principal component analysis (PCA) was used to reduce complexity of the variables and to detect patterns in the motivation and conditions of boundary spanning in VET. Based on the latent variables derived, regression models were applied to understand dependencies between variables but could only help modeling to a certain level. In a last step, partial least square structural equation modelling was applied to understand the complex interdependency of the constructs derived in the previous steps. Appendix A3 and A4 give a complete picture as to the technical details of the statistical analysis procedure. Here the focus will be on highlighting the results.

4.2.1 Principal component analysis (PCA) to reduce complexity

In order to answer how and why boundary spanning occurs in a VET department in times of digital transformation, all staff of the German VET department was asked about their opinion as to their individual **learning format preference** and perceived usefulness of trainings. Survey

respondents preferred virtual learning formats, and social learning with peers, but they also appreciated self-led learning (which may be blended, i.e., combining phases where they learn with others) and classical classroom teaching formats in presence. All in all, how one likes to learn was multi-faceted and individual. In the open comments, “exchange” was written by 13% of the respondents.

The principal component analysis (PCA) for this subsection of Learning Formats was carried out to reduce the number of succinct components. All variables proved to be relevant contributors to the components, explaining a total variance of 70% (rotation sum of squared loadings).

A second area of the questionnaire related to the situations in which people learnt from colleagues in order to understand the **conditions** of such learning. The survey respondents were asked to assess different abilities of the colleagues they learnt from. The answers were able to be subsumed under three different constructs: relational abilities together with the original variable “abilities/knowhow/competencies” and the original variable “interest in cross-regional networking” were retained. In other words: there were three conditions which were vital for learning from colleagues if one tries to categorize the answers. The respondents gave highest importance to “abilities/knowhow/competencies”, which was to be expected because technical knowhow is important for trainers. These high scores meant that the first variable did not represent a normal distribution. Normal distribution has to be carefully considered in a PCA to produce components truly independent from each other (Venables and Ripley, 1997). Therefore, the first variable was eventually taken out of the variable pool used for the PCA exercise regarding conditions. The variable “interest in cross-regional networking” was another one not appropriate to be combined with other variables in this principal component analysis. KMO and cumulative % of total variance explained would otherwise suffer. In the end, examination of KMO’s criteria yielded empirical justification for one retaining factor via PCA which accounted for 65% of the total variance. This latent variable was called RELATIONAL ABILITIES (KMO 0,769, Sig. <0,001). The original survey in English translation can be seen in Appendix A2. For details of the PCA and subsequent linear and Poisson modelling, please refer to Appendix A3.

Another facet of the survey consisted of questions about the **motivations for doing a training for colleagues** (Questions 13 of survey, see Appendix 14.2). This must not be confused with the motivation for boundary spanning, the latter one being addressed at a later point in time as a compound (latent) variable. Here, the question was about what motivated members of the

VET department to convey a training for others. Two thirds of the respondents had already conducted a training for colleagues, meaning that this was not a practice the department was unfamiliar with. Among those who had not, the single most important reason given was a lack of time. That was also confirmed by the open comments: 29% of the 17 open comments referred to time.

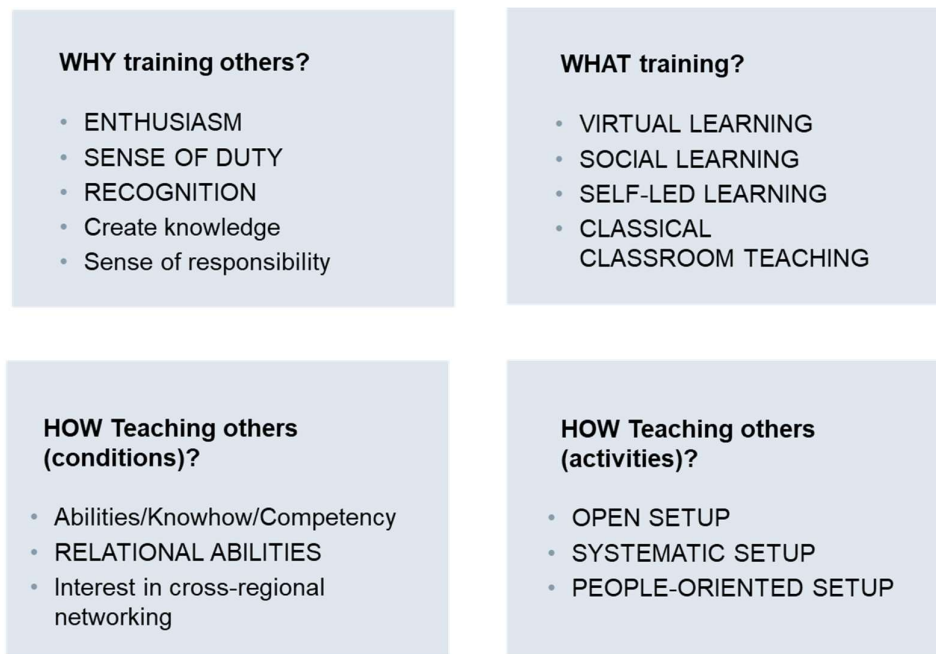
Interestingly, the single most important answer of why trainers would convey trainings to colleagues was to create, expand and share knowledge. Three other reasons subsumed via PCA why the respondents carried out training for colleagues were either enthusiasm or a sense of duty or they were seeking recognition, using such situations to gain visibility by others.

Another facet of the survey were questions as to **activities** when it comes to learning from each other. Use cases and mutual exchange were the highest answers. Reducing complexity of the answers via a PCA, three main components could be identified.

1. OPEN SETUP – considering experiments, flexibility, and interdisciplinary aspects, with mutual trust and exchange
2. SYSTEMATIC SETUP – with use cases, preparation and methodic
3. PEOPLE-ORIENTED SETUP – invoking role models, mutual trust, and exchange as well as a personal importance of the topic for learner

In general, these findings confirm how important knowhow and abilities, but also practical examples (use cases) derived from the business context, are for learning of VET trainers. Their knowledge as VET trainers is deeply rooted within the business context of the technological solutions. Besides this technical aspect, exchange is also highly valued.

An illustration of the direct findings derived from the PCA can be seen in Figure 23:



N.B.: Factors in CAPITAL letters are latent variables derived from Principle Component Analysis

Figure 23: Summary of variables derived/retained by PCA

The remaining questions of the survey centered around aspects of the transformation in the VET department. The many data resulting from these questions were able to be developed via PCA into principal components to further characterize facets of the **culture change** as perceived and assessed by the German VET team of the study. Despite the fact that leadership and trust, a new philosophy of teaching, external boundary spanning, and virtual teaching formats are different in nature and succinct concepts, they all are inductive findings and manifestos of the current change currently taking place in this VET department. They were therefore put into one illustration (see Figure 24).

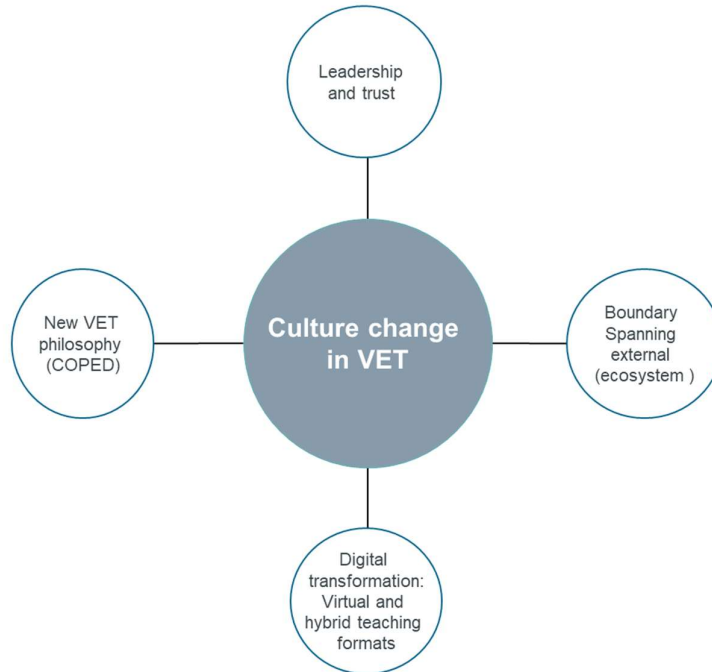


Figure 24: VET culture change in times of digital transformation

Attitude about the **VET department's operational sustainability**/organizational resilience on a scale of 0-100% was a concept that could not be further aggregated into a principal component, but was kept for further analyses as original variable of the survey. As it was an important measurement from the manager-author's perspective, it was correlated with the control variables. Trainers showed to have a less positive view of the future preparedness of the department (Sig. = 0,002). All other correlations with control variables proved not to be of significant nature. This constitutes a reality check for management insofar as more explanation and analysis is necessary about what needs to be done to secure the VET department's future and how that will sustain operations from the staff's point of view.

A crucial aspect of this research was how to define boundary spanning. This is not to be confused with the aspect of motivation (to carry out trainings for colleagues), although it looks closely linked in the first place. Boundary spanning means seeing and wanting to overcome borders in the VET department.

Variables identified to explain **boundary spanner characteristics in this study were:**

- Willingness: "Interest in cross-regional networking" (question 8f)
- Activities: "Networking/boundary spanning across hierarchies" (question 20c)

- Attitude/Propensity: “In my opinion we should do more boundary spanning across training centers and regions” (question 22a)

Different organizational levels (regions, training centers) and the hierarchical levels were addressed in this characterization. 56,4% of total variance were explained by one component, namely boundary spanner characteristics. While 56,4% may seem low in total, in such exploratory setting it is a value to be considered. A reliability analysis revealed inclusion of 84% of cases and a Cronbach’s Alpha of 0,611.

Based on the results of the survey and due to the fact that the data on know-how scored so high as an ingredient of why learning from colleagues was deemed effective, this same analysis was done with four variables assuming that boundary spanning was also dependent on the motivation to create knowledge. While “create knowledge” contributed to 0,643 (see Appendix A3, Component matrix on p. 249) to the overall factor boundary spanner characteristics, it should be noted that the extraction sums of squared loading only amounted to 47,139% (vs. 56,401% before), and while KMO was higher, and Cronbach’s Alpha was higher, far fewer cases were included from a variance explanation point of view (54,9% vs. 84,0%). The comparison of statistical values can be found in Table 19.

Boundary Spanner Characteristics explained by	3 variables	4 variables (Model not retained)
No. of items	3	4
Cronbach’s alpha	,611	,623
Valid Cases included n	147	96
Valid Cases included %	84,0%	54,9%
Extraction sums of squared loadings cumulated %	56,401%	47,139%
Kaiser-Meyer-Olkin Measure of Sampling Adequacy	,610	,647
Bartlett’s Test of Sphericity Approx. Chi Square	50,381	44,278
Bartlett’s Test of Sphericity Sig.	<0,001	<0,001

Table 19: Comparison of statistical value regarding boundary spanner characteristics (3 vs. 4 variables model)

As such, the expectation that the motivation to create knowledge was part of boundary spanner characteristics had to be rejected in this study. It was a relevant and unexpected finding that boundary spanner characteristics were not necessarily explained by the motivation to expand

knowledge in the quantitative data, although qualitative data showed that. Therefore, the final concept for boundary spanner characteristics explaining variance in N=147 cases (compared to 175 respondents in total) can be seen in Figure 25.

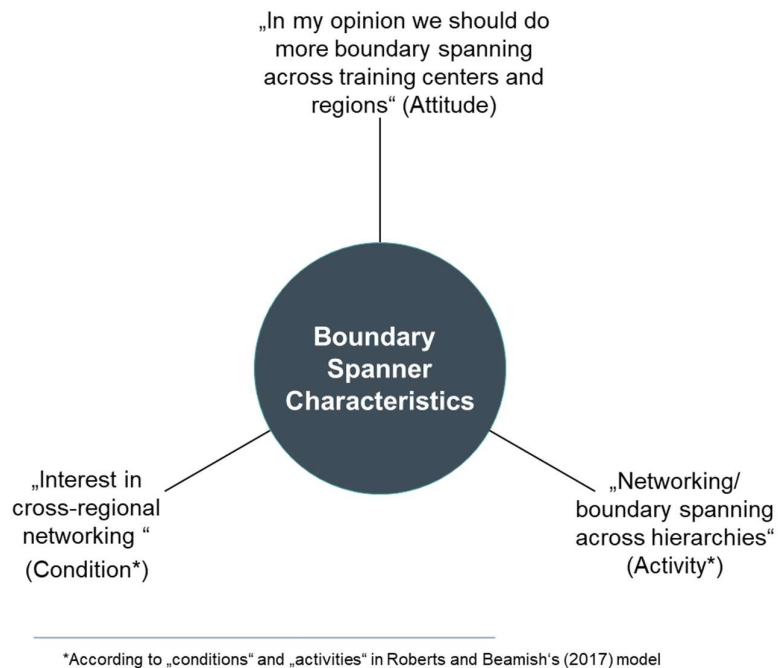


Figure 25: Boundary Spanner Characteristics concept

Correlating this new variable “boundary spanner characteristics” with the control variables helped gain clarity about boundary spanners. It significantly correlated with role (Sig. 0,003). Furthermore, it was very interesting and somewhat unexpected to see that indeed, the mean values of trainers and mentors regarding boundary spanner characteristics were negative. In other words, managers and headquarters staff scored positively regarding boundary spanner characteristics, whereas trainers and mentors had negative scores. Miscellaneous (other) functions scored basically neutral means. No other control variables proved to be significant.

4.2.2 Regression analysis-based modeling

A linear regression models strives to define the relationship between variables mathematically and can then be used for simple predictions (Cooper and Schindler, 2014).

Based on the variables which showed a significant Pearson's correlation ($<0,05^*$ or $<0,01^{**}$, in the rectangular boxes), a simple linear regression model was calculated for each variable.

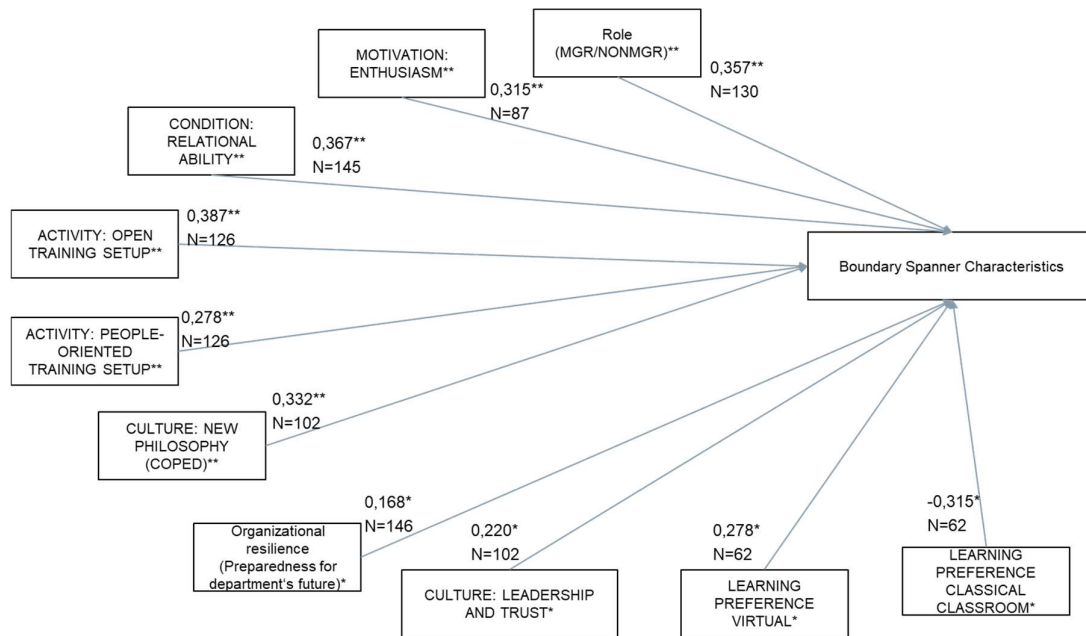


Figure 26: Identified beta variables, number of cases the variance of which is explained, and significance for linear regression models

Based on the correlation table of boundary spanner characteristics and other relevant native and latent variables, a regression model was aimed for. Therefore, multiple regression models to mathematically describe boundary spanner characteristics were built. The overview of the variables identified for a linear regression model and the outcome in terms of simple regressions is outlined in Figure 26. Combining these in a multiple regression model did not explain variance with a significant model at first. In several iterations, taking out variables one by one, always guided by the least significant value, the model was optimized according to the detailed process steps outlined in Appendix A3.

The variance of boundary spanner characteristics of 113 cases (out of 175 total) were able to be explained with an overall significance of $p<0,001$ and an adjusted R^2 of 0,303 through three independent variables ($F=17,204$).

$$F(\text{BOUNDARY SPANNER CHARACTERISTICS}) = - 0,993 + 0,305 \text{ TAOS}^{**} + 0,231 \\ \text{TAPO}^{**} + 0,370 \text{ MGR_NONMGR}^{**} (N=113)$$

TAOS: TRAINING ACTIVITY OPEN SETUP

TAPO: TRAINING ACTIVITY PEOPLE-ORIENTED SETUP

MGR_NONMGR: 1 = Trainer, 2 = MGR/HQ

The variables were

- Training activity (open set-up) TAOS
- Training activity (people-oriented set-up) TAPO and
- The role (Trainer or Mentor vs. Manager or HQ staff).

Per se, managers increased the presence of boundary spanner characteristics.

A culture change towards Digital Transformation (DT), established via virtual and hybrid formats, as it describes the circumstances of boundary spanning in a vocational education and training department, was of relevance in this quantitative study as part of the research question.

The multiple regression model below explained variance in $n=59$ cases (of 111 in total) by the single latent variable enthusiasm (in carrying out training for others). Although that seems hard to explain beyond the statistics at first glance, it makes perfect sense upon remembering, going back to chapter 4.2.1, that “enthusiasm” (ENTH) was made up of the willingness to create knowledge and the passion to do it, which makes this statistical finding easier to understand. This willingness, which is deemed so important by trainers because technical knowledge is so crucial that it needs to be proliferated to others, is particularly important in times of digital transformation, where new technologies need to be explained and understood in order to be taught to apprentices and dual students.

$$F(\text{DIGITAL TRANSFORMATION}) = 0,135 + 0,543^{**} \text{ ENTH} \\ (N=59)$$

ENTH: ENTHUSIASM

4.2.3 Poisson analysis-based modeling

Poisson regression is used for count outcome modelling (Coxe, West and Aiken, 2009). Poisson regression does not assume a linear relationship between the independent and dependent variables. It is traditionally used for incidence probability reporting. It is more appropriate if the expected value of the distribution is small as per Coxe *et al.* (2009), which is the case for operational resilience as a dependent variable (1-10). Multiple Poisson analysis-based modeling was conducted to determine the predictors of organizational resilience.

Organizational resilience, i.e., the perceived sustainability of VET operations, was explained by both a culture of leadership and trust and a culture expressing the new VET philosophy called – COPED – competence and project-oriented education (Scaled Pearson Chi Square = 53,559; $p < 0,001$). The Omnibus likelihood ratio chi-square test of 27,315 indicated that the full model was a significant improvement in fit over a null (no predictor) model (Sig. < 0,01).

$$F(\text{Organizational Resilience}) = 1,987 + 0,143^{**} \text{ CULTURE: LEADERSHIP AND TRUST} \\ + 0,130^{**} \text{ CULTURE: NEW PHILOSOPHY COPED (N=111)}$$

The model explained variance in 111 of 172 cases. LEADERSHIP AND TRUST and NEW PHILOSOPHY as variables of culture change were significant predictors of the assessment about VET department's organizational resilience. They contributed to the perception of future preparedness of the VET department.

In other words: perceiving and appreciating a change regarding leadership and trust as well as the new VET philosophy made individuals feel more positive about the department's future. While this finding is not directly related to boundary spanning, it helps to explain the preliminary research model established in Figure 22.

4.2.4 Mean value comparisons

Having explored these dependencies statistically in the previous chapter, the quest was how to further describe the sample boundary spanner "characters" vs. other survey participants. In how far do they differ? Can control variables help describe boundary spanner characteristics?

113 cases were described by the model out of 153 cases out of which the dependent variable had been calculated. The number of cases included and excluded was able to be further characterized by an analysis of variance (see Table 20).

			ANOVA Table				
			Sum of Squares	df	Mean Square	F	Sig.
1 = Trainer; 2 = MGR/HQ * 1=113; 0=excluded	Between Groups (Combined)		1,143	1	1,143	5,365	,022
	Within Groups		32,164	151	,213		
	Total		33,307	152			
1=T; 2=M; 3=HQ; 4=MGR; 5=MISC * 1=113; 0=excluded	Between Groups (Combined)		40,080	1	40,080	29,462	<,001
	Within Groups		235,349	173	1,360		
	Total		275,429	174			
Which age group do you belong to? * 1=113; 0=excluded	Between Groups (Combined)		2,186	1	2,186	2,163	,143
	Within Groups		174,809	173	1,010		
	Total		176,994	174			
How big is the training center where you currently work? * 1=113; 0=excluded	Between Groups (Combined)		,458	1	,458	1,187	,277
	Within Groups		66,662	173	,385		
	Total		67,120	174			
How many training centers have you worked at as part of regular staff (including the current one)? * 1=113; 0=excluded	Between Groups (Combined)		2,288	1	2,288	5,039	,026
	Within Groups		78,569	173	,454		
	Total		80,857	174			
Did you ever carry out a training for colleagues of other training centers? * 1=113; 0=excluded	Between Groups (Combined)		1,387	1	1,387	6,417	,012
	Within Groups		37,390	173	,216		
	Total		38,777	174			
My management acts as a role model regarding boundary spanning across training centers. * 1=113; 0=excluded	Between Groups (Combined)		,883	1	,883	,737	,392
	Within Groups		186,921	156	1,198		
	Total		187,804	157			

Table 20: ANOVA mean value comparison of control variables

The very first variable was already part of the equation itself. Consequently, the second variable (which is the original control variable for role) showed a significance of $p < 0,001$. Another significance could be seen via the variable “Did you ever carry out a training for colleagues of other training centers?” (Sig=0,012*). Furthermore, there was significance of 0,026* as to the number of training centers someone had worked in. While there were differences in mean values, numbers of responses and standard deviation values regarding the control variables of age and size of training center, these differences were not significant. Neither was it significantly relevant whether management acted as a role model regarding boundary spanning.

Managerial recommendations merit a separate chapter in this thesis, because the managerial impact constitutes such a relevant part of a Doctorate of Business Administration. Due to this

very clear outcome as to the managerial role, it is important to point it out already at this point of the dissertation: empiric data show to those managers who want to increase boundary spanning in their department that they may want to pay attention to open set-ups of all cross-team training activities. Open means to allow for enough flexibility both in participation and in themes and discussion, to build in experimental and interdisciplinary aspects while exhibiting trust. Such trust allows for time and communicative exchange. Management should also support a people-oriented set-up of training initiatives while stressing how important the topic may be for the individual learner. Other signs of people-orientation may imply seeing the person behind the human resource. In practical terms that translates to the expression of trust in the trainers' learning journey and efforts and praise of those who act in this way as role models. That will help bring the message across that boundary spanning is relevant.

Careful pondering is required before applying these results beyond the case at hand, as this case study was carried out in a specific single case and under succinct circumstances of a VET department of a big German tech company, such that validity beyond the case presented remains fragile with such interpretive stance. Further studies may be needed to compare these findings across cases.

The results so far have been very interesting for an applied researcher. Therefore, other ways to explore these findings further were taken: another way to assert out-of-case validity of these findings can be structured equation modelling (SEM). That allows for in-case and out-of-case validity assessment and will be explained in the next chapter.

4.2.5 PLS-SEM: Situating Boundary spanning in the meta context

4.2.5.1 Short introduction to PLS-SEM

Among the multivariate methods and models, Partial Least Square structural equation modeling (PLS-SEM) is a method that can help explain several numerical variables and improve prediction quality compared to linear regression models. In general, structural equation models – in contrast to explanatory models like multiple linear regression or logistic regression – can model complex interdependencies between variables. Those can be original (manifest) or latent (composite) variables or, in this case, constructs, which can be again explained by original or latent variables, and analyzed “simultaneously” (Legate, Hair, Chretien and Risher, 2021, p. 2). PLS-SEM is based on non-parametric iterative boot-strapping methodology, whereas the conditions for use are not limited by normal distribution of the data under scrutiny. PLS-SEM

is also suited for small samples (Hair, Mathews, Mathews and Sarstedt, 2017; Ringle, Sarstedt, Mitchell and Gudergan, 2020). In return, the price to pay is a higher complexity of the model.

According to Legate *et al.* (2021), PLS-SEM has advantages to covariance-based structured equation modelling (CB-SEM) but has not made itself a wide reputation in Human Resources Development research. Advantages are its flexibility regarding data characteristics, its suitability for exploratory research and its strong prediction quality of sophisticated models. “PLS-SEM is well suited for theoretically exploring model extensions and considered an appropriate methodological choice when identifying principal drivers of target outcome variables“ (Legate et al., 2021, p. 4), which is why it is used in this research project: multiple linear regression and Poisson analysis only got this thesis so far that boundary spanning characteristics, digital transformation and organizational resilience were able to be modeled, but without putting these four concepts in direct interdependency.

PLS-SEM is set up by two distinct models, i.e.,

1. an outer model to present constructs and associated original indicators, and
2. an inner model which shows the relationships between the constructs (Legate et al., 2021, p. 6).

PLS-SEM is not striving to bring about a best fit between the original data and the model. Instead, it follows an iterative process of multi-criteria optimization for “minimizing unexplained variance (residuals) in the indicators and endogenous latent variables” (Legate et al., 2021, p. 7) via bootstrapping (i.e., iterative testing). As Hair, Howard and Nitzl (2020, p. 103) phrase it: “PLS-SEM maximizes the amount of explained variance of dependent variables founded in well-developed explanations”.

The constructs can be either reflexive or formative. Reflexive constructs are manifest by observed original variables, i.e., the construct seemingly reflects the indicators. Formative constructs are caused or contributed to by original variables (similar to regression models). However, constructs themselves are not *per se* formative or reflective. Rather, it is the choice of the researcher to bring about the characteristics of the model with pragmatic considerations, although formative variables are not generally recommended (Ringle *et al.*, 2020).

The software SmartPLS 3 was used here to implement PLS-SEM on the data. All data from the survey had to be entered into the software and the latent variables had to be set up anew. In prior steps of this thesis, principal component analysis with a Varimax rotation was done to come up with uncorrelated factors suitable for linear regression modelling. In contrast, reducing

complexity in PLS-SEM meant looking for certain correlation of the latent constructs. Therefore, an Oblimin rotation was performed within principal component analysis in this step of data analysis. The detailed steps of model establishment are outlined in Appendix A4.

4.2.5.2 Development of new constructs for the PLS-SEM outer model

The following new constructs were established for PLS-SEM and sorted into the following categories. All constructs are in upper letters to differentiate them to the reader from previous latent variables:

Training Methods and Activities:

- PEOPLE-ORIENTED SETUP of training activities, where the topic is relevant to the trainee and set up in a network of mutual trust.
- OPEN SETUP of training activities, allowing for flexibility, experiments and an interdisciplinary dialogue and network.
- METHOD USE CASE as (conceptional/methodological) aspect relevant for a good training.

Trainers Motivation:

- MOTIVATION to carry out training for colleagues (because of their sense of responsibility, passion, or intent to create knowledge).

Trainers Abilities:

- TRAINERS RELATIONAL ABILITIES as a relevant criterion of situations where the interviewees learnt something from colleagues, based on the latter abilities to communicate, self-reflect, use didactics and social competency.

Boundary Spanning and Social Learning:

- BOUNDARY SPANNING PROPENSITY expresses the attitude towards boundary spanning across training centers and regions and towards internal customers.
- SOCIAL LEARNING formats considered useful, such as tandem teaching, community-based learnings, learning within the team or job shadowing (in German: "Hospitation").

Culture and Leadership:

- A perceived and appreciated TRUST AND LEADERSHIP CHANGE.

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- MANAGERIAL ROLE MODELS is a construct based on a single question related to boundary spanning across training centers.
- MANAGERS SUPPORT is another single-indicator based variable which is special to the new VET philosophy.

New Work Mindset:

- A positive opinion about new normal teaching/digital learning/hybrid Vocational Education and Training (VET) formats is used as latent variable POSITIVE ABOUT HYBRID VET with a single indicator.
- PERCEPTION ON DIGITAL TRANSFORMATION means realization of new normal VET, digital learning, and hybrid VET formats.
- POSITIVE ABOUT NEW PHILOSOPHY means a positive attitude towards the new understanding about how apprentices will be taught.
- BLENDED/INDIVIDUALLY PACED LEARNING reflects on both self-led and combined formats. Combination can be hybrid-classroom or social-individual learning phases.
- VIRTUAL LEARNING PROPENSITY is a reflective construct which describes the survey participants' acknowledged usefulness of virtual training formats (vs. in a physical on-site setting).

Two other constructs stood out for themselves:

- MANAGER YES/NO is a binary variable reflecting whether the survey respondent has a manager/headquarters role or not.
- SUSTAINABILITY assesses the survey respondents' opinion about the future-proofness of departmental operations, i.e., preparedness for future demands. It is based on a single original variable.

For all new constructs, linear interrelationships assumptions have been checked by correlation matrices in a previous step.

Specifically, the author wants to point out the following:

In previous analytical step (see chapter 4.2.1), boundary spanner characteristics had been identified as the central latent variable in combination of “Willingness: Interest in cross-regional networking (question 8f)”, “Activities: Networking/boundary spanning across

hierarchies (question 20c)” and “Attitude: In my opinion we should do more boundary spanning across training centers and regions (question 22a of survey)”.

As a measurement model in PLS-SEM, this variable was not able to be used. As KMO in this construct was $<0,7$, it was not sufficient for a latent variable in PLS-SEM (Legate et al., 2021). Therefore, boundary spanning had to be established and defined in a different manner. In this PLS-SEM model hereinafter, the construct of BOUNDARY SPANNING PROPENSITY will be in the focus. It expresses the attitude towards boundary spanning across training centers and regions and towards internal customers but does not include aspects of willingness or activities.

4.2.5.3 Development of the structural model

As described by Legate et al. (2021) a PLS-SEM model always consists of an outer model and an inner model (see Figure 27).

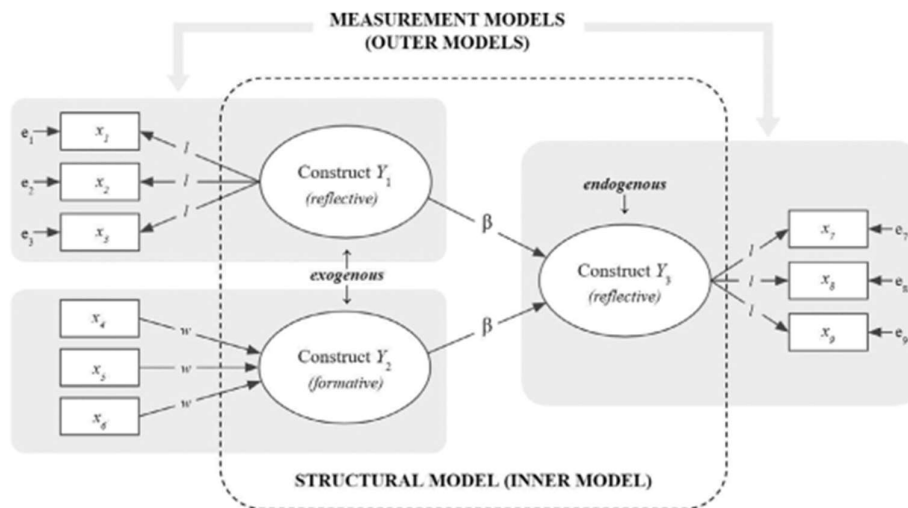


Figure 27: Outer and inner model setup as per Legate et al., 2021, p. 7.

Chapter 4.2.5.2 described how the constructs are established for the outer model. This chapter will describe the inner model, i.e., the structural model, which establishes scores between the constructs. These are “individual item weights, which are then used to compute construct scores” (Legate et al., 2021, p. 7). Empirical measures with low correlation levels between

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indicators have not been built into the model. Accordingly, arrows between constructs showing little correlation have not been drawn at all.

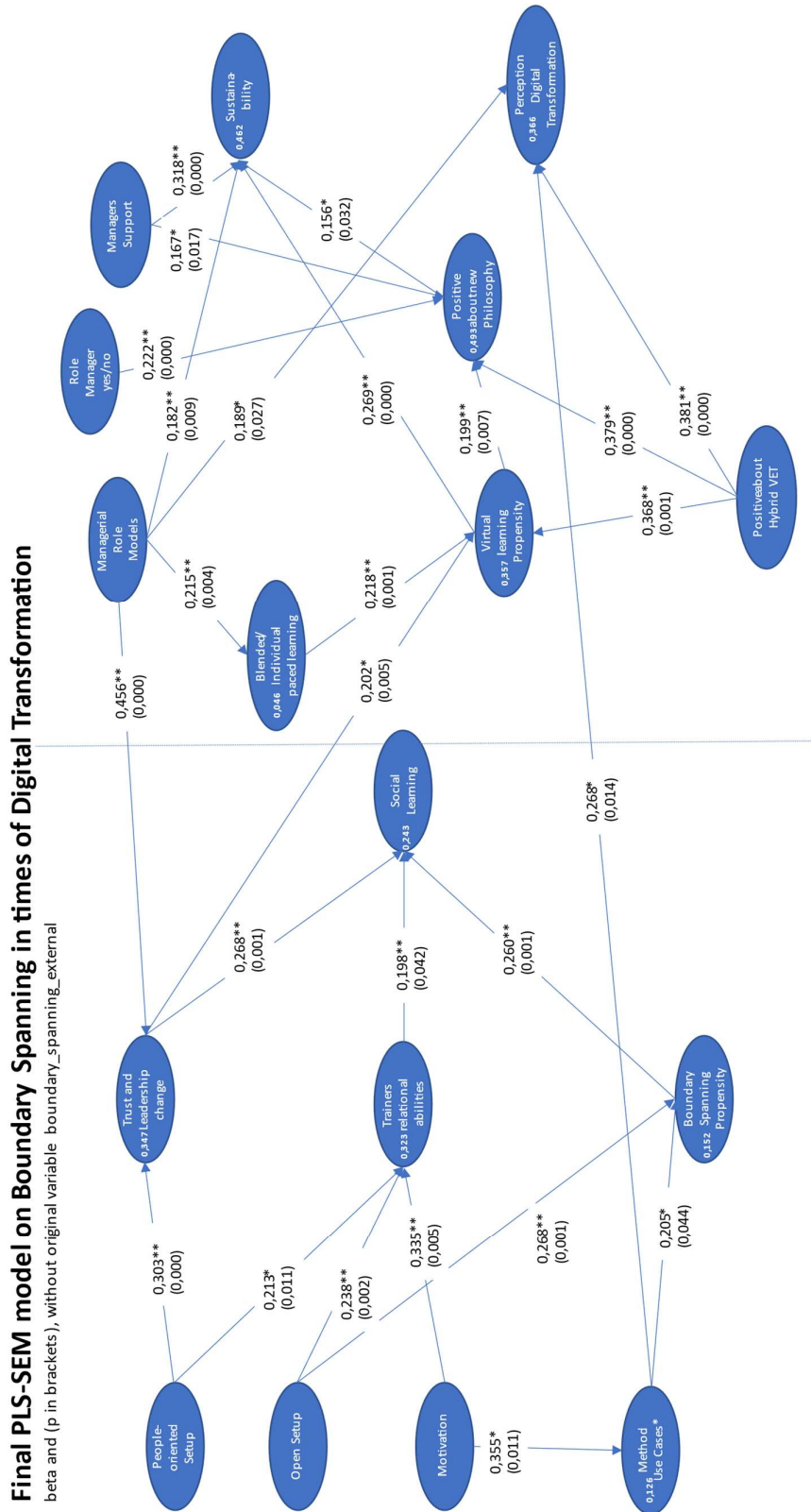


Figure 28: Meta-model

Figure 28 shows the meta model. Confirmatory composite analysis (Hair *et al.*, 2020) and structural model assessment, including out-of-case validity, were done according to Legate *et al.*, 2021 and documented in detail in Appendix A4. Arrows between the constructs indicate beta and p (in brackets). R² values are shown within the constructs' areas, if applicable.

In summary, we have a model which is quite robust for an exploratory setting. The model corroborates the findings of previous quantitative analysis of the DBA thesis; yet it shows several new aspects as to interrelation.

The model becomes clearer when the underlying categories are also shown (Figure 30). In the following we will illustrate the different findings of the model. The areas of relevance are marked green for the purpose of better clarity.

4.2.5.4 Results of PLS-SEM based modelling

In summary, in this case it can be shown that **BOUNDARY SPANNING PROPENSITY correlated with SOCIAL LEARNING (beta = 0,260**) as per Figure 29**. Social learning was further influenced by TRAINERS RELATIONAL ABILITIES (beta = 0,198**) and TRUST AND LEADERSHIP CHANGE (beta = 0,268**):

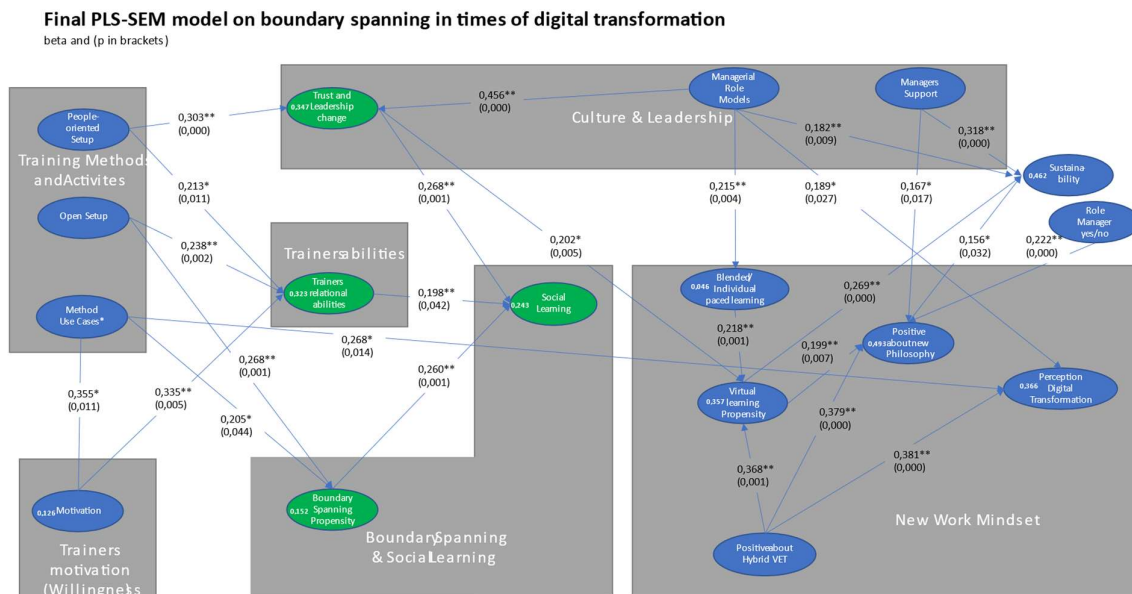


Figure 29: Social Learning

Final PLS-SEM model on boundary spanning in times of digital transformation

beta and (p in brackets)

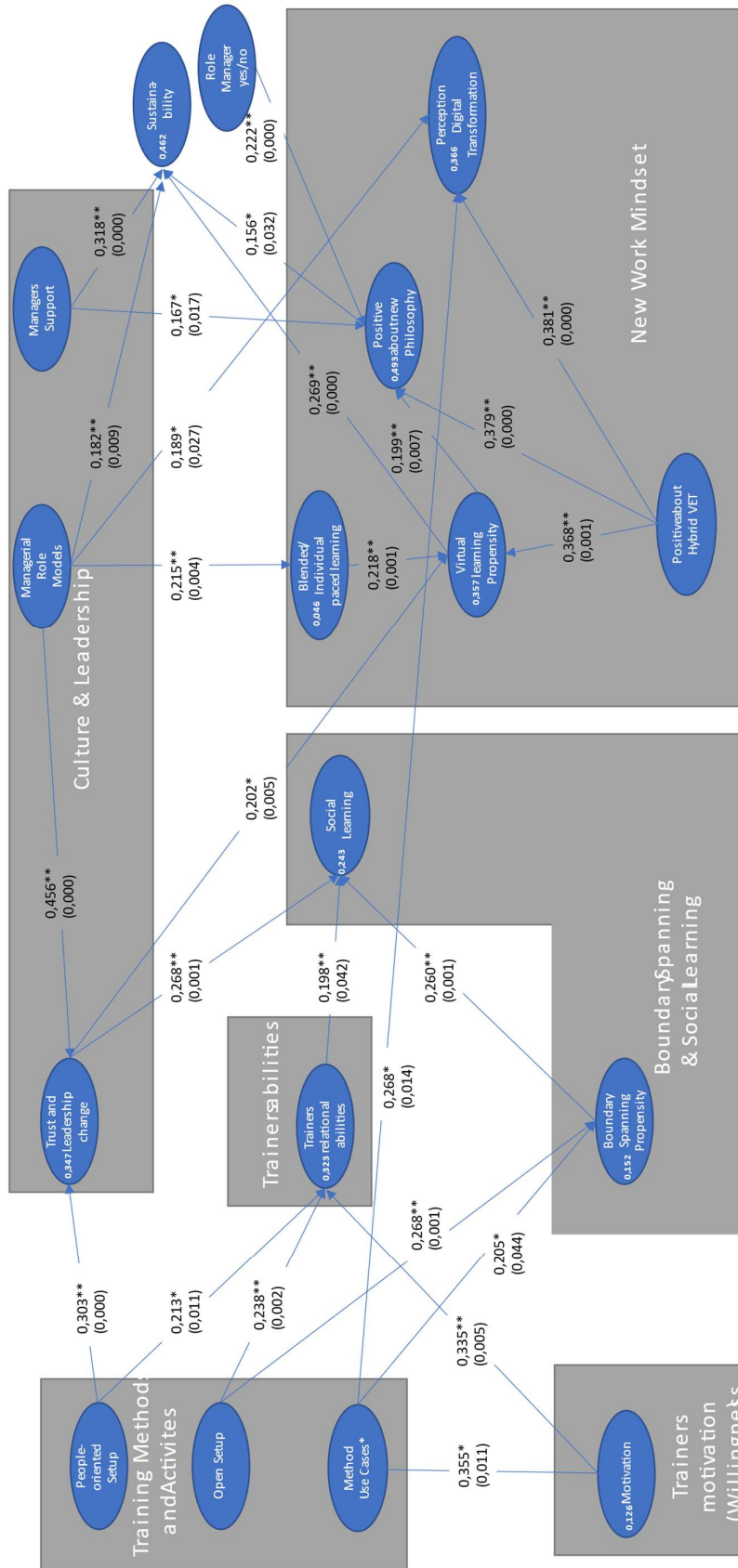


Figure 30: Meta model with underlying categories

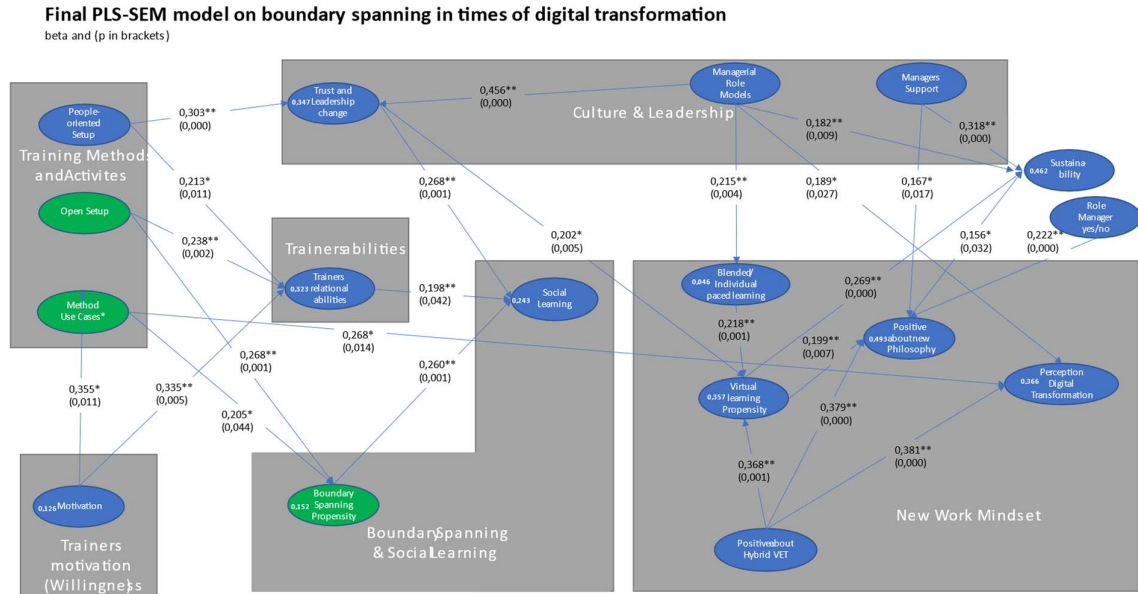


Figure 31: Boundary Spanning Propensity

BOUNDARY SPANNING PROPENSITY (Figure 31) was dependent on how training methods and activities were set up (USE CASES (beta= 0,205*), OPEN SET-UP (beta = 0,268**)). This new construct of BOUNDARY SPANNING PROPENSITY – which is different from the previously established boundary spanning characteristics – was significantly independent of the role MANAGER/NON-MANAGER.

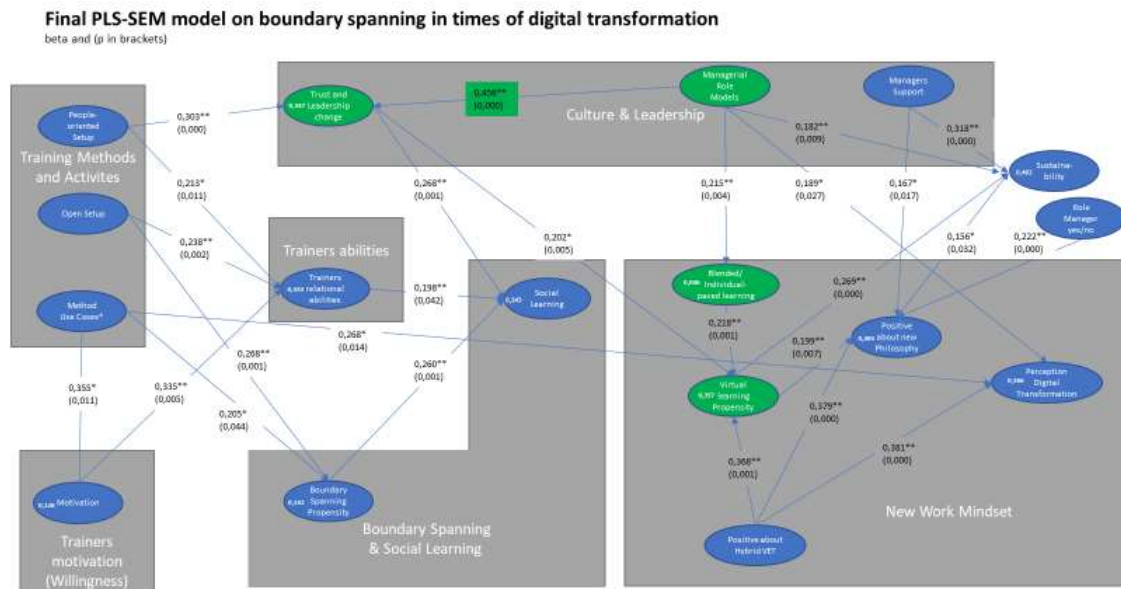


Figure 32: Managers influence on learning and change

Figure 32 shows how the **MANAGERIAL ROLE MODELS** contributed ($\beta = 0,456^{**}$) to a **TRUST AND LEADERSHIP CHANGE** which in return helped explain ($\beta = 0,268^{**}$) **SOCIAL LEARNING** (Figure 29).

It was able to be confirmed that **BOUNDARY SPANNING PROPENSITY** remained – equal to boundary spanning characteristics as defined in previous steps of the analysis – unrelated to a **DIGITAL TRANSFORMATION** and **SUSTAINABILITY** of VET operations.

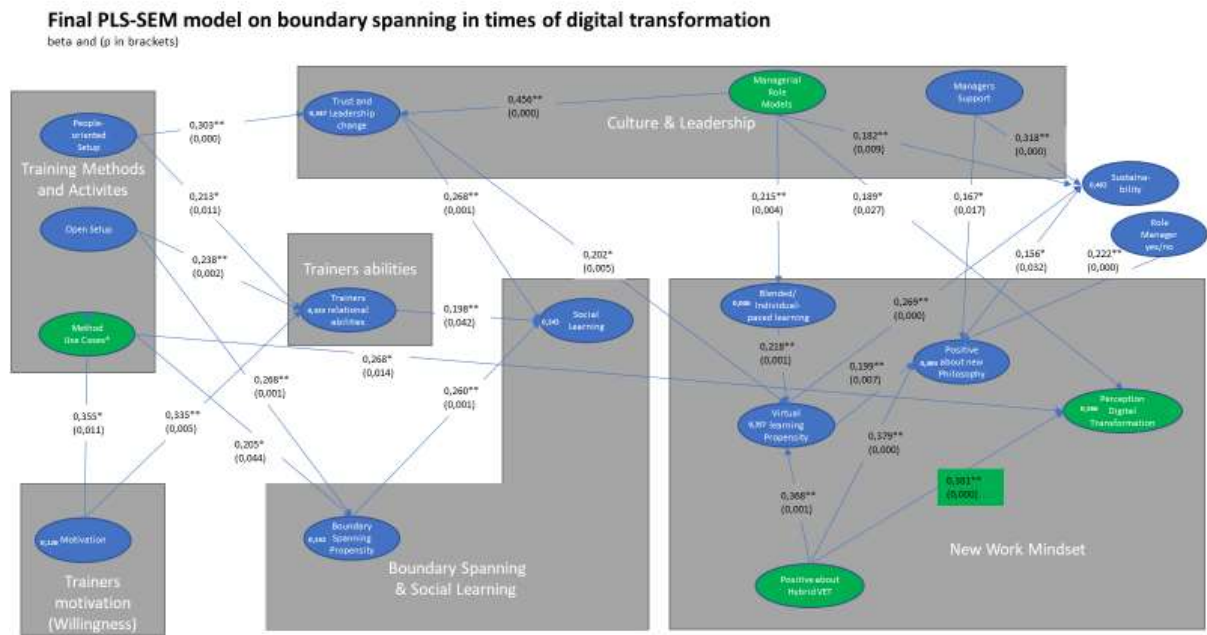


Figure 33: Digital Transformation

The perception of **DIGITAL TRANSFORMATION** in vocational education and training correlated with a **POSITIVE (attitude) TO HYBRID VET** ($\beta = 0,381^{**}$). As per Figure 33, it also became manifest via **METHOD USE CASES** ($\beta = 0,268^*$) and **MANAGERIAL ROLE MODELS** ($0,189^*$).

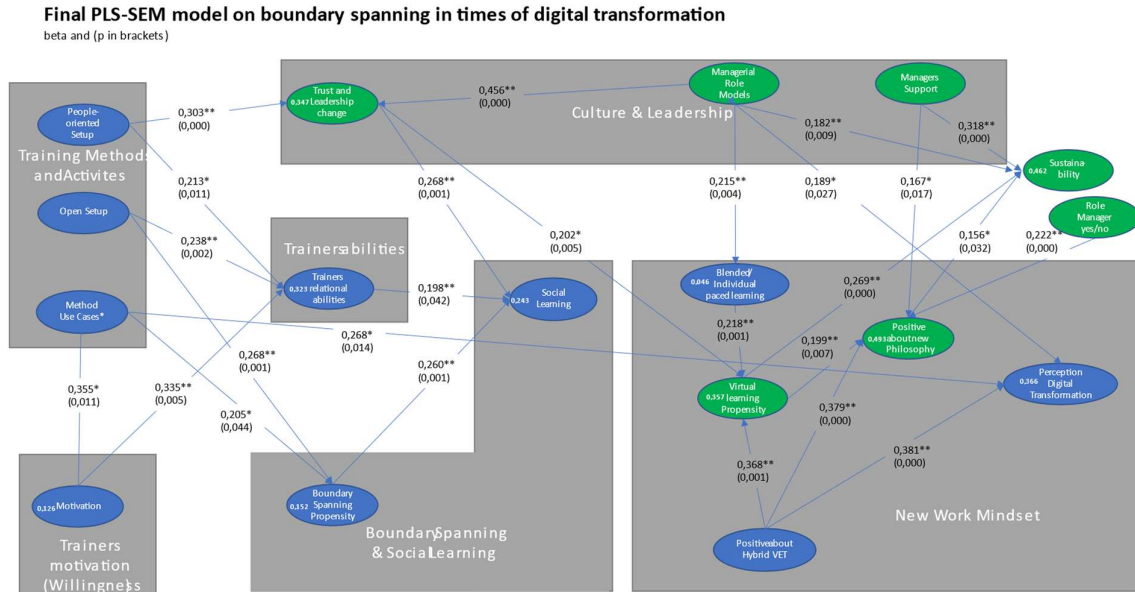


Figure 34: Sustainability of VET operations

A VIRTUAL LEARNING PROPENSITY contributed to **SUSTAINABILITY** of VET operations (aka organizational resilience) with beta = 0,269** (see Figure 34). Besides VIRTUAL LEARNING PROPENSITY, SUSTAINABILITY was explained by MANAGERIAL ROLE MODELS (beta = 0,182**), the positive attitude about NEW LEARNING PHILOSOPHY (beta = 0,156*) and MANAGERS SUPPORT (beta = 0,318**), to only name the direct indicators. In total, 46,2% of the variance of SUSTAINABILITY was explainable by constructs. While culture change in view of leadership and trust as well as the new learning philosophy were able to explain SUSTAINABILITY (i.e., organizational resilience) in the Poisson analysis, TRUST AND LEADERSHIP CHANGE could not be confirmed via PLS-SEM analysis directly, but an indirect influence of beta = 0,06 was identified, see Appendix A4, p. 31. These drivers of sustainability are relevant from a manager’s point of view because chapter 4.2.1. discussed that staff had a lower score regarding sustainability than managers.

Here is a lesson regarding impact (in Figure 34): All three managerial behavior constructs (MANAGERIAL ROLE MODELS (indirectly, beta = 0,035), ROLE MANAGER/NON-MANAGER and MANAGERS SUPPORT) from the category of Culture and Leadership contributed, directly or indirectly, to the perception of SUSTAINABILITY of VET operations. Both the ROLE OF MANAGER/NON-MANAGER (beta = 0,222**) itself and

MANAGERIAL SUPPORT (0,167*) fueled the **POSITIVE (attitude) ABOUT NEW PHILOSOPHY** perception, which was another lesson on impact from a managerial perspective. Almost half of the variance of a **POSITIVE (attitude) about NEW PHILOSOPHY** was able to be explained ($R^2 = 49,3\%$).

