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# EFFECTS OF COVID-19 ON THE WORLD OF WORK

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## ABSTRACT

The respiratory disease SARS-CoV-2 triggered a global pandemic, and efforts were made worldwide to contain the spread of the virus. These interventions impacted public and social life, as well as the world of work. Companies and organizations faced strict restrictions and regulations that forced them to restructure their daily business. In addition, supply bottlenecks and changes in demand hampered companies' and organizations' ability to work and plan ahead. On an interim basis, some companies or even entire industries had to cease operations because they were unable to implement the legal requirements. For those who were able to implement the regulations, this meant—at least temporarily—a major transformation process: Workflows, structures and procedures had to be adapted or changed, hygiene measures had to be implemented on site, and if possible, employees worked from home.

The objective of this dissertation is to understand this process of change in companies and organizations, i.e., to record the status quo in selected industries during the pandemic. From this, recommendations shall be derived for work during the pandemic or a similar crisis, as well as for a working world that is generally characterized by a high degree of volatility, uncertainty, complexity and ambiguity (VUCA world).

Two empirical investigations were conducted as part of the dissertation. The aim of the first study was to gain an overview of the measures introduced in companies and organizations in selected industries in the primary, secondary and tertiary sectors to maintain the ability to work. To this end, interviews were conducted in three different regions of Germany (Bavaria, North Rhine-Westphalia and Saxony). The aim of the second study was to look in detail at the changes for employees in a selected area of work, namely the university context. The focus was particularly on working conditions, job satisfaction and the shift of communication to the digital world. This study consists of a quantitative part, in which a questionnaire was distributed at two points in time during the pandemic (more specifically, during the first and second lockdown). Building on the survey results, the process of change during the pandemic was investigated in more detail using a qualitative follow-up interview study.

The results show that a large number of different measures were introduced in companies and organizations due to the pandemic. These include, most notably, hygiene measures, more flexible working hours and work locations, as well as the introduction of digital work processes and technologies. In addition, a strong shift of communication to the digital sphere was observed. Communication with superiors in particular suffered during the pandemic, and informal communication largely fell by the wayside.

Recommendations for three different types of work and for the operational (crisis) management were derived from the results of the empirical investigations. On the one hand, these can support managing the pandemic or a similar crisis; on the other hand, they represent general recommendations for working in a VUCA world.



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THE CHANGING WORLD OF WORK

The world, and with it the world of work, is constantly changing. This idea is associated with Heraclitus in various formulations and analogies, but its origin is actually unclear (Stern, 1991). The fact that everything is subject to constant change is initially a very all-encompassing approach. However, what this statement implies is that change is ubiquitous and universal: one's own personal development, people in one's own environment, politics, economy, research or the world of work—and this list can be continued arbitrarily. Change processes are not predictable and human systems are extremely complex (Green, 2016). They cannot be reduced to simple cause-effect chains, as many feedback loops and relationships exist between the numerous elements (Green, 2016). "In complex systems, change results from the interplay of many diverse and apparently unrelated factors. Those of us engaged in seeking change need to identify which elements are important and understand how they interact." (Green, 2016, p. 10).

Sometimes, however, explicit triggers are drivers for change and in organizational fields, a change process always requires an external factor (Hinings et al., 2004). These external factors do not lead to change in companies per se, they additionally require an interpretation of and a reaction to these external factors (Hinings et al., 2004). Such an external pressure can be of diverse origin (e.g., political pressures, functional pressures (changes in markets and technology), social pressures) and it can either cause opportunities or difficulties (Hinings et al., 2004). Depending on the nature of the pressure, the actors involved have more or less control over the speed, the shape, and the impact of change. Within an institutional change, the pressure for change, the sources of the new, the process and dynamics of deinstitutionalization and reinstitutionalization, and finally stability can be distinguished (Hinings et al., 2004)—but to better understand change processes in the context of human labor, let us first take a look back in time, as there have already been massive transformation processes in the context of work. In the following, two important drivers of these changes will be described in more detail: technological innovations and crises that affect society as a whole.

Radical upheavals in the world of work can often be traced back to technical innovations. The invention of the steam engine and other combustion machines using fossil fuels, for instance, laid the foundation for the substitution of more and more human physical labor (Bubb, 2006) and activities could be performed that exceeded human strength. Thereupon, the invention of electricity created an ubiquitous availability of energy, leading to the further development and spread of this trend (Bubb, 2006). The reduction in manual labor resulted in an increase in cognitive activities, such as service and administrative activities. With the development of the computer, it has then become possible to replace (at least parts of) cognitive work, and building on this, the networking of computers—via the Internet—has made it ubiquitously available (Bubb, 2006). "This technical development leads to the effect that, at least in the technologically highly developed countries, heavy physical work is disappearing quickly and the production industry is becoming increasingly more automated (...)" (Bubb, 2006, p. 403).

Likewise, Drucker (2009) represents the idea that modern business models and the modern economy can be traced back to the Industrial Revolution—and thus technical innovations. The associated challenges relate to the new technologies. In the nineteenth century and early twentieth century, it could be assumed that the only relevant technologies were those in the same industry. Today, however, it must be assumed that it is precisely the technologies outside one's own industry that can have the greatest impact on a company and an industry, he argues. As a result, technologies quite often crisscross and no longer run in parallel (Drucker, 2009). "Constantly, such outside technologies force an industry to learn, to acquire, to adapt, to change its very mindset, let alone its technical knowledge." (Drucker, 2007, p. 21). We must therefore assume that all technologies have an impact on every industry and are meaningful to every industry (Drucker, 2009).

### Digression

To illustrate these far-reaching effects of technological innovations, the development of technologies for exchanging (i.e., communicating) or documenting information will be used as an example. Certainly, this is of great importance in the context of work and one of the great achievements of human history. The first written records, inscriptions without using a genuine writing surface, were replaced by bamboo, clay and papyrus (Kittler, 1993). This was followed by ancient scrolls made of papyrus and afterward of parchment since 140 AD and the first books were created: "They decoupled increasingly cursory reading from the laboriousness and slowness of orality." (Kittler, 1993, p. 71). In the thirteenth century, paper arrived in Europe and contributed to the rise of universities. "Gutenberg's invention of printing using movable letters developed from book-spine stamps (...) met the demand awakened by paper." (Kittler, 1993, p. 72). The data processing capacity of books was potentiated by printing. The discrete formats were replaced by continuous paper machines from 1800 and again by the mass press in 1850. The typewriter leveled the difference between writing and printing from 1880 and opened up the space of modern literature (Kittler, 1993). This was followed by the invention of telegraphy, analog technology and finally digital technology. "In terms of organisation and technology too, telegraphy had worldwide repercussions. For absolutely the first time, information was decoupled, in the form of a massless flow of electromagnetic waves, from communication." (Kittler, 1993, p. 75). The invention of the telephone in 1876 then enabled synchronous communication over distance. The foundation for digital communication and the storage, indexing as well as editing of alphabetical and numerical data was laid by Turing's universal discrete machine (Kittler, 1993). During World War II (1939-1945), the first computers were built for the military (German Air Force) and the Von-Neumann-Machine established the architecture of current computers in 1945 (Kittler, 1993). "As a military response to the Cold War, Internet technology was the purview first of the army and then of the universities." (Ellerman, 2007, p. 19). In the 1960s, the invention and development of the Internet once again laid a foundation stone for a revolutionary change process, which also had a massive impact on the way humans communicate—and work.

We just mentioned the invention and networking of computers. The prevalence of networked computers, or in other words, digitization, enables organizations and individuals to easily connect with different stakeholders. This allows them to market and distribute services or products worldwide and without a large distribution network (R. Sauter, W. Sauter, and Wolfig, 2018). Additionally, the nature of the products themselves is changing. Due to their comparatively simple scalability, digital products, which often no longer require a physical production process, have shaped the markets in recent years. The increase in digital products (even if the production of hardware is still of great importance) goes hand

in hand with a change in the work required to create them, and thus also with a change in the skills required by employees to do so. Given the possibilities of rapid information transfer, a global market is emerging, characterized on the one hand by low barriers to entry, and on the other by increasing volatility, uncertainty, complexity and ambivalence (R. Sauter, W. Sauter, and Wolfig, 2018). The acronym VUCA (volatility, uncertainty, complexity, ambiguity)—which is originated in the U.S. military (Whiteman, 1998, as cited in Bennett and Lemoine, 2014)—describes these changing conditions that pose challenges for employees and employers.

Although this is not a new phenomenon and these developments have been discussed since at least the beginning of the 2000s, established business models are still challenged as a result of these global changes, and the requirements for work design, cooperation and collaboration are changing. Companies and organizations need to develop strategies to cope with the increasing pace of global change as well as disruptive innovation and continuously adapt to the complex, turbulent and uncertain future (R. Sauter, W. Sauter, and Wolfig, 2018). At the same time, employees need to acquire new competencies, a new behavior and new values, in order to succeed in this environment (R. Sauter, W. Sauter, and Wolfig, 2018). These include, for example, skills in problem solving, collaboration and communication, critical thinking, and creative and innovative work (e.g., T. Wagner, 2008; Binkley et al., 2012; Griffin, Care, and McGaw, 2012; Voogt and Roblin, 2012; Prasch and Bengler, 2021). The central importance above all of creativity in the context of work was postulated in particular by Florida (2004).

Apart from technical innovations, massive changes in the context of work in the past were often triggered by crises. According to the Oxford Dictionary, a crisis is “a time of great danger, difficulty, or confusion when problems must be solved or important decisions must be made” or “a time when a problem, a bad situation, or an illness is at its worst point” (Oxford University Press, n.d.). In the various disciplines there are different definitions and understandings of the term crisis (e.g., psychological crisis, political crisis). Since we are focusing here particularly on the impact of a crisis on the world of work, characteristics of an organizational crisis were added to the general crisis definition. Therefore, we want to understand a crisis as “a time of great danger [and] difficulty (...) when problems must be solved or important decisions must be made” (Oxford University Press, n.d.) as well as “a specific, unexpected, and nonroutine event or series of events that create high levels of uncertainty and threaten or are perceived to threaten (...) high-priority goals.” (Seeger, Sellnow, and Ulmer, 1998, p. 233).

An example of a crisis-related change in the work context was described in our excursion earlier and by Wellner (1981), who identified World War I (1914-1918) as a decisive factor in the development of women’s work. Due to the war, there was a shortage of workers, especially in the armaments industry, which resulted in a forced acquisition of female workers in this industry. In the six most important branches of the war industry (mechanical engineering, chemical industry, metal processing, mines, processing plants and large iron industry), the number of female workers increased from 113,750 in 1913 to 702,100 in 1917 in Germany. Systematic training and technical adaptation of production processes through mechanization originated during the war. Additionally, mechanical devices for lifting and loading were created to facilitate the work process in the physically difficult work of men drafted for the war (Wellner, 1981).

Another example of crisis-related changes in the world of work concerns the relationship between crises and innovation—and since we are talking about innovation again, we should

not neglect the ideas of Schumpeter. An entrepreneur implements *new combinations* (he did not yet use the term *innovation* in his early works) with which he steers the respective national economy in new directions (Schumpeter, 2003, first published in 1912). Schumpeter argues that a competitive market is not inherently an effective environment for promoting innovation, but that the innovation incentive is the difference between the profit that would be made without investment and the profit that could be made by investing in research and development (Gilbert, 2006).

Hud and Rammer (2014) dealt with the effects of this very decision in the context of a crisis—to invest or not. According to the authors, crisis-induced cutback in innovation spending improves the financial situation of the company in the short term, but can weaken competitiveness in the medium and long term. A closer look at research and development as well as innovation spending in the crisis year 2009 shows that companies that kept these expenses high during the economic crisis achieved significantly higher market success with market innovations in the economic upturn from 2010 than companies that had reduced this spending. Companies that had invested more in innovations during the crisis than their competitors were able to maintain their innovation lead after the crisis. Companies that had invested less in innovations during the crisis were not able to catch up again by increasing their innovation intensity after the crisis (Hud and Rammer, 2014).

Perlitz and Löbler (1985) also dealt with the topic of crisis and innovation and they described that companies are more willing to take risks in times of a crisis. In situations of opportunity (thus outside a crisis), safer alternatives, i.e., risk avoidance, tend to be preferred to uncertain ones. This is accompanied by a rather lower chance of high innovation activity, especially in terms of product innovation, and thus with a structural problem in the long term. According to the authors, companies in crisis situations exhibit a greater willingness to take risks, which goes hand in hand with the pursuit of process and product innovation and triggers a structural change in the company. Whether a process or a product innovation can be successfully introduced will determine whether the company remains in or exits the market in the long term. If the structural change is successful, the company enters a new chance situation and tends toward a more risk-averse behavior (Perlitz and Löbler, 1985). With this logic, the authors explain the phenomena of the last decades. While the crisis years after World War II (1939-1945) encouraged economic risk-taking and led to numerous process and product innovations until the mid-1950s, the 1960s were characterized by situations of opportunity and the pressure to innovate decreased. The lack of new product innovation in turn led to an economic crisis in the 1970s. According to the authors, overcoming innovation problems can only be expected from a crisis situation and not from a chance situation (Perlitz and Löbler, 1985).

Crises have of course triggered change processes not only in the context of work. Severe epidemics, such as The Black Death, have often been identified as “crucial turning points in history that sometimes led to the collapse of societies and sometimes paved the road for impressive growth.” (Alfani and Murphy, 2017, p. 314). The effects of these potentially world-changing phenomena are, however, very complex and therefore difficult to grasp in their entirety (Alfani and Murphy, 2017).

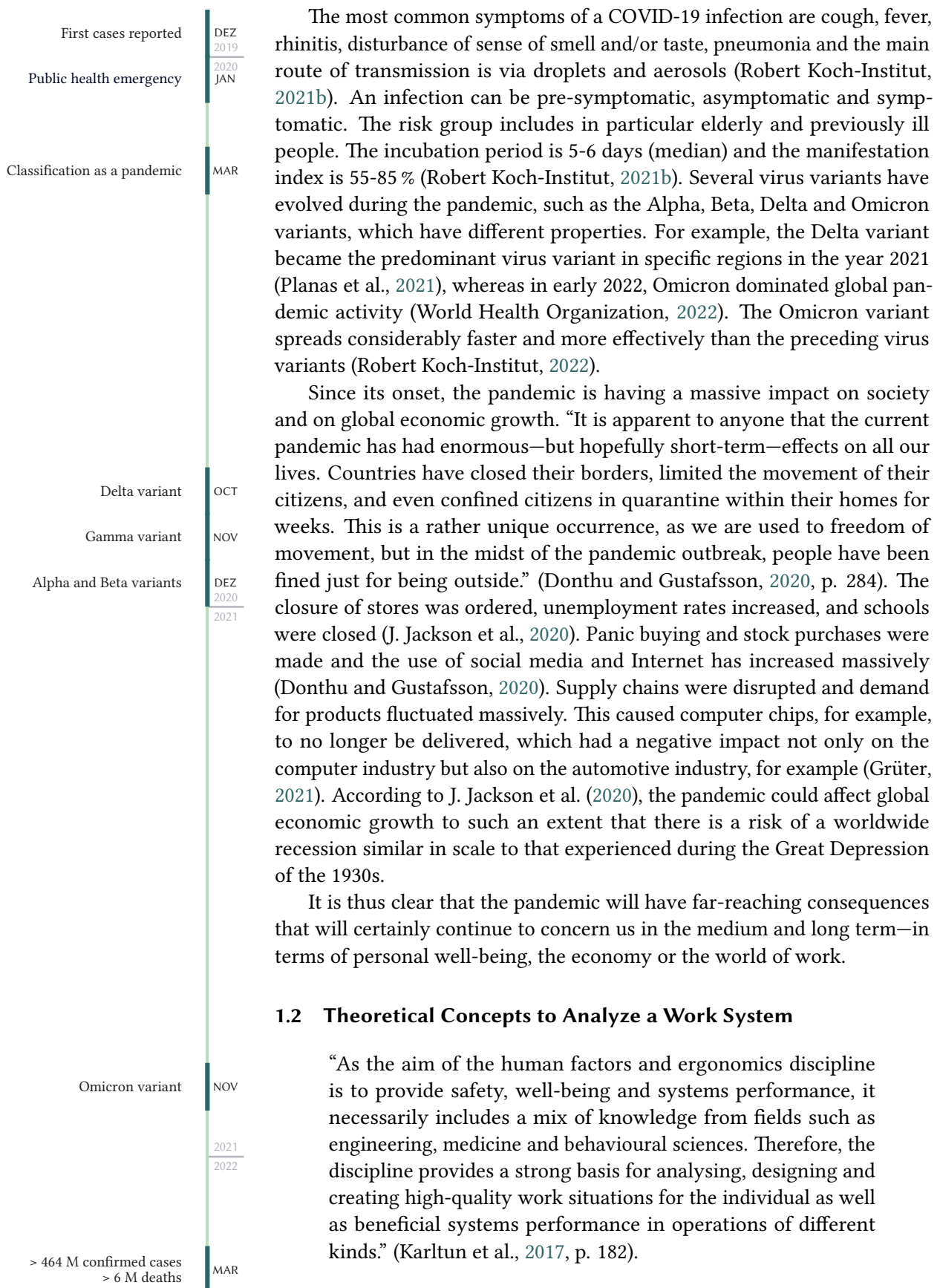
If we come back to the here and now (the year 2022), we are confronted with a very special situation: A crisis in the incarnation of the COVID-19 pandemic meets the technical innovation of computer networking, the digitization, that was just about to unleash its full potential. This constellation possibly creates immense potential for innovation and disruptive change to the world of work—but at the same time, it also poses extremely great

challenges. The fact that things are changing is nothing unusual. What is unusual, however, is the trigger, the external pressure, with the COVID-19 pandemic and the enormous speed with which the process of change is now being driven forward due to the unpredictability of the crisis. Companies and organizations had to take advantage of the opportunities offered by digitalization on an unprecedented scale and thus embarked on radical and forced learning and change processes at short notice. The world of work in general will become increasingly volatile, uncertain, complex and ambiguous with the opportunities offered by digitalization. The crisis has brought this development to an interim high and therefore provides us with the environment and opportunity to develop strategies for a world of work that is generally characterized by VUCA. Our task is therefore to learn from the crisis both for the current challenges and for the future. We need to analyze the changes, embrace the challenges, and develop new ways of working so that we are prepared for future (almost certain to occur) crises, and for the VUCA world in general.

This entire dissertation deals with the changes in the world of work caused by the COVID-19 pandemic and it is about identifying and analyzing new and changing ways of working (crisis management is again a discipline in itself). Therefore, we first need to visualize the development of the pandemic, and beyond that, we need a theoretical concept to systematically analyze the changes in the world of work. These theoretical foundations will be laid hereafter. Once this is accomplished, we will be able to gather and interpret empirical data on the impact of the pandemic on work. We will start with a very broad overview of selected industries in the different sectors of the economy in order to gain a holistic overview and then go in depth to look at particularly relevant aspects in more detail.

## 1.1 The Evolution of COVID-19 from an Epidemic to a Pandemic

On December 31, 2019, cases of pneumonia of unknown cause were reported to WHO in the Chinese city of Wuhan, and Chinese authorities identified a novel coronavirus as the cause on January 7, 2020 (World Health Organization, n.d.[a]): SARS-CoV-2 (severe acute respiratory syndrome coronavirus type 2) or COVID-19 (Robert Koch-Institut, 2021b). A lockdown of the entire Hubei province and flight restrictions to China failed to prevent the spread of the virus within China and around the world—but most likely slowed it down (Lau et al., 2020). A few weeks later, on January 30, 2020, WHO declared a public health emergency of international concern, which is the highest alert level. Back then, there were 98 cases of infection in 18 countries outside China (World Health Organization, n.d.[a]). In February 2020, it was obvious that the outbreak of COVID-19 was having a global impact. While the focus of disease remained in China, numerous cases occurred in many countries around the world, including Germany and other EU countries (Bundesministerium für Gesundheit, n.d.). WHO announced on March 11, 2020, that the COVID-19 outbreak could be classified as a pandemic due to the dramatic increase in infection cases outside of China. At that time, more than 118,000 cases were reported in 114 countries and there were 4,291 deaths (World Health Organization, n.d.[a]). With more than 40 % of the world's confirmed cases, the European region became the epicenter of the pandemic in mid-March (World Health Organization, n.d.[a]). Since then, the infection numbers decreased and increased again in recurrent waves in varying cycles worldwide. Overall, more than 464 million cases have been confirmed as of March 2022, and there have been more than 6 million deaths (World Health Organization, n.d.[b]). An overview of the period considered can be seen in the timeline in Figure 1.1.



**Figure 1.1**  
Timeline of the worldwide pandemic.

The systematic analysis, organization and design of the technical, organizational and social conditions of work processes are central tasks of the discipline of ergonomics and human factors (Schlick, Bruder, and Luczak, 2018c). Therefore, as a next step, we want to identify a theoretical concept that we can use to systematically analyze a work system. The term work system does not imply a specific level of consideration of work processes; it can refer to an individual workplace or an entire company (Schlick, Bruder, and Luczak, 2018c). A work system can be described by the elements worker, work order, work task, input, output, work equipment, work objects and environmental influences (Schlick, Bruder, and Luczak, 2018c).

There are various approaches to analyzing a work system at different levels, and a selection of approaches is discussed in more detail in the following: (1) systemic analysis approaches, (2) a concept to consider cause-effect relationships, and (3) multi-level approaches.

(1) The systemic approach enables the representation of the structure of different object areas (Schlick, Bruder, and Luczak, 2018c). A system always has a system boundary, which delimits it from the environment, system elements and relationships between the elements and, if necessary, to the environment. The superordinate system does not necessarily have to be considered. A system or a subsystem can be analyzed, which in turn contain subsystems as elements (Schlick, Bruder, and Luczak, 2018c). For example, the structure of a technical system can be considered and thus described: a component, assembly, machine or the like with the corresponding relationships of the elements to each other and to the environment, such as points of contact, energy supply or power transmission (Schlick, Bruder, and Luczak, 2018c). The human organism can also be understood as a system. It has organs, which can be understood as subsystems that are functionally related to each other and contain subsystems (cells). Humans interact with the environment, for example, via perception, action and social interaction. The individual can also be considered an element of a higher-level system, e.g., a work group or a department (Schlick, Bruder, and Luczak, 2018c). The interplay of humans and technical systems, which are interlinked and interact with each other, is emphasized in the socio-technical systems approach, which will be discussed in more detail below. Systemic approaches aim to provide a uniform and complete description of work processes and are thus suitable, for example for the detailed analysis of a single complex production or service process (Schlick, Bruder, and Luczak, 2018c).

(2) The stress-strain concept enables the representation of cause-effect relationships. Stress refers to the external characteristics of the work situation (e.g., work task, environmental conditions, special conditions such as time pressure, etc.), while strain refers to the (physical/physiological, etc.) reactions of the working person to these conditions (Schlick, Bruder, and Luczak, 2018c). Strain also depends on individual characteristics and abilities. Thus, the same stress leads to different strain levels in different people. The concept enables both the interpretation of the conditions of activity and the targeted investigation of the effect of defined conditions of activity on the human being (Schlick, Bruder, and Luczak, 2018c). The stress-strain concept is based on a highly simplified understanding of human activity. In this simple form, the stress-strain concept is only suitable for analyzing somewhat deterministic work systems (Schlick, Bruder, and Luczak, 2018c). In the extended model, stress depends first on whether and how the action is performed and, second, on the so-called psychophysiological resistance. The latter can also be referred to as the *resilience* of the working person (Schlick, Bruder, and Luczak, 2018c). Although this concept takes

into account the effects and responses in a work system, considering individual activities is too specific for the purpose pursued in this dissertation.

(3) Multi-level approaches take into account the complexity of work systems and work situations (Schlick, Bruder, and Luczak, 2018c). For this purpose, direct influencing factors of the work system (microstructure, e.g., department-specific technological and organizational conditions, group processes, tasks) and indirect influencing factors from the operational and social environment (macrostructure, e.g., general state of technical development, cost and revenue structures, market situation) are included in the analysis, evaluation and design (Schlick, Bruder, and Luczak, 2018c). Two approaches that belong to the multi-level models are the dual work situation analysis (Duale Arbeitssituationsanalyse (Elias, Gottschalk, and Staehle, 1985)) and the HTO concept (Schlick, Bruder, and Luczak, 2018c). Multi-level approaches appear to be particularly suitable for the further proceeding, as they allow a holistic view of the work system and influencing factors.

A closer look reveals that that dual work situation analysis is less applicable because of its high level of detail. The aim of the dual analysis is to develop concrete suggestions for a specific company based on a detailed and comprehensive analysis of the work situation, in the elaboration of which both parties in the company, employer and employee, have the opportunity to contribute their specific interests (Staehle, 2011).

The HTO concept (see Figure 1.2), on the other hand, provides a good theoretical basis for further action. The concept, just like the systemic approaches, is based on the idea of a socio-technical system: “The idea of a socio-technical system is that the conditions for successful organizational performance—and conversely also for unsuccessful performance—are created by the interaction between social and technical factors.” (Hollnagel, 2009, p. 19). The concept of socio-technical system design explicitly postulates the need to optimize the use of technology and the organization together, the so-called joint optimization (Ulich, 2013).

The HTO concept is based on the assumption that human, technology and organization must be reflected in their interdependency and interaction (Ulich, 2013). While the concept originally had a focus on safety aspects, it now encompasses a variety of aspects of the interactions between the dimensions of people, technology, and organization in different environments, and goes well beyond safety aspects by additionally considering system performance and health (Karlton et al., 2017). The HTO concept is the basis for the HTO analysis, which requires analyses at the levels of the company, the organizational unit, the group and the individual in seven successive steps (Ulich, 2013), and which is thus also too detailed for the further procedure.

In the HTO concept, first, there is the social sub-system (H), i.e., the employed person or people (Bundesanstalt für Arbeitsschutz und Arbeitsmedizin, n.d.). Secondly, there is the technical subsystem (T), i.e., the machines, tools and work equipment necessary to perform the work task; for example, milling machines, floor conveyors, office software or elevators. And last, there is the organization (O), i.e., the structure and processes in the company, authority or institution in which the work task is performed as well as the way in which the work is divided up, the completeness of the work tasks, etc. (Bundesanstalt für Arbeitsschutz und Arbeitsmedizin, n.d.).

The HTO concept assumes the primacy of the task. The work task links the social with the technical sub-system and connects people with the organizational structures (Ulich, 2013). The order of the linkages (HTO) is intentional. The division of tasks between human and technology plays the decisive role in the development and design of production





**Figure 1.2**  
HTO concept. Based on Ulich (1997).

systems (Ulich and Wülser, 2018). A work activity can be understood, described and analyzed through the interplay of the three dimensions, whereby each dimension could theoretically be considered as a system of its own (Karlton et al., 2017). Although the HTO concept is based on the socio-technical systems theory, there is “(...) an important difference in that the human is considered as an equal and separate sub-system and HTO includes the interactions between an organizational system, a technical system and a human system, all inseparable in a certain activity.” (Karlton et al., 2017, p. 183).

This theoretical concept will be used in the following to structure first the analysis and later the results and conclusions.



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OVERALL OBJECTIVE

The pandemic has had and continues to have (from a 2022 perspective) a massive impact on society and on the world of work—and many of the resulting consequences are undoubtedly negative. Companies and organizations were already undergoing a tremendous process of change as a result of digitalization. The pandemic has acted as a catalyst and provided the external pressure that has massively accelerated this transformation. Thus, the pandemic forced rapid adjustments in companies and organizations accompanied by learning processes among employees and executives. While initially we were just trying to scramble along somehow, given time these changes may also provide positive impetus for future work. It is therefore our duty to learn from the pandemic and the challenges it poses for our work. The fact that our work environment is becoming increasingly volatile, uncertain, complex and ambiguous is not a new development. But in the context of the pandemic we find ourselves in a situation that is particularly characterized by these attributes. It therefore holds immense potential for new insights that might also be of great importance in the medium and long term. To learn from this current situation, we need to analyze the changes, understand the challenges they present, and listen to the people affected. Implications for the (future) design of work shall then be based on employee and employer experiences, problems and suggestions.

Therefore, the overall objective of this thesis is twofold: to provide insights into the way the pandemic has changed how we work—that is, capture the status quo in selected industries—and to analyze and evaluate those changes. This shall enable the derivation of recommendations for work in an increasingly volatile, uncertain, complex and ambiguous world, especially in situations of crisis—both the current one, and a potential future one—with similar characteristics.

This includes, first and foremost, the systematic analysis and evaluation of measures taken that enabled companies and organizations to continue working despite the pandemic-related restrictions. Additionally, effects of the spatial relocation of work (insofar as this was possible) away from company premises into private households was analyzed. This occurred with special attention to the accompanying shift of collaboration and organizational communication to digital or virtual space. The analyses are intended holistically. Thus, following the HTO concept, the various dimensions of human, technology and organization are explicitly considered each time.

The two overarching questions around which the entire dissertation revolves, initially formulated in very general terms, and later specified and elaborated upon in the individual studies, are:

1. What specific impact is the current pandemic already having on selected industries in the various sectors of the economy?
2. What recommendations can be derived for companies and organizations to cope well with the current crisis or similar situations in a world characterized by high degrees of volatility, uncertainty, complexity and ambiguity?

To tackle these broad questions, two empirical investigations will be introduced as the centerpiece of this dissertation. The first study is intended to provide a general overview of the changes made by companies and organizations across economic sectors. Thus, pandemic-related measures were collected and evaluated in the primary, secondary and tertiary sectors. To provide more detail, the second study investigates spatial displacement with a special focus on the university context. Subsequently, it analyzes the process of change in working conditions as well as specific aspects of communication in the wake of the pandemic. From the results of two surveys, particularly conspicuous issues are discussed and explored in even greater detail using interviews. Finally, recommendations for companies and organizations to cope well with the current crisis and a future VUCA world will be formulated based on the entire set of findings from the empirical studies. These recommendations refer generally to the way of working in and of companies and organizations.

## MEASURES INTRODUCED IN VARIOUS ECONOMIC SECTORS

The first empirical study was to provide a systematic, comprehensive overview of the changes in the way we work due to the pandemic. The basis for this is the already introduced HTO concept, which will accompany us constantly henceforth. Due to the exploratory nature of the research, a qualitative study was conducted to examine the measures initiated by the companies and organizations considered and the effects these have had on the employees, the work equipment and technologies as well as the work processes and organization.

In order to form the basis for understanding how the pandemic has changed the way we work in German companies and organizations, we will first take a closer look at the theoretical foundation. Since this is a fairly new field of research, an overview of the very recent and extensive literature is provided. The specific research objective of the study will then be derived, followed by a description of the research approach and the presentation of the results. Finally, the results will be discussed with regard to predefined ergonomic evaluation criteria and the literature.

### 3.1 Theoretical Foundation

The goal of this section is to familiarize the reader with the impact of the pandemic on the world of work. The necessary changes in everyday work are closely linked to the pandemic activity and the associated legal regulations. Since the data collection for the dissertation was conducted in German companies and organizations, the development of the pandemic in Germany is outlined first. We will conclude this chapter with the impact of the pandemic on the way people work.

But first, in order to gain a broad overview of the process of change in the work context, a systematic classification is needed that reflects the entire world of work. Possibilities for classification are provided, for example, by the concepts of blue collar and white collar workers (e.g., used by Locke, 1973), productive and unproductive labor (to which e.g., Mohun, 1996, refers to) or physical, cognitive and emotional labor (S. Lee, Jeong, and Y. Lee, 2017). However, the clear allocation is sometimes difficult in these concepts and they do not represent an unambiguous, predefined and systematic representation of the world of work.

Beyond that, there are various holistic classifications, which map the entire world of work, each with a different focus. For example, one can take the *status of employment* as a basis and distinguish between the type of authority (ICSE-18-A) or the type of economic risk (ICSE-18-R), according to International Labour Organization (n.d.). Within the ICSE-18-A independent workers (employers, independent workers without employees) and dependent workers (dependent contractors, employees, contributing family workers) are differentiated. This is particularly useful for the consideration of business cycles and government policy. The ICSE-18-R distinguishes between workers in employment for profit (independent workers in household market enterprises, dependent contractors, contributing family workers) and workers in employment for pay (owner-operators of corporations, employees), which is particularly useful for the consideration of wage employment or economic risk (International Labour Organization, n.d.). Another classification system is based on the

*levels of competences* that are required, such as the International Standard Classification of Occupations (ISCO-08). In this classification ten major groups are distinguished (managers, professionals, technicians and associate professionals, clerical support workers, service and sales workers, skilled agricultural, forestry and fishery workers, craft and related trades workers, plant and machine operators, and assemblers, elementary occupations and armed forces occupations) (International Labour Organization, 2007). This classification suits well the exchange and comparison of administrative and statistical data. Furthermore, a classification based on *activities and tasks* can be considered, such as the Standard Occupational Classification (2018 SOC) that consists of eight major workgroups (examples of these are management, computer and mathematical, social service, education, protective service, farming, production occupations and military specific occupation) (Bureau of Labor Statistics, 2018). This is an exhaustive classification, meaning that all occupations can be assigned (Hernandez, 2018). The 2018 SOC classification reflects the occupational structure in the United States. A similar classification exists for Germany, with the classification of industries (Klassifikation der Wirtschaftszweige, WZ 2008) in which 21 industries are subdivided (Statistisches Bundesamt, 2008).

The effects of the pandemic probably hit all areas of work. However, it is not sensible to distinguish between employment status or skill levels at this point, as the impacts relate rather to the nature of activities and tasks. For example, some professions were declared relevant to the system and were therefore subject to special regulations and some other professions or even entire industries had to cease their activities to a very large extent during the pandemic. Thus, in order to identify pandemic-related measures in companies and organizations a classification according to WZ 2008 seems to be a good starting point. However, 21 industries still represent a rather small-scale classification and make it hard to give an overview of the entirety of the world of work. Therefore, we will summarize the industries once again, which leads us to the economic sectors—namely the primary, secondary and tertiary sectors. These three sectors include all of the 21 industries and thus also systematically and unambiguously cover the entire world of work.

To sum it up, in order to depict the entire world of work, we do not want to select individual industries at this point, but rather look at the sectors as a whole. Once the sectors have been considered holistically, individual industries per sector that are particularly relevant in the context of the pandemic are to be selected on the basis of WZ 2008. We thus continue to follow all of the three economic sectors, represented by certain industries.

### **3.1.1 Development of the Pandemic in Germany and Impacts on the Economic Sectors**

Chapter 1.1 outlines the course of the pandemic worldwide and the development and dynamics of the pandemic vary greatly across countries. The course of the pandemic in Germany (see Figure 3.1) and its impact on the economic sectors form the basis for understanding how the pandemic has transformed the way we work in this country.

#### **The Course of the Pandemic in Germany**

The initial infection in Germany was detected in Starnberg, Bavaria, on January 27, 2020 (Bayerisches Staatsministerium für Gesundheit und Pflege, 2020). On February 1, 2020, about 100 people were expected to return to Germany from Wuhan, where the infection figures were already relatively high. The returnees started out symptom-free and as a pre-

cautionary measure, they were isolated for 12 to 15 days in Germersheim in Rhineland-Palatinate (Bundesministerium für Gesundheit, n.d.). Sixteen infected people were identified in mid-February and all of them were isolated. At the end of February, 120 China returnees were released from quarantine with negative test results (Bundesministerium für Gesundheit, n.d.). In late February, cases of various origins began emerging: There were infections on the passenger ships *Diamond Princess* and *MS Westerdam* and more people arrived in Germany who had been in the province of Hubei. COVID-19 infections were confirmed in Baden-Wuerttemberg and North Rhine-Westphalia (Bundesministerium für Gesundheit, n.d.). In the first half of 2020, the virus then spread throughout Germany (Robert Koch-Institut, n.d.).

On March 25, 2020, the German Bundestag responded to the spread of the virus by drafting the first bills to protect the population (Deutscher Bundestag, 2020). The prime ministers agreed on a nationwide approach to introducing preventive measures, including restricting social contacts (Bundesregierung, 2020a). The so-called lockdown made an impact on the case numbers and in May 2020, restrictions were loosened in certain federal states (Bundesregierung, 2020d). During the summer 2020, the number of cases was low and a locally focused hotspot strategy was developed (Bundesregierung, 2020b). Due to increasing case numbers, another lockdown *light* was prompted, once again including the restriction of social contacts instituted on November 2, 2020 (Bundesregierung, 2020e). This lockdown *light* did not stop the exponential increase in the number of infections (Bundesregierung, 2020f) and the second lockdown was instituted starting December 16, 2020 (Bundesregierung, 2020c). The situation was aggravated by the emergence of new virus variants, e.g., the SARS-CoV-2 Alpha variant (Robert Koch-Institut, 2021a). Despite falling infection rates in the first quarter of 2021, the lockdown was maintained for the time being (Bundesregierung, 2021c). In January and February 2021, the infection rate decreased and began to rise again in March 2021 (Bundesregierung, 2021d). Even though the number of vaccinated people increased, infection protection measures had to be consistently adhered to in order to stop the spread of the virus (Bundesministerium für Gesundheit, 2021). In May 2021, the infection rates decreased again and existing contact restrictions were gradually reversed (Bundesregierung, 2021b). In the beginning of 2022, Omicron became the predominant variant of the virus worldwide—including Germany (Robert Koch-Institut, 2022).