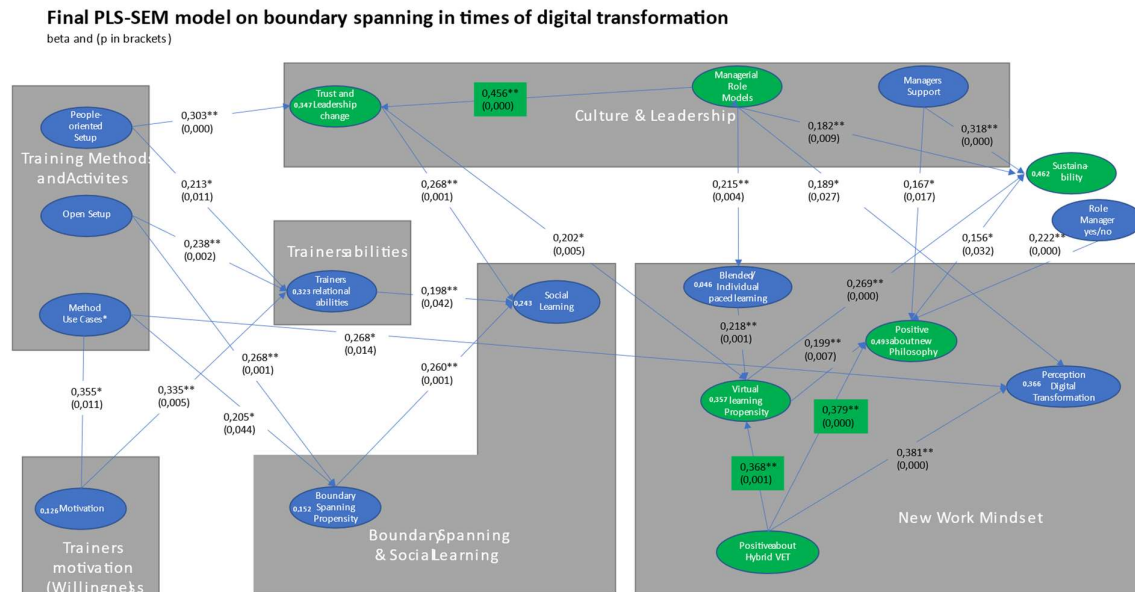


Figure 35: Individual mindset

Besides the culture and leadership aspects mentioned above, it was mindset that influenced the perception of future readiness of VET operations: a **VIRTUAL LEARNING PROPENSITY** of trainers (beta = 0,199**) and a **POSITIVE (attitude) ABOUT HYBRID VET** (beta = 0,379**) heavily influenced **SUSTAINABILITY** directly and indirectly (see Figure 35).

4.3 Integrating quantitative and qualitative findings: specific mixed-methods approach findings

“A core assumption of this [mixed methods] approach is that when an investigator combines statistical trends (quantitative data) with stories and personal experiences (qualitative data), this collective strength provides a better understanding of the research problem than either form of data alone.”

(Creswell, 2015, p. 2)

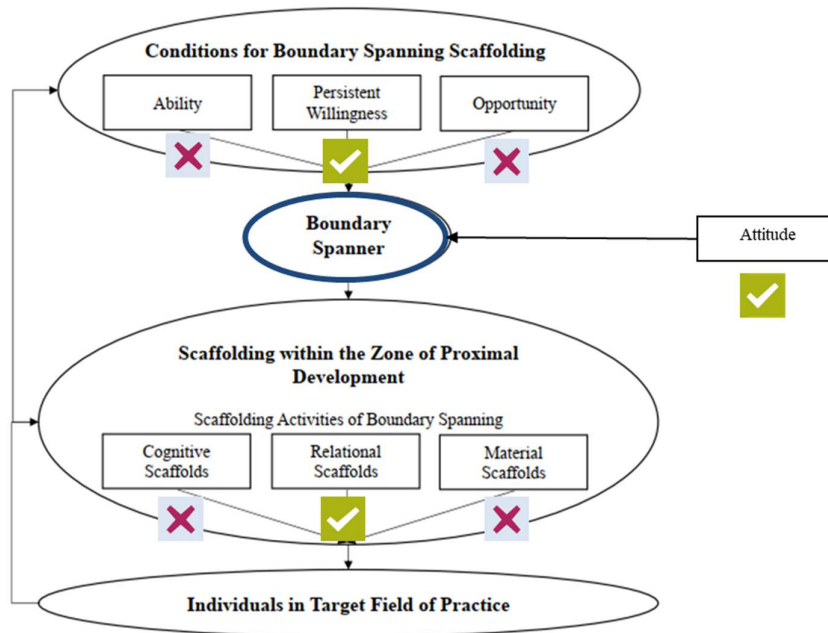
Exploring boundary spanning in VET via qualitative interviews helped to set the frame and learn about the main topics, narratives, and cultural elements relative to the case study. The abductive research design allowed for interlacing literature into the explorative findings to situate the latter in the existing scientific research body. Extant models on boundary spanning scaffolding (Roberts and Beamish, 2017) and corporate learning were able to be identified during the literature analysis. Quantitative analysis and modelling allowed to solidify the qualitative findings in order to set up an on-line questionnaire. Analyzing these respondents' answers in a quantitative manner allowed to build on existing models regarding boundary spanning in learning. In a second step, a new meta model on boundary spanning in digital transformation was able to be established.

As such, the mixed method approach proved to be very helpful in the abductive research design.

Specifically, the model of boundary spanning scaffolding (Roberts and Beamish, 2017) was able to be assessed and amended for intra-departmental boundary spanning in learning. The model proved very suitable to structure the qualitative research findings. It was also an adequate framework to develop the quantitative survey from. While concepts differed which is to be expected based on the different case at hand, themes and dimensions could be applied from the original boundary spanning scaffolding model.

The quantitative results did neither totally reflect the qualitative findings nor did they correspond entirely to the original model. In the case of this thesis, boundary spanner characteristics proved independent of ability and opportunity (see Figure 36). While ability played a big role in trainers' reputation and self-awareness, it was not shown to be significantly related to boundary spanner characteristics. Rather, boundary spanner characteristics as an

independent variable significantly correlated with a combination of persisting willingness, activity and – a new aspect – attitude, i.e., propensity (“I think we should do more boundary spanning across training centers and regions”). Similarly, cognitive scaffolds and material scaffolds did not play a big role when it came to characterize boundary spanning characteristics, but relational scaffolds did.



Adapted from Roberts, Beamish (2017), „The Scaffolding Activities of International Returnee Executives: A Learning Based Perspective of Global Boundary Spanning”, *Journal of Management Studies*, p. 531.

Figure 36: Integration of quantitative and qualitative findings

Another advantage of this combined research approach consisted in making sure that topics identified in chapter 4.1.3, namely culture change, trust, leadership, and organizational resilience, were able to be further analyzed and brought into a larger context, thereby quantifying them as variables in linear regression models and, above all, in PLS structural equation modelling. Yet, the assumptions from the construct described by Figure 22 were not able to be confirmed quantitatively in their entirety.

- Boundary spanner characteristics proved to be dependent of how training activities were set up (people-oriented, open, use cases) and whether the actor was a manager/headquarters person or a trainer (as per the linear modelling); whereas

boundary spanning propensity was independent of the trainer role (PLS-SEM results), while also being dependent of the setup (open, und with use cases).

- PLS-SEM analysis further showed that boundary spanning propensity led to social learning. Social learning was also significantly influenced by trust and leadership changes and trainers' relational capabilities.
- Digital transformation in a vocational education and training department became manifest via multiple regression via hybrid and virtual learning forms and depended on enthusiasm, i.e., creating knowledge with passion. PLS-SEM also correlated it with use case-based methods and activities and the presence of managerial role models.
- Somewhat unexpectedly, considering the research question and the qualitative results, was the following: Quantitatively, digital transformation remained a concept entirely independent of boundary spanning propensity, boundary spanner characteristics or sustainability. The qualitative framework of the 6C analysis was not able to be confirmed.
- Organizational resilience of VET proved to be dependent of the appreciation of a changing culture regarding leadership, trust, and a new training philosophy.

Therefore, the combination of qualitative and quantitative analysis proved appropriate to explore the research question thoroughly: how and why boundary spanning occurs in times of digital transformation. Without the qualitative research, important ideas like sustainability of operations, the so-called future readiness of VET for tomorrow's challenges, would not have emerged. On the other hand, without the quantitative research, it would not have been able to prove the independence of these constructs from the central topic of boundary spanning.

Topics like fear or time constraints are sensitive or political and were not able to be put into the survey *per se*. Yet, a third of the questions in the survey asked for comments, i.e., were open answer fields.

To have more time available was among the most noted comments such that additional people could carry out trainings for colleagues (7/17 comments in question 16) or do more boundary spanning (3/13 open comments). Thus, the subjective truth of the VET trainers which transpired in the qualitative interviews echoed quantitatively by the comments of a larger population. Such capacity problems may translate into a practical problem of not enough time for boundary spanning in learning, which should be solved with leadership or management measures.

Finally, the topic of organizational resilience of VET operations, which was accompanied in the survey by an open comment box, should be mentioned: 101 comments occurred there, by far the most of which (34/101) were related to building up competencies and knowhow to sustain VET operations in the future. The message to management was that there was evidently room to grow. If it had not been for the qualitative pre-work, this assessment of future-readiness of operations would have certainly not been included in a quantitative survey.

Regarding the aspect of cognitive abilities, it should be noted that somewhat unexpectedly, cognitive ability did not play a significant role regarding boundary spanner characteristics, despite its high mean values in the original survey answers: the knowledge proliferation aspect did not directly make it into any of the final quantitative models of boundary spanner characteristics, but it was part of the motivation influencing digital transformation in learning: digital transformation in the case at hand can be statistically described as dependent of the *enthusiasm to create knowledge*. Besides, it remained a qualitative finding, supported by open comments. It not being a significant condition for boundary spanning in the two final regression models, may indirectly help to motivate people with average skills to take up their courage and start boundary spanning, thereby contributing to social learning.

5. Discussion

5.1 Rigor in abductive research methods

“Every concept brought into the study or discovered in the research process is at first considered provisional. It earns its way into the theory by repeatedly being present” (Corbin and Strauss, 1990, p. 420). With the first ten interviews, it was not possible to be exhaustive or reliable yet. With 21 interviews and 290 pages of primary data, saturation was assumed (see chapter 2).

Furthermore, the Gioia method used and described in chapter 2 should be void of any literature. The concept in Figure 16 was done void of any scientific literature regarding boundary spanning, but merely based on data, but with an initial literature review before the interview guideline establishment. Prior to the second round of coding what was observed initially was situated in literature, and the semi-structured interview guide got amended by some established concepts (e.g., scaffolding, boundary spanning ability, boundary spanner-in-practice...). The abductive posture was kept intact which allows for systematic combining (Dubois and Gadde, 2002).

The third round of qualitative analysis brought about the new concept around the future preparedness/sustainability. While the author was analyzing the empiric data again in order to check whether innovation (Bourdieu (1986); Carlile (2002); Caputo *et al.* (2018)) as an outcome of boundary spanning was at all mentioned, the notion of sustainability of VET operations emerged instead. This was anchored later in scientific literature concepts under “organizational resilience” (Vogus and Sutcliffe, 2007). While organizational resilience is typically used to describe organizational state or reaction to a crisis, it is possible to consider the fourth industrial revolution, i.e., digital transformation, as exactly this: an ongoing crisis for established businesses, not to mention the pandemic which put additional stress on VET operations. Still, the notion of sustainability of VET operations was mostly kept in parallel in order not to ignore the *in vivo* tone of voice. This interlacing of theory and empiric data reflects on what Dubois and Gadde (2002, p. 558) explain as follows: “In case studies aiming at theory development, the researcher needs be open to the multitude of meanings that a certain concept can give rise to. The successive refinement of concepts implies that they constitute input, as well as output of an abductive study.”

As theoretical concepts like boundary spanning scaffolding (Roberts and Beamish, 2017) or organizational resilience (Vogus and Sutcliffe, 2007) emerged in parallel or after to the empiric findings, the research process can *grosso modo* be considered in line with the Gioia method.

The quantitative exploration leaves the reader with new findings as to conditions and activities to boundary spanning in learning. Albeit exploratory, this contributes to extant concepts and presents an abductive concept about boundary spanning. It corroborates qualitative findings and, as explained by Dubois and Gadde (2002, p. 560), “what we learn is articulated in the theoretical framework combined with the matching case. This is generally considered by far the most important outcome of the research process. How we learn is only occasionally discussed in a research report. Learning takes place in the interplay between search and discovery.” The author took this as her north star when alternating between empiric data and theory.

To finalize the scientific rigor contemplation, the process of Building Theory from Case Study Research (see Table 4) is referenced here again. The research question was defined early but kept in a preliminary state. For example, the “why” was inserted at a later point in time, because motivations proved an important ponderation for management. The specific population was able to be defined early, due to internal access to and breadth and depth of organizational layers in this VET department. Data collection methods and protocols grew iteratively, as literature analysis and findings led the way to deeper exploration. As an example, the analysis described in chapter 4.1.3. around fear and organizational resilience was not planned initially. The field work was accompanied by detailed memos and notes, the fourth and sixth of which can be seen as appendices A3 and A4. In-case qualitative patterns could not be verified across cases due to the single case study approach; yet, they could be confirmed by quantitative exploration, allowing sharpening of hypotheses and new aspects. Two of these aspects were the realization that (a) perception of organizational resilience and boundary spanning characteristics do not directly interrelate quantitatively and (b) the different influence on boundary spanning from managers/headquarters staff vs. VET trainers. Literature was enfolded incrementally. Two literature analysis iterations, incorporating the literature of 2021 and 2022 were done later in order not to miss out on recent publications. Collien (2021) or Edmondson and Hugander (2021) were some of the authors who emerged in these later analyses.

5.2 Boundary spanning: in learning: situating research findings in literature

“Where leaders used to compete by erecting barriers to manage the boundaries of the firm, the increasing interconnection of today’s business landscape requires leaders to bridge boundaries to tap the innovative outcome that lie at the intersection of groups working together [...] for new learning and development.”
(Ernst and Yip, 2009b, p. 17)

The research question strives to understand how and why boundary spanning occurs between traditional VET and new forms of education in the context of digital transformation. Digital transformation requires the trainers to learn specified new skills such as robotics, cybersecurity, digital automation, edge, and cloud, which are embedded in company-specific and product-specific use cases and applications. New forms of education include creative methodology and didactics such as virtual and hybrid learning formats, gamification software, reverse teaching (apprentices teach trainers) or common exploration of topic without the trainer having the solution ready.

Understanding activities, motivations and conditions of boundary spanners was mentioned as a subgoal. Other subgoals of the research question were the role of management support and whether boundary spanning can help an organization in times of digital transformation. In the following, the findings of this dissertation will systematically be presented as answers above in order to situate them in the scientific literature body and explain this thesis’ contribution.

5.2.1 Understanding activities, motivations, and conditions of boundary spanners in learning

This dissertation has shown that trainers need to learn and teach new skills from each other with little outside training courses at hand: often, the topics are too new or too company specific. Trainers with special domain and/or technical knowledge are therefore the main carriers of knowhow proliferation within teams and across training centers. In many cases they have the ability due to their prior experience regarding digital technologies experience in factory environments or due to their cognitive abilities. In many other cases, exchange within the ecosystem helps the learning process. That is the specific environment of the VET learning

department of this case where individual learning, team learning, and organizational learning takes place (Schuchmann and Seufert, 2015).

Both qualitatively and quantitatively, empiric data support that training **methods and activities** in times of digital transformation, fueled by the pandemic, have changed to more hybrid, more virtual, more social formats. This confirms what Seufert and Meier (2016a) recommend to training providers as new forms of learning: collaboration, exchange and learning in networks and communities. Furthermore, this dissertation explores how specific training activities contribute to boundary spanning. These are people-oriented training measures, i.e., new forms of education – “colleague-focused activities”, as Roberts and Beamish (2017, p. 536) put it – with should be set up in an open, flexible, experimental as well as non-compulsory manner, and incorporate the learners’ needs and interests and field of reference through practical use cases. The findings correspond to how Morgan (2008) defines double-loop learning. Such double-loop organizational learning which questions the underlying goals can be confirmed here in practice. Individual boulder spanner activities are fostered by management and lead to organizational learning and competency in values and culture (Bartel-Radic, 2013): in the study here, the often-mentioned new VET philosophy.

In this case, boundary spanning propensity proves to fuel social learning, which is considered an organizational competency for VET. Even more important is another **motivation** which becomes evident in this thesis: as expressed by the qualitative interview partners, social learning leads to sustainability of VET operations, i.e., the department’s ability to prepare for future challenges.

This goal is closely related to organizational resilience (Vogus and Sutcliffe, 2016) and constitutes a new contribution to boundary spanning research. Traditionally, boundary spanning is seen to foster innovation and learning (Carlile, 2002), knowledge sharing and social capital (Barner-Rasmussen et al., 2014) and offers value-add through increased effectiveness (Birkinshaw, 2017). In this particular setting of a corporate learning department catering for VET, it is the trainer learning which ensures the future.

This dissertation shows that the **conditions** for boundary spanning in times of digital transformation do not necessarily consist of technical know-how of people, but rather of trainers’ relational abilities, the so-called social skills. Communication skills, pedagogic methodic and didactic skills, an interest in exchange with others and the right mindset are more important than knowledge. Boundary spanning in this VET case is not necessarily motivated

by the *ability* to create knowledge, nor the opportunity; both themes of the original boundary spanning scaffolding model of Roberts and Beamish (2017). One might argue that elements of *opportunities* have come up in the interviews, because the interviewees brought up the perceived lack of time for learning, while members of the management team think they have already made learning a priority for trainers. This practical conflict has indeed been addressed in theory before. Roberts and Beamish (2017, p. 536) point out the “concern for the current capacity of organizational members” when trying to integrate new practices.

Propensity is seen as a separate, new theme vs. the original scaffolding model themes, at least in a considerable number of cases. Propensity is defined here as the individuals’ opinion that more boundary spanning across training centers, regions and towards internal customers should be done. The attitude – or mindset – has shown essential to define boundary spanner characteristics, while it significantly correlates with open learning set-ups and use-cases and contributes to social learning.

This contributes to the research body as an abductive finding: A definition of boundary spanning propensity helps corroborate existing research (Tang *et al.*, 2018). It also amends the boundary spanning scaffolding model of Roberts and Beamish (2017). The latter cannot be confirmed *per se*, while elements of it are able to be retained in the definition (see Figure 36). Robert and Beamish’s construct still gives a most valuable framework to structure the themes and dimensions in the qualitative part of the study.

	Roberts and Beamish (2017)	Current Thesis
Boundary objects	Foreign practices	Practices and technologies unknown to specific individuals in a domestic context
Nature of boundary	Inter-company	Intra-company
Research Method	Qualitative	Mixed
Methodology	Multi-case study	Single-case study
Population	Boundary spanners	Boundary spanners and individuals in the target field of practice
Objects	Knowledge and scaffolds	Technology skills, knowledge, teaching methods See also 6C contingencies
Interview partners	Managers	Managers and trainers (up to 2 hierarchical levels down)
Benefit for the company	Competitive edge	New skills and practices to sustain VET operations and innovativeness

Table 21: Comparison of original scaffolding model with current study

Concepts differ, as is plausible considering that the scaffolding model was established under a study exploring a different context and an international perspective. For more details as to the comparison of the original scaffolding model with the results of this study, please refer to Table 21. Roberts and Beamish only questioned managers, while the qualitative interviews and especially quantitative survey of current study include regular staff in a context where management has given room for boundary spanning and learning.

5.2.2 How management can support boundary spanners in VET

The role of management is relevant in this doctoral thesis, as indicated before. In this doctoral thesis boundary spanning characteristics significantly correlate with the role of managers and headquarters, but neither with size of training center, nor with age of respondent and only to some extent with individuals having experience in different training centers.

That boundary spanning is a task rather associated with management and leadership was indeed confirmed by researchers before. Effective leaders bridge social and cultural boundaries (Ernst and Yip, 2009a), corporate headquarter managers help smoothen and grease internally (Birkinshaw *et al.*, 2017): this could be confirmed via this study. In this specific case, as boundary spanner characteristics predominantly correlate with the role of managers and headquarters staff, the latter help overcome fear and act as role models for the new culture towards a learning culture competent to deal with digital transformation. They also are sponsors of this open way of training activities that Ernst and Yip call “creating a third space” to “suspend” (Ernst and Yip, 2009a, p. 19) other activities to make time and place for learning, and “reframe” to create an environment which is people-oriented and reflect the shared goals. Concretely put, “help an individual team experience progress on some of its most important challenges by practicing new interpersonal skills in regularly scheduled, safe sessions. Second, help participants who experience making progress on tough issues spread it to other teams, starting with the ones they lead” (Edmondson and Hugander, 2021). This is exactly what is happening in this case and confirms extant findings.

Unfortunately, most VET trainers do not exhibit boundary spanner characteristics spontaneously. While such boundary spanning individuals in the staff exist, as the qualitative data confirmed, they are a rare species, quantitatively speaking. Barner-Rasmussen *et al.*'s (2014, p. 887) “individuals who are perceived by other members of both their own in-group and/or relevant out-groups to engage in and facilitate significant interactions between the two

groups” could be qualitatively described very well by 21 interviewees in this case. Yet, power positively correlates with effective boundary spanning as observed by Mäkelä *et al.* (2019). In this regard, the present study corroborates existing research.

Considering the complexity of the knowledge to be acquired, i.e., digital technology, skills, and methods of digital transformation, it is helpful to consult the scientific literature again: effectiveness of knowledge sharing depends on the complexity of this knowledge. Therefore, it may be worthwhile to look not only at boundary spanners, but also to aim at knowledge transfer in form of a “collective bridge” (Zhao and Anand, 2013, p. 1521), as an informal gateway. Along these lines, the efforts of management to integrate learning and bridging offers as part of corporate culture and new VET philosophy, e.g., to enact *learning days* and *new normal teaching* sessions, can be seen as giving opportunities – and time – to do exactly this, confirming in practice what scientific models posit.

As stated in chapter 1, Gutierrez-Huerter *et al.* (2019) claim that the process of translation of knowledge or practices is done by the role of the translator, who is hierarchically in charge. The boundary spanners may complement translation on an individual level by specific bridging skills. This can help to answer the question of how to involve other individuals to increase boundary spanning in the future: the managers act as official translators and enable boundary spanning conditions and opportunities, while other department staff helps. The latter individuals should be identified by their attitude, their abilities, and their conditions (i.e., interest in networking).

In terms of the role of management, this dissertation echoes existing research. Quantitative modelling in this thesis confirms the relevance of management regarding boundary spanner characteristics. Indirectly, by changing leadership and culture, management contributes to social learning, to new values and a perception of new culture in the light of digital transformation.

Relating the regression models with the existing literature, the dependency of boundary spanning characteristics of valid training set-ups correspond with modern learning theory (Seufert *et al.*, 2016b; Widmann *et al.*, 2019; Moehrle, 2020) who recommend new learning models and ecosystems to foster learning. Including the role of managers/headquarters staff in the model is plausible considering the positive correlation of power and boundary spanner effectiveness mentioned above (Mäkelä *et al.*, 2019). Appropriate managerial behavior helps foster organization resilience as well as trust within the team. New forms of education such as

dual studies, upskilling measures, gamification, new technologies and corresponding use cases can be used to cross-fertilize and enhance the traditional portfolio of VET veterans.

5.2.3 How does boundary spanning help an organization in times of digital transformation and culture change?

As per the qualitative data of this thesis, boundary spanning contributes to more learning, more freedom and variety in learning and to mindset and culture change in VET. The value-add for the company lies in faster implementation of new contents, higher employability (of trainers) and sustainability of VET operations as the latter remain relevant in a changing business world in this case.

As a qualitative result, boundary spanning in VET with the aim of *sustainability of the operations* of the department is unusual compared to results from research in sales or R&D departments. Typically, boundary spanning shows to improve proliferation of knowledge, learning (Tang *et al.*, 2018), social capital (Nahapiel and Ghoshal, 1998; Karoui, Dudézert and Leidner, 2015) and *innovations* (Carlile, 2004; Arzumanyan and Mayrhofer, 2016). The difference is explainable by the context of a corporate learning department, which is regularly questioned and asked for justification of the business case for such overhead. Here, keeping knowledge up to date to teach others is vital for survival of the department, whereas in mainstream departments such as sales or R&D departments, it is innovativeness, time-to-market and sales successes which can directly be measured in their contribution to corporate success.

The effects of boundary spanning, however, can neither be related quantitatively to sustainability of operations, nor can this study prove that they directly contribute to a different perception of digital transformation.

Alas, it also belongs to this dissertation's explorative research findings that boundary spanner characteristics, and boundary spanning propensity, two concepts established within this thesis, remain statistically unrelated to notions of digital transformation and sustainability, i.e., the department's ability to prepare for future challenges. In this negation of direct relationship, this finding also contributes to the research body regarding horizontal boundary spanning.

As can be seen in the PLS-SEM meta model established in 4.2.5, the key point for implementing a new culture and leadership changes are managerial role models and, on the other hands, the individual's mindset. Does a person think positively about offering apprenticeships in a hybrid mode, as now tested during the pandemic? Does a trainer exhibit a virtual learning propensity

already? Does staff think positively about the new VET philosophy? If yes, these aspects of individual attitude contribute to the perception of whether the department is prepared for future challenges.

The trainer's perception of digital transformation is influenced by two things: technology brought to life tangibly by use cases for one thing, managerial role models for another thing. The third factor is their own attitude about hybrid VET.

These different dimensions of culture change – individual mindset and collective culture, leadership, and staff's propensities – show an organization in transition, in short: Gong and Ribiere's (2021, p. 10) "fundamental change process". While structure (and hierarchy) remains mostly untouched, systems, strategy (the new VET philosophy touches both on strategy and system), staff, skills, and subordinated goals (as per Waterman *et al.*'s 7-S framework, 1980) change to allow for flexibility. The study illustrates numerous examples of how to flexibilize the learning offers. The team has access and opportunity to learning from each other via *learning days* that were established on a monthly basis, virtual learning units in a non-mandatory set-up, job shadowing etc. These flexible learning strategies are required to allow the organization to adapt to new requirements and skills. This – sometimes – improvised change (Orlikowski and Hofman, 1997) and certainly continuously improved process (in this case: from formal trainings (prior to 2018) to virtual, individual nuggets via DLP, to *new normal great teaching* sessions (2020) via trainer-to-trainers, up to *learning days* introduced in fall 2021) reflects on what Morgan (1998) calls an open system, with managers as connecting agents and information processing as source for intelligence and success. Managing boundaries is a key skill to succeed (Caputo *et al.*, 2019; Ernst and Young, 2009b) here, and boundary spanners are actors to proliferate knowhow and social learning; social learning turns out to be one aspect of culture change needed for new forms of VET across training centers and digital transformation.

This corresponds to Vogus and Sutcliffe's (2007, p. 3420) assessment that, if a resilient organization needs not to exhibit optimism, its management representatives should certainly exhibit positiveness or "hope". It also invokes the image of an organization as a brain striving to "reinvent itself and create a new business orientation" (Morgan, 1998, p. 89).

Leadership and trust, but also the new VET learning philosophy – principal components of culture change manifested in this study (Figure 22) – need to be carefully observed for buy-in, as they are vital for carrying across the right messages and a trustful, inspiring attitude

(Schwarz Müller *et al.*, 2018), whatever crisis (COVID) or challenge (upskilling of adult employees, new forms of VET) may come up. Such responsibility can be shared by management and other boundary spanners to ensure the organizational unit is set up well for the future.

Extant management theory can be confirmed by this thesis. Its new contribution resides in a meta-model for showing how elements of culture and leadership, mindset, social learning and trainers' methods, activities, abilities, and motivations interrelate in this single case (see Figure 30).

5.3 Managerial recommendations

As to the relevance and the repercussions for management, there are consequences regarding VET training and beyond. This thesis empirically shows that corporate change by means of social learning is enabled through boundary spanning.

For managers, this means that boundary spanning across local entities – like, for instance, training centers – can be a source of organizational learning, especially in innovative environments where there is no off-the-shelf know-how available. As this study shows, boundary spanning in learning can make individual learning experiences a collective employability enhancement, which is the societal flip side of future sustainability of VET operations considering the individual's perspective. In summary, boundary spanning scaffolding is not directly linked to ensuring sustainability of operations. Fostering boundary-spanning qualities in staff and managers to enable social learning can be ensured by looking at boundary spanners' relational abilities and mindset when hiring and promoting staff.

In the following, the different management recommendations will be detailed as to the what, the how, the who and the why. A detailed checklist from the point of view of the different stakeholders will follow to operationalize the managerial recommendations. Furthermore, risks and obstacles of such an approach will be discussed.

5.3.1 How can boundary spanning facilitate learning and teaching of new content by VET trainers?

Providing learning scaffolds to trainers via boundary spanning activities helps to improve their cognitive and didactical skills in view of teaching digital technologies and methods. Cognitive scaffolds include experimental teaching, use-cases, projects, good preparation, yet flexible

reaction to questions and improvisation. Relational scaffolds mean open workshops, empathic help while trust building, aspiring for reciprocity in sharing information and experience in a secure environment. Material scaffolds, in this VET context, mostly means providing sufficient time and capacity for trainers to train, considering the equipment is available. The conditions under which such boundary spanning in learning is successful include relational abilities, interest in cross-regional networking and certain knowhow and cognitive competencies, the latter ones not as important as networking and relational abilities.

It is important and accepted to provide virtual learning opportunities which can be social (team learnings) or self-led.

It has also been shown empirically, in the qualitative interviews first and foremost, but not exclusively, that lack of capacity is the single biggest obstacle to effective learning from each other in a training department. Lack of capacity means trainers do not have the time or do not feel they can make time available for learning. Making learning a priority is something managers need to actively role model and provide staff time for. Assuming that everybody can fit such learning time somehow in a busy work week with full schedules misses the point and leaves staff alone with a serious problem: how to stay up to date regarding technologies and methods they need to teach? If not addressed openly and honestly, this problem may lead to frustration, alienation between management and staff, individual burnouts and/or resignations.

5.3.2 Which methods can managers use to foster boundary spanning in VET?

While all the above is relevant as to the conditions of boundary spanning, the methods for providing boundary spanning in VET learning should be in an open and people-oriented set-up.

That may be operationalized by practical opportunities like job rotation, job shadowing (where trainers may take part in other trainer's sessions), or tandem teaching, but also by regular cross-regional virtual meetings helping exchange or by setting up virtual platforms and communities. In the studied case, the company introduced bi-monthly two hour "great teaching" sessions for the German, Austrian and Swiss trainers to get together and discuss methods and didactics at eye-level, i.e., from trainer to trainer. That was such a success in 2021 that the concept was extended in 2022 to monthly, voluntary, "learning days" with faculty communities (for mechanics, electronics, commercial and IT personnel). Managers encouraged trainers with innovative ideas to present their topics there. The most controversial topic in this context was

the real or perceived – depending on the viewpoint of either trainers or their managers – lack of capacity, in some cases and centers, to participate on a regular basis.

Depending on the culture of the organization, asking colleagues to allow for “shadowing” their daily work, may be something the individuals are not accustomed to. Consequently, if not introduced and explained properly, it may lead to a feeling of being controlled by others spying for management, whereas the colleagues who are asked to shadow or tandem teach may feel novices again, despite their professional experience. In a setting where one trains a group of youngsters there is the additional risk of seasoned trainers to feel like they are “losing face”. Other obstacles can be financial or capacity-related, because providing learning opportunities to trainers means they cannot be actively involved in apprenticeship teaching or supervising at the same time. If the cultural assumption of trainers has been that only hours in front of the learners are truly contributing to operations, trainers may be hesitant to introduce self-learning or group-learning sessions to these learners for fear of being told not to being productive enough. It is therefore important to plan such organizational culture change carefully and holistically with all hierarchical layers involved, while paying attention that values, metrics, and goals are properly aligned and communicated to the staff who is to become a learning community. If not done well, there is a risk of organizational confusion and individuals’ frustration, besides the financial implications of training hours being allocated in vain.

5.3.3 Which characteristics and roles should manager look for to foster boundary spanning?

This dissertation has shown that boundary spanning characteristics include, besides an openness and people-orientation in the learning activities, a penchant for managerial roles. Those are the ones with direct effect on leadership styles, and influence on trust and system changes as well as shared values (e.g., change in the VET teaching philosophy). They are the ones specially contributing to a positive perception of the departmental future long-term sustainability of operations, while improving boundary spanning across training centers. A certain passion for sharing and creating knowledge across locations has been manifest in both qualitative and quantitative analyses. Managers are therefore recommended to exhibit such behaviors and to look for this fire for the cause and optimism to identify boundary spanners in their organization who should enable social learning.

In case where the management team does not have these boundary spanning champions, or there is a team unwilling to share knowledge and individuals fearing or unwilling to expose themselves in an active training role for other trainers, this could constitute obstacles to the introduction of such learning initiative. Offering proper incentives (monetary or public praise or career opportunities) may in these cases represent an appropriate mitigation, while requiring additional short- and long-term resources. Changing the requirements when hiring new managers and trainers to accommodate for these boundary spanning characteristics while paying attention to technological and methodological skills are appropriate measures in this case to alleviate the risk of failure to foster social learning.

5.3.4 How can staff be motivated to boundary span?

Formal boundary spanning encouragement may include incentives and the nomination of official boundary spanning roles and tasks to be accomplished. Yet in many cases intrinsic motivation of trainers paired with a natural curiosity as to technology and people, will do the trick. In fact, trainer communities typically have a penchant for communication. Identifying leaders for the cause is therefore the first step to take. In cases where a sufficient number of boundary spanners is not given and/or boundary spanning should be expanded, looking for boundary spanning qualities when recruiting new trainers may be the measure of choice.

It is also important to understand that boundary spanning needs time, and, to some extent, courage. Encouraging trainers to actively share their knowledge and let others participate and grow in their learnings is an important quality of management. Specifically, managers should be aware of capacity issues as the major obstacle and actively communicate the importance of learning from each other for future operational effectiveness. They should also create an atmosphere or trust, allowing for mistakes and mishaps, and “walk the talk”, i.e., be role models in learning and boundary spanning to lend credibility to their communication.

The typical obstacles of time and capacity have already been discussed. Here is another obstacle which is rarely mentioned: It is important to point out that in many cases, trainers come from a factory environment where the barriers between management and staff are perceived as higher than in an HRM context. Speaking up on behalf of management and actively identifying oneself as part of the leaders is neither everybody’s (individual) nature, nor is it part of this social group’s expectations in many cases. As a manager, understanding such subtleties to navigate

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through the tricky thorns of alleged class distinctions to bring forward the social capital for the better of the team may indeed represent a challenge but it is truly worthwhile to tackle.

Awareness and open communication while providing scaffolding (*sic!*) towards new opportunities and finding role models that actively share and talk may be appropriate in these cases.

A summary of the essential managerial recommendations, potential obstacles, and risks as well as mitigational action is illustrated in Table 22. Further details on stakeholder based operationalized management action will be illustrated in the next chapter.

Managerial questions	Managerial recommendations	Obstacles	Risks	Mitigations
How can boundary spanning facilitate learning and teaching of new content by VET trainers?	<p>Providing learning scaffolds (=help) to trainers via boundary spanning activities</p> <ul style="list-style-type: none"> - Cognitive scaffolds include experimental teaching, use-cases, projects, good preparation, yet flexible reaction to questions and improvisation. - Relational scaffolds mean open workshops, empathic help while trust building, aspiring for reciprocity in sharing information and experience in a secure environment. - Material scaffolds, in this VET context, mostly means providing sufficient time and capacity for trainers to train, considering the equipment is available. <p>Fostering conditions under which such boundary spanning in learning is successful:</p> <ul style="list-style-type: none"> - Relational abilities; - Interest in cross-regional networking - A certain knowhow and cognitive competencies, the latter ones not as important as networking and relational abilities. 	<p>Capacity shortage/insufficient time to learn during business hours;</p> <p>Fear of making mistakes, being judged by colleagues, fear of exposure.</p>	<p>Frustration; alienation between management and staff; individual burn-outs; resignations.</p>	<p>Set aside staff time for learning; be active role models in taking time to learn and to allow for an inclusive and appreciative culture.</p>
Which methods can managers use to foster boundary spanning in VET?	<p>Open and people-oriented setup</p> <ul style="list-style-type: none"> - Practical opportunities like job rotation, job shadowing (where trainers may take part in other trainer's sessions), or tandem teaching; - Regular cross-regional virtual meetings helping exchange; - Virtual platforms and communities. 	<p>Depending on the culture of the organization, teaming up colleagues may lead to a climate of hostility and mistrust, financial risk of training measures or the feeling of "losing face" or "being sped on".</p> <p>Financial or capacity-related obstacles due to double-staffing.</p> <p>Existent productivity KPIs.</p>	<p>Organizational confusion and individuals' frustrations; financial risk of training measures without desired effect.</p>	<p>Holistically plan and explain organizational culture change;</p> <p>pay attention that values, metrics and goals are properly aligned and communicated to the staff to become a learning community;</p> <p>provide time and support for boundary spanning individuals and allow for learning-from-mistakes.</p>
Which characteristics and roles should manager look for to foster boundary spanning?	<p>Managers should look for other managers as the most important actors when improving boundary spanning across training centers.</p> <p>In general, to identify boundary spanners in their organization who should enable social learning, look for</p> <ul style="list-style-type: none"> - A certain passion for sharing and creating knowledge across locations; - A fire for the cause; - Optimism. 	<p>Management teams who do not have these boundary spanning champions; teams unwilling to share knowledge; individuals unwilling to expose themselves in an active training role of other trainers.</p>	<p>Hiring or keeping people without the interpersonal skills or attitude may prevent social learning on new topics such as digital technologies and methods.</p>	<p>Take inventory of the human resources with such potential;</p> <p>offer proper incentives (monetary or public praise or career opportunities);</p> <p>add short and long term resources, if possible;</p> <p>change the requirements when hiring new managers and trainers to accommodate for these boundary spanning characteristics while paying attention to technological and methodological skills.</p>
How can staff be motivated to boundary span?	<p>Explaining necessity for a culture of learning and sharing;</p> <ul style="list-style-type: none"> - explain boundary spanning and why it is important; - encourage boundary spanning for learning explicitly. <p>Formal boundary spanning encouragement:</p> <ul style="list-style-type: none"> - nomination of official boundary spanning roles and tasks to be accomplished; - incentives (in many cases intrinsic motivation of trainers paired with a natural curiosity as to technology and people will not make incentives necessary); - identification of leaders and allies for the cause; - looking for boundary spanning qualities when recruiting new trainers. 	<p>see above;</p> <p>be aware of social/hierarchical barriers that may prevent VET trainers from seeking exposure in the formal/informal leadership arena.</p>	<p>Risk of obsolescence of individual trainers' knowledge may lead to employability issues in the long run;</p> <p>less quality in VET training may lead to</p> <ul style="list-style-type: none"> first-day readiness problems of absolvents in the job; if not addressed, VET department's reputation and sustainability of operations at stake. 	<p>Be aware and communicate openly why boundary spanning is important (see "risks");</p> <p>provide help when someone starts reaching out to other teams/cultures/methods;</p> <p>find role models that actively share and discuss the virtue of this behavior;</p> <p>allow for time when trainers to actively share their knowledge;</p> <p>actively discuss capacity conflicts and communicate the importance of learning from each other for future operational effectiveness;</p> <p>create an atmosphere of trust and "walk the talk".</p>

Table 22: Summary of managerial recommendations, obstacles, risks, and risk mitigations

5.3.5 Stakeholder-based operationalized checklists

5.3.5.1 VET managers or corporate training department leaders

As a manager of a VET or corporate training department, this translates into the following operational checklists, should boundary spanning be required to foster learning and innovation:

- ✓ Provide time for training of trainers by actively managing the capacity load and making learning a priority.
- ✓ Ensure that the skills the companies will need in the future are understood and that knowledge is built up and documented internally, or with external help. It might be of special importance to modularize training units that the latter can be re-used (for trainers, apprentices, dual students, and staff at a later point in time) and scaled up.
- ✓ Explain the necessity of train-the-trainer activities in a (life-long) learning approach, which fits the company's perspective.
- ✓ Schedule training offers openly, i.e., do not force anyone to participate, but present opportunities and upsides, allow for flexibility and experimentation with topics and methods.
- ✓ Create an atmosphere of trust; that can be done for example:
 - By stressing that it is the trainers' topics that will be discussed, not managerial ones;
 - By asking staff which topics are relevant for them;
 - By announcing that management will not be participating, at least regularly, in order to avoid a situation of controlling, judging or prying, or situations where admitting not to know anything would equal a loss of face.
- ✓ Provide opportunities for social learning within the training department:
 - Set up projects, or expert teams;
 - Offer job rotation;

- Schedule opportunities for intra-group learning from people with different professional backgrounds;
 - Allow for job shadowing;
 - Encourage job sharing;
 - Suggest tandem teaching;
 - Initiate cross-regional virtual trainings;
 - Set up virtual platforms/communities.

- ✓ Select and invite staff members who have an idea or want to discuss something to lead the effort and serve as role models for such social learning opportunities via boundary spanning.
 - Remember that relational abilities are more important than abilities;
 - Remember the special penchant of management towards boundary spanning and make sure they are actively involved in the offerings;
 - Pay attention to boundary spanning skills when hiring new trainers;
 - Remember that use case-based training, which are very application-driven, have proven their value in making trainers experience first-hand digital transformation of technologies.

- ✓ Systematically and anonymously ask for feedback on how to improve these sessions:
 - What is the best time of week/month/day to do such social learning?
 - How long should those sessions be?
 - Are the topics relevant?
 - Would they recommend them to others?
 - Keep the atmosphere low-key, easy to join and cultivate a culture where mistakes can happen.

- ✓ Lead by example. Practice these habits with your managerial peers to be credible and authentic in praising these methods.

- ✓ Challenge the existing mindset – is it a growth mindset?

- ✓ Undertake any efforts to invite other departments/regions/companies to foster boundary spanning and learning from others.
- ✓ Embrace leadership narratives and communication messages that stress the strategic importance of acquiring new skills for individual employability, organizational resilience and corporate learning and innovation.

5.3.5.2 HR managers

As a HR manager, allowing for social learning in HR ecosystems in times of digitalization means analyzing existing practices, tools, methods, and measures (e.g., DLP, SNS, workshops, ratio of virtual vs. personal trainings, culture, barriers, capacity strains) in order to understand the whereabouts of your company's needs. In case of reskilling/upskilling issues that may be satisfied by social learning in boundary spanning contexts, or in case boundaries hinder innovation and knowledge proliferation, that may be an issue which merits a senior management circle discussion, or, if rather a local issue, may lend itself to a focused approach consulting the individual department heads.

From an HR perspective, boundary leads to social learning, but will not solve the organization resilience problems nor the digital transformation topics *per se*. Rather, it is a succinct mindset that helps the organization to overcome communication and knowledge issues. This mindset will contribute to a culture change necessary to survive and thrive in times of digital transformation, where new business models occur and ecosystemic thinking is paramount.

Therefore, the following approach is recommended:

- ✓ Identify how your business model ties into both the overall strategy and the HR strategy.
- ✓ Deduce which critical skills are required to foster innovation and/or will change due to digital transformation?
- ✓ How can staff acquire such skills?

- ✓ In case skills and knowledge are tacit, or not readily available, can staff learn from each other?
 - If so, work with line managers and identify how to foster a culture of boundary spanning and social learning. The recommendations above, which are provided for corporate training managers may help, but it has to be paid attention to the fact that most staff members are not so vocal or didactically skilled to teach with ease. Here, focusing on relational abilities of potential boundary spanners will provide guidance.
 - HR managers are in the privileged position to reach across all departments, business lines, and, in MNE, across countries. As such, they can be at the forefront to initialize cross-departmental exchange and learning. Specifically, they can be at the forefront of creating a trading place of knowledge sharing by boundary spanning. Suitable measures include, among others,
 - Job shadowing;
 - Job Sharing;
 - Tandem teaching;
 - Cross-regional virtual trainings;
 - Setting up virtual platforms/communities for exchange.

5.3.5.3 CEO or General Manager level

As a **CEO**, working on a general manager level with HR to identify how to drive innovation and change in the organization is obvious; yet the ambition level for social learning via boundary spanning has to be identified in dependence of the criticality of corporate learning for overall sustainability of operations and innovation in times of digital transformation and key sustainable advantages of the business model to choose.

- ✓ Define how innovation and change in your organization is fueled by the right talents and skills;
- ✓ Develop a corporate learning strategy as part of the talent development strategy (Figure 5 may be a conceptual framework to consult);

- ✓ Carefully evaluate and adjust corporate priorities together with HR and the management board to provide strategic direction and clarity;
- ✓ Clear top-down priorities and communication allow for the business lines to justify the investment of time and resources, if necessary;
- ✓ KPIs that suit the purpose, and regular strategic reviews should support the process.

A CEO is in the special position to assess with which companies a strategic learning alliance might be useful without negative repercussions on the market positioning.

CEO's boundary spanning externally, via the employers' associations, professional boards, and contacts that other staff members will not have, can be a special advantage and an original contribution to combine resources in learning.

Learning from each other, in that case, may result in lateral pooling of resources (MNE-MNE), e.g., in non-competing sectors; or else there may be value-add in providing learning opportunities for SME-type businesses (MNE-SME), the latter ones without their own training department. Learning activities may be intensified in a customers or supplier relationship.

Such boundary spanning and external reach may also be a means to exhibit corporate and social responsibility (CSR) in the communities, full well knowing that education is one of the UNO's sustainability goals, while one of the strategic priorities of EU equally consists of upskilling/reskilling people for future employability in the realm of and to counteract any negative effects of digital transformation.

From the perspective of a CEO, a VET department, besides building up the right internal talent pipeline bottom-up, has experience and skills available to provide technical training. The translation of such technical training skills into the adult working world may be an opportunity to show CSR as well as to business acumen. Along the same lines, a corporate training department can prove to be of value for society while making money off reaching beyond the company's boundaries.

5.3.5.4 Local politicians

As a **local politician**, seeing the macro-economic reskilling/upskilling needs of a municipality and trying to provide job opportunities for voters, both up-to-date vocational education and training and sufficient relevant upskilling opportunities will be important to provide and ensure wealth of a region. Shaping a skilling ecosystem with public and private partners and with academic as well as vocational institutions may be a decisive strategic advantage for the region, and a way to differentiate from political adversaries. Therefore, intensifying the contact with local players in the VET, upskilling and reskilling market provides an immense upside.

Furthermore, opportunities for initial VET keep the next generation in the region, help reduce youth unemployment as well as secure human resources for local industries and foster local industrial development. Boundary spanning – the art of reaching across to create value via learning and innovation – is paramount here. From a company’s perspective, reaching out to the public service and governmental representative as part of the local and national ecosystem may tap resources and potential otherwise not accessible, while exhibiting corporate social responsibility, if well done.

5.3.5.5 Vocational School Directors or Academic directors

A vocational school director is responsible for about a third of the learning time and curricula of apprentices, in concurrence with existing norms and regulations. Along the same line, university managers are responsible for about the third of the learning time and curricula of dual students. While collaborations with local companies are the essence of their work and have always been nurtured, the context of digital transformation poses challenges not only for VET trainer learning, but also for vocational teacher learning, (and, to some extent, academic teachers). Such learning can go hand-in-hand with all sorts of virtual, social and/or in presence learning in the company context. Companies may be in the privileged position to have technology use cases at hand, which facilitate learning.

Reaching across and understanding the corporate realities, practices, use cases, technologies, and cultures, helps understand the needs of apprentices and dual students. Therefore, social learning should happen across these boundaries as well. Not unlike the pilot model in Baden-Württemberg, Germany, initiated by the Holtzbrinck Stiftung³, allowing teachers to work as a quasi-internship with companies for a period of time (6 months, part-time), fighting for similar

³ <https://www.dvhstiftung.com/die-hospitanz>, assessed on May 3, 2022

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models to make vocational schoolteachers understand corporate work life and vice versa is an active contribution to boundary spanning in practice.

Potential methods can be:

- ✓ internships,
- ✓ common projects and initiatives,
- ✓ regular exchange,
- ✓ job shadowing,
- ✓ round tables.

These are examples of methods that help build bridges for further learning and innovation, if not of technologies, then of methods.

The repercussions are not unlike those identified in a corporate training arena:

- ✓ providing time,
- ✓ creating open and people-oriented set-ups where digital transformation ultimately leads to social learning and innovation may be a way to go.

Scientific evaluation of such routes will be suggested in the next chapter.

Universities have increasingly tapped the market of professional upskilling and reskilling. This market is growing, profitable and challenging, while universities – at a different level of abstraction but not unlike VET departments – are uniquely skilled in technology and didactic abilities.

The EU has fueled such academic collaboration (e.g., EuroTeQ⁴ initiative by Technical University of Munich, Technical University of Denmark, Eindhoven University of Technology, Ecole Polytechnique l’X de Paris, Czech Technical University in Prague, and Tallinn University of Technology) in order to foster proliferation of academic knowledge and increase

⁴ <https://euroteq.eurotech-universities.eu/>, assessed on May 3, 2022

the digital workforce by offering micro-credential for skilled workers with technical career ambitions for continued learning. This is co-funded by the ERASMUS+ program, aiming to provide financial stimulus to skilled worker upskilling initiatives. From a corporate perspective, boundary spanning in times of digital transformation to enable social learning may effectively involve such ecosystems in order to have access to a broader pool of knowledge and capacity.

5.3.5.6 National politicians

As a politician working on the federal or state level, orchestrating the national education arena with the different players, i.e.

- ✓ Companies,
- ✓ social partners,
- ✓ vocational schools,
- ✓ universities,
- ✓ parents,
- ✓ workers,
- ✓ apprentices and dual students,

represents an elaborate multi-criteria optimization. Having said this, society is increasingly aware of digital transformation and, if not managed well, of the adverse potential macro-economic and sociological repercussions which may face the industrialized nations in the years to come. Working with the different stakeholders and – again – spanning boundaries across the divide in order to foster social learning in education eco-systems is something which can be orchestrated nationally, while effectively operationalized locally, bearing in mind that most employees and young people are not mobile enough to seize educational opportunities outside their regional or local situation. Here, digital transformation can provide opportunities to scale up and multiply initiatives otherwise requiring displacement, helping SME as well as MNE to access and leverage training opportunities.

Social learning and innovation, fueled by boundary spanning across and potentially learning from front-runner players, can be fostered if suitable opportunities are identified and built up. In the EU and in some national countries, such opportunities are currently being developed (e.g., European Round Table R4E Reskilling for Employment initiative, Germany's Nationale Weiterbildungsstrategie⁵).

5.3.5.7 Professional training companies

In the past, many companies have outsourced their professional trainings to institutions adjacent to CCIs, to employers' associations and private specialized training companies. Some other training companies have specialized in offering temporary VET trainers who support the staff capacity in corporate VET departments. In principle, all those are already in transition. Their trainers must also face and master the challenge of upskilling their practical knowledge. While it may be difficult to job shadow at a client in the latter case of the specialized temp trainer agencies, it is not uncommon. Boundary spanning towards the industrial VET trainers and vice versa may accelerate digital transformation of trainers' abilities. These companies are big enough to face similar challenges – trainers unwilling to share their knowledge or trainers unwilling to learn new things, capacity problems and leadership challenges. Staying at the forefront of VET technology and methods is part of the business model of such agencies and training companies, such that some of this thesis' findings may apply.

⁵ https://www.bmbf.de/bmbf/de/bildung/weiterbildung/nationale-weiterbildungsstrategie/nationale-weiterbildungsstrategie_node.html, assessed on May 3, 2022

6. Conclusion

6.1 Summary of the results

The fact of the matter is: the more the pace of technological progress accelerates, the less there are ready-made off-the-shelf learning offers for those who should lead the troops through their learning journeys. That leaves trainers, especially in-house corporate trainers with hands-on, medium level professional qualifications, on the sidelines if no intra-organizational efforts are made, respectively internal resources are used, to enable organizational learning and organizational resilience in digital transformation. Boundary spanning across training centers – training centers acting as loosely coupled systems (Weick, 1976; Orton and Weick, 1990) – has shown to be a valid vehicle as to organizational learning in this study.

The research question explored how and why boundary spanning occurs between traditional VET and new forms of education in the context of digital transformation. As per a quantitative online survey with 175 participants of a German VET department in an exploratory research design, this dissertation shows that new learning methods and activities, along with the enthusiasm to create new knowledge and trainers' relational abilities, fosters social learning in the context of intra-departmental digital transformation. Boundary spanning characteristics in this study are persisting willingness (as a condition), relational scaffolding (as an activity), and – as a new variable – *propensity*. Themes like ability and opportunity did not significantly influence boundary spanning characteristics. Propensity is defined here as the individuals' opinion that more boundary spanning across training centers, regions and towards internal customers should be done. It significantly correlates with open learning set-ups and use-cases and contributes to social learning.

A change in leadership and trust as well as a new philosophy as to VET learning positively contribute to both social learning and future readiness of the department. This future readiness, sometimes referred to as *sustainability of the operations*, represents a new notion in boundary spanning theory in learning and a theoretical contribution. At the same time, it cannot directly be proven that boundary spanning is a visible and concrete dimension of culture change in multi-layer Vocational Education and Training (VET) environments like the one described in this single case study. Nor can it be quantitatively demonstrated that people who practice boundary spanning believe in organizational resilience.

What can be demonstrated in this thesis is the relevance of managerial role models influencing the individual's perception for digital transformation to happen in VET. Managerial role models furthermore are proven to lead to a positive view of sustainability of VET operations in the sense of operational resilience. The lesson learnt here for managerial practice is that in times of digital transformation, leadership counts a lot towards department's perceived future readiness, the famous "Zukunftsfähigkeit", as the German interview partners express it. This is in alignment with management theory (Brahm und Kunze, 2012; Kazim, 2019; Schwarzmüller *et al.*, 2020).

As to scientific contributions specific to boundary spanning research, this dissertation shows that – while the proliferation of knowledge and the enthusiasm for sharing knowledge plays a big role for trainers – cognitive ability and knowhow are not important when describing a boundary spanner. Rather it is a question of the person's conditions, activities, and attitudes. As such, the boundary spanning model in learning scaffolding of Roberts and Beamish (2017) can be amended as an abductive finding of this dissertation, the latter one providing a new measurement for boundary spanning characteristics. This operationalized boundary spanning measure has shown to correlate with the role of the manager, in contrast to VET trainers, and is dependent of how learning is set up.

6.2 Academic relevance

This thesis helps to answer a research call to explore boundary spanning not only in the context of roles and motivations, but also with respect to processes and methods, i.e., as "organizational level research" (Schotter *et al.*, 2017, p. 406). Besides, boundary spanning applied to an intra-company, intra-function change management context has also been established as an explicit research gap regarding intra-MNE horizontal boundary spanning and its methods (Schotter *et al.*, 2019). Furthermore, it has been pointed out in chapter 1.4.1., that specific aspects of learning or learning organizations in intra-organizational boundary spanning have only recently been in the focus of management research. In this context, further research is suggested to understand:

- the "how" and the "what" of activities and conditions,
- the "why": the willingness of individuals to act as boundary spanners,
- the "how much": evidence regarding learning activities in the context of boundary spanning as a predictor of performance and success (Roberts and Beamish (2017)).

It has also been established in said chapter, that there seems to be little field research pertaining to intra-company, intra-function research on boundary-spanning within a context where culture is changing (e.g., due to digital transformation).

The definition and position of attitude – boundary spanning propensity – in the meta-model adds to the boundary spanning research body (Tang *et al.*, 2018).

This thesis answers some of the research gaps identified above by presenting an abductive model to Roberts and Beamish (2017). Intra-functional boundary spanning research on conditions, activities and motivations of learning scaffolding therefore constitutes a relevant novel research contribution to the area of intra-company boundary spanning research. The context of culture change in vocational education and training (VET) stemming from digital transformation is original. Extant concepts and theory in boundary spanning scaffolding have been enriched by this research.

6.3 Avenues for future research

A single-case study has its limitations as to its validity and objectivity. Even though the two-step mixed-method approach in an exploratory sequential design helps to obtain a more comprehensive, more objective understanding and integration, a single-case is limited as to generalizability of the results (Welch *et al.*, 2011). Yet, while generalization *per se* is neither possible nor intended in case study research, out-of-case prediction with PLSpredict (see Appendix A4) shows a robust model (Figure 30) and this case gives insights into departmental details otherwise not accessible to the research community. Rich analysis with contextualized explanations and detailed documentation was carried out to counteract any potential bias resulting from the fact that the author-researcher happens to be the German manager of the VET department. It also ensures that the grounded theory is “reproducible in the limited sense that it is verifiable” (Corbin and Strauss, 1990, p. 424).

Some of the concepts developed in the qualitative analysis are not taken up again during the quantitative study. As examples, control variables like gender or level of education were not asked for, to avoid potential conflict with worker’s committee and data privacy regulations. Other examples of excluded variables consist of the exploration of fear as a topic that came up during the qualitative phases. This topic is very sensitive and may have caused either irritation or withdrawal from the voluntary survey by potential respondents. In any case, management

decided not to pursue it in such questionnaire. It would have needed other avenues – potentially qualitative ones – to explore such psychologically sensitive topic further.

Other concepts available in boundary spanning theory were not taken up in detail. For example, neither were the interactions with other departments or contingency on team-level or task-level antecedents taken into consideration, nor was boundary spanning discussed in the context of inter-departmental conflicts and competition for resources (Joshi *et al.*, 2009). This might represent an interesting research angle for further study on this case.

Finally, there was one poorly developed question in the German survey, which inhibited further clarity regarding one factor of boundary spanning characteristics. Rather than asking for the ability of networking (see chapter 4.1.2.1.1., networkability across locations as a concept), unfortunately, the survey question was altered into “interest in networking”, being less precise. Most unfortunately, this proved to be a relevant factor for boundary spanner characteristics. Future surveys may want to split this survey question in both “willingness to network” and “network-ability”, to correspond more to the original themes of the scaffolding model (Roberts and Beamish, 2017), thereby allowing a better comparability of results.

The primary research part of this thesis was done in German, transcribed, and coded in NVivo in German and analyzed in German, which is the author’s first language. Only at the end of the thesis preparation, the translation of primary and secondary codes into English was carried out. This was done to keep the semantic logic and comparability across quotes for the longest possible period. “Tensions arise between coding in one’s first language and in English”, hints Charmaz (2014, p. 1078), and while it may be easier to code in one’s first language, the author’s familiarity with business English and the conciseness and concept-ability of the English language helped find crisp English codes for the translations. The same cannot be said for the translation of the original respondents’ quotes. They lose originality in translation, but that is unavoidable. To counteract this phenomenon, it was pondered to keep the German original voices in the text when deemed necessary, although this certainly proved to be of little value for all non-German-speaking readers.

Yet, this translation process was not void of ambiguity. Organizational resilience is a concept which was developed from the German “Zukunftsfähigkeit” (English literal translation: future ability, translated somewhat awkwardly by “sustainability of VET operations” or “future orientation” in the qualitative and quantitative parts of the research findings; the notion of sustainability to be confused with neither ecological sustainability nor green skills), a verbatim

notion that emerged in the interviews. Finding the adequate English expression with abstraction sometimes proved challenging. Hence, synonymous notions were sometimes kept for better English-German contextualization.

Future avenues for research may want to explore more cases in the VET context. The author recommends to also explore related contexts such as corporate upskilling and reskilling domains, in technical schools and colleges, possibly in other cultural – national or professional – contexts. In such environments, similar challenges stemming from digital transformation will make culture change and new forms of learning and upskilling of trainers and teachers emerge, which can be fostered by boundary spanning. To understand conditions, motivations, and activities of trainers in different contexts is relevant, corresponds with the actual scientific research agenda and will be interesting to compare with the current case to further enrich the findings discussed in this thesis.

Bibliography

A

Acedo, F. J., Barroso, C. and Galan, J. L. (2006) "The resource-based theory: dissemination and main trends", *Strategic management journal*, Vol. 27 No. 7, pp. 621-636.

Aldrich, H. and Herker, D. (1977) "Boundary Spanning Roles and Organization Structure", *Academy of Management Review*, April, pp. 217-230.

Argyris, C. (2002) "Double-Loop Learning, Teaching, and Research", *Academy of Management Learning and Education*, Vol. 1, No. 2, pp. 206-218.

Arzumanyan, L. and Mayrhofer, U. (2016) "L'adoption des outils numériques dans les communautés de pratique. Le cas du Groupe SEB", *Revue Française de Gestion*, Vol. 42, No. 254, pp. 147-162.

Autorengruppe Bildungsberichterstattung (eds.) (2020) "*Bildung in Deutschland 2020*", Bielefeld: wbv Publikation, pp. 151-176.

Avenier, M.-J. and Thomas, C. (2015) "Finding one's way around various methodological guidelines for doing rigorous case studies: a comparison of four epistemological frameworks", *Systèmes d'information & management*, Vol. 20, pp. 61-98.

B

Barlatier, P.-J., (2019) "Case Studies", in: (eds.) Chevalier, F., Cloutier, L. M., Mitev, N., *Research Methods for the DBA*, Business Science Institute Collection, Paris: Editions EMS, pp. 171-182.

Barner-Rasmussen, W., Ehrnrooth, M., Koveshnikov A. and Mäkelä K. (2014) "Cultural and language skills as resources for boundary spanning within the MNC", *Journal of International Business Studies*, Vol. 45, No. 7, pp. 886-905.

Barmeyer, C. and Grosskopf, S. (2020) "Von sozialem zu interkulturellem Kapital: Migranten als interkulturelle Brückenbauer in Organisationen", in: (eds.) Genkova, P. and Riecken, A., *Handbuch Migration und Erfolg*, Wiesbaden: Springer, pp. 407-422.

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Bartel-Radic, A. (2013) ““Estrangeirismo” and flexibility: intercultural learning in Brazilian MNCs”, *Management international/International Management/Gestìon Internacional*, Vol. 17 No. 4, pp. 239-253.

Bartel-Radic, A. and Paturel, R. (2006) “L’apprentissage organisationnel de la compétence interculturelle“, *Recherches en sciences de gestion*, Vol. 57, pp. 55-86.

Bennett, N. and Lemoine, J. (2014) “What a difference a word makes: Understanding threats to performance in a VUCA world”, *Business Horizons*, Vol. 57, No. 3, pp. 311-317.

Beugelsdijk, S., Kostova, T. and Roth, K. (2017) “An overview of Hofstede-inspired country-level culture research in international business since 2006”, *Journal of International Business Studies*, Vol. 48, pp. 30-47.

Birkinshaw, J., Ambos, T. C. and Bouquet, C. (2017) “Boundary spanning activities of corporate HQ executives: insights from a longitudinal study”, *Journal of Management Studies*, Vol. 54, No. 4, pp. 422-454.

Bitkom (2018) “*Digitale Bildung – Handlungsempfehlungen für den Bildungsstandort Deutschland. Positionspapier Bitkom*“, <https://www.bitkom.org/sites/default/files/file/import/FirstSpirit-1515141793223180103-Positionspapier-Digitale-Bildung-Neuaufgabe.pdf>. Accessed on 15.05.2021.

Bourdieu, P. (1986) “The Forms of Capital”, in: J. Richardson (ed.), *Handbook for Theory and Research in Sociology of Education*, New York: Greenwood, pp. 46-58.

Brahm, T. and Kunze F. (2012) “The role of trust climate in virtual teams”, *Journal of Management Psychology*, Vol. 27, No. 6, pp. 595-614.

Bundesinstitut für Berufsbildung (ed.) (2018a) “*Ausbildung Gestalten. Digitale Metallberufe*“, Bonn: Buderich, pp. 16-30.

Bundesinstitut für Berufsbildung (ed.) (2018b) “*Pressemitteilung: Metall- und Elektroberufe zukunftsfest gestaltet*“, Newsletter 34/2018, 19.06.2018, pp. 1-3.

Bundesvereinigung Deutscher Arbeitgeberverbände (ed.) (2021) “*Neue digitale Weiterbildungstools in der betrieblichen Praxis: Trends, Chancen, Hürden*“, 06/2021. <https://arbeitgeber.de/newsroom/publikationen/>.

Burkhardt, J. C. (2002) “Boundary-spanning leadership in higher education”, *Journal of Leadership Studies*, Vol. 8, No. 3, pp. 145-150.

C

Caputo, A., Fiorentino, R. and Garzella, S. (2019) “From the boundaries of management to the management of boundaries: business processes, capabilities and negotiations”, *Business Process Management Journal*, Vol. 25, No. 3, pp. 391-413.

Carlile, P. (2002) “A Pragmatic View of Knowledge and Boundaries: Boundary Objects in New Product Development”, *Organizational Science*, Vol. 13, No. 4, pp. 442-445.

Carlile, P. (2004) “Transferring, Translating, and Transforming: An Integrative Framework for Managing Knowledge Across Boundaries”, *Organization Science*, Vol. 15, No. 5, pp. 555-568.

Casciaro, T, Edmondson A.C. and Jang, S. (2019) “Cross-Silo Leadership. How to create more value by connecting experts from inside and outside the organization”, *Harvard Business Review*, Vol. 97, No. 3, pp. 130-139.

Chandler, A. D. (1962) “Strategy and Structure”, in: Foss, N. (ed.) *Resources, Firms, and Strategies: A Reader in the Resource-based Perspective*, Cambridge, New York: Oxford University Press, 1997, pp. 40-51.

Charmaz, K. (2014) “Grounded Theory in Global Perspective: Reviews by International Researchers”, *Qualitative Inquiry*, Vol. 20, No. 9, pp. 1074-1084.

Colbert, A., Yee, N. and George, G. (2016), “The digital workforce and the workplace of the future”, *Academy of Management Journal*, Vol. 39, No. 3, pp. 731-739.

Collien, I. (2021) “Concepts of power in boundary spanning research: A review and research agenda”, *International Journal of Management Reviews*, Vol, 23, pp. 443-465.

Cooper, D. R. and Schindler, P. S. (2014) “*Business Research Methods*”, New York: McGraw-Hill/Irwin, 12th Edition, p. 479.

Corbin, J. and Strauss A. (1990) “Grounded Theory Research: Procedures, Canons, and Evaluative Criteria”, *Zeitschrift für Soziologie*, Vol. 19, No. 6, pp. 418-427.

Coxe, S., West, S. G. and Aiken, L. S. (2009) “The Analysis of Count Data: A gentle Introduction to Poisson Regression and Its Alternatives”, *Journal of Personality Assessment*, Vol. 91, No. 2, pp. 121-136.

Creswell, J. W. (2015) “*A Concise Introduction to Mixed Methods Research*”, Los Angeles: Sage Publications, pp. 74-88.

D

Davis, F. D. (1989) "Perceived Usefulness, Perceived Ease of Use, and User Acceptance of Information Technology", *MIS Quarterly*, Vol. 13, No. 3, pp. 319-340.

Destatis (ed.) (2022), „Studienanfängerinnen und -anfänger 2021 um 4 % niedriger als im Vorjahr“, Press Release No. 106, 14. März 2022, Wiesbaden: Statistisches Bundesamt. [https://www.destatis.de/DE/Presse/Pressemitteilungen/2022/03/PD22_106_213.html#:~:text=WIESBADEN%20%E2%80%93%20Im%20Studienjahr%202021%20\(Sommersemester,an%20einer%20deutschen%20Hochschule%20eingeschrieben.](https://www.destatis.de/DE/Presse/Pressemitteilungen/2022/03/PD22_106_213.html#:~:text=WIESBADEN%20%E2%80%93%20Im%20Studienjahr%202021%20(Sommersemester,an%20einer%20deutschen%20Hochschule%20eingeschrieben.)

Drucker, P. (1974) "New Templates for Today's Organizations", *Harvard Business Review*, Vol. 52, No. 1, pp. 45-52.

Dubois, A. and Gadde, L.-E. (2002) "Systematic combining: an abductive approach to case research", *Journal of Business Research*, Vol. 55, pp. 553-560.

Dudézert, A. (2018) "*La transformation digitale des entreprises*", Paris: La Découverte, pp. 85-109.

E

Edmondson, A. C. and Hugander, P. "4 Steps to Boost Psychological Safety at Your Workplace", *Harvard Business Review (Digital Articles)*, June 2021, pp. 1-6.

Eisenhardt, K. (1989) "Building Theories from Case Study Research", *The Academy of Management Review*, Vol. 14, No. 4, pp. 532-550.

Ernst, C. and Yip, J. (2009a) "Boundary Spanning Leadership: Tactics to Bridge Social Identity Groups in Organizations", in: (ed.) T. Pittinsky, *Crossing the divide: Intergroup leadership in a world of difference*. Boston, MA: Harvard Business School Press, pp. 1-18.

Ernst, C., Yip, J. and Campbell M. (2009b) "*Boundary Spanning Leadership: Mission Critical Perspectives from the Executive Suite*", Center for Creative Leadership, pp. 1-26.

F

Fani, T. and Ghaemi, F. (2011) "Implications of Vygotsky's zone of proximal development (ZPD) in teacher education: ZPTD and self-scaffolding", *Procedia-Social and Behavioral Sciences*, Vol 29, p. 1549-1554.

Flake, R., Werner D. and Zibrowius, M. (2016) “Karrierefaktor berufliche Fortbildung: Einkommensperspektiven von Fortbildungsabsolventen”, *IW-Trends – Vierteljahresschrift zur empirischen Wirtschaftsforschung*, Köln: Institut der deutschen Wirtschaft, Vol. 43, No.1.

Flores, L. G., Zheng, W., Rau, D. and Thomas, C. H. (2012) “Organizational Learning: Subprocess Identification, Construct Validation, and an Empirical Test of Cultural Antecedents”, *Journal of Management*, Vol 38, No. 2, pp. 640-667.

Fougère, M., Solitander, N. and Maheshwari, S. (2020) “Achieving Responsible Management Learning Through Enriched Reciprocal Learning: Service-Learning Projects and the Role of Boundary Spanners”, *Journal of Business Ethics*, pp. 795-812.

G

Gartner (ed.) (2020) “*Gartner HR Research Finds Employees Are Only Applying 54% of Newly Learned Skills*”, Stamford: Gartner Newsroom Press Releases, 19/8/2020, pp. 1-2.

Gehman, J., Glaser, V. L., Eisenhardt, K. M., Gioia, D., Langlely, A. and Corley, K.G. (2018) “Finding Theory–Method Fit: A Comparison of Three Qualitative Approaches to Theory Building”, *Journal of Management Inquiry*, Vol. 27, Nr. 3, pp. 284-300.

Geis-Thöne, W. (2021) “Mögliche Entwicklungen des Fachkräfteangebots bis zum Jahr 2040: Eine Betrachtung der zentralen Determinanten und Vorausberechnung“, *IW Report*, Köln: Institut der deutschen Wirtschaft, 4/2021.

Gibson, C. and Birkinshaw, J. (2004) “The Antecedents, Consequences, and Mediating Role of Organizational Ambidexterity”, *Academy of Management Journal*, Vol. 47, No. 2, pp. 209-226.

Gioia, D., Corley, K., and Hamilton, A. (2013) “Seeking Qualitative Rigor in Inductive Research: notes on the Gioia Methodology”, *Organizational Research Methods*, Vol. 16, No. 1, pp. 15-31.

Goldin and Katz (2010) “The race between technology and education”, in: *OECD Future of Education and Skills 2030: OECD Learning Compass 2030*, OECD, 2019, pp. 5-18.

Gong, C. and Ribiere, V. (2021) “Developing a unified definition of digital transformation”, *Technovation*, Vol. 102, pp. 102217 (1-17).

Graf, L. (2014) “Growing in a Niche: Dual Study Programs Contribute to Change in Germany’s Higher Education”, in: (eds.) Stoop, P., Kammerer, G., Roth, C., Schneider, K., *WZB Report 2014*, Berlin: WZB Berlin Social Science Center, pp. 33-36.

Barbara OFSTAD

Grant, R. M. (1996) "Towards a knowledge-based theory of the firm", *Strategic Management Journal*, Vol. 17, pp. 109-122.

Gutierrez-Huerter, Moon, Gold and Chapple (2019) "Micro-processes of translation in the transfer of practices from MNE headquarters", *Journal of International Business Studies*, Vol. 51, pp. 389-413.

H

Hair, J.F. Jr., Howard, M.C. and Nitzl, C. (2020) "Assessing measurement model quality in PLS-SEM using confirmatory composite analysis", *Journal of Business Research*, Vol. 109, pp. 101-110.

Hair, J. F. Jr., Matthews, L. M., Matthews, R. L. and Sarstedt, M. (2017) "PLS-SEM or CB-SEM: updated guidelines on which method to use", *International Journal of Multivariate Data Analysis*, Vol. 1, No. 2, pp. 107–123.

Hall, A. (2021) "Alles beim Alten? Bildungserträge höherer beruflicher und akademischer Abschlüsse vor und nach Bologna", *Kölner Zeitschrift für Soziologie und Sozialpsychologie*, Vol. 73, No. 4, pp. 527-553.

Hansjosten, H. (2000) "*Lohnt sich die betriebliche Ausbildung? Eine Studie am Beispiel der DaimlerChrysler AG*", München und Mering: Rainer Hampp Verlag, pp. 199-225.

Higgins, J. (2005) "The Eight 'S's of Successful Strategy Execution", *Journal of Change Management*, Vol. 5, No. 1, pp. 3-13.

Hollatz, J. and Ofstad, B. (2021) "Digitalisierung in der Berufsbildung: Zur Operationalisierung von Kenntnissen und Fähigkeiten", in: (ed.) Philip Ramin: *Handbuch Digitale Kompetenzentwicklung*, München: Hanser Verlag, pp. 353-367.

J

Jaeger, K. and Pedersen, A. (2020) "Understanding organizational boundaries", *Globe: A Journal of Language, Culture and Communication*, Vol. 9, pp. 1-14.

Joshi, A., Pandey N. and Han, G. (2009) "Bracketing team boundary spanning: an examination of task-based, team-level, and contextual antecedents", *Journal of Organizational Behavior*, Vol. 30, pp. 731-759.

K

Kane, A. and Levina, N. (2017) “‘Am I Still One of Them?’: Bicultural Immigrant Managers Navigating Social Identity Threats When Spanning Global Boundaries”, *Journal of Management Studies*, Vol. 54, No. 4, pp. 540-577.

Karoui, M., Dudézert, A. and Leidner, D. E. (2015) “Strategies and symbolism in the adoption of organizational social networking systems”, *The Journal of Strategic Information Systems*, Vol. 24, No. 1, pp. 15-32.

Kazim, F.A.B. (2019) “Digital Transformation and Leadership Style: A Multiple Case Study”, *ISM Journal*, Vol. 3, No. 1, pp. 24-33.

Klein, H.K. and Myers, M.D. (1999) “A Set of Principles for Conducting and Evaluating Interpretive Field Studies in Information Systems”, *MIS Quarterly*, Vol. 23, No. 1, pp. 67-93.

Kuh, G. (2019) “Why Skills Training Can’t Replace Higher Education”, *Harvard Business Review (Digital Articles)*, 10/9/2019, pp. 2-4.

Kusunoki, K., Nonaka I. and Nagata, A. (1998) “Organizational Capabilities in Product Development of Japanese Firms: A Conceptual Framework and Empirical Findings”, *Organizational Science*, Vol. 9, No. 6, pp. 699-718.

L

Legate, A. E., Hair J. F. Jr., Lambert Chretien, J. and Risher, J.J. (2021) “PLM-SEM: Prediction-oriented solutions for HRD researchers”, *Human Resource Development Quarterly*, pp. 1-19.

Leifer R. and Delbecq A. (1978) “Organizational/Environmental Interchange: A Model of Boundary Spanning Activity”, *Academy of Management Review*, January, pp. 40-50.

Lewin, K. (1947) “Group Decision and Social Change”, in: (eds.) Newcombe, E. and Harley, R. *Readings in Social Psychology*, New York: Henry Holt [as cited by Orlikowski and Hofman, 1997].

M

MacDonald, M. (2001) “Finding a critical perspective in grounded theory” in: Schreiber, R. and Stern, P. (eds.) *Using grounded theory in nursing*, New York: Springer, pp. 113-157.

Barbara OFSTAD

Mäkelä, K., Barner-Rasmussen, W., Ehrnrooth, M. and Koveshnikov, A. (2019) "Potential and recognized boundary spanners in multinational corporations", *Journal of World Business*, Vol. 54, No. 4, pp. 335-349.

Mehta, N., Chauhan S., Gupta, P. and Jaiswal M. (2021) "Pursuing Digital Learning Platform Success: A Meta-Analytic Investigation of User and Cultural Contingencies", *Communications of the Association for Information Systems*, Vol. 48, pp. 305-322.

Moehrle, M. (2020) "Corporate learning as an accelerator of digital transformation", *EFMD Global Focus*, Vol. 14, No. 2, 2020, pp. 48-51.

Morgan, G. (2011) "Reflections on Images of Organization and Its Implications for Organization and Environment", *Organization & Environment*, Vol. 24, No. 4, pp. 459-478.

Morgan, G. (1998) "*Images of Organization*", Thousand Oaks/London/New Delhi: Sage, pp. 35-109.

Moscarola, J. (2019) "Questionnaires and Online Questionnaires", in : (eds.) Chevalier, F., Cloutier, L. M., Mitev, N., *Research Methods for the DBA*, Business Science Institute Collection, Paris: Editions EMS, pp. 229-244.

N

Nahapiet, J. and Ghoshal, S. (1998) "Social Capital, Intellectual Capital, and the Organizational Advantage", *The Academy of Management Review*, Vol. 23, No. 2, pp. 242-266.

O

Ofstad, B. and Wolf, D. (2017) "Ausbildungsvorbereitung für Flüchtlinge", in: (eds.) Stähler G. and Audebert, F., *Vom Flüchtling zum Arbeitnehmer*, Stuttgart: Schäffer-Poeschel, pp. 45-52.

Oliveira, T. and Martins, M. (2011) "Literature Review of Information Technology Adoption Models at firm Level", *The Electronic Journal Information Systems Evaluation*, Vol 14, No. 1, pp. 110-121.

Orlikowski, W. J. and Hofman, J. (1997) "An Improvisational Model of Change Management: The Case of Groupware Technologies" In: (eds.) Malone, T., Laubacher, R., Scott Morton, M. S., *Inventing the Organizations of the 21 Century*, Cambridge, Mass.: MIT Press, 2003, pp. 265-282.

Barbara OFSTAD

Orton, D. J. and Weick, K. E. (1990) "Loosely Couped Systems: A Reconceptualization", *The Academy of Management Review*, Vol. 15, No. 2, pp. 203-223.

P

Parnack, C. and Pletter R.(2021) "Judith Wiese: Ich werfe meine Angel aus", in: (ed.) Jochen Wegner, *Die Zeit*, Hamburg: Zeitverlag Gerd Bucerius, 31.03.2021, p. 24.

Peach, D., Cates, C., Il, B., Jones, J. and Lechleiter, H. (2011) "Responding to rapid change in higher education: Enabling university departments responsible for work related programs through boundary spanning", *Journal of Cooperative Education and Internships*, Vol. 45, No. 1, pp. 94-106.

Peters, T. J. and Waterman, R. H., Jr. (1982) "*In Search of Excellence: Lessons from America's best-run companies.*" New York: Warner Books. [as cited by Orton and Weick (1990), p. 222.]

Popper, K. (2004) "*Alles Leben ist Problemlösen*", München: Piper, pp. 15-45.

Porter, M. E. (1979) "How competitive forces shape strategies", *Harvard Business Review*, Vol. 57, pp. 137-145.

PR Newswire US (01/21/2020) "Global IoT Market Report, history and Forecast 2013-2025", <https://reports.valuates.com/sreport/QYRE-Othe-3D175/global-iot-market>, assessed on May 8, 2021.

R

Ringle, C. M., Sarstedt, M., Mitchell, R. and Gudergan, S. P. (2020) "Partial least squares structural equation modeling in HRM research", *The International Journal of Human Resource Management*, Vol. 31, No. 12, pp. 1617-1643.

Roberts, M.J.D. and Beamish, P.W. (2017) "The Scaffolding Activities of International Returnee Executives: A Learning Based Perspective of Global Boundary Spanning", *Journal of Management Studies (Special Issue: Boundary Spanning in Global Organizations)*, Vol. 54, No. 4, pp. 511-539.

Romani, L., Barmeyer C., Primecz H. and Pilhofer, K. (2018) "Cross-cultural Management Studies: State of the Field in the Four Research Paradigms", *International Studies of Management & Organization*, Vol. 48, No. 3, pp. 247-263.

Rotter, C. (2021) "HR-Technologie-Innovationen: Welchen Stellenwert haben RPA und KI?", *B2B Insider*, pp. 1-6.

S

Saukkonen, J., Kreuz, P., Obermayer, N., Rodriguez Ruíz, O. and Haaranen, M. (2019) "AI, RPA, ML and other emerging technologies: anticipating adoption in the HRM field." In: (eds) P. Griffiths & M. N. Kabir, *Proceedings of the European Conference on the Impact of Artificial Intelligence and Robotics ECIAIR 2019*, Oct/Nov 2019, pp. 287-296.

Schein, E. (1990) "Organizational Culture", *American Psychologist*, Vol 45, No. 2, pp. 109-119.

Schuchmann, D. and Seufert S. (2015) "Corporate learning in times of digital transformation: a conceptual framework and service portfolio for the learning function in banking organisations", *International Journal of Corporate Learning*, Vol. 8, No. 1, pp. 31-39.

Schwarz Müller, T., Brosi, P., Duman, D. and Welpel, I. M. (2018) "How Does the Digital Transformation Affect Organizations? Key Themes of Change in Work Design and Leadership", *mrev management revue*, Vol. 29, No. 2, pp. 114-138.

Seufert, S. and Meier, C. (2016a) "From eLearning to Digital Transformation: A Framework and Implications for L&D", *International Journal of Advanced Corporate Learning*, Vol. 9, No. 2, pp. 27-33.

Seufert S., Schuchmann, D., Meier, C. and Fandel-Meyer, T. (2016b) "Steigerung der Lern- und Innovationsfähigkeit von Unternehmen und Organisationen", in (eds.): Hofmann, C.P. *et al.*, *Business innovation: Das St. Galler Modell*, pp. 283-311.

Snow, C. C., Fjelstad, Ø. D. and Langer A. M. (2017) "Designing the digital organization", *Journal of Organization Design*, Vol. 6, No. 1, pp. 1-13.

T

Tang, R., Qiu, X. and Zhang, M. (2018) "Spanning the Boundary of Organisations: A Systematic Review of the Inter-Organisational Boundary-Spanning Literature", in: Zhang, M. (ed.) *Trust Building and Boundary Spanning in Cross-Border Management*, New York: Taylor & Francis, pp. 181-217.

Tilson, D., Lyytinen, K. and Sørensen, C. (2010) "Research Commentary: Digital Infrastructures: The Missing IS Research Agenda", *Information Systems Research*, Vol. 21, No. 4, pp. 748-759.

V

Venables, N. and Ripley, B.D. (1997) “*Statistics Complements to Modern Applied Statistics with S-Plus*”, New York: Springer, 2nd Edition, pp. 65-66.

Venkatesh, V., Thong, J. and Xu, X. (2012) “Consumer Acceptance and Use of Information Technology: Extending the Unified Theory of Acceptance and Use of Technology”, *MIS Quarterly*, Vol. 36, No. 1, pp. 157-178.

Venkatesh, V., Davis, F. D. and Morris, M.G. (2007) “Dead or Alive? The Development, Trajectory And Future Of Technology Adoption Research”, *Journal of the Association for Information Systems*, Vol. 8, No.. 4, pp. 267-286.

Venkatesh, V. and Davis, F.D. (2000) “A Theoretical Extension of the Technology Acceptance Model: Four Longitudinal Field Studies”, *Management Science*, Vol. 46, No. 2, pp. 186-204.

Vogus, T. J. and Sutcliffe, K. M. (2007) “Organizational resilience: Towards a theory and research agenda”, *2007 IEEE International Conference on Systems, Man and Cybernetics*, pp. 3418-3422.

Vygotsky, L.S. (1978) “*Mind in Society: The Development of Higher Psychological Processes*”, (eds.) Cole, M., John-Steiner, V., Scribner, S., Souberman, E., Cambridge/London: Harvard University Press, p. 86. [as cited by Wass *et al.*, 2011.]

W

Walsh, I. (2017), *Discovering new theories*, Paris: Éditions EMS, pp. 19-62.

Wass, R., Harland, T. and Mercer, A. (2011) “Scaffolding critical thinking in the zone of proximal development”, *Higher Education Research & Development*, Vol. 30, No. 3, pp. 317-328.

Waterman, R. H. Jr., Peters, T. J. and Phillips, J. R. (1980), “Structure is not Organization”, *Business Horizons*, pp. 14-26.

Weick, K. E. (1976) “Educational organizations as loosely coupled systems”, *Administrative Science Quarterly*, Vol. 21, No. 1, pp. 1-19.

Weick, K. E. and Sutcliffe, K. M. (2015) “*Managing the unexpected*”, Hoboken, N.J.: Wiley.

Barbara OFSTAD

Welch, C., Piekkari, R., Plakoyiannaki, E. and Paavilainen-Mäntymäki, E. (2011) “Theorising from case studies: Towards a pluralist future for international business research”, *Journal of International Business Studies*, Vol. 42, pp. 740-762.

Widmann, A., Mulder, R. and König, C. (2019) “Team learning behaviours as predictors of innovative work behavior – a longitudinal study”, *Innovation: Organization & Management*, Vol. 21, No. 2, pp. 298-316.

Widmann, A., Messmann, G. and Mulder, R. (2016) “The Impact of Team Learning Behaviors on Team Innovative Work Behavior: A Systematic Review.”, *Human Resource Development Review*, Vol. 15, No. 4, pp. 429-458.

Wood, D., Bruner, J. S. and Ross, G. (1976) “The role of tutoring in problem solving”, *Journal of Child Psychology and Psychiatry*, Vol. 17, No. 2, pp. 89-100.

Y

Yagi, N. and Kleinberg, J. (2011) “Boundary work: An interpretive ethnographic perspective on negotiating and leveraging cross-cultural identity negotiating and leveraging cross-cultural identity”, *Journal of International Business Studies*, Vol. 42, pp. 629-653.

Z

Zhao, Z. J. and Anand, J. (2013) “Beyond Boundary Spanners: The “Collective Bridge” as an efficient interunit structure for transferring collective knowledge”, *Strategic Management Journal*, Vol. 34, No. 13, pp. 1513-1530.

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List of abbreviations

AI	Artificial Intelligence
ANOVA	Analysis of Variance
Bitkom	Bundesverband Informationswirtschaft, Telekommunikation und Neue Medien e.V. (Association of information economy, telecommunications and new media)
CCI	Chamber of Commerce and Industry
CHRO	Chief Human Resources Officer, typically member of the board
CHRM	Chief Human Resources Manager
COPED	Competency and project-based education (new VET philosophy)
DA	Dual Apprenticeship
DBA	Doctorate of Business Administration
DHBW	Duale Hochschule Baden-Württemberg
DSP	Dual Study Programs
DLP	Digital Learning Platforms
DT	Digital Transformation
EBT	Elektroniker für Betriebstechnik [In English: ~Electric Fitter]
EDBAC	Executive DBA Council
EMS	Engagement Management Scholarship
EURAM	European Academy of Management
EQR	Europäischer Qualifikationsrahmen, i.e., European Qualification Framework
HR	Human Resources
HRD	Human Resources Department
HRM	Human Resources Managers

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IM	International Management
IT	Information Technology
IoT	Internet of Things
K1-K21	Colleague 1 – 21 during the interviews
KMO	Kaiser-Meyer-Olkin measure of Sampling Adequacy
LCS	Loosely coupled systems
MNC	Multi-national corporation, syn. MNE
MNE	Multi-national enterprise, syn. MNC
OD	Organizational Development
OL	Organizational Learning
P1-P21	Interview partner 1 – Interview partner 21 (interviewees)
PCA	Principal Component Analysis
RPA	Robotic Process Automation
SNS	Social Networking Systems (e.g., Facebook, Yammer)
TAM	Technology Acceptance Model
TVET	Technical Vocational Education and Training
UTAUT	Unified Theory of Acceptance and Use of Technology
VDE	Verband der Elektrotechnik, Elektronik und Informationstechnik e.V. [In English: Association of German Electronic, Electrotechnical and IT Manufacturer]
VET	Vocational Education and Training
VUCA	Volatile, Unpredictable, Complex, Ambiguous

Detailed overview of thesis

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Appendix

Appendix 1 : Qualitative study

A1.1 Cause

6C Model	Relevant quote
CAUSE	
Need to secure competencies	<p>It is our goal to enable our VET trainers to be fit enough, such that we have at least two per local training center per topic. This way, they have a partner for sparring and exchange (P10) – extrinsic</p> <p>Even in their free time they do continuous education. This life-long learning for them is not just a flowery phrase, this is life for them (P3) – intrinsic</p>
Self-conception is changing	<p>Life of a VET trainer changes, in my opinion, respectively, has already changed substantially. Isolated („Island“) competency is something we do not need any longer. A VET trainer must be able to convey comprehensive knowhow, and even sometimes has to admit, if he is not the expert in one special area, exactly that. Maybe he teaches together with a colleague, maybe he searches for solutions or asks colleagues. Those may be experts in this domain, well, without saying that this lesson cannot be taught by me. That can serve as an example for the boys and girls how to come to a solution without trying to dodge the responsibility. (P6) – extrinsic</p> <p>I think VET trainers have acquired more self-confidence. They realize their task is not just to show up in the morning and to teach their learning units and to go home in the evenings. I think you will always have some of those but [...] there are VET trainers with a lot of potential. These want more, they want to be visible, they want to shape VET - and I think, without knowing whether this is the right term - their self-confidence and courage has increased to openly discuss issues and to make suggestions and to contribute.. (P7) – intrinsic</p>
Transformational Challenge	Digitalization, COVID-19, Speed, Balancing Act, Change – extrinsic, see below:
Digitalization	<p>In general, we started the digitalization roadmap a while ago, much more intensively, I might say, to integrate all these technological changes into VET. (P3)</p> <p>Hardware is one side of this whole topic, didactics, methods is the other side. And the latter is much more important regarding digitalization.(P3)</p>
COVID-19	<p>Well, I think psychologically, I mean, a lot has been superimposed by COVID. By doing so much online, I don't know how it is elsewhere, but I realize this. Well, there are many training center locations that do lots of VET trainings online. If you want to do this seriously, then you need a concept, you need to have a concept for the courses which have been done in the training centers before. You need a completely new deck of cards and you need to think how to do it. That requires lots of time. Psychologically, I think some of them wish a bit more appreciation for this. (P12)</p> <p>For example, we have at once initiated a digital schedule, when Corona happened. We, at once, took our VET trainers along, MS Teams trainings, Concept board trainings, we introduced very fast this “New Normal Great Teaching” with didactics/methodic [support]. We repeatedly do sessions where we show methods, try methods, or collect ideas via Concept board, such that everybody writes down what he does to motivate a group. What are good examples? Real Best Practice Sharing, well, exchange things, simple tricks: how to structure a virtual day for an apprentice? How to teach them that they write down into the chat if they are gone for a bio break, not just disappear virtually, but write down that they are gone and write down that they are back? A certain commitment even in virtual VET... I think we are extremely advanced in our thinking and how we conveyed that to our VET trainers. I truly think that we are on a good path and that Corona has helped us following it. (P16)</p>

6C Model	Relevant quote
Speed	<p>We are much faster, because before, as I said, one would have done such changes maybe in five years, six years, seven years. And if I consider how much investments we did in the last years, that has been in the last years about ten times as much as usual [due to digitalization]. And that has to be implemented and operationalized. (P3)</p> <p>To prepare ourselves for those ever-speedier topics, to always jump on new topics, and not to lose the VET trainers, really take them along, motivate them to dig into the topics but also provide help for them to succeed. (P16)</p>
Balancing Act	<p>In the dual vocational and educational training system, we are very strongly ruled by laws and regulations, which may not be appropriate for today's time and speed. Hence, it is a balancing act, there are things from the past which won't change swiftly. (P4)</p> <p>Well, the challenge for me is, in particular, that we are a very modern company, and we look very far out. Yet, we move in governmental corsets, and this is not meant in a negative way, because it gives us a certain safety. We should not forget this, these corsets, and laws and VET etc. From my point of view this is a huge balancing act sometimes, to train within this corset, including work time legislation, VET laws, and the curricular content must still be trained, even though I like the content. The content is not bad, I think. But modern VET we must do and also want to do, it is also a good thing. (P9)</p>
Change	<p>Today I consider us not to be a vocational education and training department, but a true (education and) training department. And now we can debate how to differentiate this, vocational or not, but we have a mission to educate both for initial vocational training (where we have a historic tradition) and for continuous education and training for our staff. This has changed, but I see our goal and this goal will always be in change because our staff changes, because our corporate goals change and because our products and changes undergo change. (P4)</p> <p>The tasks of the VET trainers change tremendously, also in our project, i.e., the trainer is not the conveyer of knowledge any longer, but he is also the coach and the learning progress companion. He does not teach things any longer which he knows by heart and which he is expert in and understands, but he must have a broader standing and accompany the learning process. This constitutes a challenge. (P4)</p>

A1.2 Context

6C Model	Relevant quote
CONTEXT	Summary: Barriers, Fear, Team spirit, Hierarchy, Diversity of Training Centers
Fear	<p>Employability. You start thinking „What do I do if this gets too much for me or if I do not like it any longer or it simply overwhelms me?“ Or if you cannot reach the young audience any longer. (P1)</p> <p>Then I realize: it would be better if the colleagues were in a network and could get information on their own. But they all think, at least this is my interpretation, they are all afraid to get new tasks. Afraid that if they start working in these networks they get tasks, because in principle there are tasks, of course. And these tasks get distributed among those who are present. In this case you are notably absent and do it yourself. (P13)</p>

	<p>Fear to try something new maybe and make mistakes. [...] Especially in these learning communities there are colleagues who are experts in their field and now I need to grow out of my comfort zone and don't want to make mistakes and still need to do my job. (P14)</p>
Barriers	<p>Nonetheless there are friction losses, nonetheless, I speak openly here, nothing against the regional managers, but they are a layer of clay. (P5)</p> <p>That was quite difficult. If you do bridge building, then you need to watch out that the actual manager doesn't tear down the bridge again. (P21)</p> <p>Of course, time is always a topic. (P3).</p>
Laws and regulations	<p>I consider this a huge challenge. I think technically and pandemic-related operationalization of how we do VET in a virtual manner – there we are really good, because we have the financial means and the flexibility to do this. However, I think not everybody sees it the same way. I believe they really want the corset because they feel good in it. (P9)</p> <p>To set up the whole issue of laws and regulations in this new normal work world such that we don't risk being non-compliant, i.e., the employees and the managers, because these are the laws. That does not fit with the new normal as we imagine it. (P8)</p>
Hierarchy	<p>I realize that we still work in a way where you were five years ago, what you describe as hierarchy-based often. (P5)</p> <p>At the beginning of the nineties, it was much more hierarchic, i.e., hierarchy issues were much stronger. (P3)</p> <p>If you do not have trust then you create such structures and eventually it counteracts quality. If you have such a culture of fear [...], such a culture of control, for instance, and such a watchdog mentality. (P7)</p>
Team Spirit	<p>And that is something what we like here. As stupid as this may sound, we can laugh about each other without being cross with each other and this creates this easiness which I mentioned, and this is important. [...] they act based on this original trust and say, no matter what happens, [...] I may make mistakes, and this is ok. And if someone thinks he knows better, then he is allowed to do so, if it is correct. And if it is not correct, then I am cool, and we discuss it. (P18)</p> <p>You are always as open to change as the people in your environment. (P13)</p> <p>And this is also a type of group constellation and of group size. [...] Then you also have the type who says: „I have been in VET for so long, you don't need to tell me that, I already know everything and have my fixed structures and have been doing this for 20 years and...“ This type exists, of course, and if you have a lot of these types in a group, that it gets difficult to envision something else and to say “What do you think about doing it this way?” (P14; reports to P13)</p>

A1.3 Concept

6C Model	Relevant quote
CONCEPT – Boundary Spanning	
Boundary spanning informal	<p>According to my perception, this last learning from each other, this very informal learning, this is a form of learning which has always been present in one way or another. But not in the manner that it constituted a separate way of learning. That was more on a cooperative, interhuman level. In other words: I go over to my colleague XY, and we talk about a topic and out of this situation I am learning, but not within a certain format. Hence, people had to get used to this. (P14)</p> <p>But it is difficult to measure, because before it was much more informal in the corridor and now it is more like „I set up a meeting and talk about it for half an hour or fifteen minutes. Hence... (P15)</p> <p>Mostly, it is informal, almost exclusively, I'd say, if we fix something in writing then we do little notes, there was no formalism, no obligation. A lot on Concept board. If colleagues work something out, they have Concept board, they have access to Concept board, such that we select things together, use things from each other. This way we can file a note on Sharepoint, we can file a hint that we have common spreadsheets. That is the way we do things, but mostly it is informal. Well, informal. In order to simply keep the dynamic character and instead of writing it into any minutes, I can type it five times into the editor. (P18)</p>
Boundary Spanning across training centers	<p>Not only the training center somewhere because – clearly, exchange of knowhow has always worked somewhere – what I really mean is to consider VET a community and really do exchange beyond the single training center, and tell the colleagues „Hey, I do it differently.” According to my perception, we have further chances there. (P6)</p> <p>I have many more colleagues who really proactively want to participate, actually, ask to do it, by the way, who want to contribute to product development. Of course, they multiply much more directly, this multiplication [of know-how] happens much more directly and becomes benchmark. I.e., things get suggested for us to participate in the region, and beyond, throughout Germany. And it is a much stronger give and take and I think, this is the way to go, that we communicate much more directly than in the past when there were two hierarchical layers in-between, and the only way this works, candidly, is via central [headquarters] support and we are grateful for it. (P3)</p>
Boundary Spanning within training centers	<p>We talk a lot about it, we are in a dialogue, that I strive to keep up continuously. With regards to learning it is the path I took: I started with little nuggets, really, did not paint the whole picture because that might have been depressing, but rather tried a bit to visualize the dialogue together. What are the next little steps? And then aim at small success stories, say, this is a tool I have learned to master, and it works. In the next step, I will deep-dive into 3D printing, and then I share this. We had such nuggets. One of the team members is really fit in terms of robotics. And then we said „OK, this one does a two-hour training in the afternoon”, while the apprentices were tied up with some safety training. This time we use, even the team assistant participated, such that really everybody knew what this was about. And everyone participated. Then there</p>

	<p>was another part where we said: „Ok, and now we do 3D printing.” And not just this „I got it“, but rather this successful feeling of “I could teach this.”. That was the value-add. (P15)</p> <p>If know-how exists in our training center... there I can present an example. Take, for instance, the two trainers K21 and K22. Both have a similar situation; they train 2nd and 3rd year electrician’s apprentices. One of them has been a VET trainer for many years, knows the equipment and has been abroad in foreign countries. The other one is relatively young and not very seasoned. One has an engineering diploma, the other one has done an apprenticeship and there are really a few things they can learn from each other. [...] Well, and there it is visible again that especially the younger ones strive to do things themselves. And often I get asked whether I could help, and that is something we do often within the team. That works well. Our working student is another example. That is a good group. Even without me having to micro-manage, they are well integrated and that works out. Even though it does not always work out how I imagine it. (P13)</p>
<p>Boundary Spanning between training centers and headquarters</p>	<p>My task is rather, if I realize there is an expert team somewhere, to raise my hand and ask: „Think about me as well, I do the general train-the-trainer rollout from a headquarters perspective.” I am the last man standing [i.e., I represent the last step of the PLM process.]. (P16)</p> <p>In all fairness, not everybody is that way. There are some who do that in the region, no question about that. In other training centers, there are others, but working in superordinated tasks or with project experience in PLM or central projects, in which they cooperate. They are in special positions, firstly, because they know each other, and [secondly] because they realize via the position “for this topic I am the expert, or I have been the expert and that means I need to contribute with my know-how”. That is a process. That is nothing which they do from one day to another. If they realize, ok, I do have the know-how and others consult me for this, then I see this expectation of others and I serve. Typical example: a colleague who was in the German norming committee for electricity, he was the mother of all norms in Germany. For every question in this domain. He knew it and he proactively asked others if they had problems and if they needed support and he acted upon that. I.e., with this level of expertise, you have to decide whether you are a multiplier or not. (P3)</p>
<p>Boundary spanning towards businesses</p>	<p>We have always had in the region.... There is one event called „5-7“, where promoters introduce actualities. [...] The VET team is typically invited, and we watch what technologies are introduced by the businesses, what do they try to market? Right now, there is a beautiful example regarding the current taster-system, not with a switch and a cable, but with a bus-system behind it. We then called the person who resented and asked him about his beautiful feature. We asked him to come by and show it and consult us in VET and he really liked to show up in his old training center. And then we compare notes and look at the equipment and see which two or three parts are good to integrate into VET operations. That is initiated by the sales subsidiaries, but we get a lot out of these events. Sometimes, they have other bachelor and master students independent of dual VET operations. (P20)</p> <p>But we also know that if they have a technical master student in the sales subsidiary, and they realize that we in the VET department have technology that might help him, then they ask us ,</p>

	<p>can we use it, can you help hardwire something, whatever cannot be done in their department. If yes, they come with their student and we get to talk “What do you do there?” and “Watch out for this” and then we can derive lots of topics and say “OK, that makes sense for us to use as well”. The last presenter had built some frequency converter for his area. (P20)</p> <p>And we said „Look at our equipment, please, you fabricate engines, what is here to improve?“ Our equipment and our engines were relatively old. Then he showed us the news about engines. This is a real give and take, what is new across departments, but what is most important is the contact which we need to fundamentally maintain, and I think, when there are already contacts at eye level established, then it is good to simply keep this up. (P20)</p> <p>What has happened now, he simply approached colleagues from his former department [in the factory], who have other responsibilities in construction, and he asked them to give him a crash course. But he did not approach his colleagues in VET. You need to consider that. Because, despite all online meetings, there is a higher barrier when it comes to approaching colleagues. I would not have ill feelings asking colleagues, or calling them, even though they are in another organizational unit, if I know there is an expert for a specific domain. So much for learning formats. (P13)</p> <p>In my point of view, you get visibility, yes, but rather by the regional partners, due to the fact that we have a very regional/local set-up, [...] not so much by the higher ranks. (P6)</p>
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A1.4 Contingency

6C Model	Relevant quote
CONTINGENCY	
Foster opportunities	<p>We have the transfer of knowledge of managers as a fixed appointment in the regional meeting. That is where you exchange, of course the experts also exchange [information] and managers as well, via MS Teams, via projects. (P18)</p> <p>Consciously leaving your own training center and the limitations of your own training center. [...] I personally think it is good to leave your habitual context in order to engage with new things, not only on a cognitive level, but also on a physical level. And that really works. If they, let’s say, really work together within a workshop, and work out solutions... (P10)</p>
Look for boundary spanning qualities in recruiting	<p>In my opinion, social competencies are the decisive factor for someone to bring in, rather than, comparing this to the past maybe we said getting technical expertise across was vital. (P6)</p> <p>These days, one has to value communication skills, this ability to talk to network and the ability to combine this, to lead and network... this is maybe more important than the last technical aspect. (P3)</p>
Value and incentivize	<p>We really took notes and documented every best practice (no matter how weird I might have personally judged those practices), simply because we wanted to express appreciation. (P21)</p>

boundary spanning by trainers	There is always a big thanks by the managers for this job, but also by the employees who say „Thanks for initializing this. We may not have had the foresight, or we did not have the opportunity here to look into this.“ (P21)
Nominate VET trainers as formal boundary spanners	<p>Let me express it this way: I could not say about any manager in region [name], I could not say „Well, stay in your training center, stay calm...“ I haven’t met such attitude. There is really the motivation to say „well, look, where do I get this information from? Contribute, please!“ And this represents a value-add for all, eventually. (P18)</p> <p>...I told him, for instance, as mentor or coach or whatever...I told him to watch out for K12, he should be his contact person. „Just watch out [...] that you stand by his side, not as a father, but as a contact person.“ (P12)</p> <p>And sometimes the manager has to maybe command this. (P2)</p>

A1.5 Conditions

6C Model	Relevant quote
CONDITION	
Leadership	<p>Fundamentally, I can state that managers today are striving much more to act at eye level with their staff. (P7)</p> <p>Every now and then I trigger individuals. The majority [of staff] moves and cares by itself. Hence, one needs to push individuals a bit.. (P11)</p> <p>Empathy means for me not laissez-faire, not at all, but the capability to understand colleagues in certain points and then, to spar with them in order to move them into another direction. (P6)</p> <p>Culture has definitely changed. It became more open, what, I think, is appreciated by everyone. And this open culture, that is, I think, the same for all. That is fun. That raises or keeps up motivation. [...] I think managers should live this topic [as a role model] and ask for it. (P8)</p>
Values	<p>And yes, it is like this, one is open among colleagues, doesn’t make a difference and... we are all equals, no matter how old, how tall, how... you know. Just does not matter. (P18)</p> <p>I think the trainer who says I ultimately stand in front of my group, and I do this in a formal classroom setting and I wait until headquarters gives me a VET curriculum how to convey my topics in a project setting or in a MS Teams setting... because I do not have ideas how to do online VET training... I think this type of person, who, as matter of fact, acts like a first-year apprentice (I am a bit catty now), that this type of person will not have a home in VET, because we have this quest for quality for our businesses. Sounds brutal, but I am convinced of that. (P6)</p>
Mindset	And perhaps really this job shadowing, such stories emphasize and enforce opportunities. And if I say „enforce“ I don’t mean it in the sense of „you must“, but in the sense of a proposition,

	<p>an opportunity to create free space. I believe, if you want to have a change of culture in the long run, then you can't have enforced goals and constraints, you need to get into the heads of your people and therefore you will – in the sense of constant dripping wearing away the stone - again and again deal with this. Especially for the older colleagues who, I'd say, are a bit more set in their ways, change of culture is nothing which catches on. (P11)</p> <p>But this new, open thinking, to say we discuss this, we allow for solutions out of the ordinary, that may fail, but we take aspects which may bring about a solution, we question those critically [...] both sides may benefit from this. And to get back to the question of how we learn, there is the third type who likes everything and who likes to jump around flexibly. This is what I discovered for myself. (P18)</p> <p>No, no, it is not like this, I have to express my praise here. I have never experienced in VET that anyone would block. To the opposite: in VET, you always motivate. Here is a group. Here is the opportunity. Either in small, simple courses or in job shadowing, in a bigger setting, if you say, one really wants to attain another level of education, a continuous education type of qualification, which allows someone to continue to be employable in the everyday work environment. I must say, this is different in this VET department compared to other departments where I worked. (P19)</p>
Flexibility	<p>Flexible career paths. Diversity. (P10)</p> <p>It is our advantage to be a small training center. You can implement something like this easier. (P15)</p> <p>I just did not want to say „small“. “We rely on each other, i.e., we have a high dependency on each other. [...] We don't actually have a „No, I don't do this for you“, but we stand in for each other. This is very cooperative, almost familiar, so to say, to say, ok, we do this, and we manage this.. (P18)</p>
Trust	<p>This basic trust in colleagues, they realize that this is particularly good and that backs them if they go to other regions and sites, in cross-regional teams so-to-speak. (P18)</p> <p>A real aspect for me, according to my perception, was to win trust. And winning trust via action and not via talking. (P10)</p>

A1.6 Consequences

6C Model	Relevant quote
CONSEQUENCE -	
Scaffolding	Pragmatically put, job shadowing is the easiest and cheapest means to close knowledge gaps. If it is really the cheapest means should be checked, but in any case it is the easiest means. The trainer is planned to shadow, and you have the least stomach aches and you do not need to

	<p>organize a rental car and what else is needed [for an external course]. Well, pragmatically put, this is the paramount reason why one does it. (P17)</p> <p>I must build coalitions, I must accept to a much further extent that I do not know everything, Instead, I must [...] find someone suitable, even though that might appear more expensive at first sight. I must consider this for the sake of the company. And the company benefits because this network thinking, this systemic thinking provides a value-add. (P3)</p>
<p>More freedom and variety in learning</p>	<p>From a customer perspective, I think we are on the right path. Sometimes we are too successful because we challenge our own training centers too much, as portfolio elements [demanded by internal customers] are asking for more diversity. (P15)</p> <p>In the beginning, they were a bit irritated. I think we got on their nerves, because VET, you know, VET in the business is not a top priority. Yet, I have the experience that going on someone's nerves may help. Although you must not drive it too far. And they accepted it. What I really like about this is that not only the business but also worker's council identify with their VET department. That can only be realized if local VET trainers are given freedom and trust to take networking into their own hands. To build it up and nurture it. (P7)</p>
<p>Culture and Mindset Change</p>	<p>And what really is undergoing change now, is this whole topic of learning communities, sometimes also smaller nuggets, shorter sessions, simple opportunities for exchange. In fact, I perceive this as a clash of generation, it really depends on your normal workday, how well you can integrate this into your VET operations, your everyday work. If you are something who does a lot of classroom teaching, can you build it into your sessions or not? Acceptance differs, I think, it still has to become mainstream. This is a change we are currently stuck in. (P14)</p> <p>In our training center location [the old manager] has retired, and he was really fully complying with what came from headquarters. And now they have someone sitting there who says, „Well, let us do trainings together, let us continue it here and now.“ (P15)</p> <p>Culture has definitely changed. It became more open, what, I think, is appreciated by everyone. And this open culture, that is, I think, the same for all. That is fun. That raises or keeps up motivation. (P8)</p>
<p>Value-add for the company</p>	<p>And these are things where I simply say that will give us a value-add in the long term from a business perspective. [...] Therefore, boundary spanning is not only a topic across regions within VET, but this is a topic – and here I would like to mention the term “co-creation” of internal customer [in the business] and VET – where VET operations and our learners can be enabled such that cross-organizational thinking becomes second nature. (P10)</p> <p><i>Speed:</i> In the past we would have done it in a way that we would have set up a product team and then we would have created ideas how to get these VET things done ourselves. Of course, we would have looked left and right, who could be our partners, professional didactic suppliers, but it does not work this way [any longer]. You need to look faster: how is the topic positioned in our business? Where can I get content from fast? Which options do I have to assess content where everyone agrees that this would be relevant for all learners, vs. content which must be customized for technicians or commercial clerks? And that is something where you would</p>

involve the business, or the technology teams, because they have the contacts into the business, to play this network completely. On the other side you need to watch out what others have done already, because you never start at zero. We follow the business. Hence, what exists in the business, what exists outside the business, in order not to start at zero? Well. (P5)

Employability: And that is, I believe, exactly this culture change that we need. Because a young person who starts with his first job and who thinks his responsibility starts in the mornings at 8 a.m. and does certainly not go beyond 8 hours and waits for this time being over, that young person will have a general problem. This is exactly the issue here. Along these lines, the question of „how do I go about work?“ must be asked. This is about solution orientation and continuous new acquisition of competencies. This is the mindset which we need to convey to young learners. (P6)

Sustained VET operations: We can only win if we are perceived as customized qualifier (in German: „passgenauer Qualifizierer“]. There is a social context somewhere, as it has made dual VET made in Germany successful, because of this customized qualification towards the businesses' needs. This helped reduce youth unemployment. (P6)

We really want to stand there well and secure the future of our employees. (P17)

The biggest challenge? To convey the future technology topics. (P16)

How do we maintain such quality teaching in the future? (P13)

Technology/Innovation: Hence, more motivation of employees would be such an output and faster implementation of new technologies, because they are able to teach themselves the topics, thanks to their basic skills and knowledge. (P8)

Well, and now I would like to come back to what you said before: comprehensive job shadowing, VET trainers, deployment across training centers. We have entered the digital age. If we want to be innovative I think, if I do a training in F., project management, electrotechnical basics, lean management? I could do this for Germany, not just for the group in F. (P19)

Appendix 2: Quantitative Survey

Learning from each other in VET

Dear colleagues,

One of our most important topics in the new fiscal year will be our continuous education, i.e. our personal and collective learning in [our VET department]. In this context, learning from each other, learning across training center sites and boundary spanning with other units and partners will be of particular interest. This is how we can better understand and share all the new topics around digitalization and technology.