In line with this overall trend, the way the COVID-19 virus manifested itself in the federal states also varied, characterized by higher and lower case numbers in certain phases and regions (Robert Koch-Institut, n.d.), which is why different regions of Germany should be included in the data collection.

### The Impact of the Pandemic on the Economic Sectors

As already indicated, all industries can be divided into three economic sectors. The primary sector includes raw materials such as agriculture, forestry and fishing. The secondary sector comprises manufacturing and construction



**Figure 3.1**  
Timeline. Focus on Germany.

(Kenessey, 1987) and the tertiary sector involves services (Rutzer and Weder, 2021). Kenessey (1987) argues that there are quaternary activities including finance, insurance and real estate as well as services. However, in this thesis, the three-sectors theory will be followed as this is commonly used for purposes of differentiation (as it is used e.g., in Rutzer and Weder, 2021; Häussermann and Siebel, 2011; Castillo-Rosa et al., 2017; Wolfe, 1955). In 2021, 1.3 % of the 44,920 employees in Germany worked in the primary sector, 23.8 % in the secondary sector and 75 % in the tertiary sector (Statistisches Bundesamt, 2022).

The primary sector is facing upheaval during the COVID-19 pandemic, the origins of which are often to be found in downstream production stages or pandemic-related market shifts (ifo Institut, 2020). According to the industry atlas agriculture of the ifo Institute, a key factor was the shift in consumption during periods of curfews and hospitality industry closures. There was e.g., a surplus of pigs ready for slaughter, parts of the potato harvest had to be destroyed, and agreements to cut production in exchange for a drop in the price of milk (ifo Institut, 2020).

Further effects on the primary sector can be seen in forestry. The pandemic hit the forestry industry in early 2020 in a phase in which the forestry operations affected by the forest damage had already been facing enormous challenges for two years and the market was characterized by oversupply (Bundesministerium für Ernährung und Landwirtschaft, 2021). On the timber markets downstream of the forestry industry, the pandemic-related restrictions initially affected the supply chains and, in particular, the sales situation on the international export markets. However, the situation on the timber markets then quickly rebounded (Bundesministerium für Ernährung und Landwirtschaft, 2021).

The secondary and tertiary sectors were affected to varying degrees by the pandemic. In April 2020, the International Labour Organization identified manufacturing, real estate, wholesale and retail trade, as well as accommodation and food services, as the industries at greatest risk for job loss, based on economic and financial data (International Labour Organization, 2020). Transport and storage as well as arts, entertainment and recreation were reported as the economic sectors with the second highest risk of job loss (International Labour Organization, 2020). This forecast overlapped the assessment of the Austrian Institute of Economic Research, which estimated the consequences of the pandemic—and the measures associated with it—to be most severe for the lodging and catering, arts and entertainment, education and training, as well as trade and transport sectors (Bachtrögler et al., 2020).

Initially, the restrictions in the logistics sector were particularly noticeable due to the partial closure of borders within Europe or the loss of goods flow from the Asian region (Schnelle, Schöpfer, and Kersten, 2021). As a result, the logistics industry in Germany had to adapt to the altered circumstances. On the one hand, there has been a shift or reduction in the flow of goods and, on the other, B2C online trade has increased, while shipments to business customers have decreased (Schnelle, Schöpfer, and Kersten, 2021).

According to a survey of Deutscher Industrie- und Handelskammertag e.V. (2020) in November 2020 with about 13,000 companies, more than 2/3 expected a decline in sales. Especially in the travel industry (94 %), the hospitality industry (93 %) and the cultural and creative industries (90 %), almost all companies expected a sales decline in the year 2020 compared to 2019. Seventy-four percent of the companies in transport and storage and 73 % of the companies in motor trade stated that they expected this negative trend, followed by the industrial sector (69 %), retail trade (66 %), health industry (65 %) and other services (64 %). In wholesale and retail trade, 61 % of the companies reported a decline in



sales, and in financial and insurance services, 54 % of the companies expected a decline in sales. The industry with the lowest negative expectations was construction, where 37 % of the companies assumed a decline, whereas 25 % even expected an increase in sales in 2020. Overall, 69 % of the companies expected a decline in sales and 17 % expected a decline of more than 50 % (Deutscher Industrie- und Handelskammertag e.V., 2020). The measures that companies intend to take to counteract this are to postpone or cancel investments (49 %), to use saving potentials or to rationalize (40 %) and to increase digitization in the company (36 %) (Deutscher Industrie- und Handelskammertag e.V., 2020).

The healthcare sector was also particularly affected. As a cross-sector industry, the healthcare sector is made up of various sub-sectors that are located in different economic areas of the overall economy (Bundesministerium für Wirtschaft und Energie, 2021a). These include both manufacturing and processing sectors as well as services. Overall, the healthcare industry contracted more sharply than the economy as a whole for the first time in a crisis year in 2020, with a -3.7 % decline in value added and a -1.6 % drop in employment compared with the previous year (Bundesministerium für Wirtschaft und Energie, 2021a).

The pandemic thus affects large parts of all economic sectors and therefore all sectors should be represented in the data collection. For this purpose, as already indicated, particularly relevant industries are to be selected for each sector based on WZ 2008 (Statistisches Bundesamt, 2008). The details are described in Chapter 3.3.

### 3.1.2 Impacts of the Pandemic on the Way People Work

Studies in various disciplines try to understand the implications of this crisis on work. Since this dissertation focuses on the transformation of work from a human factors and ergonomics perspective (both macro and micro), the following section discusses the scientific findings in the occupational context, in which sub-aspects of the dimensions of human, technology and organization are examined. The literature reveals changes and new developments predominantly in the digitization of work processes and work equipment, an increasing flexibility of working time and place, and a change in leadership culture. These three topics will be elaborated upon in more detail below. Since the data collection relates to Germany, the literature is reviewed with a focus on studies and research projects in Germany. Where it appears necessary, this consideration is supplemented by the inclusion of international studies. Due to the topicality of the subject, some of the publications dealt with are reports generated by research projects.

### Digital Transformation of Work

Digital transformation does not only imply the usage of digital technology, but to explicitly use these technologies in order to forge ahead with substantial changes to the company's business model (Soto-Acosta, 2020). Digital technologies were available prior to the pandemic and yet the crisis has boosted the digital transformation of companies and even entire industries (Soto-Acosta, 2020). “[O]rganizations are accelerating the adoption of digital transformation as the best way to avoid a short-term economic collapse and combat the COVID-19 pandemic with resilience. Whether this trend has come to stay will depend on how we as humans define the role of technology in our work and life.” (Soto-Acosta, 2020, p. 265). In line with the HTO concept, the author's remarks thus emphasizes the need for a holistic consideration.

The digital transformation in Germany has been the subject of a number of studies, and the basic tenor is that in Germany there was—or rather there is—some need to catch up in terms of digitization. Engels (2020) refers to the results of various studies on digitization in recent years which point out that Germany is lagging behind in digitization (e.g., Demary et al., 2016; Lichtblau et al., 2018). The pandemic now exposes the deficits as well as the achievements of digitization within a very short period of time and thus becomes a litmus test for Germany. While companies have been quick to acquire laptops and implement digital communication and collaboration technologies, it can be difficult for businesses and their employees to adapt to the new processes quickly enough to maintain workflow (Engels, 2020).

A similar narrative can be found in a recent study of Bundesministerium für Wirtschaft und Energie (2021b): Germany has fallen behind many other OECD countries in terms of both the expansion of its digital infrastructure and the use of digital technologies and services (the authors do not specify how many OECD countries and which ones exactly are meant). However, the pandemic has led to a sharp increase in digitization. Companies invested in laptops, VPN and software and in many cases, operational workflows and communication channels were able to be adapted to online communication surprisingly quickly without any major problems. However, the lack of skills and experience in using digital technologies presents a challenge and there is a lack of a suitable, secure and data-protection-compliant digital infrastructure (Bundesministerium für Wirtschaft und Energie, 2021b). It should be mentioned in this context that these considerations only include the use of digital technologies and not the development of digital business models, where Germany is also lagging behind if we take a closer look at digital business models and the global players in this field (Ahmad et al., 2020).

In April 2020, 211 experts in the fields of artificial intelligence, digitization and technology in Germany participated in an online survey and gave their assessment of possible development paths of the long-term changes caused by the COVID-19 pandemic in the world of work (Krcmar and Wintermann, 2020). Ninety-two percent of the participants assumed that the pandemic accelerated the digital transformation in companies. According to 92 % of the experts, video conferencing software will become an integral part of daily work routines. When asked which trends would persist after the pandemic, the participants named virtual conferencing (85 %), virtual learning opportunities (54 %), private communication via digital means of communication (45 %) and an e-commerce push (37 %) (Krcmar and Wintermann, 2020)—aspects that can be connected to a digital change as well.

### **Increasing Flexibility of Working Time and Place**

There is an overwhelming number of studies on remote working as employers were obliged to allow employees to work from home unless there were compelling operational reasons not to do so (Bundesregierung, 2021a), and therefore working from home obviously was widespread. Commonly, a flexible work place is accompanied by more flexible working hours (Hofmann, A. Piele, and C. Piele, 2020). The studies on flexibility of working time and place focus in particular on (1) the positive and negative effects of working from home, (2) the environment while working from home and (3) the dissemination of working from home (during the pandemic and intentions for the future).

(1) In November 2020, a representative study was conducted by forsa Politik- und Sozialforschung GmbH on behalf of DAK Bayern, in which 1,006 dependent employees participated. They were asked about their opinions on and experiences with the option

of working from home (Forsa, 2020). According to their findings, 39 % of the respondents frequently or nearly constantly felt stressed. Thirty-seven percent felt stressed once in a while, 20 % rarely and only 3 % never felt stressed. Seventy percent of the participants stated that they lacked social contact and exchange with colleagues and 33 % lacked the structure they were used to in their daily work routine. About a third (32 %) reported that they were experiencing more tension and pains lately and 22 % worried more often. For 18 %, the current situation was causing sleep problems and 15 % said that the constant accessibility while working from home was a burden. However, the participants stated positive effects, too. Eighty-one percent indicated that their work-life balance had improved and that they saved time due to no commuting times (85 %). Seventy-three percent said they were more productive while working from home. Most participants (73 %) reported working the same hours and times of day at home as they did at work (Forsa, 2020).

Kunze, Hampel, and Zimmermann (2020) conducted a survey of 700 employees working from home in Germany at nine points in time between March 3, 2020 and May 15, 2020. More than three-quarters of the respondents reported that they were motivated and, according to their self-assessment, productive while working from home. Nearly half of the participants indicated that they worked better and more effectively at home than in an office and more than 70 % were particularly positive about the possibility of combining work and private life while working from home (Kunze, Hampel, and Zimmermann, 2020). Emotional exhaustion and social isolation were mentioned as negative effects associated with working from home. Emotional exhaustion increased slightly over the survey period and was on average 16 %. About 20 % of the participants felt socially isolated whereby the general contact ban probably had an influence here, too (Kunze, Hampel, and Zimmermann, 2020).

The ambivalent attitude of employees toward working from home is not a new phenomenon and the pros and cons of working remotely are the subject of numerous studies prior to and during the pandemic. The most frequently named advantages in current studies are an increase in productivity, concentration and work performance (e.g., Krcmar and Wintermann, 2020; Umbs, 2020; Rief, 2021; Ipsen, Veldhoven, et al., 2021; Bonin et al., 2020; Bundesministerium für Wirtschaft und Energie, 2021b), improved work-life balance (e.g., Krcmar and Wintermann, 2020; Rief, 2021; Alipour, Falck, and Schüller, 2020; Kunze, Hampel, and Zimmermann, 2020; Landes et al., 2021; Ipsen, Veldhoven, et al., 2021; Bonin et al., 2020) and job satisfaction (e.g., Umbs, 2020; Bolisani et al., 2020; Bonin et al., 2020; Bundesministerium für Wirtschaft und Energie, 2021b), elimination of commuting distances (e.g., Krcmar and Wintermann, 2020; Alipour, Falck, and Schüller, 2020; Frodermann, Grunau, Haas, et al., 2021; Bonin et al., 2020), opportunities for cross-border work (e.g., Rief, 2021; Müller, Lalive, and Lavanchy, 2020) and positive effects in terms of sustainability due to new, flexible work models: reduction of business trips, traffic volume (e.g., Krcmar and Wintermann, 2020; Rief, 2021; Alipour, Falck, and Schüller, 2020; Landes et al., 2021; Bolisani et al., 2020; Bundesministerium für Wirtschaft und Energie, 2021b).

The most frequently named disadvantages in current studies are social isolation (e.g., Alipour, Falck, and Schüller, 2020; Bolisani et al., 2020), emotional exhaustion and overwork (e.g., Alipour, Falck, and Schüller, 2020; Kunze, Hampel, and Zimmermann, 2020; Frodermann, Grunau, Haas, et al., 2021), compulsion and job insecurity (e.g., Ipsen, Veldhoven, et al., 2021), increased pressure to perform (e.g., Alipour, Falck, and Schüller, 2020), difficulties in separating work and private life (e.g., Alipour, Falck, and Schüller, 2020; Diwald, 2020; Frodermann, Grunau, Haas, et al., 2021; Bonin et al., 2020; Bundesministerium für Wirtschaft und Energie, 2021b), difficulties in cooperating and communicating

with colleagues (e.g., Frodermann, Grunau, Haas, et al., 2021), lack of technical equipment for working from home (e.g., Kunze, Hampel, and Zimmermann, 2020; Grunau, Steffes, and Wolter, 2020; Ipsen, Veldhoven, et al., 2021; Bonin et al., 2020; Bundesministerium für Wirtschaft und Energie, 2021b) and a lack of workspace or working environment at home (e.g., Frodermann, Grunau, Haas, et al., 2021; Bonin et al., 2020; Bundesministerium für Wirtschaft und Energie, 2021b).

(2) In the last paragraph, the lack of technical equipment and the lack of appropriate workspace and working environment as a negative consequence for some employees while working from home were already mentioned. In a mixed-methods study, Cuerdo-Vilches, Navas-Martín, and Oteiza (2021) investigated the suitability of the working environments in Spanish households during the lockdown in spring 2020 on the basis of 1,800 surveys and more than 200 images and texts. They found that in 27.5 % of the cases, the working spaces at home were (absolutely) inadequate. About half of the participants (46 %) had an adequate working space and 25.8 % had a very adequate and absolutely adequate working space. From the perspective of the participants, the most appreciated aspects of the working environment at home were the availability of daylight, the size and temperature of the room, the furniture and surface properties, and the view outside (Cuerdo-Vilches, Navas-Martín, and Oteiza, 2021).

Sandrock et al. (2021) conducted an online survey (July - September 2020) with 165 data sets from the metal and electrical industry in Germany. They queried the technical equipment employees had at their disposal while working from home. One hundred and fifty-two participants worked with a laptop and 106 had an extra mouse. About one-third of the respondents had an additional keyboard and an external monitor available. With regard to the technical equipment and organizational aspects, employees had acceptable working conditions while working from home (Sandrock et al., 2021).

However, according to Forsa (2020) 54 % of the participants indicated that their working environment at home was less well equipped than at the company.

(3) The percentage of people working from home has increased due to the pandemic. According to Kunze, Hampel, and Zimmermann (2020), only 12 % of employees in Germany regularly worked from home in 2016 (Brenke, 2016), compared to 35 % in May 2020 (S. Bartsch et al., 2021). According to Forsa (2020), 67 % of dependent employees in Bavaria had never worked from home before the pandemic and this number decreased to 47 % during the pandemic. For the period after the pandemic, 55 % of the employees included into the survey would like to work from home regularly (16 % once a week, 28 % several times a week and 11 % almost every day) (Forsa, 2020). The results of Kunze, Hampel, and Zimmermann (2020) show a similar picture, 56 % of the participants want to work from home at least partially. Twenty-five percent would like to work from home exclusively and 42 % would like to work from home 2-3 days a week (Kunze, Hampel, and Zimmermann, 2020).

The employees' wishes coincide with the ideas of many companies. Based on experiences during the pandemic, 42 % of the nearly 500 German companies participating in the survey of Hofmann, A. Piele, and C. Piele (2020) in May 2020 would like to expand the possibility for their employees to work from home in the future. Forty-four percent of the companies were still indecisive.

## Changes in Leadership Culture

The third topic that will be discussed in more detail in this chapter is a change in leadership culture. Large parts of the workforce worked from home at short notice and some supervisors and managers suddenly had a virtual team from one day to the next. Supervisors and managers have substantially reduced their reservations about working from home as a result of the positive experiences during the pandemic. Forty-seven percent of the participants in the survey of Hofmann, A. Piele, and C. Piele (2020) in Germany indicated that managers who initially had reservations concerning working from home reduced them in many cases. In the sample considered, only 2.4 % agreed that there were more conflicts at work between employees and superiors caused by working from home, which is a positive signal. The vast majority of the participants stated that supervisors and managers were not (34 %) or were seldom (40 %) overburdened. However, there would be a need to train supervisors and managers to manage a virtual team (40 %).

In the qualitative study of Ipsen, Edwards, et al. (2021) with 13 Danish first- and second-line managers, experiences with distance management was investigated between May and December 2020. They found that superiors took responsibility to make working from home work for their employees and tried to find new ways to manage and organize working from home. Participants stated that they liked the flexibility and had acquired new skills. It was positively emphasized that meetings were more equal, inclusive and efficient. However, aspects such as challenging and long working hours and the lack of social interaction, which made it difficult to build trust and a sense of proximity, were highlighted negatively. So, both positive and negative experiences were reported: “If workplaces are to continue with [working from home] or hybrid-remote-work workplaces[, then] they are to ensure that managers’ wellbeing is safeguarded by new efficient ways of working rather than working harder and longer.” (Ipsen, Edwards, et al., 2021, p. 600).

Finally, there is a trend toward a culture of trust instead of control in Germany (e.g., Krcmar and Wintermann, 2020; Diewald, 2020; Sandrock et al., 2021), which is expected to continue. There is a need for transparency about the intentions and consequences of working from home, and this transparency is a prerequisite for trust, which can compensate for the elimination of compulsory attendance in the workplace (Diewald, 2020).

## 3.2 Research Objective

Based on the overall objective of this thesis, which is to capture the status quo in companies and organizations during the pandemic and thus analyze pandemic-related changes in work, the first empirical investigation focused on general changes in the everyday work in companies and organizations. More precisely, the goal was to gain a comprehensive overview of measures that have been implemented in order to be able to continue to work even with the restrictions caused by the pandemic. For this reason, different regions and all economic sectors—the primary, secondary and tertiary sectors—were considered. Following the HTO concept, measures can be considered in companies and organizations in the three dimensions of human, technology and organization. These dimensions should serve as a basis for identifying and structuring the measures introduced.

From the literature review in Chapter 3.1.2, it becomes obvious that previous studies and research activities mainly focused on the acceleration of the digital transformation (e.g., Engels, 2020; Krcmar and Wintermann, 2020; Soto-Acosta, 2020; Bundesministerium für Wirtschaft und Energie, 2021b), the increased flexibility in working time and place (e.g.,

Forsa, 2020; Kunze, Hampel, and Zimmermann, 2020; Cuerdo-Vilches, Navas-Martín, and Oteiza, 2021; Sandrock et al., 2021; Hofmann, A. Piele, and C. Piele, 2020) and the culture of leadership (e.g., Krcmar and Wintermann, 2020; Umbs, 2020; Diewald, 2020; Sandrock et al., 2021; Hofmann, A. Piele, and C. Piele, 2020; Ipsen, Edwards, et al., 2021). There is a lack of research according to the author's knowledge regarding a systematic investigation of the entirety of measures introduced in companies and organizations from an ergonomics and human factors perspective.

This leads us to the following research question:

1. Which measures have been implemented in companies and organizations to be able to continue working during the COVID-19 pandemic in the dimensions of human, technology and organization in selected industries in the three economic sectors?

Since the aim is to have an overview of the entirety of measures introduced, it is to be expected that the results will show a great quantity and variety and therefore an assessment of good measures is then to be made on the basis of ergonomic evaluation criteria. Therefore, the second research question builds on the first and is as follows:

2. Which of the measures identified can be considered *good* on the basis of predefined ergonomic evaluation criteria?

The approach used to answer these research questions and to specify the field of study will be explained in the next section.

### 3.3 Design

The study design and methodological approach were developed as part of the research project COVID19LL (Gute Lösungen für die Zukunft nutzen—COVID-19 Lessons Learned. BMBF: 02L18A700). The project was realized in cooperation with the Chair and Institute of Industrial Engineering and Ergonomics, RWTH Aachen University and the Chair of Labour Engineering, Technische Universität Dresden. An overview of the general approach and preliminary results have been pre-published for this thesis in Adam, Bengler, Brandl, et al. (2021) and Bengler et al. (2021). In addition, quarterly interim reports were published on the project homepage (Adam, Pütz, Jochum, Ott, Bengler, et al., 2020; Adam, Pütz, Jochum, Ott, Arcidiacono, et al., 2020; Adam, Pütz, Jochum, Ott, Arcidiacono, et al., 2021; Adam, Pütz, Ott, Arcidiacono, et al., 2021), reporting on the current status of the project, as the results may have been of immediate relevance to companies and organizations due to the ongoing pandemic. Building on these publications and reports, the study conducted is outlined in the following and, in addition, the results will be evaluated with regard to the ergonomic criteria as well as discussed against the backdrop of the literature. In terms of the overall objective of this thesis, the results will then be considered in a holistic context with the second investigation and general recommendations for companies and organizations to cope well with the current crisis or similar situations and a world characterized by high degrees of VUCA will be derived.

The subsequent sections first describe the methodology, followed by an explanation of the sample and the procedure.

## Qualitative Interviews

Following the research objective that aims to describe a phenomenon (in this case how the COVID-19 pandemic has changed the way people work) in more detail, a qualitative approach is the means of choice (Flick, 2013). The individual and subjective assessment from the respondent's perspective is of interest in order to answer the research question and therefore qualitative interviews is a suitable method (Helfferich, 2011). The partially structured guideline interview was chosen as the interview form. In a semi-structured interview, the questions do not have to be in a fixed order and can be asked spontaneously and flexibly throughout the course of the interview (Helfferich, 2011; Mayring, 2016). The guideline serves as a common thread for the course of the conversation, gives structure to the course of communication, allows a better comparison of results and narrows down the topic (Misoch, 2019). Additionally, the comparability of the content of several interviews is ensured by the guideline defined in advance (Helfferich, 2011).

Eligible interview partners were selected depending on the region as well as the economic sector and industry. During the course of the pandemic there were regional differences with regard to the incidence of infection (Chapter 3.1.1). In order to take into account different regions spread throughout Germany, North Rhine-Westphalia (NRW), Bavaria and Saxony were selected for data collection.

The interviews were conducted in the primary, secondary and tertiary sector for the sake of a broad overview of different fields of work and because of the fact that all sectors were affected by the pandemic (Chapter 3.1.1). As explained earlier, a consideration of all sectors of the economy was identified as particularly suitable, because they represent the entire world of work—thus represent the entirety of the workforce—and provide a systematic classification. As already indicated, we will now take a look at particularly relevant industries within the sectors.

Within WZ 2008 (Statistisches Bundesamt, 2008), one industry can be assigned to the primary sector, five industries can be assigned to the secondary sector and 15 industries can be assigned to the tertiary sector<sup>1</sup>. Selection criteria were defined in order to identify the industries to be included in the analysis:

First, the number of employees and the contribution to value added were taken into account in the selection process as key aspects of the regional importance of the respective industry. In Bavaria, the automotive industry plays a major role whereas in Saxony the mechanical engineering industry and in NRW the chemical industry are of great importance (Sporn and Mayer, 2013).

Second, the degree to what extent the industry was affected by the pandemic was taken into account, referring in particular to fundamental changes in the way of working, as in the system-relevant areas, and not primarily to economic cuts. In the primary sector, agriculture and forestry were particularly affected (ifo Institut, 2020; Bundesministerium für Ernährung und Landwirtschaft, 2021). In the secondary sector, the manufacturing industries were highly affected by the pandemic and in the tertiary sector this is the case for trade, transport and storage, hospitality, education, health and social work as well as arts, entertainment and recreation (Nothnagel et al., 2020; Bachtrögler et al., 2020; International Labour Organization, 2020).

In the respective industries and regions, companies and organizations were acquired via e-mail and interview appointments were scheduled with persons of different levels of

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<sup>1</sup>Industries A are assigned to the primary sector, industries B to F to the secondary sector, and industries G to U to the tertiary sector according to WZ 2008 (Statistisches Bundesamt, 2008).

hierarchy: members of the management (with personnel responsibility), employees and works council members. Different levels were requested in order to gain insights from different perspectives on the phenomenon investigated.

### **The Process Model**

Based on the HTO concept (Chapter 1.2), a process model was developed that enables us to describe the process of change during the COVID-19 pandemic (see Figure 3.2), thus to look at a crisis-related transformation process. This extended theoretical model was pre-published to this thesis in Bengler et al. (2021). In order to use the HTO concept to consider or analyze a process of change in the context of a crisis, the concept was extended to include various points in time. The extended model allows for a systematic view of the pre-pandemic period (status quo ante), the dynamic process of change during the pandemic (process of change), and a future post-pandemic phase (status quo post).

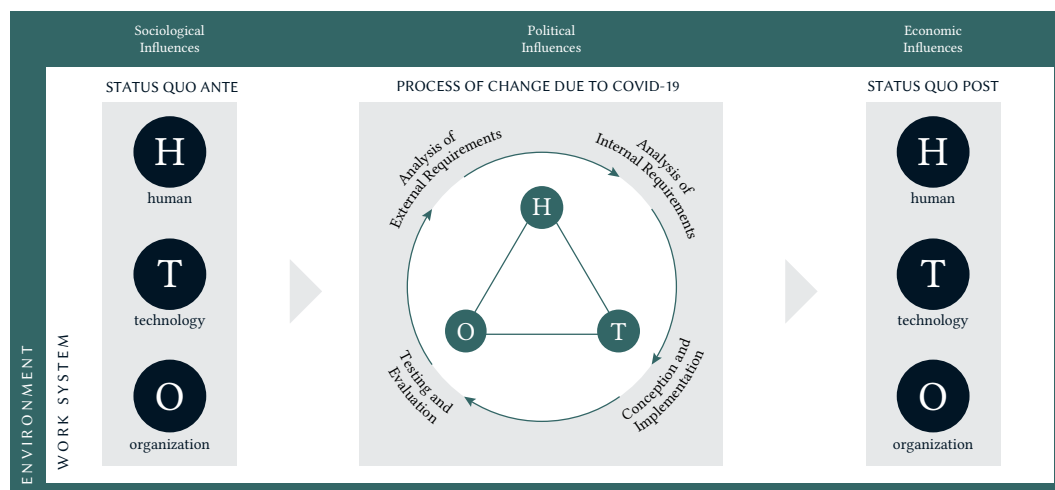
To evaluate the process of change, the initial state must first be ascertained. For this purpose, all three dimensions should be examined more closely. Otherwise, the changes cannot be traced back to the crisis. The process of change is illustrated in a circular way with numerous internal and external requirements. This is to reflect the fact that flexible adaptations are necessary, as dynamic changes require constant review and adjustment of measures and approaches. The circular representation is thus intended to match an iterative development of measures. Internal requirements that need to be analyzed to understand the process of change refer to the general conditions in the company, such as company agreements, ordinances and occupational health and safety. External conditions include fluctuations and disruptions, such as changes in demand, disrupted supply chains, and legal regulations (e.g., contact restrictions). Analyzing the change process takes into account the iterative development and introduction of measures in all three dimensions of the HTO concept. To evaluate the change process, the status quo post must finally be considered. Similar to the status quo ante, the status quo post should be described using the three facets of the HTO concept. The extended process model thus enables a holistic view of the process of change based on the HTO concept and is therefore intended to serve as the basis for data collection. For a more detailed depiction of the extended model, see Bengler et al. (2021).

### **Definition of a *Good* Solution**

In order to identify *good* solutions that companies and organizations introduced during the pandemic, criteria to assess detected measures must be defined. These criteria are derived from the fundamental principles of ergonomics: Human factors/ergonomics “focuses on two closely related outcomes: performance and well-being” (Dul et al., 2012, p. 377). This goal of ergonomics and human factors—to optimize the well-being of people and the performance of the overall system—is also defined in DIN EN ISO 6385:2016-12.

These two assessment dimensions are perceived to provide a good basis in a crisis situation, since on the one hand they include the entrepreneurial perspective and thus the basis of the company’s existence, and on the other hand they consider the human being with his or her social needs as a central element in the company or organization. As early as the 1930s, the human being as a social and motivated acting being—and thus human needs—came to the fore as central determinants in the context of work (Badke-Schaub, Hofinger, and Lauche, 2008). The foundation for the resulting Human Relations Approach was laid by the Hawthorne experiments (Roethlisberger and Dickson, 2003, first published





**Figure 3.2**

Process Model. Based on the HTO concept Ulich (1997) and Bengler et al. (2021).

in 1939), which emphasized the importance of interpersonal relationships for satisfaction and job performance (Badke-Schaub, Hofinger, and Lauche, 2008).

The two basic objectives of performance and well-being were further specified to meet the particularities of the pandemic situation:

#### Performance

- **Economic Efficiency.** Economic efficiency is a central component of performance. This criterion is aimed on the one hand directly at the individual measures and on the other hand at the productivity of the company as a whole.
- **Cooperation and Collaboration.** Working together in a team is usually more fun than working alone; in a group, the basic human needs for sociability and influence can be satisfied (Nerdinger, 2019). The possibilities for cooperating or even collaborating in a team were significantly affected due to the key measure of physical distancing with which companies and organizations had to deal during the pandemic. Therefore, positive examples of promoting cooperation and collaboration during the pandemic should be considered as part of the evaluation criteria.
- **Environmental Sustainability.** According to the World Commission on Environment and Development, a development should be sustainable “to ensure that it meets the needs of the present without compromising the ability of future generations to meet their own needs.” (United Nations, 1987, cf. I.3.27). Particularly, with regard to long-term consequences, this criterion is relevant for the performance of companies and organizations.

#### Well-being

- **Job Satisfaction.** “Job satisfaction is simply how people feel about their jobs and different aspects of their job. It is the extent to which people like (satisfaction) or dislike (dissatisfaction) their job. (...) Job satisfaction can be considered a global feeling about the job or as a related constellation of attitude about various aspects or

facets of the job.” (Spector, 1997, p. 2). For example, to improve job satisfaction and thus well-being, Dul et al. (2012) emphasize creating opportunity to learn and grow. The degree to which the measures have influenced job satisfaction in the context of the pandemic was therefore included as an assessment criterion.

- **Occupational Health and Safety.** The improvement of physical well-being regarding health and safety due to the optimization of work environments is another ergonomics goal (Dul et al., 2012). Due to the pandemic and the associated changes in the way people work, the workplace, and work equipment, the focus on health and safety aspects in the evaluation of measures is inherent from an ergonomics point of view.
- **Influence and Design Possibilities.** The opportunity to make decisions and to influence one’s own work in the sense of scope of action can be an important contribution to stress prevention (Prümper, Hartmannsgruber, and Frese, 1995) and thereby improve well-being. “Challenge and responsibility—being able to contribute and have impact; knowing that one’s work makes a difference” was also emphasized as one of the highly valued factors by Florida (2004, p. 92). The effects of pandemic-related measures on the influence and the possibility to participate in shaping the work was therefore explicitly included.
- **Compatibility of Work and Life.** The influence of the measures introduced due to the pandemic on the compatibility of work and life is another assessment criterion, as a good work-life balance is associated with greater satisfaction and mental health (Haar et al., 2014).

### Amendment

Besides the Human Relations Approach, the above subcategories are closely linked to fundamental findings and models from the field of ergonomics and human factors, of which three particularly relevant models will be explained below.

The demand-control model (DCM) was developed by Karasek (1979), predicting that the interaction of job decision latitude and job demands lead to mental strain. According to Karasek (1979, p. 285) “it is the combination of low decision latitude and heavy job demands which is associated with mental strain. This same combination is also associated with job dissatisfaction.” Bakker and Demerouti (2007) criticize this approach and argue that “one basic premise in the DCM is that employees who can decide themselves how to meet their job demands do not experience job strain (e.g., job-related anxiety, health complaints, exhaustion, and dissatisfaction)” (Bakker and Demerouti, 2007, p. 310). While there is evidence that low job control combined with high job demands can amplify psychological strain, there is a lack of evidence that control can buffer the demands (Bakker and Demerouti, 2007).

The effort-reward imbalance model was developed by Siegrist (1996). “The focus of this model is on reciprocity of exchange in occupational life where high-cost/low-gain conditions are considered particularly stressful.” (Siegrist, 1996, p. 27). Thus, the model does not focus on the control structure, but on the reward (Bakker and Demerouti, 2007). Strain results, according to this approach, from the imbalance between reward (e.g., appreciation, salary, career opportunities/security) and effort (extrinsic demands and intrinsic motivation to fulfill these demands) (Bakker and Demerouti, 2007). The effort-reward imbalance model was confirmed in the fact that the combination of high effort and low reward at work is a risk factor for e.g., burnout and subjective health (Bakker and Demerouti, 2007).

The Job Demands-Resources model is a synthesis and further development of the demand-control model and the effort-reward imbalance model. It assumes that the interaction between job resources and job demands should be considered, i.e., that demands may be buffered by resources. Demands represent, for example, unclear roles, emotional demands or high work pressure, while resources represent, for example, autonomy, performance feedback and social support (Bakker and Demerouti, 2007). “The reason why job resources can act as buffers is different for different resources. For example, a high quality relationship with one’s supervisor may alleviate the influence of job demands (e.g. work overload, emotional and physical demands) on job strain, since leaders’ appreciation and support puts demands in another perspective.” (Bakker and Demerouti, 2007, p. 315).

Since these models are closely related to the evaluation criteria, the results of the interviews will be related to the models in the discussion below.

Whether or not a measure or solution was successful was initially assessed by the interview partners themselves. Successful is defined in the sense that it has proven useful and would be considered again in a similar situation, based on the just defined subcategories of performance and well-being. The results thus obtained within the interviews will then be discussed in more depth by the author (Chapter 3.7).

### The Interview Guideline

On the basis of the extended HTO process model (see Figure 3.2), the interview guideline was developed, following the SPSS approach by Helfferich (2011). The first step is to brainstorm questions. Next, this set of questions should be revised and questions on facts, irrelevant questions regarding the topic, rhetorical questions and questions that address abstract relationships should be eliminated. Afterward, the remaining questions should be sorted and subsumed. Following this procedure and based on the extended HTO process model (see Figure 3.2), a set of key questions and sub-questions emerged.

The interview guideline is in Appendix A. During the interview, the three phases (status quo ante, process of change, status quo post) are considered, each referring to the three dimensions of the HTO concept. In total, the guideline consists of four parts:

1. Introduction as well as questions about the interviewee and the company/organization: The interviewee was asked to explain his/her role in the company or organization and to characterize the industry of the company or organization according to WZ 2008 (Statistisches Bundesamt, 2008). Additionally, the annual revenue as well as the number of employees according to European Commission (2020) should be specified.
2. Status quo ante: The second part of the interview addressed the status quo ante, i.e., the time before the pandemic. The interviewee should describe the work system in the dimensions human, technology and organization and the pre-pandemic framework conditions and starting conditions. In the human dimension, the workforce should be described in terms of demographics, qualifications, digital competences, and needs or flexibility. In the dimension of technology, the central technologies and tools that were used should be described and the spatial conditions specified. In the dimension of organization, working hours and flexible working were addressed, as well as team structures and communication (communication channels as well as horizontal and vertical communication).

3. The process of change: The third part dealt with the process of change itself and thus represents the main part of the interview. Measures that were introduced in the companies or organizations due to the pandemic within the three dimensions of the HTO concept were collected and afterward illuminated in more detail. For each measure, the trigger for the introduction (e.g., lockdown, physical distancing, hygiene concept, changes in demand) was queried. Afterward, the measure was considered regarding the development process and the internal prerequisites (e.g., financial resources, number of employees affected, occupational health and safety, company agreements) as well as the drivers that led to the adaption of the measure. The interviewee was asked to describe the conceptual design (persons involved and obstacles) and the evaluation of the measures (communication of the change, systematic of the evaluation, termination criteria) and to assess the effect of the measures on the predefined criteria of performance and well-being.
4. Status quo post: Last, addressing the status quo post, the measures discussed were appraised by the interviewee regarding the transfer potential to a time after the pandemic and whether there would be a need for additional action.

### 3.4 Sample

To gather insights into how companies and organizations were dealing with the COVID-19 pandemic, a total of 52 interviews were conducted with representatives from 34 different companies and organizations in Bavaria, NRW and Saxony. The companies were contacted personally, by mail or phone. In addition, companies were informed on the project homepage that they could contact the project team if they were interested in an interview. The contact request was based on the defined selection criteria (region, sector, industry affected). Companies and organizations were acquired in all three regions, but the response rate varied. The distribution of interviews by region and sector can be seen in Table 3.1. Overall,  $n = 16$  women and  $n = 36$  men participated in the interviews, of which  $n = 35$  (67%) worked in a management position (with personnel responsibility). The first interview in each company was conducted with a member of the management board, a division manager or a corresponding manager. If the first interview showed that many pandemic-related measures had been introduced, further interviews were conducted with employees who were either involved in the development and implementation of measures or whose work processes were directly influenced by the implemented measures.

In the primary sector, the interviewees worked in forestry and agriculture. According to the definition of the European Commission (2020), three interviewees came from micro companies, two from small companies and one from a medium-sized business. Following the classification of Statistisches Bundesamt (2008), the industries represented in the secondary sector ranged from manufacturing companies, engineering and steel construction to pharmaceutical industry, packaging industry and confectionery industry. Interviews were conducted with, among others, the management, the divisional management, the works council and employees. One small company, two medium-sized companies and seven large enterprises participated in the data collection. In the tertiary sector, interviews were conducted inter alia with the management, human resources management, employees, administrative staff and nursing staff. The industries considered include information and communication industry, healthcare facilities, district office, education and service. Two of the interviewed companies were small businesses, three companies can be classified

**Table 3.1**  
Interviews conducted per region and economic sector.

|                        | Primary Sector | Secondary Sector | Tertiary Sector |
|------------------------|----------------|------------------|-----------------|
| Bavaria                | 2              | 6                | 6               |
| Saxony                 | 1              | 4                | 13              |
| North Rhine-Westphalia | 3              | 9                | 8               |

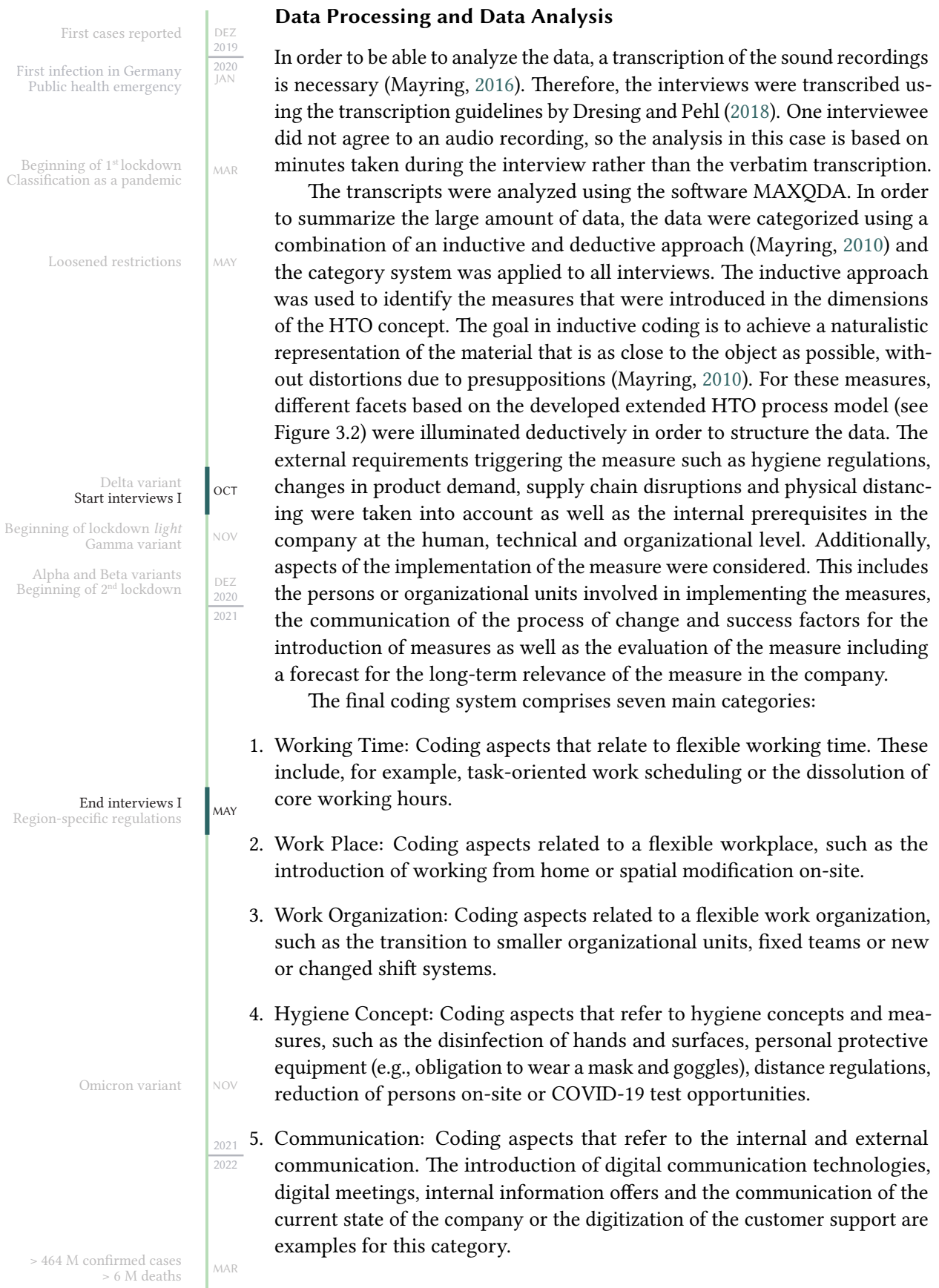
**Table 3.2**  
Classification of the surveyed companies and organizations by industry.

| Industry  | Comp./Org. | Interviews |
|---|------------|------------|
| Manufacturing Industry                            | 10         | 19         |
| Agriculture and Forestry                          | 6          | 6          |
| Public Administration, Social Security            | 5          | 7          |
| Health Care and Social Services                   | 4          | 7          |
| Information and Communication                     | 3          | 7          |
| Education and Training                            | 2          | 2          |
| Professional, Scientific and Technical Activities | 1          | 1          |
| Other Service Activities                          | 1          | 1          |
| Trade   | 1          | 1          |
| Arts, Entertainment and Recreation                | 1          | 1          |

as medium-sized businesses, three large enterprises, and 10 organizations participated in the survey. For a detailed overview of the industries, see Table 3.2. The majority of the interviews took place in the secondary and tertiary sectors, in which a large percentage of employees in Germany work. It should be noted that the retail and restaurant industries were excluded from the data collection because they were not allowed to provide their actual services during the lockdowns.

### 3.5 Procedure

The data was collected between October 2020 and May 2021 (see Figure 3.3). The interviews were conducted by the respective institutes on-site (Bavaria: Caroline Adam, Chair of Ergonomics and Georg Jochum, Friedrich Schiedel Chair of Sociology of Science, TUM; NRW: Sebastian Pütz, Chair and Institute of Industrial Engineering and Ergonomics, RWTH Aachen University; Saxony: Gritt Ott and Elena Montenegro, Chair of Labour Engineering, TU Dresden). Due to the travel ban and contact restrictions, the interviews were conducted online via the online-conference tool Zoom. The interviewees signed the consent form and declared themselves in agreement with the Zoom local recording. In addition, they agreed to the transcription of the interviews. For the classification of the industry and the classification of the company size, the relevant information was shared via screen sharing. The interviews were conducted following the prepared guideline.



6. Operational Management: Coding aspects that refer to the operational crisis management such as the introduction of a crisis unit, the involvement of the works council, the approach to the development of measures or the changeover to other services.
7. Entrepreneurial Modification: Coding aspects that refer to entrepreneurial modifications. This includes especially the digitization and automation of various processes and services.

All measures identified were classified into these seven categories. As expected, the number and variety of measures was enormous. In order to deal with the complexity arising from the interrelationship of the measures with the external and internal preconditions and framework conditions, the results should be presented in a coherent manner. Therefore, the results in connection with their success factors and obstacles should be embedded in stories that are closely oriented to everyday work in different areas—with the help of scenarios.

### Development of Scenarios

The extensive results are to be presented in scenarios in order to be able to describe and prepare them in connection with their framework conditions. A scenario approach was chosen, because scenarios “can themselves be generated as part of communicative processes and thus serve to stimulate a discourse in which they help to promote a common, shared understanding of a problem while also promoting an exchange of ideas and the integration of different perspectives concerning a topic.” (Kosow and Gaßner, 2008, p. 19). They can improve communication processes while creating a network e.g., between theoreticians and practitioners (Kosow and Gaßner, 2008), which is advantageous for such a current and practice-oriented topic. Additionally, the scenario approach allows us to present the different dimensions of the HTO concept collected in the interviews in a holistic and coherent way within the framework of a story.

According to Kosow and Gaßner (2008), a scenario is “a description of a possible future situation (conceptual future), including paths of development which may lead to that future situation.” (Kosow and Gaßner, 2008, p. 11). The authors combined this statement from definitions in Reibnitz (1992, p. 14), Götze (1993, p. 36), Gausemeier, Fink, and Schlake (1996, p. 90) and Steinmüller (2002, p. 6).

For all types of scenarios, there are criteria of quality that should be fulfilled. According to Kosow and Gaßner (2008), a good scenario must be *plausible*, meaning that the described developments should not be impossible. Additionally, a good scenario should be *consistent*, which means that the different paths and developments within the scenario must not be mutually exclusive or contradictory. Furthermore, a scenario should be transparent in order to increase the degree of legitimacy and verifiability and it should be *comprehensible* in terms of the level of complexity and details. If multiple scenarios are developed, then another criterion is the *distinctness*, meaning that the different scenarios should clearly be distinguishable from one another. Additionally, there should be a high *degree of integration*, meaning whether the interactions of developments are integrated at different levels (Kosow and Gaßner, 2008). Since the scenarios developed from the survey results are not falsifiable (they are the combination of the findings with the framework conditions rather than a description of a potentially occurring future), the quality criteria should be thoroughly incorporated into the development of the scenarios and be subject to mandatory review. In addition, a standardized procedure should be followed when developing and writing

the scenarios, which depends on the type of scenario and thus on the function that the scenario is to fulfill.

There are different functions a scenario can fulfill and along with this, different types of scenarios exist. The functions can be categorized into four different dimensions: (1) a goal-setting function, (2) a scientific and/or explorative function, (3) a communication function and (4) a decision-making and strategy formation function (Kosow and Gaßner, 2008). Following the aforementioned objective of preparing the results in order to communicate them, the communication function and decision-making and strategy formation function are adopted.

The scenarios developed from the results of the interviews should be used to inform about the measures and strategies introduced by different companies and organizations to cope with the challenges that come along with the pandemic in the dimensions of human, technology and organization. Additionally, the scenarios are intended to serve as a basis for decision-making processes and strategy formation as different options for taking action within companies and organizations in dealing with the pandemic are outlined. They ought to provide starting points for future improvements in work processes and link these to the influencing factors and corporate framework conditions that are relevant for a successful implementation.

In order to define the basic characteristics of scenarios, a distinction can be made between explorative and normative approaches, and between qualitative and quantitative approaches (Van Notten et al., 2003; Kosow and Gaßner, 2008).

Within explorative scenarios a broad field of possible events can be described regardless of whether these events are desired or not (Greeuw et al., 2000). “The primary function of such techniques is to lay bare the unpredictabilities, the paths of development, and the key factors involved.” (Kosow and Gaßner, 2008, p. 31). In normative scenarios, a desired target state can be identified and the scenario describes ways in which this target state can be achieved (Kosow and Gaßner, 2008). Since the scenarios should describe good strategies on how to deal with specific facets of the pandemic, a target state is defined and a normative approach will be pursued (see Chapter 3.6 for the objective of the scenarios).

Depending on the type of data or information acquired, a qualitative or quantitative scenario can be developed. While quantitative data is mostly used in the fields of economics or demography, qualitative approaches are sometimes applied when tackling e.g., institutional, political or cultural topics (Kosow and Gaßner, 2008). Besides, “[q]uantitative scenarios make it necessary to arrive at a firm definition of a reduced number of factors, whereas qualitative scenarios make it possible to achieve an intrinsically more meaningful observation of details and nuances without the need of definitively including or excluding key factors.” (Kosow and Gaßner, 2008, p. 33). The qualitative data acquired in the interviews and the prerequisite of a high level of detail in order to obtain a comprehensible and easy-to-access scenario results in the decision for a qualitative scenario approach. The ideal-typical scenario technique within qualitative scenarios is a literary and/or narrative technique (Kosow and Gaßner, 2008).

Therefore, normative-narrative scenarios in a quasi-literary shape using a brief narrative about fictitious persons were developed that aim to make a desirable and possible future imaginable and thus provide a basis for discussions about opportunities for action (cf. Kosow and Gaßner, 2008). This type of scenario is suitable for a communicative nature of the task and encourages one to realize high degrees of detail, realism and correctness (Kosow and Gaßner, 2008). A scenario should contain the following components: (1) a



short introduction with background information on the context, (2) a main part, which is the actual story in which one or more persons and/or organizations act, and (3) *Marginalia*, marginal notes that highlight certain aspects to help the reader (Kosow and Gaßner, 2008).

To develop a scenario Kosow and Gaßner (2008) suggest the following seven steps, which were followed as a standardized process in creating the scenarios from the interview results:

1. Scenario workshop: During the workshop, the vision ideas and goals should be developed in cooperation with experts and the key factors should be analyzed. Due to the fact that the scenarios developed in the context of the COVID-19 pandemic already have a defined goal and do not focus on the distant future, there was no dedicated scenario workshop conducted and the developed scenarios should be closely connected to the data obtained in the interviews. The results of the interviews and the category system developed therefore serve as a basis for the scenarios.
2. Scenario exposé: As the next step, the main characteristics should be summarized in a scenario exposé and feedback should be obtained. The analysis and interpretation of the interview data resulted in four different subject areas that were presented and discussed within the project consortium. The feedback was incorporated and the four topics were further elaborated upon and developed into four scenarios for different types of work and operational management within the storyboard.
3. Story-board: Four storyboards were developed and the content was concertized. For this purpose, a suitable fictitious character was developed for each of the four scenarios with the aim that this person experiences the measures and framework conditions described in his or her scenario and, if necessary, explains and evaluates them. Subsequently, the contents from the results, i.e., the measures identified in the HTO dimensions and framework conditions that should be addressed in the scenarios, were systematically assigned. The results from the interviews were to be reproduced in their entirety. The contents were assigned to the scenario in which they fit best and finally it was checked whether all results were assigned to one scenario and there were no unnecessary redundancies between the scenarios. The results were initially assigned to the scenarios on a bullet-point basis.
4. Scenario writing: The next step was to write the scenarios. First, a specific goal was defined and the scenario's connection to potentially relevant industries was shown. A brief introduction was phrased, describing the context and the fictional character. Then the core was formulated, in which the story-board with the measures and the framework conditions was elaborated upon. Throughout the writing process, attention was paid to present the various facets of the HTO concept holistically, and as recommended, key aspects were highlighted and included as marginal notes. Quality criteria were kept in mind constantly while developing the scenarios.
5. Optimization: After several rounds of feedback received from the project consortium, the final versions of the scenarios were completed.
6. Evaluation: According to Kosow and Gaßner (2008), evaluating the scenario within a workshop is optional and depends on the character of the process. Since the review of the quality criteria of the developed scenarios was considered mandatory in this case, a workshop was conducted, which will be described in the next section in more

detail. Additionally, a Delphi study was conducted in November 2021 to evaluate the suitability of individual projections from the scenarios for coping with the pandemic and for a post-pandemic period, which is not part of the dissertation. For further details see Chapter 6.

7. Publication: Following the communication function the scenarios should fulfill, they were published and distributed (see Chapter 3.6).

### **Workshop to Evaluate the Scenarios**

To evaluate the quality criteria of the scenarios (plausibility, consistency, comprehensibility, distinctness and degree of integration; for further information see Kosow and Gaßner (2008)), a workshop was conducted with six experts from the field of ergonomics. The experts were research associates at the Chair of Ergonomics, TUM. Three women and 3 men participated in the workshop, with a mean age of 28 years ( $SD = 2$ ). The workshop was conducted on November 19, 2021 online via Zoom and Miro was used as a collaboration platform. In addition, LimeSurvey was used for a quantitative data collection on the criteria plausibility, consistency, comprehensibility of the scenario texts.

At the beginning of the workshop, the topic was briefly introduced and the process for creating the scenarios and the goal of the workshop were explained. All participants were assigned two scenarios. Care was taken to ensure that all participants received different combinations and that all scenarios were represented three times. Participants then had 30 minutes to read both scenarios and, immediately after reading one scenario, to rate it in a short online survey according to the criteria of plausibility, consistency and comprehensibility. Participants indicated the extent to which they agreed with each quality criterion in relation to the scenario under consideration on a 6-point Likert scale (strongly disagree; disagree; somewhat disagree; somewhat agree; strongly agree). The criterion plausibility was queried with the factors feasibility and credibility. Consistency was queried with the factors consistent structure and stringent progression and comprehensibility with the factors understandable design (e.g., abbreviations, format), readability (e.g., language level, syntax), as well as appropriate level of complexity and detail. For each statement, participants could justify their assessment in a non-mandatory comment. The questions for the evaluation of these four quality criteria can be seen in Appendix A.

For the second main part, the participants were divided into two groups, again ensuring that all scenarios and different combinations were represented in each group. The groups had 45 minutes to work on the criteria of distinctness and degree of integration (see Figure 1 in Appendix A). Each group had its own template in Miro and worked in a breakout session with the assistance of a workshop leader if problems or questions arose. In the context of distinctiveness, the groups were asked to identify commonalities or overlaps in the scenarios as well as differences between the scenarios. In the context of the degree of integration, it should be discussed whether causal relationships between social, economic, environmental and/or institutional developments have been considered and investigated. In addition, it should be discussed whether the scenarios are specific or non-specific in terms of sectors and industries.

Finally, the groups presented their results to each other in a short pitch and drew a joint conclusion. The workshop was scheduled for a total of 2 hours.

### 3.6 Results

The data analysis showed that a large number of interrelated measures in all dimensions of the HTO concept were introduced in the companies and organizations considered. These measures were coded into the previously mentioned 7 main categories (Chapter 3.5). Overall, similar measures were found in all economic sectors. The differentiation, the analysis showed, is not related to the assignment to a particular economic sector, but rather to the suitability of the measures for certain types of work—depending on how much physical presence is required on-site.

To be more specific, some of the measures identified apply exclusively to work areas where activities are performed on-site, including, in particular, hygiene measures and changes to on-site team structures. Some of the measures relate exclusively to work areas where activities are performed remotely, including many aspects of digital collaboration and digital processes (e.g., remote on-boarding). Some of the measures relate to a very flexible way of working, where work is performed partly on-site and partly remotely. This includes, for example, the self-determined and flexible handling of the work location. Finally, some of the measures described do not concern the work execution itself, but are more of a company organizational nature—they concern the operational management of the crisis in the company/organization. These include aspects such as the adjustment of the service portfolio or the introduction of a crisis team.

Since the measures introduced in companies and organizations differ with regard to the need for physical presence and physical contact at the workplace to perform the tasks, the results obtained in the interviews and prepared in scenarios were not differentiated by economic sector or industry. Instead, they were differentiated by the just explained type of work execution. The following three scenarios on the types of work were determined:

- Scenario of location-dependent work: Physical presence on-site is indispensable.
- Scenario of partly location-dependent work: Physical presence on-site is partly necessary, work can be done partly remotely.
- Scenario of location-independent work: Work can be done fully remotely.

These three scenarios on the types of work are supplemented by a fourth scenario which focuses on operational crisis management. In this scenario, the general approach and the experiences of the companies and organizations in dealing with the challenges posed by the pandemic are described.

The classification just described, was derived from the data and is initially suitable for presenting the results obtained in the interviews within the scenarios. The extent to which this classification is appropriate to represent the work in general was examined during the scenario evaluation workshop, the results of which are presented at the end of this chapter.

As already indicated in Chapter 3.5, scenarios require a goal, which is determined in the first step of scenario development. For the scenarios developed, the goal is: The aim of the company or organization is to maintain or promote its ability to work with regard to the challenges posed by the pandemic, while complying with the standards of *good work*. Furthermore, future-relevant solutions are to be examined with respect to their implementation in the company.

All the scenarios (Adam, Pütz, Ott, Jochum, et al., 2022) were written in German and can be found via the following link: <https://osf.io/gxm8j/><sup>2</sup>. Since the scenarios themselves are very extensive, they are not depicted in the main body of the text. The English translations can be found in Appendix A.

The following is a comprehensive overview of the measures addressed in the scenarios, i.e., the interview results, categorized by the dimensions of the HTO concept. Subsequently, the results of the workshop used to assess the quality of the scenarios will be outlined. Analogous to the presentation of the interview results in the dissertation, the data has been pre-published for this thesis in German in Adam, Bengler, Brandl, et al. (2021).

Before presenting the results in detail, it is noteworthy that when asked to evaluate the measures in terms of the evaluation criteria (performance and well-being), the interviewees remarked that they had only followed up on good and successful measures and therefore the measures described were good from their point of view. These measures have proven successful (i.e., they allowed the work to continue) and they would use them again in a similar situation. If negative effects were detected, countermeasures were taken and the measures were adjusted. Measures that did not work were quickly discarded and not elaborated upon by respondents. However, there was no systematic approach or monitoring underlying the evaluation of the individual measures in most companies/organizations.

### 3.6.1 Scenario 1: Location-Dependent Work

The first scenario deals with location-dependent work meaning that the employee must be on-site to execute the work activities e.g., for technological or interpersonal reasons. Laura, who is the fictitious character in this scenario, experiences a typical day in her company on-site.

**Human** The key aspects from the interviews addressed in this scenario in the human dimension based on the HTO concept are: (1) personal protective measures, (2) having a say, (3) social connections, (4) qualification, and (5) sense of security.

(1) Personal protective measures. Obligatory personal protective measures, e.g., masks such as FFP2 masks, medical masks or mouth nose covering, that must be worn on-site are an additional strain for employees while working. However, due to the fact that they allow the possibility to work on-site, they are accepted by a majority of the interview partners.

(2) Having a say. Due to the challenging situation for the companies and organizations many top-down decisions were made. However, according to the interviewees, the workforce should also be able to have a say in selected areas, such as shift planning, and should be involved wherever possible.

(3) Social connections. Reduced or missing social contacts due to physical distancing, the elimination of common breaks and on-site meetings negatively influenced the sense of togetherness, according to the interviewees.

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<sup>2</sup>The original scenarios were written by: Caroline Adam, location-dependent work; Sebastian Pütz, partly location-dependent work; Caroline Adam, location-independent work; Gritt Ott, operational crisis management.

(4) **Qualification.** Due to restrictions, some work tasks could not be executed during the pandemic. The time *saved* can be spent in further education and training of the employees, according to an interviewee.

(5) **Sense of security.** As the virus is highly contagious, it is essential that suspected and infected cases are reported as quickly as possible. It was reported that a standardized process can help to reduce barriers for employees and to give them a sense of security as well as prevent fears of stigmatization and uncertainty.

**Technology** The key aspects in the dimension of technology specified in the scenario of location-dependent work are: (1) information and communication technology and (2) technical hygiene measures.

(1) **Information and communication technology.** The introduction of information and communication technology enabled the companies or organizations to conduct online job interviews and online appointments to maintain processes. In addition, the ability to provide information through synchronous and asynchronous communication channels was reported to be important to allow direct questions and ensure that the workforce can access the information at any time.

(2) **Technical hygiene measures.** In on-site work, new technical hygiene measures were introduced as a result of the pandemic, such as disinfection of rooms and work equipment or Perspex panels between desks. Since the hygiene measures in general also contributed to a decrease in the overall sickness rate, comprehensive hygiene measures will remain after the pandemic, according to several company representatives.

**Organization** In the organization dimension, the following key aspects are included: (1) spatial conditions and (2) communication structure.

(1) **Spatial conditions.** The changes in spatial conditions as well as the workplace and working hours have a strong impact not only on remote work but also on on-site work. For example, new shift systems with small, fixed teams and staggered breaks lead to less contact between employees overall. In the case of an infection, this means that only a small group is affected by quarantine. However, this also leads to the fact that there are altogether few and always the same contacts and thus a danger of splitting departments or teams was reported.

(2) **Communication structure.** The structures and ways of disseminating information is an important aspect in the interviews and thus addressed in all scenarios. The need for a transparent and comprehensible explanation is raised as an important criterion for success, as is a comprehensible justification for the introduction or adaptation of certain measures. The involvement of the works council can provide particular support in this respect. According to the interview results, regular and transparent communication of changes and new processes within the company or organization can increase acceptance of the measures among the workforce.

### 3.6.2 Scenario 2: Partly Location-Dependent Work

In the second scenario, partly location-dependent work is addressed, which means that employees must be on-site for some tasks whereas there are some tasks that can be completed remotely as well. The fictitious character in this scenario is Paul. He switches flexibly between the at-home and on-site worksites. Since he has a daughter of school age, a flexible concept suits him very well and this is addressed in the scenario. In this scenario, the double burden of many employees with childcare or care for relatives is to be addressed. Although this is not primarily part of the work, it was found to be a strong influencing factor in the data collection process.

**Human** In terms of the human dimension, three main topics are considered in this scenario, namely (1) context-dependent choice of workplace, (2) flexible workplace, and (3) social connections.

(1) Context-dependent choice of workplace. Employees should be given the opportunity to choose their workplace, depending on the task to be performed. This high degree of flexibility and co-determination (what is meant by this is an opportunity to have a say, not primarily the right to co-determination) in the choice of the work place is a future concept that many interviewees would like to see. Certain tasks require certain work environments, and when the work location is discretionary, employees can choose an environment that is appropriate for the task at hand. For tasks that require a high level of concentration and therefore a silent work environment without any interruptions, working from home can be suitable (as long as there are good working conditions at home). For complex collaborative problem-solving or decision-making processes, where a lot of coordination and communication is needed within the company, being on-site can accelerate and improve these processes.

(2) Flexible workplace. According to the interviewees, switching flexibly between different locations can improve work-life balance, especially in combination with the associated reduction in business trips. If the opportunity of switching flexibly between different locations comes with a flexible work time, then it allows employees to adapt their work better to their private lives.

(3) Social connections. Being on-site from time to time can also help to maintain social contacts and preserve personal exchange among colleagues, according to the interview results. Social isolation while working from home is described as a danger associated with strictly remote scenarios. This can be counteracted with flexible solutions, as is described in this scenario.

**Technology** In the technology dimension, there are three key aspects discussed in the scenario: (1) information and communication technology, (2) workflow support, and (3) external communication.

(1) Information and communication technology. The possibility of extending face-to-face meetings via video conferencing and thus making meetings accessible to people who do not work on-site is an important prerequisite for actually implementing the flexible concept,

which is addressed in this scenario. Additionally, a flexible choice regarding the workplace requires functioning communication channels for formal and informal communication. In particular, technologies that include various forms of interaction such as chat, video conferencing and data exchange were described as being particularly helpful for the work process.

(2) **Workflow support.** It was reported that if the workforce switches flexibly between different locations, then it is necessary to always have a transparent overview of who is on-site (e.g., by implementing digital technology for attendance planning) and how to quickly reach supervisors and managers, colleagues and subordinates when working remotely in order to sustain the workflow. This allows work phases that require on-site presence to be used in a targeted manner.

(3) **External communication.** Using digital means for communicating with client companies e.g., by digitizing support processes or remote maintenance can increase response times and reduce the number of business trips required, according to the interview results. This, however, increases the requirements for comprehensive IT equipment for employees and effective data protection concepts.

**Organization** The organization dimension in the scenario of partly location-dependent work comprises two key factors: (1) contracts and framework conditions as well as (2) flexible work time.

(1) **Contracts and framework conditions.** Regulations on the choice of workplace and flexible work time should be specified in the employment contract in order to guarantee planning certainty for employers and employees. According to the interviewees, irregular attendance at the workplace or in the offices will lead to new requirements for the workplace. Specific working environments are needed for specific activities that require the employees to be on-site.

(2) **Flexible work time.** A flexible work place is often accompanied by flexible work time. On the one hand, this can improve the compatibility of work and private life. On the other hand, transparency and management of accessibility and availability are becoming more important. During the pandemic additional exemptions were granted in some cases, e.g., for caring for relatives or children.

### 3.6.3 Scenario 3: Location-Independent Work

The third scenario concerns location-independent work. In this scenario the employee can work entirely from home and does not have to be on-site. Hanna, the fictional character in this scenario, has just started working at a new company and has been working from home since she started there.

**Human** The key aspects from the interviews addressed in this scenario in the human dimension are: (1) personal resources, (2) competences, (3) emotional bonds, and (4) personal exchange.

(1) Personal resources. The topic of personal resources was also addressed in the interviews. While working exclusively from home, the boundaries of work and personal life are becoming blurred. Due to the fact that transit times are omitted and online meetings are often tightly scheduled there is a greater densification of work, which on the one hand can increase productivity but on the other hand can result in very exhausting working days. This trend is exacerbated by the fact that the incentive for breaks to get together with colleagues is not present when working from home, and therefore some employees take few or no breaks. In addition, it was reported that many employees feel they have to be constantly available and work even harder to show they are productive when working from home.

(2) Competences. Working alone leads to a high level of self-responsibility and requires advanced competences in self-organization and self-reliance, according to the interview results. These competences should be promoted. Additionally, open communication of expectations and early communication of important deadlines, including planning reliability, can help the workforce to manage work better in a remote-only scenario.

(3) Emotional bonds. The pandemic-related decline in face-to-face meetings and contacts risks diminishing the emotional bond between employees. Trust and the sense of togetherness, which was already discussed within the first scenario, build up more slowly via digital communication technologies, according to the interviewees. Even though overcoming a difficult situation together, e.g., a crisis, can strengthen the feeling of togetherness, team cohesion should be specifically promoted.

(4) Personal exchange. Improving the just-mentioned team cohesion can be realized by introducing dedicated face-to-face meetings with selected colleagues and by implementing, say, a mentoring program, especially for new employees. Activating the camera may help to promote social proximity and to capture non-verbal reactions, according to the interviewees.

**Technology** In the dimension of technology there are two key aspects addressed in the scenario: (1) digital technologies and (2) digital processes.

(1) Digital technologies. Especially when hiring new employees in a remote setting, the results show that digital technologies can offer great added value. Application interviews can be conducted online and a virtual tour through the company can provide a good insight into the premises. A formalized on-boarding process can be implemented via digital technologies as well and a remote-incorporation supported by the IT department seems to be a good alternative to an incorporation on-site.

(2) Digital processes. As key success factors for fully-remote scenarios the digitization of entire processes (e.g., administration or organizational issues) including the implementation of digital signatures (that however requires a high level of data protection) were named. In addition, communication technologies should be available for formal and informal exchange, which can include the introduction of a group chat, virtual coffee breaks, or online team-building offerings.



**Organization** In terms of organization, four main topics are considered in the scenario of location-independent work, namely (1) leadership, (2) flexible workplace and work time, (3) client acquisition and (4) contracts and legal framework.

(1) Leadership. Given the large number of employees who work from home, interviewees describe that remote leadership is becoming increasingly important. It is perceived as more difficult to assess subordinates' work progress and workload remotely, as well as to communicate complex issues via digital communication tools. Additionally, important meeting should be communicated in a timely manner and should not be outside core working hours, if possible.

(2) Flexible workplace and work time. A flexible work time and workplace can lead to a more effective use of time and less distraction. High degrees in self-responsibility and self-determination are considered to be positive in the interviews conducted. Due to the possibilities opened up by digital technologies, the place of work and residence do not necessarily have to match and cross-site cooperation seems to have improved. However, creative collaboration is described to be challenging over distance.

(3) Client acquisition. Especially the acquisition of new customer contacts is challenging via online-only formats—whereby the additional possibilities of online formats to prepare and present content differentiated depending on the specific target groups are positively emphasized.

(4) Contracts and legal framework. The adjustment of employment contracts including the contractual assurance of an increased degree of flexibility in terms of work time and workplace is discussed due to the pandemic in companies and organizations whereby the specifications for occupational health and safety must be complied with.

#### **3.6.4 Scenario 4: Operational Crisis Management**

The fourth scenario addresses the operational crisis management. This scenario describes how companies and organizations have introduced measures to implement crisis-related regulations parallel to their day-to-day operations. This affects companies and organizations in all sectors of the economy, with the exception of those whose operations have had to be discontinued completely. The fictitious character in this scenario is Maximilian, who is the management consultant.

The scenario on operational crisis management addresses mainly organizational aspects of the HTO concept. For this reason, there will be no differentiation between the dimensions human and technology in the following. The key aspects from the interviews addressed in the scenario are: (1) effects due to external factors, (2) adjustment of the service portfolio, (3) introduction of a crisis management team, (4) communication of the measures, and (5) workforce participation.

(1) Effects due to external factors. The companies included into the analysis were partially confronted with changes in demand from customer companies or end customers. Some industries, such as retail or gastronomy that were not classified as systemically relevant or could not comply with the hygiene rules, had to completely stop working, which in

turn also had an impact on other industries. However, only few of the companies surveyed were affected by difficulties in the supply of materials. The hygiene regulations increased the time, financial and organizational effort required in the provision of services or in production within the companies.

(2) Adjustment of the service portfolio. In the early days of the pandemic, anything that was deemed non-essential for survival of the company or systemically relevant from the perspective of the customers was temporarily suspended. In some cases, employees were temporarily transferred to other areas of the company and in some cases activities that were on hold before the pandemic were tackled. In other cases, there was a switch to alternative offerings, such as new online services.

(3) Introduction of a crisis management team. Introducing a crisis management team in the beginning of the pandemic proved to be helpful and purposeful. The team composition varied depending on the company. An appropriate composition included for example the management, safety specialist, company physician and other relevant department representatives. The initial period of the pandemic was very volatile and decisions had to be made flexibly and at short notice. Accordingly, the frequency of meetings was very high. In the course of the pandemic a certain routine occurred and meetings were scheduled regularly and at more frequent intervals as needed. The development of a *pandemic plan* or *crisis plan* where certain measures were linked to certain risk levels increased the responsiveness in companies enormously.

(4) Communication of the measures. Different channels and forms of communication in the dissemination of information should be used. For one thing, the official communication on the introduction of new measures and changes is important. Then again, the personal communication, preferably by the direct superior, is beneficial—especially if the meaning and the effects of the measure for the specific division can be explained. Transparent communication increases comprehensibility and thus acceptance within the workforce. Additionally, it can be useful to disclose the economic situation of the company to increase the acceptance of the workforce for potential cuts or negative impacts.

(5) Workforce participation. Including the employees into the development and implementation of the measures can additionally increase the acceptance. However, this can be difficult in the times of a crisis, where a quick implementation of partly pragmatic solutions is needed. If measures are implemented without the participation of the workforce, one should gather feedback on mandatory modifications from the employees' perspective.

### 3.6.5 Evaluating the Criteria of Quality

The results of the quality criteria assessment workshop are presented below.

Results for the scenario of location-dependent work led to different assessments. Two participants (fully) agreed that the scenario is feasible and one person fully agreed that the scenario is credible. One person rather agreed that the scenario is feasible, but referred to the spatial conditions that could make it difficult to implement individual measures. Two participants tended to agree that the scenario was credible, but that it felt like a mix of a production and office workplace, which sometimes led to unrealistic situations. Two

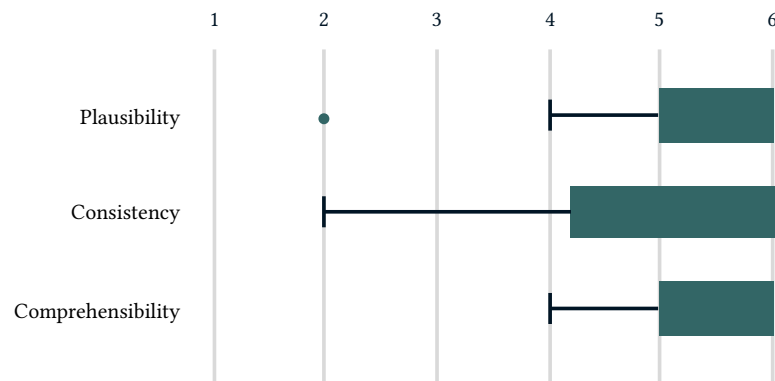
persons fully agreed that the scenario is structured consistently and stringently, while one person (rather) disagreed. The rationale for this was that all scenarios should be structured in the same way in terms of content and that the non-applicable topics should be highlighted. Additionally, it was noted that some points from the first scenario were also relevant to the second scenario. Participants (fully) agreed that the scenario was comprehensible, with one exception in the understandable design and the comment that the landscape format made it difficult to read. One person stated that he/she felt somewhat underwhelmed while reading.