This explains why we do this survey: We want get insights into how you learn. At the same time, some of the results will be analyzed and re-used in a scientific context.

We thank you for your participation. All data will be handled anonymously. Participation is voluntary.

Please note that this survey will not be used to assess employee performance. Therefore, your answers should not include names or descriptions that could be used to identify individuals.

* Erforderlich

1. What is your main role/task in the VET department? *

- Trainer
- Mentor (includes coach, students' trainer, teacher)
- Central/headquarters function in VET department
- Manager
- Miscellaneous

2. Which age group do you belong to? *

- < 30 years
- 30-39 years
- 40-49 years
- 50-59 years
- > 59 years

3. How big is the training center where you currently work? *

- small (<5 people)
- medium (5-15 people)
- big (> 15 people)

4. How many training centers have you worked at as part of regular staff (including the current one)? *

- Only this training center
- Two in total
- Three or more in total

5. During the last fiscal year, we have tried out many new learning methods re: digitalization topics, virtual learning and new VET philosophy Which formats do you prefer?
(1= not at all, 5 = like very much) *

	1	2	3	4	5	don't know
Trainer-led courses in presence	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Virtual trainer-led courses	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Blended Learning	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Self-paced Learning	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
On-the-Job Learning	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Community-based Learning (team-based learning)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

6. In the VET department, we have established different formats to learn with/via colleagues. Which formats do you consider useful? (1= not at all, 5 = very helpful) *

	1	2	3	4	5	don't know
Train-the-Trainer Sessions in Learning Communities (e.g., Digitale Fertigung, Low Coding)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Train-the-Trainer Sessions bi-monthly with recurring virtual meeting (e.g., methodics/didactics topics)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
multi-regional virtual Trainings e.g., process topics (Recruiting, copyrights...)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Learning within the team of colleagues (exchange, best practice sharing)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Tandem Teaching	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Hospitations	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Miscellaneous	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

7. Which other learning formats do you consider useful? Bullet point answers suffice.

8. When you think of situations where you learnt anything from colleagues: which of their abilities/competencies contributed to your learning? (1= not important, 5 = very important) *

	1	2	3	4	5	don't know
Specifics Knowhow and expertise	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Ability to communicate	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Methodic/didactic abilities	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Social competency	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Self-reflection ability	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Interest in boundary spanning across training center locations	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Other	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

9. If you chose "Other" in the previous question: which other abilities/competencies were relevant?

10. Did you ever carry out a training for colleagues from other training centers? *

yes

no

11. In which format have you done trainings for colleagues?
(1 = not at all, 5 = very often)

	1	2	3	4	5	don't know
Trainer-led courses in presence	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Virtual trainer-led courses	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Blended Learning	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
On-the-job learning	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Hospitations	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Other	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

12. If you chose "Other" in the previous question: which other teaching formats did you carry out for colleagues?

13. What were the reasons that motivated you to carry out a training for colleagues?

	1	2	3	4	5	don't know
Willingness to create, expand and share knowledge	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Sense of responsibility for our department	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Passion for the topic/for the cause	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Recognition and cudos	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
It's part of my job.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
My boss asked me to do it.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Other	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

14. If you chose "Other" in the previous question: Which other reasons motivated you to offer a training for colleagues?

15. Why haven't you offered a training for colleagues yet?
(1 = completely disagree, 5 = completely agree)

	1	2	3	4	5	don't know
Hasn't happened yet, but I could very well imagine myself doing this	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
I don't feel comfortable/little experience	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
I do not consider this part of my job.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
I have not time.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

16. What would you imagine that would help you carry out a training for colleagues in the future?

17. Why in your opinion are colleagues motivated to carry out a training for you?
(1 = no motivation, 5 = very strong motivation)

	1	2	3	4	5	weiß nicht
Willingness to create, expand and share knowledge	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Sense of responsibility for our department	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Passion for the topic/for the cause	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Recognition	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
It is part of his/her job.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
He/she was asked to do it by his/her boss.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Other	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

18. In case you chose "Other" in the previous question: would you like to elaborate on it?

19. Which (conceptional-methodological) aspects do you consider relevant for a good training by a colleague ?
(1= not at all 5 =very relevant) *

	1	2	3	4	5	don't know
use cases / practical cases	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
good methods/methodology	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
good preparation	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
experimental teaching	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Flexibility and improvisation skills	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Interdisziplinäre / boundary spanning approach	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Importance of topic for me	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

20. Which (relational/social) aspects do you consider relevant for a good training by a colleague ?
(1= not at all 5 =very relevant) *

	1	2	3	4	5	weiß nicht
Empathy of trainer	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Trainer is a role model in learning	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Boundary spanning across hierarchies	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Mutual trust	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Mutual exchange (aka give and take)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Learning feels like a "safe" environment	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

21. Are there other important aspects for learning across training centers?

22. VET includes networking. We are interested in your assessment of this topic. Please evaluate the following statements (1 = don't agree, 5 = completely agree): *

	1	2	3	4	5	don't know
In my opinion we should do more boundary spanning across training centers and regions.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
In my opinion we should do more boundary spanning towards customers.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
in my opinion we should do more external boundary spanning.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
My management acts as a role model regarding boundary spanning across training centers.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

23. To what extent do you perceive any culture change in the last years in our VET department?

(1 = not at all, 5 = strong change) *

	1	2	3	4	5	weiß nicht
New Normal / virtual cooperation	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
New Normal / digital learning / hybrid VET training formats	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
New VET philosophy	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Leadership behavior/style	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Trust within the team	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

24. If you perceived culture change: what is your opinion about this change?

(1 = very critical, 5 = very positive)

	1	2	3	4	5	weiß nicht
New Normal / virtual collaboration	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
New Normal / digital learning / hybrid VET training formats	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
New VET philosophy	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Leadership behavior/style	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Trust within the team	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

25. Have you noticed other aspects of this culture change, and what is your perception of these aspects?

26. We introduced our new VET philosophy this year. Please indicate how much you agree with the following statements:

(1 = Don't agree, 5 = Completely agree)

	1	2	3	4	5	weiß nicht
Our new VET philosophy enables us to better support and develop our learners' competencies.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
I feel well informed about our new VET philosophy.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
I look forward to implementing our new VET philosophy.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
I feel well supported by my manager regarding our new VET philosophy.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

27. What is your assessment about our VET department's sustainability/preparedness for future demands?

0	1	2	3	4	5	6	7	8	9	10
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not at all prepared for the future

100% prepared for the future

28. Please explain your assessment.

Operational Memo Quantitative Research

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1. Status of Primary Research Project

This memo is written after conducting the quantitative primary research, i.e., the online survey in MS Forms. The latter was published via email by the departmental coordinator of internal surveys. The survey ran from November 15 to December 3, 2021. A copy of the English translation of the survey can be found in Annex of the thesis.

2. Selection of Data

This group of interviews was conducted with 286 participants of a German MNE vocational education and training department, 190 of which were trainers of apprentices or dual students (comparable to the British degree apprenticeships or the French l'apprentissage dans l'éducation supérieure).

61% (175 participants) answered to the survey in total, thereof 104 trainers.

In order not to divulge explicitly the topic of the study, i.e., boundary spanning, the questions were combined with general questions about new forms of learning (e.g., learning format preferences, opinions about how the new philosophy is being implemented). Consequently, not all questions are relevant for this DBA analysis, the research question of which centers around how and why boundary spanning occurs in VET in the context of digital transformation.

3. Data analysis

Data were downloaded from MS Forms as a MS Excel file and imported in SPSS V28.0.0.0.

For the different aspects of interest (learning preferences, motivations, abilities/conditions, and activities as well as how to define boundary spanning) a separate analysis was done as to their descriptive statistics, correlation, principal component analysis, and, in a later step, regression.

4. Results

4.1 Learning formats

Descriptive statistics of the learning format section derived from questions 5 and 6 of the survey resulted in the following overview:

	Descriptive Statistics									
	N Statistic	Minimum Statistic	Maximum Statistic	Mean Statistic	Std. Deviation Statistic	Skewness		Kurtosis		
						Statistic	Std. Error	Statistic	Std. Error	
Which learning formats do you prefer? trainer-led courses in presence	165	1	5	4,20	1,077	-1,473	,189	1,589	,376	
Which learning formats do you prefer? virtual trainer-led courses	167	1	5	3,47	1,129	-,464	,188	-,426	,374	
Which learning formats do you prefer? blended learning	144	1	5	3,45	1,023	-,284	,202	-,217	,401	
Which learning formats do you prefer? self-paced learning	170	1	5	3,38	1,191	-,170	,186	-,909	,370	
Which learning formats do you prefer? learning-on-the-job	168	1	5	3,87	1,068	-,883	,187	,224	,373	
Which learning formats do you prefer? community-based learning (team-based)	165	1	5	3,59	1,104	-,638	,189	-,223	,376	
Which learning formats do you consider useful? TTT/learning communities technologies	134	1	5	3,50	1,116	-,495	,209	-,253	,416	
Which learning formats do you consider useful? TTT/methodics-didactics/NewNormalGreatTeaching	155	1	5	3,45	1,202	-,385	,195	-,680	,387	
Which learning formats do you consider useful? TTT/cross-regional process	169	1	5	3,56	1,164	-,538	,187	-,479	,371	
Which learning formats do you consider useful? learning within the teams	170	1	5	4,29	,833	-1,406	,186	2,465	,370	
Which learning formats do you consider useful? tandem Teaching	89	1	5	3,56	1,167	-,438	,255	-,598	,506	
Which learning formats do you consider useful? hospitation	138	1	5	3,88	1,190	-,932	,206	,069	,410	
Valid N (listwise)	64									

Both kurtosis and skewness remain in the limits of what is applicable for a future principal component analysis (PCA).

In a next step, the data were checked for possible correlation.

Correlations

		Which learning formats do you prefer? trainer-led courses in presence	Which learning formats do you prefer? virtual trainer-led courses	Which learning formats do you prefer? blended learning	Which learning formats do you prefer? self-paced learning	Which learning formats do you prefer? learning-on-the-job	Which learning formats do you prefer? community-based learning (team-based)	Which learning formats do you consider useful? TTT/learning communities technologies	Which learning formats do you consider useful? TTT/methodics/New Normal/Great Teaching	Which learning formats do you consider useful? TTT/cross-regional process	Which learning formats do you consider useful? learning within the teams	Which learning formats do you consider useful? tandem Teaching	Which learning formats do you consider useful? hospitalation
Which learning formats do you prefer? trainer-led courses in presence	Pearson Correlation	1	.015	.029	-.082	.012	.134	.106	.002	-.117	.153	.022	.277**
	Sig. (2-tailed)		.853	.733	.294	.882	.092	.232	.982	.141	.053	.839	.001
	N	165	162	139	164	162	158	130	150	161	161	87	135
Which learning formats do you prefer? virtual trainer-led courses	Pearson Correlation	.015	1	-.408**	.166*	-.129	.262**	.481**	.491**	.445**	.214**	.131	.150
	Sig. (2-tailed)	.853		<.001	.033	.099	<.001	<.001	<.001	<.001	.006	.231	.083
	N	162	167	142	166	164	162	130	149	163	164	86	134
Which learning formats do you prefer? blended learning	Pearson Correlation	.029	-.408**	1	-.396**	.225**	.239**	.309**	.346**	.273**	.124	.178	.252**
	Sig. (2-tailed)	.733	<.001		<.001	.007	.004	<.001	<.001	<.001	.141	.120	.006
	N	139	142	144	144	143	141	111	131	142	142	78	118
Which learning formats do you prefer? self-paced learning	Pearson Correlation	-.082	.166*	.396**	1	.239**	.011	.263**	.179*	.253**	.137	.010	.106
	Sig. (2-tailed)	.294	.033	<.001		.002	.886	.002	.027	<.001	.079	.925	.220
	N	164	166	144	170	168	164	132	152	166	166	87	136
Which learning formats do you prefer? learning-on-the-job	Pearson Correlation	.012	.129	.225**	.239**	1	.382**	.362**	.326**	.250**	.395**	.366**	.238**
	Sig. (2-tailed)	.882	.099	.007	.002		<.001	<.001	<.001	.001	<.001	<.001	.006
	N	162	164	143	168	168	162	131	150	164	164	86	134
Which learning formats do you prefer? community-based learning (team-based)	Pearson Correlation	.134	.262**	.239**	.011	.382**	1	.351**	.490**	.315**	.512**	.463**	.289**
	Sig. (2-tailed)	.092	<.001	.004	.886	<.001		<.001	<.001	<.001	<.001	<.001	<.001
	N	158	162	141	164	162	165	128	147	161	162	86	133
Which learning formats do you consider useful? TTT/learning communities technologies	Pearson Correlation	.106	.481**	.309**	.263**	.362**	.351**	1	.717**	.594**	.392**	.178	.253**
	Sig. (2-tailed)	.232	<.001	<.001	.002	<.001	<.001		<.001	<.001	<.001	.114	.006
	N	130	130	111	132	131	128	134	131	132	131	80	118
Which learning formats do you consider useful? TTT/methodics/New Normal/Great Teaching	Pearson Correlation	.002	.491**	.346**	.179*	.326**	.490**	.717**	1	.615**	.421**	.413**	.223**
	Sig. (2-tailed)	.982	<.001	<.001	.027	<.001	<.001	<.001		<.001	<.001	<.001	.012
	N	150	149	131	152	150	147	131	155	153	152	83	127
Which learning formats do you consider useful? TTT/cross-regional process	Pearson Correlation	-.117	.445**	.273**	.253**	.250**	.315**	.594**	.615**	1	.338**	.337**	.180**
	Sig. (2-tailed)	.141	<.001	<.001	<.001	.001	<.001	<.001	<.001		<.001	<.001	.038
	N	161	163	142	166	164	161	132	153	169	166	88	134
Which learning formats do you consider useful? learning within the teams	Pearson Correlation	.153	.214**	.124	.137	.395**	.512**	.392**	.421**	.338**	1	.534**	.395**
	Sig. (2-tailed)	.053	.006	.141	.079	<.001	<.001	<.001	<.001	<.001		<.001	<.001
	N	161	164	142	166	164	162	131	152	166	170	88	135
Which learning formats do you consider useful? tandem Teaching	Pearson Correlation	.022	.131	.178	.010	.366**	.463**	.178	.413**	.337**	.534**	1	.621**
	Sig. (2-tailed)	.839	.231	.120	.925	<.001	<.001	.114	<.001	.001	<.001		<.001
	N	87	86	78	87	86	86	80	83	88	88	88	89
Which learning formats do you consider useful? hospitalation	Pearson Correlation	.277**	.150	.252**	.106	.238**	.289**	.253**	.223**	.180**	.395**	.621**	1
	Sig. (2-tailed)	.001	.083	.006	.220	.006	<.001	.006	.012	.038	<.001	<.001	
	N	135	134	118	136	134	133	118	127	134	135	85	138

** Correlation is significant at the 0.01 level (2-tailed).
* Correlation is significant at the 0.05 level (2-tailed).

As there are considerable correlations, a principal component analysis was carried out to reduce the number of succinct components. KMO test proved significant, with four components identified which summarize the learning preference dimensions.

KMO and Bartlett's Test

Kaiser-Meyer-Olkin Measure of Sampling Adequacy.		.751
Bartlett's Test of Sphericity	Approx. Chi-Square	304,807
	df	66
	Sig.	<.001

At the same time, all variables proved to be relevant contributors to the components, explaining a total variance of 70% (rotation sum of squared loadings).

The four components that are part of learning preference were

1. VIRTUAL LEARNING formats in times of digital transformation
2. SOCIAL LEARNING with peers
3. SELF-LED LEARNING which may be blended (hybrid, i.e., with presence and virtual elements)
4. Classical CLASSROOM TEACHING in presence

and saved as latent (aka compound) variables.

Communalities

	Initial	Extraction
Which learning formats do you prefer? trainer-led courses in presence	1,000	,857
Which learning formats do you prefer? virtual trainer-led courses	1,000	,709
Which learning formats do you prefer? blended learning	1,000	,687
Which learning formats do you prefer? self-paced learning	1,000	,689
Which learning formats do you prefer? learning-on-the-job	1,000	,521
Which learning formats do you prefer? community-based learning (team-based)	1,000	,565
Which learning formats do you consider useful? TTT/learning communities technologies	1,000	,715
Which learning formats do you consider useful? TTT/methodics-didactics/NewNormalGreatTeaching	1,000	,868
Which learning formats do you consider useful? TTT/cross-regional process	1,000	,749
Which learning formats do you consider useful? learning within the teams	1,000	,738
Which learning formats do you consider useful? tandem Teaching	1,000	,689
Which learning formats do you consider useful? hospitation	1,000	,629

Extraction Method: Principal Component Analysis.

Total Variance Explained

Component	Initial Eigenvalues			Extraction Sums of Squared Loadings			Rotation Sums of Squared Loadings		
	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %
1	4,498	37,485	37,485	4,498	37,485	37,485	2,790	23,249	23,249
2	1,547	12,890	50,375	1,547	12,890	50,375	2,778	23,147	46,396
3	1,242	10,347	60,722	1,242	10,347	60,722	1,599	13,324	59,720
4	1,130	9,415	70,137	1,130	9,415	70,137	1,250	10,417	70,137
5	,792	6,600	76,736						
6	,714	5,953	82,689						
7	,582	4,847	87,537						
8	,452	3,768	91,305						
9	,369	3,074	94,379						
10	,311	2,591	96,969						
11	,217	1,810	98,779						
12	,147	1,221	100,000						

Extraction Method: Principal Component Analysis.

Rotated Component Matrix^a

	Component			
	1	2	3	4
Which learning formats do you prefer? Trainer-led courses in presence				,923
Which learning formats do you prefer? Virtual trainer-led courses	,694			
Which learning formats do you prefer? Blended learning			,758	
Which learning formats do you prefer? Self-paced learning			,771	
Which learning formats do you prefer? Learning-on-the-job		,538		
Which learning formats do you prefer? Community-based learning (team-based)		,644		
Which learning formats do you consider useful? TTT/learning communities technologies	,812			
Which learning formats do you consider useful? TTT/methodics-didactics/NewNormalGreat Teaching	,884			

Which learning formats do you consider useful? TTT/cross-regional process	,780			
Which learning formats do you consider useful? Learning within the teams		,799		
Which learning formats do you consider useful? Tandem Teaching		,794		
Which learning formats do you consider useful? Hospitation		,760		

Extraction Method: Principal Component Analysis.

Rotation Method: Varimax with Kaiser Normalization.

a. Rotation converged in 7 iterations.

4.2 Conditions/Abilities

Descriptive statistics of the conditions section derived from question 8 resulted in the following overview:

	N Statistic	Minimum Statistic	Maximum Statistic	Mean Statistic	Std. Deviation Statistic	Skewness		Kurtosis	
						Statistic	Std. Error	Statistic	Std. Error
Situations where you learnt anything from colleagues: abilities knowhow/competency	174	1	5	4,62	,693	-2,291	,184	6,403	,366
Situations where you learnt anything from colleagues: abilities kommunikation	172	1	5	4,22	,952	-1,472	,185	2,284	,368
Situations where you learnt anything from colleagues: abilities methodics/didactics	173	1	5	3,92	,918	-,751	,185	,514	,367
Situations where you learnt anything from colleagues: abilities social competency	170	1	5	4,01	,970	-1,075	,186	1,149	,370
Situations where you learnt anything from colleagues: abilities self reflexion	166	1	5	3,78	1,052	-,616	,188	-,187	,375
Situations where you learnt anything from colleagues: interest in cross-regional networking	164	1	5	3,74	1,122	-,693	,190	-,370	,377
Valid N (listwise)	159								

One must know that for a PCA to be carried out correctly, skewness should be in a range of -2 to 2. For the first variable this is not a given.

The PCA will therefore be carried out once including and another time excluding this variable to assess the difference.

Before PCA, a look at potential correlations shows the following picture:

		Correlations					
		Situations where you learnt anything from colleagues: abilities knowhow/competency	Situations where you learnt anything from colleagues: abilities kommunikation	Situations where you learnt anything from colleagues: abilities methodics/didactics	Situations where you learnt anything from colleagues: abilities social competency	Situations where you learnt anything from colleagues: abilities self reflexion	Situations where you learnt anything from colleagues: interest in cross-regional networking
Situations where you learnt anything from colleagues: abilities knowhow/competency	Pearson Correlation	1	,355**	,308**	,324**	,276**	,240**
	Sig. (2-tailed)		<,001	<,001	<,001	<,001	,002
	N	174	172	173	170	166	164
Situations where you learnt anything from colleagues: abilities kommunikation	Pearson Correlation	,355**	1	,507**	,626**	,503**	,277**
	Sig. (2-tailed)	<,001		<,001	<,001	<,001	<,001
	N	172	172	171	170	166	163
Situations where you learnt anything from colleagues: abilities methodics/didactics	Pearson Correlation	,308**	,507**	1	,490**	,418**	,332**
	Sig. (2-tailed)	<,001	<,001		<,001	<,001	<,001
	N	173	171	173	169	165	163
Situations where you learnt anything from colleagues: abilities social competency	Pearson Correlation	,324**	,626**	,490**	1	,686**	,269**
	Sig. (2-tailed)	<,001	<,001	<,001		<,001	<,001
	N	170	170	169	170	165	161
Situations where you learnt anything from colleagues: abilities self reflexion	Pearson Correlation	,276**	,503**	,418**	,686**	1	,388**
	Sig. (2-tailed)	<,001	<,001	<,001	<,001		<,001
	N	166	166	165	165	166	161
Situations where you learnt anything from colleagues: interest in cross-regional networking	Pearson Correlation	,240**	,277**	,332**	,269**	,388**	1
	Sig. (2-tailed)	,002	<,001	<,001	<,001	<,001	
	N	164	163	163	161	161	164

** Correlation is significant at the 0.01 level (2-tailed).

Correlations are significant; yet, as it turns out, the PCA with and without the first question does not lead to more than one component with a cumulative coverage of 0,51 respectively 0,57 (without “abilities/knowhow/competencies”). The facets of conditions/abilities cannot be further reduced other than to “abilities/Interest” in general which does not help gaining more insights. One could subsume this with “penchant for teaching” but it is neither very helpful nor expressive.

KMO and Bartlett's Test

Kaiser-Meyer-Olkin Measure of Sampling Adequacy.		,803
Bartlett's Test of Sphericity	Approx. Chi-Square	309,066
	df	15
	Sig.	<,001

Without “abilities/knowhow/competencies”:

KMO and Bartlett's Test

Kaiser-Meyer-Olkin Measure of Sampling Adequacy.		,776
Bartlett's Test of Sphericity	Approx. Chi-Square	279,683
	df	10
	Sig.	<,001

Total Variance Explained

Component	Total	Initial Eigenvalues		Extraction Sums of Squared Loadings		
		% of Variance	Cumulative %	Total	% of Variance	Cumulative %
1	3,098	51,634	51,634	3,098	51,634	51,634
2	,829	13,821	65,455			
3	,779	12,988	78,442			
4	,601	10,020	88,462			
5	,426	7,106	95,569			
6	,266	4,431	100,000			

Extraction Method: Principal Component Analysis.

(Without abilities/knowhow/competencies):

Total Variance Explained

Component	Total	Initial Eigenvalues		Extraction Sums of Squared Loadings		
		% of Variance	Cumulative %	Total	% of Variance	Cumulative %
1	2,873	57,460	57,460	2,873	57,460	57,460
2	,814	16,279	73,739			
3	,613	12,252	85,991			
4	,435	8,691	94,682			
5	,266	5,318	100,000			

Extraction Method: Principal Component Analysis.

Rather, we only show the results without Abilities/knowhow/competency in the following, as the remaining factors have a higher cumulative % of extraction sums of squared loadings:

Communalities

	Initial	Extraction
Situations where you learnt anything from colleagues: abilities kommunikation	1,000	,651
Situations where you learnt anything from colleagues: abilities methodics/didactics	1,000	,531
Situations where you learnt anything from colleagues: abilities social competency	1,000	,718
Situations where you learnt anything from colleagues: abilities self reflexion	1,000	,670
Situations where you learnt anything from colleagues: interest in cross-regional networking	1,000	,304

Extraction Method: Principal Component Analysis.

Component Matrix^a

	Component 1
Situations where you learnt anything from colleagues: abilities kommunikation	,807
Situations where you learnt anything from colleagues: abilities methodics/didactics	,729
Situations where you learnt anything from colleagues: abilities social competency	,847
Situations where you learnt anything from colleagues: abilities self reflexion	,818
Situations where you learnt anything from colleagues: interest in cross-regional networking	,551

Extraction Method: Principal Component Analysis.

a. 1 components extracted.

As “interest in cross-regional networking” does not lead to high extraction, one can take it out again and try the PCA.

KMO and Bartlett's Test

Kaiser-Meyer-Olkin Measure of Sampling Adequacy.		,769
Bartlett's Test of Sphericity	Approx. Chi-Square	244,731
	df	6
	Sig.	<,001

Total Variance Explained

Component	Total	Initial Eigenvalues		Extraction Sums of Squared Loadings		
		% of Variance	Cumulative %	Total	% of Variance	Cumulative %
1	2,624	65,606	65,606	2,624	65,606	65,606
2	,624	15,596	81,202			
3	,465	11,631	92,833			
4	,287	7,167	100,000			

Extraction Method: Principal Component Analysis.

KMO is lower again, but extraction values are all >,5 and 65% of cumulative variance is explained.

Communalities

	Initial	Extraction
Situations where you learnt anything from colleagues: abilities kommunikation	1,000	,667
Situations where you learnt anything from colleagues: abilities methodics/didactics	1,000	,528
Situations where you learnt anything from colleagues: abilities social competency	1,000	,768
Situations where you learnt anything from colleagues: abilities self reflexion	1,000	,661

Extraction Method: Principal Component Analysis.

Component Matrix^a

	Component 1
Situations where you learnt anything from colleagues: abilities kommunikation	,817
Situations where you learnt anything from colleagues: abilities methodics/didactics	,726
Situations where you learnt anything from colleagues: abilities social competency	,876
Situations where you learnt anything from colleagues: abilities self reflexion	,813

Extraction Method: Principal Component Analysis.

a. 1 components extracted.

Components have high relevance for this latent factor

1. RELATIONAL ABILITIES, which together with
2. the original variable “abilities/knowhow/competencies” and
3. the original variable “interest in cross-regional networking”

cannot be further reduced as to conditions.

4.3 Motivation

Descriptive Statistics

	N Statistic	Minimum Statistic	Maximum Statistic	Mean Statistic	Std. Deviation Statistic	Skewness		Kurtosis	
						Statistic	Std. Error	Statistic	Std. Error
What were the reasons that motivated you to carry out a training for colleagues: create knowledge	112	1	5	4,54	,781	-2,342	,228	6,914	,453
What were the reasons that motivated you to carry out a training for colleagues: sense of responsibility	112	1	5	4,04	1,094	-1,141	,228	,775	,453
What were the reasons that motivated you to carry out a training for colleagues: passion	114	1	5	4,46	,832	-1,874	,226	4,195	,449
What were the reasons that motivated you to carry out a training for colleagues: recognition	109	1	5	2,82	1,226	,021	,231	-,884	,459
What were the reasons that motivated you to carry out a training for colleagues: part of job	110	1	5	3,65	1,302	-,676	,230	-,661	,457
What were the reasons that motivated you to carry out a training for colleagues: boss asked for it	106	1	5	2,94	1,372	,036	,235	-1,129	,465
Valid N (listwise)	98								

		Correlations					
		What were the reasons that motivated you to carry out a training for colleagues: sense of responsibility	What were the reasons that motivated you to carry out a training for colleagues: passion	What were the reasons that motivated you to carry out a training for colleagues: recognition	What were the reasons that motivated you to carry out a training for colleagues: part of job	What were the reasons that motivated you to carry out a training for colleagues: boss asked for it	What were the reasons that motivated you to carry out a training for colleagues: create knowledge
What were the reasons that motivated you to carry out a training for colleagues: sense of responsibility	Pearson Correlation	1	,346**	,161	,166	-,009	,485**
	Sig. (2-tailed)		<,001	,095	,087	,927	<,001
	N	112	112	108	107	103	111
What were the reasons that motivated you to carry out a training for colleagues: passion	Pearson Correlation	,346**	1	,137	,213*	,070	,623**
	Sig. (2-tailed)	<,001		,155	,026	,477	<,001
	N	112	114	109	109	105	112
What were the reasons that motivated you to carry out a training for colleagues: recognition	Pearson Correlation	,161	,137	1	-,014	,046	-,004
	Sig. (2-tailed)	,095	,155		,890	,645	,969
	N	108	109	109	104	103	108
What were the reasons that motivated you to carry out a training for colleagues: part of job	Pearson Correlation	,166	,213*	-,014	1	,394**	,172
	Sig. (2-tailed)	,087	,026	,890		<,001	,076
	N	107	109	104	110	102	107
What were the reasons that motivated you to carry out a training for colleagues: boss asked for it	Pearson Correlation	-,009	,070	,046	,394**	1	,108
	Sig. (2-tailed)	,927	,477	,645	<,001		,278
	N	103	105	103	102	106	103
What were the reasons that motivated you to carry out a training for colleagues: create knowledge	Pearson Correlation	,485**	,623**	-,004	,172	,108	1
	Sig. (2-tailed)	<,001	<,001	,969	,076	,278	
	N	111	112	108	107	103	112

** . Correlation is significant at the 0.01 level (2-tailed).

* . Correlation is significant at the 0.05 level (2-tailed).

Another facet of the survey consists of the motivations for doing a training for colleagues (Question 13). Please note that this must not be confused with the motivation for boundary spanning, the latter one being addressed at a later point in time as a compound (latent) variable.

Here, the question is about what motivated members of the VET department to convey a training.

Again, descriptive statistics show us the variables in question.

“Create knowledge” turns out to be a variable, the skewness of which is beyond the range of -2 and +2 and therefore must be analyzed with care in such PCA.

Correlation is only significant in some cases, hence a PCA to determine whether the variables can be subsumed into components is appropriate.

KMO and Bartlett's Test

Kaiser-Meyer-Olkin Measure of Sampling Adequacy.		,548
Bartlett's Test of Sphericity	Approx. Chi-Square	78,276
	df	15
	Sig.	<,001

Communalities

	Initial	Extraction
What were the reasons that motivated you to carry out a training for colleagues: create knowledge	1,000	,765
What were the reasons that motivated you to carry out a training for colleagues: sense of responsibility	1,000	,452
What were the reasons that motivated you to carry out a training for colleagues: passion	1,000	,692
What were the reasons that motivated you to carry out a training for colleagues: recognition	1,000	,972
What were the reasons that motivated you to carry out a training for colleagues: part of job	1,000	,680
What were the reasons that motivated you to carry out a training for colleagues: boss asked for it	1,000	,702

Extraction Method: Principal Component Analysis.

While KMO shows relevant sampling adequacy, the “sense of responsibility” variable has the lowest loading and is therefore eliminated in the second iteration. As a first approximation, these PCA results are fair with a loading of 71% in total and a KMO of 0,548 with significance according to Bartlett.

Total Variance Explained

Component	Initial Eigenvalues			Extraction Sums of Squared Loadings			Rotation Sums of Squared Loadings		
	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %
1	1,935	32,250	32,250	1,935	32,250	32,250	1,866	31,100	31,100
2	1,321	22,022	54,272	1,321	22,022	54,272	1,369	22,810	53,910
3	1,006	16,766	71,038	1,006	16,766	71,038	1,028	17,127	71,038
4	,776	12,936	83,974						
5	,595	9,913	93,887						
6	,367	6,113	100,000						

Extraction Method: Principal Component Analysis.

Barbara OFSTAD

A second iteration will reduce the input variables. That will significantly increase coverage, albeit at the cost of a somewhat lower KMO of 0,486:

KMO and Bartlett's Test

Kaiser-Meyer-Olkin Measure of Sampling Adequacy.		.486
Bartlett's Test of Sphericity	Approx. Chi-Square	54,906
	df	10
	Sig.	<,001

All variables have high extraction values:

Communalities

	Initial	Extraction
What were the reasons that motivated you to carry out a training for colleagues: create knowledge	1,000	,802
What were the reasons that motivated you to carry out a training for colleagues: passion	1,000	,795
What were the reasons that motivated you to carry out a training for colleagues: recognition	1,000	,982
What were the reasons that motivated you to carry out a training for colleagues: part of job	1,000	,683
What were the reasons that motivated you to carry out a training for colleagues: boss asked for it	1,000	,694

Extraction Method: Principal Component Analysis.

Total variance explained increases to 79% via 3 components:

Total Variance Explained

Component	Initial Eigenvalues			Extraction Sums of Squared Loadings			Rotation Sums of Squared Loadings		
	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %
1	1,641	32,820	32,820	1,641	32,820	32,820	1,561	31,220	31,220
2	1,310	26,206	59,026	1,310	26,206	59,026	1,369	27,371	58,592
3	1,005	20,097	79,123	1,005	20,097	79,123	1,027	20,532	79,123
4	,631	12,625	91,748						
5	,413	8,252	100,000						

Extraction Method: Principal Component Analysis.

Rotated Component Matrix^a

	Component		
	1	2	3
What were the reasons that motivated you to carry out a training for colleagues: create knowledge	,887		
What were the reasons that motivated you to carry out a training for colleagues: passion	,873		
What were the reasons that motivated you to carry out a training for colleagues: recognition			,990
What were the reasons that motivated you to carry out a training for colleagues: part of job		,821	
What were the reasons that motivated you to carry out a training for colleagues: boss asked for it		,831	

Extraction Method: Principal Component Analysis.
Rotation Method: Varimax with Kaiser Normalization.

a. Rotation converged in 4 iterations.

The three components of motivation were

1. ENTHUSIASM
2. SENSE OF DUTY
3. RECOGNITION

and saved as latent (aka compound) variables.

4.4 Activities

Another facet of the survey were questions as to activities when it comes to learning from each other. Besides the first variable (“use cases”) which shows extreme value as to skewness and

kurtosis and therefore must be analyzed carefully, the descriptive statistics show no unusual data.

	Descriptive Statistics									
	N	Minimum	Maximum	Mean	Std. Deviation	Skewness		Kurtosis		
						Statistic	Std. Error	Statistic	Std. Error	
Which (conceptional/methodological) aspects do you consider relevant for a good training? use cases	174	1	5	4,72	,621	-3,247	,184	14,214	,366	
Which (conceptional/methodological) aspects do you consider relevant for a good training? methodics	174	1	5	4,33	,821	-1,321	,184	2,091	,366	
Which (conceptional/methodological) aspects do you consider relevant for a good training? preparation	173	1	5	4,40	,813	-1,592	,185	3,027	,367	
Which (conceptional/methodological) aspects do you consider relevant for a good training? experiments	168	1	5	3,80	1,074	-,716	,187	,043	,373	
Which (conceptional/methodological) aspects do you consider relevant for a good training? flexibility	173	1	5	3,84	,985	-,679	,185	,287	,367	
Which (conceptional/methodological) aspects do you consider relevant for a good training? interdisciplinary/networking	157	1	5	3,59	1,012	-,274	,194	-,403	,385	
Which (conceptional/methodological) aspects do you consider relevant for a good training? importance of topic for me	164	1	5	4,15	1,094	-1,331	,190	1,130	,377	
Which (relational/social) aspects do you consider relevant for a good training? empathy	169	1	5	4,38	,755	-1,511	,187	3,660	,371	
Which (relational/social) aspects do you consider relevant for a good training? role models	166	1	5	4,14	,946	-1,019	,188	,578	,375	
Which (relational/social) aspects do you consider relevant for a good training? networking	155	1	5	3,53	1,118	-,342	,195	-,599	,387	
Which (relational/social) aspects do you consider relevant for a good training? mutual trust	169	1	5	4,27	,850	-1,436	,187	2,735	,371	
Which (relational/social) aspects do you consider relevant for a good training? mutual exchange	174	1	5	4,45	,816	-1,918	,184	4,577	,366	
Which (relational/social) aspects do you consider relevant for a good training? safe atmosphere	161	1	5	3,94	1,023	-,691	,191	-,335	,380	
Valid N (listwise)	131									

The correlation chart shows high scores.

Correlations

		Which (conceptual/methodological) aspects do you consider relevant for a good training? use cases	Which (conceptual/methodological) aspects do you consider relevant for a good training? methodics	Which (conceptual/methodological) aspects do you consider relevant for a good training? preparation	Which (conceptual/methodological) aspects do you consider relevant for a good training? experiments	Which (conceptual/methodological) aspects do you consider relevant for a good training? flexibility	Which (conceptual/methodological) aspects do you consider relevant for a good training? interdisciplinary/networking	Which (conceptual/methodological) aspects do you consider relevant for a good training? importance of topic for me	Which (relational/social) aspects do you consider relevant for a good training? empathy	Which (relational/social) aspects do you consider relevant for a good training? role models	Which (relational/social) aspects do you consider relevant for a good training? networking	Which (relational/social) aspects do you consider relevant for a good training? mutual trust	Which (relational/social) aspects do you consider relevant for a good training? mutual exchange	Which (relational/social) aspects do you consider relevant for a good training? safe atmosphere
Which (conceptual/methodological) aspects do you consider relevant for a good training? use cases	Pearson Correlation	1	.499**	.510**	.347**	.280**	.222**	.233**	.289**	.345**	.233**	.391**	.431**	.253**
	Sig. (2-tailed)		<.001	<.001	<.001	<.001	.005	.003	<.001	<.001	.004	<.001	<.001	.001
	N	174	174	173	168	173	157	164	169	166	155	169	174	161
Which (conceptual/methodological) aspects do you consider relevant for a good training? methodics	Pearson Correlation	.499**	1	.678**	.234**	.243**	.381**	.242**	.381**	.311**	.032	.271**	.403**	.385**
	Sig. (2-tailed)	<.001		<.001	.002	.001	<.001	.002	<.001	<.001	.694	<.001	<.001	<.001
	N	174	174	173	168	173	157	164	169	166	155	169	174	161
Which (conceptual/methodological) aspects do you consider relevant for a good training? preparation	Pearson Correlation	.510**	.678**	1	.220**	.155**	.204**	.281**	.263**	.293**	.023	.214**	.301**	.255**
	Sig. (2-tailed)	<.001	<.001		.004	.042	.011	<.001	<.001	<.001	.779	.005	<.001	.001
	N	173	173	173	167	172	156	163	188	165	155	168	173	161
Which (conceptual/methodological) aspects do you consider relevant for a good training? experiments	Pearson Correlation	.347**	.234**	.220**	1	.470**	.421**	.121	.312**	.228**	.296**	.353**	.347**	.188**
	Sig. (2-tailed)	<.001	.002	.004		<.001	<.001	.129	<.001	.003	<.001	<.001	<.001	.019
	N	168	168	167	168	168	153	160	164	163	152	164	168	156
Which (conceptual/methodological) aspects do you consider relevant for a good training? flexibility	Pearson Correlation	.280**	.243**	.155**	.470**	1	.532**	.153	.240**	.293**	.258**	.452**	.334**	.211**
	Sig. (2-tailed)	<.001	.001	.042	<.001		<.001	.050	.002	<.001	.001	<.001	<.001	.007
	N	173	173	172	168	173	157	164	168	166	155	169	173	161
Which (conceptual/methodological) aspects do you consider relevant for a good training? interdisciplinary/networking	Pearson Correlation	.222**	.381**	.204**	.421**	.532**	1	.226**	.365**	.278**	.380**	.431**	.391**	.206**
	Sig. (2-tailed)	.005	<.001	.011	<.001	<.001		.005	<.001	<.001	<.001	<.001	<.001	.012
	N	157	157	156	153	157	157	150	154	153	143	154	157	148
Which (conceptual/methodological) aspects do you consider relevant for a good training? importance of topic for me	Pearson Correlation	.233**	.242**	.281**	.121	.153	.226**	1	.188**	.318**	.243**	.268**	.259**	.157
	Sig. (2-tailed)	.003	.002	<.001	.129	.050	.005		.017	<.001	.003	<.001	<.001	.052
	N	164	164	163	160	164	150	164	161	160	147	161	164	155
Which (relational/social) aspects do you consider relevant for a good training? empathy	Pearson Correlation	.289**	.381**	.263**	.312**	.240**	.365**	.188**	1	.456**	.257**	.370**	.391**	.267**
	Sig. (2-tailed)	<.001	<.001	<.001	<.001	.002	<.001	.017		<.001	.001	<.001	<.001	<.001
	N	169	169	168	164	168	154	161	169	164	153	165	169	159
Which (relational/social) aspects do you consider relevant for a good training? role models	Pearson Correlation	.345**	.311**	.293**	.228**	.293**	.278**	.318**	.456**	1	.213**	.458**	.409**	.147**
	Sig. (2-tailed)	<.001	<.001	<.001	.003	<.001	<.001	<.001	<.001		.008	<.001	<.001	.065
	N	166	166	165	163	166	153	160	164	166	153	164	166	157
Which (relational/social) aspects do you consider relevant for a good training? networking	Pearson Correlation	.233**	.032	.023	.296**	.298**	.380**	.243**	.257**	.213**	1	.530**	.351**	.236**
	Sig. (2-tailed)	.004	.694	.779	<.001	.001	<.001	.003	.001	.008		<.001	<.001	.004
	N	155	155	155	152	155	143	147	153	153	155	153	155	150
Which (relational/social) aspects do you consider relevant for a good training? mutual trust	Pearson Correlation	.391**	.271**	.214**	.353**	.452**	.431**	.266**	.370**	.458**	.530**	1	.609**	.325**
	Sig. (2-tailed)	<.001	<.001	.005	<.001	<.001	<.001	<.001	<.001	<.001	<.001		<.001	<.001
	N	169	169	168	164	169	154	161	165	164	153	169	169	158
Which (relational/social) aspects do you consider relevant for a good training? mutual exchange	Pearson Correlation	.431**	.403**	.301**	.347**	.334**	.391**	.259**	.391**	.409**	.351**	.609**	1	.430**
	Sig. (2-tailed)	<.001	<.001	<.001	<.001	<.001	<.001	<.001	<.001	<.001	<.001	<.001		<.001
	N	174	174	173	168	173	157	164	169	166	155	169	174	161
Which (relational/social) aspects do you consider relevant for a good training? safe atmosphere	Pearson Correlation	.253**	.385**	.255**	.188**	.211**	.206**	.157	.267**	.147	.236**	.325**	.430**	1
	Sig. (2-tailed)	.001	<.001	.001	.019	.007	.012	.052	<.001	.065	.004	<.001	<.001	
	N	161	161	161	156	161	148	155	159	157	150	158	161	161

** Correlation is significant at the 0.01 level (2-tailed).
* Correlation is significant at the 0.05 level (2-tailed).

Analogous to the process described in the earlier subchapters, activities were this time evaluated via three iterations. The first iteration included all questions (KMO = 0,799, significance, 4 components, total coverage 55%).

KMO and Bartlett's Test

Kaiser-Meyer-Olkin Measure of Sampling Adequacy.		,799
Bartlett's Test of Sphericity	Approx. Chi-Square	530,015
	df	78
	Sig.	<,001

Three questions proved extraction factors $<0,5$ and were therefore one by one eliminated in the second to fourth iterations (“safe atmosphere”, then “use cases”, afterwards “empathy”). Each time, this led to an improvement of the rotation sum of squared loadings (explaining total variance coverage) which went from 55,992% eventually to 66,036% at the cost of a lower KMO (0,763 vs. the earlier 0,799).

Communalities

	Initial	Extraction
Which (conceptional/methodological) aspects do you consider relevant for a good training? use cases	1,000	.457
Which (conceptional/methodological) aspects do you consider relevant for a good training? methodics	1,000	.750
Which (conceptional/methodological) aspects do you consider relevant for a good training? preparation	1,000	.719
Which (conceptional/methodological) aspects do you consider relevant for a good training? experiments	1,000	.528
Which (conceptional/methodological) aspects do you consider relevant for a good training? flexibility	1,000	.516
Which (conceptional/methodological) aspects do you consider relevant for a good training? interdisciplinary/networking	1,000	.542
Which (conceptional/methodological) aspects do you consider relevant for a good training? importance of topic for me	1,000	.509
Which (relational/social) aspects do you consider relevant for a good training? empathy	1,000	.461
Which (relational/social) aspects do you consider relevant for a good training? role models	1,000	.643
Which (relational/social) aspects do you consider relevant for a good training? networking	1,000	.541
Which (relational/social) aspects do you consider relevant for a good training? mutual trust	1,000	.652
Which (relational/social) aspects do you consider relevant for a good training? mutual exchange	1,000	.532
Which (relational/social) aspects do you consider relevant for a good training? safe atmosphere	1,000	.429

Extraction Method: Principal Component Analysis.

Total Variance Explained

Component	Total	Initial Eigenvalues		Extraction Sums of Squared Loadings			Rotation Sums of Squared Loadings		
		% of Variance	Cumulative %	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %
1	4,499	34,604	34,604	4,499	34,604	34,604	2,860	21,996	21,996
2	1,620	12,459	47,063	1,620	12,459	47,063	2,479	19,066	41,063
3	1,161	8,928	55,992	1,161	8,928	55,992	1,941	14,929	55,992
4	,896	6,896	62,888						
5	,849	6,534	69,422						
6	,752	5,787	75,208						
7	,681	5,240	80,449						
8	,624	4,799	85,247						
9	,555	4,270	89,517						
10	,413	3,180	92,697						
11	,390	3,003	95,700						
12	,301	2,313	98,013						
13	,258	1,987	100,000						

Extraction Method: Principal Component Analysis.

The next tables show the fifth iteration. As the variable re: "role model" proved extraction factor <0,5, it was again eliminated in a further iteration.

KMO and Bartlett's Test

Kaiser-Meyer-Olkin Measure of Sampling Adequacy.		,763
Bartlett's Test of Sphericity	Approx. Chi-Square	377,423
	df	45
	Sig.	<,001

Total Variance Explained

Component	Total	Initial Eigenvalues		Extraction Sums of Squared Loadings			Rotation Sums of Squared Loadings		
		% of Variance	Cumulative %	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %
1	3,604	36,036	36,036	3,604	36,036	36,036	2,582	25,822	25,822
2	1,496	14,955	50,991	1,496	14,955	50,991	1,841	18,414	44,235
3	1,104	11,045	62,036	1,104	11,045	62,036	1,780	17,800	62,036
4	,769	7,695	69,730						
5	,751	7,511	77,241						
6	,654	6,542	83,783						
7	,559	5,593	89,376						
8	,463	4,631	94,007						
9	,314	3,143	97,150						
10	,285	2,850	100,000						

Extraction Method: Principal Component Analysis.

Communalities

	Initial	Extraction
Which (conceptional/methodological) aspects do you consider relevant for a good training? methodics	1,000	,812
Which (conceptional/methodological) aspects do you consider relevant for a good training? preparation	1,000	,789
Which (conceptional/methodological) aspects do you consider relevant for a good training? experiments	1,000	,538
Which (conceptional/methodological) aspects do you consider relevant for a good training? flexibility	1,000	,549
Which (conceptional/methodological) aspects do you consider relevant for a good training? interdisciplinary/networking	1,000	,616
Which (conceptional/methodological) aspects do you consider relevant for a good training? importance of topic for me	1,000	,620
Which (relational/social) aspects do you consider relevant for a good training? role models	1,000	,496
Which (relational/social) aspects do you consider relevant for a good training? networking	1,000	,585
Which (relational/social) aspects do you consider relevant for a good training? mutual trust	1,000	,672
Which (relational/social) aspects do you consider relevant for a good training? mutual exchange	1,000	,527

Extraction Method: Principal Component Analysis.

The third iteration slightly worsened KMO but increased total variance coverage to 65%.

KMO and Bartlett's Test

Kaiser-Meyer-Olkin Measure of Sampling Adequacy.		,739
Bartlett's Test of Sphericity	Approx. Chi-Square	343,883
	df	36
	Sig.	<,001

All variables now proved high extraction rates:

Communalities

	Initial	Extraction
Which (conceptional/methodological) aspects do you consider relevant for a good training? methodics	1,000	,820
Which (conceptional/methodological) aspects do you consider relevant for a good training? preparation	1,000	,811
Which (conceptional/methodological) aspects do you consider relevant for a good training? experiments	1,000	,531
Which (conceptional/methodological) aspects do you consider relevant for a good training? flexibility	1,000	,579
Which (conceptional/methodological) aspects do you consider relevant for a good training? interdisciplinary/networking	1,000	,609
Which (conceptional/methodological) aspects do you consider relevant for a good training? importance of topic for me	1,000	,691
Which (relational/social) aspects do you consider relevant for a good training? networking	1,000	,640
Which (relational/social) aspects do you consider relevant for a good training? mutual trust	1,000	,671
Which (relational/social) aspects do you consider relevant for a good training? mutual exchange	1,000	,531

Extraction Method: Principal Component Analysis.

Total Variance Explained

Component	Initial Eigenvalues			Extraction Sums of Squared Loadings			Rotation Sums of Squared Loadings		
	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %
1	3,372	37,467	37,467	3,372	37,467	37,467	2,379	26,436	26,436
2	1,473	16,371	53,838	1,473	16,371	53,838	1,778	19,752	46,188
3	1,037	11,526	65,363	1,037	11,526	65,363	1,726	19,175	65,363
4	,767	8,524	73,887						
5	,655	7,274	81,161						
6	,628	6,982	88,144						
7	,465	5,167	93,311						
8	,317	3,518	96,829						
9	,285	3,171	100,000						

Extraction Method: Principal Component Analysis.

The rotated component matrix shows the following three components of activities:

Rotated Component Matrix^a

	Component		
	1	2	3
Which (conceptional/methodological) aspects do you consider relevant for a good training? methodics		,872	
Which (conceptional/methodological) aspects do you consider relevant for a good training? preparation		,892	
Which (conceptional/methodological) aspects do you consider relevant for a good training? experiments	,712		
Which (conceptional/methodological) aspects do you consider relevant for a good training? flexibility	,751		
Which (conceptional/methodological) aspects do you consider relevant for a good training? interdisciplinary/networking	,734		
Which (conceptional/methodological) aspects do you consider relevant for a good training? importance of topic for me			,785
Which (relational/social) aspects do you consider relevant for a good training? networking			,667
Which (relational/social) aspects do you consider relevant for a good training? mutual trust	,526		,626
Which (relational/social) aspects do you consider relevant for a good training? mutual exchange			

Extraction Method: Principal Component Analysis.
 Rotation Method: Varimax with Kaiser Normalization.

a. Rotation converged in 5 iterations.

1. Experiments/flexibility/interdisciplinary approach – OPEN SETUP
2. Methodics and preparation – SYSTEMATIC SETUP
3. Subjective relevance, cross-hierarchy networking, and mutual trust – PEOPLE-ORIENTED SETUP

These three components will be retained as latent variables in the database.

4.5 Culture change

Perception of culture change concerns the remaining questions around change, future-orientation/sustainability, new VET philosophy etc. The descriptive statistics are shown below.

As can be seen, future orientation shows a high standard deviation, indicating a bigger variety of answers in comparison to the other questions.

	Descriptive Statistics								
	N	Minimum	Maximum	Mean	Std. Deviation	Skewness		Kurtosis	
	Statistic	Statistic	Statistic	Statistic	Statistic	Statistic	Std. Error	Statistic	Std. Error
Perception of culture change: new normal/virtual collaboration	167	1	5	4,48	,759	-1,893	,188	4,875	,374
Perception of culture change: hybrid VET training formats	164	1	5	4,38	,785	-1,473	,190	3,034	,377
Perception of culture change: new philosophy	159	1	5	3,89	1,128	-,858	,192	,101	,383
Perception of culture change: leadership behavior/style	159	1	5	3,38	1,140	-,394	,192	-,510	,383
Perception of culture change: trust within the team	157	1	5	3,44	1,184	-,535	,194	-,570	,385
Evaluation of culture change: new normal/virtual collaboration	167	1	5	4,05	1,023	-1,020	,188	,656	,374
Evaluation of culture change: hybrid VET training formats	161	1	5	3,83	1,058	-,736	,191	-,036	,380
Evaluation of culture change: new philosophy	161	1	5	3,30	1,229	-,363	,191	-,734	,380
Evaluation of culture change: leadership behavior/style	146	1	5	3,59	1,213	-,622	,201	-,445	,399
Evaluation of culture change: trust within the team	144	1	5	3,88	1,176	-,879	,202	-,056	,401
New VET philosophy enables us to better support and develop our learners' competencies.	159	1	5	3,32	1,229	-,490	,192	-,672	,383
I feel well informed about our new VET philosophy.	166	1	5	3,60	1,067	-,467	,188	-,394	,375
I look forward to implementing our new VET philosophy.	154	1	5	3,26	1,230	-,445	,195	-,635	,389
I feel well supported by my manager regarding our new VET philosophy.	151	1	5	3,62	1,254	-,637	,197	-,564	,392
What is your assessment about our VET department's sustainability/preparedness for future demands?	172	0	10	7,35	2,132	-1,212	,185	1,381	,368
In my opinion we should do more boundary spanning across training centers and regions.	171	1	5	3,87	,988	-,689	,186	,292	,369
In my opinion we should do more boundary spanning towards customers.	169	1	5	3,96	,912	-,691	,187	,426	,371
In my opinion we should do more external boundary spanning.	161	1	5	3,27	1,095	-,244	,191	-,495	,380
Valid N (listwise)	110								

Correlation among these variables can be seen in the next table.

Some significant correlations can be identified; however, there are other variables without significance in the Pearson correlation score. Therefore, a PCA helps reducing complexity by identifying non-correlating compounds that constitute culture change.

Barbara OFSTAD

Communalities		
	Initial	Extraction
In my opinion we should do more boundary spanning across training centers and regions.	1,000	,751
In my opinion we should do more boundary spanning towards customers.	1,000	,640
in my opinion we should do more external boundary spanning.	1,000	,778
My management acts as a role model regarding boundary spanning across training centers.	1,000	,720
Perception of culture change: new normal/virtual collaboration	1,000	,705
Perception of culture change: hybrid VET training formats	1,000	,791
Perception of culture change: new philosophy	1,000	,732
Perception of culture change: leadership behavior/style	1,000	,741
Perception of culture change: trust within the team	1,000	,696
Evaluation of culture change: new normal/virtual collaboration	1,000	,713
Evaluation of culture change: hybrid VET training formats	1,000	,695
Evaluation of culture change: new philosophy	1,000	,840
Evaluation of culture change: leadership behavior/style	1,000	,762
Evaluation of culture change: trust within the team	1,000	,665
New VET philosophy enables us to better support and develop our learners' competencies.	1,000	,821
I feel well informed about our new VET philosophy.	1,000	,638
I look forward to implementing our new VET philosophy.	1,000	,896
I feel well supported by my manager regarding our new VET philosophy.	1,000	,754
What is your assessment about our VET department's sustainability/preparedness for future demands?	1,000	,621

Extraction Method: Principal Component Analysis.