For the partly location-dependent work scenario, the scenario was rated overall as plausible, consistent and understandable. All participants who rated this scenario (fully) agreed that the scenario is feasible and two participants (fully) agreed that the scenario is credible. One person tended to agree that it was credible, referring to the very different corporate policies and the resulting very different trust relationships. Two people fully agreed that the scenario has a consistent structure and stringent progression. One person agreed and tended to agree on these two dimensions, again suggesting that all scenarios should be structured the same in terms of content and that topics that do not apply should be flagged. All participants (fully) agreed that the scenario is easy to read and has an appropriate level of complexity and detail. Two participants also (fully) agreed that the design is understandable and one person agreed on this but noted that the landscape format makes it difficult to keep a clear overview, as already mentioned for the first scenario.

For the third scenario of location-independent work, comprehensibility in particular was rated as very good; one person was somewhat critical of plausibility and consistency. All participants (fully) agreed that the scenario is feasible and two participants fully agreed that the scenario is credible—one person disagreed but did not indicate why. Consistency was rated differently. While two persons (fully) agreed that the scenario has a consistent structure and a stringent progression, one person each indicated that they tended to disagree about the structure and tended to agree about the progression. The reasons for this were that, on the one hand, it was pointed out that working on a computer screen is very strenuous and, on the other hand, reference was made to online offers for social exchange. With regard to the progression, it was noted that the focus was more on the application procedure and administrative tasks and less on the day-to-day work. All participants (fully) agreed that comprehensibility was given in all aspects.

The fourth scenario on operational crisis management was rated good in terms of plausibility; opinions on consistency and comprehensibility were mixed. Participants unanimously (fully) agreed that the scenario is feasible and credible. Two persons (fully) agreed that the scenario is written consistently and stringently, while one person indicated that he/she rather agreed with the consistent structure, pointing out individual aspects that were out of context, but agreed with the stringent progression. With regard to the comprehensibility of the scenario, the answers ranged from partial agreement to full agreement in all sub-aspects. The participants pointed out a varying degree of detail and a lack of stringent highlighting (bold text) of text passages. It was suggested that the scenarios could additionally be implemented graphically.

The results of the aggregated data of plausibility (feasibility and credibility), consistency (consistent structure and stringent progression) and comprehensibility (understandable design, readability and appropriate level of complexity and detail) for all scenarios can be seen in Figure 3.4.



**Figure 3.4**

Plausibility, consistency and comprehensibility of the four scenarios (1 = strongly disagree; 6 = strongly agree). Based on the data of six experts who rated two scenarios each.

Overall, the scenarios were judged to be distinct, with the main distinguishing characteristics being the types of work or work task and the location of work. It was highlighted that some of the same measures and situations are described repeatedly as they are relevant to multiple scenarios. The scenarios have a slightly different basic structure and the level of detail of the initial conditions varies. However, they are united by the general topic in the context of work.

The degree of integration is given. Social aspects are included in all scenarios, as are causal connections with economic (e.g., service restrictions), ecological (e.g., reduction of business trips) and institutional (e.g., handling of sensitive company data) developments in some cases. The participants agreed that the scenarios do not apply specifically to individual sectors or industries. According to the participants, all scenarios are relevant for each industry, although the share of the respective types of work varies depending on the industry.

The conclusion of the participants was that the scenarios are very readable and that the presentation format could be improved in terms of structure and clarity. Overall, the scenarios were evaluated as versatile and that one can identify well with them.

### 3.7 Discussion

The first research question asked what measures in the dimensions of the HTO concept were implemented in companies and organizations of selected industries within the three economic sectors to be able to operate during the COVID-19 pandemic. A summary of the measures identified within the interviews was presented in Chapter 3.6.

In order to gain insights into whether there are differences between the various sectors of the economy, the primary, secondary and tertiary sectors were considered in the data collection. It became apparent that the measures introduced cannot be associated with a specific sector or industry, but with different types of work. Therefore, a differentiation of the findings obtained into the economic sectors is not suitable for the data collected, but a differentiation into the different types of work, namely location-dependent work, partly location-dependent work and location-independent work. This classification was suitable for presenting the results of the data collection. The suitability of this classification was also confirmed by the workshop participants, who argued that the types of work

cannot be assigned to individual economic sectors, but all types of work can be found in all sectors as well as industries. The participants were able to empathize well with the situations described, indicating a good suitability of the form of data presentation. Although, according to the experts, the work types occur to varying degrees in different economic sectors and industries, they agreed that these types of work are relevant to all industries. It can therefore be assumed that the classification into the developed work types is a good alternative to represent the world of work. Based on the results, it can be at least said that these types of work are a necessary condition for the representation of the world of work. However, it cannot be said with certainty at this point, whether it is also sufficient, i.e., whether there are other types of work that are needed to represent the entire world of work. Nevertheless, the fact that the types of work occur across sectors and industries allows for a high transfer potential of the identified measures to various fields of employment, depending on the specific use case, i.e., type of work.

On the basis of the data collected, for an ergonomic and broad-based consideration or analysis of work, a differentiation into the various types of work seems generally more sensible and expedient than a division into sectors—especially when this categorization is complemented by the consideration of the operational management. Particularly in the context of the changes in the world of work brought about by digitalization in recent decades, which have affected all economic sectors, a differentiation into industries or sectors does not appear suitable for generating recommendations on work design (this may not be the case for other disciplines, though). However, a division of labor that takes into account the high flexibility of work location and working time, which strongly shapes the daily work of many employees, seems appropriate. Particularly considering the developments described in Chapter 3.1.2 that, on the one hand, many activities can be performed remotely and an increase in home-based work compared to the pre-pandemic period can be expected in the future and, on the other hand, many people want to work on-site again and numerous activities require the presence in the company premises. This is exactly reflected by the developed classification.

Overall, the scenarios fulfill the criteria of quality to a high degree. All scenarios were rated as *comprehensible* and, with a single exception for the third scenario in the credibility category, the scenarios were also rated as *plausible*. For the quality criterion consistency, there was one exception for each of the first and third scenarios; apart from that, the scenarios were rated as *consistent*. Furthermore, the scenarios exhibit a *high degree of distinction* and *integration*. Since the scenarios are a compilation of the interview results, they do not claim to be generally valid in terms of content. They rather represent a collection of the measures described in the interviews—and thus a fictitious example on a case-by-case basis.

The holistic view of the work system based on the process model and the dimensions of human, technology and organization has proven to be purposeful in the analysis. By systematically structuring the interviews into the status quo ante, the change process and the status quo post, each taking into account the HTO facets, it was possible to identify numerous measures and framework conditions affecting different areas of the company/organization. Thus, four scenarios could be developed, which include a versatile consideration of the work system.

Overall, as already discussed in Adam and Bengler (2021), the interviews revealed a great variety of small measures that, taken together, helped companies and organizations remain actionable, flexible and adaptable. On the one hand, a consistent and in part pragmatic

approach enabled a very high level of responsiveness and speed to unforeseen changes. On the other hand, no individual *lighthouse measures* could be identified; rather, the interplay of measures represented the actual innovation in the working environment during the pandemic. The data collection took place over a relatively long period of time, between October 2020 and May 2021, and the large number of minor changes and measures was also striking over the course of the pandemic. When asked what the interviewees would do differently in a future lockdown, they referred to past experiences in dealing with the pandemic and the measures that were currently taken and that would be continued or applied in the future. This suggests that the strategies companies and organizations adopted during the initial phase of the pandemic have proven effective. Nevertheless, no failures were revealed in the interviews, which could, however, also have an important learning effect—and certainly did for the respective company/organization.

The set of the measures has already been briefly discussed in part in Adam, Bengler, Brandl, et al. (2021). However, an evaluation of the measures with regard to the defined criteria (the subcategories of performance and well-being) and an embedding in the current literature is still pending. This is the intention of the second research question and represents a prerequisite for the derivation of recommendations for companies and organizations, which (deduced from the first and second empirical investigations) constitute the overall objective of the dissertation. Therefore, in the following, the identified measures will be discussed in combination with the ergonomic criteria (*performance*: economic efficiency, cooperation and collaboration, environmental sustainability; *well-being*: job satisfaction, occupational health and safety, influence and design possibilities, compatibility of work and life) and against the backdrop of the relevant literature. Since some concepts emerged as particularly important in the interviews (which, however, were not explicitly part of the research question and therefore have not been addressed in the theory so far), these will now be contextualized within the respective theoretical foundations.

### **Assessment of the Results on Location-Dependent Work**

Far-reaching preventive measures to further slow the spread of the virus were determined (Bundesregierung, 2020a) and thus also had a massive impact on the world of work. Without the hygiene and protective measures, companies and organizations would not have been allowed to maintain day-to-day business on-site. So these measures represent a key component of *productivity and economic efficiency*. Additionally, the measures improve the *safety* of employees in the workplace by reducing the risk of infection. A standardized process for dealing with suspected cases enables the rapid identification of infections and can give employees a sense of security. These findings are in accordance with the recommendations by Pieter et al. (2021) who presented a comprehensive list of measures for public service work. The authors point out that in some cases, measures are required that go even beyond distance protection, hand hygiene as well as coughing and sneezing etiquette. In these cases, measures should follow the STOP principle and avoid unnecessary contact, follow hygiene and distance rules, and introduce small fixed teams to reduce quarantine cases. Additionally, personal protective equipment should be offered and defined contact persons in the event of infection should support the preservation of the functionality of system-relevant areas (Pieter et al., 2021). The fact that safety needs (such as stability, security, protection, freedom from anxiety, chaos and fear, etc.) are extremely important for humans was already stated in Maslow's well known hierarchy of needs (Maslow, 1970, first published in 1954). There is still a consensus today that fear and insecurity at work are significant stress factors (Kubek,

2012). Interestingly, forecasts for the future have already been made by some interviewees, who stated that they planned to maintain extended hygiene concepts after the pandemic, because they noticed a general decrease in the overall sickness rate.

In order to increase well-being in terms of *influence and design possibilities*, the involvement of the workforce should be sought. Due to the need to react quickly to changing circumstances (e.g., due to changes in demand (ifo Institut, 2020) or volatile infection rates (Robert Koch-Institut, n.d.) and associated restrictions and relaxations), this was sometimes not possible from the point of view of the management staff. If it is not possible to involve the workforce, care should at least be taken to ensure that the consistency of the measures and the reliability as well as the traceability in the introduction and implementation is high. Although co-determination and participation in the narrow sense are not the subject of this study, these terms will be referred to here. The demands for and possibilities of participation range from employee participation in various workshops to activity in the works council (Bamberg, Ducki, and Metz, 1998; Schlick, Bruder, and Luczak, 2018b). Different forms (information flow, consultation and co-decision) of co-determination and participation are used to define the concepts (Bamberg, Ducki, and Metz, 1998; Schlick, Bruder, and Luczak, 2018b). Co-determination is identified as an essential aspect of successful workplace health promotion (Bamberg, Ducki, and Metz, 1998). An important prerequisite for the self-determination and contribution of the individuals is that they have the required level of knowledge (Schlick, Bruder, and Luczak, 2018b). As already described in the context of the demand-control model (Karasek, 1979), a high workload with little control over one's own job is associated with high psychological strain (Bakker and Demerouti, 2007). In particular, autonomy is considered an important resource in the Job Demands-Resources model, in order to be able to compensate for high demands in one's job (Badke-Schaub, Hofinger, and Lauche, 2008). This demonstrates how important it is to involve employees even in a crisis situation and give them as much decision latitude as possible.

The way how decisions and measures were communicated was another determining factor to successfully manage the crisis in the companies and organizations. Continuous and transparent communication of decisions and reasons for the introduction and, if necessary, adaptation of measures was an important factor for the acceptance amongst employees. If the workforce supports and realizes necessary measures, it can help to ensure that work processes run smoothly and thus productivity and *performance* can be maintained. The security this gives employees with regard to their health and their job can also increase *job satisfaction*. A clear communication of internally agreed measures was also emphasized by Pieter et al. (2021).

Due to physical distancing social contacts and thus also social connections were reduced on purpose by the means of new shift systems and/or changes in spatial conditions. This poses particular dangers for the *cooperation and collaboration* in a team. However, good cooperation and collaboration make an important contribution to the company's performance and job satisfaction. Therefore, the danger of splitting teams and disrupting cooperative working relationships should be countered—especially, since social support is an important resource in coping with work demands (Bakker and Demerouti, 2007).

### **Assessment of the Results on Partly Location-Dependent Work**

In the second scenario, in which a very flexible working concept is described, employees can decide on the place of work depending on the tasks to be performed. Choosing a location that is ideally suited to the task at hand can increase productivity and thus *performance*.

This is in line with the findings of e.g., Krcmar and Wintermann (2020), Umbs (2020), and Ipsen, Veldhoven, et al. (2021), who reported that for many employees, productivity and performance are higher when they work from home. When employees have a say in where they want to work and are able to make decisions and *influence* their own work, this can also increase employee well-being. Flexibility and *having a say* in the choice of work location is a widely desired concept for the future. This also coincides with the findings of Kunze, Hampel, and Zimmermann (2020) who found that employees would like to work from home for 2-3 days on average. Again, referring to the demand-control model (Karasek, 1979) and the Job Demands-Resources model (Bakker and Demerouti, 2007), employees should be given the opportunity to help shape their own work situation.

If the workplace is chosen flexibly, *work-life balance* can be improved and the problems of working solely from home, such as a reduction of social involvement, can be weakened. An active promotion of social connections can improve *job satisfaction* and a good team spirit can also have a positive effect on *cooperation and collaboration* and thus performance. Bolisani et al. (2020) also postulate the risk of declining productivity and interpersonal relationships and calls for companies to take appropriate action. If the opportunities offered by flexible working can be exploited and the amount of work-related mobility as well as the number of business trips can be reduced, this can also have a positive impact on *environmental sustainability*.

In flexible working scenarios, transparency about attendance, availability and performance is found to be a key success factor. A good overview of accessibility, attendance and absence can support a better workflow and increase the *efficiency* while working. In order to give employees planning security, employment contracts should be adapted and if the flexible workplace is accompanied by flexible work time, it becomes even more important to know who is where and when. In accordance with Krcmar and Wintermann (2020), Rief (2021), and Alipour, Falck, and Schüller (2020) the results show that the flexible place and time concept has potential to improve the *compatibility of work and private life* and thus increase well-being.

In order to actually implement a flexible work concept on-site meetings should be optionally expandable to include persons that work from home or any other location using communication technologies. Since, according to Krcmar and Wintermann (2020), online meetings are expected to remain in place after the pandemic, this becomes even more important. Otherwise, the positive impact on *work-life balance* and *opportunities for influence* will be undermined.

Another fundamental prerequisite for flexible work concepts is implementing data protection, comprehensive IT equipment and defined digital processes for internal communication as well as for external communication to enable *efficient work*. This requirement is highlighted by Bundesministerium für Wirtschaft und Energie (2021b), too. Particularly, when communication with external partners can take place partially online and, as already mentioned, the number of business trips is reduced, the *environmental benefits* come into play once again.

### **Assessment of the Results on Location-Independent Work**

In a remote-only scenario, it can easily happen that work and private life can hardly be separated anymore. It is therefore important to raise the awareness of managers and employees for a conscious approach to a high degree of personal responsibility and self-organization. For the employees results show that they sometimes feel that they have to



get more work done than on-site in order to show that they are productive when working from home as well. While some studies report higher worker productivity when working from home (Krcmar and Wintermann, 2020; Rief, 2021; Umbs, 2020), they also frequently warn of emotional exhaustion and overwork (Alipour, Falck, and Schüller, 2020; Kunze, Hampel, and Zimmermann, 2020; Frodermann, Grunau, Haas, et al., 2021). Based on the data collected in the interviews, one can only agree with this ambivalence. Diewald (2020) states that it is necessary to communicate intentions and consequences transparently. In addition to this, the interview results show that expectations should be communicated early and in a timely manner. However, the situation poses a challenge for supervisors and managers, too, because it is more difficult to assess the work progress and the workload of the workforce. Therefore, superiors also need to be prepared for a remote-only scenario and for digital leadership. Only if this succeeds and employees and superiors can build up these personal resources and competences, a remote-only scenario can have a positive effect on *performance and efficiency* as well as successful *cooperation and collaboration*. These personal resources can then have a positive impact on the well-being of employees and superiors in terms of *job satisfaction* and *mental health*. Competencies, in turn, are a separate field of research. We want to understand competencies as available or learnable cognitive abilities and skills for problem solving (Schlick, Bruder, and Luczak, 2018a). They also include the associated motivational, social and volitional willingness and ability to use these problem solutions successfully and responsibly in variable situations (Schlick, Bruder, and Luczak, 2018a). Competencies are knowledge-based and dependent on learning and experience. It can be assumed that the development of competencies takes place in several development stages or phases (Schlick, Bruder, and Luczak, 2018a). The development of relevant competencies is therefore a central prerequisite for coping with job demands.

While working exclusively from home, the personal exchange and emotional bonds run the risk of deteriorating. According to the interview results, it is possible to build up trust and a sense of togetherness via digital means of communication, however, it takes more time. In order to improve both management and employee *cooperation and collaboration* and the *job satisfaction*, a special focus should be placed on improving personal exchange and team cohesion. The lack of personal exchange has also been identified by e.g., Forsa (2020) as a negative consequence of working from home due to the pandemic. Considering the Job Demands-Resources model (Bakker and Demerouti, 2007), developing the aforementioned resources and competences and focusing on a good social environment at work (and thus promoting social support) is particularly important.

The use of digital technologies offers many additional possibilities for effective communication and an efficient flow of information. In the interviews, digital technologies were mentioned for the process of hiring new employees and digital processes, including the introduction of digital signatures. In addition, the associated possibility that work and home locations do not necessarily have to coincide was highlighted, as well as the fact that there are additional possibilities of online formats to prepare and present content. At this juncture, it must be emphasized again that data protection is a fundamental prerequisite for *working efficiently* with digital technologies in the corporate context. This challenge has also been emphasized by Bundesministerium für Wirtschaft und Energie (2021b). Flexibility in working hours and place of work should be contractually regulated and a *health-promoting and safe workplace* should be created in a remote scenario, too.

## Assessment of the Results on Operational Crisis Management

To stay flexible, a successful strategy for some companies and organizations was to adjust the service portfolio or reorganize their service provision, e.g., by transferring employees to other areas, focusing on activities that were on hold or a switch to other offerings. This flexibility allowed some companies and organizations to remain *economically efficient* while increasing the scope for responding to external regulations.

Introducing a crisis management team made a valuable contribution to handling the crisis in many companies and organizations. One important success factor was the inclusion of different perspectives and competences. The crisis management team considerably accelerated the conversion processes in the company and thus made a positive contribution to *economic efficiency, performance* and *occupational health and safety*. The results are supported by the findings of Demmelhuber (2022). The author examined the crisis management organization of 394 companies in manufacturing, services, trade and construction. The survey results show that as of October 2021, three-quarters of respondents had a crisis management system and since the start of the COVID-19 pandemic, an increase of about 17 % was observed. Fixed crisis teams increased the most and the majority of newly established crisis teams were implemented during the first lockdown in March 2020. At the majority of companies, crisis managers are vested with decision-making authority (Demmelhuber, 2022).

Transparent, comprehensive and barrier-free communication of the actual situation supported the necessary situational adjustment of decisions made and measures implemented in the companies and organizations. It has been shown that direct as well as synchronous and asynchronous communication play a key role in crisis communication and that it is important that the individual measures are interpreted for the individual areas as well as, if applicable, with regard to how the individual is personally affected. According to the interviewees, good communication increases acceptance among the workforce and can thus also increase *job satisfaction*. In addition to this, workforce participation can help to increase employee acceptance towards the introduction of extensive measures. Subsequent collection of feedback should take place in any case. As already mentioned, the involvement of the workforce refers to the possibility that they can help shape their own work situation and co-determination in the narrow sense is not the subject of this study.

## Limitations

There are some limitations that must be considered. The results and the scenarios are neither representative for Germany nor for the three economic sectors. The study provides a selective insight into the broad spectrum of economic sectors and industries, entrepreneurial framework conditions and their interactions. The inclusion of three different regions in Germany, different company sizes and different industries in 52 interviews nevertheless gives a vast overview. However, this comprehensive approach also leads to the fact that assessments for the interplay of certain framework conditions in a particular industry are mostly based on the perspectives of individual respondents. Accordingly, the findings from the interviews conducted, in line with their processing in the scenarios developed, are rather an aggregation of the experience gathered, which benefits from the diverse professional backgrounds of the participants. They cannot be seen as a comparison of the effectiveness of individual measures between different companies and organizations. The

high degree of agreement on the main findings in the interviews is an indication, albeit not proof, that the identified measures can be generalized to the German economy.

It is also critical to note that respondents did not report on measures that were poorly implemented or discarded, but only on those that proved successful and were retained. This could be due to the fact that they were asked about currently implemented measures. Another limitation is the fact that people may not remember things correctly because the time gap is too long, the relevance is too small, or there is a *social-desirability bias* (Möhring and Schlütz, 2010). In addition, the interviews were not evenly distributed across regions and industries, and the number of interviews per company or organization also varied, skewing the results toward individual companies, industries and sectors.

Another limitation is the relatively long period of data collection. The interviews were conducted between October 2020 and May 2021. Therefore, some of the companies and organizations were in a phase of easing between the lockdowns at the time of the interviews, while other companies and organizations were interviewed towards the end of the second lockdown. The experiences of the interviewees in dealing with the challenges posed by the pandemic were therefore different as well as the subjective assessment of the pandemic during the interview. Due to the fact that the pandemic was still ongoing when data were collected, analyzed and published, it has not been possible to test the relevance and practicality of the measures introduced in times without crisis-related requirements. Accordingly, the future suitability of these solutions can only be assessed on the basis of experience-based forecasts by the experts and cannot yet be empirically examined in practice.

Regarding the methodological implementation, it should be noted that the interviews were not coded multiple times and that different persons coded the transcripts. Although all coders have a background in ergonomics or work science, the coder's prior experience and personality influence which text modules are assigned to which code. The developed scenarios have been checked for the quality criteria. Nevertheless, they are strongly influenced by the researcher. For the validation of the contents of the scenarios see Adam, Bengler, Berger, et al. (2022).

### 3.8 Summary

The aim of the first empirical investigation was to collect and evaluate measures that companies and organizations had introduced because of the pandemic. For this purpose, a total of 52 qualitative interviews were conducted in 34 companies and organizations in Bavaria, Saxony and North Rhine-Westphalia in the primary, secondary and tertiary sectors. The results show a large variety of identified measures that can be located in the different sub-systems of the HTO concept. It is not possible to clearly assign certain measures to specific sectors; rather, it was found that the measures differ in their suitability for certain types of work. These types of work (that emerged from the data) are location-dependent work, where physical presence on-site is essential, partially location-dependent work, where physical presence on-site is partially required and work can be partially done remotely, location-independent work, where work can be done entirely remotely. The results were prepared in four scenarios covering the three different types of work, complemented by a scenario for operational crisis management.

Overall, the measures mainly comprised changes in working times, the place of work and work organization, as well as the introduction of hygiene concepts. In addition, communication processes were adapted, numerous decisions were taken on operational

crisis management, and corporate changes were made. Many of the findings can be traced back to well-established concepts and knowledge of the human factors and ergonomics discipline. The fact that these aspects came up during the interviews on coping with the pandemic underlines the importance of the concepts and models in this crisis situation as well as in the context of a (future) VUCA world. Since the measures were identified across sectors and industries, there is high potential for transfer to different fields of work. This, of course, depends on the work type. The pragmatic introduction of a wide range of measures shows that the pandemic had a strong impact on the companies and organizations surveyed. Various measures were tested and retained, and measures that did not work were quickly discarded. The interplay of the numerous measures was remarkable and determined the strategy of the companies and organizations in dealing with the pandemic.

With this study, we were able to gain initial insight into the profound impact of the pandemic in companies and organizations. However, before we derive recommendations for dealing with the pandemic or a future VUCA world, we would like to dive a little deeper into the changes in the world of work caused by the pandemic in the second empirical investigation.

## CHANGES IN WORKING RESOURCES AND ASPECTS OF COMMUNICATION

In this chapter, we will go into a bit more detail and take a closer look at the changes in a defined environment. Being research in the field of ergonomics and human factors, we will focus on working conditions and the workplace on the one hand and well-being and performance on the other. We will take a closer look at job satisfaction, which is closely linked to well-being, as job satisfaction can be seen as a measure of how people feel about their jobs (Spector, 1997). The theoretical basis on the topic of job satisfaction is presented in the course of this chapter. The theoretical basis for the impact of the pandemic on the working conditions is reported in Chapter 3.1.2.

One aspect that has already been described in the context of performance is the issue of cooperation and collaboration. In many cases, the pandemic led to a disruption of cooperative and collaborative working relationships due to the reduced physical presence on-site in the company or organization. As a result, communication with various interlocutors frequently shifted to the digital world due to the pandemic, and this short-term shift created challenges for companies and employees. (The far-reaching consequences of technological progress in the context of communication—for exchanging or documenting information—have been illustrated at the outset.) As already described in Chapter 3.1.2, the number of employees working from home increased sharply. This demonstrates the need to address working conditions and the issue of communication. In order to understand the changes regarding communication in the context of work, we should first take a look at the theoretical basics on the topic of communication, organizational communication and digital communication.

Again, the HTO concept serves as the starting point for this study. We are still aiming for a holistic view of the work system, only this time at the organizational level rather than at the level of sectors and industries. This means that we can look at the three facets of the concept—human, technology and organization—in a little more detail. First, let us consider communication in the HTO concept. We want to adopt the premise that communication always includes people and can thus be located both in the human dimension and at the interfaces with technology and organization (so we leave the communication between machines aside for the time being), be it communication between employees, communication by means of technology (synchronous or asynchronous), communication between an employee and a machine, or forms of vertical and horizontal collaboration in the organization.

The environment we want to look at more closely for this investigation is the sphere of universities. Belonging to the field of education and training (according to WZ 2008 (Statistisches Bundesamt, 2008)) this area is particularly interesting, as this is where a high potential to work from home meets a strong impact of the pandemic: There was no longer any presence, the teaching and research of students and staff shifted home. Against the backdrop of the expansion of working from home and the introduction of new digital communication channels and pathways in the context of the pandemic, the question arises as to how the working conditions and the communication has changed at the university

due to the pandemic. We will start with a survey at two points in time, and then drill even deeper to understand the changes in detail by the means of interviews.

## 4.1 Theoretical Foundation

The following section outlines key concepts and the impact of digital communication on employees, as well as the changes in communication resulting from the pandemic. The theoretical foundation is based on the work of Niehues (2021)<sup>1</sup> and Els (2021)<sup>2</sup>. The chapter concludes by examining the concept of job satisfaction.

### 4.1.1 Communication in the Context of Work

As already indicated, we refer to communication between humans from the perspective of the HTO concept. The term communication is widely used and is derived from the latin word *communicare* meaning “to share” or “to be in relation with” (Cobley, 2008). Across scientific disciplines, there is no generally accepted definition of the concept of communication to date. The ambiguity and diversity of the concept of communication can be explained by the different professional perspectives, the change in the meaning of the content over time, and the components of communication that are not directly observable (Röhner and Schütz, 2016). However, when viewed abstractly, most definitions of communication include the five factors of sender, message, receiver, channel and effect (Beck, 2013). A humanities and social science approach is chosen for the definition of the term communication in this thesis. The transmission is the only necessary prerequisite for the message. Accordingly, communication is understood here as a reciprocal, i.e., double or mutual mediation process in which people interact socially and share common meanings. This understanding goes beyond the one-sided transmission, transfer or transmission process of signals (Beck, 2013). To initiate a communication, it takes at least two people (Alter, 2018; Schönenberger, 2006; Röhner and Schütz, 2016), having the intention and the will to communicate something to each other (Scheufele, 2007). Within interpersonal communication there are three means of communication: speech behavior (verbal, e.g., words, sentences, structure, facts, arguments), body language (non-verbal, e.g., facial expression, gestures, posture, eye contact) and speaking behavior (prosodic, e.g., volume, emphasis, breathing, articulation) (Alter, 2018). We communicate something via simultaneous physical presence without linguistic expression. In an interpersonal relationship it is thus impossible not to communicate (Alter, 2018).

Sender and receiver enter a relationship with each other through the exchange of signs and symbols. A common stock of signs and symbols is important for the success of communication. Through signs and symbols, the sender encodes a message, which the receiver decodes—not always in agreement. The use of appropriate means and modalities (e.g., speech by telephone) is assumed. Communication is an interactive process in which the participants influence each other. Communication is always goal-oriented, but not always fully conscious (Six, Gleich, and Gimmler, 2007, as cited in Röhner and Schütz, 2016).

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<sup>1</sup>Master’s Thesis, Sina Niehues, 2021, Measures to Design Digital Communication at Work in Times of COVID-19—Evaluation to Develop Design Recommendations.

<sup>2</sup>Master’s Thesis, Katharina Els, 2021, Changes in Communication in the Context of University during the COVID-19 Pandemic—A Qualitative Study at the Faculty of Mechanical Engineering.

## Amendment

The explanations on communication are based on established concepts of communication. The following is a brief summary of relevant key concepts.

The Shannon–Weaver communication model goes back to Shannon (1948). It describes the path of a message from its source through the transmission channel to the addressee. According to the author, a communication system consists of five parts: the source of information, a transmitter (which turns the message into a signal), a channel (which transmits the signal), a receiver (which turns the signal into a message), and the destination (the person who is to receive the message) (Shannon, 1948). The model considers information transmission in a linear way and without feedback between sender and receiver—i.e., without feedback loops (Böhringer, Bühler, and Schlaich, 2007; Scheufele, 2007). Moreover, it is a purely physical approach that does not consider the social component (Scheufele, 2007).

Paul Watzlawick described his five famous basic axioms in Watzlawick, Beavin, and D. D. Jackson (1969). In his explanations, communication is understood as a circular system with feedback (Böhringer, Bühler, and Schlaich, 2007; Röhner and Schütz, 2016). The axioms include the ideas that (1) “one cannot not communicate.” (Watzlawick, Beavin, and D. D. Jackson, 2007, p. 277); (2) “Every communication has a content and a relationship aspect such that the latter classifies the former and is therefore a metacommunication.” (Watzlawick, Beavin, and D. D. Jackson, 2007, p. 278); (3) “The nature of a relationship is contingent upon the punctuation of the communicational sequences between the communicants.” (Watzlawick, Beavin, and D. D. Jackson, 2007, p. 281); (4) “Human beings communicate both digitally and analogically.” (Watzlawick, Beavin, and D. D. Jackson, 2007, p. 284); (5) “All communicational interchanges are either symmetrical or complementary, depending on whether they are based on equality or difference.” (Watzlawick, Beavin, and D. D. Jackson, 2007, p. 285). Psychological aspects such as the relationship between sender and recipient are taken into account in his considerations (Alter, 2018).

Based on the ideas of Watzlawick, Beavin, and D. D. Jackson (1969) and Bühler, who differentiated three aspects of language (symbol, symptom and appeal) (Bühler, 1943, as cited in Schulz von Thun, 2016), Schulz von Thun postulated his four-sides model (Schulz von Thun, 2016, first published in 1981), which is also known as communication square or four-ears model. His consideration includes the factual information, a self-revelation aspect, a relationship aspect and an appeal aspect on the part of both, the sender and the receiver (Schulz von Thun, 2016).

Similar to Schulz von Thun’s model, Neuberger’s TALK model also deals with the analysis of interpersonal communication, but with a special focus on conversations in the work environment (Neuberger, 1985). The initial letters of the four partial aspects of a message (in the German versions)—fact representation, expression, guidance and contact—constitute the theoretical model (Neuberger, 1985).

## Organizational Communication

Communication within a company can be differentiated into external and internal communication (Blazenaite, 2012). External communication refers to the interaction of organizational members with people outside the organization to influence the behavior of environmental representatives in relation to the organization. Internal communication refers to the transportation of messages that enable formal task development, accomplishment, and coordination (Blazenaite, 2012). The focus of this thesis is the internal communication, which is therefore examined in more detail below—thus we are now looking at the interface of the human-organization interface of the HTO concept. There are various terms used

in the literature to describe internal communication within a company: employee information, employee communication, internal (corporate) communication or internal public relations (Einwiller, Klöfer, and Nies, 2008). Communication within a company should not be misunderstood as a one-sided top-down information but includes the employee's point of view and the principle of reciprocity in the communication process (Einwiller, Klöfer, and Nies, 2008).

Following the explanation by Spieß and Winterstein (1999), Torjus (2013) attributes the primary and secondary functions to internal communication. The primary functions, such as the determination and coordination of actions based on the division of labor, can be controlled by formal organizational structures. They can also be fulfilled by structural conditions, whereas the secondary functions are characterized by a time-delayed and indirect effect (as cited in Torjus, 2013).

In addition, Blazenaite (2012) states that organizational communication can take place at different levels and can differ in terms of direction, formality and mode:

**Levels of Communication.** Blazenaite (2012) distinguishes among four levels of communication: (1) Organizational communication, where a company is represented as a whole or organizational activities are directed; (2) Hierarchical or managerial communication, which in turn can be differentiated according to the various management levels, e.g., supervisors or middle/senior/superior management; (3) Group communication, which involves communication among at least 3 people, and (4) interpersonal communication, which refers to the communication between two individuals. Therefore, different levels of communication relate to the interface of the HTO concept between humans and the organization.

**Directions of Communication.** Communication can be vertical, horizontal or diagonal (Blazenaite, 2012). Vertical communication, on the one hand, represents the flow of information from top to bottom (Blazenaite, 2012) and includes e.g., information about tasks, measures, practices, evaluation of performance, transmission of objectives (Einwiller, Klöfer, and Nies, 2008). On the other hand, vertical communication includes the traveling of information upwards (Blazenaite, 2012) by the means of bottom-up communication. This includes, for example, communication processes from employees to superiors or from the workforce to management. Information about e.g., operational processes, problems, suggestions, feelings, experiences is exchanged. Horizontal or in-between communication refers to people communicate who are on the same level of the hierarchy, or between people on different levels but without authority to issue instructions. This form of communication mainly serves for coordinating tasks as well as the socio-emotional support of the members (Einwiller, Klöfer, and Nies, 2008). Finally, the diagonal communication direction can be differentiated, which refers to the communication crossing functions of departments or levels in the organization (Blazenaite, 2012).

**Formality of Communication.** Organizational communication can be either (1) formal or (2) informal.

(1) Formal communication follows external structural guidelines with regard to the occasion and the process (Frindte, 2001). Additionally, formal communication is directly observable and focused on achieving organizational objectives as well as the exchange of operational and performance-related information (Torjus, 2013). There are digital instruments that are used to *institutionalize* formal communication: These include, for example,



the classic circular letter circulated via a distribution list, employee meetings, company events, the bulletin board, as well as digital emails, online video conferences, chats and the intranet (Torjus, 2013). Formal communication:

- uses internal, standardized communication channels (the so-called *official channel*) (Nerdinger, 2014; Torjus, 2013)
- takes place in official meeting rooms, offices or special conference rooms (Nerdinger, 2014)
- is characterized by commitment and authority figures (e.g., manual instructions from the superior) (Nerdinger, 2014)
- is clearly attributable to a source, since there is written documentation or there are witnesses (Nerdinger, 2014; Torjus, 2013)
- is planned and determined in advance (both the group of participants and the topics) (Held et al., 1999; Kraut et al., 1990)
- is often based on a predefined agenda (Kraut et al., 1990)
- has an overall formal character and is based on a business-like linguistic style (Held et al., 1999; Kraut et al., 1990; Torjus, 2013)

(2) Informal communication depends on individual personalities and situational circumstances. The occasion and/or the course of the communication develops dynamically through the communicative reciprocity of the participants (Kraut et al., 1990). Neither time, nor participants or topic are planned beforehand (Kraut et al., 1990).

“Informal communication is a loosely defined concept and is often treated as the residual category in organizational theory. According to this perspective, informal communication is that which remains when rules and hierarchies, as ways of coordinating activities, are eliminated. More positively, informal communication is communication that is spontaneous, interactive and rich.” (Kraut et al., 1990, p. 5). Informal communication is characterized by an interactive exchange of unmodified information that is not prepackaged. Waldstrøm (2001) and Torjus (2013) differentiate among four main areas of contents of informal communication: (1) affective area, such as friendship and trust, (2) political area, such as authority and power, (3) productive area, such as exchange of technical knowledge and innovation, and (4) cultural area. Informal communication can have a task-related function or a social function (Held et al., 1999). Forwarding relevant information using *unofficial channels* in order to reduce coordination effort while solving complex tasks or to accelerate problem solving are examples for a task-related function of informal communication. Aspects like team building and interaction in a group are related to the social function (Held et al., 1999). This social function plays a major role in employees’ job satisfaction: “By having informal communication, employees can talk about their problems, attitudes, job, whatever they like, which then lead[s] to satisfaction.” (Kandlousi, Ali, and Abdollahi, 2010, p. 52). Informal communication:

- takes place in the peripheral areas of an organization, such as the coffee kitchen, elevator or parking lot (Nerdinger, 2014; Torjus, 2013)
- occurs between known or familiar people (Nerdinger, 2014)

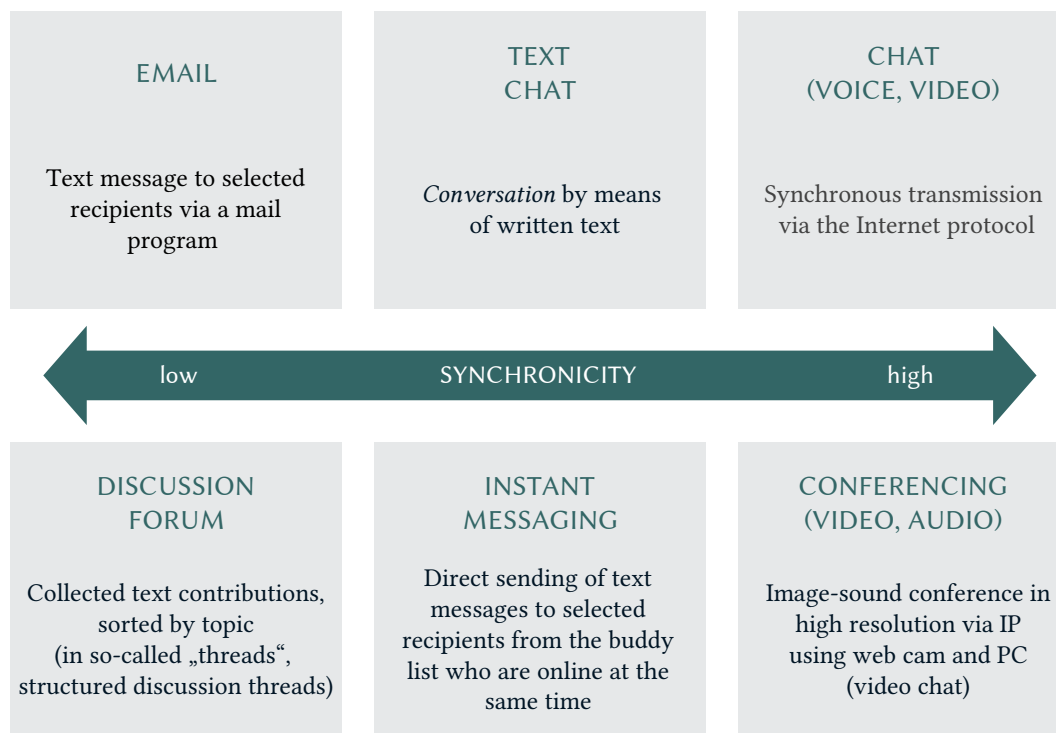
- is characterized by non-commitment (for example, rumors, the truth of which no one has to answer for) (Nerdinger, 2014; Torjus, 2013)
- is ad-hoc, that is: unplanned, spontaneous and interactive (Nerdinger, 2014; Held et al., 1999; Kraut et al., 1990; Torjus, 2013), and it does not specify a group of participants or a topic in advance (Held et al., 1999; Kraut et al., 1990)
- uses everyday/common language (Nerdinger, 2014; Held et al., 1999; Kraut et al., 1990; Torjus, 2013)
- has a less official character (Held et al., 1999)
- cannot be referred to a clear source and is not documented in writing (Nerdinger, 2014)

Modes of Communication. Finally, a distinction can be made between verbal and non-verbal communication (Blazenaite, 2012). In verbal communication, which can be oral or written (Nerdinger, 2014), the content is focused on. Non-verbal communication focuses on the way something is said (Röhner and Schütz, 2016). Non-verbal signs can be facial expressions, pantomime, eye contact, tactility, para-linguistics and staffage. These can complement verbal communication as well as increase redundancies (Frindte, 2001).

#### 4.1.2 Digital Communication

Röhner and Schütz (2016) proclaim, following Six et al. (2007) and Tropp (2011, 2014), that communication can basically be divided into direct communication (communication without the use of technical means) and media communication (communication via technical means). Media communication thus enables communication across spatial and/or temporal distances through the use of technical means (Röhner and Schütz, 2016). So the interface of the HTO concept that we are now looking at in more detail is the one between humans and technology. Communication media are characterized by a different *richness*. According to Daft and Lengel (1986) the richness depends on the immediacy of the feedback, the number of communication channels, the personalization of the communication and the variety of codes. In accordance with the media richness model, the fit between the richness of the medium and the complexity of the communication task is crucial for the effectiveness of the communication (Daft and Lengel, 1986).

If media communication uses a digital communication channel, such as the Internet, it can be referred to as digital communication (Meinel and Sack, 2009). Digital communication enables a combination of different media types, such as text, images, audio and video. The technology enables communication even virtually, regardless of time and space. Digital communication is *ubiquitous*, i.e., everywhere (Meinel and Sack, 2009). When using digital technologies, a distinction can be made between synchronous and asynchronous communication. In synchronous communication, the communicators participate in simultaneous communication, whereas in asynchronous communication, the participants communicate with a time delay (Röhner and Schütz, 2016). The main advantage of asynchronous communication is that the message is stored independently of the simultaneous availability of other team members. This relieves the sender, who can thus get things out of his/her head. The recipient can flexibly retrieve and process the message to his or her own workflow. However, the disadvantage is that feedback processes, which are important for effective



**Figure 4.1**

Classification of digital means of communication based on Herrmann, Hüneke, and Rohrberg (2007).

communication, are delayed (Herrmann, Hüneke, and Rohrberg, 2007). In contrast, synchronous communication allows these direct feedback processes, but can interrupt the workflow of the recipient and disrupt concentration phases.

Herrmann, Hüneke, and Rohrberg (2007) differentiated among 20 new communication media, eight of which specifically support (digital) communication: email, discussion forums, instant messaging, text chat, voice chat, video chat, audio conferencing and video conferencing. These communication media differ in terms of their synchronicity and thus in terms of their suitability for different situations of knowledge and information exchange. A short description of the functions of the digital means of communication (Herrmann, Hüneke, and Rohrberg, 2007) and a classification with regard to their synchronicity based on the explanations of Herrmann, Hüneke, and Rohrberg (2007) is shown in Figure 4.1.

### Impact of Digital Communication on Employees

Digital communication can increase stress and strain for employees. Kordsmeyer et al. (2019a) list general psychological stress factors in connection with the use of new information and communication technologies (ICT). The absence or reduction of non-verbal communication in digital communication results in a lower information density compared to face-to-face communication and makes it more difficult to perceive emotions and hierarchies. Additionally, the absence of information about the context, the uneven distribution of information or different communication frequencies can also lead to misinterpretations and misunderstandings. Furthermore, the increased susceptibility to conflict, which can result, for example, from the fact that information is passed on directly, meaning that situations might thus be hastily judged based on an incomplete set of facts (Kordsmeyer et al., 2019a).

Additionally, the number of emails is negatively related to well-being and leads to constant distraction for some employees. This emerges from the study results of the DAK Health Report 2020 with 7,054 employees on the effects of digitization on working (DAK, 2020). The respondents stated that they feel burdened by the fact that they receive more emails than they can process, that they have to take note of many emails that are not relevant to their work and that many emails have to be answered that have nothing to do with their actual tasks (DAK, 2020). In addition, digital communication can also result in the experience of information overload or technostress (Rau and Hoppe, 2020). In connection with digital communication and video conferencing, the so-called Zoom fatigue phenomenon is mentioned in the literature (Streim and Britze, 2021; Rump and Brandt, 2020a; Fauville et al., 2021). *Zoom fatigue* is the term used to describe the tiredness and exhaustion that sets in after numerous virtual meetings throughout the day and week. Zoom should be understood as *pars pro toto* in this case and represents virtual communication platforms in general (Rump and Brandt, 2020a). Fauville et al. (2021) describe Zoom fatigue as “the feeling of exhaustion associated with using video conferencing.” (Fauville et al., 2021, p. 2). According to Streim and Britze (2021), digital video meetings are tiring due to the permanent analysis of gestures and facial expressions of the counterpart, which is often only visible in small image details, and the attention to one’s own appearance.

The Institute for Employment and Employability collected empirical data on Zoom fatigue by the means of two surveys in September 2020 ( $n = 422$ ) (Rump and Brandt, 2020a) and December 2020 ( $n = 330$ ) (Rump and Brandt, 2020b) and refer to possible health consequences due to digital communication. In the first survey period, which covers six months since COVID-19 pandemic onset, about 60 % of respondents felt Zoom fatigue (Rump and Brandt, 2020a). In the second survey in December 2020, 62.4 % of the participants felt Zoom fatigue and when asked how Zoom fatigue has evolved since the summer of 2020, 67.2 % of respondents affected by Zoom fatigue said they recognize an increase in fatigue (Rump and Brandt, 2020b). According to the participants, the most common symptoms of exhaustion were reduced concentration, impatience, irritability and headaches (Rump and Brandt, 2020b). The authors identified stress factors, such as the absence of facial expressions and body posture, the absence of break times, the elimination of small talk, the tight scheduling of meetings, and relatively sober meetings due to an increased objectification of conversations (Rump and Brandt, 2020b). The authors conclude that the lack of social and informal interpersonal communication (small talk, non-verbal communication) are the strongest stressors (Rump and Brandt, 2020a).

Further problems and challenges of digital collaboration are outlined in the *Emotions in Virtual Collaboration* project, which started in March 2020 (Klopprogge, Burmeister, and Eichinger, 2020). The boundary between private life and work becomes blurred as work activities and communication are shifted to the home due to virtual collaboration. Reticent employees or those who need support and interaction may receive little attention. Overall, digital video and telephone conversations, in which everything revolves around the facts, offer little space for relationships, emotions and other dimensions of human interaction (Klopprogge, Burmeister, and Eichinger, 2020).

Furthermore, digital communication is associated with less social presence (Kordsmeyer et al., 2019b), which can result in less social interaction, greater perceived isolation, a sense of not belonging, impeded trust development (Kordsmeyer et al., 2019a), and aggravated cooperation (Klammer et al., 2017).

The use of digital communication media is sometimes accompanied by the explicit or implicit expectation of continuous availability, which can be perceived as stressful (Bordi et al., 2018) and even if this constant accessibility is voluntary, which it mostly is, it is often accompanied by a deterioration in work-life balance (DAK, 2020).

In an international study Karl, Peluchette, and Aghakhani (2021) analyzed the use of video conferencing for work-related meetings. They identified several negative aspects, such as the delayed start of a meeting or delayed showing up of the participants and the lack of a prepared agenda. Furthermore, there is a higher risk of employees conducting side activities during meetings by multitasking, which in turn can make meetings inordinately long and decrease contributions to solutions because they are distracted. In addition, poor microphone quality with echo and background noise were complained about, as well as camera problems (wrong angle, poor lighting, strangers in the video background) and the number of meetings, which take up the entire working day and sometimes do not allow for any breaks (Karl, Peluchette, and Aghakhani, 2021). Other challenges associated with virtual settings were mentioned by Kellner et al. (2020), who describe that creative work and an active discussion culture are more difficult to achieve in a digital setting. Furthermore, Lindner (2020) emphasizes that virtual collaboration requires more self-organization at work.

However, there are positive aspects associated with digital communication as well. For example, Rief (2021) mentions the possibilities due to improved collaboration between multiple industries and locations. In addition, digital, location-independent communication offers companies the opportunity to integrate and recruit experts and their professional expertise more easily, since these people do not necessarily have to change their home location (Rief, 2021).

Lindner (2020) also mentions this aspect and emphasizes that skilled personnel can be recruited more easily thanks to independence of location and digital communication options and companies can improve their international presence through virtual and global collaboration. There is also the opportunity to improve flexibility and agility by working digitally across different time zones worldwide. Lastly, travel can be eliminated or reduced through increased digital collaboration and thus save costs (Lindner, 2020) and personal resources.

In addition, as described earlier, digital communication allows people to work from home and can therefore have a positive impact on work-life balance, and furthermore, asynchronous communication allows things to get done even if the recipient does not yet have time to do so.

#### **4.1.3 Changes in Communication at Work Due to the Pandemic**

With the pandemic leading to a sharp increase in working from home, organizational communication has increasingly shifted to digital channels and has thus probably changed. This can be seen, for example, in the results of the Institute for Employment Research, that compares the changes in communication channels from 2019 to 2020 among three different groups: (1) employees who do not work from home, (2) employees who work from home, and (3) employees who switched to working from home due to the pandemic (Frodermann, Grunau, Haepf, et al., 2020). A total of 1,200 employees were surveyed, and in all groups, a sharp decrease in on-site meetings has been shown between 2019 and 2020. Even among employees who worked on-site during the pandemic, the percentage of face-to-face meetings dropped by 28.4 % from 2019 to 2020 (Frodermann, Grunau, Haepf,

et al., 2020), while asynchronous digital communication increased slightly. For the two groups who worked from home in 2020 (groups 2 and 3), location-independent synchronous communication, in the form of telephone or video meetings, increased from 2019 to 2020. Overall, asynchronous digital communication was the most-used communication channel across all groups in 2020 (Frodermann, Grunau, Haepf, et al., 2020). With this shift to digital synchronous and asynchronous communication due to the lack of physical proximity, daily work routines, and with them formal and informal communication, were affected (Fraunhofer FIT, 2020; Prinz, 2021).

### Formal Communication

Odgers Berndtson (2020) conducted a survey in May 2020 among 1,480 executives from Switzerland, Austria and Germany using online questionnaires in order to analyze their impressions from the first lockdown. In order to maintain formal communication, virtual meetings, conferences and workshops were used in nearly all companies surveyed (85 %) to reach employees during the first lockdown while working from home. Overall, about 54 % of the managers rated formal communication within the team as difficult and 49 % rated formal communication between supervisors and the team as challenging (Odgers Berndtson, 2020).

Kunze and Hampel (2020) conducted a survey with 700 employees starting in March 2020 on the most frequently used communication tools for team exchange. According to their results, distancing and the associated elimination of informal and formal meetings led to increased use of digital communication technologies. Traditional communication channels such as email and telephone continued to dominate among workers during the pandemic. Digital means of communication such as email (89 %), chat (44 %) and video conferencing (27 %) were frequently used means of communication in March 2020. Between the lockdown in March 2020 and a period of relaxed restrictions in mid-May 2020, the use of video conferencing increased significantly (+7 %)—while communication by chat (-2 %) and email (-9 %) declined. This shows that many companies were increasingly conducting synchronous digital meetings (Kunze and Hampel, 2020). However, video conferencing was perceived as the most burdensome means of communication and only 23 % of the respondents named video conferencing as the most productive means of communication. The most productive and at the same time least stressful in the sample considered is perceived to be email (Kunze and Hampel, 2020).

According to Berg (2021), the use of messenger services and collaboration technologies (such as MS Teams and Slack) for internal communication increased and video conferencing is now part of companies' standard repertoire for digital communications, with more than two-thirds of respondents (67 %) using it in 2021, compared to only 48 % three years earlier. These are the results from a representative study on the change in communication with 1,106 participants in 2018 and 1,104 participants in 2020 (Berg, 2021).

In an August 2020 online survey of 1,006 employees on digital meeting culture, 82 % of respondents said that short meetings can be completely or almost equally replaced by online conferences (NeXR Technologies SE, 2020). However, 43 % stated that a short telephone call was sufficient for short arrangements and that a video conference was not necessarily required. For longer meetings, 60 % of the respondents agreed that online meetings are a reasonable substitute. However, in the case of a full-day seminar, 58 % indicated that online conferences are considered less or not equivalent. Thirty-four percent of employees were

frustrated and would like to see face-to-face meetings resumed (NeXR Technologies SE, 2020).

DeFilippis et al. (2020) examined the change in digital communication patterns during the time points of the initial lockdown and the eight subsequent weeks in North America, Europe and the Middle East using digital metadata of conversations and emails from 3,143,270 employees. They found a 12.9 % increase in meeting frequency per day compared to pre-pandemic levels. They also found an increase in average meeting attendance of +13.5 % (+2.1 % attendees per meeting), while average meeting duration decreased by -20.1 % (-12.1 minutes per meeting) (DeFilippis et al., 2020). It can be seen that with the onset of the first lockdown, companies hold meetings more frequently and with a higher number of participants but a shorter duration.

### **Informal Communication**

In their survey, Odgers Berndtson (2020) also addressed the topic of informal communication. They found that about 67 % of the managers surveyed considered maintaining informal communication to be a great challenge to working remotely. Although virtual meetings were used in almost all companies to maintain employee communication, virtual events for team processes and virtual socializing events were only initiated by about half of the managers.

Kellner et al. (2020) collected data from 300 Austrian company representatives in April and May 2020. Forty-four percent of the respondents reported conducting virtual initiatives for their employees to maintain informal exchange. Sixty-seven percent of the company representatives stated that the virtual ideas were initiated primarily by the employees. These measures were also actuated by the fact that—according to 40 % of the managers—the employees missed social exchange and the colleagues in the office very much. Virtual events that were introduced included, for example, virtual after-work drinks, lunch rounds via Skype and virtual coffee breaks. The authors considered that it would be difficult to cover informal communication exclusively via virtual settings in the future (Kellner et al., 2020).

Beno, Hvorecký, and Cagánová (2021) distributed an online questionnaire among 1,680 managers from Slovakia, Austria and the Czech Republic during the COVID-19 pandemic. Based on 900 records analyzed, they concluded that 68 % of managers find it difficult to maintain informal communication. Measures to promote team spirit, like virtual events for socialising, were taken in only one-third of the companies surveyed. The authors concluded that “[t]he biggest problem area seems to be how to promote informal communication among staff.” (Beno, Hvorecký, and Cagánová, 2021, p. 94).

Informal communication was considered with a specific industry focus as well. Based on a literature review and with the aim of providing recommendations for team-based care (which has increased due to the pandemic), Mitzel et al. (2021) also emphasize the importance of informal communication. They see the interruption of informal communication as a potential challenge for virtual teams and recommend that time be set aside for this (Mitzel et al., 2021). Subramaniam, Ismail, and Rani (2021) conducted a literature review, too, focused on the construction industry during the pandemic and emphasize that informal communication (online or offline) is important for teams to functioning.

In an international online survey with 1,750 white collar workers from the UK, US, France, Germany, Australia, India and United Arab Emirates, 60 % of the respondents indicated the lack of personal face-to-face communication due to the pandemic being the

main reason for more difficult collaboration and social networking while working from home (Barco, 2020). Due to the difficulty of maintaining teamwork and social exchange, the surveyed employees would like to return to face-to-face work or hybrid meetings: 45 % of them found it easier to collaborate with other colleagues by working with them on-site at the company and another 45 % found it easier to interact and socialize with colleagues while being on-site. According to the authors, informal communication is important for workforce morale, as it can improve the spontaneous exchange of information, team collaboration and enhance the social side of everyday work as well as increase productivity. Respondents preferred a face-to-face meeting in the office to working from home when it came to resolving a conflict with colleagues (49 %), getting to know each other (45 %), and making important decisions (42 %). When sharing large amounts of information or in meetings that require creative thinking, hybrid meetings would be feasible for about 60 % of participants, who indicated that it does not matter if many participants dialed in remotely (Barco, 2020).

#### 4.1.4 Job Satisfaction

In Chapter 3.3 job satisfaction is defined, following the definition of Spector (1997), as the feeling one has about one's job—whether one likes it or not. Since the construct of job satisfaction is to be explicitly considered and surveyed in the following study, it is to be examined now in more depth.

Job satisfaction is of great importance, since work takes up a large part of the day and thus of one's entire life (Kauffeld and Schermuly, 2011). Therefore, it seems desirable that workers feel satisfaction with their occupational activities. In addition, job satisfaction can be understood as a means to achieve other organizational goals. For example, high job satisfaction can help reduce absenteeism or turnover or increase job performance (Kauffeld and Schermuly, 2011). In their definition, Kauffeld and Schermuly (2011) describe job satisfaction as what people think and feel about their job or individual facets of it. Similar to Spector (1997), job satisfaction, according to Kauffeld and Schermuly (2011), describes the extent to which people like (satisfaction) or dislike (dissatisfaction) their job. We can differentiate an overall, global satisfaction and individual facets—because a work situation is multi-layered and complex (Kauffeld and Schermuly, 2011). Facets of work can be, for example, the work task, colleagues, supervisors and working conditions (Felfe and Six, 2006).

There are a number of theories on job satisfaction and two of them, namely the two-factor theory and the Zurich model of job satisfaction, are explained briefly in the following.

Herzberg, Mausner, and Bloch Snyderman (1959) identified two factors when asking about work situations in which study participants were exceptionally satisfied or exceptionally dissatisfied. The first factor (motivators) includes variables that exclusively affect employee satisfaction, while the second factor (hygiene factors) includes those that exclusively affect job dissatisfaction (Kauffeld and Schermuly, 2011). Thus, according to Herzberg, there is no bipolar dimension to job satisfaction—job satisfaction is not the opposite of job dissatisfaction, but job satisfaction and job dissatisfaction are two different factors (Kauffeld and Schermuly, 2011). If motivators are present, this ensures job satisfaction; if they are absent, this leads to a neutral state (non-satisfaction). The opposite is true, according to the model, for hygiene factors. They can prevent job dissatisfaction (non-satisfaction), but when they are given they do not promote job satisfaction (Kauffeld and Schermuly, 2011). Some criticisms of this model concern the equation of satisfaction and motivation, the fact that the categories are still very abstract and an inadmissible generalization of motivators



and hygiene factors (Becker, 2019). Furthermore, it is criticized that the reproducibility of the results seems to be tied to the method of critical events (Kauffeld and Schermuly, 2011).

In the Zurich model, which is based on the ideas of Bruggemann (1976), it is taken into account that both the emergence and the handling of job satisfaction and dissatisfaction are not static, but dynamic (Kauffeld and Schermuly, 2011). The Zurich model of job satisfaction postulates different types of job satisfaction. The starting point of the model is a comparison between one's own needs and expectations (target) and their actual realization in the work situation (actual). If the result is negative, the individual has various strategies to deal with this unpleasant state. Depending on the strategy, this can lead to further types of job satisfaction or dissatisfaction. If the comparison between target and actual is positive, the level of aspiration can be increased (progressive job satisfaction) or maintained (stabilized job satisfaction). An increased level of aspiration leads to new goals, which form the new basis for the next actual-target assessment (Kauffeld and Schermuly, 2011).

There are differing and varying findings on the development of job satisfaction during the pandemic in Germany. According to a representative survey conducted by Stürz, Stumpf, Schlude, et al. (2021) with four survey periods and 1,550 participants, the satisfaction with the working situation while working from home reached in general high levels. In May 2021 86 % of participants were rather satisfied and very satisfied with their current working situation, while 15 % were not satisfied. After a slightly lower value in February (with 79 % of participants being rather satisfied and very satisfied), the values in May have risen again to a similar level of June 2020 (with 85 % of participants being rather satisfied and very satisfied).

Niebuhr et al. (2022) also focused on job satisfaction in pandemic home-based work. They surveyed 519 workers across Germany and the data showed a differentiated picture. While the functionality of technical equipment and a high degree of autonomy had a positive effect on job satisfaction, a high percentage of working from home per week was associated with more stress-related symptoms and negatively influenced job satisfaction.

Furthermore, Bünning, Hipp, and Munnes (2020) collected 6,200 data sets on inter alia job satisfaction using an online survey in March and April, 2020. According to their description, prior to the pandemic, men and women were similarly satisfied with their jobs. However, since the start of the pandemic, job satisfaction has declined slightly more for women (difference of -4 %). These changes suggest that women are slightly more dissatisfied with their jobs than men since the pandemic-related measures. Since job satisfaction declined less for childless employees than for parents, the authors assume that the double burden of work and family is a main reason for lower job satisfaction.

For those working on-site, job satisfaction was examined particularly in the area of health care. For example Schug et al. (2022), who conducted an online survey with 757 nurses, found that 18.9 % reported an intention to quit and 12.3 % reported more than 25 days of sick leave in 12 months. Additionally, based on the data they assumed that both, the intention to quit and sick leave, were buffered by perceived reward. Similarly, C. Bartsch et al. (2021) emphasized that “[a]ny lack of formal rewards should be countered, professional resources should be sustainably secured, and the autonomy of nurses and their interpersonal relationships should be strengthened” (C. Bartsch et al., 2021, p. 5). These recommendations were obtained based on an online study in the second wave of the pandemic, which included 1,027 cases. Key resources (such as autonomy, professional resources, and interpersonal relationships) and demands (such as lack of formal rewards and work overload) were collected (C. Bartsch et al., 2021).

Beyond job satisfaction, but closely related to it, general well-being has been the subject of research activities. According to an investigation by Zacher and Rudolph (2021) with 979 participants, subjective well-being in Germany decreased between March and May 2020. Peters et al. (2020), who examined the impact of the pandemic in May 2020 using a total sample of 113,928 participants, reported an increase in perceived stress in all age groups, both women and men. The COVID-19 pandemic can be considered an eminent stressor and consequently detrimental to mental health (Pfeifer et al., 2021). According to Brakemeier et al. (2020), the main reason is that it is a global pandemic of indeterminate duration, which has both individual effects on several areas of life and systemic effects on different areas of society at the same time. In addition, the pandemic can trigger feelings of loss of control and helplessness, and coping can be impaired by the associated restrictions on many activities (Brakemeier et al., 2020).

## 4.2 A Quantitative Analysis of Two Points in Time During the Pandemic

Based on the theoretical foundations, it becomes recognizable that the impact of the pandemic on everyday work—and thus also job satisfaction—and especially on communication was immense. Many employees were faced with the challenge of using effective communication via digital channels within a very short period of time, while they completely lacked face-to-face conversation—at least during the lockdowns. The key was to use the right and sufficiently rich media in relation to the complexity of the message and to decide whether synchronous or asynchronous communication was required. It also meant that the common stock of signs and symbols necessary for successful communication had to be transferred to the digital realm and that we had to learn to convey body language and language behavior in digital conversation as well. This transfer had to succeed for horizontal, vertical and diagonal communication as well as for communication within the group and interpersonal communication. Since communication also occurs through mere presence and this was no longer the case from one day to the next, a major change was required.

The first study to shed some light on the changes in everyday work, using the example of employees at the university, is a quantitative data collection, looking at specific aspects of communication with different interlocutors, the working environment and (job) satisfaction. Preliminary results and the approach of this study were pre-published in Adam and Bengler (2021). The detailed procedure, a short summary of the published results and the unpublished results are presented below.

### 4.2.1 Research Objective

The focus in the following is on the working conditions and internal communication in the university environment. If we want to understand the impact of the pandemic on work, i.e., record the status quo, we should analyze the transition to digital communication and the impact on work processes as well as on the social fabric and the workers themselves. As the pandemic has led to an increase in working from home, a massive increase in digital communication is the result, and the use of digital communication technologies has become a prerequisite for communication in general. Along with this, the work equipment and working conditions that employees encounter at home then became a key prerequisite for successful work during the pandemic. There was thus a process of change in all dimensions of the HTO concept: in terms of technology with the abrupt switch to digital communication, in terms of humans with the elimination of face-to-face meetings, and in

terms of organization with the change of work location. Each of these changes in itself affects the other dimensions, but because the changes affect all areas, the interactions are complex.

A number of studies describes the positive (e.g., Lindner, 2020; Rief, 2021) and negative (e.g., Karl, Peluchette, and Aghakhani, 2021; Klopprogge, Burmeister, and Eichinger, 2020; Kordsmeyer et al., 2019a) effects of digital communication on employees—in general and during the pandemic. In the context of the pandemic, there are some studies on the changes in the nature of meetings (e.g., DeFilippis et al., 2020; NeXR Technologies SE, 2020) and the use of digital resources (e.g., Berg, 2021; Kunze and Hampel, 2020) as well as on the lack of informal communication (e.g., Kellner et al., 2020; Odgers Berndtson, 2020; Barco, 2020). However, at this point in time, at least to the author's knowledge, there is a lack of research on how communication changed over the course of the pandemic to the various interlocutors, with a particular focus on the use of digital means of communication and how employees dealt with the technologies and the general situation.

On the basis of a case study with employees of the Faculty of Mechanical Engineering, these aspects will be considered in more detail. The goal is to gain insights into specific aspects of communication (access, accuracy and lack of information as well as satisfaction with the communication relationship) with different interlocutors, changes in the use of digital means of communication and working conditions as well as employee (job) satisfaction while working from home during the pandemic. In line with the HTO concept, aspects related to the employees as well as the technical and organizational framework conditions are therefore included and the following research questions were formulated:

1. What were the working conditions for the university staff working from home during the pandemic at the different points in time?<sup>3</sup>
2. Which digital working resources were used during the two data collection periods?<sup>3</sup>
3. How do the employees feel about the digital means of communication and what is their future intention about using them?
4. Are there differences in communication in terms of *access to information*, *lack of information*, *accuracy of the information received*, and *satisfaction with the communication relationship* with superiors, colleagues, and subordinates between the two data collection periods?<sup>3</sup>
5. Are there differences in employee (job) satisfaction between the two data collection periods?

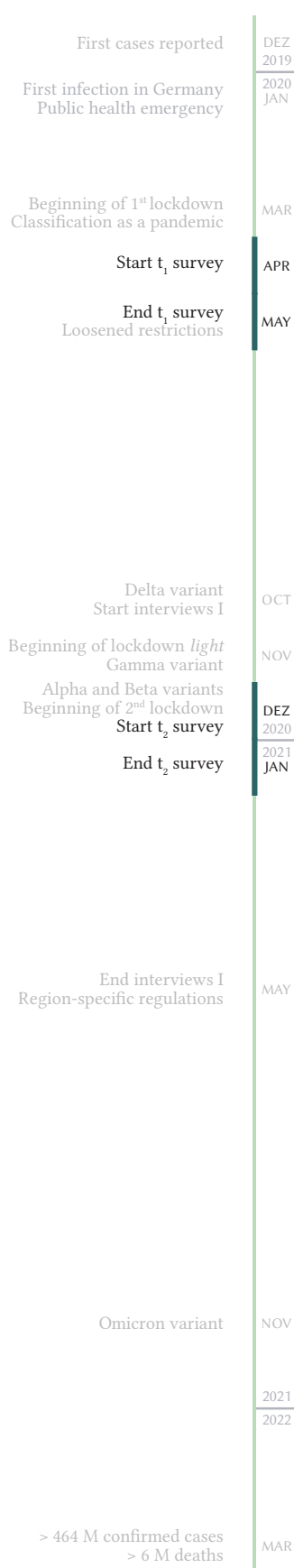
To answer the research questions and gain an overview of changes over the course of the pandemic, quantitative data were collected over two time periods.

#### 4.2.2 Design

The first survey period was conducted during the first lockdown in April and May 2020 (see Figure 4.2). The university staff had to work from home with the exception of those who work in professions critical to the system. Students had no access to the university and teaching took place online. The second survey period took place between December 2020

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<sup>3</sup>These research questions were addressed in Adam and Bengler (2021).



and January 2021 during the second lockdown, as the lockdown *light* did not show sufficient effect. Whenever a task could be completed from home, this option should have been used. Lectures and courses did not occur in the classroom setting during this time, either. The peculiarities of working at a university are already evident here; there are professors, scientific staff, non-scientific staff and students, all of whom work in a hierarchical and sometimes highly dependent relationship.

A fully structured, written survey was chosen as the methodology for a targeted and systematic survey of the employees' subjective experience and behavior. A standardized online questionnaire was used as the survey instrument, which could be completed on a computer or mobile device (Döring and Bortz, 2016). Through the management of the faculty, all scientific and non-scientific employees of the faculty were contacted by email at the beginning of each of the two data collections and asked to participate in the study.

A brief overview of the questionnaire has already been given in Adam and Bengler (2021). In the following, the structure of the questionnaire and the scales and items used will be explained. The questionnaire can be found in Appendix B. The participants had the option of choosing between the German and English version of the questionnaire.

### The Questionnaire

First of all, participants were asked about their current work situation. In the first survey period, participants indicated how long they had already been working from home, since at this time university staff were supposed to be working exclusively from home. In the second survey period, in which the work situation differed among employees, they were asked how many days they work from home at this time. They were then questioned how often they had worked from home before the pandemic. Next, the equipment (such as laptop, external monitor, computer mouse, etc.) as well as the room in which they mainly worked and the housing situation (whether they lived alone or with other adults/children) while working from home were queried. The final question in this section addressed the contractually agreed hours and the hours participants actually worked.

The second part of the questionnaire focused on the digital means of communication. Participants listed the five most important digital means of communication, and sorted them in descending order of frequency of use. For each means of communication, respondents were then asked whether they found it difficult or easy to work with it and whether they disliked or enjoyed working with it (5-point Likert scale). Additionally, participants indicated when they had started to work with it (before the pandemic or during the pandemic) and whether they intended to continue using it in the future.

The third section of the questionnaire dealt with specific aspects of communication that are contained in the KomminO questionnaire (Sperka, 1996; Sperka and Rózsa, 2007). Prerequisites for selecting this questionnaire were that there is a German and English version, the scales are validated,

**Figure 4.2**  
Timeline. Timing of the surveys.

the questionnaire is not too long, the content fits well to the current situation during the pandemic and different interlocutors are considered. During the research, numerous questionnaires were considered (such as the Organizational Communication Questionnaire (Roberts and O'Reilly, 1974), the Communication Satisfaction Questionnaire (Downs and Hazen, 1977) or the ICA Communication Audit (Goldhaber and Rogers, 1979)), but only the KomminO questionnaire met all requirements.

In his dissertation, Sperka (1996) developed the KomminO questionnaire to record communication processes. The questionnaire consisted of 14 scales to assess the communication situation and to evaluate one's own communication behavior, of which four scales were selected, as they contain central aspects of formal and informal communication: (1) access to information, (2) lack of information, (3) accuracy of the information received, and (4) satisfaction with the communication relationship. It is assumed that these sub-aspects of communication are particularly influenced by the shift in communication to the digital, as richness and synchronicity of the technologies used are crucial for successful communication and transmitting information (verbal and non-verbal). Therefore, the accuracy, lack of, and access to information as well as the satisfaction with communication relationship should provide initial clues regarding the extent to which these aspects of communication have successfully shifted to the digital world. Considering different interlocutors, vertical and horizontal communication is captured.

For a more detailed description of the KomminO questionnaire and the scales included, see Sperka (1996). It must be emphasized that there was no external criterion available to validate the questionnaire. Construct validity was empirically tested on the basis of hypotheses and a factor analysis. Although weaknesses in statistical indicators were found, the author considered the questionnaire to be suitable for collecting essential characteristics of internal organizational communication from the respondents' point of view and for enabling a comparative assessment by creating contrasting samples between organizations, departments or hierarchical levels (Sperka, 1996). The limitations mentioned refer to the entire questionnaire. In the present study, however, only individual scales were used whose description and reliability parameters are reported below. An alpha of  $\alpha > .8$  can be considered good, while an  $\alpha > .7$  is acceptable and  $\alpha > .6$  is questionable (J. A. Gliem and R. R. Gliem, 2003).

1. Access to Information. This scale measures the extent to which respondents believe they can obtain information from different groups of people. This includes, on the one hand, whether the respondents believe that the respective persons have relevant information available and, on the other hand, whether they believe that the persons will actually pass on the information when asked. The scale consists of three items, one of which is negatively poled. The easier information can be obtained from a particular source, the more likely that source will be used before others (Sperka, 1996). Cronbach's  $\alpha$  is given as a measure of reliability:  $\alpha_{\text{superior}} = .73$  and  $\alpha_{\text{colleagues}} = .62$  (Sperka, 1996).

2. Lack of Information. Lack of information is understood as the absence of work-relevant information (Sperka, 1996). Respondents indicate whether they receive too little information from certain communication partners to be able to work well and whether they could work better if they received more information. The scale consists of three items with a Cronbach's  $\alpha$  of  $\alpha_{\text{superior}} = .86$  and  $\alpha_{\text{colleagues}} = .76$  (Sperka, 1996).

3. Accuracy of the Information Received. Accurate information can be interpreted unambiguously and establishes a clear reference to action. Inaccurate information arises when the meaning cannot be grasped clearly due to background noise, for example, or when the information itself is ambiguous. If information is ambiguous, there is uncertainty about what is expected. Ambiguity can be deliberately induced, e.g., to enable diversity of opinion or to secure or expand power vis-à-vis control systems (Sperka, 1996). The scale consists of three items, two of which are negatively poled. Cronbach's  $\alpha$  is indicated with  $\alpha_{\text{superior}} = .85$  and  $\alpha_{\text{colleagues}} = .67$  (Sperka, 1996).

4. Satisfaction with the Communication Relationship. A general subjective evaluation of communication is surveyed with this scale, which can be understood as part of the global construct of employee satisfaction (Sperka, 1996). The participants are asked whether they are bothered by the fact that they are rarely informed or how satisfied they are with communication with certain communication partners. They are also asked whether they would like to see better communication with certain people (Sperka, 1996). This scale consists of 4 items, two of which are poled negatively. Cronbach's  $\alpha$  is indicated with  $\alpha_{\text{superior}} = .87$  and  $\alpha_{\text{colleagues}} = .76$  (Sperka, 1996).

All items should be rated on a 5-point Likert scale (2 = most applicable; -2 = not applicable) and each item is asked three times with regard to superiors, colleagues and subordinates (Sperka, 1996).