In total, 73% of total variance can be explained via cumulative % of rotation sums of squared loadings.

Total Variance Explained

Component	Initial Eigenvalues			Extraction Sums of Squared Loadings			Rotation Sums of Squared Loadings		
	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %
1	5,816	30,612	30,612	5,816	30,612	30,612	3,865	20,343	20,343
2	2,676	14,085	44,698	2,676	14,085	44,698	3,430	18,051	38,393
3	1,876	9,874	54,572	1,876	9,874	54,572	2,678	14,093	52,487
4	1,491	7,847	62,419	1,491	7,847	62,419	1,440	7,578	60,064
5	1,080	5,684	68,103	1,080	5,684	68,103	1,289	6,785	66,849
6	1,020	5,370	73,473	1,020	5,370	73,473	1,259	6,624	73,473
7	,824	4,336	77,809						
8	,617	3,249	81,059						
9	,598	3,146	84,205						
10	,546	2,874	87,078						
11	,483	2,540	89,618						
12	,399	2,099	91,717						
13	,341	1,793	93,510						
14	,301	1,582	95,092						
15	,272	1,433	96,526						
16	,227	1,194	97,720						
17	,186	,977	98,696						
18	,139	,731	99,427						
19	,109	,573	100,000						

Extraction Method: Principal Component Analysis.

The rotated component matrix shows six different latent variables indicating culture change perception:

1. LEADERSHIP&TRUST IN THE FUTURE
2. NEW VET PHILOSOPHY BUY-IN
3. Virtual and hybrid formats indicating DIGITAL TRANSFORMATION
4. BOUNDARY SPANNING (TCC) across training centers, customers, positively related with the future
5. NEW VET PHILOSOPHY awareness
6. BOUNDARY SPANNING (X) externally towards the ecosystem

NEW VET PHILOSOPHY awareness shows negative load regarding boundary spanning towards customers. After careful consideration there is no obvious explanation of this negative loading. Still, it is important to point this out as a possible aberration.

Rotated Component Matrix^a

	Component					
	1	2	3	4	5	6
In my opinion we should do more boundary spanning across training centers and regions.				,814		
In my opinion we should do more boundary spanning towards customers.				,446	-,626	
in my opinion we should do more external boundary spanning.						,833
My management acts as a role model regarding boundary spanning across training centers.	,668					
Perception of culture change: new normal/virtual collaboration			,786			
Perception of culture change: hybrid VET training formats			,840			
Perception of culture change: new philosophy					,732	
Perception of culture change: leadership behavior/style	,700					
Perception of culture change: trust within the team	,771					
Evaluation of culture change: new normal/virtual collaboration			,699			
Evaluation of culture change: hybrid VET training formats			,717			
Evaluation of culture change: new philosophy		,878				
Evaluation of culture change: leadership behavior/style	,828					
Evaluation of culture change: trust within the team	,788					
New VET philosophy enables us to better support and develop our learners' competencies.		,875				
I feel well informed about our new VET philosophy.		,633				
I look forward to implementing our new VET philosophy.		,923				
I feel well supported by my manager regarding our new VET philosophy.	,710					
What is your assessment about our VET department's sustainability/preparedness for future demands?	,521			,403		

Extraction Method: Principal Component Analysis.
 Rotation Method: Varimax with Kaiser Normalization.

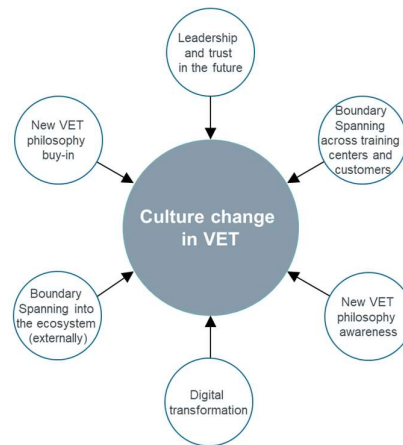
a. Rotation converged in 11 iterations.

An illustration of the direct findings derived from the survey can be seen below.

**How and why does boundary spanning occur in VET in the context of digital transformation?
Findings of quantitative analysis re: conditions, motivations and activities
as per principle component analysis (PCA)**



N.B.: Factors in CAPITAL letters are latent variables derived from Principal Component Analysis



4.6 Boundary spanner character(istic)s definition

Another aspect concerns how to identify boundary spanners. As indicated in 4.3, this must not be confused with the motivation for providing training for colleagues. Boundary spanners see and want boundary spanning.

Based on the PCA findings, it could be assumed that boundary spanner characteristics can be found in the following variables:

- **Willingness:** Interest in cross-regional networking (question 8f)
- **Activities:** Networking/boundary spanning across hierarchies (question 20c; please note that in SPSS, the aspect of “across hierarchies” does not appear in the short description. However, it is par of the original survey’s text.)
- **Attitude:** In my opinion we should do more boundary spanning across training centers and regions (question 22a)

KMO and Bartlett's Test

Kaiser-Meyer-Olkin Measure of Sampling Adequacy.		,610
Bartlett's Test of Sphericity	Approx. Chi-Square	50,381
	df	3
	Sig.	<,001

Communalities

	Initial	Extraction
Situations where you learnt anything from colleagues: interest in cross-regional networking	1,000	,668
In my opinion we should do more boundary spanning across training centers and regions.	1,000	,510
Which (relational/social) aspects do you consider relevant for a good training? networking	1,000	,514

Extraction Method: Principal Component Analysis.

Total Variance Explained

Component	Total	Initial Eigenvalues		Extraction Sums of Squared Loadings		
		% of Variance	Cumulative %	Total	% of Variance	Cumulative %
1	1,692	56,401	56,401	1,692	56,401	56,401
2	,759	25,296	81,697			
3	,549	18,303	100,000			

Extraction Method: Principal Component Analysis.

56,4% of total variance are explained via one component, namely BOUNDARY SPANNER CHARACTERISTICS. While 56,4% may seem low in total, in such exploratory setting it is a value to be considered.

Component Matrix^a

	Component 1
Situations where you learnt anything from colleagues: interest in cross-regional networking	,817
In my opinion we should do more boundary spanning across training centers and regions.	,714
Which (relational/social) aspects do you consider relevant for a good training? networking	,717

Extraction Method: Principal Component Analysis.

a. 1 components extracted.

Rotated Component Matrix^a

--

a. Only one component was extracted. The solution cannot be rotated.

A reliability analysis reveals inclusion of 84% of cases and a Cronbach's Alpha of 0,611.

Case Processing Summary

		N	%
Cases	Valid	147	84,0
	Excluded ^a	28	16,0
	Total	175	100,0

a. Listwise deletion based on all variables in the procedure.

Reliability Statistics

Cronbach's Alpha	N of Items
,611	3

Considering this with four variables, assuming that boundary spanning is also dependent on the motivation to create knowledge, the following stats would be relevant:

KMO and Bartlett's Test

Kaiser-Meyer-Olkin Measure of Sampling Adequacy.		,647
Bartlett's Test of Sphericity	Approx. Chi-Square	44,278
	df	6
	Sig.	<,001

Communalities

	Initial	Extraction
Situations where you learnt anything from colleagues: interest in cross-regional networking	1,000	,594
In my opinion we should do more boundary spanning across training centers and regions.	1,000	,391
Which (relational/social) aspects do you consider relevant for a good training? networking	1,000	,487
What were the reasons that motivated you to carry out a training for colleagues: create knowledge	1,000	,413

Extraction Method: Principal Component Analysis.

Total Variance Explained

Component	Total	Initial Eigenvalues		Extraction Sums of Squared Loadings		
		% of Variance	Cumulative %	Total	% of Variance	Cumulative %
1	1,886	47,139	47,139	1,886	47,139	47,139
2	,832	20,792	67,931			
3	,766	19,156	87,087			
4	,517	12,913	100,000			

Extraction Method: Principal Component Analysis.

Component Matrix^a

	Component 1
Situations where you learnt anything from colleagues: interest in cross-regional networking	,771
In my opinion we should do more boundary spanning across training centers and regions.	,625
Which (relational/social) aspects do you consider relevant for a good training? networking	,698
What were the reasons that motivated you to carry out a training for colleagues: create knowledge	,643

Extraction Method: Principal Component Analysis.

a. 1 components extracted.

While “create knowledge” contributes to ,643 to the overall factor boundary spanner characteristics, please note that the extraction sums of squared loading only amount to 47% (vs. 56% before), and while KMO is higher, and Cronbach’s Alpha is higher, far fewer cases are valid (54,9% vs. 84%!). As such, the hypothesis that the motivation to create knowledge is part of boundary spanner characteristics, must be rejected in this study.

Case Processing Summary

		N	%
Cases	Valid	96	54,9
	Excluded ^a	79	45,1
	Total	175	100,0

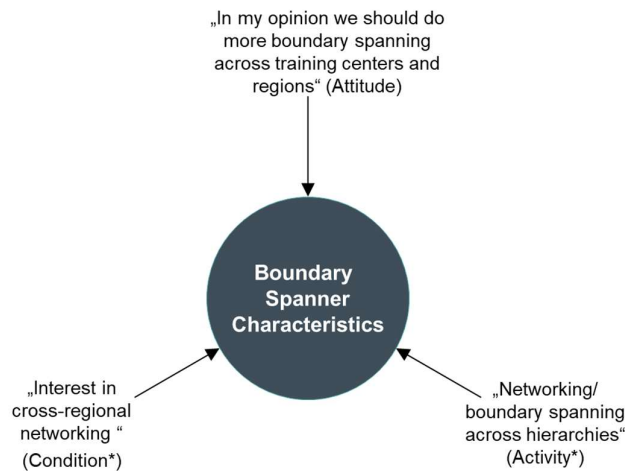
a. Listwise deletion based on all variables in the procedure.

Reliability Statistics

Cronbach's Alpha	N of Items
,623	4

In summary, it is a relevant and unexpected finding that statistically, boundary spanner characteristics prove to be statistically unrelated to the motivation to expand knowledge. The same is true for the latent variable “RELATIONAL ABILITIES” which does not help increasing Cronbach’s Alpha nor the number of cases included.

Therefore, the final model for boundary spanner characteristics (N=147) as it derives from this quantitative sample , looks as follows:



*According to „conditions“ and „activities“ in Roberts and Beamish's (2017) model

4.7 Culture Change reloaded

To properly analyze possible interdependencies between boundary spanner characteristics and culture change, the PCA of chapter 4.5 must be redone; this time, however, without including the original variable of “In my opinion we should do more boundary spanning across training centers and regions” (Attitude). Thereby, the author strives to avoid having the same original variable as both part of y and of x (independent and dependent variable, respectively) in regression modelling.

We start with all variables but “In my opinion we should do more boundary spanning across training centers and regions” (Attitude).

KMO and Bartlett's Test

Kaiser-Meyer-Olkin Measure of Sampling Adequacy.		,795
Bartlett's Test of Sphericity	Approx. Chi-Square	1009,153
	df	153
	Sig.	<,001

Barbara OFSTAD

KMO is slightly better than before with 0,795 (vs. 0,784), Approx. Chi-Square slightly lower (1009,153 vs. 1049,487) and significance is equally high.

Communalities

	Initial	Extraction
In my opinion we should do more boundary spanning towards customers.	1,000	,601
in my opinion we should do more external boundary spanning.	1,000	,763
My management acts as a role model regarding boundary spanning across training centers.	1,000	,645
Perception of culture change: new normal/virtual collaboration	1,000	,705
Perception of culture change: hybrid VET training formats	1,000	,770
Perception of culture change: leadership behavior/style	1,000	,718
Perception of culture change: trust within the team	1,000	,662
Evaluation of culture change: new normal/virtual collaboration	1,000	,718
Evaluation of culture change: hybrid VET training formats	1,000	,675
Evaluation of culture change: new philosophy	1,000	,846
Evaluation of culture change: leadership behavior/style	1,000	,764
Evaluation of culture change: trust within the team	1,000	,651
New VET philosophy enables us to better support and develop our learners' competencies.	1,000	,823
I feel well informed about our new VET philosophy.	1,000	,524
I look forward to implementing our new VET philosophy.	1,000	,887
I feel well supported by my manager regarding our new VET philosophy.	1,000	,757
What is your assessment about our VET department's sustainability/preparedness for future demands?	1,000	,545
Perception of culture change: new philosophy	1,000	,559

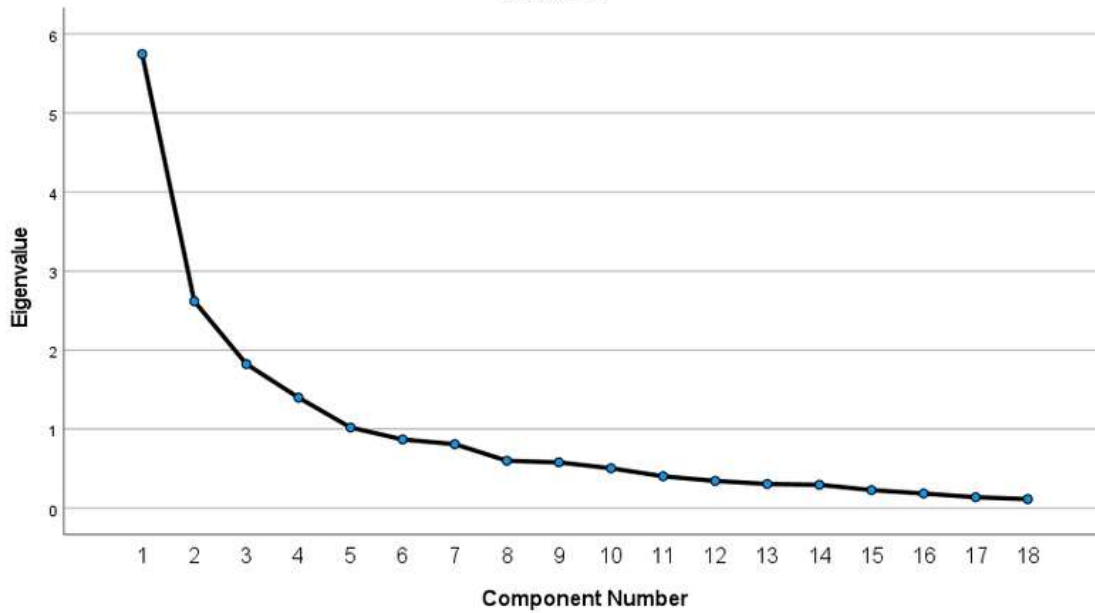
Extraction Method: Principal Component Analysis.

Total Variance Explained

Component	Initial Eigenvalues			Extraction Sums of Squared Loadings			Rotation Sums of Squared Loadings		
	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %
1	5,747	31,926	31,926	5,747	31,926	31,926	3,865	21,471	21,471
2	2,619	14,553	46,479	2,619	14,553	46,479	3,502	19,457	40,928
3	1,824	10,133	56,612	1,824	10,133	56,612	2,673	14,852	55,780
4	1,400	7,779	64,391	1,400	7,779	64,391	1,326	7,364	63,144
5	1,021	5,672	70,063	1,021	5,672	70,063	1,246	6,919	70,063
6	,870	4,835	74,898						
7	,811	4,503	79,401						
8	,601	3,338	82,738						
9	,580	3,223	85,962						
10	,505	2,808	88,769						
11	,404	2,243	91,013						
12	,345	1,919	92,931						
13	,307	1,704	94,635						
14	,296	1,647	96,282						
15	,229	1,275	97,557						
16	,186	1,032	98,589						
17	,139	,772	99,361						
18	,115	,639	100,000						

Extraction Method: Principal Component Analysis.

Scree Plot



Rotated Component Matrix^a

	Component				
	1	2	3	4	5
In my opinion we should do more boundary spanning towards customers.				-,755	
in my opinion we should do more external boundary spanning.					,832
My management acts as a role model regarding boundary spanning across training centers.	,732				
Perception of culture change: new normal/virtual collaboration			,795		
Perception of culture change: hybrid VET training formats			,847		
Perception of culture change: leadership behavior/style	,626				
Perception of culture change: trust within the team	,719				
Evaluation of culture change: new normal/virtual collaboration			,688		
Evaluation of culture change: hybrid VET training formats			,708		
Evaluation of culture change: new philosophy		,899			
Evaluation of culture change: leadership behavior/style	,823				
Evaluation of culture change: trust within the team	,776				
New VET philosophy enables us to better support and develop our learners' competencies.		,887			
I feel well informed about our new VET philosophy.		,590			
I look forward to implementing our new VET philosophy.		,928			
I feel well supported by my manager regarding our new VET philosophy.	,752				
What is your assessment about our VET department's sustainability/preparedness for future demands?	,579				
Perception of culture change: new philosophy				,609	

Extraction Method: Principal Component Analysis.
 Rotation Method: Varimax with Kaiser Normalization.

a. Rotation converged in 6 iterations.

Component Transformation Matrix

Component	1	2	3	4	5
1	,700	,542	,457	,091	,008
2	,452	-,826	,263	,110	,179
3	-,501	-,056	,817	,105	-,260
4	-,086	,042	,230	-,791	,559
5	-,220	,138	,043	,586	,767

Extraction Method: Principal Component Analysis.

Rotation Method: Varimax with Kaiser Normalization.

Unfortunately, the factor of “I feel well informed about the new philosophy” (0,524) shows low extraction value and is therefore eliminated. In a second iteration, “Perception of culture change: new philosophy” (value 0,540), is furthermore eliminated. A third iteration took out “In my opinion we should do more boundary spanning towards customers” (0,496), and a fourth iteration took out “What is your assessment about our VET department’s sustainability/preparedness for future demands?” (0,543).

All remaining extraction values are above ,620 and the final component analysis shows rotation sums of squared loading of cumulative 72,971% with four components.

KMO and Bartlett's Test

Kaiser-Meyer-Olkin Measure of Sampling Adequacy.		,805
Bartlett's Test of Sphericity	Approx. Chi-Square	827,177
	df	91
	Sig.	<,001

Communalities

	Initial	Extraction
in my opinion we should do more external boundary spanning.	1,000	,837
My management acts as a role model regarding boundary spanning across training centers.	1,000	,609
Perception of culture change: new normal/virtual collaboration	1,000	,658
Perception of culture change: hybrid VET training formats	1,000	,749
Perception of culture change: leadership behavior/style	1,000	,620
Perception of culture change: trust within the team	1,000	,678
Evaluation of culture change: new normal/virtual collaboration	1,000	,727
Evaluation of culture change: hybrid VET training formats	1,000	,659
Evaluation of culture change: new philosophy	1,000	,860
Evaluation of culture change: leadership behavior/style	1,000	,772
Evaluation of culture change: trust within the team	1,000	,663
New VET philosophy enables us to better support and develop our learners' competencies.	1,000	,798
I look forward to implementing our new VET philosophy.	1,000	,888
I feel well supported by my manager regarding our new VET philosophy.	1,000	,700

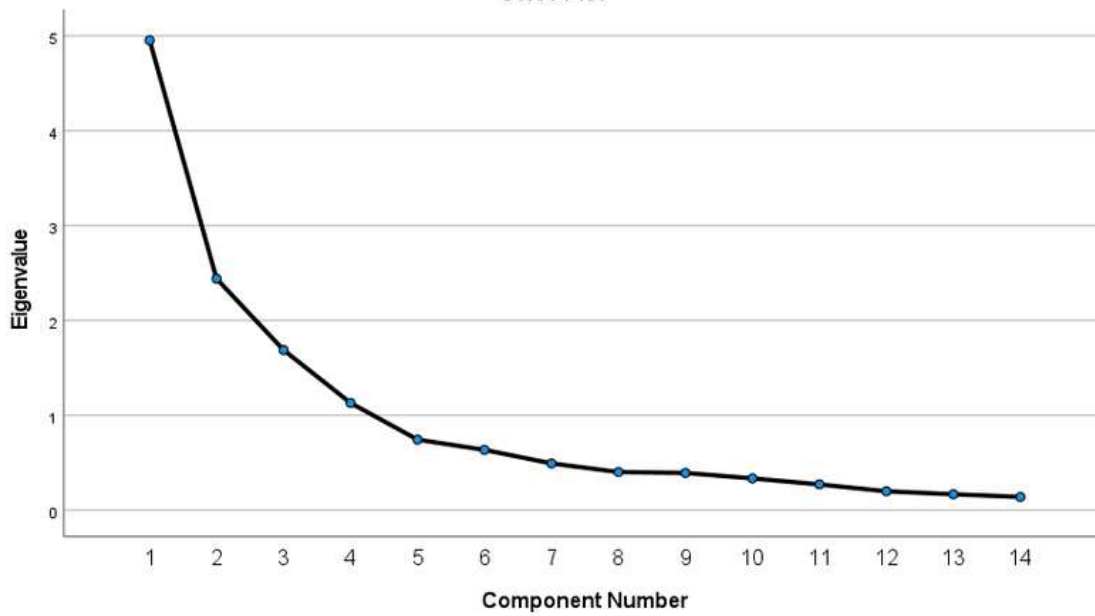
Extraction Method: Principal Component Analysis.

Total Variance Explained

Component	Initial Eigenvalues			Extraction Sums of Squared Loadings			Rotation Sums of Squared Loadings		
	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %
1	4,955	35,393	35,393	4,955	35,393	35,393	3,570	25,501	25,501
2	2,441	17,435	52,827	2,441	17,435	52,827	2,926	20,901	46,401
3	1,689	12,065	64,893	1,689	12,065	64,893	2,564	18,316	64,717
4	1,131	8,078	72,971	1,131	8,078	72,971	1,155	8,253	72,971
5	,745	5,319	78,290						
6	,636	4,543	82,833						
7	,493	3,524	86,357						
8	,403	2,876	89,232						
9	,393	2,804	92,037						
10	,335	2,395	94,432						
11	,272	1,944	96,376						
12	,199	1,424	97,801						
13	,168	1,201	99,001						
14	,140	,999	100,000						

Extraction Method: Principal Component Analysis.

Scree Plot



Rotated Component Matrix^a

	Component			
	1	2	3	4
in my opinion we should do more external boundary spanning.				,909
My management acts as a role model regarding boundary spanning across training centers.	,668			
Perception of culture change: new normal/virtual collaboration			,776	
Perception of culture change: hybrid VET training formats			,840	
Perception of culture change: leadership behavior/style	,732			
Perception of culture change: trust within the team	,791			
Evaluation of culture change: new normal/virtual collaboration			,733	
Evaluation of culture change: hybrid VET training formats			,725	
Evaluation of culture change: new philosophy		,907		
Evaluation of culture change: leadership behavior/style	,827			
Evaluation of culture change: trust within the team	,786			
New VET philosophy enables us to better support and develop our learners' competencies.		,891		
I look forward to implementing our new VET philosophy.		,933		
I feel well supported by my manager regarding our new VET philosophy.	,700			

Extraction Method: Principal Component Analysis.

Rotation Method: Varimax with Kaiser Normalization.

a. Rotation converged in 5 iterations.

Component Transformation Matrix

Component	1	2	3	4
1	,736	,443	,511	-,022
2	-,392	,893	-,211	-,067
3	-,541	-,057	,821	-,173
4	-,106	,061	,142	,982

Extraction Method: Principal Component Analysis.
 Rotation Method: Varimax with Kaiser Normalization.

As four different latent variables indicating culture change, the following can be retained.

1. LEADERSHIP&TRUST
2. NEW VET PHILOSOPHY (COPEd)
3. Virtual and hybrid formats indicating DIGITAL TRANSFORMATION
4. BOUNDARY SPANNING externally towards the ecosystem

The rotation sums of squared loading cumulative show 72,971% (vs. 73,473% before) and have not substantially worsened.

Final PCA result: culture change in VET



For the sake of complete data representation, the descriptive stats of the latent variables are included here.

Descriptive Statistics									
	N	Minimum	Maximum	Mean	Std. Deviation	Skewness		Kurtosis	
	Statistic	Statistic	Statistic	Statistic	Statistic	Statistic	Std. Error	Statistic	Std. Error
Motivation for training: enthusiasm 1 for analysis 1	99	-5,42497	,86534	,0000000	1,00000000	-2,094	,243	7,578	,481
Motivation for training: sense of duty 2 for analysis 1	99	-2,20726	1,65478	,0000000	1,00000000	-,112	,243	-,538	,481
Motivation for training: recognition 3 for analysis 1	99	-1,77247	1,97583	,0000000	1,00000000	-,064	,243	-,856	,481
Learning preference: virtual	64	-2,75676	1,99574	,0000000	1,00000000	-,725	,299	,741	,590
Learning preference: social	64	-3,20321	2,03728	,0000000	1,00000000	-,833	,299	1,532	,590
Learning preference: self-paced	64	-1,99012	2,26917	,0000000	1,00000000	,426	,299	-,462	,590
Learning preference: classical classroom	64	-3,43969	1,46583	,0000000	1,00000000	-1,421	,299	2,510	,590
Training activity: open setup	133	-3,25885	2,33700	,0000000	1,00000000	-,451	,210	,241	,417
Training activity: systematic setup	133	-4,66198	1,89228	,0000000	1,00000000	-1,473	,210	3,846	,417
Training activity: people-oriented setup	133	-3,75549	1,79047	,0000000	1,00000000	-,789	,210	,472	,417
BOUNDARY SPANNER CHARACTERISTICS	147	-3,43967	1,56115	,0000000	1,00000000	-,508	,200	,111	,397
Conditions: RELATIONAL ABILITIES	164	-3,75093	1,28211	,0000000	1,00000000	-1,061	,190	1,593	,377
CULTURE: LEADERSHIP&TRUST	111	-2,53917	1,85638	,0000000	1,00000000	-,689	,229	,107	,455
CULTURE: NEW PHILOSOPHY COPED	111	-2,54387	1,69606	,0000000	1,00000000	-,733	,229	-,066	,455
CULTURE: DIGITAL TRANSFORMATION (hybrid and virtual)	111	-3,62838	1,54174	,0000000	1,00000000	-1,108	,229	1,431	,455
CULTURE: BOUNDARY SPANNING EXT	111	-2,65430	2,90084	,0000000	1,00000000	,101	,229	,177	,455
Valid N (listwise)	23								

4.8 Activities reloaded

To properly analyze possible interdependencies between boundary spanner characteristics and activities, the PCA of chapter 4.4. must be redone; the rationale is the same as in chapter 4.7. The original variable of “Which (relational/social) aspects do you consider relevant for a good training? Networking (across hierarchies)” has to be taken out of the set of original variables used for the PCA because it is used in defining the latent variable “boundary spanning characteristics” which serves as one of the dependent variables later in the regression analysis

part. Again, the author strives to avoid having the same original variable as both part of y and of x (independent and dependent variable, respectively) in regression modelling.

KMO and Bartlett's Test

Kaiser-Meyer-Olkin Measure of Sampling Adequacy.		,809
Bartlett's Test of Sphericity	Approx. Chi-Square	462,405
	df	66
	Sig.	<,001

Communalities

	Initial	Extraction
Which (conceptional/methodological) aspects do you consider relevant for a good training? use cases	1,000	,503
Which (conceptional/methodological) aspects do you consider relevant for a good training? methodics	1,000	,737
Which (conceptional/methodological) aspects do you consider relevant for a good training? preparation	1,000	,768
Which (conceptional/methodological) aspects do you consider relevant for a good training? experiments	1,000	,559
Which (conceptional/methodological) aspects do you consider relevant for a good training? flexibility	1,000	,583
Which (conceptional/methodological) aspects do you consider relevant for a good training? interdisciplinary/networking	1,000	,540
Which (conceptional/methodological) aspects do you consider relevant for a good training? importance of topic for me	1,000	,454
Which (relational/social) aspects do you consider relevant for a good training? empathy	1,000	,466
Which (relational/social) aspects do you consider relevant for a good training? role models	1,000	,667
Which (relational/social) aspects do you consider relevant for a good training? mutual trust	1,000	,632
Which (relational/social) aspects do you consider relevant for a good training? mutual exchange	1,000	,534
Which (relational/social) aspects do you consider relevant for a good training? safe atmosphere	1,000	,337

Extraction Method: Principal Component Analysis.

Total Variance Explained

Component	Initial Eigenvalues			Extraction Sums of Squared Loadings			Rotation Sums of Squared Loadings		
	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %
1	4,169	34,743	34,743	4,169	34,743	34,743	2,494	20,781	20,781
2	1,464	12,196	46,939	1,464	12,196	46,939	2,281	19,009	39,790
3	1,147	9,557	56,496	1,147	9,557	56,496	2,005	16,706	56,496
4	,894	7,452	63,948						
5	,844	7,036	70,985						
6	,747	6,224	77,208						
7	,635	5,292	82,501						
8	,567	4,729	87,229						
9	,469	3,904	91,134						
10	,396	3,301	94,435						
11	,388	3,233	97,668						
12	,280	2,332	100,000						

Extraction Method: Principal Component Analysis.

While KMO is sufficient and model significance is a given, the cumulative % of rotation sum of current loadings is rather low (56,496). Therefore, the factor with the single lowest extraction value (“safe atmosphere”) is eliminated from the analysis.

KMO and Bartlett's Test

Kaiser-Meyer-Olkin Measure of Sampling Adequacy.		,804
Bartlett's Test of Sphericity	Approx. Chi-Square	435,426
	df	55
	Sig.	<,001

Total Variance Explained

Component	Initial Eigenvalues			Extraction Sums of Squared Loadings			Rotation Sums of Squared Loadings		
	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %
1	3,946	35,872	35,872	3,946	35,872	35,872	2,359	21,448	21,448
2	1,431	13,010	48,882	1,431	13,010	48,882	2,133	19,387	40,835
3	1,095	9,958	58,840	1,095	9,958	58,840	1,980	18,005	58,840
4	,860	7,817	66,657						
5	,770	7,003	73,660						
6	,678	6,167	79,827						
7	,620	5,639	85,466						
8	,508	4,622	90,088						
9	,411	3,736	93,824						
10	,401	3,643	97,468						
11	,279	2,532	100,000						

Extraction Method: Principal Component Analysis.

Communalities

	Initial	Extraction
Which (conceptional/methodological) aspects do you consider relevant for a good training? use cases	1,000	,505
Which (conceptional/methodological) aspects do you consider relevant for a good training? methodics	1,000	,740
Which (conceptional/methodological) aspects do you consider relevant for a good training? preparation	1,000	,791
Which (conceptional/methodological) aspects do you consider relevant for a good training? experiments	1,000	,556
Which (conceptional/methodological) aspects do you consider relevant for a good training? flexibility	1,000	,619
Which (conceptional/methodological) aspects do you consider relevant for a good training? interdisciplinary/networking	1,000	,581
Which (conceptional/methodological) aspects do you consider relevant for a good training? importance of topic for me	1,000	,450
Which (relational/social) aspects do you consider relevant for a good training? empathy	1,000	,446
Which (relational/social) aspects do you consider relevant for a good training? role models	1,000	,609
Which (relational/social) aspects do you consider relevant for a good training? mutual trust	1,000	,643
Which (relational/social) aspects do you consider relevant for a good training? mutual exchange	1,000	,532

Extraction Method: Principal Component Analysis.

Barbara OFSTAD

Furthermore, “empathy” must be eliminated because cumulative % of rotation sum of current loading does not significantly improve (58,840) compared to the first iteration.

Taking out “empathy” brings the total number of components down to 10 (KMO 0,828, Chi Square 484,044, sig < 0,001), while cumulative % of rotation sum of current loading rises to 64.712, whereas all extraction factors are >0,5.

KMO and Bartlett's Test

Kaiser-Meyer-Olkin Measure of Sampling Adequacy.		,828
Bartlett's Test of Sphericity	Approx. Chi-Square	484,044
	df	45
	Sig.	<,001

Total Variance Explained

Component	Initial Eigenvalues			Extraction Sums of Squared Loadings			Rotation Sums of Squared Loadings		
	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %
1	4,165	41,655	41,655	4,165	41,655	41,655	2,430	24,297	24,297
2	1,301	13,011	54,666	1,301	13,011	54,666	2,178	21,783	46,080
3	1,005	10,046	64,712	1,005	10,046	64,712	1,863	18,632	64,712
4	,754	7,541	72,253						
5	,659	6,586	78,839						
6	,593	5,934	84,773						
7	,544	5,438	90,211						
8	,367	3,669	93,881						
9	,359	3,587	97,467						
10	,253	2,533	100,000						

Extraction Method: Principal Component Analysis.

Communalities

	Initial	Extraction
Which (conceptional/methodological) aspects do you consider relevant for a good training? use cases	1,000	,603
Which (conceptional/methodological) aspects do you consider relevant for a good training? methodics	1,000	,770
Which (conceptional/methodological) aspects do you consider relevant for a good training? preparation	1,000	,833
Which (conceptional/methodological) aspects do you consider relevant for a good training? experiments	1,000	,581
Which (conceptional/methodological) aspects do you consider relevant for a good training? flexibility	1,000	,644
Which (conceptional/methodological) aspects do you consider relevant for a good training? interdisciplinary/networking	1,000	,608
Which (conceptional/methodological) aspects do you consider relevant for a good training? importance of topic for me	1,000	,576
Which (relational/social) aspects do you consider relevant for a good training? role models	1,000	,601
Which (relational/social) aspects do you consider relevant for a good training? mutual trust	1,000	,680
Which (relational/social) aspects do you consider relevant for a good training? mutual exchange	1,000	,576

Extraction Method: Principal Component Analysis.

Rotated Component Matrix^a

	Component		
	1	2	3
Which (conceptional/methodological) aspects do you consider relevant for a good training? use cases		,663	
Which (conceptional/methodological) aspects do you consider relevant for a good training? methodics		,831	
Which (conceptional/methodological) aspects do you consider relevant for a good training? preparation		,892	
Which (conceptional/methodological) aspects do you consider relevant for a good training? experiments	,705		
Which (conceptional/methodological) aspects do you consider relevant for a good training? flexibility	,786		
Which (conceptional/methodological) aspects do you consider relevant for a good training? interdisciplinary/networking	,751		
Which (conceptional/methodological) aspects do you consider relevant for a good training? importance of topic for me			,741
Which (relational/social) aspects do you consider relevant for a good training? role models			,729
Which (relational/social) aspects do you consider relevant for a good training? mutual trust	,569		,594
Which (relational/social) aspects do you consider relevant for a good training? mutual exchange	,508		,507

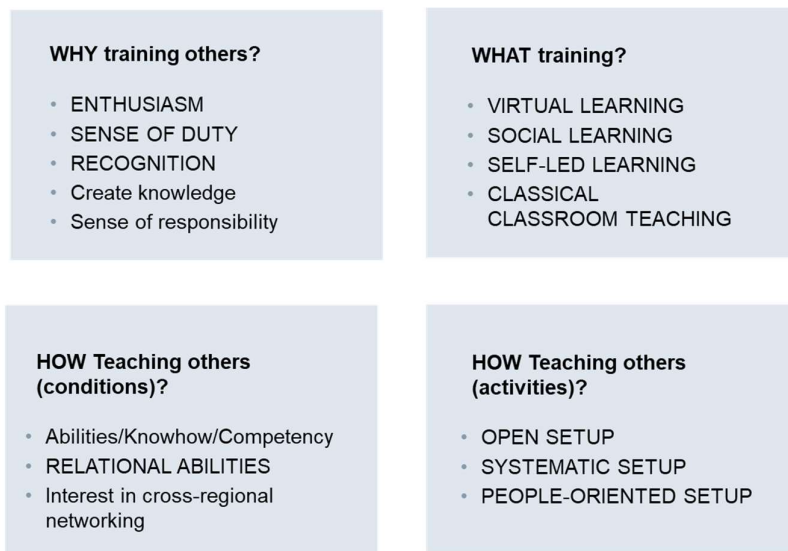
Extraction Method: Principal Component Analysis.
Rotation Method: Varimax with Kaiser Normalization.

a. Rotation converged in 5 iterations.

This brings us to three principal components defining activities:

1. OPEN SETUP – considering experiments, flexibility, and interdisciplinary aspects, with mutual trust and exchange
2. SYSTEMATIC SETUP – with use cases, preparation and methodic
3. PEOPLE-ORIENTED SETUP – invoking role models, mutual trust, and exchange as well as a personal importance of the topic for learner

While the overarching themes remain the same, these latent variables are differently composed than the ones defined in chapter 4.4. Therefore, they will be saved anew in the databases. This time, the original variable “use cases” is part of the systematic setup, despite the skewness.



N.B.: Factors in CAPITAL letters are latent variables derived from Principle Component Analysis

4.9 Relevant results vs. Control variables

A few relevant dependent variables and latent variables will be analyzed in the following subchapter as to their correlation with independent variables (role, age group, size of training center, experience in different training centers.)

Please note that the following scales for independent variables apply, codified in 1-5 respectively 1-3 for each answer:

2. Which age group do you belong to? *

- < 30 years
- 30-39 years
- 40-49 years
- 50-59 years
- > 59 years

3. How big is the training center where you currently work? *

- small (<5 people)
- medium (5-15 people)
- big (> 15 people)

4. How many training centers have you worked at as part of regular staff (including the current one)? *

- Only this training center
- Two in total
- Three or more in total

4.4.10 Sustainability vs. Control variables

What is your assessment about our VET department's sustainability/preparedness for future demands? * Which role/task do you mostly carry out in the VET department?

What is your assessment about our VET department's sustainability

Which role/task do you mostly carry out in the VET department?	Mean	N	Std. Deviation
Führungskraft	7,72	25	1,458
GSP / BO OS	8,67	24	1,167
Mentor (auch Coach oder Lernprozessbegleiter)	7,00	28	2,073
Sonstiges	7,76	21	2,364
Trainer	6,81	74	2,321
Total	7,35	172	2,132

Trainers have a less positive view of the future preparedness of the department, which is a significant finding as can be seen from the next chart.

ANOVA Table

			Sum of Squares	df	Mean Square	F	Sig.
What is your assessment about our VET department's sustainability/preparedness for future demands? * Which role/task do you mostly carry out in the VET department?	Between Groups	(Combined)	73,536	4	18,384	4,364	,002
	Within Groups		703,534	167	4,213		
	Total		777,070	171			

What is your assessment about our VET department's sustainability/preparedness for future demands? * Which age group do you belong to?

What is your assessment about our VET department's sustainability

Which age group do you belong to?	Mean	N	Std. Deviation
1	7,67	9	1,936
2	7,38	52	1,891
3	7,18	55	2,065
4	7,38	47	2,355
5	7,67	9	3,082
Total	7,35	172	2,132

ANOVA Table

			Sum of Squares	df	Mean Square	F	Sig.
What is your assessment about our VET department's sustainability/preparedness for future demands? * Which age group do you belong to?	Between Groups	(Combined)	3,474	4	,868	,187	,945
	Within Groups		773,596	167	4,632		
	Total		777,070	171			

The attitude re: future preparedness of the department is not significantly dependent of age.

What is your assessment about our VET department's sustainability/preparedness for future demands? * How big is the training center where you currently work?

What is your assessment about our VET department's sustainability

How big is the training center where you currently work?	Mean	N	Std. Deviation
1	7,92	12	1,379
2	7,18	73	2,162
3	7,41	87	2,192
Total	7,35	172	2,132

Small training centers staff seems to feel more positive about the preparedness of the department for future challenges. The difference, however, shows not to be significant (0,499) in the next table:

ANOVA Table

		Sum of Squares	df	Mean Square	F	Sig.
What is your assessment about our VET department's sustainability/preparedness for future demands? * How big is the training center where you currently work?	Between Groups (Combined)	6,365	2	3,182	,698	,499
	Within Groups	770,705	169	4,560		
	Total	777,070	171			

What is your assessment about our VET department's sustainability/preparedness for future demands? * How many training centers have you worked at as part of regular staff (including the current one)?

What is your assessment about our VET department's sustainability

How many training centers have you worked at as part of regular staff (including the current one)?	Mean	N	Std. Deviation
1	7,19	116	2,238
2	7,43	37	2,076
3	8,16	19	1,302
Total	7,35	172	2,132

ANOVA Table

			Sum of Squares	df	Mean Square	F	Sig.
What is your assessment about our VET department's sustainability/preparedness for future demands? * How many training centers have you worked at as part of regular staff (including the current one)?	Between Groups (Combined)		15,635	2	7,817	1,735	,180
	Within Groups		761,435	169	4,506		
	Total		777,070	171			

Staff with experience in more than two training centers feels more positive about the preparedness of the department for future challenges. Again, significance of this finding is not a given if you consider ANOVA (Sig. = 0,180).

4.4.11 Boundary Spanning vs. control variables

Boundary spanner characteristics proves to significantly correlate with role. However, as can be seen from the following tables, it does not correlate to age group and size of training center, nor experience in many different training centers, if you look at significance.

Report

BOUNDARY SPANNER CHARACTERISTICS

Which role/task do you mostly carry out in the VET department?

	Mean	N	Std. Deviation
Führungskraft	,4271373	23	,63259786
GSP / BO OS	,5045095	22	,77803381
Mentor (auch Coach oder Lernprozessbegleiter)	-,1709658	26	,83511790
Sonstiges	,0056175	17	1,33694606
Trainer	-,2809110	59	1,04417479
Total	,0000000	147	1,00000000

ANOVA Table

			Sum of Squares	df	Mean Square	F	Sig.
BOUNDARY SPANNER CHARACTERISTICS * Which role/task do you mostly carry out in the VET department?	Between Groups (Combined)		15,212	4	3,803	4,129	,003
	Within Groups		130,788	142	,921		
	Total		146,000	146			

It is very interesting and somewhat unexpected to see that indeed, the means of trainers and mentors (i.e., trainers for dual students) regarding boundary spanner characteristics are negative. In other words, managers and headquarters staff score positively regarding boundary

spanner characteristics, whereas trainers and mentors have negative scores. Other functions (in German: “Sonstiges”) are basically neutral.

BOUNDARY SPANNER CHARACTERISTICS * Which age group do you belong to?

Report

BOUNDARY SPANNER CHARACTERISTICS

Which age group do you belong to?	Mean	N	Std. Deviation
1	,4588988	8	,82203173
2	-,1384377	43	,96247865
3	-,0291059	48	1,00476188
4	,0895438	42	1,05775271
5	-,0136877	6	1,10941510
Total	,0000000	147	1,00000000

ANOVA Table

		Sum of Squares	df	Mean Square	F	Sig.
BOUNDARY SPANNER CHARACTERISTICS * Which age group do you belong to?	Between Groups (Combined)	2,887	4	,722	,716	,582
	Within Groups	143,113	142	1,008		
	Total	146,000	146			

Measures of Association

	Eta	Eta Squared
BOUNDARY SPANNER CHARACTERISTICS * Which age group do you belong to?	,141	,020

Report

BOUNDARY SPANNER CHARACTERISTICS

How many training centers have you worked at as part of regular staff (including the current one)?	Mean	N	Std. Deviation
1	-,1290978	98	1,02990630
2	,2253357	31	1,00389191
3	,3147875	18	,68110891
Total	,0000000	147	1,00000000

ANOVA Table

			Sum of Squares	df	Mean Square	F	Sig.
BOUNDARY SPANNER CHARACTERISTICS * How many training centers have you worked at as part of regular staff (including the current one)?	Between Groups	(Combined)	4,991	2	2,495	2,548	,082
	Within Groups		141,009	144	,979		
	Total		146,000	146			

BOUNDARY SPANNER CHARACTERISTICS * How big is the training center where you currently work?

Report

BOUNDARY SPANNER CHARACTERISTICS

How big is the training center where you currently work?	Mean	N	Std. Deviation
1	,2302818	11	,62113649
2	-,0211969	58	,90444704
3	-,0167139	78	1,11006801
Total	,0000000	147	1,00000000

ANOVA Table

			Sum of Squares	df	Mean Square	F	Sig.
BOUNDARY SPANNER CHARACTERISTICS * How big is the training center where you currently work?	Between Groups	(Combined)	,631	2	,316	,313	,732
	Within Groups		145,369	144	1,010		
	Total		146,000	146			

Measures of Association

	Eta	Eta Squared
BOUNDARY SPANNER CHARACTERISTICS * How big is the training center where you currently work?	,066	,004

Report

BOUNDARY SPANNER CHARACTERISTICS

How many training centers have you worked at as part of regular staff (including the current one)?

	Mean	N	Std. Deviation
1	-,1290978	98	1,02990630
2	,2253357	31	1,00389191
3	,3147875	18	,68110891
Total	,0000000	147	1,00000000

ANOVA Table

		Sum of Squares	df	Mean Square	F	Sig.
BOUNDARY SPANNER CHARACTERISTICS * How many training centers have you worked at as part of regular staff (including the current one)?	Between Groups (Combined)	4,991	2	2,495	2,548	,082
	Within Groups	141,009	144	,979		
	Total	146,000	146			

Measures of Association

	Eta	Eta Squared
BOUNDARY SPANNER CHARACTERISTICS * How many training centers have you worked at as part of regular staff (including the current one)?	,185	,034

As we have seen, boundary spanner characteristics are role dependent. Having established this, the variable “ROLE_MGR_NONMGR” was created with the two values 1 = Trainer; 2 = MGR/HQ. Within trainer are subsumed trainers and mentors, within MGR/HQ are subsumed managers and headquarters staff.

5. Regression Analysis Boundary Spanner Characteristics

5.1 Introduction

A linear regression model strives to define the relationship between variables mathematically and can then be used for simple predictions (Coopers and Schindler (2014), p. 479).

An equation would define the dependent variable $y = f(x)$, in this case, boundary spanner characteristics, as an independent variable x with slope β_1 and Y intercept point β_0 .

The following assumptions must be met (Lund and Lund, 2020):

- (a) The dependent variable must be measured on a continuous scale. As both BOUNDARY SPANNING CHARACTERISTICS and DIGITAL TRANSFORMATION CHARACTERISTICS are latent variables derived by PCA, they are indeed continuous.
- (b) Two or more independent variables can be continuous or categorical (ordinal or nominal).
- (c) Independence of observations should be a given (not very relevant here, because we have a questionnaire and no timelines with natural order), as well as
- (d) a supposed linear relationship,
- (e) homoscedasticity (assumption of equal or similar variances in different groups being compared, also a given because of the initial Likert model),
- (f) no multicollinearity (which had already been established during the PCA via VARIOMAX and can be seen in the table below),
- (g) and there should not be significant outliers (as the original variables are all based on Likert scales, that is not possible).

5.2 Establishing correlations for multiple regression

First, we look at the correlation table for all latent variables derived in the previous chapters to identify those relevant for a linear regression. As you can see from these correlations across latent variables, boundary spanner characteristics correlate significantly with $p < 0,01^{**}$ with ROLE_MGR_NONMGR, OPEN TRAINING SETUP, PEOPLE-ORIENTED SETUP as well as ENTHUSIASM, CULTURE: NEW VET PHILOSOPHY (COPEd) and RELATIONAL ABILITIES.

It furthermore correlates with $p < 0,05^*$ as to LEARNING PREFERENCE: VIRTUAL and LEARNING PREFERENCE: CLASSICAL CLASSROOM.

Correlations

		BOUNDARY SPANNER CHARACTERISTICS	What is your assessment about our VET department's sustainability/preparedness for future demands?	My management acts as a role model regarding boundary spanning across training centers.	Did you ever carry out a training for colleagues of other training centers?
BOUNDARY SPANNER CHARACTERISTICS	Pearson Correlation	1	,168*	,166	-,105
	Sig. (2-tailed)		,042	,051	,204
	N	147	146	139	147
What is your assessment about our VET department's sustainability/preparedness for future demands?	Pearson Correlation	,168*	1	,466**	-,041
	Sig. (2-tailed)	,042		<,001	,590
	N	146	172	157	172
My management acts as a role model regarding boundary spanning across training centers.	Pearson Correlation	,166	,466**	1	-,125
	Sig. (2-tailed)	,051	<,001		,117
	N	139	157	158	158
Did you ever carry out a training for colleagues of other training centers?	Pearson Correlation	-,105	-,041	-,125	1
	Sig. (2-tailed)	,204	,590	,117	
	N	147	172	158	175

*. Correlation is significant at the 0.05 level (2-tailed).

**. Correlation is significant at the 0.01 level (2-tailed).

We also look at some of the non-latent (original) variables again, as we suppose they are relevant for this model. It is interesting to see a significance ($p=0,042$) in correlation between boundary spanner characteristics and the assessment about the department's sustainability/preparedness for future demands.

Furthermore, we retain the variable `ROLE_MGR_NONMGR` which we established in the previous chapter.

A regression model will be aspired for that should consider variables with significant correlation values in view of boundary spanner characteristics. At the same time, variables should be independent (read: uncorrelated) from each other. We can see above that the variables under consideration do not correlate, other than:

- You see from the table above that “management acting as a role model” correlates** with department's sustainability. As the same original variable does not significantly correlate with BOUNDARY SPANNER CHARACTERISTICS, this can be ignored.
- You see from the table on the page before that OPEN TRAINING SET-UP correlates significantly with ENTHUSIASM, SOCIAL LEARNING PREFERENCE, CULTURE: LEADERSHIP AND TRUST and RELATIONAL ABILITIES **. This must be carefully managed in the following steps.
- SYSTEMATIC TRAINING SET-UP correlates ** with SENSE OF DUTY and ENTHUSIASM. As it, however, does not correlate with BSC, it can be ignored.
- TRAINING ACTIVITY: PEOPLE-ORIENTED SETUP correlates with CULTURE: LEADERSHIP&TRUST* and RELATIONAL ABILITIES**. This must be carefully managed in the following steps.
- LEARNING PREFERENCE: CLASSROOM correlates with `ROLE_MGR_NONMGR`. This must be carefully managed in the following steps. (It

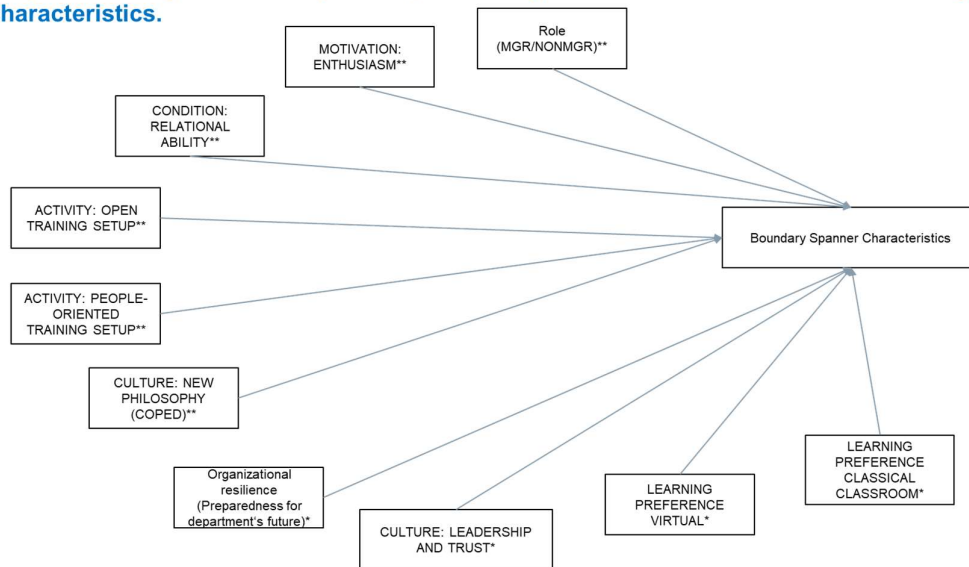
also correlates with recognition but that can be ignored as the latter does not correlate with BSC).

- SUSTAINABILITY correlates with ROLE_MGR_NONMGR, LEARNING PREFERENCE: VIRTUAL, CULTURE: LEADERSHIP AND TRUST and CULTURE: NEW PHILOSOPHY. This must be carefully managed in the following steps.
- “SOCIAL LEARNING” correlates with “OPEN SETUP” and “RELATIONAL ABILITIES” but not with “BOUNDARY SPANNER CHARACTERISTICS, such that it can be ignored here.

5.3 Multiple regression models (Models A-C)

Here is the overview of the variables suitable for a linear regression model:

How and why does boundary spanning occur in VET in the context of digital transformation? Simple linear regression components, all with significant * or ** correlation to boundary spanner characteristics.



We do a first attempt with all variables included (Scenario A):

Model Summary^b

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	,756 ^a	,572	,183	,68741549

a. Predictors: (Constant), What is your assessment about our VET department's sustainability/preparedness for future demands?, Motivation for training: enthusiasm 1 for analysis 1, CULTURE: LEADERSHIP&TRUST , TRAINING ACTIVITY: PEOPLE-ORIENTED SETUP, 1 = Trainer; 2 = MGR/HQ, Learning preference: virtual, Conditions: RELATIONAL ABILITIES , Learning preference: classical classroom, TRAINING ACTIVITY: OPEN SETUP, CULTURE: NEW PHILOSOPHY COPED

b. Dependent Variable: BOUNDARY SPANNER CHARACTERISTICS

ANOVA^a

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	6,950	10	,695	1,471	,268 ^b
	Residual	5,198	11	,473		
	Total	12,148	21			

a. Dependent Variable: BOUNDARY SPANNER CHARACTERISTICS

b. Predictors: (Constant), What is your assessment about our VET department's sustainability/preparedness for future demands?, Motivation for training: enthusiasm 1 for analysis 1, CULTURE: LEADERSHIP&TRUST , TRAINING ACTIVITY: PEOPLE-ORIENTED SETUP, 1 = Trainer; 2 = MGR/HQ, Learning preference: virtual, Conditions: RELATIONAL ABILITIES , Learning preference: classical classroom, TRAINING ACTIVITY: OPEN SETUP, CULTURE: NEW PHILOSOPHY COPED

Coefficients^a

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.
		B	Std. Error	Beta		
1	(Constant)	-1,742	1,135		-1,534	,153
	1 = Trainer; 2 = MGR/HQ	,512	,434	,339	1,181	,263
	TRAINING ACTIVITY: OPEN SETUP	-,086	,400	-,088	-,215	,834
	TRAINING ACTIVITY: PEOPLE-ORIENTED SETUP	,225	,329	,255	,685	,508
	CULTURE: NEW PHILOSOPHY COPEd	-,172	,286	-,254	-,600	,561
	Motivation for training: enthusiasm 1 for analysis 1	,285	,227	,362	1,255	,236
	Conditions: RELATIONAL ABILITIES	,198	,353	,208	,559	,587
	CULTURE: LEADERSHIP&TRUST	-,082	,246	-,110	-,332	,746
	Learning preference: classical classroom	,059	,356	,060	,165	,872
	Learning preference: virtual	,179	,259	,198	,691	,504
	What is your assessment about our VET depart ment's sustainability/preparedne ss for future demands?	,155	,121	,482	1,283	,226

a. Dependent Variable: BOUNDARY SPANNER CHARACTERISTICS

Residuals Statistics^a

	Minimum	Maximum	Mean	Std. Deviation	N
Predicted Value	-,8179201	1,1640360	,0790247	,57527867	22
Residual	-,88087565	1,18873644	,00000000	,49751480	22
Std. Predicted Value	-1,559	1,886	,000	1,000	22
Std. Residual	-1,281	1,729	,000	,724	22

a. Dependent Variable: BOUNDARY SPANNER CHARACTERISTICS

Unfortunately, this does not include more than N=22 cases and significance values of the factors are not good enough. Overall ANOVA shows a poor significance of 0,268.

Therefore, all factors with an original correlation >0,01 will be taken off the linear model and only the following will be considered in Scenario B, which improves overall significance of the model with $p < 0,002^{**}$ and 49 cases included.

Scenario B:

Model Summary^b

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	,621 ^a	,386	,298	,76542147

a. Predictors: (Constant), Conditions: RELATIONAL ABILITIES , CULTURE: NEW PHILOSOPHY COPED, 1 = Trainer; 2 = MGR/HQ, TRAINING ACTIVITY: PEOPLE-ORIENTED SETUP, TRAINING ACTIVITY: OPEN SETUP, Motivation for training: enthousiasm 1 for analysis 1

b. Dependent Variable: BOUNDARY SPANNER CHARACTERISTICS

ANOVA^a

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	15,479	6	2,580	4,404	,002 ^b
	Residual	24,607	42	,586		
	Total	40,086	48			

a. Dependent Variable: BOUNDARY SPANNER CHARACTERISTICS

b. Predictors: (Constant), Conditions: RELATIONAL ABILITIES , CULTURE: NEW PHILOSOPHY COPED, 1 = Trainer; 2 = MGR/HQ, TRAINING ACTIVITY: PEOPLE-ORIENTED SETUP, TRAINING ACTIVITY: OPEN SETUP, Motivation for training: enthousiasm 1 for analysis 1

Coefficients^a

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.
		B	Std. Error	Beta		
1	(Constant)	-,931	,356		-2,613	,012
	1 = Trainer; 2 = MGR/HQ	,578	,234	,318	2,465	,018
	TRAINING ACTIVITY: OPEN SETUP	,231	,147	,224	1,576	,123
	TRAINING ACTIVITY: PEOPLE-ORIENTED SETUP	,064	,134	,064	,482	,632
	CULTURE: NEW PHILOSOPHY COPED	,181	,113	,209	1,603	,116
	Motivation for training: enthousiasm 1 for analysis 1	,092	,117	,117	,783	,438
	Conditions: RELATIONAL ABILITIES	,205	,171	,188	1,197	,238

a. Dependent Variable: BOUNDARY SPANNER CHARACTERISTICS

Residuals Statistics^a

	Minimum	Maximum	Mean	Std. Deviation	N
Predicted Value	-1,8043449	1,0137995	-,0868142	,56787922	49
Residual	-1,59827960	1,43380606	,00000000	,71598622	49
Std. Predicted Value	-3,024	1,938	,000	1,000	49
Std. Residual	-2,088	1,873	,000	,935	49

a. Dependent Variable: BOUNDARY SPANNER CHARACTERISTICS

Considering the low significance of the different factors (Adjusted R Square = 0,298, 49 cases included), an iterative attempt for a linear regression analysis will be carried out in the following, leaving out the lowest coefficient (PEOPLE-ORIENTED SETUP, then, one by one: ENTHUSIASM, RELATIONAL ABILITIES, CULTURE: NEW PHILOSOPHY COPED) for a Scenario C. The aim is to include as many cases of the n=147 cases as possible where boundary spanner characteristics can be established.

Scenario C:**Model Summary^b**

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	,518 ^a	,269	,255	,79846142

a. Predictors: (Constant), TRAINING ACTIVITY: OPEN SETUP, 1 = Trainer; 2 = MGR/HQ

b. Dependent Variable: BOUNDARY SPANNER CHARACTERISTICS

ANOVA^a

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	25,769	2	12,885	20,210	<,001 ^b
	Residual	70,129	110	,638		
	Total	95,898	112			

a. Dependent Variable: BOUNDARY SPANNER CHARACTERISTICS

b. Predictors: (Constant), TRAINING ACTIVITY: OPEN SETUP, 1 = Trainer; 2 = MGR/HQ

Coefficients^a

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.
		B	Std. Error	Beta		
1	(Constant)	-1,045	,227		-4,601	<,001
	1 = Trainer; 2 = MGR/HQ	,755	,156	,396	4,833	<,001
	TRAINING ACTIVITY: OPEN SETUP	,283	,078	,298	3,643	<,001

a. Dependent Variable: BOUNDARY SPANNER CHARACTERISTICS

Residuals Statistics^a

	Minimum	Maximum	Mean	Std. Deviation	N
Predicted Value	-1,2128992	,9145711	-,0136000	,47966714	113
Residual	-2,18421316	1,54943478	,00000000	,79130019	113
Std. Predicted Value	-2,500	1,935	,000	1,000	113
Std. Residual	-2,736	1,941	,000	,991	113

a. Dependent Variable: BOUNDARY SPANNER CHARACTERISTICS

More cases can such be expressed by the equation model (N=113), while significance (Anova) is a given with <0,001** and F rises to 20,210, with Adj. R square at 0,255. For an exploratory model, these values are satisfactory.

In a next step, it will be relevant to improve the model to potentially encompass more than N=113 cases. We will first calculate simple linear regressions for all variables correlating with significance >0,005, i.e., with only one independent variable at the time.

5.4 Simple multiple regression models

5.4.1 Role: Manager/Non-Manager

Model Summary^b

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	,357 ^a	,127	,120	,89475250

a. Predictors: (Constant), 1 = Trainer; 2 = MGR/HQ

b. Dependent Variable: BOUNDARY SPANNER CHARACTERISTICS

ANOVA^a

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	14,926	1	14,926	18,644	<,001 ^b
	Residual	102,475	128	,801		
	Total	117,401	129			

a. Dependent Variable: BOUNDARY SPANNER CHARACTERISTICS

b. Predictors: (Constant), 1 = Trainer; 2 = MGR/HQ

Coefficients^a

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.
		B	Std. Error	Beta		
1	(Constant)	-,960	,236		-4,074	<,001
	1 = Trainer; 2 = MGR/HQ	,712	,165	,357	4,318	<,001

a. Dependent Variable: BOUNDARY SPANNER CHARACTERISTICS

Please note that variance of boundary spanner characteristics in N=130 cases can be explained via the variable MGR_NONMGR.

Residuals Statistics^a

	Minimum	Maximum	Mean	Std. Deviation	N
Predicted Value	-,2472807	,4649637	-,0007346	,34015609	130
Residual	-2,37626147	1,80842698	,00000000	,89127772	130
Std. Predicted Value	-,725	1,369	,000	1,000	130
Std. Residual	-2,656	2,021	,000	,996	130

a. Dependent Variable: BOUNDARY SPANNER CHARACTERISTICS

5.4.2 Motivation: Enthusiasm

Model Summary

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	,315 ^a	,100	,089	,87030941

a. Predictors: (Constant), Motivation for training: enthusiasm 1 for analysis 1

ANOVA^a

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	7,116	1	7,116	9,395	,003 ^b
	Residual	64,382	85	,757		
	Total	71,498	86			

a. Dependent Variable: BOUNDARY SPANNER CHARACTERISTICS

b. Predictors: (Constant), Motivation for training: enthusiasm 1 for analysis 1

Coefficients^a

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.
		B	Std. Error	Beta		
1	(Constant)	-,010	,093		-,111	,912
	Motivation for training: enthusiasm 1 for analysis 1	,287	,094	,315	3,065	,003

a. Dependent Variable: BOUNDARY SPANNER CHARACTERISTICS

5.4.3 Condition: Relational Abilities

Model Summary^b

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	,367 ^a	,134	,128	,93179471

a. Predictors: (Constant), Conditions: RELATIONAL ABILITIES

b. Dependent Variable: BOUNDARY SPANNER CHARACTERISTICS

ANOVA^a

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	19,282	1	19,282	22,209	<,001 ^b
	Residual	124,159	143	,868		
	Total	143,441	144			

a. Dependent Variable: BOUNDARY SPANNER CHARACTERISTICS

b. Predictors: (Constant), Conditions: RELATIONAL ABILITIES

Coefficients^a

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.
		B	Std. Error	Beta		
1	(Constant)	-,005	,077		-,060	,952
	Conditions: RELATIONAL ABILITIES	,363	,077	,367	4,713	<,001

a. Dependent Variable: BOUNDARY SPANNER CHARACTERISTICS

Residuals Statistics^a

	Minimum	Maximum	Mean	Std. Deviation	N
Predicted Value	-1,3654876	,4604555	-,0154957	,36593111	145
Residual	-3,22661829	2,02555943	,00000000	,92855367	145
Std. Predicted Value	-3,689	1,301	,000	1,000	145
Std. Residual	-3,463	2,174	,000	,997	145

a. Dependent Variable: BOUNDARY SPANNER CHARACTERISTICS

5.4.4 Activity: Open Training Set-Up

Model Summary^b

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	,387 ^a	,150	,143	,90510276

a. Predictors: (Constant), TRAINING ACTMITY: OPEN SETUP

b. Dependent Variable: BOUNDARY SPANNER CHARACTERISTICS

ANOVA^a

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	17,895	1	17,895	21,845	<,001 ^b
	Residual	101,582	124	,819		
	Total	119,478	125			

a. Dependent Variable: BOUNDARY SPANNER CHARACTERISTICS

b. Predictors: (Constant), TRAINING ACTMITY: OPEN SETUP

Coefficients^a

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.
		B	Std. Error	Beta		
1	(Constant)	-,017	,081		-,217	,829
	TRAINING ACTIVITY: OPEN SETUP	,383	,082	,387	4,674	<,001

a. Dependent Variable: BOUNDARY SPANNER CHARACTERISTICS

5.4.5 Activity: People-Oriented Training Set-Up

Model Summary^b

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	,278 ^a	,077	,070	,94303943

a. Predictors: (Constant), TRAINING ACTMITY: PEOPLE-ORIENTED SETUP

b. Dependent Variable: BOUNDARY SPANNER CHARACTERISTICS

ANOVA^a

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	9,201	1	9,201	10,347	,002 ^b
	Residual	110,276	124	,889		
	Total	119,478	125			

a. Dependent Variable: BOUNDARY SPANNER CHARACTERISTICS

b. Predictors: (Constant), TRAINING ACTMITY: PEOPLE-ORIENTED SETUP

Coefficients^a

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.
		B	Std. Error	Beta		
1	(Constant)	-,028	,084		-,328	,744
	TRAINING ACTIVITY: PEOPLE-ORIENTED SETUP	,280	,087	,278	3,217	,002

a. Dependent Variable: BOUNDARY SPANNER CHARACTERISTICS

5.4.6 Culture: New Philosophy COPED

Variables Entered/Removed^a

Model	Variables Entered	Variables Removed	Method
1	CULTURE: NEW PHILOSOPHY COPED ^b		Enter

a. Dependent Variable: BOUNDARY SPANNER CHARACTERISTICS

b. All requested variables entered.

Model Summary^b

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	,332 ^a	,110	,101	,95156895

a. Predictors: (Constant), CULTURE: NEW PHILOSOPHY COPED

b. Dependent Variable: BOUNDARY SPANNER CHARACTERISTICS

ANOVA^a

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	11,213	1	11,213	12,384	<,001 ^b
	Residual	90,548	100	,905		
	Total	101,762	101			

a. Dependent Variable: BOUNDARY SPANNER CHARACTERISTICS

b. Predictors: (Constant), CULTURE: NEW PHILOSOPHY COPED

Coefficients^a

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.
		B	Std. Error	Beta		
1	(Constant)	-,085	,094		-,897	,372
	CULTURE: NEW PHILOSOPHY COPED	,326	,093	,332	3,519	<,001

a. Dependent Variable: BOUNDARY SPANNER CHARACTERISTICS

5.4.7 Sustainability: Assessment about department's future-orientation

Variables Entered/Removed^a

Model	Variables Entered	Variables Removed	Method
1	What is your assessment about our VET department's sustainability/preparedness for future demands? ^b	.	Enter

a. Dependent Variable: BOUNDARY SPANNER CHARACTERISTICS

b. All requested variables entered.

Model Summary^b

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	,168 ^a	,028	,022	,99220549

a. Predictors: (Constant), What is your assessment about our VET department's sustainability/preparedness for future demands?

b. Dependent Variable: BOUNDARY SPANNER CHARACTERISTICS

ANOVA^a

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	4,139	1	4,139	4,204	,042 ^b
	Residual	141,764	144	,984		
	Total	145,903	145			

a. Dependent Variable: BOUNDARY SPANNER CHARACTERISTICS

b. Predictors: (Constant), What is your assessment about our VET department's sustainability/preparedness for future demands?

Coefficients^a

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.
		B	Std. Error	Beta		
1	(Constant)	-,603	,304		-1,981	,049
	What is your assessment about our VET department's sustainability/preparedness for future demands?	,081	,040	,168	2,050	,042

a. Dependent Variable: BOUNDARY SPANNER CHARACTERISTICS

5.4.8 Culture: Leadership and Trust

Model Summary^b

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	,220 ^a	,048	,039	,98408386

a. Predictors: (Constant), CULTURE: LEADERSHIP&TRUST

b. Dependent Variable: BOUNDARY SPANNER CHARACTERISTICS

ANOVA^a

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	4,920	1	4,920	5,080	,026 ^b
	Residual	96,842	100	,968		
	Total	101,762	101			

a. Dependent Variable: BOUNDARY SPANNER CHARACTERISTICS

b. Predictors: (Constant), CULTURE: LEADERSHIP&TRUST

Coefficients^a

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.
		B	Std. Error	Beta		
1	(Constant)	-,081	,097		-,829	,409
	CULTURE: LEADERSHIP&TRUST	,221	,098	,220	2,254	,026

a. Dependent Variable: BOUNDARY SPANNER CHARACTERISTICS

5.4.9 Learning preference: Virtual

Model Summary^b

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	,278 ^a	,077	,062	,97452918

a. Predictors: (Constant), Learning preference: virtual

b. Dependent Variable: BOUNDARY SPANNER CHARACTERISTICS

ANOVA^a

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	4,778	1	4,778	5,031	,029 ^b
	Residual	56,982	60	,950		
	Total	61,760	61			

a. Dependent Variable: BOUNDARY SPANNER CHARACTERISTICS

b. Predictors: (Constant), Learning preference: virtual

Coefficients^a

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.
		B	Std. Error	Beta		
1	(Constant)	,090	,124		,730	,469
	Learning preference: virtual	,285	,127	,278	2,243	,029

a. Dependent Variable: BOUNDARY SPANNER CHARACTERISTICS

5.4.10 Learning preference: Classroom

Model Summary^b

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	,315 ^a	,099	,084	,96291092

a. Predictors: (Constant), Learning preference: classical classroom

b. Dependent Variable: BOUNDARY SPANNER CHARACTERISTICS

ANOVA^a

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	6,129	1	6,129	6,610	,013 ^b
	Residual	55,632	60	,927		
	Total	61,760	61			

a. Dependent Variable: BOUNDARY SPANNER CHARACTERISTICS

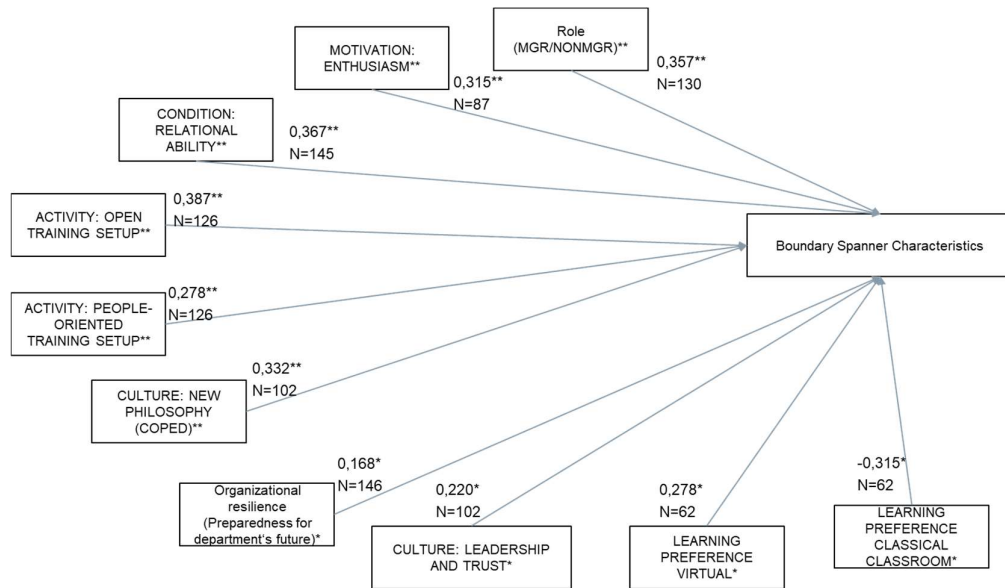
b. Predictors: (Constant), Learning preference: classical classroom

Coefficients^a

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.
		B	Std. Error	Beta		
1	(Constant)	,096	,122		,784	,436
	Learning preference: classical classroom	-,313	,122	-,315	-2,571	,013

a. Dependent Variable: BOUNDARY SPANNER CHARACTERISTICS

The regression statistical beta values in a first iteration, if computed as simple linear regression equations, show the following beta parameters:



	Variable	# of factors	N cases	Adj. R Square	F	beta	Sig.
5.4.1.	Role: Manager/Non-Manager	1	130	0,120	18,644	0,357	<0,001
5.4.2.	Motivation : Enthusiasm	1	87	0,089	9,395	0,315	0,003
5.4.3.	Condition : Relational Abilities	1	145	0,128	22,209	0,367	<0,001
5.4.4.	Activity: Open Training Set-Up	1	126	0,143	21,845	0,387	<0,001
5.4.5.	Activity: People-Oriented Training Set-Up	1	126	0,070	10,347	0,278	0,002
5.4.6.	Culture : new philosophy COPED	1	102	0,101	12,384	0,332	<0,001

5.4.7.	Sustainability: Assessment about department's future-orientation	1	146	0,022	4,204	0,168	0,042
5.4.8.	CULTURE : Leadership and Trust	1	102	0,039	5,080	0,220	0,026
5.4.9.	Learning preference : Virtual	1	62	0,062	5,031	0,278	0,029
5.4.10.	Learning preference : Classroom	1	62	0,084	6,610	-0,315	0,013

5.5 Finalizing the multiple regression model (Models C-F)

As it turns out, variables with a lower correlation to boundary spanning as dependent variable in the first place do not lead to significant regression analysis values. Yet, this exercise helps confirming that the model should be built around the four variables “Role”, “Condition: Relational Abilities”, “Activity: Open Set-Up”, “Culture: new philosophy COPED”, as we did before.

We will retain the equation from Scenario C:

$$f(\text{BOUNDARY SPANNER CHARACTERISTICS}) = - 1,045 + 0,298 \text{ TAOS} + 0,396$$

$$\text{MGR_NONMGR} (N=113),$$

$$\text{where MGR_NONMGR: } 1 = \text{Trainer, } 2 = \text{MGR/HQ}$$

It is important to note here that none of these variables shows significant correlation with other variables in the equation, as established in chapter 5.2.

Because of the importance of the relationship between boundary spanning and sustainability of VET operations (i.e., organizational resilience) as per the qualitative research, we will start from Scenario C and we strive to bring in the variable “Sustainability: assessment about department’s future-orientation”. This can be argued by hypothesizing that boundary spanning

is more related to an optimistic outlook on the VET department's future rather than to the role of manager.

Scenario D:

Model Summary^b

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	,522 ^a	,272	,252	,80352913

a. Predictors: (Constant), What is your assessment about our VET department's sustainability/preparedness for future demands?, TRAINING ACTIVITY: OPEN SETUP, 1 = Trainer; 2 = MGR/HQ

b. Dependent Variable: BOUNDARY SPANNER CHARACTERISTICS

ANOVA^a

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	26,061	3	8,687	13,454	<,001 ^b
	Residual	69,731	108	,646		
	Total	95,792	111			

a. Dependent Variable: BOUNDARY SPANNER CHARACTERISTICS

b. Predictors: (Constant), What is your assessment about our VET department's sustainability/preparedness for future demands?, TRAINING ACTIVITY: OPEN SETUP, 1 = Trainer; 2 = MGR/HQ

Coefficients^a

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.
		B	Std. Error	Beta		
1	(Constant)	-,951	,334		-2,852	,005
	1 = Trainer; 2 = MGR/HQ	,785	,165	,411	4,746	<,001
	TRAINING ACTIVITY: OPEN SETUP	,281	,078	,297	3,594	<,001
	What is your assessment about our VET department's sustainability/preparedness for future demands?	-,019	,042	-,039	-,450	,653

a. Dependent Variable: BOUNDARY SPANNER CHARACTERISTICS

Unfortunately, significance for the new variable in this multiple regression model is not manifest.

If we try to add LEARNING PREFERENCE: CLASSROOM instead of “Sustainability: assessment about department’s future-orientation”, significance cannot be established either.

Scenario E:

If we add MOTIVATION: ENTHUSIASM, the overall equation looks promising, while significance and adjusted R Square improve.

Model Summary^b

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	,583 ^a	,340	,313	,73154446

a. Predictors: (Constant), Motivation for training: enthusiasm
1 for analysis 1, 1 = Trainer; 2 = MGR/HQ, TRAINING ACTIVITY: OPEN SETUP

b. Dependent Variable: BOUNDARY SPANNER CHARACTERISTICS

ANOVA^a

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	19,609	3	6,536	12,214	<,001 ^b
	Residual	37,996	71	,535		
	Total	57,605	74			

a. Dependent Variable: BOUNDARY SPANNER CHARACTERISTICS

b. Predictors: (Constant), Motivation for training: enthusiasm 1 for analysis 1, 1 = Trainer; 2 = MGR/HQ, TRAINING ACTIVITY: OPEN SETUP

Coefficients^a

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.
		B	Std. Error	Beta		
1	(Constant)	-,855	,259		-3,303	,002
	1 = Trainer; 2 = MGR/HQ	,591	,174	,331	3,396	,001
	TRAINING ACTIVITY: OPEN SETUP	,247	,090	,283	2,743	,008
	Motivation for training: enthusiasm 1 for analysis 1	,224	,087	,265	2,588	,012

a. Dependent Variable: BOUNDARY SPANNER CHARACTERISTICS

Residuals Statistics^a

	Minimum	Maximum	Mean	Std. Deviation	N
Predicted Value	-1,8134769	,8737278	-,0605784	,51476305	75
Residual	-2,33188748	1,51436365	,00000000	,71656244	75
Std. Predicted Value	-3,405	1,815	,000	1,000	75
Std. Residual	-3,188	2,070	,000	,980	75

a. Dependent Variable: BOUNDARY SPANNER CHARACTERISTICS

Scenario E, however, does not improve the $n=113$ from Scenario C while decreasing significance of the variable OPEN SETUP. It is therefore rejected.

Scenario F:

Scenario F replaces MOTIVATION: ENTHUSIASM by the variable ACTIVITY: PEOPLE-ORIENTED SETUP.

Model Summary^b

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	,567 ^a	,321	,303	,77270839

a. Predictors: (Constant), TRAINING ACTIVITY: PEOPLE-ORIENTED SETUP, TRAINING ACTIVITY: OPEN SETUP, 1 = Trainer; 2 = MGR/HQ

b. Dependent Variable: BOUNDARY SPANNER CHARACTERISTICS

ANOVA^a

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	30,817	3	10,272	17,204	<,001 ^b
	Residual	65,082	109	,597		
	Total	95,898	112			

a. Dependent Variable: BOUNDARY SPANNER CHARACTERISTICS

b. Predictors: (Constant), TRAINING ACTIVITY: PEOPLE-ORIENTED SETUP, TRAINING ACTIVITY: OPEN SETUP, 1 = Trainer; 2 = MGR/HQ

Coefficients^a

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.
		B	Std. Error	Beta		
1	(Constant)	-,993	,220		-4,504	<,001
	1 = Trainer; 2 = MGR/HQ	,705	,152	,370	4,634	<,001
	TRAINING ACTIVITY: OPEN SETUP	,289	,075	,305	3,843	<,001
	TRAINING ACTIVITY: PEOPLE-ORIENTED SETUP	,233	,080	,231	2,908	,004

a. Dependent Variable: BOUNDARY SPANNER CHARACTERISTICS

Residuals Statistics^a

	Minimum	Maximum	Mean	Std. Deviation	N
Predicted Value	-1,3932970	,9975221	-,0136000	,52454881	113
Residual	-2,33396244	1,60393190	,00000000	,76228937	113
Std. Predicted Value	-2,630	1,928	,000	1,000	113
Std. Residual	-3,020	2,076	,000	,987	113

a. Dependent Variable: BOUNDARY SPANNER CHARACTERISTICS

In Scenario F, variance of 113 cases can be explained (as in Scenario C), Adjusted R Square is higher than in C, F is 17,204 (almost at Scenario C's level of 20.210) and the model is significant. The standard error of the estimate is slightly lower than in Scenario C. We have furthermore established in chapter 5.2 that none of these variables shows significant correlation with other variables in the equation.

We therefore retain this improved model F:

$$f(\text{BOUNDARY SPANNER CHARACTERISTICS}) = -0,993 + 0,305 \text{ TAOS}^{**} + 0,231 \text{ TAPO}^{**} + 0,370 \text{ MGR_NONMGR}^{**} \quad (N=113),$$

where MGR_NONMGR: 1 = Trainer, 2 = MGR/HQ

For the sake of completeness, please note that the author also modelled the remaining variable LEARNING PREFERENCE: VIRTUAL with and without ACTIVITY: PEOPLE-ORIENTED SETUP. In both cases, the statistical test did not show superiority of these models. Scenario F is therefore ultimately retained for quality.

6. Regression Analysis Digital Transformation Characteristics

6.1 Introduction

As this doctoral thesis is about boundary spanning in the context of digital transformation (DT), we retain the latent variable of CULTURE: Virtual and hybrid formats indicating DIGITAL TRANSFORMATION from Chapter 4.5. Exploring the dependencies of these new types of learning culture is of relevance in this quantitative study, as digital transformation is part of the research question.

6.2 Establishing correlations for multiple regression modelling

Correlations of DT and other relevant variables are shown in the table below.

Relevant correlating latent variables are

- Motivation: ENTHUSIASM**
- Training activities: SYSTEMATIC SET-UP*
- Conditions: RELATIONAL ABILITIES*

In order not to fail to see correlations with original variables, relevant original variables which are not subsumed by latent variables (as per Principal Component Analysis) are also looked at:

Correlations

		CULTURE; DIGITAL TRANSFORM ATION (hybrid and virtual)	1 = Trainer; 2 = MGR/HQ	What is your assessment about our VET depart ment's sustainability/ preparednes s for future demands?
CULTURE: DIGITAL TRANSFORMATION (hybrid and virtual)	Pearson Correlation	1	,252*	,108
	Sig. (2-tailed)		,012	,258
	N	111	98	111
1 = Trainer; 2 = MGR/HQ	Pearson Correlation	,252*	1	,296**
	Sig. (2-tailed)	,012		<,001
	N	98	153	151
What is your assessment about our VET depart ment's sustainability/preparedne ss for future demands?	Pearson Correlation	,108	,296**	1
	Sig. (2-tailed)	,258	<,001	
	N	111	151	172

*. Correlation is significant at the 0.05 level (2-tailed).

**. Correlation is significant at the 0.01 level (2-tailed).

Relevant original variables are

- Trainer/manager

6.3 Multiple regression modelling (Models G-J)

As before, we try a first multiple regression model with all variables identified above.

6.3.1 Scenario G:

ANOVA^a

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	19,913	4	4,978	7,598	<,001 ^b
	Residual	30,137	46	,655		
	Total	50,050	50			

a. Dependent Variable: Culture: DIGITAL TRANSFORMATION

b. Predictors: (Constant), TRAINING ACTIVITY: SYSTEMATIC SETUP, 1 = Trainer; 2 = MGR/HQ, Conditions: RELATIONAL ABILITIES , Motivation for training: enthusiasm 1 for analysis 1

Coefficients^a

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.
		B	Std. Error	Beta		
1	(Constant)	-,387	,355		-1,090	,281
	Motivation for training: enthusiasm 1 for analysis 1	,291	,125	,339	2,329	,024
	Conditions: RELATIONAL ABILITIES	,214	,164	,180	1,310	,197
	1 = Trainer; 2 = MGR/HQ	,286	,232	,144	1,235	,223
	TRAINING ACTIVITY: SYSTEMATIC SETUP	,197	,116	,219	1,693	,097

a. Dependent Variable: Culture: DIGITAL TRANSFORMATION

Variance of 51 cases (of n=111 for DIGITAL TRANSFORMATION) is explained, and while overall model significance is given, the different variables do not show significance.

Therefore, the least expressive variable is eliminated (TRAINER VS MANAGER).

6.3.2 Scenario H:

Model Summary^b

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	,626 ^a	,392	,356	,81487404

a. Predictors: (Constant), TRAINING ACTIVITY: SYSTEMATIC SETUP, Conditions: RELATIONAL ABILITIES , Motivation for training: enthusiasm 1 for analysis 1

b. Dependent Variable: Culture: DIGITAL TRANSFORMATION

ANOVA^a

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	21,438	3	7,146	10,762	<,001 ^b
	Residual	33,201	50	,664		
	Total	54,639	53			

a. Dependent Variable: Culture: DIGITAL TRANSFORMATION

b. Predictors: (Constant), TRAINING ACTIVITY: SYSTEMATIC SETUP, Conditions: RELATIONAL ABILITIES , Motivation for training: enthusiasm 1 for analysis 1

Coefficients^a

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.
		B	Std. Error	Beta		
1	(Constant)	,062	,114		,546	,587
	Motivation for training: enthusiasm 1 for analysis 1	,323	,124	,366	2,600	,012
	Conditions: RELATIONAL ABILITIES	,281	,159	,235	1,767	,083
	TRAINING ACTIVITY: SYSTEMATIC SETUP	,155	,114	,168	1,364	,179

a. Dependent Variable: Culture: DIGITAL TRANSFORMATION

Residuals Statistics^a

	Minimum	Maximum	Mean	Std. Deviation	N
Predicted Value	-3,1081457	,7988987	,0736189	,63600303	54
Residual	-2,66022778	1,31567824	,00000000	,79147563	54
Std. Predicted Value	-5,003	1,140	,000	1,000	54
Std. Residual	-3,265	1,615	,000	,971	54

a. Dependent Variable: Culture: DIGITAL TRANSFORMATION

This scenario is not more expressive from a significance point of view. TRAINING ACTIVITY: SYSTEMATIC SETUP is therefore eliminated.

6.3.3 Scenario I:

Model Summary^b

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	,574 ^a	,329	,305	,84489785

a. Predictors: (Constant), Conditions: RELATIONAL ABILITIES , Motivation for training: enthousiasm 1 for analysis 1

b. Dependent Variable: Culture: DIGITAL TRANSFORMATION

ANOVA^a

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	19,257	2	9,629	13,488	<,001 ^b
	Residual	39,262	55	,714		
	Total	58,519	57			

a. Dependent Variable: Culture: DIGITAL TRANSFORMATION

b. Predictors: (Constant), Conditions: RELATIONAL ABILITIES , Motivation for training: enthousiasm 1 for analysis 1

Coefficients^a

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.
		B	Std. Error	Beta		
1	(Constant)	,100	,113		,889	,378
	Motivation for training: enthusiasm 1 for analysis 1	,370	,118	,417	3,146	,003
	Conditions: RELATIONAL ABILITIES	,276	,162	,226	1,701	,095

a. Dependent Variable: Culture: DIGITAL TRANSFORMATION

As significance of the variable CONDITIONS: RELATIONAL ABILITIES remains at $p=0,095$, it is eliminated.

6.3.4 Scenario J:

Model Summary^b

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	,543 ^a	,295	,283	,85151818

a. Predictors: (Constant), Motivation for training: enthusiasm 1 for analysis 1

b. Dependent Variable: Culture: DIGITAL TRANSFORMATION

ANOVA^a

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	17,309	1	17,309	23,871	<,001 ^b
	Residual	41,330	57	,725		
	Total	58,638	58			

a. Dependent Variable: Culture: DIGITAL TRANSFORMATION

b. Predictors: (Constant), Motivation for training: enthusiasm 1 for analysis 1

Coefficients^a

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.
		B	Std. Error	Beta		
1	(Constant)	,135	,111		1,219	,228
	Motivation for training: enthusiasm 1 for analysis 1	,481	,098	,543	4,886	<,001

a. Dependent Variable: Culture: DIGITAL TRANSFORMATION

Residuals Statistics^a

	Minimum	Maximum	Mean	Std. Deviation	N
Predicted Value	-2,4724808	,5510927	,1272865	,54628268	59
Residual	-2,55313444	1,57519734	,00000000	,84414559	59
Std. Predicted Value	-4,759	,776	,000	1,000	59
Std. Residual	-2,998	1,850	,000	,991	59

a. Dependent Variable: Culture: DIGITAL TRANSFORMATION

Model J shows DIGITAL TRANSFORMATION being significantly dependent of MOTIVATION: ENTHUSIASM. This model explains variance in n=59 cases (of 111 in total). For an exploratory setting, it is a relevant finding, which needs, however, to be further manifested and explored in future studies. Adjusted R Square = 0,283, F=23,1

$$f(\text{DIGITAL TRANSFORMATION}) = 0,135 + 0,543 \text{ ENTHUSIASM}^{**} (N=59)$$

6.4 Summary

Model J explains N=59 and 28% of variance of DIGITAL TRANSFORMATION by the single latent variable “enthusiasm” (in carrying out training for others), although that seems hard to explain beyond the statistics. If we go back to Chapter 4.3, we will remember that “ENTHUSIASM” (ENTH) is made up of the willingness to create knowledge and the passion to do it, which makes this statistical finding easier to understand.

$$F(\text{DIGITAL TRANSFORMATION}) = 0,135 + 0,543 \text{ ENTH}^{**} (N=59)$$

7. Poisson regression: assessing organizational resilience and trust (Model K)

7.1 Introduction

Poisson regression is used for count outcome modelling (Coxe, West and Aiken, 2009). Poisson regression does not assume a linear relationship between the independent and dependent variables. It is traditionally used for incidence probability reporting. It is more appropriate if the expected value of the distribution is small as per Coxe *et al.* (2009), which is the case for organizational resilience (“What is your assessment about our VET department’s sustainability/preparedness for future demands?”) as a dependent variable (with ordinal values as answers ranging from 1-10).

Furthermore, in such explorative setting we use the Likelihood ratio rather than the Wald test for overall (omnibus) model assessment.

7.2 Establishing correlations for Poisson regression modelling

As per Chapter 5.2, we know that organizational resilience correlates with

- TRAINER_MANAGER **
- LEARNING PREFERENCE: VIRTUAL**
- CULTURE: LEADERSHIP AND TRUST**
- CULTURE: NEW PHILOSOPHY (COPEd)**
- My management acts as role model for boundary spanning**
- BOUNDARY SPANNER CHARACTERISTICS*

7.3 Poisson regression modelling organizational resilience

In a first attempt, we use all variables as per chapter 7.2 of this appendix.

Model Information

Dependent Variable	What is your assessment about our VET department's sustainability/preparedness for future demands?
Probability Distribution	Poisson
Link Function	Log

Case Processing Summary

	N	Percent
Included	43	24,6%
Excluded	132	75,4%
Total	175	100,0%

Continuous Variable Information

		N	Minimum	Maximum	Mean	Std. Deviation
Dependent Variable	What is your assessment about our VET department's sustainability/preparedness for future demands?	43	2	10	7,26	2,205
Covariate	1 = Trainer; 2 = MGR/HQ	43	1,00	2,00	1,3256	,47414
	BOUNDARY SPANNER CHARACTERISTICS	43	-1,88122	1,56115	,0578531	,87270570
	My management acts as a role model regarding boundary spanning across training centers.	43	1	5	3,51	1,183
	CULTURE: LEADERSHIP&TRUST	43	-2,51988	1,85638	,0820023	,95838853
	CULTURE: NEW PHILOSOPHY COPED	43	-2,54387	1,57840	-,0127530	1,02422895
	Learning preference: virtual	43	-2,75676	1,95854	,0808918	,87814844

Omnibus Test^a

Likelihood Ratio Chi-Square	df	Sig.
15,502	6	,017

Dependent Variable: What is your assessment about our VET department's sustainability/preparedness for future demands?

Model: (Intercept), 1 = Trainer; 2 = MGR/HQ, BOUNDARY SPANNER CHARACTERISTICS, My management acts as a role model regarding boundary spanning across training centers., CULTURE: LEADERSHIP&TRUST, CULTURE: NEW PHILOSOPHY COPED, Learning preference: virtual

a. Compares the fitted model against the intercept-only model.

The likelihood ratio chi-square test indicates that the full model was not yet a significant improvement in fit over a null (no predictor) model (Sig. 0,17).

In the next table, we see that there is only one variable “CULTURE: NEW PHILOSOPHY COPED” which shows statistical significance* in this model.

Tests of Model Effects

Source	Likelihood Ratio Chi-Square	Type III	
		df	Sig.
(Intercept)	603,503	1	,000
1 = Trainer; 2 = MGR/HQ	,002	1	,963
BOUNDARY SPANNER CHARACTERISTICS	,180	1	,671
My management acts as a role model regarding boundary spanning across training centers.	,011	1	,918
CULTURE: LEADERSHIP&TRUST	1,849	1	,174
CULTURE: NEW PHILOSOPHY COPED	5,359	1	,021
Learning preference: virtual	1,460	1	,227

Dependent Variable: What is your assessment about our VET depart ment's sustainability/preparedness for future demands?
 Model: (Intercept), 1 = Trainer; 2 = MGR/HQ, BOUNDARY SPANNER CHARACTERISTICS, My management acts as a role model regarding boundary spanning across training centers. , CULTURE: LEADERSHIP&TRUST , CULTURE: NEW PHILOSOPHY COPED, Learning preference: virtual

Parameter Estimates

Parameter	B	Std. Error	95% Wald Confidence Interval		Hypothesis Test		
			Lower	Upper	Wald Chi-Square	df	Sig.
(Intercept)	1,921	,3333	1,268	2,574	33,235	1	<,001
1 = Trainer; 2 = MGR/HQ	-,007	,1477	-,296	,283	,002	1	,963
BOUNDARY SPANNER CHARACTERISTICS	-,036	,0854	-,204	,131	,180	1	,671
My management acts as a role model regarding boundary spanning across training centers.	,008	,0760	-,141	,157	,011	1	,918
CULTURE: LEADERSHIP&TRUST	,145	,1070	-,065	,354	1,833	1	,176
CULTURE: NEW PHILOSOPHY COPED	,162	,0710	,023	,301	5,198	1	,023
Learning preference: virtual	,094	,0782	-,059	,247	1,452	1	,228
(Scale)	1 ^a						

Dependent Variable: What is your assessment about our VET depart ment's sustainability/preparedness for future demands?
 Model: (Intercept), 1 = Trainer; 2 = MGR/HQ, BOUNDARY SPANNER CHARACTERISTICS, My management acts as a role model regarding boundary spanning across training centers. , CULTURE: LEADERSHIP&TRUST , CULTURE: NEW PHILOSOPHY COPED, Learning preference: virtual

a. Fixed at the displayed value.

Running the model again, one by one taking out the Parameter with the least significance (first TRAINER_MANAGER, then BOUNDARY SPANNER CHARACTERISTICS, thereafter “My management acts as a role model”, finally LEARNING PREFERENCE: VIRTUAL) gets us to a model K with only two independent variables, both significant.

Model K:

Model Information

Dependent Variable	What is your assessment about our VET department's sustainability/preparedness for future demands?
Probability Distribution	Poisson
Link Function	Log

Case Processing Summary

	N	Percent
Included	111	63,4%
Excluded	64	36,6%
Total	175	100,0%

Continuous Variable Information

		N	Minimum	Maximum	Mean	Std. Deviation
Dependent Variable	What is your assessment about our VET department's sustainability/preparedness for future demands?	111	0	10	7,42	2,177
Covariate	CULTURE: LEADERSHIP&TRUST	111	-2,53917	1,85638	,0000000	1,00000000
	CULTURE: NEW PHILOSOPHY COPED	111	-2,54387	1,69606	,0000000	1,00000000

Goodness of Fit^a

	Value	df	Value/df
Deviance	61,251	108	,567
Scaled Deviance	61,251	108	
Pearson Chi-Square	53,549	108	,496
Scaled Pearson Chi-Square	53,549	108	
Log Likelihood ^b	-240,722		
Akaike's Information Criterion (AIC)	487,443		
Finite Sample Corrected AIC (AICC)	487,668		
Bayesian Information Criterion (BIC)	495,572		
Consistent AIC (CAIC)	498,572		

Dependent Variable: What is your assessment about our VET department's sustainability/preparedness for future demands?

Model: (Intercept), CULTURE: LEADERSHIP&TRUST , CULTURE: NEW PHILOSOPHY COPED

- a. Information criteria are in smaller-is-better form.
- b. The full log likelihood function is displayed and used in computing information criteria.

Omnibus Test^a

Likelihood Ratio Chi-Square	df	Sig.
27,315	2	<,001

Dependent Variable: What is your assessment about our VET department's sustainability/preparedness for future demands?

Model: (Intercept), CULTURE: LEADERSHIP&TRUST , CULTURE: NEW PHILOSOPHY COPED

- a. Compares the fitted model against the intercept-only model.

Tests of Model Effects

Source	Likelihood Ratio Chi-Square	Type III	
		df	Sig.
(Intercept)	1707,875	1	,000
CULTURE: LEADERSHIP&TRUST	15,149	1	<,001
CULTURE: NEW PHILOSOPHY COPED	12,759	1	<,001

Dependent Variable: What is your assessment about our VET department's sustainability/preparedness for future demands?
 Model: (Intercept), CULTURE: LEADERSHIP&TRUST , CULTURE: NEW PHILOSOPHY COPED

Parameter Estimates

Parameter	B	Std. Error	95% Wald Confidence Interval		Hypothesis Test		
			Lower	Upper	Wald Chi-Square	df	Sig.
(Intercept)	1,987	,0355	1,918	2,057	3137,352	1	,000
CULTURE: LEADERSHIP&TRUST	,143	,0373	,069	,216	14,605	1	<,001
CULTURE: NEW PHILOSOPHY COPED	,130	,0371	,058	,203	12,322	1	<,001
(Scale)	1 ^a						

Dependent Variable: What is your assessment about our VET department's sustainability/preparedness for future demands?
 Model: (Intercept), CULTURE: LEADERSHIP&TRUST , CULTURE: NEW PHILOSOPHY COPED

a. Fixed at the displayed value.

The model explains variance of 111 cases.

ORGANIZATIONAL RESILIENCE is explained by both a culture of leadership and trust as well as a culture expressing the new VET philosophy called COPED (competence and project-oriented education). (Scaled Pearson Chi Square = 53,559; p<0,001). The likelihood ratio chi-square test indicates that the full model was a significant improvement in fit over a null (no predictor) model (Sig.<0,001).

$f(\text{Organizational Resilience}) = 1,987 + 0,143^{**} \text{ CULTURE: LEADERSHIP AND TRUST} + 0,130^{**} \text{ CULTURE: NEW PHILOSOPHY COPED (N=111)}$

8. Bibliography

Coxe, S., West, S. G. and Aiken, L. S. (2009) “The Analysis of Count Data: A gentle Introduction to Poisson Regression and Its Alternatives”, *Journal of Personality Assessment*, Vol. 91, No. 2, pp. 121-136.

Cooper, D.R. and Schindler, P.S. (2014) “Business Research Methods”, 12th Edition, New York: McGraw-Hill/Irwin.

Statistics Laerd (2020), (Eds.) Lund A. and Lund M., <https://statistics.laerd.com/spss-tutorials/multiple-regression-using-spss-statistics.php>, Assessed on March 20, 2022.

Operational Memo PLS-SEM

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1. Status of Primary Research Project

This memo is written as part of a DBA thesis carried out as a single case study based on a mixed model exploratory sequential research design. Specifically, this memo is written

- after the online survey in MS Forms has been done in October through December 2021
- after ample analysis and modelling (see Memos Appendix 3) of linear regression models as well as a Poisson analysis-based model have been carried out during December 2021 and March 2022.

The purpose of this memo is to describe how, independently of the analysis described in the second bullet point above, PLM-SEM analysis helps to further explore boundary spanning and corporate learning based on the case of a corporate training department in times of digital transformation. The department carries out trainings for apprentices, dual students, and employees of a multi-national enterprise in the industrial domain. This research is an exploratory one sampling the German team with complex interrelationships. Thus, PLS-SEM is a well-suited method to assess and explain our single case study.

2. Introduction to PLS-SEM

Among the multivariate methods and models, Partial Least Square structural equation modeling (PLS-SEM) is a method that can help explain several numerical variables. In general, structural equation models – in contrast to explanatory models like multiple linear regression or logistic regression – can model complex interdependencies between variables. Those can be original (manifest) or latent (composite) variables or, in this case, constructs, which can be again explained by original or latent variables, and analyzed “simultaneously” (Legate, Hair, Chretien and Risher, 2021, p. 2). PLS-SEM is based on non-parametric iterative boot-strapping methodology, whereas the conditions for use are not limited by normal distribution of the data under scrutiny. PLS-SEM is also suited for small samples (Hair, Mathews, Mathews and Sarstedt, 2017; Ringle, Sarstedt, Mitchell and Gudergan, 2020). This does not come for free. In return, the price to pay constitutes in a higher complexity of the model.

According to Legate *et al.* (2021), PLS-SEM has advantages to covariance-based structured equation modelling (CB-SEM) but has not made itself a wide reputation in the Human Resources Development (HRD) arena. Advantages are its flexibility regarding data characteristics, its suitability for exploratory research and its sophisticated prediction quality.

“PLS-SEM is well suited for theoretically exploring model extensions and considered an appropriate methodological choice when identifying principal drivers of target outcome variables“ (Legate *et al.*, 2021, p. 4), which is why it is used in this research project: multiple linear regression and Poisson analysis only got the research such far that boundary spanning characteristics, digital transformation and organizational resilience could be modeled, without, however, putting these four concepts in direct interdependency.

PLS-SEM is set up by two distinct models, i.e.,

3. an outer model to present constructs and associated original indicators and
4. an inner model which shows the relationships between the constructs (Legate *et al.*, 2021, p. 6).

PLS-SEM is not striving to bring about a best fit between the original data and the model. Instead, it follows an iterative process of multi-criteria optimization for “minimizing unexplained variance (residuals) in the indicators and endogenous latent variables” (Legate *et al.*, 2021, p. 7) via bootstrapping (i.e., iterative testing). As Hair, Howard and Nitzl (2020, p. 103) phrased it so aptly: “PLS_SEM maximizes the amount of explained variance of dependent variables founded in well-developed explanations”.

The constructs can be either reflexive or formative. Reflexive constructs are manifest by observed original variables, i.e., the construct seemingly reflects the indicators. Formative constructs are caused or contributed to by original variables (not unlike regression model). However, constructs themselves are not per se formative or reflective. Rather, it is the choice of the researcher to bring about the characteristics of the model while pragmatic considerations, although formative variables are not generally recommended (Ringle *et al.*, 2020).

In the next steps, the variables to establish the constructs (i.e., the composite variables of PLS-SEM) are described in chapter for social learning (and 6 for the meta model). Afterwards, the relationship between the constructs as inner model (structural model) for social learning in chapter 5 (and 7 for the meta model) will be established. Prior to these steps, it is indispensable to carefully explain all original variables (chapter 3).

3. Recap of variables: original and latent variables established

Table 23 shows the original and latent variables established via former analyses and, again, for PLS-SEM. All data must be entered, and the latent variables must be set up in SmartPLS 3 software anew, for the software to work. In contrast to prior principal component analysis steps

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of current doctoral thesis (to reduce complexity of models), reducing complexity in PLS-SEM means looking for certain correlation of the latent constructs. Thus, the algorithm for principal component analysis is OBLIMIN rather than VARIMAX.

As the formerly established latent variables, which had been used to calculate Poisson and multiple regression models, do not correspond directly to the new constructs, Table 23 gives a detailed overview of all variables, such that interpretations of the new models do not create misunderstandings with other findings of this doctoral thesis.

The constructs identified are as follows:

PEOPLE-ORIENTED SETUP of training activities, where the topic is relevant to the trainee and set up in a network of mutual trust

OPEN SETUP of training activities, allowing for flexibility, experiments and an interdisciplinary dialogue and network

MOTIVATION to carry out training for colleagues (because of their sense of responsibility, passion, or intent to create knowledge.

METHOD USE CASE as (conceptional/methodological) aspect relevant for a good training

A perceived and appreciated TRUST AND LEADERSHIP CHANGE

TRAINERS RELATIONAL ABILITIES as a relevant criterion of situations where the interviewees learnt something from colleagues, based on the latter abilities to communicate, self-reflect, use didactics and social competency.

SOCIAL LEARNING formats considered useful, such as tandem teaching, community-based learnings, learning within the team or job shadowing (in German: "Hospitation").

Specifically, the author wants to point out the following:

In previous analytical step (multiple regression, see Memos No. 4 and No. 5, respectively chapter 4 in main body of Doctoral Thesis) BOUNDARY SPANNER CHARACTERISTICS (BSC)⁶ had been identified as the central latent variable in combination of

- **Willingness:** Interest in cross-regional networking (question 8f)
- **Activities:** Networking/boundary spanning across hierarchies (question 20c)

⁶ All latent variables and constructs hereinafter are indicated by UPPER CASE writing.

Attitude: In my opinion we should do more boundary spanning across training centers and regions (question 22a)

As a formative measurement model in PLS-SEM, this variable cannot be used. As KMO in this construct was $<0,7$, it is not sufficient for a latent variable in PLS-SEM (Legate *et al.*, 2021).

Therefore, boundary spanning must be established and defined in a different manner. In this PLS-SEM model hereinafter, BOUNDARY SPANNING PROPENSITY is defined as a formative measure combining the scores of

- In my opinion we should do more boundary spanning **across training centers and regions**.
- In my opinion we should do more boundary spanning **towards [internal] customers**.
- In my opinion we should do more **external** boundary spanning.

In summary, the latent construct BOUNDARY SPANNING PROPENSITY used hereinafter is an entirely different variable than BOUNDARY SPANNING CHARACTERISTICS. It rather looks at the individuals' attitude towards boundary spanning, without taking into consideration interest or activities.

Furthermore, the notion of customers here is stated from the perspective of an internal service department, offering VET for other departments of the company. As such, customers are always meant as internal customers (within the MNE).

Finally, it can be seen in the following that the third original variable "3. In my opinion we should do more external boundary spanning" shows extraction values with a low weight (see Table 24, value 0,007 in red). Therefore, it can be derived that this latent construct BOUNDARY SPANNING PROPENSITY shows a predominantly internal (intra-departmental and inter-departmental) focus. Yet, with formative constructs, one should strive to include all indicators (Diamantopoulos, 2011). [We will see later in chapter 5 of this appendix that this original variable must be taken out due to unfitness for the model. The BOUNDARY SPANNING PROPENSITY construct then becomes a reflective one. For now, we do the exercise with it being a formative construct.]

research institutes focusing on vocational education etc.), albeit with an intra-company predominance. Other than boundary spanning, the following latent variables were established based on the outer loadings of original variables indicated in Table 24.

For all new constructs, linear interrelationships assumptions have been checked by correlation matrices in previous steps. Empirical measures with low correlation levels between indicators have not been built into the model as reflective ones. Accordingly, arrows between constructs showing little correlation have not been drawn at all.

As a result, six reflective latent variables (PEOPLE-ORIENTED SETUP, OPEN SETUP, MOTIVATION: Passion, TRUST AND LEADERSHIP CHANGE, TRAINERS RELATIONAL ABILITIES) and one formative latent variable (BOUNDARY SPANNING PROPENSITY) have been identified (see appendix). According to the exploratory nature of this research, one latent variable (METHOD: USE CASES) with a single indicator has been integrated into the analysis.

	BoundarySpanning Propensity	Trust and Leadership Change	MethodUseCases	Motivation	OpenSetup	PeopleOrientedSetup	SocialLearning	Trainers Relational Abilities
Learnpreference_community_based							0,732	
activity_boundary_spanning_cognitive_experimentalwo					0,774			
activity_boundary_spanning_cognitive_flex					0,845			
activity_boundary_spanning_cognitive_interdiscipl					0,779			
activity_boundary_spanning_cognitive_relevance						0,491		
activity_boundary_spanning_cognitive_usecases			1,000					
activity_boundary_spanning_relational_acrosshierarch						0,714		
activity_boundary_spanning_relational_trust						0,927		
boundary_spanning_external	0,007							
boundary_spanning_across_training_centers	0,727							
boundary_spanning_customers	0,848							
condition_boundary_spanning_Abilities_MethoDid								0,757
condition_boundary_spanning_Abilities_Selfreflexion								0,804
condition_boundary_spanning_Abilities_Socialkomp								0,863
condition_boundary_spanning_Abilities_comm								0,801
condition_boundary_spanning_willingness_createknow				0,897				
condition_boundary_spanning_willingness_passion				0,825				
condition_boundary_spanning_willingness_responsibili				0,679				
culture_change_eval_leadership		0,850						
culture_change_eval_trust		0,802						
culture_change_perception_leadership		0,778						
culture_change_perception_trust		0,777						
practical_preference_Hospitalation							0,630	
practical_preference_Tandem							0,745	
practical_preference_xchange_colleagues							0,800	

Table 24: Original variables used for latent variables constructs, outer loadings

	BoundarySpanning Propensity	Trust and Leadership Change	MethodUseCases	Motivation	OpenSetUp	PeopleOrientedSetUp	SocialLearning	Trainers Relational Abilities
Learnpreference_community_based							0,368	
activity_boundary_spanning_cognitive_experimentalwo					0,406			
activity_boundary_spanning_cognitive_flex					0,462			
activity_boundary_spanning_cognitive_interdiscipl					0,379			
activity_boundary_spanning_cognitive_relevance						0,238		
activity_boundary_spanning_cognitive_usecases			1,000					
activity_boundary_spanning_relational_acrosshierarch						0,314		
activity_boundary_spanning_relational_trust						0,711		
boundary_spanning_external	-0,299							
boundary_spanning_across_training_centers	0,525							
boundary_spanning_customers	0,731							
condition_boundary_spanning_Abilities_MethoDid								0,329
condition_boundary_spanning_Abilities_Selfreflexion								0,316
condition_boundary_spanning_Abilities_Socialkomp								0,313
condition_boundary_spanning_Abilities_comm								0,282
condition_boundary_spanning_willingness_createknow				0,504				
condition_boundary_spanning_willingness_passion				0,412				
condition_boundary_spanning_willingness_responsibili				0,307				
culture_change_eval_leadership		0,357						
culture_change_eval_trust		0,302						
culture_change_perception_leadership		0,285						
culture_change_perception_trust		0,298						
practical_preference_Hospitation							0,227	
practical_preference_Tandem							0,370	
practical_preference_xchange_colleagues							0,391	

Table 25: Original variables used for latent variables constructs, outer weights

Latent variables characteristics (i.e., constructs) can be statistically described as follows (Table 26):

	Mean	Median	Min	Max	Standard Deviation	Excess Kurtosis	Skewness	Number of Observations Used
BoundarySpanning Propensity	0,000	0,000	-3,971	2,107	1,000	0,855	-0,520	175,000
Trust and Leadership Change	0,000	0,181	-2,932	1,620	1,000	0,571	-0,751	175,000
MethodUseCases	0,000	0,447	-6,030	0,447	1,000	14,310	-3,256	175,000
Motivation	0,000	0,000	-6,069	1,040	1,000	11,724	-2,581	175,000
OpenSetUp	0,000	-0,075	-3,459	1,568	1,000	0,367	-0,479	175,000
PeopleOrientedSetUp	0,000	0,053	-3,584	1,252	1,000	1,878	-1,120	175,000
SocialLearning	0,000	0,073	-4,228	1,705	1,000	2,870	-1,162	175,000
Trainers Relational Abilities	0,000	0,032	-3,868	1,332	1,000	1,653	-1,032	175,000

Table 26: Construct characteristics

Reflective and formative variables need to be distinguished when it comes to the model assessment. Model assessment – a confirmatory composite analysis (CCA) – must be done in such elaborate SEM.