The fourth part of the questionnaire queries (job) satisfaction. Overall satisfaction was assessed by the faces scale that was originally evolved by Kunin (1955). The version used was adopted from Maddox (1985). The scale has good acceptance and is (still) being used (Neuberger, 1974; Bowling, S. H. Wagner, and Beehr, 2018; Byza et al., 2019; Meyerding and Lehberger, 2018). Job satisfaction was measured with a three-item scale adapted from the Michigan Organizational Assessment Questionnaire (Cammann, 1983, as cited in Bowling and Hammond, 2008). Participants were asked whether they *generally* liked working for their employer, liked their job, and were satisfied with their job, and whether they *currently* liked working for their employer, liked their job, and were satisfied with their job. The questions were answered on a 7-point Likert scale (1 = strongly disagree to 7 = strongly agree).

In an optional open question, participants had the option of indicating what they would like to change about their current work situation, and finally provided demographic data (gender, year of birth, educational level, job title and self-generated code to connect data of the two surveys).

The relationships to be examined in research questions 4 and 5 require inferential statistical analysis. Due to the crisis situation, it is difficult to make a prediction about whether the changes in the scales under consideration are positive or negative, which is why two-sided hypotheses are formulated:

#### Access to Information

H (1.1)<sub>1</sub>: There is a difference in the access to information from superiors between the two data collection periods.

H (1.2)<sub>1</sub>: There is a difference in the access to information from colleagues between the two data collection periods.

H (1.3)<sub>1</sub>: There is a difference in the access to information from subordinates between the two data collection periods.

#### Lack of Information

H (2.1)<sub>1</sub>: There is a difference in the lack of information from superiors between the two data collection periods.

H (2.2)<sub>1</sub>: There is a difference in the lack of information from colleagues between the two data collection periods.

H (2.3)<sub>1</sub>: There is a difference in the lack of information from subordinates between the two data collection periods.

#### Accuracy of the Information Received

H (3.1)<sub>1</sub>: There is a difference in the accuracy of the information received from superiors between the two data collection periods.

H (3.2)<sub>1</sub>: There is a difference in the accuracy of the information received from colleagues between the two data collection periods.

H (3.3)<sub>1</sub>: There is a difference in the accuracy of the information received from subordinates between the two data collection periods.

#### Satisfaction with the Communication Relationship

H (4.1)<sub>1</sub>: There is a difference in the satisfaction with the communication relationship with superiors between the two data collection periods.

H (4.2)<sub>1</sub>: There is a difference in the satisfaction with the communication relationship with colleagues between the two data collection periods.

H (4.3)<sub>1</sub>: There is a difference in the satisfaction with the communication relationship with subordinates between the two data collection periods.

#### (Job) Satisfaction

H (5.1)<sub>1</sub>: There is a difference in the general satisfaction between the two data collection periods.

H (5.2)<sub>1</sub>: There is a difference in the general job satisfaction between the two data collection periods.

H (5.3)<sub>1</sub>: There is a difference in the current job satisfaction between the two data collection periods.

Since no assumption was made as to whether the aspects of communication and satisfaction under consideration improved or deteriorated between the survey periods, two-sided testing was carried out. Differences should be determined by the means of a *t*-test for independent samples. Since the questionnaire was sent to a large number of people, it is assumed that predominantly different people participated in the two data collections. By

**Table 4.1**

Sample and data sets in the survey periods  $t_1$  (April 2020/May 2020) and  $t_2$  (December 2020/January 2021). Participants who participated twice are listed in order to show all data sets that are included in the analysis.

| Participants                                   | $t_1$     | $t_2$   |
|--|-----------|---------|
| Male   | 106       | 76      |
| Female   | 68        | 57      |
| Other  | 0         | 1       |
| N/A  | 4         | 3       |
| Scientific Staff (Thereof Research Associates) | 140 (125) | 97 (93) |
| Non-Scientific Staff                           | 36        | 31      |
| N/A  | 2         | 9       |
| Data Sets in Total                             | 178       | 137     |

the means of the individual self-generated code, participants who took part in both surveys were able to be detected, in order to be able to exclude them from the independent samples test. An error probability of  $\alpha = .05$  was applied according to usual conventions (Bortz, Lienert, and Boehnke, 2008). The a-priori sample planning using G\*Power (Faul et al., 2007) (two tailed test,  $\alpha = .05$ , power of 80 %) yields the following results: The required sample size for group  $t_1$   $n = 64$  as well as for group  $t_2$   $n = 64$ .

### 4.2.3 Sample

As described in the introduction to this chapter, the focus of the study is the university context. The data collection took place in two survey periods during the pandemic at the Faculty of Mechanical Engineering at a German university. Table 4.1 shows the samples of the two survey periods.

In total,  $N = 315$  data sets from 277 participants were collected. The code generated by the respondents showed that 38 people took part in both surveys. For the inferential statistical analysis, therefore, dependent and independent samples were separated.

The mean year of birth was 1990 in both survey periods, with a range of 1958 - 1996 in the first survey period and a range of 1958 - 2002 in the second survey period.

The highest qualification level of the participants was as follows: 23 of the participants had a doctorate, 219 had a university degree (*Hochschulabschluss*), 5 had a technician (*Meister*), 16 had a higher education entrance qualification (*Abitur*), 9 had an intermediate school-leaving certificate (*Mittlere Reife*), and 2 participants had a secondary school diploma (*Hauptschulabschluss*). Three persons did not specify any of these categories.

The survey required specific job titles. The participants stated their occupation in different formulations, which makes it difficult to categorize them unambiguously. Since some statements were very generic, those that can be clearly assigned are reported here. Of the scientific staff, the largest percentage were research associates ( $n = 218$ ). Two professors participated in the surveys, and 15 participants indicated that they held a postdoc or equivalent position. Non-scientific staff included shop floor personnel (mechanics/electronic technicians), the clerical staff, the study program administration, the management and the administration.

Before the pandemic about 60 % ( $n = 167$ ) of the participants had never worked from home, 22 % ( $n = 61$ ) had worked from home maximum of once a month and 12 % ( $n = 34$ )



**Table 4.2**

Description of the participants' housing situation in the two survey periods ( $n_{t1} = 178$  and  $n_{t2} = 137$ ). Multiple entries were possible.

| Housing situation                               | $t_1$ | $t_2$ |
|---|-------|-------|
| I live alone                                    | 32    | 21    |
| I live with other adults                        | 133   | 105   |
| Children (younger than 13) live in my household | 22    | 21    |

maximum of once a week. Additionally, 5.4 % ( $n = 15$ ) of the participants had worked from home several times a week.

Participants were asked to only participate in the survey if they were working (partly) from home at the time of the survey. In the first survey period, 30 participants indicated that they had already worked from home for more than 5 weeks, about 50 % of the participants ( $n = 90$ ) had worked from home for 4 to 5 weeks and 45 participants for 3 to 4 weeks. Thirteen participants had worked from home for 3 weeks or less. In the second survey period, where working from home was not mandatory but strongly recommended, 10 participants worked from home 5 days a week and 22 participants 4 days a week. Most of the participants worked from home for 3 days ( $n = 38$ ) or 2 days ( $n = 30$ ) and 13 participants indicated that they worked from home once a week. Twenty-four participants specified different work routines, such as working 1-2 days or 2-3 days a week from home.

The participants' housing situation while working from home is displayed in Table 4.2. Most of the participants lived together with other adults and in both survey periods, a relatively small number lived alone or together with children 12 years old or younger.

In the first survey period, the majority of the participants ( $n = 94$ ) indicated that they had worked from home the hours stipulated in their contract. Fifty-three participants reported working more (average +9.6 hours) and 25 participants reported working less (average -8.3 hours) than contractually agreed upon. The rest of the participants made inaccurate statements. In the second survey period, 13 participants stated that they had worked from home as many hours as agreed in the contract and 18 participants reported working more (average +10.2 hours). 92 of the participants indicated that they had worked from home for less than the contractually agreed time—but, since the participants were also able to work on-site in the office and these hours were mostly not specified, the figures given in this aspect are not meaningful. The rest of the participants made inaccurate statements, too.

#### 4.2.4 Procedure

Complete data sets were included in the analysis only. Excel and JASP were used to process and analyze the collected data: Negatively polarized items were inverted and the variables of the respective scales were merged for the inferential statistical analyses. Mean values were calculated for the communication scales and summed values for the job satisfaction scales. To answer research questions 1, 2 and 3, the frequencies were analyzed. In order to answer the research questions 4 and 5, mean value comparisons were calculated in order to test the previously formulated hypotheses.

The data of the independent samples tested were not normally distributed according to Shapiro-Wilk test in all dependent variables. Nevertheless, since the  $t$ -test is relatively

robust against an infringement of the assumption of normal distribution (Kubinger, Rasch, and Moder, 2009; Rasch and Guiard, 2004) and the data set is relatively large, several independent samples *t*-tests were conducted, as recommended by Lumley et al. (2002).

Regarding the independent samples, Levene's test showed that the variances were not equal for access to information with the superior as well as colleagues, lack of information with subordinates, communication relationship with subordinates, and job satisfaction, both general and current. Due to the indicated violation of the assumption of homoscedasticity a Welch's *t*-test was chosen as recommended by Kubinger, Rasch, and Moder (2009) for a sample larger than 30. If there are unequal sample sizes and unequal variances, this is also recommended by Ruxton (2006) and Derrick, Toher, and White (2016). The results of the test requirements are shown in Tables 2, 3, 5, and 6 in Appendix B.

For the 38 individuals who participated in both surveys and were therefore excluded from the inferential statistical analyses for independent samples, test procedures for paired samples were applied. A post hoc power analysis using G\*Power (Faul et al., 2007) for the paired samples *t*-test (two tails effect size  $d_z = 0.5$ , error probability of  $\alpha = .05$ , and sample size  $n = 38$ ) showed a power of 85 %. Additionally, a separate analysis of normal distribution was conducted using the Shapiro-Wilk test. Despite violation of the assumption of normal distribution in several dependent variables (see Tables 1 and 4 in Appendix B), student *t*-tests were used due to the robustness when used with large sample sizes. Since two tests (paired and independent samples) were calculated for each hypothesis, correction of significance level was considered. However, for  $n = 2$  significance tests, Bonferroni-Holm does not require adjustment, which is why significance levels were kept constant at 5 %. The effect sizes were calculated by Cohen's *d*.

Participants had the opportunity to provide additional comments at the end of the survey and were asked an optional question regarding what they would like to change in their current work situation. This information was coded inductively and will be reported grouped according to the categories.

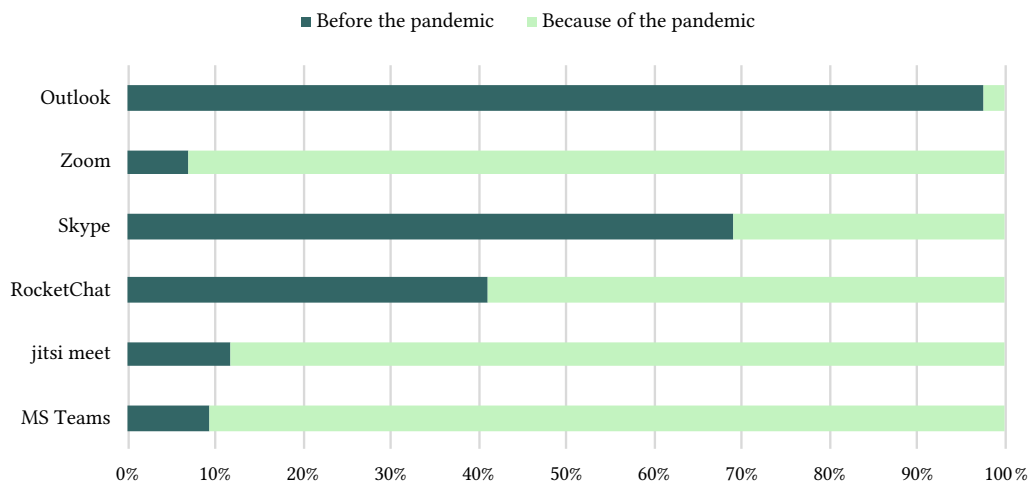
#### 4.2.5 Results

In the next section, the descriptive data are presented first, followed by the results of the inferential statistical analyses.

#### Univariate Analysis

A short summary of the results published in Adam and Bengler (2021) will be provided in the following and based on this, the results of the further analyses will be presented.

The working conditions for the employees while working from home were the subject of Adam and Bengler (2021). In the first survey period, three quarters and in the second survey period, two thirds of the participants did not work in rooms dedicated to working from home, but rather worked in living rooms or bedrooms. In the first survey period, slightly more participants had ergonomic working equipment such as an external monitor or keyboard, a computer mouse, and an office chair at their disposal (Adam and Bengler, 2021). The use of digital means of communication also changed between the survey periods. "When looking at the relative distribution of digital communication for work, email programs such as Outlook were used by almost all the participants and there was practically no difference here between the data collection periods. Zoom was the second most commonly used program, followed by Skype; one difference between the data collection periods became



**Figure 4.3**

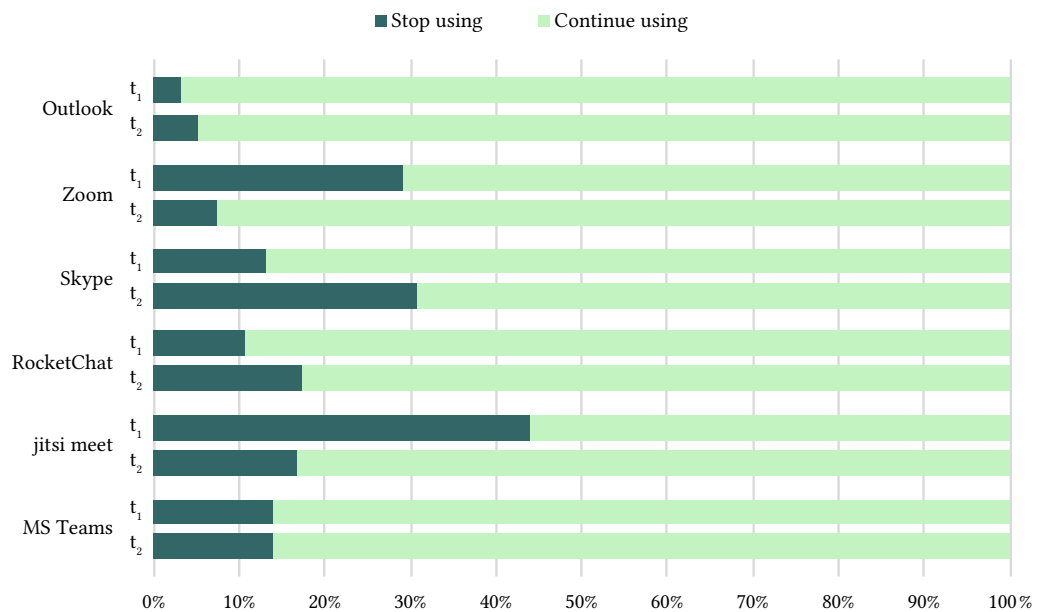
Percentage of participants indicating whether they had already used the respective means of communication before the pandemic or had started using them because of the pandemic ( $t_1$ ;  $n = 178$ ).

clear in this regard. While the use of Zoom increased, the use of Skype decreased. MS Teams in particular was mentioned far more often in the second data collection period.” (Adam and Bengler, 2021, p. 499).

A closer look at the most commonly used technologies identified in Adam and Bengler (2021) as: Outlook, Zoom, Skype, RocketChat, jitsi meet, and MS Teams shows that many participants have started to use several technologies because of the pandemic. In both survey periods, many employees stated that they began using Zoom, MS Teams and jitsi meet because of the pandemic. RocketChat was already used by about half of the participants before the pandemic, as was Skype, which was used by about a third of the participants. Outlook is the only communication medium that had already been used by almost all participants before the pandemic in the list of technologies most frequently used during the survey periods. The data for the first survey period can be seen in Figure 4.3. The data for the second survey period can be viewed in Figure 2 in Appendix B for the sake of completeness, but since there were hardly any differences between the survey periods, the data are not presented here.

Most of the participants indicated that they planned to use the respective means of communication after the pandemic. The only exceptions were jitsi meet in the first survey period and Skype in the second survey period. However, both means of communication were already being used considerably less in the second survey period (Adam and Bengler, 2021). Between the two survey periods, a difference in the intention to use Zoom can be observed. While in the first survey period, 30 % of the participants no longer wanted to use this technology after the pandemic, in the second survey period, this figure was just under 10 %, while at the same time the frequency of use had increased considerably in the second survey period. The future intention to use the communication media can be seen in Figure 4.4.

Almost all participants found it (very) easy to use the technologies in both survey periods. There were individual difficulties in the use of Zoom, Skype and MS Teams in both survey periods, and in the use of jitsi meet in the first data collection period. While the rating of Skype, which was used by fewer people in the second survey period, deteriorated slightly



**Figure 4.4**

Percentage of participants indicating whether they would like to continue using the respective means of communication after the pandemic for the different survey periods ( $n_{t1} = 178$ ;  $n_{t2} = 137$ ).

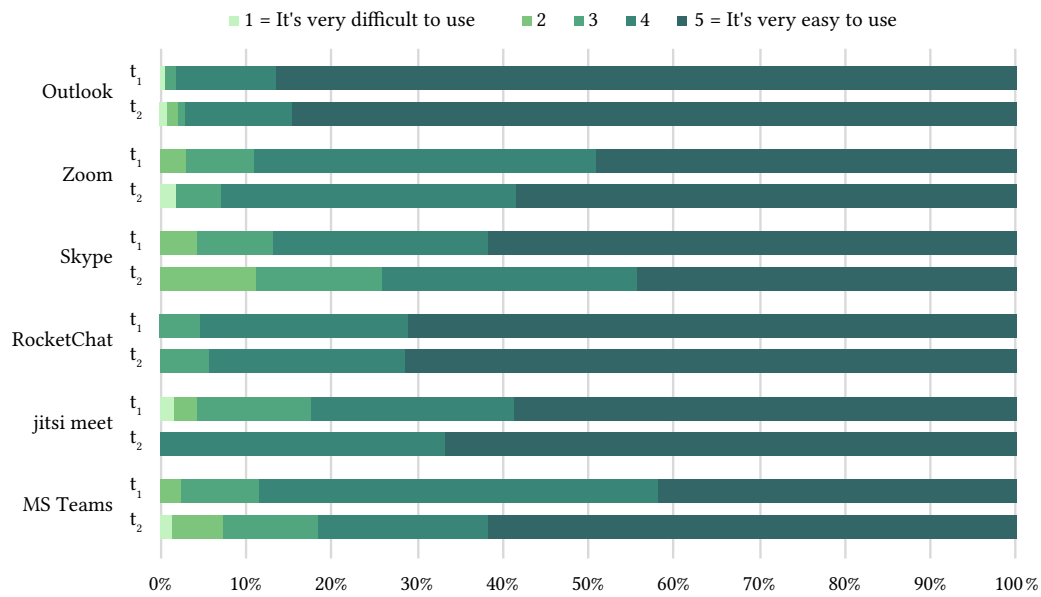
between the data collection periods, the rating of MS Teams, which was used by far more people in the second survey period, improved slightly. Jitsi meet was only used by a very small number of people in the second survey period (Adam and Bengler, 2021), but they did not have any problems using it. The data is displayed in Figure 4.5.

Finally, the results on how participants felt about using each technology are shown in Figure 4.6. Especially during the first data collection period, about 25 % of the participants indicated that they did not like using jitsi meet (at all) while in the second survey period (where less people used it), this number decreased to about 17 %. The rest of the users really enjoyed using it. Skype was used less often in the second survey period, but was rated worse by those who used it. One-third of the users said they did not like using Skype (at all) in the second survey period, while this was indicated by 12 % of the users in the first survey period. The participants liked using Outlook, Zoom, and MS Teams. RocketChat was popular with participants in both survey periods. In the first survey, 44 % used it with great pleasure; in the second survey period, 57 % of users said so.

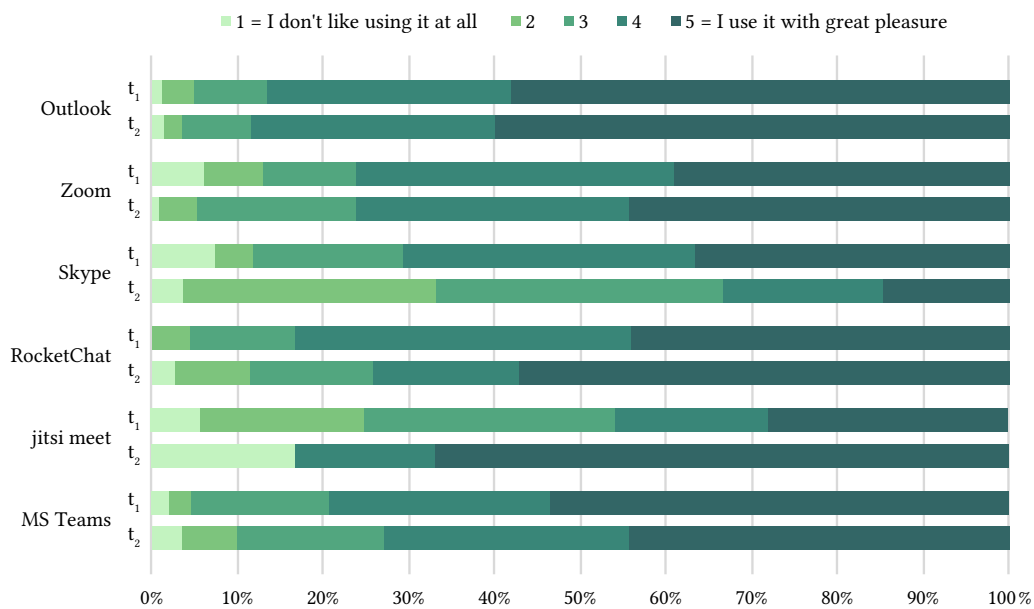
### Inferential Statistical Analysis

The results of the independent samples *t*-test regarding the communication scales, have already been published in Adam and Bengler (2021, p. 501): “The data showed significant effects between the two periods of data collection on three scales referring to superiors: access to information ( $t(190, 486) = 2.945, p = .004, d = 0.392$ ), accuracy of the information received ( $t(194, 016) = 3.115, p = .002, d = 0.413$ ), the satisfaction with the communication relationship ( $t(192, 443) = 2.647, p = .009, d = 0.352$ ) and on one scale referring to colleagues: access to information ( $t(184, 558) = 1.972, p = .050, d = 0.263$ ).”

The descriptive data for the paired sample, which were still outstanding, can be seen in Table 4.3. Analyses using *t*-tests show significant effects between the two periods in three



**Figure 4.5** Percentage of participants indicating how difficult or easy it was for them to deal with the respective means of communication for the different survey periods ( $n_{t1} = 178$ ;  $n_{t2} = 137$ ).



**Figure 4.6** Percentage of participants indicating whether they like or dislike using the respective means of communication for the different survey periods ( $n_{t1} = 178$ ;  $n_{t2} = 137$ ).

**Table 4.3**  
Descriptives of the communication scales of  $n = 38$  paired samples.

|                            |              | $t_1$  |       | $t_2$  |       |
|----------------------------|--------------|--------|-------|--------|-------|
|                            |              | Mean   | SD    | Mean   | SD    |
| Access to Information      | Superior     | 1.553  | 0.645 | 1.298  | 0.762 |
|                            | Colleagues   | 1.746  | 0.487 | 1.711  | 0.460 |
|                            | Subordinates | 1.202  | 0.885 | 1.096  | 0.845 |
| Lack of Information        | Superior     | -1.009 | 0.944 | -0.772 | 1.176 |
|                            | Colleagues   | -1.491 | 0.789 | -1.289 | 0.901 |
|                            | Subordinates | -1.175 | 0.896 | -0.886 | 0.888 |
| Accuracy of Information    | Superior     | 0.912  | 1.130 | 0.395  | 1.294 |
|                            | Colleagues   | 1.447  | 0.716 | 1.360  | 0.850 |
|                            | Subordinates | 1.096  | 0.897 | 0.930  | 0.940 |
| Communication Relationship | Superior     | 1.039  | 0.833 | 0.704  | 1.070 |
|                            | Colleagues   | 1.349  | 0.713 | 1.401  | 0.779 |
|                            | Subordinates | 1.072  | 0.840 | 0.888  | 0.894 |

**Table 4.4**

Paired samples  $t$ -test of  $n = 38$  participants between both points in time for the respective dimensions in the communication scales.

| Dimension ( $t_1$ vs. $t_2$ ) |              | $t$    | df | $p$   | Cohen's $d$ |
|-------------------------------|--------------|--------|----|-------|-------------|
| Access to Information         | Superior     | 2.285  | 37 | .028* | 0.371       |
|                               | Colleagues   | 0.361  | 37 | .720  | 0.059       |
|                               | Subordinates | 0.734  | 37 | .468  | 0.119       |
| Lack of Information           | Superior     | -1.237 | 37 | .224  | -0.201      |
|                               | Colleagues   | -1.215 | 37 | .232  | -0.197      |
|                               | Subordinates | -2.058 | 37 | .047* | -0.334      |
| Accuracy of Information       | Superior     | 3.005  | 37 | .005* | 0.487       |
|                               | Colleagues   | 0.490  | 37 | .627  | 0.080       |
|                               | Subordinates | 1.091  | 37 | .282  | 0.177       |
| Communication Relationship    | Superior     | 2.133  | 37 | .040* | 0.346       |
|                               | Colleagues   | -0.348 | 37 | .730  | -0.056      |
|                               | Subordinates | 1.457  | 37 | .153  | 0.236       |

scales referring to superiors: access to information ( $t(37) = 2.285, p = .028, d = 0.371$ ), accuracy of the information received ( $t(37) = 3.005, p = .005, d = 0.487$ ), and satisfaction with the communication relationship ( $t(37) = 2.133, p = .040, d = 0.346$ ) as well as on the lack of information scale of subordinates ( $t(37) = -2.058, p = .047, d = -0.334$ ). An overview of the overall results can be found in Table 4.4. An examination of the mean values (see Table 4.3) shows a deterioration in all scales with the exception of the communication relationship with colleagues.

The descriptive data for the independent sample regarding (job) satisfaction can be seen in Table 4.5 (the values of the items were summed). For the independent samples, the  $t$ -tests show significant effects for the general satisfaction ( $t(203, 513) = 2.075, p = .039, d = 0.274$ ), as well as for the general ( $t(191, 487) = 2.628, p = .009, d = 0.349$ ) and cur-

**Table 4.5**Descriptives of the (job) satisfaction scales of  $n_{t1} = 140$  and  $n_{t2} = 99$  independent samples.

|                          | $t_1$ |        |       | $t_2$ |        |       |
|--------------------------|-------|--------|-------|-------|--------|-------|
|                          | $n$   | Mean   | SD    | $n$   | Mean   | SD    |
| General Satisfaction     | 140   | 3.786  | 0.888 | 99    | 3.535  | 0.940 |
| General Job Satisfaction | 140   | 18.571 | 2.612 | 99    | 17.586 | 3.017 |
| Current Job Satisfaction | 140   | 17.950 | 3.357 | 99    | 16.515 | 4.107 |

**Table 4.6**Independent samples  $t$ -test of  $n_{t1} = 140$  and  $n_{t2} = 99$  participants between both points in time for the respective dimensions in the (job) satisfaction scales.

|                          | $t$   | df      | $p$   | Cohen's $d$ |
|--------------------------|-------|---------|-------|-------------|
| General Satisfaction     | 2.075 | 203.513 | .039* | 0.274       |
| General Job Satisfaction | 2.628 | 191.487 | .009* | 0.349       |
| Current Job Satisfaction | 2.865 | 183.605 | .005* | 0.383       |

**Table 4.7**Descriptives of the (job) satisfaction scales of  $n = 38$  paired samples.

|                          | $t_1$  |       | $t_2$  |       |
|--------------------------|--------|-------|--------|-------|
|                          | Mean   | SD    | Mean   | SD    |
| General Satisfaction     | 3.974  | 0.854 | 3.816  | 0.896 |
| General Job Satisfaction | 19.026 | 1.716 | 18.184 | 2.846 |
| Current Job Satisfaction | 18.816 | 1.971 | 17.237 | 3.381 |

rent ( $t(183, 605) = 2.865, p = .005, d = 0.383$ ) job satisfaction. An overview of the results can be seen in Table 4.6 and the examination of the mean values (see Table 4.5) shows a deterioration in all scales.

The descriptive data for the paired sample regarding (job) satisfaction is displayed in Table 4.7. The  $t$ -tests for general satisfaction show no significant effects ( $t(37) = 1.639, p = .110, d = 0.266$ ) for the paired sample, but significant effects for the general job satisfaction ( $t(37) = 2.400, p = .022, d = 0.389$ ) and current ( $t(37) = 3.649, p < .001, d = 0.592$ ) job satisfaction. In Table 4.8 an overview of the results is displayed. Again, an examination of the mean values in Table 4.7 shows a deterioration in all scales.

**Table 4.8**Paired samples  $t$ -test of  $n = 38$  participants between both points in time for the respective dimensions in the (job) satisfaction scales.

| Dimension ( $t_1$ vs. $t_2$ ) | $t$   | df | $p$     | Cohen's $d$ |
|-------------------------------|-------|----|---------|-------------|
| General Satisfaction          | 1.639 | 37 | .110    | 0.266       |
| General Job Satisfaction      | 2.400 | 37 | .022*   | 0.389       |
| Current Job Satisfaction      | 3.649 | 37 | < .001* | 0.592       |

**Table 4.9**  
Overview of the alternative hypotheses ( $H_1$ ) accepted and rejected.

| Hypotheses          | Topic                      | Interlocutor | Status   |
|---------------------|----------------------------|--------------|----------|
| H(1.1) <sub>1</sub> | Access to Information      | Superiors    | Accepted |
| H(1.2) <sub>1</sub> |                            | Colleagues   | Rejected |
| H(1.3) <sub>1</sub> |                            | Subordinates | Rejected |
| H(2.1) <sub>1</sub> | Lack of Information        | Superiors    | Rejected |
| H(2.2) <sub>1</sub> |                            | Colleagues   | Rejected |
| H(2.3) <sub>1</sub> |                            | Subordinates | Rejected |
| H(3.1) <sub>1</sub> | Accuracy of Information    | Superiors    | Accepted |
| H(3.2) <sub>1</sub> |                            | Colleagues   | Rejected |
| H(3.3) <sub>1</sub> |                            | Subordinates | Rejected |
| H(4.1) <sub>1</sub> | Communication Relationship | Superiors    | Accepted |
| H(4.2) <sub>1</sub> |                            | Colleagues   | Rejected |
| H(4.3) <sub>1</sub> |                            | Subordinates | Rejected |
| H(5.1) <sub>1</sub> | General Satisfaction       |              | Rejected |
| H(5.2) <sub>1</sub> | General Job Satisfaction   |              | Accepted |
| H(5.3) <sub>1</sub> | Current Job Satisfaction   |              | Accepted |

An overview of the hypotheses and whether the respective  $H_1$  was accepted or rejected can be seen in Table 4.9.  $H_1$  was assumed if both the independent and the paired samples showed significant results.

### Qualitative Data

The final questions on the desired work situation and further comments resulted in six categories: (1) Working From Home [30 statements], (2) (Technical) Equipment [25 statements], (3) Social Aspects [14 statements], (4) Prerequisites [12 statements], (5) Communication [11 statements], and (6) Other Aspects [7 statements].

1. Working From Home. The participants emphasized that very many of their activities could be done very well or better from home. The current situation was described by two people as performance-enhancing, satisfying and goal-oriented. In 17 statements, the desire was expressed to increase the possibility to work from home in the future, ideally 2-3 days per week, which should, however, be flexible in use. According to the participants, there should be official regulations for working from home in the future.

In 7 statements, participants' desire to have the pre-pandemic situation back was evident, and it was emphasized that, at least, occasional attendance was important.

2. (Technical) Equipment. In 10 statements, participants indicated that they needed better technical equipment or infrastructure to be able to work from home. This included, for example, better laptops, webcam, microphone or speakers, or better access to servers. Another four people stated that they could only work on private devices because they did not have (sufficient) hardware available. In addition, two persons lacked scanners and printers when working from home. Nine statements were aimed at the need for an ergonomic workplace. In addition to unsuitable premises, this included a lack of screens,



suitable seating and desks. The need to digitize administrative processes to improve working from home was mentioned by 4 people. There were individual reports of problems with the use of digital technologies and privately incurred costs.

3. Social Aspects. In 7 statements, participants indicated that they lacked real interaction and personal contact with colleagues, students and project partners. Team cohesion and interpersonal relationships suffered during the pandemic. One person noted that people were often alone with their concerns and problems. There was a lack of joint activities, such as excursions, celebrations (first day or birthday) or the odd after-work beer.

4. Prerequisites. In particular, good accessibility of colleagues was highlighted (4 mentions) and participants indicated a need for clear rules and structures. They wanted concrete goals, good communication regarding tasks, quick feedback and the opportunity to be involved in decisions. In addition, two individuals indicated that the superior's trust is very important in a remote setting and two others indicated that they would like to have more appreciation for their work.

5. Communication. The statements on communication mainly referred to the employees' wish that communication between the various departments be improved and that there be uniform and well-coordinated regulations. Employees stated that decisions were often made late and information was passed on hesitantly, sparsely and ambiguously. They also wished for more efficient and better communication with superiors and project partners.

6. Other Aspects. Three people reported an immense amount of extra work. There were complaints about a lot of stress and about the double burden because of childcare. The separation between work and private life was difficult for participants. Although the freedom to work from home was emphasized positively, long working hours and perceived inefficient working were reported at the same time.

#### 4.2.6 Discussion

The results of research questions 1, 2 and 4 have already been briefly discussed in parts in Adam and Bengler (2021). In the following, the results will be embedded in the HTO concept and all research questions will be discussed in the overall context and taking into account the current literature.

#### Working Conditions

The first research question addressed the working conditions for the university staff while working from home, as a prerequisite for being able to work from home at all. It was found that most participants had rather poorly equipped ergonomic workstations, which participants specified and highlighted in the additional comments. These results are in line with the findings of other studies, for example, Sandrock et al. (2021), who reported that about one-third of their participants, employees in the metal and electrical industries, had an external monitor. This is even less than among the university staff. The findings of Cuervo-Vilches, Navas-Martín, and Oteiza (2021) also indicate that the adequacy of the work environment during the pandemic was often insufficient. In connection with the predominant computer work while working from home, musculoskeletal disorders occur

particularly frequently, which can be explained by a high daily sitting duration (Okezue Obinna et al., 2020; Wu et al., 2012). For example, there is increased discomfort in the area of the neck and lower back (Ariens, 2001; Hartvigsen et al., 2000). According to a study by Radulović et al. (2021), one-third of participants working from home during the pandemic said they did not suffer from musculoskeletal problems, while the remaining respondents said they suffered from more severe back, neck or hand pain in the home office compared to working in the office. Similar results are shown by Gerding et al. (2021), who found that about 40 % of their participants working from home reported being affected by physical complaints of moderate or severe intensity (Gerding et al., 2021). Furthermore, the authors of Forsa (2020) reported increased pain and tension among their study participants since the pandemic. In a study among university employees (Davis et al., 2020), an ergonomic assessment of workplaces was carried out using photographs. This showed that 42 % of people were not using a proper office chair and that the chairs used were not the right height in 43 % of cases. Other problems identified included armrests not being used or screens being placed too low or to the side (Davis et al., 2020). This suggests that both in the survey data presented and in other studies, participants did not find technical and organizational conditions that optimally supported their work task. Ergonomic workplace design has been shown to have positive effects on musculoskeletal complaints (Amick et al., 2003; Robertson et al., 2009; Niekerk, Louw, and Hillier, 2012; Seva, Tejero, and Fadrilan-Camacho, 2021) and an improvement of the work situation should therefore be strived for.

During the first lockdown, the participants of the present surveys were even better equipped than during the second lockdown. This may be due to the fact that they took equipment from their offices to their homes and returned it after the first lockdown, which was discussed in Adam and Bengler (2021). They probably did not assume that working from home would be permanent or long-lasting, but rather a brief interlude, and accordingly did not create a good working environment at home on a long-term basis. This fact does not fit with the desire of many employees to work from home more often in the future (2-3 days a week, flexible in use). However, they may also have assumed that, as soon as the pandemic permitted, they would no longer be allowed to work from home or would have to decide whether to use their work equipment in the office or at home. If more work is done from home in the future, care must be taken to ensure that both workplaces are appropriately equipped.

The results of this study also show that for some participants, working from home was associated with a more difficult separation between work and leisure time, considering the optional comments—a phenomenon also described by Bonin et al. (2020), Frodermann, Grunau, Haepf, et al. (2020), and Alipour, Falck, and Schüller (2020). Since the surveys in this thesis show that most people work in living spaces rather than work spaces, this is not unexpected. At the same time, it was also reported that many activities can be done very well or even better from home and that working from home is perceived as beneficial to performance. Giving employees the freedom to decide for themselves when to come to the office and when to work from home can improve this situation by allowing them to individually combine the benefits of both work environments (flexibility when working from home and separation of work and private life when working in the office).