Reflective variables are assessed in terms of internal consistency, convergent validity and discriminant validity (J. Hair *et al.*, 2016; Sarstedt *et al.*, 2017).

For reflective measures, an exploratory factorization procedure has been applied using SPSS (V28). The Kaiser-Meyer-Olkin (KMO) measure of sampling adequacy has been checked (KMO > 0.7). Bartlett’s Test of Sphericity has been checked too (statistical significance $p < .001$). To assess the dimensionality of the measures the Kaiser criterion (eigenvalue > 1) has been used. With multidimensional measures, Oblimin rotation has been applied to maximize loadings and measure correlations between resulting factors.

	Cronbach's Alpha	rho_A	Composite Reliability	Average Variance Extracted (AVE)
BoundarySpanning Propensity		1,000		
Trust and Leadership Change	0,816	0,823	0,878	0,644
MethodUseCases	1,000	1,000	1,000	1,000
Motivation	0,728	0,779	0,845	0,649
OpenSetUp	0,719	0,728	0,842	0,640
PeopleOrientedSetUp	0,588	0,881	0,766	0,537
SocialLearning	0,709	0,725	0,819	0,532
Trainers Relational Abilities	0,821	0,822	0,882	0,652

Table 27: Construct reliability and validity

Internal consistency is shown in Table 27. Traditionally, Cronbach's Alpha is used for evaluation, expressing intercorrelations of the observed indicator variables. In Table 27 all latent variables other than PEOPLEORIENTED SETUP show a Cronbach's Alpha, Rho A and Composite Reliability $>0,7$. In an exploratory setting, the lower value can also be deemed acceptable, although is to be handled with care.

The indicator **outer loadings relevance testing** shows values $>0,70$. As per Legate et al. (2021), outer loading relevance should be equal or greater than 0,708. That is a given as per Table 24 for all values other than boundary_spanning_external and practical_preference_hospitation and relevance (of the topic for the learner).

Convergent validity as indicated by AVE is $>0,5$. As per Hair *et al.* (2017, p. 111), a "rule of thumb for adequate convergence is an AVE > 0.50 , indicating that more than half of the indicator variance is included in the construct score".

Discriminant validity means a succinct distinction of constructs from each other. This can be established by showing that the "absolute value of the correlation between the measures [intended to measure distinct constructs] after correcting for measurement error is low enough for the measures to be regarded as measuring distinct constructs" (Rönkkö and Cho, 2022, p. 11). As can be seen in table 28 via the Fornell-Larcker criterion, i.e., square root of AVE vs. latent variable correlation, which should be higher than its maximum correlation with any other construct (J. Hair *et al.*, 2017), discriminant validity is given.

	BoundarySpanning Propensity	Trust and Leadership Change	MethodUseCases	Motivation	OpenSetUp	PeopleOrientedSetUp	SocialLearning	Trainers Relational Abilities
BoundarySpanning								
Culture Change Leadership and Trust	0,035	0,802						
MethodUseCases	0,323	0,239	1,000					
MotivationPassion	0,243	0,112	0,355	0,805				
OpenSetUp	0,321	0,218	0,347	0,146	0,800			
PeopleOrientedSetUp	0,245	0,382	0,393	0,238	0,502	0,733		
SocialLearning	0,364	0,331	0,298	0,242	0,265	0,291	0,729	
Trainers Relational Abilities	0,293	0,243	0,388	0,421	0,393	0,412	0,336	0,807

Table 28: Fornell-Larcker criterion: Square roots of the AVE in the diagonal

	BoundarySpanning Propensity	Trust and Leadership Change	MethodUseCases	Motivation	OpenSetUp	PeopleOrientedSetUp	SocialLearning	Trainers Relational Abilities
Learnpreference_community_based	0,220	0,340	0,182	0,118	0,306	0,200	0,732	0,233
activity_boundary_spanning_cognitive_experimentalwo	0,242	0,121	0,337	0,122	0,774	0,348	0,198	0,312
activity_boundary_spanning_cognitive_flex	0,316	0,221	0,280	0,110	0,845	0,417	0,292	0,322
activity_boundary_spanning_cognitive_interdiscipl	0,202	0,176	0,214	0,120	0,779	0,444	0,132	0,311
activity_boundary_spanning_cognitive_relevance	0,164	0,128	0,224	0,125	0,196	0,491	0,112	0,157
activity_boundary_spanning_cognitive_usecases	0,323	0,239	1,000	0,355	0,347	0,393	0,298	0,388
activity_boundary_spanning_relational_acrosshierarch	0,136	0,223	0,200	0,110	0,347	0,714	0,104	0,158
activity_boundary_spanning_relational_trust	0,230	0,395	0,389	0,245	0,487	0,927	0,326	0,458
boundary_spanning_external	0,007	0,096	-0,031	0,080	0,131	0,176	-0,059	0,010
boundary_spanning_across_training_centers	0,727	0,125	0,205	0,200	0,219	0,265	0,294	0,238
boundary_spanning_customers	0,848	-0,003	0,283	0,221	0,335	0,217	0,263	0,234
condition_boundary_spanning_Abilities_MethoDid	0,219	0,151	0,297	0,397	0,297	0,363	0,269	0,757
condition_boundary_spanning_Abilities_Selfreflexion	0,223	0,251	0,301	0,295	0,425	0,339	0,251	0,804
condition_boundary_spanning_Abilities_Socialkomp	0,271	0,189	0,362	0,330	0,313	0,308	0,306	0,863
condition_boundary_spanning_Abilities_comm	0,232	0,195	0,288	0,331	0,224	0,316	0,256	0,801
condition_boundary_spanning_willingness_createknow	0,257	0,041	0,363	0,897	0,112	0,225	0,231	0,394
condition_boundary_spanning_willingness_passion	0,187	0,108	0,319	0,825	0,217	0,147	0,205	0,304
condition_boundary_spanning_willingness_responsibili	0,120	0,152	0,132	0,679	0,000	0,210	0,134	0,316
culture_change_eval_leadership	0,058	0,850	0,194	0,124	0,145	0,341	0,315	0,197
culture_change_eval_trust	0,057	0,802	0,190	0,098	0,093	0,263	0,294	0,048
culture_change_perception_leadership	-0,038	0,778	0,196	0,081	0,210	0,271	0,251	0,243
culture_change_perception_trust	0,027	0,777	0,188	0,049	0,262	0,345	0,193	0,299
practical_preference_Hospitalitation	0,171	0,159	0,291	0,251	0,130	0,143	0,630	0,162
practical_preference_Tandem	0,292	0,207	0,130	0,170	0,138	0,274	0,745	0,322
practical_preference_xchange_colleagues	0,350	0,238	0,300	0,202	0,184	0,214	0,800	0,242

Table 29: Cross-Loadings

Other sources (Henseler, Ringle and Sarstedt, 2015) recommend to rather look at HTMT (heterotrait-monotrait ratio), measuring between-trait correlations vs. within-trait correlations, thereby using a value of lower than 0,85 to evaluate discriminant validity (J. Hair *et al.*, 2017). HTMT can be seen in Table 30. HTMT is a given.

	Trust and Leadership Change	MethodUseCases	Motivation	OpenSetUp	PeopleOrientedSetUp	SocialLearning	Trainers Relational Abilities
Culture Change Leadership and Trust							
MethodUseCases	0,265						
MotivationPassion	0,164	0,395					
OpenSetUp	0,287	0,408	0,197				
PeopleOrientedSetUp	0,485	0,477	0,337	0,718			
SocialLearning	0,421	0,367	0,347	0,366	0,367		
Trainers Relational Abilities	0,300	0,427	0,541	0,508	0,497	0,429	

Table 30: Heterotrait monotrait ratio, threshold <0,85

Formative measurement model assessment cannot be done via the same measurement criteria as discussed above. In this model, the latent construct BOUNDARY SPANNING is a formative measurement.

As per Legate *et al.* (2021, p. 10), convergent validity can be checked via

- a redundancy analysis, which cannot be done here. As per Hair *et al.* (2020), such analysis would require a reflective measure of the same construct using different indicators
- via multicollinearity which can be checked with $VIF < 3$, see Table 31

	VIF
Learnpreference_community_based	1,341
activity_boundary_spanning_cognitive_experimentalwork	1,342
activity_boundary_spanning_cognitive_flex	1,518
activity_boundary_spanning_cognitive_interdispl	1,421
activity_boundary_spanning_cognitive_relevance	1,085
activity_boundary_spanning_cognitive_usecases	1,000
activity_boundary_spanning_relational_acrosshierarchy	1,331
activity_boundary_spanning_relational_trust	1,361
boundary_spanning	1,093
boundary_spanning_across_training_centers	1,182
boundary_spanning_customers	1,201
condition_boundary_spanning_Abilities_MethoDid	1,454
condition_boundary_spanning_Abilities_Selfreflexion	1,886
condition_boundary_spanning_Abilities_Socialkomp	2,366
condition_boundary_spanning_Abilities_comm	1,810
condition_boundary_spanning_willingness_createknowlege	1,809
condition_boundary_spanning_willingness_passion	1,614
condition_boundary_spanning_willingness_responsibility	1,276
culture_change_eval_leadership	2,273
culture_change_eval_trust	2,094
culture_change_perception_leadership	1,890
culture_change_perception_trust	1,834
practical_preference_Hospitation	1,327
practical_preference_Tandem	1,394
practical_preference_xchange_colleagues	1,486

Table 31: Collinearity Statistics (VIF) Variance Inflation Factor – outer model

- via size and significance of indicators (indicator outer weights) (J. F. Hair *et al.*, 2020, p. 106).

Origin	Samp	Standar	T	P
al	le	d	Statistics	Valu
Sampl	Mean	Deviati	(O/STDE	es
e (O)	(M)	on	V)	
		(STDE		
		V)		

Learnpreference_community_based <- Social Learning	0,368	0,375	0,068	5,403	0,000
activity_boundary_spanning_cognitive_experimentalwork <- Open SetUp	0,406	0,401	0,067	6,056	0,000
activity_boundary_spanning_cognitive_flex <- Open SetUp	0,462	0,464	0,062	7,479	0,000
activity_boundary_spanning_cognitive_interdiscipl <- Open SetUp	0,379	0,377	0,065	5,818	0,000
activity_boundary_spanning_cognitive_relevance <- People Oriented SetUp	0,238	0,222	0,113	2,111	0,035
activity_boundary_spanning_cognitive_usecases <- Method Use Cases	1,000	1,000	0,000		
activity_boundary_spanning_relational_acrosshierarchy <- People Oriented SetUp	0,314	0,314	0,077	4,103	0,000
activity_boundary_spanning_relational_trust <- People Oriented SetUp	0,711	0,706	0,068	10,405	0,000
boundary_spanning external-> Boundary Spanning Propensity	-0,299	-0,256	0,213	1,402	0,161
boundary_spanning_across_training_centers -> Boundary Spanning Propensity	0,525	0,502	0,178	2,953	0,003
boundary_spanning_customers -> Boundary Spanning Propensity	0,731	0,704	0,137	5,348	0,000
condition_boundary_spanning_Abilities_Method <- Trainers Relational Abilities	0,329	0,326	0,040	8,306	0,000
condition_boundary_spanning_Abilities_Selfreflection <- Trainers Relational Abilities	0,316	0,322	0,034	9,202	0,000
condition_boundary_spanning_Abilities_Socialkomp <- Trainers Relational Abilities	0,313	0,313	0,029	10,980	0,000
condition_boundary_spanning_Abilities_comm <- Trainers Relational Abilities	0,282	0,282	0,033	8,457	0,000
condition_boundary_spanning_willingness_createknowledge <- Motivation	0,504	0,500	0,050	10,167	0,000
condition_boundary_spanning_willingness_passion <- Motivation	0,412	0,412	0,065	6,323	0,000
condition_boundary_spanning_willingness_responsibility <- Motivation	0,307	0,315	0,081	3,819	0,000
culture_change_eval_leadership <- Culture Change Leadership and Trust	0,357	0,356	0,045	7,933	0,000
culture_change_eval_trust <- Trust and Leadership change	0,302	0,296	0,057	5,329	0,000

culture_change_perception_leadership <- Trust and Leadership change	0,285	0,286	0,047	6,026	0,000
culture_change_perception_trust <- Trust and Leadership change	0,298	0,302	0,044	6,751	0,000
practical_preference_Hospitation <- Social Learning	0,227	0,220	0,065	3,474	0,001
practical_preference_Tandem <- Social Learning	0,370	0,369	0,064	5,738	0,000
practical_preference_xchange_colleagues <- Social Learning	0,391	0,386	0,050	7,745	0,000

Table 32: Outer Weights

- and their absolute contribution (indicator outer loadings).

Boundary_spanning_external as an indicator proves to be problematic (see Table 32, Table 33).

Its significance is not given with $p = 0,973$ (loading) and $p = 0,161$ (weight).

	Original Sample (O)	Sample Mean (M)	Standard Deviation (STDEV)	T Statistics (O/STDEV)	P Values
Learnpreference_community_based <- Social Learning	0,732	0,734	0,053	13,709	0,000
activity_boundary_spanning_cognitive_experimentalwork <- Open SetUp	0,774	0,769	0,066	11,701	0,000
activity_boundary_spanning_cognitive_flex <- Open SetUp	0,845	0,844	0,041	20,498	0,000
activity_boundary_spanning_cognitive_interdisciplinary <- Open SetUp	0,779	0,773	0,059	13,189	0,000
activity_boundary_spanning_cognitive_relevance <- People Oriented SetUp	0,491	0,467	0,154	3,195	0,001
activity_boundary_spanning_cognitive_usecases <- Method Use Cases	1,000	1,000	0,000		
activity_boundary_spanning_relational_acrosshierarchy <- People Oriented SetUp	0,714	0,703	0,089	7,985	0,000
activity_boundary_spanning_relational_trust <- People Oriented SetUp	0,927	0,924	0,023	39,554	0,000
boundary_spanning_external -> Boundary Spanning Propensity	0,007	0,029	0,209	0,034	0,973
boundary_spanning_across_training_centers -> Boundary Spanning Propensity	0,727	0,700	0,145	5,026	0,000

boundary_spanning_customers -> Boundary Spanning Propensity	0,848	0,825	0,104	8,124	0,000
condition_boundary_spanning_Abilities_MethoDid <- Trainers Relational Abilities	0,757	0,752	0,045	16,904	0,000
condition_boundary_spanning_Abilities_Selfreflexion <- Trainers Relational Abilities	0,804	0,804	0,040	19,877	0,000
condition_boundary_spanning_Abilities_Socialkomp <- Trainers Relational Abilities	0,863	0,861	0,028	30,696	0,000
condition_boundary_spanning_Abilities_comm <- Trainers Relational Abilities	0,801	0,794	0,059	13,671	0,000
condition_boundary_spanning_willingness_createknowlege <- Motivation	0,897	0,888	0,036	25,267	0,000
condition_boundary_spanning_willingness_passion <- Motivation	0,825	0,810	0,077	10,709	0,000
condition_boundary_spanning_willingness_responsibility <- Motivation	0,679	0,674	0,107	6,366	0,000
culture_change_eval_leadership <- Trust and Leadership change	0,850	0,846	0,035	24,392	0,000
culture_change_eval_trust <- Trust and Leadership change	0,802	0,794	0,063	12,824	0,000
culture_change_perception_leadership <- Trust and Leadership change	0,778	0,778	0,055	14,250	0,000
culture_change_perception_trust <- Trust and Leadership change	0,777	0,778	0,043	17,976	0,000
practical_preference_Hospitation <- Social Learning	0,630	0,611	0,100	6,278	0,000
practical_preference_Tandem <- Social Learning	0,745	0,739	0,062	12,048	0,000
practical_preference_xchange_colleagues <- Social Learning	0,800	0,792	0,055	14,632	0,000

Table 33: Outer loadings

While not all values confirm validity, for an exploratory setting they will be retained for now to assess structural model quality. However, `boundary_spanning_external` shows a non-significant loading.

5. Establishment of PLS-SEM Model regarding social learning

As described by Legate *et al.* (2021) a PLS-SEM model always consists of an outer model and an inner model (see Figure 37).

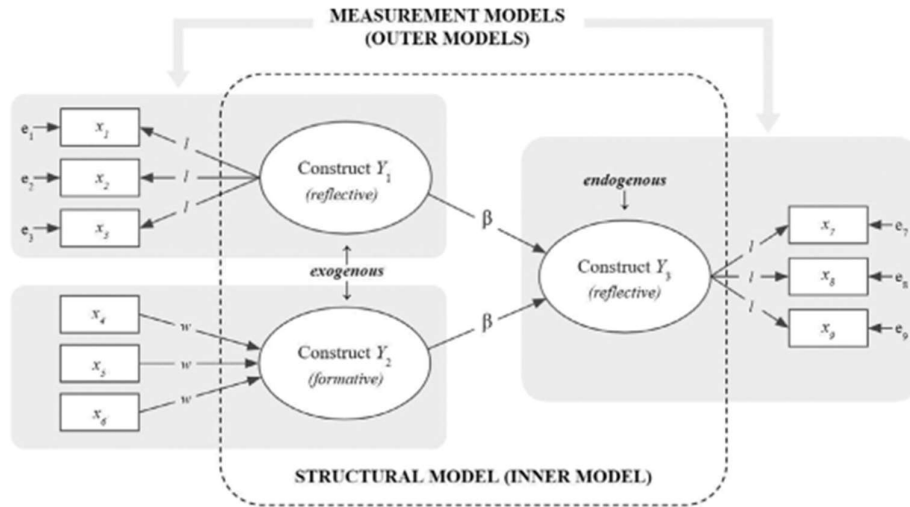


Figure 37: Outer and inner model setup as per Legate et al., 2021, p. 7.

Chapter 4 of this appendix described how the constructs are established. This chapter will describe the inner model, i.e., the structural model, which establishes scores between the constructs. These are “individual item weights, which are then used to compute construct scores” (Legate et al., 2021, p. 7).

The structural model established looks as follows (see Figure 38):

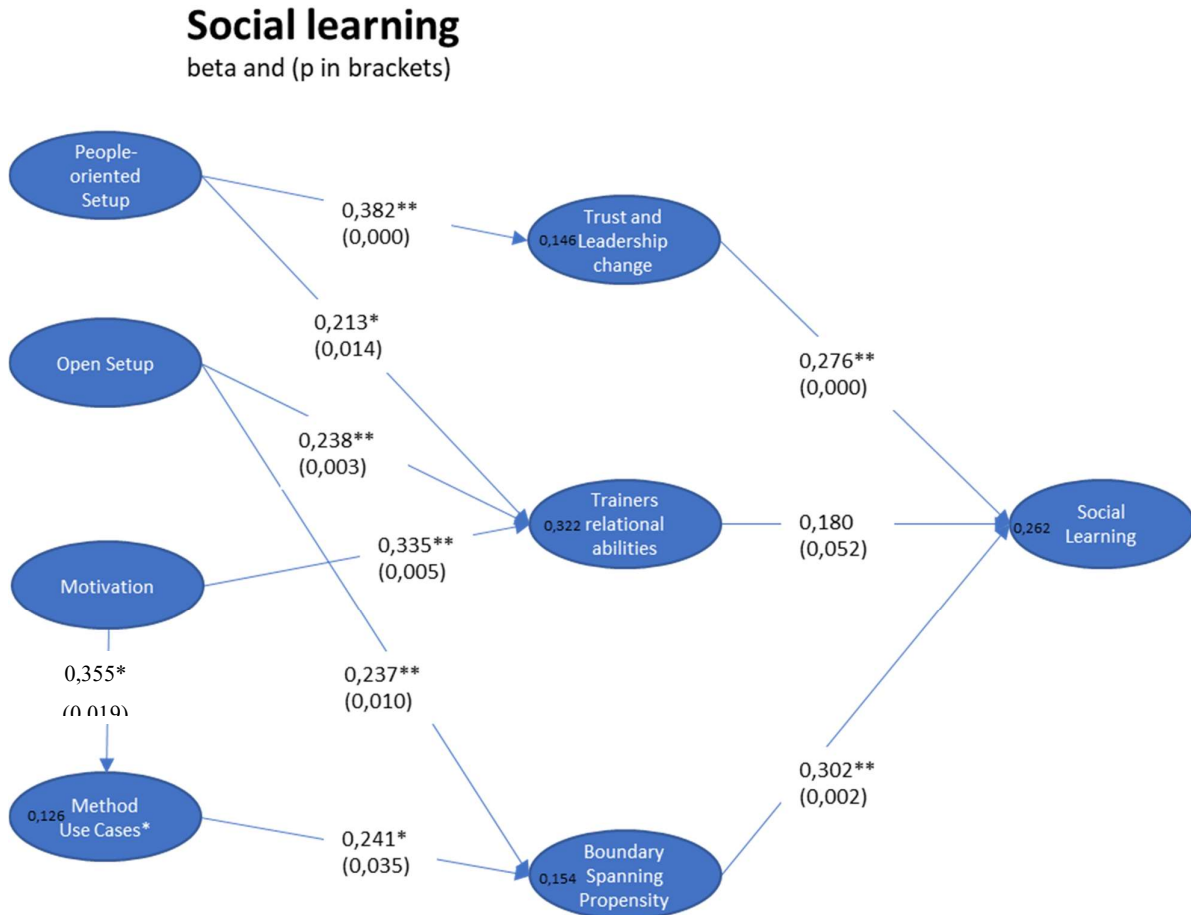


Figure 38: Structural Model Social Learning – size and significance of path coefficients (beta and p, R² in black within blue dot)

As can be seen in Figure 38, BOUNDARY SPANNING PROPENSITY is influenced by an OPEN TRAINING SET-UP (beta =0,237**) and USE-CASE-BASED METHOD (beta = 0,241*). In other words, those who appreciate an open setup for trainings and esteem use cases as a suitable method for learning, have a high propensity for boundary spanning. That, in return, contributes to SOCIAL LEARNING with beta=0,302**, along WITH TRAINERS' RELATIONAL ABILITIES (beta = 0,180*) and TRUST AND LEADERSHIP CHANGES (beta = 0,276**). MOTIVATION (the motivation to share knowledge, with passion and a sense of responsibility) contributes to the METHOD OF USE CASES and to TRAINERS' RELATIONAL ABILITIES. TRAINERS' RELATIONAL ABILITIES also depend on a PEOPLE-ORIENTED (beta = 0,213*) and OPEN SETUP (beta = 0,238**) OF TRAINING ACTIVITIES.

As per the R² values (in black within the blue dots as per Figure 38, and in Table 36) it is obvious that 26,2% of SOCIAL LEARNING can be explained via the three variables

BOUNDARY SPANNING, TRAINERS’ RELATIONAL ABILITIES and TRUST AND LEADERSHIP CHANGE.

It is part of the beauty of such PLS-SEM model that it can display the complexity of an interrelated system of latent constructs.

How to assess such a structural model? As per Legate *et al.* (2021), assessment for multicollinearity, size and significance of path coefficients, in-sample predictive ability, effect size of predictive ability and out-of-sample predictive ability should be addressed to evaluate the model quality.

Assessment for multicollinearity via $VIF < 3$ has already been done in the previous chapter for the outer model. Table 34 shows VIF for the inner model. The model is valid.

	BoundarySpanning Propensity	Trust and Leadership Change	MethodUseCases	Motivation	OpenSetUp	PeopleOrientedSetUp	SocialLearning	Trainers Relational Abilities
BoundarySpanning Propensity							1,096	
Trust and Leadership Change							1,065	
MethodUseCases	1,137							
Motivation			1,000					1,061
OpenSetUp	1,137							1,338
PeopleOrientedSetUp		1,000						1,388
SocialLearning								
Trainers Relational Abilities							1,163	

Table 34: Assessment for multicollinearity (VIF inner model)

Size and significance of path coefficients can be seen in Figure 38. Table 35 shows the same information as an overview and furthermore includes the indirect path coefficients as well (i.e., Method Use case (\rightarrow MOTIVATION \rightarrow BOUNDARY SPANNING PROPENSION, $\beta = 0,086$). Obviously, the higher the coefficient, the better the model.

	BoundarySpanning Propensity	Trust and Leadership Change	MethodUseCases	Motivation	OpenSetUp	PeopleOrientedSetUp	SocialLearning	Trainers Relational Abilities
BoundarySpanning Propensity							0,302	
Trust and Leadership Change							0,276	
MethodUseCases	0,241						0,073	
Motivation	0,086		0,355				0,086	0,335
OpenSetUp	0,237						0,114	0,238
PeopleOrientedSetUp		0,382					0,144	0,213
SocialLearning								
Trainers Relational Abilities							0,180	

Table 35: Direct and indirect standardized path coefficients (beta)

In-Sample predictive ability can be assessed with R Square of the endogenous variables. The in-sample predictive ability is low in all cases but two: SOCIAL LEARNING and TRAINERS’

RELATIONAL ABILITIES show a moderate predictive ability (Legate *et al.*, 2021). Those are the ones with the highest (explanatory) loads in the blue circles.

	R Square	R Square Adjusted
BoundarySpanning Propensity	0,154	0,144
Trust and Leadership Change	0,146	0,141
MethodUseCases	0,126	0,121
SocialLearning	0,262	0,249
Trainers Relational Abilities	0,322	0,310

Table 36: In-sample predictive model ability

Effect size of predictive ability is evaluated by f square effect size. Table 37 shows that effect size of predictive ability is small in all cases but two: PEOPLE-ORIENTED SET-UP OF ACTIVITIES on TRUST AND LEADERSHIP CHANGE has significant predictive ability. MOTIVATION on TRAINERS’ RELATIONAL ABILITIES has medium predictive ability. Those are the two relationships with highest beta factors.

	BoundarySpanning Propensity	Trust and Leadership Change	MethodUseCases	Motivation	OpenSetUp	PeopleOrientedSetUp	SocialLearning	Trainers Relational Abilities
BoundarySpanning Propensity							0,113	
Trust and Leadership Change							0,097	
MethodUseCases	0,061							
Motivation			0,144					0,156
OpenSetUp	0,058							0,062
PeopleOrientedSetUp		0,170						0,048
SocialLearning								
Trainers Relational Abilities							0,038	

Table 37: Effect size of predictive ability

Furthermore, **out-of-sample predictive ability** is measured with Q^2_{predict} root mean squared error (RMSE) as per Hair *et al.* (2020; p. 106).

5 folds and 10 repetitions have been done in PLSpredict procedure to have a hold-out sample > 30 (see Hair *et al.*, 2020; p. 107).

If $Q^2_{\text{predict}} < 0$, prediction with PLS is lower than naïve one (Legate *et al.*, p. 13; Hair *et al.*, 2020, p. 107). The native variable boundary_spanning_external has a Q^2_{predict} value < 0, but for the primary endogenous construct (Social Learning) and other endogenous constructs the value is sufficient with $Q^2_{\text{predict}} > 0$.

RMSE	MAE	MAPE	Q^2_{predict}
------	-----	------	------------------------

boundary_spanning_across_training_centers	0,955	0,758	26,825	0,050
boundary_spanning_external	1,053	0,831	35,791	-0,004
boundary_spanning_customers	0,853	0,665	21,648	0,098
culture_change_perception_leadership	1,055	0,830	36,015	0,061
culture_change_eval_leadership	1,054	0,808	34,668	0,103
culture_change_perception_trust	1,062	0,830	37,158	0,107
culture_change_eval_trust	1,042	0,807	31,305	0,055
activity_boundary_spanning_cognitive_usecases	0,607	0,393	12,075	0,044
practical_preference_Hospitation	1,041	0,769	31,795	0,037
Learnpreference_community_based	1,038	0,831	34,186	0,069
practical_preference_xchange_colleagues	0,801	0,631	19,225	0,057
practical_preference_Tandem	0,812	0,549	21,404	0,056
condition_boundary_spanning_Abilities_Selfreflexion	0,920	0,732	25,866	0,201
condition_boundary_spanning_Abilities_comm	0,888	0,658	23,572	0,120
condition_boundary_spanning_Abilities_MethoDid	0,814	0,640	20,932	0,211
condition_boundary_spanning_Abilities_Socialkomp	0,881	0,695	24,142	0,158

Table 38: Out-of-sample predictive ability Q^2

Consequently, the original variable `boundary_spanning_external` as an indicator for BOUNDARY SPANNING PROPENSITY must be removed.

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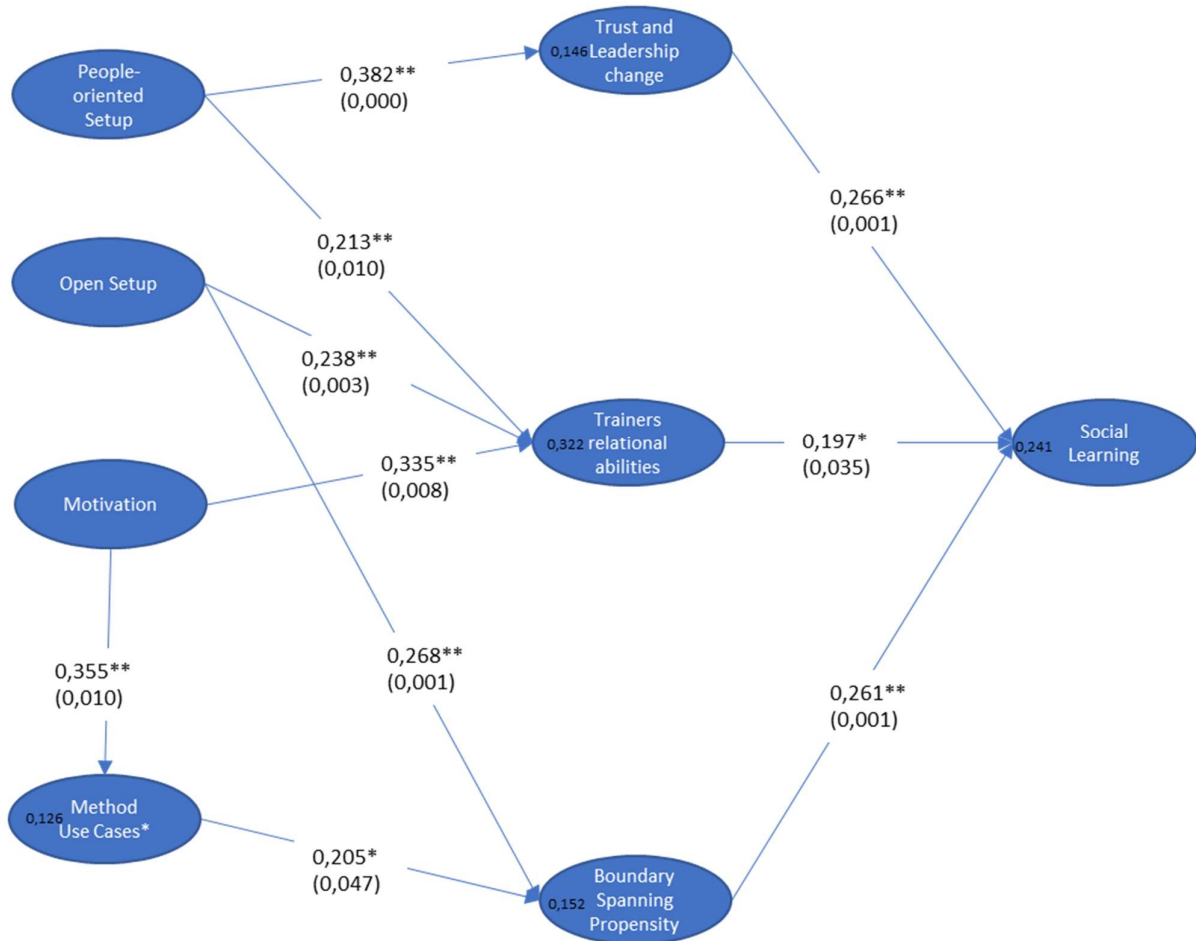
The final theoretical model on social learning after taking out the original variable of boundary_spanning_external can be seen in Figure 39 (at the bottom of this appendix the outer model is shown as well).

Eight reflective exogenous indicators were defined reflecting

- PEOPLE-ORIENTED SETUP
- OPEN-SETUP
- METHOD USE CASE
- MOTIVATION
- TRUST AND LEADERSHIP CHANGE
- TRAINERS RELATIONAL ABILITIES
- BOUNDARY SPANNING PROPENSITY
- SOCIAL LEARNING.

Final PLS-SEM model on Social learning

beta and (p in brackets), without original variable boundary_spanning_external



beta and p (in brackets), R² in oval constructs

Figure 39: Social Learning PLS-SEM final model

METHOD USE CASE is represented by a single-item construct measured on a five-point Likert scale.

Following the deletion of the indicator Boundary_Spanning_External, the construct BOUNDARY SPANNING PROPENSITY becomes a reflective one (indicating instead of fully explaining it via the remaining two variables) and CCA was repeated to estimate the updated model. The results for the updated measurement model are presented in Table 39ff.

Two outer loadings (activity_boundary_spanning_relevance [of the topic for the learner]: 0,491) and condition_boundary_spanning_responsibility [for the department as a condition to be willing to conduct trainings for others]: 0,679) are still slightly below the recommended

threshold of 0,7. Yet the composite reliability of the constructs PEOPLE ORIENTED SETUP (Cronbach’s alpha = 0,588, but CR = 0,766 and AVE = 0,537) and MOTIVATION (Cronbach’s alpha = 0,845, CR = 0,845 and AVE = 0,649) are within the valid boundaries (Legate et al., 2021).

Same can be said for the construct of BOUNDARY SPANNING PROPENSITY, which shows sufficient outer loading values, construct internal consistency reliability (CR = 0,811, while Cronbach’s alpha with 0,539 remains below the threshold level) and sufficient convergent validity (AVE = 0,683) as per the recommended guidelines (Legate et al., 2021). It should be noted that per Hair et al., (2020), CR is deemed a more valid measurement than Cronbach’s alpha

Discriminant validity is checked via HTMT; all values per Table 45 are lower than 0,9.

In summary, the reflective measurement models stay within the recommended guidelines (Legate et al., 2021).

	Boundary Spanning Propensity	Trust and Leadership Change	Method Use Cases	Motivation	Open Setup	People Oriented Setup	Social Learning	Trainers Relational Abilities
Learnreference_community_based							0,736	
activity_boundary_spanning_cognitive_experimentalwork					0,778			
activity_boundary_spanning_cognitive_flex					0,838			
activity_boundary_spanning_cognitive_interdiscipl					0,785			
activity_boundary_spanning_cognitive_relevance						0,491		
activity_boundary_spanning_cognitive_usecases			1,000					
activity_boundary_spanning_relational_acrosshierarchy						0,714		
activity_boundary_spanning_relational_trust						0,927		
boundary_spanning_across_training_centers	0,794							
boundary_spanning_customers	0,858							
condition_boundary_spanning_Abilities_MethoDid								0,756
condition_boundary_spanning_Abilities_Selfreflexion								0,804
condition_boundary_spanning_Abilities_Socialkomp								0,863
condition_boundary_spanning_Abilities_comm								0,801
condition_boundary_spanning_willingness_creatknowledge				0,897				
condition_boundary_spanning_willingness_passion				0,825				
condition_boundary_spanning_willingness_responsibility				0,679				
culture_change_eval_leadership		0,850						
culture_change_eval_trust		0,802						
culture_change_perception_leadership		0,779						
culture_change_perception_trust		0,777						
practical_preference_Hospitalation							0,627	
practical_preference_Tandem							0,742	
practical_preference_xchange_colleagues							0,801	

Table 39: Outer loadings, updated model

	Boundary Spanning Propensity	Trust and Leadership Change	Method Use Cases	Motivation	Open Setup	People Oriented Setup	Social Learning	Trainers Relational Abilities
Learnreference_community_based								0.373
activity_boundary_spanning_cognitive_experimentalwork					0.413			
activity_boundary_spanning_cognitive_flex					0.444			
activity_boundary_spanning_cognitive_interdiscipl					0.391			
activity_boundary_spanning_cognitive_relevance						0.238		
activity_boundary_spanning_cognitive_usscases			1,000					
activity_boundary_spanning_relational_acrosstierarchy						0.314		
activity_boundary_spanning_relational_trust						0.711		
boundary_spanning_across_training_centers	0.553							
boundary_spanning_customers	0.654							
condition_boundary_spanning_Abilities_Methodid								0.329
condition_boundary_spanning_Abilities_Selfreflexion								0.316
condition_boundary_spanning_Abilities_Socialkomp								0.313
condition_boundary_spanning_Abilities_comm								0.282
condition_boundary_spanning_willingness_creatknowlege				0.504				
condition_boundary_spanning_willingness_passion				0.412				
condition_boundary_spanning_willingness_responsibility				0.307				
culture_change_eval_leadership		0.357						
culture_change_eval_trust		0.302						
culture_change_perception_leadership		0.285						
culture_change_perception_trust		0.298						
practical_preference_Hospitalation								0.224
practical_preference_Tandem								0.365
practical_preference_xchange_colleagues								0.393

Table 40: Outer weights, updated model

	Mean	Median	Min	Max	Standard Deviation	Excess Kurtosis	Skewness	Number of Observations Used
Boundary Spanning Propensity	0.000	0.102	-3.797	1.402	1.000	1.083	-0.637	175.000
Trust and Leadership Change	0.000	0.189	-2.932	1.620	1.000	0.571	-0.752	175.000
Method Use Cases	0.000	0.447	-6.036	0.447	1.000	14.310	-3.256	175.000
Motivation	0.000	0.000	-6.068	1.040	1.000	11.724	-2.581	175.000
Open Setup	0.000	-0.079	-3.459	1.573	1.000	0.367	-0.475	175.000
People Oriented Setup	0.000	0.053	-3.584	1.252	1.000	1.878	-1.120	175.000
Social Learning	0.000	0.082	-4.225	1.703	1.000	2.861	-1.164	175.000
Trainers Relational Abilities	0.000	0.032	-3.868	1.332	1.000	1.653	-1.032	175.000

Table 41: construct characteristics, updated model

	Cronbach's Alpha	rho_A	Composite Reliability	Average Variance Extracted (AVE)
Boundary Spanning Propensity	0.539	0.548	0.811	0.683
Trust and Leadership Change	0.816	0.823	0.878	0.644
Method Use Cases	1.000	1.000	1.000	1.000
Motivation	0.728	0.779	0.845	0.649
Open Setup	0.719	0.723	0.842	0.641
People Oriented Setup	0.588	0.881	0.766	0.537
Social Learning	0.709	0.726	0.818	0.532
Trainers Relational Abilities	0.821	0.822	0.882	0.652

Table 42: Construct reliability and validity, updated model

	Boundary Spanning Propensity	Trust and Leadership Change	Method Use Cases	Motivation	Open Setup	People Oriented Setup	Social Learning	Trainers Relational Abilities
Boundary Spanning Propensity	0.626							
Trust and Leadership Change	0.067	0.802						
Method Use Cases	0.298	0.239	1.000					
Motivation	0.256	0.112	0.355	0.805				
Open Setup	0.339	0.217	0.347	0.146	0.800			
People Oriented Setup	0.288	0.382	0.393	0.238	0.502	0.733		
Social Learning	0.335	0.331	0.298	0.242	0.264	0.291	0.729	
Trainers Relational Abilities	0.285	0.243	0.388	0.421	0.394	0.412	0.336	0.807

Table 43: Fornell Larcker, updated model

	Boundary Spanning Propensity	Trust and Leadership Change	Method Use Cases	Motivation	Open SetUp	People Oriented Setup	Social Learning	Trainers Relational Abilities
Learnpreference_community_based	0.202	0.340	0.182	0.118	0.304	0.200	0.736	0.233
activity_boundary_spanning_cognitive_experimentalwork	0.270	0.121	0.337	0.122	0.778	0.348	0.188	0.312
activity_boundary_spanning_cognitive_flex	0.304	0.221	0.280	0.110	0.836	0.417	0.293	0.323
activity_boundary_spanning_cognitive_interdiscipl	0.237	0.176	0.214	0.120	0.785	0.444	0.133	0.311
activity_boundary_spanning_cognitive_relevance	0.151	0.128	0.224	0.125	0.197	0.491	0.111	0.157
activity_boundary_spanning_cognitive_usecases	0.298	0.239	1.000	0.355	0.347	0.393	0.298	0.388
activity_boundary_spanning_relational_acrosshierarchy	0.185	0.223	0.200	0.110	0.349	0.714	0.105	0.158
activity_boundary_spanning_relational_trust	0.273	0.395	0.389	0.245	0.486	0.927	0.325	0.458
boundary_spanning_across_training_centers	0.794	0.125	0.205	0.200	0.218	0.265	0.295	0.238
boundary_spanning_customers	0.858	-0.003	0.283	0.221	0.335	0.217	0.283	0.234
condition_boundary_spanning_Abilities_MethoDid	0.220	0.151	0.297	0.297	0.297	0.363	0.289	0.756
condition_boundary_spanning_Abilities_Selfreflexion	0.204	0.251	0.301	0.295	0.425	0.339	0.251	0.804
condition_boundary_spanning_Abilities_Socialkomp	0.247	0.189	0.362	0.330	0.313	0.308	0.305	0.863
condition_boundary_spanning_Abilities_comm	0.250	0.195	0.288	0.331	0.224	0.316	0.256	0.801
condition_boundary_spanning_willingness_createtknelege	0.257	0.041	0.363	0.897	0.113	0.225	0.231	0.394
condition_boundary_spanning_willingness_passion	0.177	0.108	0.319	0.825	0.217	0.147	0.205	0.304
condition_boundary_spanning_willingness_responsibility	0.173	0.152	0.132	0.679	0.000	0.210	0.133	0.316
culture_change_eval_leadership	0.060	0.850	0.194	0.124	0.143	0.341	0.315	0.197
culture_change_eval_trust	0.064	0.802	0.190	0.098	0.090	0.263	0.295	0.046
culture_change_perception_leadership	0.008	0.779	0.196	0.081	0.211	0.271	0.252	0.243
culture_change_perception_trust	0.057	0.777	0.188	0.049	0.264	0.345	0.194	0.299
practical_preference_Hospitalation	0.151	0.159	0.291	0.251	0.128	0.143	0.627	0.162
practical_preference_Tandem	0.255	0.207	0.130	0.170	0.137	0.274	0.742	0.322
practical_preference_xchange_colleagues	0.337	0.238	0.300	0.202	0.182	0.214	0.801	0.242

Table 44: Cross loadings, updated model

	Boundary Spanning Propensity	Trust and Leadership Change	Method Use Cases	Motivation	Open SetUp	People Oriented Setup	Social Learning	Trainers Relational Abilities
Boundary Spanning Propensity								
Trust and Leadership Change	0.143							
Method Use Cases	0.401	0.265						
Motivation	0.403	0.194	0.385					
Open SetUp	0.534	0.297	0.408	0.197				
People Oriented Setup	0.492	0.485	0.477	0.337	0.718			
Social Learning	0.526	0.421	0.367	0.347	0.366	0.367		
Trainers Relational Abilities	0.430	0.300	0.427	0.541	0.508	0.497	0.429	

Table 45: Discriminant validity HTMT, updated model

Evaluating the structural (inner) model now that it has been updated, means interpreting its relevance and predictive ability.

Multicollinearity can be shown as below; the acceptable threshold of VIF < 3 as per Table 46 is given.

	Boundary Spanning Propensity	Trust and Leadership Change	Method Use Cases	Motivation	Open SetUp	People Oriented Setup	Social Learning	Trainers Relational Abilities
Boundary Spanning Propensity								1,088
Trust and Leadership Change								1,063
Method Use Cases	1,137							
Motivation			1,000					1,061
Open SetUp	1,137							1,339
People Oriented Setup		1,000						1,389
Social Learning								
Trainers Relational Abilities								1,152

Table 46: Inner VIF showing collinearity, updated model

Relevance of the model can be established by assessing path coefficients' values as to size and significance.

Size and significance of path coefficients is given as per Table 47 with p < 0,05 in all cases and f² effect sizes which were all small but for two cases. Effect sizes of Motivation → Trainers relational abilities and People Oriented Setup → Trust and Leadership change are in the medium range. The path coefficient for Trainers Relational Abilities → Social learning is somewhat low, but acceptable for this explorative setting.

As can be seen in Figure 39, the results from the inner model indicate a PEOPLE-ORIENTED SETUP to be a strong indicator ($\beta = 0,382^{**}$) of TRUST AND LEADERSHIP CHANGE. Furthermore, strong indications are shown from MOTIVATION to METHOD USE CASE ($\beta = 0,355^{**}$) and MOTIVATION to TRAINERS RELATIONAL ABILITIES ($\beta = 0,335^{**}$).

Variance of the central object of this thesis, BOUNDARY SPANNING PROPENSITY, is explained to the amount of $R^2 = 0,152$ by Open Set Up ($\beta = 0,268^{**}$) and Method use case ($\beta = 0,205^{**}$). In other words, in an environment free of constraints in training and where hands-on, real use cases are used to teach and exemplify, a boundary spanning mindset can thrive.

	beta	p	f ²
Boundary Spanning Propensity -> Social Learning	0,261	0,001	0,082
Trust and Leadership change -> Social Learning	0,266	0,001	0,088
Method Use Cases -> Boundary Spanning Propensity	0,205	0,047	0,004
Motivation -> Method Use Cases	0,355	0,010	0,144
Motivation -> Trainers Relational Abilities	0,335	0,008	0,156
Open SetUp -> Boundary Spanning Propensity	0,268	0,001	0,075
Open SetUp -> Trainers Relational Abilities	0,238	0,003	0,062
People Oriented SetUp -> Trust and Leadership change	0,382	0,000	0,170
People Oriented SetUp -> Trainers Relational Abilities	0,213	0,010	0,048
Trainers Relational Abilities -> Social Learning	0,197	0,035	0,044

Table 47: Structural revised model results

	R Square
Boundary Spanning Propensity	0,152
Trust and Leadership Change	0,146
Method Use Cases	0,126
Social Learning	0,241
Trainers Relational Abilities	0,322

Table 48: Structural model prediction, updated model

According to the same logic, please note that a third of variance of TRAINERS RELATIONAL ABILITIES ($R^2 = 0,322$) can be explained by the three constructs PEOPLE-ORIENTED SETUP, OPEN SETUP and MOTIVATION.

Out-of-sample predictions are assessed using the PLSpredict procedure (Legate *et al.*, 2021; Hair *et al.*, 2020). As shown in Table 49, naïve benchmark was overcome because Q^2 predict values show superiority of the model. The structural model has a strong predictive capability, “if the RMSE for the PLS-SEM model is (a) lower than the RMSE for the LM for all items of

this construct” (Legate *et al.*; p. 14). “When none of the dependent construct indicators have higher RMSE or MAE prediction errors compared to the naïve LM benchmark, the model has high predictive power” (Hair *et al.*; p. 108).

For the indicators of the primary endogenous construct SOCIAL LEARNING (practical_preference_xchange_colleagues, practical_preference_Hospitation, Learnpreference_community_based, practical_preference_Tandem), it can be shown in Table 53 that the root mean square error (RMSE) of PLS SEM is lower than that of the naïve linear modelling comparison. Hence, the model has strong predictive capability.

For the indicators of the endogenous construct BOUNDARY SPANNING PROPENSITY (boundary_spanning_customers, boundary_spanning_across_training_centers), PLS SEM RMSE is also lower than that of the naïve linear modelling benchmark. It can therefore be concluded that the model is of strong predictive capability.

PLS	RMSE	MAE	MAPE	Q ² _predict
boundary_spanning_customers	0,850	0,664	21,584	0,105
boundary_spanning_across_training_c	0,957	0,762	26,879	0,048
culture_change_eval_leadership	1,052	0,807	34,598	0,102
culture_change_perception_trust	1,061	0,829	37,130	0,106
culture_change_perception_leadership	1,056	0,833	36,065	0,060
culture_change_eval_trust	1,039	0,805	31,232	0,055
activity_boundary_spanning_cognitive	0,606	0,393	12,050	0,051
practical_preference_xchange_colleagu	0,801	0,630	19,195	0,055
practical_preference_Hospitation	1,038	0,767	31,688	0,038
Learnpreference_community_based	1,041	0,834	34,273	0,067
practical_preference_Tandem	0,809	0,548	21,351	0,055
condition_boundary_spanning_Abilities	0,896	0,667	23,871	0,108
condition_boundary_spanning_Abilities	0,890	0,702	24,414	0,140
condition_boundary_spanning_Abilities	0,817	0,642	20,946	0,202
condition_boundary_spanning_Abilities	0,926	0,737	26,054	0,189

Linear Model	RMSE	MAE	MAPE	Q ² _predict
boundary_spanning_customers	0,874	0,697	22,215	0,052
boundary_spanning_across_training_c	0,980	0,774	26,993	0,001
culture_change_eval_leadership	1,070	0,822	34,990	0,072
culture_change_perception_trust	1,104	0,866	38,088	0,031
culture_change_perception_leadership	1,102	0,862	37,266	-0,022
culture_change_eval_trust	1,076	0,825	32,055	-0,012
activity_boundary_spanning_cognitive	0,592	0,404	11,657	0,095
practical_preference_xchange_colleagu	0,830	0,643	19,386	-0,016
practical_preference_Hospitation	1,058	0,789	32,190	-0,001
Learnpreference_community_based	1,080	0,861	34,944	-0,005
practical_preference_Tandem	0,838	0,601	22,585	-0,015
condition_boundary_spanning_Abilities	0,900	0,683	23,997	0,100
condition_boundary_spanning_Abilities	0,899	0,706	24,316	0,123
condition_boundary_spanning_Abilities	0,839	0,663	21,505	0,159
condition_boundary_spanning_Abilities	0,957	0,751	26,380	0,133

Delta	RMSE	MAE
boundary_spanning_customers	-0,025	-0,032
boundary_spanning_across_training_c	-0,023	-0,013
culture_change_eval_leadership	-0,018	-0,015
culture_change_perception_trust	-0,044	-0,037
culture_change_perception_leadership	-0,046	-0,029
culture_change_eval_trust	-0,036	-0,020
activity_boundary_spanning_cognitive	0,014	-0,011
practical_preference_xchange_colleagu	-0,029	-0,014
practical_preference_Hospitation	-0,021	-0,022
Learnpreference_community_based	-0,039	-0,027
practical_preference_Tandem	-0,029	-0,052
condition_boundary_spanning_Abilities	-0,004	-0,016
condition_boundary_spanning_Abilities	-0,009	-0,004
condition_boundary_spanning_Abilities	-0,022	-0,022
condition_boundary_spanning_Abilities	-0,031	-0,015

Table 49: PLS-SEM out-of-sample prediction

6. Development of new constructs regarding the complete meta model on digital transformation and departmental sustainability

The model of chapter 5 of this appendix folds into a larger model, which also incorporates constructs such as VIRTUAL LEARNING PROPENSITY and POSITIVE ABOUT HYBRID VET, DIGITAL TRANSFORMATION, and departmental SUSTAINABILITY (i.e., organizational resilience).

For all new constructs, linear interrelationships assumptions have been checked by correlation matrices in a previous step. Empirical measures with low correlation levels between indicators have not been built into the model as reflective ones. Accordingly, arrows between constructs showing little correlation have not been drawn at all.

A schematic illustration of the meta model can be found in Figure 40.

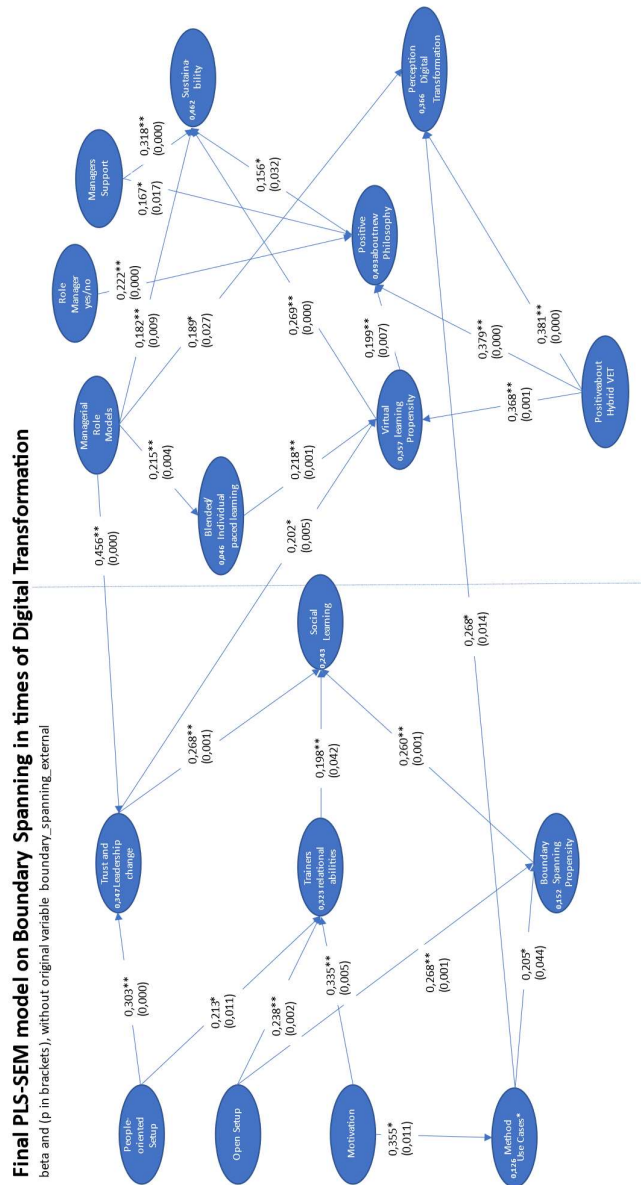


Figure 40: Meta-model social learning and departmental sustainability

The process of establishing this bigger model is analogous to that described in Chapter 4 and 5 of this appendix.

Nine latent constructs were formed. As there are indicators from the left side to the right side and vice versa, the following tables include all variables, not only those of the model on SOCIAL LEARNING described in chapter 4 of this appendix. The entire model will be referred to as meta model.

Table 29 shows all latent constructs, including the ones established in chapter 4 of this appendix.

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A positive opinion about new normal teaching/digital learning/hybrid Vocational Education and Training (VET) formats is used as latent variable POSITIVE ABOUT HYBRID VET with a single indicator.

MANAGERIAL ROLE MODELS is also a construct based on a single question related to boundary spanning across training centers.

MANAGERS SUPPORT is another single-indicator based variable which is special to the new VET philosophy.

MANAGER YES/NO is a binary variable reflecting whether the survey respondent has a manager/headquarters role or not.

The other constructs are reflective. The author's simplistic explanation to the reflective character of constructs is they are indicated/exemplified/reflected by the original variables rather than completely defined/explained/caused (like formative constructs). Hair et al. (2020, p. 104) describes it as such that the original variables "are seen as a manifestation of the empirical surrogates (proxy variables) for the latent variable".

PERCEPTION ON DIGITAL TRANSFORMATION means realization of new normal VET, digital learning, and hybrid VET formats.

POSITIVE ABOUT NEW PHILOSOPHY means a positive attitude towards the new understanding about how apprentices will be taught.

BLENDED/INDIVIDUALLY PACED LEARNING reflects on both self-led and combined formats. Combination can be hybrid-classroom or social-individual learning phases.

SUSTAINABILITY assesses the survey respondents' opinion about the future-proof-ness of departmental operations, i.e., preparedness for future demands.

VIRTUAL LEARNING PROPENSITY is a reflective construct which describes the survey participants' acknowledged usefulness of virtual training formats (vs. in a physical on-site setting).

Table 51 shows the construct characteristics of this meta model. The characteristics are sometimes slightly different than those for Table 25 (e.g., social learning). This is because the variables are depending on the interaction with the other variables

	Mean	Median	Min	Max	Standard Deviation	Excess Kurtosis	Skewness	Number of Observations Used
Boundary Spanning Propensity	0.000	0.102	-3.797	1.402	1.000	1.093	-0.637	175.000
Trust and Leadership Change	0.000	0.201	-2.943	1.609	1.000	0.599	-0.762	175.000
Positive about Hybrid VET	0.000	0.172	-2.793	1.160	1.000	0.223	-0.766	175.000
Managerial Role Models	0.000	0.299	-2.597	1.265	1.000	0.615	-0.848	175.000
Managers Support	0.000	0.331	-2.254	1.193	1.000	-0.172	-0.685	175.000
MethodsUseCases	0.000	0.447	-6.030	0.447	1.000	14.310	-3.258	175.000
Motivation	0.000	0.000	-6.099	1.040	1.000	11.723	-2.581	175.000
OpenSetUp	0.000	-0.079	-3.459	1.573	1.000	0.367	-0.475	175.000
PeopleOrientedSetUp	0.000	0.056	-3.586	1.251	1.000	1.885	-1.122	175.000
Perception Digital Transformation	0.000	0.102	-5.066	0.845	1.000	6.849	-2.034	175.000
Positive about New Philosophy	0.000	0.079	-3.014	1.363	1.000	0.408	-0.767	175.000
Role Manager Yes/No	0.000	-0.754	-0.734	1.558	1.000	-1.177	0.831	175.000
Blended/individually paced learning	0.000	-0.107	-2.492	1.877	1.000	-0.202	0.019	175.000
Social Learning	0.000	0.082	-4.226	1.702	1.000	2.864	-1.165	175.000
Sustainability	0.000	0.309	-3.487	1.258	1.000	1.457	-1.222	175.000
Trainers Relational Abilities	0.000	0.033	-3.866	1.333	1.000	1.649	-1.030	175.000
Virtual Learning Propensity	0.000	0.152	-2.893	1.746	1.000	0.588	-0.701	175.000

Table 51: Construct characteristics – Meta model

The original variables weights used for the constructs can be seen in Table 52.

	Cronbach's Alpha	rho_A	Composite Reliability	Average Variance Extracted (AVE)
Boundary Spanning Propensity	0,539	0,548	0,811	0,683
Trust and Leadership Change	0,816	0,826	0,878	0,643
Positive about Hybrid VET	1,000	1,000	1,000	1,000
Managerial Role Models	1,000	1,000	1,000	1,000
Managers Support	1,000	1,000	1,000	1,000
MethodUseCases	1,000	1,000	1,000	1,000
Motivation	0,728	0,779	0,845	0,649
OpenSetUp	0,719	0,723	0,842	0,641
PeopleOrientedSetUp	0,588	0,885	0,766	0,536
Perception Digital Transformation	0,776	0,776	0,899	0,817
Positive about New Philosophy	0,630	0,662	0,841	0,727
Role Manager Yes/No	1,000	1,000	1,000	1,000
Blended/individually paced learning	0,523	0,590	0,800	0,669
SocialLearning	0,709	0,726	0,818	0,532
Sustainability	1,000	1,000	1,000	1,000
Trainers Relational Abilities	0,821	0,822	0,882	0,651
Virtual Learning Propensity	0,804	0,811	0,873	0,632

Table 53: Construct reliability and validity – meta model

Discriminant validity as per Table 54 can be measured via HTMT (Hair *et al.*, 2020; Legate *et al.*, 2021), which should be $<0,85$. HTMT shows outer model discriminant validity. Furthermore, Fornell-Larcker criterion as per Table 54 is fulfilled: the table shows that square roots of AVE vs. latent variable correlation are higher than maximum correlation with any other construct (J. Hair *et al.*, 2017).

	Boundary Spanning Propensity	Trust and Leadership Change	Positive about Hybrid VET	Managerial Role Models Support	MethodUseClass Motivation	OpenSetup	PeopleOriented Setup	Perception Digital Transformation	Positive about New Philosophy	Role Manager Yes/No	Blended/visually paced learning	Sustainability	Trainers Rational Abilities	Virtual Learning Propensity
Boundary Spanning Propensity	0.143	0.442	0.556	0.286	0.511	0.244	0.118	0.489	0.463	0.213	0.210	0.281	0.258	0.258
Trust and Leadership Change	0.173	0.642	0.364	0.511	0.244	0.118	0.489	0.463	0.463	0.213	0.210	0.281	0.258	0.258
Positive about Hybrid VET	0.160	0.556	0.286	0.511	0.244	0.118	0.489	0.463	0.463	0.213	0.210	0.281	0.258	0.258
Managerial Role Models	0.173	0.642	0.364	0.511	0.244	0.118	0.489	0.463	0.463	0.213	0.210	0.281	0.258	0.258
Managerial Support	0.160	0.556	0.286	0.511	0.244	0.118	0.489	0.463	0.463	0.213	0.210	0.281	0.258	0.258
MethodUseClass	0.173	0.642	0.364	0.511	0.244	0.118	0.489	0.463	0.463	0.213	0.210	0.281	0.258	0.258
Motivation	0.160	0.556	0.286	0.511	0.244	0.118	0.489	0.463	0.463	0.213	0.210	0.281	0.258	0.258
OpenSetup	0.173	0.642	0.364	0.511	0.244	0.118	0.489	0.463	0.463	0.213	0.210	0.281	0.258	0.258
PeopleOrientedSetup	0.160	0.556	0.286	0.511	0.244	0.118	0.489	0.463	0.463	0.213	0.210	0.281	0.258	0.258
Perception Digital Transformation	0.173	0.642	0.364	0.511	0.244	0.118	0.489	0.463	0.463	0.213	0.210	0.281	0.258	0.258
Positive about New Philosophy	0.160	0.556	0.286	0.511	0.244	0.118	0.489	0.463	0.463	0.213	0.210	0.281	0.258	0.258
Role Manager Yes/No	0.173	0.642	0.364	0.511	0.244	0.118	0.489	0.463	0.463	0.213	0.210	0.281	0.258	0.258
Blended/visually paced learning	0.160	0.556	0.286	0.511	0.244	0.118	0.489	0.463	0.463	0.213	0.210	0.281	0.258	0.258
Sustainability	0.173	0.642	0.364	0.511	0.244	0.118	0.489	0.463	0.463	0.213	0.210	0.281	0.258	0.258
Trainers Rational Abilities	0.160	0.556	0.286	0.511	0.244	0.118	0.489	0.463	0.463	0.213	0.210	0.281	0.258	0.258
Virtual Learning Propensity	0.173	0.642	0.364	0.511	0.244	0.118	0.489	0.463	0.463	0.213	0.210	0.281	0.258	0.258

	Boundary Spanning Propensity	Trust and Leadership Change	Positive about Hybrid VET	Managerial Role Models Support	MethodUseClass Motivation	OpenSetup	PeopleOriented Setup	Perception Digital Transformation	Positive about New Philosophy	Role Manager Yes/No	Blended/visually paced learning	Sustainability	Trainers Rational Abilities	Virtual Learning Propensity
Boundary Spanning Propensity	0.225	0.802	0.410	1.000	0.254	0.181	0.266	0.492	0.315	0.228	0.301	0.468	0.501	0.796
Trust and Leadership Change	0.154	0.907	0.280	1.000	0.254	0.181	0.266	0.492	0.315	0.228	0.301	0.468	0.501	0.796
Positive about Hybrid VET	0.117	0.599	0.304	0.511	0.254	0.181	0.266	0.492	0.315	0.228	0.301	0.468	0.501	0.796
Managerial Role Models	0.173	0.642	0.364	0.511	0.254	0.181	0.266	0.492	0.315	0.228	0.301	0.468	0.501	0.796
Managerial Support	0.160	0.556	0.286	0.511	0.254	0.181	0.266	0.492	0.315	0.228	0.301	0.468	0.501	0.796
MethodUseClass	0.173	0.642	0.364	0.511	0.254	0.181	0.266	0.492	0.315	0.228	0.301	0.468	0.501	0.796
Motivation	0.160	0.556	0.286	0.511	0.254	0.181	0.266	0.492	0.315	0.228	0.301	0.468	0.501	0.796
OpenSetup	0.173	0.642	0.364	0.511	0.254	0.181	0.266	0.492	0.315	0.228	0.301	0.468	0.501	0.796
PeopleOrientedSetup	0.160	0.556	0.286	0.511	0.254	0.181	0.266	0.492	0.315	0.228	0.301	0.468	0.501	0.796
Perception Digital Transformation	0.173	0.642	0.364	0.511	0.254	0.181	0.266	0.492	0.315	0.228	0.301	0.468	0.501	0.796
Positive about New Philosophy	0.160	0.556	0.286	0.511	0.254	0.181	0.266	0.492	0.315	0.228	0.301	0.468	0.501	0.796
Role Manager Yes/No	0.173	0.642	0.364	0.511	0.254	0.181	0.266	0.492	0.315	0.228	0.301	0.468	0.501	0.796
Blended/visually paced learning	0.160	0.556	0.286	0.511	0.254	0.181	0.266	0.492	0.315	0.228	0.301	0.468	0.501	0.796
Sustainability	0.173	0.642	0.364	0.511	0.254	0.181	0.266	0.492	0.315	0.228	0.301	0.468	0.501	0.796
Trainers Rational Abilities	0.160	0.556	0.286	0.511	0.254	0.181	0.266	0.492	0.315	0.228	0.301	0.468	0.501	0.796
Virtual Learning Propensity	0.162	0.907	0.284	0.288	0.254	0.181	0.266	0.492	0.315	0.228	0.301	0.468	0.501	0.796

Table 54: HTMT and Fornell-Larcker Criterion - meta model

7. Establishment of PLS-SEM Meta Model

The full model can be seen in Figure 41.

In-Sample predictive ability can be assessed with R Square of the endogenous variables. It may differ from the Social Learning-only model of Chapter 5 of this appendix, as now more constructs interrelate.

The in-sample predictive ability is moderate for TRUST AND LEADERSHIP CHANGE, PERCEPTION DIGITAL TRANSFORMATION, POSITIVE ABOUT NEW PHILOSOPHY, SUSTAINABILITY. It is low regarding BOUNDARY SPANNING PROPENSITY, METHOD USE CASE, BLENDED/INDIVIDUALLY PACED LEARNING and SOCIAL LEARNING (Legate *et al.*, 2021).

With respect to the doctoral thesis under way, these are interesting values.

	R Square
Boundary Spanning Propensity	0,152
Trust and Leadership Change	0,347
MethodUseCases	0,126
Perception Digital Transformation	0,366
Positive about New Philosophy	0,493
Blended/Individually paced learning	0,046
SocialLearning	0,243
Sustainability	0,462
Trainers Relational Abilities	0,323
Virtual Learning Propensity	0,357

Table 55: In-sample predictive ability (R²) - meta model

Essentially, half of POSITIVE ABOUT NEW PHILOSOPHY can be explained by the model (49,3%), while SUSTAINABILITY is explained to the amount of 46,2%. About a third of the constructs PERCEPTION DIGITAL TRANSFORMATION, TRUST AND LEADERSHIP CHANGE, TRAINERS RELATIONAL ABILITIES as well as VIRTUAL LEARNING PROPENSITY can also be explained within this case.

It is worthwhile noting that this meta model explains TRUST AND LEADERSHIP CHANGE much more comprehensively than the social learning model established in chapter 5 of this appendix alone. In other words, MANAGERIAL ROLE MODELS with beta=0,457 and VIRTUAL LEARNING PROPENSITY (beta = 0,202) have a strong influencing position in this meta model.

How to assess this inner model qualitatively? Following the procedure described in chapter 5 of this appendix, we look at different quality indicators.

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Assessment for multicollinearity is done by VIF (Table 56) and looks fine (threshold level <3).

Size and significance of path coefficients (beta) should be close to | 1 |, the stronger the better.

	Boundary Spanning Propensity	Trust and Leadership Change	Positive about Hybrid VET	Managerial Role Models Support	Method/Case	Motivation	Open/Setup	People Oriented Setup	Perception Digital Transformation	Positive about New Philosophy	Role Manager Yes/No	Blended/virtuality placed	Social Learning	Sustainability	Trainers' Relational Ability	Virtual Learning Propensity
Boundary Spanning Propensity																
Trust and Leadership Change																
Positive about Hybrid VET		0.455														
Managerial Role Models Support																
Method/Case																
Motivation	0.205															
Open/Setup		0.268				0.355										
People Oriented Setup																
Perception Digital Transformation																
Positive about New Philosophy																
Role Manager Yes/No										0.222						
Blended/virtuality placed																
Social Learning																
Sustainability																
Trainers' Relational Ability																
Virtual Learning Propensity											0.124		0.198	-0.113	0.208	

Table 57: Path coefficients (beta) - meta model

Unfortunately, the values are rather in the 0,1 to the 0,4 range. The strongest beta is shown from MANAGERIAL ROLE MODELS to CHANGE CULTURE LEADERSHIP AND TRUST (beta = 0,456). Still, in such exploratory research context, a model like this adds value.

Indirect effects can also be measured:

	Specific Indirect Effects
Managerial Role Models -> Blended/Individually paced learning -> Virtual Learning Propensity -> Sustainability	0,013
Managerial Role Models -> Trust and Leadership Change -> Virtual Learning Propensity	0,092
Motivation -> MethodUseCases -> Perception Digital Transformation	0,095
Motivation -> MethodUseCases -> Boundary Spanning Propensity	0,073
OpenSetUp -> Trainers Relational Abilities -> Sustainability	-0,027
Managerial Role Models -> Trust and Leadership Change -> Virtual Learning Propensity -> Positive about New Philosophy -> Sustainability	0,003
Managers Support -> Positive about New Philosophy -> Sustainability	0,026
MethodUseCases -> Boundary Spanning Propensity -> SocialLearning	0,053
Blended/Individually paced learning -> Virtual Learning Propensity -> Positive about New Philosophy -> Sustainability	0,007
PeopleOrientedSetUp -> Trust and Leadership Change -> Virtual Learning Propensity	0,061
Motivation -> Trainers Relational Abilities -> Sustainability	-0,038
PeopleOrientedSetUp -> Trust and Leadership Change -> Virtual Learning Propensity -> Sustainability	0,017
PeopleOrientedSetUp -> Trainers Relational Abilities -> SocialLearning	0,042
OpenSetUp -> Boundary Spanning Propensity -> SocialLearning	0,070
Managerial Role Models -> Blended/Individually paced learning -> Virtual Learning Propensity -> Positive about New Philosophy	0,009
Positive about Hybrid VET -> Virtual Learning Propensity -> Positive about New Philosophy -> Sustainability	0,011
PeopleOrientedSetUp -> Trust and Leadership Change -> Virtual Learning Propensity -> Positive about New Philosophy -> Sustainability	0,002
Managerial Role Models -> Trust and Leadership Change -> SocialLearning	0,122
Trust and Leadership Change -> Virtual Learning Propensity -> Sustainability	0,054
Trust and Leadership Change -> Virtual Learning Propensity -> Positive about New Philosophy	0,040
Blended/Individually paced learning -> Virtual Learning Propensity -> Positive about New Philosophy	0,043
Motivation -> MethodUseCases -> Boundary Spanning Propensity -> SocialLearning	0,019
Role Manager Yes/No -> Positive about New Philosophy -> Sustainability	0,035
Trust and Leadership Change -> Virtual Learning Propensity -> Positive about New Philosophy -> Sustainability	0,006
PeopleOrientedSetUp -> Trust and Leadership Change -> Virtual Learning Propensity -> Positive about New Philosophy	0,012
OpenSetUp -> Trainers Relational Abilities -> SocialLearning	0,047
PeopleOrientedSetUp -> Trust and Leadership Change -> SocialLearning	0,081
Managerial Role Models -> Blended/Individually paced learning -> Virtual Learning Propensity	0,047
Managerial Role Models -> Blended/Individually paced learning -> Virtual Learning Propensity -> Positive about New Philosophy -> Sustainability	0,001
Positive about Hybrid VET -> Virtual Learning Propensity -> Sustainability	0,099
Positive about Hybrid VET -> Virtual Learning Propensity -> Positive about New Philosophy	0,073
Blended/Individually paced learning -> Virtual Learning Propensity -> Sustainability	0,059
Virtual Learning Propensity -> Positive about New Philosophy -> Sustainability	0,031
Managerial Role Models -> Trust and Leadership Change -> Virtual Learning Propensity -> Positive about New Philosophy	0,018
Motivation -> Trainers Relational Abilities -> SocialLearning	0,066
PeopleOrientedSetUp -> Trainers Relational Abilities -> Sustainability	-0,024
Positive about Hybrid VET -> Positive about New Philosophy -> Sustainability	0,059
Managerial Role Models -> Trust and Leadership Change -> Virtual Learning Propensity -> Sustainability	0,025

Table 58: Specific indirect effects - meta model

Effect size of predictive ability (f^2) can also be assessed. It is medium to low (Legate *et al.*, 2021). For all values of Table 59 shown in green it is medium.

Medium predictive ability effect size is a given for

- Motivation → Trainers relational abilities
- Managerial Role Models → Trust and Leadership changes
- Positive [attitude] about hybrid VET → Virtual learning propensity
- Positive [attitude] about hybrid VET → Positive [attitude] about new philosophy
- Positive [attitude] about hybrid VET → Perception regarding Digital Transformation

Boundary Spanning Propensity	Trust and Leadership Change	Positive about Hybrid VET	Managerial Role Models	Managers Support	Method/Cases	Motivation	Openness	PsychOpenness	Perception Digital Transformation	Positive about New Philosophy	Role Manager Yr/Mo	Blended/individually paced learning	SocialLearning	Sustainability	Trainers Multitask Abilities	Virtual Learning Propensity
0.094	0.310								0.268	0.143			0.062			0.053
0.044	0.137				0.124			0.151	0.043	0.043		0.048				0.113
0.025								0.104								0.116
																0.124
																0.062
																0.048
										0.086						0.133
																0.056
																0.022
										0.150			0.046			0.061

Table 59: Effect size of predictive ability f^2

Out-of-sample predictive ability Q^2 root mean squared error showed smaller than for the naïve linear model, against which it was benchmarked.

PLS Predict	RMSE	MAE	MAPE	$Q^2_{predict}$
boundary_spanning_across_training_centers	0,954	0,759	26,775	0,051
boundary_spanning_customers	0,851	0,666	21,617	0,104
culture_change_perception_leadership	1,004	0,775	32,741	0,148
culture_change_perception_trust	1,010	0,785	33,996	0,193
culture_change_eval_trust	0,951	0,716	27,098	0,206
culture_change_eval_leadership	0,948	0,729	29,931	0,270
activity_boundary_spanning_cognitive_usecases	0,614	0,397	12,139	0,023
culture_change_perception_hybrid_collab	0,669	0,500	14,658	0,188
culture_change_perception_hybrid_apprenticeship	0,656	0,499	14,533	0,258
culture_change_eval_philosophy	1,080	0,874	39,256	0,162
culture_change_eval_hybrid_collab	0,741	0,548	19,241	0,451
Learnpreference_Self_paced	1,176	0,986	40,257	0,005
Learnpreference_bleneded	0,914	0,712	26,960	0,033
practical_preference_xchange_colleagues	0,788	0,620	18,868	0,082
practical_preference_Tandem	0,811	0,552	21,342	0,049
Learnpreference_community_based	1,025	0,826	33,765	0,090
practical_preference_Hospitation	1,031	0,766	31,491	0,052
boundary_spanning_relevance_for_sustainability	1,739	1,335	infinite	0,328
condition_boundary_spanning_Abilities_Selfreflexion	0,919	0,734	25,955	0,201
condition_boundary_spanning_Abilities_comm	0,888	0,657	23,546	0,121
condition_boundary_spanning_Abilities_MethoDid	0,814	0,639	20,919	0,207
condition_boundary_spanning_Abilities_Socialkomp	0,883	0,698	24,285	0,150
practical_preference_TTT_community_methods	1,025	0,816	33,853	0,182
practical_preference_TTT_community_technology	0,903	0,676	26,705	0,149
Learnpreference_virtual_course	0,992	0,791	32,788	0,196
practical_preference_VT_central	1,059	0,840	35,126	0,148

Linear Model Naive Predict	RMSE	MAE	MAPE	$Q^2_{predict}$
boundary_spanning_across_training_centers	0,962	0,755	26,143	0,035
boundary_spanning_customers	0,890	0,710	22,739	0,019
culture_change_perception_leadership	1,010	0,774	32,114	0,138
culture_change_perception_trust	1,028	0,818	34,429	0,164
culture_change_eval_trust	0,936	0,698	25,827	0,231
culture_change_eval_leadership	0,868	0,670	26,705	0,389
activity_boundary_spanning_cognitive_usecases	0,596	0,421	11,841	0,078
culture_change_perception_hybrid_collab	0,708	0,545	15,636	0,092
culture_change_perception_hybrid_apprenticeship	0,698	0,525	15,320	0,162
culture_change_eval_philosophy	1,099	0,885	38,995	0,133
culture_change_eval_hybrid_collab	0,774	0,547	19,039	0,402
Learnpreference_Self_paced	1,174	0,980	38,254	0,007
Learnpreference_bleneded	0,942	0,732	27,526	-0,027
practical_preference_xchange_colleagues	0,798	0,628	18,489	0,059
practical_preference_Tandem	0,845	0,597	22,517	-0,034
Learnpreference_community_based	1,074	0,855	34,162	0,001
practical_preference_Hospitation	1,066	0,806	32,624	-0,014
boundary_spanning_relevance_for_sustainability	1,730	1,326	infinite	0,335
condition_boundary_spanning_Abilities_Selfreflexion	0,963	0,751	26,466	0,123
condition_boundary_spanning_Abilities_comm	0,912	0,691	24,269	0,072
condition_boundary_spanning_Abilities_MethoDid	0,854	0,680	22,008	0,126
condition_boundary_spanning_Abilities_Socialkomp	0,914	0,713	24,669	0,091
practical_preference_TTT_community_methods	1,054	0,827	34,385	0,134
practical_preference_TTT_community_technology	0,941	0,722	27,560	0,078
Learnpreference_virtual_course	1,030	0,805	33,162	0,134
practical_preference_VT_central	1,064	0,842	34,076	0,139

Delta (PLS Predict - Linear Modelling Predict)	RMSE	MAE
boundary_spanning_across_training_centers	-0,008	0,004
boundary_spanning_customers	-0,039	-0,044
culture_change_perception_leadership	-0,006	0,001
culture_change_perception_trust	-0,018	-0,033
culture_change_eval_trust	0,015	0,018
culture_change_eval_leadership	0,081	0,059
activity_boundary_spanning_cognitive_usecases	0,018	-0,024
culture_change_perception_hybrid_collab	-0,038	-0,045
culture_change_perception_hybrid_apprenticeship	-0,041	-0,026
culture_change_eval_philosophy	-0,019	-0,011
culture_change_eval_hybrid_collab	-0,032	0,001
Learnpreference_Self_paced	0,001	0,006
Learnpreference_bleneded	-0,028	-0,020
practical_preference_xchange_colleagues	-0,010	-0,007
practical_preference_Tandem	-0,035	-0,045
Learnpreference_community_based	-0,049	-0,029
practical_preference_Hospitation	-0,035	-0,041
boundary_spanning_relevance_for_sustainability	0,009	0,009
condition_boundary_spanning_Abilities_Selfreflexion	-0,044	-0,017
condition_boundary_spanning_Abilities_comm	-0,024	-0,035
condition_boundary_spanning_Abilities_MethoDid	-0,040	-0,041
condition_boundary_spanning_Abilities_Socialkomp	-0,030	-0,016
practical_preference_TTT_community_methods	-0,030	-0,011
practical_preference_TTT_community_technology	-0,037	-0,046
Learnpreference_virtual_course	-0,038	-0,014
practical_preference_VT_central	-0,005	-0,002

Table 60: Out-of-sample predictive ability - meta model

In summary, we have a model which is quite robust for an exploratory setting.

The model corroborates the findings of previous quantitative analysis of the DBA thesis; yet it shows several new aspects as to interrelation. In the following, beta and p can be seen:

	beta	P Values
Boundary Spanning Propensity -> SocialLearning	0,260	0,001
Trust and Leadership Change -> SocialLearning	0,268	0,001
Trust and Leadership Change -> Virtual Learning Propensity	0,202	0,005
Positive about hybrid VET -> Perception Digital Transformation	0,381	0,000
Positive about hybrid VET -> Positive about New Philosophy	0,379	0,000
Positive about hybrid VET -> Virtual Learning Propensity	0,368	0,000
Managerial Role Models -> Trust and Leadership Change	0,456	0,000
Managerial Role Models -> Perception Digital Transformation	0,189	0,027
Managerial Role Models -> Blended/Individually-Paced Learning	0,215	0,004
Managerial Role Models -> Sustainability	0,182	0,009
Managers Support -> Positive about New Philosophy	0,167	0,017
Managers Support -> Sustainability	0,318	0,000
MethodUseCases -> Boundary Spanning Propensity	0,205	0,044
MethodUseCases -> Perception Digital Transformation	0,268	0,014
Motivation -> MethodUseCases	0,355	0,011
Motivation -> Trainers Relational Abilities	0,335	0,004
OpenSetUp -> Boundary Spanning Propensity	0,268	0,001
OpenSetUp -> Trainers Relational Abilities	0,238	0,002
PeopleOrientedSetUp -> Trust and Leadership Change	0,303	0,000
PeopleOrientedSetUp -> Trainers Relational Abilities	0,213	0,011
Positive about New Philosophy -> Sustainability	0,156	0,032
Role Manager Yes/No -> Positive about New Philosophy	0,222	0,000
Blended/Individually-Paced Learning -> Virtual Learning Propensity	0,218	0,001
Trainers Relational Abilities -> SocialLearning	0,198	0,042
Trainers Relational Abilities -> Sustainability	-0,113	0,066
Virtual Learning Propensity -> Positive about New Philosophy	0,199	0,007
Virtual Learning Propensity -> Sustainability	0,269	0,000

Table 61: beta and p for model on virtual learning

The arrow between TRAINERS RELATIONAL ABILITIES → SUSTAINABILITY was eliminated in view of the p value above.

What can we learn from this model?

The different areas of the model can be seen in Figure 41 as well.

- Training Methods (“Activities”), trainers’ motivation (“Willingness”) and trainers’ abilities (Roberts and Beamish, 2017, p. 513).
- Boundary Spanning and Social Learning
- Collective Culture & Leadership
- Individual New Work Mindset

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- Role Manager Yes/no as control variable
- Sustainability/Departmental resilience as separate area.

Final PLS-SEM model on boundary spanning in times of digital transformation

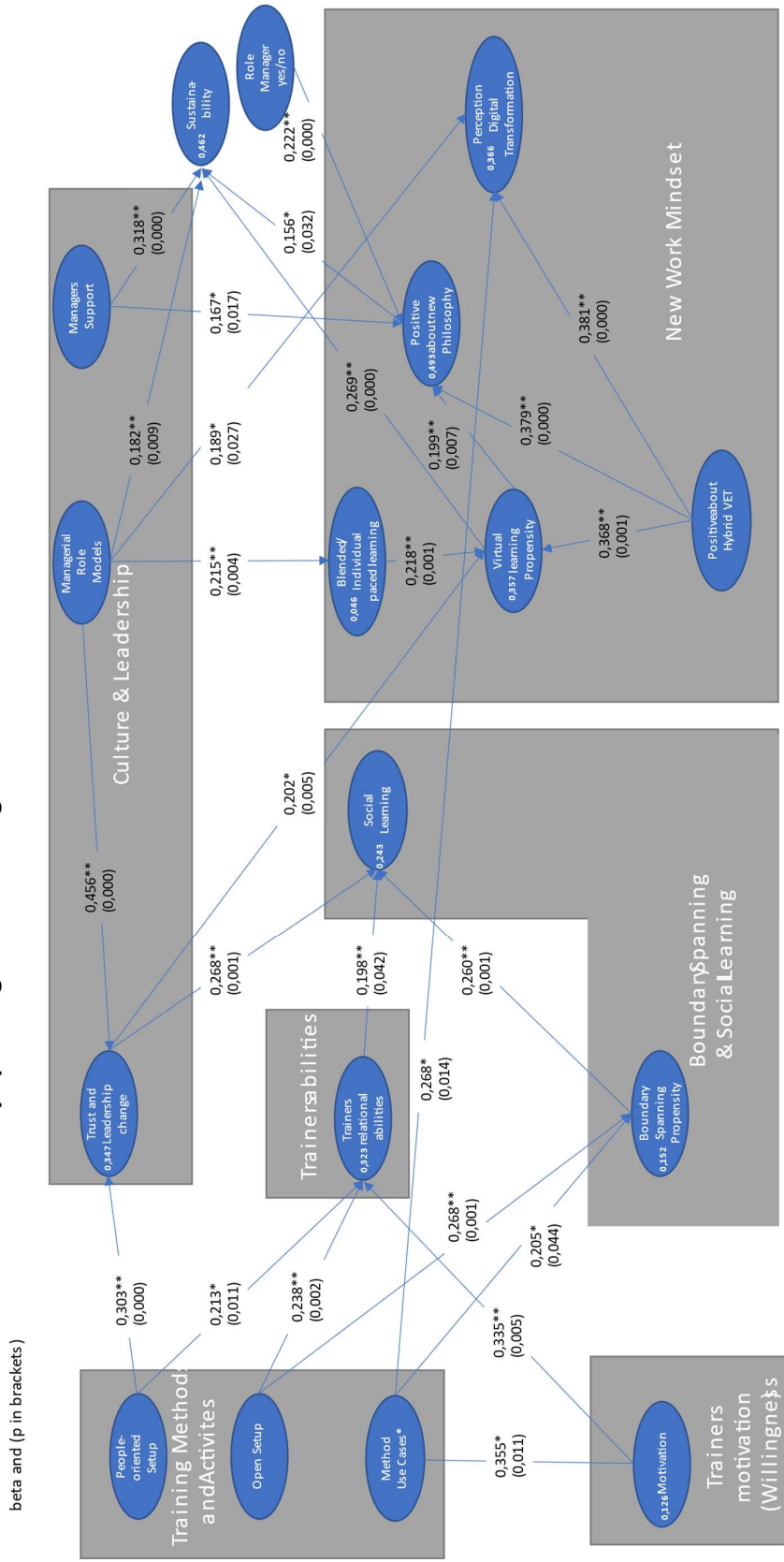


Figure 41: Meta model areas

BOUNDARY SPANNING PROPENSITY (Figure 43) is dependent on how training activities are set up (USE CASES (beta= 0,205*), OPEN SET-UP (beta = 0,268)). This new construct of BOUNDARY SPANNING PROPENSITY – which is different from the previously established boundary spanning characteristics – is significantly independent of the role MANAGER/NON-MANAGER.**

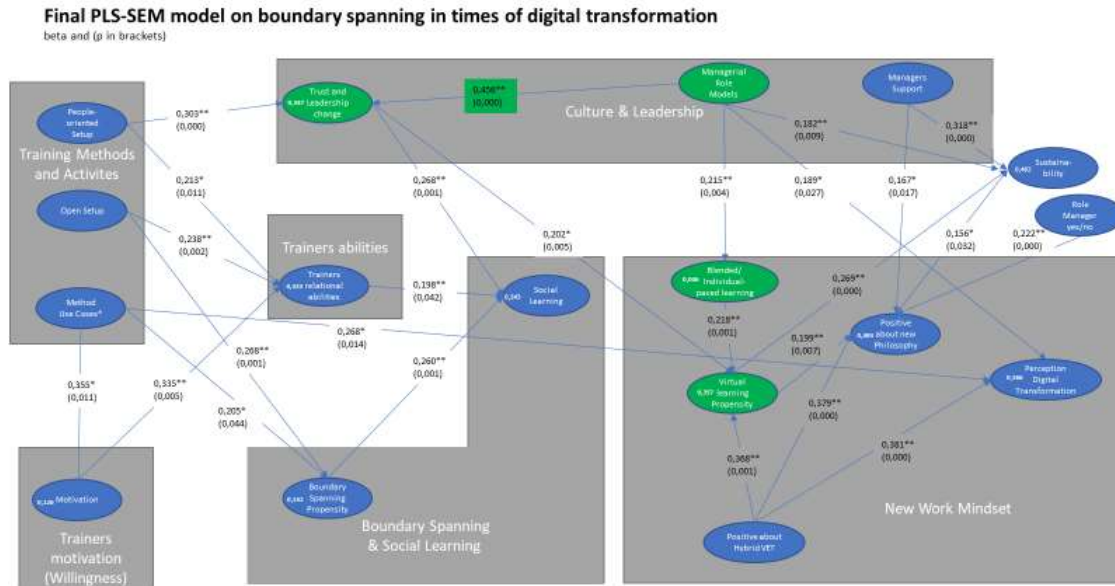


Figure 44: Managers influence on learning and change

MANAGERIAL ROLE MODELS contribute (beta = 0,456**) to a TRUST AND LEADERSHIP CHANGE which in return helps explain (beta = 0,268**) SOCIAL LEARNING (Figure 44).

It can be confirmed that BOUNDARY SPANNING PROPENSITY remains – equal to BOUNDARY SPANNING CHARACTERISTICS as defined in previous memos – unrelated to a POSITIVE (attitude) TO HYBRID LEARNING, PERCEPTION OF DIGITAL TRANSFORMATION and SUSTAINABILITY of VET operations.

A VIRTUAL LEARNING PROPENSITY contributes to **SUSTAINABILITY** of VET operations (aka organizational resilience) with $\beta = 0,269^{**}$ (see Figure 46). Besides VIRTUAL LEARNING PROPENSITY, SUSTAINABILITY is explained by MANAGERIAL ROLE MODELS ($\beta = 0,182^{**}$), the positive attitude about NEW LEARNING PHILOSOPHY ($\beta = 0,156^*$) and MANAGERS SUPPORT ($\beta = 0,318^{**}$), to only name the direct indicators. In total, 46,2% of the variance of SUSTAINABILITY is explainable by constructs. While the **POSITIVE (attitude) ABOUT NEW LEARNING PHILOSOPHY** was also able to explain SUSTAINABILITY in the Poisson analysis, TRUST AND LEADERSHIP CHANGE as an influencer of SUSTAINABILITY according to formerly established equations, could not be confirmed via PLS-SEM analysis directly. In case of a VIRTUAL LEARNING PROPENSITY, they do influence SUSTAINABILITY with $\beta = 0,054$.

Here is a lesson regarding impact (Figure 46): All three managerial behavior constructs (MANAGERIAL ROLE MODELS (indirectly, $\beta = 0,035$), ROLE MANAGER/NON-MANAGER and MANAGERS SUPPORT) contribute, directly or indirectly, to the perception of SUSTAINABILITY of VET operations. Both the ROLE OF MANAGER/NON-MANAGER ($\beta = 0,222^{**}$) itself and the MANAGERIAL SUPPORT ($0,167^*$) influence the **POSITIVE (attitude) ABOUT NEW PHILOSOPHY** perception. Another lesson on impact from a managerial perspective! Almost half of the variance of a POSITIVE (attitude) about NEW PHILOSOPHY can be explained ($R^2 = 49,3\%$).

Besides the two constructs mentioned above, a VIRTUAL LEARNING PROPENSITY of trainers ($\beta = 0,199^{**}$) and a POSITIVE (attitude) ABOUT HYBRID VET ($\beta = 0,379^{**}$) heavily influence it (indirectly) from the perspective of an individual mindset level (see Figure 47).

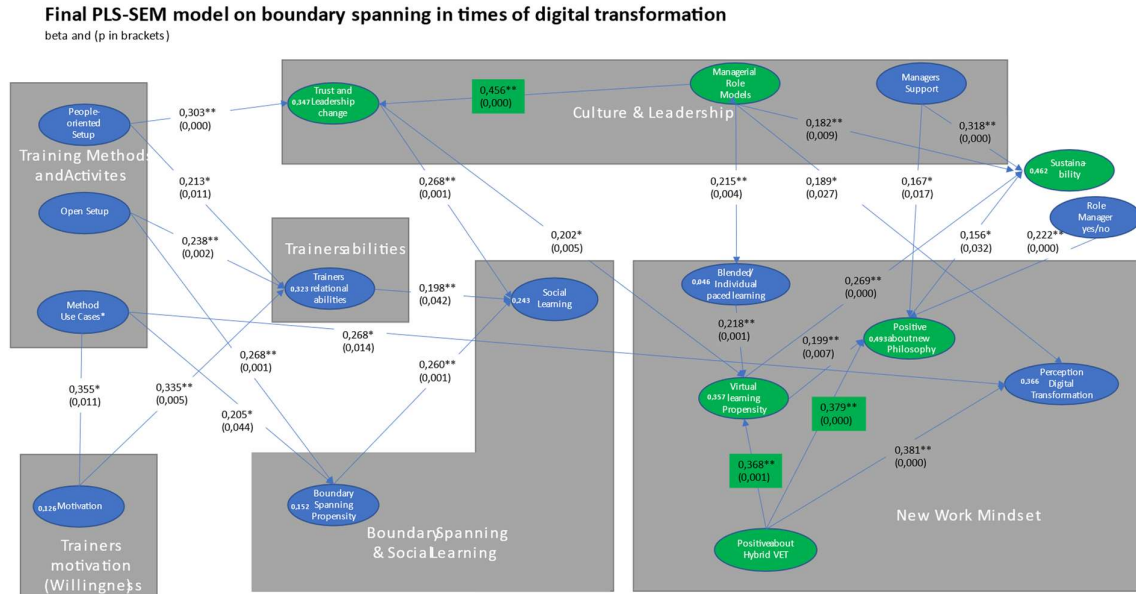


Figure 47: Individual mindset

8. Discussion

In this case study's, PLS-SEM based, meta model, a positive attitude towards boundary spanning, i.e., **boundary spanning propensity, leads to social learning.**

Contrary to extant literature, where effective leaders bridge social and cultural boundaries (Ernst and Yip, 2009a) and corporate headquarter managers help smoothen and grease internally (Birkinshaw et al., 2017), boundary spanning as a task rather associated with management and leadership could not be confirmed by this PLS-SEM model per se. (Previous multiple regression, which incorporated a slightly different, more person-oriented definition of “boundary spanner characteristics”, was, however, congruent with extant literature.)

Yet, what was clearly visible in the meta model of this case does indeed correspond to scientific research on learning theory and digital transformation: we see a department in transition to virtual learning, fueled by cultural changes: leadership and trust changes, virtual learning becomes available, hybrid VET is discussed, and a new philosophy is introduced. Here, managerial role models can help influence this new culture. Acknowledged usefulness of virtual learning (i.e., new forms of learning) influences the assessment of departmental sustainability, the so-called organizational resilience mentioned before. It is the acknowledged impression of being future proof, which is the aim of many endeavors of the team, be it the new philosophy of learning and teaching, be it managerial support regarding this philosophy and managerial

role models regarding boundary spanning across training centers. While **managerial role models** of this sort do not contribute to boundary spanning propensity (of survey respondents), these role models do **contribute (beta = 0,456) to trust and leadership change**. Such culture change, in return, influences the acknowledged usefulness of virtual trainings, **and indirectly, sustainability (sum of indirect effects = 0,042)**.

The different dimensions of culture change – which management strives to influence in order to aspire to an ecosystem approach of learning while breaking the boundaries across training centers and reaching out to customers – show an organization in transition, in short: Gong and Ribiere’s (2021) “fundamental change process”, where collaboration across and management of boundaries (Kazim, 2019) are paramount to succeed, whereas new learning models, in ecosystems and communities, become apparent (Schuchmann and Seufert, 2015; Widmann et al., 2016; Ernst and Yip, 2009b).

Such culture change is required to prepare the VET organization for resilience. In this context the different training centers act as loosely coupled systems (Weick, 1976) the synergies of which could be combined in a mostly virtual manner to allow for individual, team level and organizational level learning (Schuchmann and Seufert, 2015). This – sometimes – improvised change (Orlikowski and Hofman, 1997) and certainly continuously improved process [in this case: from formal trainings (prior to 2018) to virtual, individual nuggets via DLP, to “new normal great teaching” sessions (2020) via trainer-to-trainers up to “learning days” introduced in fall 2021] reflects on what Morgan (1998) calls an open system learning organization, with managers as connecting agents and information processing as source for intelligence and success.

Alas, another hypothesis of the qualitative study cannot be proven. It is not possible based on the data of this study to statistically explain DT (as defined here) by organizational resilience or vice versa.

Via Poisson analysis, organizational resilience was shown to significantly ($p < ,001$) depend on leadership and trust (beta = 0,143**) and to depend on the new VET philosophy (beta = 0,130**) as predictors, explaining variance in $n=111$ cases ($N=172$). This could be confirmed by this PLS-SEM meta model. In other words: **leadership and trust (sum of indirect effects = 0,061) as well as shared values (new philosophy, beta = 0,156) make individuals feel more positive about the department’s future, fueled by managers’ support.**

As to the interrelation of confidence in organizational resilience and aspects of culture change, leadership, trust, and shared values, it constitutes an explorative finding of the qualitative part of this research study and is confirmed by the quantitative part. This corresponds to Vogus and Sutcliffe's (2007, p. 3420) assessment that, if a resilient organization needs not to exhibit optimism, its representatives should certainly exhibit positiveness or "hope".

Leadership and trust, but also the new VET learning philosophy need to be carefully observed for how the team buys into them. In this respect, managers are vital for carrying across the right messages and a trustful, inspiring attitude (Schwarz Müller et al., 2018), whatever crisis (COVID) or challenge (upskilling of adult employees, new forms of VET) may come up. Such responsibility can be shared by management and other boundary spanners to ensure the organizational unit is set up well for the future.

9. Conclusion

In the introduction, it was stated that previous analysis methods did not fully explain conditions, motivations, and activities of trainers' boundary spanning in a complex model: boundary spanning characteristics, digital transformation and organizational resilience could be modeled, without, however, putting these three constructs in direct interdependency.

PLS-SEM brings about this interrelatedness. While a direct correlation among boundary spanning, digital transformation and sustainability of VET operations can still not be established, indirect influence can be made visible. The constructs remain separate, whereas PLS-SEM can help put together a complex model which explains indirect and direct effects from boundary spanning to social learning, from culture change in terms of leadership and trust to virtual learning and sustainability while spanning the room towards what is perceived in the department as digital transformation. It clearly shows the influencing constructs and their power.

For management this means that their acting as role models regarding boundary spanning across local training centers helps foster social learning, virtual learning, and indirectly, sustainability and carry across authentically a new philosophy. But the individual trainers' mindsets cannot be neglected. Being positive about hybrid VET has an influence regarding the perception of digital transformation and fuels the attitude about virtual learning and the new philosophy.

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Recruiting and promoting the right individuals to managers and to boundary spanners is therefore relevant for mastering change, learning and success of the case at hand.

10. Bibliography

Birkinshaw, J., Ambos, T. C. and Bouquet, C. (2017) "Boundary spanning activities of corporate HQ executives: insights from a longitudinal study", *Journal of Management Studies*, Vol. 54 (4)., pp. 422-454.

Ernst, C. and Yip, J. (2009a) "Boundary Spanning Leadership: Tactics to Bridge Social Identity Groups in Organizations." In: (ed.) T. Pittinsky, *Crossing the divide: Intergroup leadership in a world of difference*. Boston, MA: Harvard Business School Press, pp. 1-18.

Ernst, C., Yip, J. and Campbell M. (2009b) "*Boundary Spanning Leadership: Mission Critical Perspectives from the Executive Suite*", Center for Creative Leadership, pp. 1-26.

Gong C. and Ribiere V. (2021) "Developing a unified definition of digital transformation", *Technovation*, Vol. 102, pp. 102217 (1-17).

Hair J.F. Jr., Howard, M. C., Nitzl, C. (2020) "Assessing measurement model quality in PLS-SEM using confirmatory composite analysis", *Journal of Business Research*, Vol. 109, pp. 101-110.

Hair J. F. Jr., Matthews, L. M., Matthews, R. L. and Sarstedt, M. (2017) "PLS-SEM or CB-SEM: updated guidelines on which method to use", *International Journal of Multivariate Data Analysis*, Vol. 1, No. 2, pp. 107–123.

Henseler, J., Ringle, C. and Sarstedt, M (2015) "A new criterion for assessing discriminant validity in variance-based structural equation modeling", *Journal of the Academy of Marketing Science*, Vol. 43 No. 1, pp. 115-135.

Kazim, F. A. B. (2019) "Digital Transformation and Leadership Style: A Multiple Case Study", *ISM Journal*, Vol. 3, issue 1, pp. 24-33.

Legate, A. E., Hair J. F. Jr., Lambert Chretien, J., Risher, J.J. (2021) "PLM-SEM: Prediction-oriented solutions for HRD researchers", *Human Resource Development Quarterly*, pp. 1-19.

Morgan, G. (1998) "*Images of Organization*", Thousand Oaks/London/New Delhi: Sage, pp. 35-109.

Orlikowski, W. J. and Hofman, J. (1997) "An Improvisational Model of Change Management: The Case of Groupware Technologies" In: (eds.) Malone, T., Laubacher, R., Scott Morton, M.

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S., *Inventing the Organizations of the 21 Century*, Cambridge, Mass.: MIT Press, 2003, pp. 265-282.

Ringle, C. M., Sarstedt, M., Mitchell, R. and Gudergan, S. P. (2020) "Partial least squares structural equation modeling in HRM research", *The International Journal of Human Resource Management*, Vol. 31, No. 12, pp. 1617-1643.

Ringle, C. M., Wende, S., and Becker, J.-M (2015) "SmartPLS 3", Boenningstedt: SmartPLS GmbH, <http://www.smartpls.com>.

Roberts, M.J.D. and Beamish, P.W. (2017) "The Scaffolding Activities of International Returnee Executives: A Learning Based Perspective of Global Boundary Spanning", *Journal of Management Studies (Special Issue: Boundary Spanning in Global Organizations)*, Vol. 54, Iss. 4, pp. 511-539.

Rönkkö, M. and Cho, M. (2022) "An updated guideline for assessing discriminant validity", *Organizational Research Methods*, Vol. 25, No. 1, pp. 6-14.

Schuchmann, D. and Seufert S. (2015) "Corporate learning in times of digital transformation: a conceptual framework and service portfolio for the learning function in banking organisations", *International Journal of Corporate Learning*, Vol. 8, No. 1, pp. 31-39.

Vogus, T. J. and Sutcliffe, K. M. (2007) "Organizational resilience: Towards a theory and research agenda", *2007 IEEE International Conference on Systems, Man and Cybernetics*, pp. 3418-3422.

Weick, K. E. (1976) "Educational organizations as loosely coupled systems", *Administrative Science Quarterly*, Vol. 21, Iss. 1, pp. 1-19.

Widmann, A., Messmann G. and Mulder, R. (2016) "The Impact of Team Learning Behaviors on Team Innovative Work Behavior: A Systematic Review.", *Human Resource Development Review*, Vol. 15, Iss. 4, pp. 429-458.

11. Addendum of Appendix 4

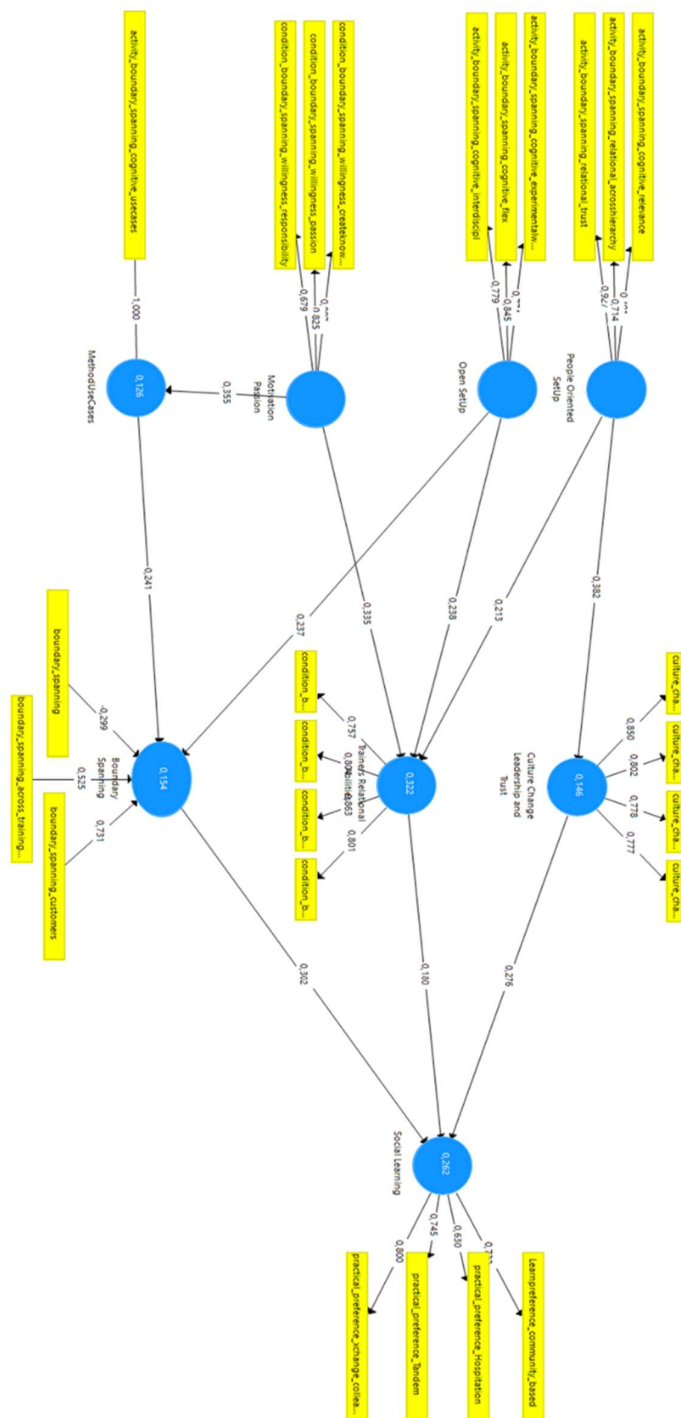


Figure 48: Initial model on Social learning including formative and instructive outer model

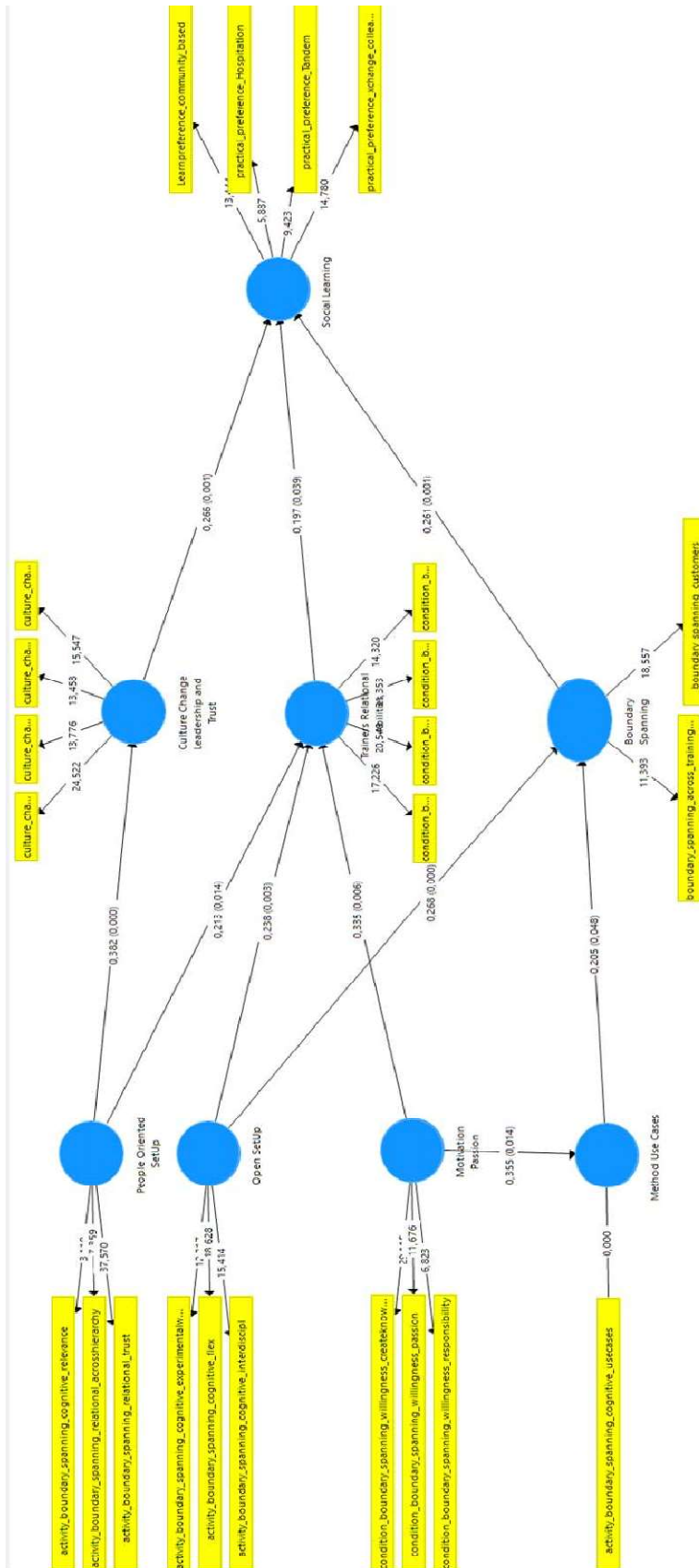


Figure 49: Final model on Social Learning including outer and inner model

Back cover with abstract

In a vocational education and training (VET) department of a high-tech multinational enterprise, VET trainers need to continuously acquire new digital competencies and new methods of teaching to ensure that apprentices enter their work life with the right skills. Boundaries may hinder efficient exchange of know-how and team learning. In this research context, a boundary is the border between training centers, regions, and shop floors, but also the invisible border between old fashioned VET and new forms of learning. By exploring in a single mixed-methods case study how high-quality collaboration across intra-organizational boundaries fosters organizational resilience and learning, the manager of a VET department, i.e., the author of this thesis makes an original contribution to organizational behavior and change management theories by answering the research question about understanding how and why boundary spanning occurs between traditional VET and new forms of education in the context of digital transformation to secure sustainability of operations.

Keywords: Boundary spanning, culture change, digital transformation, learning, mixed methods, organizational resilience, vocational education and training

Dans un service d'apprentissage d'une grande entreprise multinationale dans le secteur de la haute technologie, les instructeurs doivent acquérir de manière constante des nouvelles compétences digitales ainsi que des nouvelles méthodes d'enseignement afin d'assurer que les apprentis entrent leurs vies professionnelles avec le savoir-faire adéquat. Des limites – la notion anglaise de « boundaries » – peuvent empêcher l'échange de savoir-faire et d'apprentissage. Dans le contexte de cette recherche, les « boundaries » sont les bornes entre des centres d'apprentissages, des régions, des ateliers productifs, mais aussi les bornes invisibles entre apprentissage traditionnel et des nouvelles formes d'apprendre. En explorant par une étude de case singulière et par des méthodes mixtes comme la collaboration de haute qualité puisse augmenter la résilience et les connaissances organisationnelles, le manager d'un service d'apprentissage, c'est-à-dire l'auteur de ce doctorat, rend une contribution originelle à la théorie de comportement organisationnel et du management de change en répondant à la question de recherche comment et pourquoi s'effectue le « boundary spanning » de l'apprentissage traditionnel à travers les nouvelles méthodes d'éducation face à la transformation digitale afin de soutenir les opérations.

Mots clés : apprentissage, boundary spanning, changement de culture, méthodes mixtes, résilience organisationnelle, transformation digitale