### **Use of Digital Working Resources**

The use of digital working resources, which was objective of the second research question and focused the technical facet of the HTO concept, changed between the two data collection periods, and there was a trend toward rich, versatile and less diverse digital means of communication (Adam and Bengler, 2021). The use of Skype and jitsi meet for video conferencing decreased and the use of Zoom, which was systematically introduced by the university, increased. The fact that many different communication technologies were tried out at the beginning of the pandemic because no unified solution was initially offered meant that employees had to become familiar with many different means of communication. The decision to deploy Zoom at the end of April 2020 (the end of the first lockdown) led to a sharp increase in the number of people using the platform. At this point, this meant that the technology required for many work activities was systematically made available across the university and staff were supported in its use, providing a positive example of the HTO approach. Other studies also show that the use of synchronous communication technologies, particularly videoconferencing systems, increased during the pandemic (Odgers Berndtson, 2020; Berg, 2021). In the results of Kunze and Hampel (2020) for example, the use of videoconferencing systems increased between the first lockdown and mid-May, but the use of chat and email decreased. In addition to the increased use of Zoom at the Faculty, the use of MS Teams, which combines multiple functions such as video conferencing, chat, and file sharing, increased and as a chat tool, RocketChat has prevailed.

The results of this study indicate that many different technologies were used and tried at the beginning of the pandemic, and that as the pandemic progressed, certain technologies emerged that were increasingly used by participants to collaborate and communicate. The need to try different technologies first is consistent with the fact that most participants had little experience with working from home, which was evident in the sample description. However, it should be noted at this point that some participants stated that they did not have sufficient hardware for remote work. In particular, a lack of webcam, microphone and speakers are counterproductive to an increase in communication via digital channels—especially with regard to the transport of nonverbal and prosodic aspects. It is not possible to conclude from the data for which content or with which interlocutor the respective technologies were used and whether, consequently, sufficiently rich media were used for complex content with all communication partners. What can be said at this point, however, is that rich media in particular were increasingly being used which offer the possibility of transporting various signs and symbols. This shared repertoire of signs and symbols is in turn an important basis for successful communication (Röhner and Schütz, 2016).

### **Assessment of Digital Working Resources**

Digital communication is here to stay. This is reflected in the fact that many participants have started to use digital communication technologies due to the pandemic and there is a clear intention to use them in the post-pandemic period. The sub-aspect that digital communication technologies were introduced due to the pandemic was also described in Odgers Berndtson (2020), Berg (2021), and Krcmar and Wintermann (2020). The high intention to use the technologies in the future could be due, among other things, to the fact that the participants found it (very) easy to use the technologies and that they also liked using some of the technologies (very much), which is a fairly clear answer to the third research question. The trend toward fewer different communication technologies indicates

that participants developed a preference for single technologies and made greater use of them. This likely led to individual technologies becoming prevalent in the respective teams. Some team members may therefore have had to use technologies they did not actually like, which could explain the partly continuing poor scores in the popularity of single means of communication during the second lockdown. Communication with external partners could also be an explanation for the isolated and limited use of e.g., Skype, which was not really popular, especially in the second survey period. The fact that only very few additional problems were reported when using the digital technologies underlines the good practicability of the existing solutions. However, if the use of technologies is to be maintained, it is necessary to ensure that the introduction of technology is also considered holistically in the dimensions of human and organization. In general, the use of technology to support interpersonal communication was viewed positively.

### **Communication with Superiors, Colleagues, and Subordinates**

The fourth research question focused on individual aspects of communication and thus on the human dimension of the HTO concept. The tendencies already shown in Adam and Bengler (2021), namely that some of the communication aspects under consideration deteriorated significantly between the two survey periods at the university, can be observed among the participants who participated in both surveys. Here, too, the scales with significant effects related primarily to superiors. The mean values of all scales (with one exception for the communication relationship with colleagues in the paired sample) indicate a downward trend, even if this is not significant in all scales. In both samples (paired and independent) the data show that access to information as well as the accuracy of information from superiors deteriorated and that the communication relationship with superiors also worsened between the first and the second survey periods. In this context, the question arises as to why the scales relating to superiors in particular show such clear effects, compared to the other communication partners. Three possible reasons for this phenomenon will be elaborated in the following.

Firstly, an explanation could be found at the interface between human and technology, being that superiors maybe did not use media that was rich enough. One indicator could be that circular letters are a common instrument to institutionalize formal communication (Torjus, 2013) and therefore were used frequently. The lack of immediate feedback due to asynchronous communication or a limited variety of codes may have had negative effects on the communication aspects related to superiors. The fact that—and the reasons why—digital communication can have negative effects on communication has been explained in Chapter 4.1.2. In particular, the lack of non-verbal communication and the resulting impeded perception of emotions and hierarchies as well as the lack of information about the context or the uneven distribution of information due to digital technologies are considered challenges (Kordsmeyer et al., 2019a).

Secondly (also addressing the interface between human and technology), a possible explanation could be that both, formal and informal communication had to be shifted to digital. Before the pandemic, informal communication usually happened unplanned in the peripheral areas of an organization (Nerdinger, 2014). In the context of the pandemic, this option was no longer given and the need to plan informal communication, e.g., by the introduction of virtual after-work drinks, lunch or coffee appointments arose (Kellner et al., 2020). It can be assumed that both the level of communication (e.g., group or interpersonal communication) and the direction of communication (vertical or horizontal) have an impact

on emerging digital communication, and that different new routines and technologies have been established in each case. An explanation for the differences in the results with the respective interlocutors may be that informal communication with colleagues (horizontal informal communication) has partially made the transition to digital, but not that with superiors (vertical informal communication). And since informal communication in general has an affective area (Waldstrøm, 2001; Torjus, 2013) or social function (Held et al., 1999) as well as a productive area (Waldstrøm, 2001; Torjus, 2013) or task-related function (Held et al., 1999) this could be a reason for the deterioration in the communication relationship with superiors as well as in the information accuracy and access.

Lastly, an explanation is indicated by the additional statements made by some participants. The comments that trust from managers is important, that participants wished for more appreciation and feedback from their superiors, and the fact that top-down communication was criticized (e.g., delayed decisions as well as hesitant, scanty and ambiguous information transfer) gave initial indications that the contents communicated particularly from superiors were not ideal. In this case, the problem would be in the human facet of the HTO concept.

However, no reliable conclusions about the reasons for the deterioration can be drawn from this database, and follow-up research is needed to examine in more detail which digital means of communication (media richness) were used with the respective interlocutors and for the respective content, and how formal and informal communication changed over the course of the pandemic.

### **(Job) Satisfaction**

Participants were rather satisfied with their job in general and also in the current situation, which answers the fifth research question (which can be located mainly in the human dimension and at the interface with the organizational dimension). Overall, the satisfaction scores deteriorated somewhat between the two survey periods, with significant effects, but are still at a relatively high level. The general job satisfaction was rated slightly better than the current job satisfaction during the pandemic. When asked how the participants currently felt, respondents were slightly more negative in the second survey period, with only the independent sample showing significant effects. However, given the relatively high standard deviation, it should not be disregarded that some individuals fared very poorly. If we relate the results of this survey to the Zurich model (Bruggemann, 1976) described above, we should bear in mind that job satisfaction must be considered dynamically. Since general job satisfaction was rated higher than current job satisfaction (and due to the fact that the general well-being in the population was lower due to the pandemic (Zacher and Rudolph, 2021; Peters et al., 2020)) and when considering the qualitative results, it can be assumed that the reasons for the deterioration are at least largely attributable to the pandemic. Thus, the deterioration in job satisfaction, is not likely to be attributed by employees (exclusively) to the employer. This suggests that the situation will improve again if the pandemic-related restrictions are reversed and employers invest in additional measures to increase job satisfaction. However, if it does not, an increase in absenteeism, turnover or reduced performance (Kauffeld and Schermuly, 2011) might be the result. The overall quite high level of satisfaction has been found in other studies, too (e.g., Umps, 2020; Bonin et al., 2020; Stürz, Stumpf, Schlude, et al., 2021).

A high amount of digital communication is sometimes accompanied by e.g., a sense of not belonging, less social interaction and perceived isolation (Kordsmeyer et al., 2019a)

and the absence of interpersonal, informal communication goes hand in hand with an increase in stress (Rump and Brandt, 2020a). Since informal communication and well-being are closely related (Kandlousi, Ali, and Abdollahi, 2010), it is also possible that a lack of informal communication contributed to the (albeit small) deterioration of (job) satisfaction. Additionally, the phenomenon of Zoom fatigue should be mentioned here, as many online sessions can be strenuous and thus a reason for the decrease in (job) satisfaction scores.

On the one hand, the additional comments show that some participants described the current opportunities of working from home as positive, satisfying and performance-enhancing and would like to have this opportunity in the future. Similarly, positive effects can be found e.g., in the results of Davis et al. (2020) who also investigated university employees. Respondents who work from home were found to be less stressed because of the elimination of travel time between their workplace and home (Davis et al., 2020).

On the other hand, some participants expressed a desire to return to their pre-pandemic work routines. The lack of social contacts and joint activities was highlighted, and team cohesion apparently suffered. This likely had a negative impact on participants' well-being and job satisfaction. A high workload, which was mentioned in the comments and that was already reflected in the fact that many people worked more hours than contractually agreed upon, is expected to be a further explanation for the deterioration in satisfaction scores, in addition to the double burden of juggling children and family as mentioned by individual participants. With regard to the description of the sample, it should be noted that overall only a few households accommodated children, thus implying that this double burden affected only a few participants in the sample under consideration—but certainly constituted a burden for them and is likely to have a greater impact on overall society.

However, the single statements cannot sufficiently explain the results and in a further study, the reasons for this development shall be investigated—focusing on working conditions and a more differentiated consideration of communication.

### **Limitations**

It cannot be assumed that the study results are transferable to the entire population and causal statements cannot be derived. Nevertheless, in the spirit of the exploratory approach, initial insights can be gained into the effects and changes caused by the pandemic in employees' everyday work and in organizational communication.

First of all, it must be emphasized that communication as a whole was not surveyed, but only single partial aspects, which relate in particular to the transmission and quality of information as well as the communication relationship in general. This resulted in many individual scales being considered, which must be critically emphasized. The same applies to the need for a differentiated consideration of the paired and independent samples that had to be combined for answering the hypotheses. Moreover, as already explained in Chapter 4.2.2, the scales used have weaknesses in the statistical parameters.

Next, the issue of (job) satisfaction during a pandemic is difficult to assess and interpret. Since the overall situation was challenging, frightening and stressful for many people, the results cannot be compared with studies outside a pandemic. Possibly an additional or different measurement would have to be considered here.

Additionally, the data collection took place as a case study at the Faculty of Mechanical Engineering, so no conclusions can be drawn about trends in the population as a whole, nor is it transferable to other universities or faculties. Nevertheless, transferring the findings to other areas of work that have similar characteristics would be potentially useful. Moreover,

the data are two snapshots taken during the lockdowns and therefore conclusions cannot be drawn about developments over the entire period of time.

Other limitations of the study are that, although the questionnaire was sent to the entire faculty (as of 2020, approximately 1000 employees, 39 of whom were professors), the response rate was rather low with 178 participants in the first survey period and even lower in the second survey period with only 137 participants. The low numbers, and especially the decrease in the second survey period, as well as the fact that only 38 people participated in both surveys, can possibly be attributed to the fact that a very large number of surveys on the topic of work were distributed during the pandemic and the motivation to participate in the studies decreased as the pandemic progressed.

#### 4.2.7 Summary

The goal of the first part of the second empirical investigation was to gain deeper insights into certain aspects of the three dimensions of the HTO concept and the interfaces between human, technology, and organization: The communication with various interlocutors, changes in the use of digital communication resources and working conditions, as well as the job satisfaction of employees working from home during the pandemic. For data collection, an online questionnaire was designed and distributed to the staff of the Faculty of Mechanical Engineering. The data collection took place during the lockdowns in April 2020/May 2020 ( $n = 178$ ) and in December 2020/January 2021 ( $n = 137$ ).

This first sub-study shows that the pandemic had a massive impact on the work of employees at the Faculty of Mechanical Engineering. Overall, it was apparent that many participants did not have a suitable working environment at home. Communication shifted to digital channels, and a trend toward richer and less diverse technologies for communication was evident between the two survey periods. It was relatively easy for participants to use the technologies and there was a high willingness to use them in the future. Looking at the communication aspects surveyed, there is a deterioration in the scales, particularly for superiors. Between the two survey periods, access to and accuracy of information from superiors deteriorated significantly, and the assessment of the communication relationship with superiors deteriorated significantly, too. Furthermore, it was found that although the general and current job satisfaction was at a relatively high level, it deteriorated significantly between the two survey periods.

The reasons for the changes between the two survey periods cannot be adequately explained on the basis of the available data, and the data also provide an insight into a rather heterogeneous group. Therefore, further research will be conducted as part of a qualitative study in order to understand the phenomena under consideration and to be able to derive recommendations. Since the sample of the surveys consisted predominantly of research associates, the focus of the follow-up analysis should be shifted to this target group in order to be able to explain the data at hand.

### 4.3 A Qualitative Analysis of the Process of Change

Based on the results of the two surveys, the following qualitative investigation should answer the questions that remained unclear from the quantitative data collection. The study presented below was conducted as part of her Master's Thesis by Els (2021)<sup>4</sup>.

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<sup>4</sup>Master's Thesis, Katharina Els, 2021, Changes in Communication in the Context of University during the COVID-19 Pandemic—A Qualitative Study at the Faculty of Mechanical Engineering.

### 4.3.1 Research Objective

The surveys have provided a good overview of the digital working resources used during the lockdowns, the changes in specific aspects of communication with different communication partners and the changes in (job) satisfaction. However, the results leave some questions unanswered. The survey periods were momentary recordings and do not allow conclusions to be drawn about the process of change. The quantitative data provide a broad insight, but not a differentiated picture of the overall situation.

Now it is a matter of understanding the working conditions of the individual employees in more detail, how they assess the current situation and how they cope with it—in the course of the pandemic. It will be analyzed which technologies were used with which interlocutors and for which form of communication. Both, formal and informal communication will be examined in more detail to explain the reasons for the deterioration of the communication scales—especially those with superiors.

Formal communication represents the main part of work-related communication, as it concerns the achievement of organizational goals and the processing and exchange of performance-related information (Torjus, 2013), and should therefore be explicitly considered. Since informal communication affects employee satisfaction (Kandlousi, Ali, and Abdollahi, 2010) and since job satisfaction deteriorated significantly in the survey data, we will pay special attention not only to communication with superiors but also with other communication partners. Informal communication is considered to have a strong influence on well-being and work activity, i.e., performance, due to its task-related and social function, and is therefore worth a closer look.

By the means of a qualitative follow-up interview study the process of change will be analyzed. Most of the participants in the two surveys were research associates, therefore this study focuses on research associates and their various communication partners. The research questions are:

1. How did the working conditions of the research associates and the digital working resources used change during the course of the COVID-19 pandemic?
2. How has (formal and informal) communication of research associates changed over the course of the COVID-19 pandemic?

### 4.3.2 Design

To better explain the results of the quantitative study, qualitative interviews should provide a more nuanced understanding of the changes for university staff due to the pandemic.

#### Qualitative Interview

A problem-centered, partially standardized interview technique was adopted. The central feature of problem-centered interviews is that it is based on a current social topic (the *problem*), which is dealt with by the researcher before the interview is conducted, with the aim of generating a subjective viewpoint of the interviewee(s) (Helfferich, 2011; Mayring, 2016; Misoch, 2019). In this case, the COVID-19 pandemic is the current social issue and the author has already dealt with the research subject in previous surveys. The problem-centered interview enables an open interactive conversation (Helfferich, 2011). Although the respondents are guided to some extent by the interviewer and the guideline, they should be able to answer the questions openly. Therefore, similar to the previous interview study,



a semi-structured interview guideline was used. Thus, the interview is characterized by open-ended questions and allows the interviewer to flexibly adapt the guideline to the interview situation by, for example, changing the wording or the order of the questions.

### **The Interview Guideline**

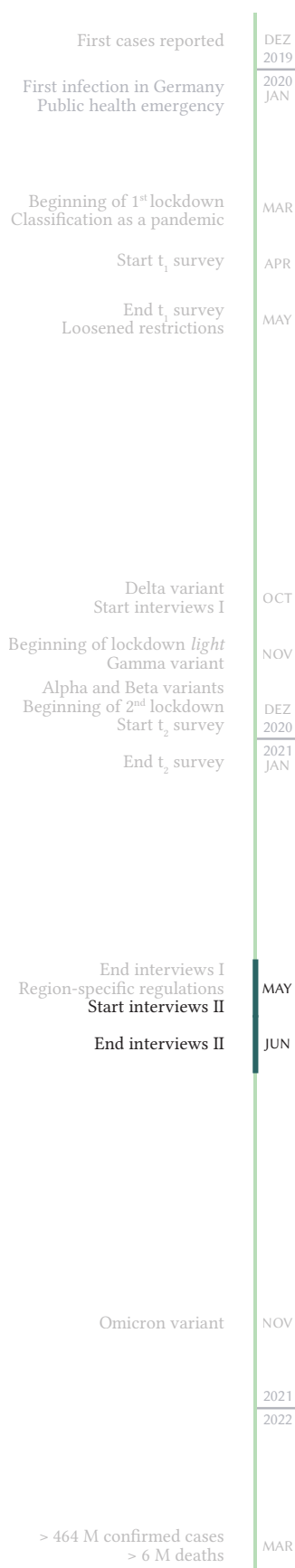
The interviews focus on various aspects of the HTO concept that remained unclear in the questionnaire study. As in the previous study (Chapter 3.3), the interview guideline was developed using the SPSS procedure (Helffferich, 2011). Analogous to the first empirical investigation and following the developed process model (Chapter 3.3), first the status quo ante was addressed and then the process of change was illuminated. Finally, the interviewees were asked to give an outlook on the status quo post. The structure of the final guideline is divided into five parts:

1. Welcome and introduction: The interviewees were asked to describe a typical working day. This included the main activities as well as the approximate percentage distribution of the activities in order to be able to contextualize the statements when analyzing the interviews.
2. Formal communication: The second part focused on the change in formal communication over the course of the pandemic. In a first step, the interviewees were asked to describe how formal communication had happened before the pandemic. The interview partners then described how formal communication with different communication partners changed over the course of each phase of the pandemic (first lockdown, phase of loosened restrictions, lockdown light/second lockdown). Participants were asked to describe how work-related meetings had changed, focusing inter alia on meeting length, number of attendees, frequency, technologies used and benefits and problems. The final topic of this interview section was opportunities and risks of digital communication from the interviewees' point of view.
3. Informal communication: The third section of the interview dealt with the changes in informal communication. Once again, first the interviewees described the situation prior to the pandemic and afterward they described how the informal communication has changed due to the pandemic.
4. Environment while working from home: The penultimate section covered working from home. First, the interviewees were again asked what the situation was like before the pandemic and then how the situation changed during the pandemic across the different phases. This included, e.g., the working conditions, the working equipment, the perceived productivity, working and break times, or the work-life balance.
5. Conclusion and farewell: Finally, the interview participants were asked how they would like their work situation to be after the pandemic and whether there was anything they would like to address that had not yet been touched upon.

The guideline can be found in Appendix B.

#### **4.3.3 Sample**

The study population consisted of scientific personnel (research associates) at the Faculty of Mechanical Engineering of the same university considered in the preceding study.  $N = 16$



research associates aged 26 to 34 ( $M = 29.38$  and  $SD = 2.36$ ) participated in the study, six of whom were female and ten male. Five different chairs or professorships were acquired. These included two professorships (less than 10 research associates) and three chairs (more than 15 research associates) from which a minimum of two and a maximum of four persons participated in the study. Different chairs and several people per chair were included in order to obtain a differentiated insight into the faculty.

The start of employment was a selection criterion for participation in the study. To analyze changes in formal and informal communication due to the pandemic, participants should have worked at the university during this time (or at least a large part of the time during the pandemic). Thirteen participants started working at the university before the pandemic. Two individuals started working at their respective department during the pandemic (starting in the middle and end of 2020) and one individual worked half-time due to parental leave.

#### 4.3.4 Procedure

The interviews were conducted in May and June 2021 (see Figure 4.7). Similar to the first interview study, the interviews were conducted online via the online-conference tool Zoom. Again, the interviewees signed the consent form and declared themselves in agreement with the Zoom local recording and consented to the transcription of the interviews. Before the interview began, participants were presented with the definition of formal and informal communication as described in Chapter 4.1.3. For a better overview and to help participants remember the individual phases of the pandemic, a timeline of the COVID-19 pandemic was shared. The course of the pandemic, with a delineation of the different stages and the most important facts, was briefly explained. Then the interview was conducted following the prepared guideline.

#### Data Processing and Data Analysis

The collected interview data were analyzed using qualitative content analysis according to Mayring (2015), which is characterized by strict methodological control as well as a systematic and step-by-step analysis. Rules and analysis steps are defined in advance in a clear sequence for the text analysis (Mayring, 2015). In the following, the qualitative content analysis will be explained following the steps of the process model by Mayring (2015) and directly applied to the material at hand.

**Determination of the Material.** The material as well as the data collection situation have already been described in the Chapters 4.3.2 and 4.3.3. The interview recordings were fully transcribed according to the transcription rules of Dresing and Pehl (2018). To ensure that no conclusions can be drawn about the individuals on the basis of the transcripts, the interviews were pseudonymized and the respective text passages anonymized.

**Figure 4.7**  
Timeline. Timing of the interviews II.

**Issue of the Analysis.** The interviews were conducted to gain a deeper insight into the background of pandemic-related changes in communication among the university's academic staff. Therefore, the personal assessment, expectations, interests, experiences, intentions and the emotional situation of the respondents are of importance and the subjective opinions and impressions should be captured. The interviewee with his/her personal statements is in the center of the analysis and the emotional and cognitive background thus determine the direction of the text analysis. The research question is derived theoretically from the current state of research and from the study results of the preceding quantitative analysis.

**Process of analysis.** The technique of summarizing content analysis is used to reduce the material so that the essential content is preserved, but abstraction results in a manageable corpus that represents the basic material (Mayring, 2015). The categories were developed inductively and thus derived directly from the material. The units of analysis were determined as follows:

- Coding unit, which defines the smallest part of text that may be assigned to a category (Mayring, 2015): A single word
- Context unit, which defines the largest part of text that may be assigned to a category (Mayring, 2015): A complete interview response to the respective question; may also include several sections which are related to the same topic
- Evaluation unit, which defines which parts of the text are analyzed in which order (Mayring, 2015): Complete material, i.e., 16 interviews

The selection criterion for the category formation is defined as follows: All text passages that depict personal experiences, assessments, opinions, retrospective memories, descriptions, and factual enumerations regarding the change in communication while working from home during the COVID-19 pandemic are to be coded, as well as all statements that refer to wishes for the future. Text passages that are not related to the topics of the study were omitted and not coded. According to the selection criterion, the transcripts were processed line by line and the categories were formed, bringing the formulations to a uniform level of abstraction. Following the recommendation of Mayring (2015), the categories were revised after considering 10 % to 50 % of the material. For the data analysis the software MAXQDA was used. Following the procedure of the summarizing content analysis (Mayring, 2015), the coded text passages were paraphrased, that is, they were put into a short, concise form, brought to a consistent level of language, and repetitions and embellishments were omitted. Subsequently, the paraphrases were generalized and brought to a uniform level of abstraction. In the course of the first reduction (reduction by selection), paraphrases with the same meaning or irrelevant content were deleted. In the context of the second reduction (reduction by bundling), statements were bundled and summarized into one statement. For large amounts of text, the steps (paraphrasing, generalization, first and second reduction) can be combined (Mayring, 2015). After routine was gained in the evaluation, the steps were summarized.

When the interviews had been processed according to this procedure, all statements were compiled across the interviews according to the category system. Thus, the entire material was sorted into the individual categories or sub-categories and all statements of the interviewees that were relevant to the content were listed for each category or sub-category.

Finally, it must be verified that the category system reflects the original data. For this purpose, all paraphrases were compared with the categories for consistency. If the amount of material is still too extensive after one pass of the summary, the entire material has to be revised again. For this purpose, the reductions are generalized again and further reduced (Mayring, 2015). With the data at hand, the intended level of abstraction had been achieved and the scope of the material sufficiently reduced so that the data could be reported. Therefore, the material was not revised again.

#### 4.3.5 Results

The data analysis resulted in five different categories: (1) Environment while working from home, (2) digital communication, (3) formal communication, (4) informal communication, and (5) desired situation for the post-pandemic period. The contents of the categories will be reported in the following.

##### Environment While Working from Home

Before the pandemic, a majority of interviewees did not work from home at all ( $n = 7$ ), one person worked from home only in exceptional cases, 4 people worked from home 1-2 days a month, and 2 people worked from home one day per week. According to the interviewees, the superiors preferred a culture of presence, which was the main reason for the low percentage of remote work.

In the early stages of the pandemic, prior to the initial lockdown, the university maintained operations on-site as long as possible. During the first lockdown, all interviewees worked full-time from home. During the phase of relaxed restrictions during the summer, the data varied between the individual chairs. While one chair worked almost exclusively on-site, another chair worked almost exclusively remotely. In general, there was a resumption of on-site work and a corresponding decrease in working from home (about 1 to 2.5 days per week). During the second lockdown, there was again a lot of remote work and with the end of the lockdown, the attendance at the university increased again. The interviewees reported that they were allowed to decide very autonomously whether they wanted to work on-site or at home.

The working situation at home differed greatly among the respondents. Six people rated the working conditions as positive (suitable rooms and good technical and ergonomic equipment), 7 people rated their working situation at home as unsuitable (they worked at the kitchen table, balcony table, living room table or ironing board). Private investments for external monitors, laptops, keyboards, mice and desks were reported, and in some cases equipment from the chair was borrowed on a transitional basis.

The technical equipment in terms of Internet failures and slow Internet connections was rated as a major source of disruption. Partners, roommates or children often led to distraction and some study participants also named the lack of spatial separation between work and living areas and the lack of an ergonomically designed workstation as distracting. Comments on perceived productivity vary. It was reported that productivity dropped when working exclusively from home and that a combination of on-site and home-based work depending on the respective task would be ideal. According to the interviewees, working hours were handled differently and more flexibly while working from home, but the overall trend was toward longer working hours compared to office work.

Overall, the high degree of self-determination with regard to the flexible arrangement of work location and working hours was highlighted as positive, as was the elimination of travel time and the ability to concentrate fully on the professional activity. On the other hand, the current work situation was perceived as stressful, nerve-racking and exhausting. Social and personal interaction was lacking, and respondents considered that teamwork and cohesion might suffer as a result. They also expressed that workloads had increased, with working hours extending well into the evening or weekend, and that the boundary between personal life and work is becoming increasingly blurred.

### **Digital Communication**

According to the study participants, the influence and impact of digital communication on the team is stronger than on the work itself. Communication of work content works well, but collaboration with colleagues deteriorated during the pandemic due to the distance.

The majority of respondents experienced digital meetings as efficient. They explained the increase in efficiency with the independence of location, a less frequent digression into the informal, the possibility of carrying out secondary activities and a lower potential for distraction. However, they also point out that efficiency depends on the participants, the topic and the number of participants. For example, online meetings with professors and colleagues are described as more efficient than meetings with external project partners. In addition, digital meetings are described as well suited for presenting data and results, but not for creative processes, brainstorming and developing a study design. Digital meetings with a low number of participants are described as more efficient than those with a high number of participants.

Study participants report a sharp increase in the frequency of digital meetings with the onset of the first lockdown. Meetings in the digital space are described as shorter because there is less small talk, and according to the interviewees, the number of participants has not changed compared to a time before the pandemic.

The research associates agree that team cohesion and interpersonal relationships have suffered. There have been far fewer private exchanges, and the barrier to spontaneously calling colleagues is described to be much greater than before the COVID-19 pandemic. In particular, personal feelings and moods are only communicated to a limited extent. This leads, in the interviewees' view, to a loss of mutual understanding and empathy. One interviewee has the impression that some colleagues have become more selfish and have developed into lone warriors. For newcomers in particular, integration into the team has been very difficult.

An overview of the chances and risks of digital communication and digital meetings that were identified through the analysis of the interviews can be seen in Table 4.10 and Table 4.11.

### **Formal Communication**

The majority of interviewees named face-to-face dialogue as the most common communication channel for formal communication before the COVID-19 pandemic. Face-to-face dialogue had been preferred especially for more complex matters, while telephone and email were used primarily for minor issues. Communication with external project partners had been the only exception. In this case telephone, email and web conferences had been used to the same extent as face-to-face meetings. Digital videoconferencing systems were

**Table 4.10**  
Chances and risks of digital communication.

| Chances of Digital Communication                                    | Risks of Digital Communication  |
|---|---|
| Spatial and temporal <b>flexibility</b>                             | <b>Facial expressions and gestures</b> are difficult to interpret, perception of <b>non-verbal communication</b> is limited                     |
| <b>Time savings</b> due to elimination of commuting time            | High distance, <b>impersonal</b> character of conversation, different atmosphere of conversation  |
| <b>Easy participation</b> in international conferences and meetings | <b>Constant accessibility</b> through synchronization of notifications on various end devices: working time and leisure can hardly be separated |
| Environmental factor: reduction of business trips                   | <b>Unsuitable</b> for workshops, demos, experimental setups and hardware tests  |
|   | Perceived loss of <b>creativity</b> and <b>new impulses</b>   |
|   | <b>Technical problems:</b> video and sound dropouts, poor sound quality   |
|   | <b>Informal exchange</b> is reduced: social structure and team cohesion suffer  |
|   | Getting to know new colleagues is more difficult  |

used for the correspondence over long distances. All interviewees consistently reported that pre-pandemic group meetings had been guided by a clear agenda, a pre-determined list of topics, or the presentation of results, which had provided structure to the conversation. Meetings had always been face-to-face in conference rooms, offices or laboratories. Respondents also indicated that there had been a lot of discussion and feedback in their meetings, that conversations occasionally had veered into the informal, and that short parallel conversations sometimes had occurred with those sitting next to them. Additionally, the research associates had often met before the start of a meeting and had exchanged information afterward. Important decision-making processes that affected the entire team had been mainly announced in person by superiors at weekly team meetings or at staff meetings held every few months. When decisions affected individual research associates, an appointment was made and the matter was discussed face-to-face. Communication by email had been used by superiors only rarely and only to clarify minor issues. Before the

**Table 4.11**  
Chances and risks of digital meetings.

| Chances of Digital Communication   | Risks of Digital Communication   |
|--|--|
| <b>Efficient use of time:</b> elimination of travel time and commuting between meetings                          | <b>Less interaction</b> and less active participation of the participants, stringing together of monologues, only one person can speak at a time: discussion culture suffers |
| Good <b>accessibility</b> of colleagues and superiors  | High degree of <b>anonymity</b> leads to less interaction  |
| Short and prompt <b>communication channels</b>   | <b>Direct feedback</b> is missing, one speaks into the void  |
| <b>Flexibility</b> in terms of location (dial-up in the office or from home, from an external company or abroad) | <b>Distraction</b> sometimes leads to difficulties in concentration (depending on the environment)   |
| Unlimited number of <b>participants</b>  | Reduction of <b>small talk</b>   |
| Lower inhibition threshold to <b>call a meeting</b>  | <b>Looseness</b> in conversations is missing   |
| More frequent and short-term coordination with <b>external partners</b>  | Meetings with a very large number of participants are <b>ineffective</b> : fatigue, impaired attention   |
| Easy <b>screen sharing</b> and <b>information sharing</b>  | <b>Technical problems:</b> video and sound dropouts, poor sound quality  |
| Good <b>suitability</b> for collaborative sketching, project management, sharing documents                       |  |
| <b>Fewer distractions</b> and often more concentrated work atmosphere (depending on the environment)             |  |

start or after the end of a meeting, conversations—even with superiors—sometimes drifted a little into the informal realm. Conversations were generally characterized by discussion and feedback.

In the first lockdown, when participants worked exclusively remotely, there was an immediate transition to digital formats. Various digital means of communication were tried, with some initial technical problems. The interviewees reported a general increase in (digital) communication during the pandemic, and the share of formal communication increased more than the share of informal communication. According to one of the interviewees, one reason for this lopsided increase was that online conversations quickly shifted to work-related formal topics. Online videoconferencing was used consistently throughout all phases of the pandemic. For the interviewees, they were associated with the elimination of spontaneity, small talk and discussion. Respondents reported that meetings were similar to what they had been in the past, except for the fact that digital meetings eliminate commuting times. An agenda still provided the necessary structure to the meetings. Overall, the chairs tried different digital technologies, including Zoom, BigBlue Button, Skype, RocketChat, and MS Teams for formal communication. Zoom was used at all chairs and was used heavily at three chairs (a Zoom license was introduced by the university at the end of April 2020). Three chairs used MS Teams in particular.

During the period of relaxed restrictions between the two lockdowns, there were major differences between the various chairs. While some worked exclusively on-site or exclusively remotely, both forms of work were combined at other chairs. The focus, however, was on digital communication. Video conferencing was an accepted means of communication and the telephone was used only for brief arrangements. In some cases, hybrid meetings were conducted, with some participating on-site and others online. Additionally, there was an increase in formal face-to-face communication with colleagues and superiors due to the increased presence on-site, especially for small meetings. Formal conversations took place in the offices, but still less frequent than before the pandemic. Large meetings took place online throughout.

In the second lockdown, face-to-face meetings began declining again, and more work was being done from home. At some chairs, formal communication again shifted entirely to virtual channels, and business call forwarding to personal cell phones was enabled. The use of digital means of communication became more natural and frictionless, and there were more spontaneous online calls, even for minor issues. Face-to-face meetings in large groups remained prohibited.

Crisis information on the COVID-19 pandemic was communicated via email and in online staff meetings and team meetings by the direct superior. In the online meetings, there was an opportunity to discuss the new regulations and ask questions. Information from higher levels was sent exclusively by circular email. Overall, the research associates were satisfied with the crisis communication (top-down communication) by their direct superiors. The provision of information was described as helpful, timely and prompt. However, the respondents criticized the crisis communication of the higher authorities. According to the interviewees, some of the information was of little help, was announced late, was vaguely formulated, and was insufficient in content. The direct superiors (chair holders) also received information late. One interviewee remarked that the employees were not included in the decisions. Additionally, it was emphasized that the chairs had acted very differently due to the unclear information and that there were inconsistent rules within the faculty at times.



In Table 4.12 and 4.13 the changes in formal communication with different communication partners before and during the pandemic are summarized.

### **Informal Communication**

Prior to the COVID-19 pandemic, there were many unplanned, spontaneous conversations in the coffee kitchen and during coffee breaks, at lunch, or through impromptu visits to colleagues' offices. Before and after meetings, communication sometimes digressed into the informal realm, with colleagues but also with supervisors. The most frequently used communication channel for informal exchange had been face-to-face conversations, followed by phone calls (for brief arrangements and appointments) and emails. In addition, WhatsApp had been used for informal communication, and in some cases, other chat programs (RocketChat, MS Teams and Slack).

During the first lockdown, chance encounters and conversations in the hallway immediately fell away. This was accompanied by a sharp drop in informal communication. While it used to be possible to knock on the nearby office door for a quick informal chat or even a spontaneous meeting, working from home now requires the increased use of digital technology. There were no more group activities and only digital conversations with a very formal character. In some cases, informal communication with colleagues shifted to digital channels, such as WhatsApp or RocketChat. Overall, informal communication declined very sharply and, in some cases, came to a complete standstill. The interviewees referred to the lack of spontaneous conversations as a reason for this trend, citing as an obstacle the fact that most informal exchanges during the pandemic had to be deliberately planned, agreed upon and scheduled. In addition, small talk before meetings began had also decreased.

Between the two lockdowns there was deliberately planned informal communication between colleagues. There was a resumption and considerable improvement in informal communication within the team, especially due to increased presence and due to the fact that the importance of informal communication was recognized by the research associates. They tried to maintain informal communication by talking at lunch, going into the dining room, drinking coffee, and meeting outside. The situation was described similarly to the time before pandemic, although there were no meetings in large groups.

During the lockdown light, informal communication temporarily decreased again. However, during the second lockdown the research associates took countermeasures to proactively maintain informal communication in the team. Different technologies were systematically used to preserve informal communication during the pandemic despite contact restrictions and remote work, such as Zoom, RocketChat, WhatsApp, MS Teams and Slack. In particular, MS Teams and Zoom, were used for digital informal exchanges.

The interviewees reported the development of a routine and more forced, planned informal communication with colleagues. Dedicated channels or rooms via MS Teams, Zoom or Big Blue Button were set up for virtual conversations. Digital coffee breaks, lunches, after-work beers, wine nights and game nights were initiated, too. Regular meetings were scheduled for informal (digital) conversations. Furthermore, there were digital Christmas parties. Despite the positive perception of digital exchange, the shift of informal communication to the digital world was assessed negatively, too, as no normal conversations occur in the digital space, because only one person can speak at a time and you cannot talk to the person(s) you actually want to talk to. Additionally, the spontaneity and looseness of the conversations had been lost.

**Table 4.12**

Formal communication with different communication partners prior to and in the course of the pandemic (1/2).

| Interlocutors | Prior to the Pandemic  | During the Pandemic   |
|---------------|--|---|
| Superior      | Personal <b>face-to-face</b> meetings with appointment or during the office hours  | <b>Mix</b> of digital and face-to-face meetings   |
|               | On-site meetings in the superior's or employee's office, telephone for minor issues only                                       | 1 <sup>st</sup> lockdown: little communication; use of video conferencing, followed by phone calls and email correspondence, no face-to-face meetings         |
|               | Sometimes <b>spontaneous meetings</b> in the corridor, in the coffee kitchen or when intercepting the superior after a lecture | Transition phase: fewer phone calls, continued use of video conferencing and email correspondence, opportunity for face-to-face meetings in superior's office |
|               |  | 2 <sup>nd</sup> lockdown: video conferencing, some superiors were completely on-site, resumption of face-to-face meetings                                     |
|               |  | Appointments were sometimes time pressured, but it was easier to reach superiors and to make appointments   |
| Students      | Always a <b>personal meeting</b> in one's own office, laboratory, conference room, etc.  | Complete shift of meetings to <b>digital channels</b> : video conferencing at all stages  |
|               | Weekly regular meetings to discuss current issues  | Additionally, email, telephone and WhatsApp   |
|               | Emails for short interim questions and telephone availability for emergencies  | Hardly any personal contact   |
|               |  | After the 2 <sup>nd</sup> lockdown: personal contact increases again, as experiments can be carried out on-site again   |

**Table 4.13**

Formal communication with different communication partners prior to and in the course of the pandemic (2/2).

| Interlocutors | Prior to the Pandemic  | During the Pandemic   |
|---------------|--|---|
| Colleagues    | <p>Personal <b>face-to-face</b> conversations, telephone calls and emails</p> <p>Appointments were made by email, by phone or in the hallway</p> <p>Meetings took place primarily in colleagues' offices, there were spontaneous visits and office doors were usually open</p> <p>Group meetings were held in conference rooms</p> | <p>Increase in <b>digital calls and emails</b></p> <p>1<sup>st</sup> lockdown: very many phone calls, emails, and video conferences; digital meetings only</p> <p>Transition phase: continuation of video conferencing, increased use of chat (Slack and RocketChat), attempt to initiate more face-to-face meetings</p> <p>2<sup>nd</sup> lockdown: video conferencing and chats, followed by emails, low percentage of face-to-face meetings</p> <p>Development towards hybrid meetings: partly with colleague on-site, partly online</p> |
| External      | <p><b>Face-to-face</b> meetings on-site or at the chair with prior arrangement, email correspondence, scheduled conference calls</p> <p>Business trips</p> <p><b>Sometimes digital</b> video conferences via Zoom, MS Teams and WebEx (especially with foreign partners)</p>   | <p><b>Communication severely limited</b>, especially during the 1<sup>st</sup> lockdown</p> <p>Project meetings via digital channels e.g., MS Teams, Zoom and WebEx</p> <p>Transition phase: some face-to-face company visits</p> <p>Additional email and phone traffic, accessibility via private cell phone</p> <p>Contact rather impersonal, some without camera activated</p> <p>No more chatting, strong focus on work-related topics</p>  |

In the course of the pandemic, conversations via digital communication channels increasingly included informal matters, and this development was actively encouraged by some interviewees. However, contact with close colleagues has changed as a result of the COVID-19 pandemic. On the one hand, the research associates reported that contact with close colleagues and friendships in the workspace had flattened and broken off. Although communication via chat programs has increased, according to the interviewees, it is challenging to build or maintain friendships via these technologies. Using these technologies to maintain contacts was assessed as more difficult, requires more effort and getting to know new colleagues was described to be particularly difficult. In some cases, however, it was also reported that close contacts have not diminished and that more intensive contact has even developed with some colleagues in the meantime. The interviewees' reports on informal communication during the pandemic refer exclusively to the team and colleagues—and not at all to superiors.

In general, the interviewees were satisfied with the current situation regarding informal communication, as there were numerous opportunities for (digital) exchange, e.g., fixed regular appointments for informal exchange. Nevertheless, on-site meetings in large groups and short door-to-door talks were missed.

### **Desired Situation for the Post-Pandemic Period**

The interviewed research associates hope that the current acceptance and trust regarding working from home by the employers will be maintained after the pandemic. They expressed a desire to work from home one to three days per week. Equipment and infrastructure at the chairs should be improved in the long term with regard to hybrid meetings. Digital meetings should continue to be possible in the future, but personal contact in particular should be promoted by reducing the number of digital meetings.

The majority of respondents would like to be able to work from home flexibly, self-determined and spontaneously, and to retain the freedom to organize their time.

### **4.3.6 Discussion**

The findings of the surveys presented in Chapter 4.2 were to be examined and explained in more detail in the course of the interviews. In the following, the results of the interviews will be discussed in conjunction to the survey results as well as the theoretical foundation and located in the HTO concept. Due to the exploratory nature of the research, the inductive approach and the goal of maintaining proximity to the data, the discussion will be structured on the results and the system of categories that emerged from the data.

### **Situation While Working from Home**

Based on the results of the surveys, which have already been discussed against the backdrop of the literature, we already knew that a remarkable number of participants did not work in rooms dedicated for working and lacked some technical and ergonomic equipment, such as an external monitor, an office chair or a desk lamp. A few participants specified this and stated that they would have needed webcams, microphones or even laptops as well as better access to the servers and a better Internet connection. It was already apparent that the shift to working from home was not being addressed holistically in all dimensions of the HTO concept, and while an organizational change was happening, the technical equipment was lacking. However, it was not possible to determine how the participants

evaluated their respective work situations. The interview results then showed a similar but more differentiated picture and thus answers part of the first research question, how working conditions changed for the research associates over the course of the pandemic.

About half of the research associates stated that their working conditions were positive. The other half described their working environment as unsuitable and expressed dissatisfaction with this situation. They criticized the equipment they had at their disposal and named it as a problem. The participants actually stated, as already assumed, that they only borrowed the equipment temporarily. This explains the somewhat poorer equipment in the second lockdown that has been shown in the survey results. Those who did not have a study available worked in environments that did not have good ergonomic working conditions. It can be seen that the technological framework conditions of the work environments were, on the one hand, very different between the chairs and, on the other hand, very different individually. The fact that the working conditions differed greatly between employees at home within the samples considered was also shown in other studies. In the case of Forsa (2020), for example, around half of the participants stated that their workplace at home is worse equipped than their workplace outside the home—so it was apparently fine for the other half. According to Frodermann, Grunau, Haas, et al. (2021), 67 % had a fixed workplace at home, while this was 77 % in Stürz, Stumpf, Putfarken, et al. (2021). Thus, the rest apparently worked with a temporary or provisional workstation. In Frodermann, Grunau, Haas, et al. (2021) about one-third of the employees reported having no explicit workspace and regularly working at the dinner table.

As already suspected on the basis of the survey data, the interviewees stated that it was difficult for them to separate work and private life and that they sometimes also work late in the evening or on weekends since they increasingly work from home. As already described in Chapter 4.2.3, more respondents indicated that they work more than the contracted hours than those who indicated that they work less than the contracted hours—in both survey periods. The trend towards longer working hours and overtime when working from home, is also reflected in the results of Frodermann, Grunau, Haas, et al. (2021), Grunau, Ruf, et al. (2019), and Messenger (2017). The connection that these conditions can lead to employees finding it difficult to separate work and private life and to switch off from work, which is perceived as stressful, is described by Messenger (2017), for example.

On the one hand, there were negative aspects connected to working from home during the pandemic, such as the lack of social interaction, team cohesion and a very high workload, which is why the work was perceived as stressful and exhausting. In accordance with this, the authors of Forsa (2020) describe that employees often feel stressed, that they miss social interaction with colleagues and that it is more difficult to separate work and private life. However, the high degree of self-determination is positively highlighted, as well as the fact that the interviewees are able to concentrate well due to the free choice of workplace and are relieved by the elimination of commuting times. Following the ideas of the demand-control model (Karasek, 1979), it obviously is the case that it helps participants coping with those high demands if they have higher degrees of self-determination and autonomy. According to the Job Demands-Resources model (Bakker and Demerouti, 2007), as explained earlier, autonomy is, after all and also in times of a crisis, an important resource.

So during the pandemic, the already well-known benefits and challenges associated with working from home became apparent. In addition, however, social isolation, which showed up in the interview results and have already been discussed in Chapter 3, was one of the greatest challenges for employees intensified and conditioned by the pandemic—probably

not only in the context of work, but also in their private lives due to the official restrictions and regulations.

### **Digital Communication**

The second part of the first research question asked how the digital working resources used changed during the course of the pandemic. With this research question we are clearly in the technical dimension of the HTO concept as well as at the human-technology and organization-technology interfaces. First, we will discuss the changes caused by digital communication. The communication media that was used for formal and informal communication will then be discussed in the respective sections.

In the results of the interviews, digital meetings were found to be (sometimes even more) productive and suitable for communicating facts, such as the presentation of data. However, they were considered less suitable for creative processes (which was also mentioned by Kellner et al. (2020)) and the development of something new. In contrast, the results of Kunze and Hampel (2020) show that only one in four people found video conferencing to be the most productive communication technology, which the authors explain by the fact that the respondents perceived video conferencing to be the most stressful means of communication, as its use was described as strenuous and tiring in the long run.

The impact of digital communication on work processes was considered less serious than the impact on the team. According to the interviewees, team cohesion and interpersonal relationships suffered from the fact that there was less private exchange, the inhibition threshold to talk to each other became higher in general, and less was shared about personal feelings and moods. This led to a loss of understanding and empathy. In line with these findings, the lack of space for relationships, emotions and other dimensions of human interaction was described by Klopprogge, Burmeister, and Eichinger (2020) as well.

Chapter 4.1.2 has already outlined benefits (e.g., Rief, 2021; Lindner, 2020) and risks (e.g., Rump and Brandt, 2020a; Streim and Britze, 2021; Kordsmeyer et al., 2019a; Karl, Peluchette, and Aghakhani, 2021) of digital meetings and digital communication that have been shown in other studies. The interviews also reveal benefits related to digital meetings and digital (synchronous and asynchronous) communication, such as the spatial and temporal flexibility, the time savings due to the elimination of travel and commuting, the good accessibility, shorter communication paths, good digital collaboration possibilities and the unlimited number of participants. The risks, however, such as the more difficult interpretation of facial expressions, gestures and non-verbal communication, the challenges regarding informal exchange, the limited opportunities for discussion, the constant accessibility and greater distance, and thus a changed and more impersonal atmosphere for discussion, as well as technical problems, accompany the use of digital means of communication.

### **Formal Communication**

It was assumed that formal communication with the various communication partners had changed considerably as a result of the switch to working from home and that this affected communication with superiors in particular. How formal communication has changed over the course of the pandemic was matter of the second research question.

Interviews revealed that superiors preferred a face-to-face culture prior to the pandemic, and the option to work from home was only offered in individual cases. This phenomenon was prevalent in Germany. According to Stürz, Stumpf, Mendel, et al. (2020), before COVID-

19 only a small proportion (13 %) of the employees in Germany had worked regularly or occasionally from home. A similar picture emerged from Brenke (2016), where only 12 % of the employees surveyed conducted their work from home, meaning that the potential to work from home had not been fully exploited. Brenke (2016), Grunau, Ruf, et al. (2019) and Grunau, Steffes, and Wolter (2020) confirm in their studies that on-site presence was desired by employers and that technology problems were a major obstacle to working from home. Overall, conversations with superiors, colleagues and students apparently took place almost exclusively on-site and face-to-face, and since this was not possible during the pandemic, entirely new routines had to be created.

According to Kunze and Hampel (2020), many companies switched to synchronous digital meetings, and the use of videoconferencing systems increased considerably—and this is also reflected in the interviews. Due to the pandemic (formal) communication shifted to the digital world. At the beginning of the pandemic, it took a while for teams to become familiar with the use of communication technologies. Initially, different means of communication were tried, which explains the tendency that some media such as Skype or jitsi meet were used less during the second lockdown, according to the survey results. Only in the beginning there were some technical problems.

Although between the different phases and the different chairs the regulations for being on-site differed, the focus was on digital communication for formal communication at all stages (in the first and second lockdowns as well as between the lockdowns). In the course of the pandemic the use of communication technologies became more frictionless and natural. Zoom was introduced systematically by the university and thus represents the only official organizational measure. Other than that, it was simply an attempt to shift face-to-face communication one-to-one to digital channels. This also confirmed the findings of Niehues et al. (2022), who emphasize that the pandemic-related challenges apparently led to companies not being able to plan and implement the switch to digital communications in a holistic manner. Due to a lack of (time) resources, the holistic implementation of measures at the organizational and social levels tended to be neglected (Niehues et al., 2022).

The interview results show that there has been an overall increase in communication. The formal share of communication has increased rather than the informal share. The reason given for this phenomenon was the strong focus on work-related and formal topics in online meetings. Respondents reported a lack of spontaneity, small talk and discussion, which is consistent with the comments in the survey in which participants wished more feedback and appreciation.

The results show that face-to-face and direct conversation was sought whenever possible. Although, according to the interviewees, superiors were more accessible through digital channels, the switch to digital communication appears to have had a negative impact on the communication relationship with the management level, as revealed in the survey results. It does not appear to have been the case that direct superiors underutilized rich media, as they made use of both various synchronous and asynchronous communication channels. Especially for the superiors, a culture of presence was very important and their main communication channel with employees was face-to-face communication, e.g., in on-site staff meetings or in one-on-one conversations. The elimination of on-site meetings, the diminished culture of discussion and feedback in online meetings, and the absence of digressions into the informal sphere before and after an on-site meeting thus obviously had a particularly strong impact on communication with superiors.

Additionally, the interviews gave a more differentiated insight into top-down communication of information related to the pandemic. Crisis communication was managed by the direct superior via email and in online staff meetings or team meetings. In the online meetings, there was an opportunity to discuss the new regulations and ask questions. At the higher levels, information was disseminated exclusively by circular mail, which was perceived as insufficient by the interviewees. This could explain why the results in the considered aspects of communication with superiors deteriorated in the survey, as access to and accuracy of information were addressed in particular. The results may therefore be due in particular to higher hierarchical levels rather than direct superiors. The need for early, clear and detailed communication became obvious. This was already discussed in Chapter 3.

Overall, it can be seen that formal communication during the pandemic shifted heavily toward the human-technology interface of the HTO concept. This process was largely involuntary and was hardly accompanied by organizational measures (apart from the systematic introduction of Zoom).

### **Informal Communication**

The pending aspect of the second research question asked how informal communication has changed over the course of the pandemic for the research associates. Other studies have already described that informal communication has decreased during the pandemic (e.g., Barco, 2020; Odgers Berndtson, 2020). However, how informal communication changed over time has not yet been examined in detail. It is assumed that informal communication is one of the reasons for the deterioration of job satisfaction and of communication scales.

Before the pandemic, there were many spontaneous and unplanned encounters in the hallway, in the coffee kitchen or at lunch. On-site activities were organized at the chairs before the pandemic, such as after-work barbecues, restaurant visits, summer and Christmas parties to create a less official framework. Similarly, Kellner et al. (2020) report that informal communication has occurred in face-to-face conversations at the coffee machine, printer, or in the hallway. It is precisely this unplanned character and the conversations in the peripheral areas of the company that represent core aspects of informal communication (Nerdinger, 2014). According to Held et al. (1999) a less official character and the use of everyday language are typical of informal communication. However, before the pandemic informal exchanges, according to the interviewees, also took place in the context of formal face-to-face meetings, especially with colleagues and superiors.

Overall, the proportion of informal communication decreased considerably compared to the formal proportion during the COVID-19 pandemic and informal communication decreased especially during the first and the beginning of the second lockdowns. Similarly, Kunze and Hampel (2020) describe that the absence of physical contact on-site has considerably changed the exchange between employees. However, according to the interview results, the research associates took active countermeasures to maintain informal communication.

In the course of the pandemic informal communication has changed. While it declined sharply at the beginning of the pandemic and at the beginning of the second lockdown, more and more active measures were taken by the research associates to maintain informal communication. Dedicated video conference rooms and chat channels for informal communication were set up in many cases, and regular meetings were scheduled for digital informal conversations. This is in line with the results of e.g., Kellner et al. (2020), who



report actively planned informal communication, such as after-work drinks, joint lunch breaks and coffee breaks in the companies, especially initiated by the employees themselves. It thus becomes apparent that informal communication has turned into a forced and planned event—which actually contradicts the nature of informal communication.

The fact that informal communication is important and has been a challenge during the pandemic—and generally in the digital sphere—is in line with the findings of various other studies (e.g., Beno, Hvorecký, and Cagánová, 2021; Mitzel et al., 2021). Also in line with other studies is the fact that employees—or in some cases managers—introduced virtual events to maintain informal communication among employees (e.g., Odgers Berndtson, 2020; Kellner et al., 2020; Beno, Hvorecký, and Cagánová, 2021). In the university context, e.g., Blanchard (2021) investigated this phenomenon and describes that her employees noticed a lack of informal communication and actively counteracted it on their own initiative.

However, if we now take a closer look at the measures taken to improve informal communication in the sample considered in this study, it becomes apparent that the measures were predominantly at the initiative of the research associates (except the Christmas parties) and especially, they were exclusively related to the promotion of informal communication among themselves (horizontal (digital) informal communication)—and not to promote informal communication with various interlocutors and thus not with superiors. These measures were positively assessed and seem to work (especially when the pandemic has already been going on for a while)—even if informal communication turned into a planned and enforced event. Therefore, in contrast to formal communication, where we can see a shift of horizontal and vertical communication into the digital sphere, only a partial shift of informal communication to the digital world and hence to the human-technology interface of the HTO concept can be observed: among colleagues. A transfer of informal communication with superiors to the digital sphere was, however, not reported. Neither planned nor at the beginning or end of official meetings, which were very much focused on the formal aspects in the digital version. Thus, the level of communication obviously has a major impact here. It can be assumed that this was—at least temporarily—accompanied by a poorer communication relationship with superiors, which was also reflected in the survey. The fact that informal communication was explicitly encouraged among colleagues, especially between the lockdowns and during the second lockdown (which is the second survey period), may indeed explain why the results in the communication scales deteriorated less in relation to colleagues than in relation to superiors (the communication relationship with colleagues even improved slightly in the paired sample, although without a significant effect). However, the data on informal communication do not explain why the job satisfaction of research associates deteriorated between the survey dates. It may be that the active promotion of informal communication in the course of the pandemic cushioned a greater decline in this aspect. The reported loss of spontaneity and looseness of conversations as well as a decline in friendships and contacts with colleagues probably are a reason for the lower satisfaction ratings in the second survey.

In accordance with existing research (e.g., Haave and Vold, 2021; Blanchard, 2021), there is a loss or lack of informal communication during the pandemic, however, this is not generally the case, since active countermeasures have been taken within the teams and among colleagues. These countermeasures at least improved the situation for the research associates and they were generally satisfied with the informal exchange during the pandemic; the actual extent to which these countermeasures can be a sufficient substitute compared to informal communication before the pandemic, and whether this also applies

to other samples and industries, requires further investigation. Additionally, it must be examined whether the countermeasures taken by the research associates or similar ones might also improve the situation across hierarchical levels—and thus also improve communication with superiors. In general, we need to explore what measures can be taken to improve informal digital communication with various interlocutors.

Now, we should by no means demonize digital meetings and digital communication, but we should use them purposefully. In the future, in face-to-face meetings, there should be enough freedom and time for informal exchange and it would not be expedient to translate the (highly frequented and fact-heavy) meetings that took place during the pandemic in the digital world one-to-one into face-to-face meetings on-site. Rather, the advantages of both formats should be exploited in the future. For future flexible and digital work concepts, it is very promising that the active promotion of informal communication in the digital world is positively valued and can succeed to a certain extent. However, that transferring vertical informal communication, especially with superiors, to the digital sphere seems to be difficult should not be underestimated and definitely requires action and further research.

### **Desired Situation for the Post-Pandemic Period**

In line with the results of the comments in the survey and with the results of Frodermann, Grunau, Haas, et al. (2021), Forsa (2020), Stürz, Stumpf, Putfarken, et al. (2021), and Kunze, Hampel, and Zimmermann (2020), the interviewees wish for a more flexible choice of work place in the future. The exact number of days respondents would like to work from home varies slightly, ranging from one or two to three days per week.

What is important, however, is that they want to manage this flexibly. Flexibility in terms of the times they are on-site (e.g., to avoid heavy traffic) and also in terms of the number and choice of days per week is the desired concept for the future. They would like to adjust their working hours and location to the tasks at hand. A rigid set of rules cannot do justice to a working environment with many different tasks and responsibilities.

### **Limitations**

Due to the small sample, the interviews only provide insights and directional perspectives for the university considered and the results cannot be generalized to other industries and universities or departments. Additionally, the data collected only provide insights into the research associates' point of view; however, this target group forms the largest employment group within the Faculty of Mechanical Engineering and the preceding quantitative survey. The perspective of other university staff was not considered in the interviews. Furthermore, the interview questions partly asked for a retrospective view of the study participants on the time before the start of the COVID-19 pandemic, during the first lockdown as well as the relaxation phase. The extent to which the answers deviate from earlier perceptions cannot be verified, as they are past experiences and memories.

A large part of the study focused on informal communication. Although a definition of formal and informal communication was provided, the concept is still somewhat fuzzy and it is difficult to delineate the forms of communication. It can therefore not be ensured that the participants made a clean separation of the two constructs in their statements.

It must be remarked that the phenomenon of *socially desirable response behavior* (Möhring and Schlütz, 2010) could pose a difficulty in this study and possibly distort the results. Lastly, to ensure objectivity, several people should have been involved in

the coding process (Mayring and Fenzl, 2019). The subjective view of the author had an influence on the evaluation and interpretation of the results.

#### 4.3.7 Summary

The aim of the second part of the second empirical investigation is to explain the results of the surveys and to gain a differentiated and detailed understanding of the process of change in order to derive recommendations from the current situation for now and for the future. Thus, the study sought to examine how communication (formal and informal) and the use of technology, as well as the work situation at home, changed over the course of the pandemic.

For this purpose, qualitative interviews were conducted at the Faculty of Mechanical Engineering with 16 research associates from five different chairs and professorships. The results of the qualitative content analysis according to Mayring yielded five different main categories, namely the environment in which interviewees worked from home, digital communication, changes in formal and in informal communication as well as the desired situation for the post-pandemic period and these findings were embedded in the HTO concept.

The heterogeneous field that has been shown in the survey was confirmed in the interviews. Some participants had very good equipment, while others worked from home under very poor (ergonomic) conditions. Both the already well known negative and the positive side effects of working from home came up during the interviews. In the beginning of the first lockdown, various technologies were tested and, over time, single technologies became established within the teams. The (sudden) switch to digital communication was not seen as critical for the work process, but for the team cohesion. This was particularly evident in informal communication, which initially came to an almost complete standstill. In the course of the pandemic, active countermeasures were successfully taken and informal communication among colleagues became a planned and enforced event. After initial difficulties, horizontal (digital) informal communication worked well for the research associates during the pandemic. In contrast, no informal communication with superiors during the pandemic was reported throughout the time period considered. Formal communication was viewed more positively and digital meetings were perceived as (sometimes even more) productive and well suited for communicating facts, such as presenting data.

The fact that the communication relationship as well as the access to and accuracy of information deteriorated, especially in relation to superiors, has possible explanations in the interviews. On the one hand, the prevalent use of low-richness media (e.g., circulars) especially from higher authorities was considered problematic for crisis communication. On the other hand, the need to plan and actively enforce informal communication during the pandemic posed a challenge, particularly with regard to vertical informal communication. Informal communication, with its social and task-related function, is important, and a special focus should therefore be on maintaining it in all communication relationships—including with superiors.

Finally, the data from this study also confirms that, regardless of the pandemic, study participants want to be flexible in deciding where they work in the future—they may want to work on-site or from home, depending on the task at hand.



## CONCLUSION AND RECOMMENDATIONS

The aim of this work is to gain initial insights into the impact of the pandemic on the working world in order to derive recommendations for companies and organizations so that they can cope well with the current or similar situations as well as with a future of work characterized by high degrees of volatility, uncertainty, complexity, and ambiguity. To this end, data was collected at several levels to record the status quo. First, the aim was to obtain a broad overview of many different areas of the world of work, and then to go into increasing detail on individual aspects.

In addition to the different levels, different dimensions were included in the consideration, namely the dimensions of the HTO concept: human, technology and organization. This approach allowed for a systematic view of the process of change, especially based on the developed process model, which can be found in Chapter 3.3. In the scientific monitoring of the process of change caused by the COVID-19 pandemic, the extended process model proved to be particularly useful, as it led to the explicit inclusion of all three areas (human, technology, organization) and time periods (status quo ante, process of change and outlook into the future) in the data collection—and thus facilitated a holistic consideration of the process of change. To fully comply with the process model, though, data would still need to be collected to evaluate the results beyond the crisis situation (even if COVID-19 is to become a constant companion, we will not be in crisis mode all the time), which is not possible at this stage. It was merely possible to gain an insight into the participants' wishes for the future.

Overall, the impact of the pandemic on the world of work was extensive in the short term: There was an immediate switch to working from home and far-reaching measures were introduced on-site. The main characteristic in the companies and organizations examined during the pandemic was the extremely large variety of different and interrelated measures. In the short term, these measures and actions worked very well, and most companies and organizations that were included in data collection, were able to operate almost continuously. However, as the pandemic progressed, the disadvantages and challenges of physical distance and remote-only work solutions became increasingly apparent. This was evident in the companies and organizations interviewed and confirmed by a detailed look at the university environment in particular. In many cases, measures that have been introduced in the companies and organizations considered have not been systematically reviewed and monitored, or only partially. When introducing such drastic measures, however, key figures should be defined to verify the (positive or negative) effects of the measures. In accordance with fundamental ergonomic principles, the results emphasize that a mere focus on economic aspects, such as productivity will not be sufficient. Additionally, key figures should include the well-being or job satisfaction of the employees to allow for a comprehensive evaluation. These two parameters, which also formed the basis for the analysis in the studies conducted, can be considered suitable indicators for monitoring the (implementation of) measures.

Looking more closely at job satisfaction, the second empirical investigation in the university context shows that current and general job satisfaction worsened over the

course of the pandemic and that current job satisfaction was generally rated slightly lower than general job satisfaction. However, considering that overall job satisfaction was rated relatively high, and taking into account the qualitative results, it can be assumed that most of the deterioration in the job satisfaction scales was due to the pandemic. The fact that employees currently attribute many negative effects in their daily work to the pandemic (an external factor) is likely to be the case in other industries as well. Since job satisfaction is a dynamic construct, it is imperative that a strong focus be placed on improving employee job satisfaction once the pandemic-related constraints have been removed. Otherwise, there is a risk that lower job satisfaction will be attributed to the employer in the medium term and that corresponding consequences will be drawn.

An important aspect that is also closely related to job satisfaction is informal communication. First of all, it was found that most of the sub-aspects of communication considered generally deteriorated between the two survey periods, and significantly so for superiors. It was already known that informal communication in particular is a challenge in digital communication and thus it could be assumed that it would also be a challenge during the pandemic. Nevertheless, according to the data, there are differences between different interlocutors. Informal communication among colleagues transferred quite well to digital channels (although this took some time and does not ensure that it is a sufficient substitute) and was maintained during the pandemic, but vertical informal communication was not reported and apparently did not manage this transfer. This finding cannot be generalized based on the available data, which was collected from a limited sample in the university context. Nevertheless, it is an important starting point for future research and can make a valuable contribution to a sophisticated understanding of the challenges of digital communication in the work context. Based on further research, it will then be possible to actively improve digital communication in general and with all interlocutors so that future flexible and digital working environments work even better.

For the data at hand, it was found in the first empirical investigation that classifying the results into the different types of work is more meaningful than classifying them into economic sectors. This classification was initially very suitable for categorizing and presenting the data from the interviews. However, there was agreement in the workshop that these types of work can be found in all sectors and industries and, furthermore, that all of them are of great importance to all industries. The classification into the work types thus enables an extremely high transfer potential of the findings across different industries and sectors. The developed classification should be verified in any case, but when looking at such and similar phenomena and collecting data, the use of this classification should be considered.

In the following, the conclusions and recommendations from the overall results will be presented and they will be assigned to the various types of work for which they are particularly relevant. In any case, they cannot be exclusively allocated to individual areas and should be understood holistically. Some of this content is not new, but reflects established knowledge and theoretical concepts from ergonomics and human factors. Nevertheless, this is important here because many of these aspects were not implemented or were neglected in companies and organizations during the pandemic. The dissertation has shown, however, that this knowledge and the theoretical concepts considered are reflected in the results and are therefore of the utmost importance in the current crisis—and thus presumably also in any other time characterized by high degrees of VUCA—and should therefore be considered in companies and organizations.

## 5.1 Inferences for Location-Dependent Work

Both during the pandemic and in a future VUCA world, there will always be areas where people work on-site. In the context of increasing flexibility, on the one hand, they must be included in the flexible structures and should be given special consideration, especially in measures that affect the on-site premises. On the other hand, a high degree of flexibility should also be granted to these employees (e.g., having a say in shift planning).

Comprehensive hygiene concepts had a strong impact on work processes during the pandemic, especially for on-site staff. They allowed workers to work on the premises of the companies or organizations during the pandemic and they also reduced the risk of contracting diseases in general. When drastic processes of change are imminent or drastic measures, such as those that have been necessary during the pandemic, are introduced (which affect employees as directly as hygiene regulations), communication plays an extremely important role. If possible, complex and far-reaching issues should be discussed in direct and face-to-face (group) meetings. In a direct conversation, the impact of the measures on the respective area can be explained, questions can be answered immediately and concerns can be addressed. Additionally, if the physical and social distance between employees within individual teams becomes large (e.g., due to fixed small teams in order to reduce contacts on-site), cooperation and collaboration can suffer within the department. In this case, it is important to promote department-wide team cohesion—even on-site—through active measures.

### Recommendations:

1. A say should also be ensured for those who always have to or want to be on-site, e.g., in shift planning, and good ties between those who are on-site and those who are not should be ensured at all times.
2. Comprehensive hygiene concepts were and are a prerequisite for on-site work during the pandemic. As they generally can contribute to improve health and safety, extended hygiene concepts should be considered beyond the pandemic.
3. If employees are on-site, it is advisable for complex and important issues to be communicated in face-to-face (group) meetings. There should be sufficient space and time to answer questions and express concerns. In personal dialog with the individual teams, measures and changes can be translated directly into the respective area.
4. The loss of personal contact through spatial separation, e.g., through the introduction of fixed small units, can lead to the splitting of teams. This development, as well as the disruption of cooperative working relationships, which is also a risk for remote scenarios, should be actively counteracted.

## 5.2 Inferences for Partly Location-Dependent Work

In a highly volatile environment, a high degree of flexibility is required from companies or organizations and employees—and was also necessary during the pandemic. There is general consensus that many employees are looking for precisely this flexibility in their current and future work, the freedom to decide when to work from where—from home, on

the fly, or on-site—depending on the task they are currently working on. This would allow us to get the best of both worlds: The advantages of working remotely, such as a better work-life balance or reduced commuting times, and avoid the disadvantages, such as social isolation. The same applies to digital communication. We should use it in situations where it brings benefits, such as presenting facts and results, communicating over long distances, communicating asynchronously, or enabling many people to easily participate in digital meetings with very low barriers to participation.

For creative and collaborative processes, however, on-site meetings should be preferred. In this context, the importance of informal communication, which usually takes place spontaneously and ad-hoc on-site, should not be underestimated—so if informal communication occurs, it should not be squelched. Additionally, in a flexible environment, we need transparency about where to find the person we are looking for and a way how to contact him/her. Of course, flexible concepts have to be truly flexible, and they only are if use of technologies and hybrid sessions are targeted and smooth (otherwise it does not work—or simply is not flexible). Finally, employees, supervisors and managers must be empowered to deal with this (new) flexibility. It takes trust, discipline and good communication to make a completely flexible work concept work. Needless to say, functioning digital processes, data security and well-equipped workplaces at the various work locations are a prerequisite for success.

### **Recommendations:**

1. A flexible working concept should be facilitated, particularly with regard to the place of work. In this way, the workplace can be selected to best suit the task at hand. However, both employees and employers need to be empowered to handle this freedom.
2. With a flexible working concept, employees should be free to choose when they work from where. Since most employees want to work on-site a few days a week anyway, there is no need for strict rules. The fact that remote-working works was once again confirmed during the pandemic. So it is a sign of trust toward the employees to let them make this decision themselves and the legal framework must be created accordingly.
3. Flexible switching between working from home or remotely and working on-site offers great potential not only to reap the benefits, such as the elimination of commuting time, but at the same time to avoid the main problems of pure remote work, such as the reduction in social involvement.
4. In flexible working concepts, a targeted use of digital communication and direct face-to-face conversation should be the goal. Digital synchronous and asynchronous communication can be very productive and brings numerous advantages. At the same time, face-to-face conversation should be deployed purposefully with sufficient opportunities for informal exchange.
5. For a flexible working concept to work, there should be a good overview of who can be found where and there should be quick and easy ways to contact everyone.
6. To actually allow for flexibility, there should always be the possibility to extend on-site meetings with people in another location using communication technology.



For many employees, using these software tools does not pose much of a challenge; it is rather the hardware (camera, microphone, speakers, mobile devices) and Internet connection that present a hurdle. An essential prerequisite for flexible working concepts, however, is for hybrid meetings to run smoothly.

7. As part of a flexible work approach, employees need a flexible, plug-and-play mobile work environment, both for on-site and remote work. This requires not only ergonomic and technical equipment, but also suitable premises and the necessary skills in dealing with it.

### 5.3 Inferences for Location-Independent Work

If you work exclusively from home, problems such as the lack of separation between work and private life or social isolation cannot be eliminated so easily by switching to a workplace on the company premises—and during the pandemic, this was the reality for many employees. There are people who cope very well with this situation and one might consider giving them the opportunity to work fully remotely as part of a flexible approach. However, working exclusively remotely for an extended period of time can create challenges that may not cause problems or negative impacts in the short term. In the short term, almost any activity that requires communication or working with a computer can be done remotely. Some negative effects occur after some time, such as problems resulting from social isolation or physical problems due to poor ergonomic equipment. Nevertheless, employees should be able to decide for themselves how long they want to work from where, provided the content of the work permits this. Since most employees would like to work on-site from time to time, the problems that arise from working exclusively remotely for an extended period of time are unlikely to be of much consequence in the long run, anyway. A very recent example shows that bringing employees back to the office against their will can be counterproductive: Apple's AI chief quit after the company announced that at least three days a week should be spent working from the office (Byers, 2022).

Working exclusively from home or remotely requires an extremely high level of self-organization and responsibility, self-confidence and discipline, so we need to improve personal resources and skills to work completely remotely or from home. It was found that trust and appreciation are particularly important for employees in times of crisis and physical distance, and that working from home has led to longer working hours or stress at home for many employees (e.g., due to the double burden of work and family or the more difficult separation of private life and work). Quick feedback, concrete and clearly defined goals as well as good communication of tasks can therefore help at this point.

The data show a tendency that interpersonal team structure suffers more than the substantive aspects of work during the pandemic as a result of working from home. Therefore, special attention should be paid to continuing informal communication to promote team cohesion and emotional relationships in the workplace. Informal communication has to be actively encouraged and planned during the pandemic, which seems to be especially challenging for vertical communication. Actively planning informal communication, however, can be quite successful (as shown in the second interview study) and should thus also be considered in remote-only scenarios in general. Although there were fewer problems with formal digital communication during the pandemic according to the second empirical investigation, it is important for complex issues, collaboration, and creative processes to use rich media. In general, digital communication media should be used in a targeted

manner, especially with regard to richness, synchronicity and versatility. Attention should be paid to good interface compatibility of the technologies, and a good meeting culture should be promoted within the teams (e.g., by introducing netiquette, such as activating cameras and active participation in discussions). Meetings should not be scheduled too tightly, even if there is no walking or commuting between appointments, as constant online sessions are very tiring (Zoom fatigue) and the additional opportunities offered by digital communication should be exploited. Good ergonomic equipment should be available both for working from home and for any other form of mobile working.

### **Recommendations:**

1. Working from home requires high degrees of self-organization and personal responsibility. Employers and employees should be supported in dealing with these high degrees of self-organization and personal responsibility in a conscious manner.
2. A high level of trust and active communication of appreciation to employees is very important, especially when leading from a distance. There should be good communication of tasks, regular feedback and a concrete and clear definition of goals.
3. In remote-only scenarios, the relationship of trust between employees and supervisors/managers as well as the emotional bond within the workforce and with supervisors/managers are of particular importance. It should be considered that it takes longer to build these relationships via digital technologies.
4. In a purely remote setting, informal communication must be actively planned and pushed. This seems to be a particular challenge between different hierarchical levels, as informal vertical communication may fail to make the leap to the digital world.
5. Rich media should be used when communicating complex or far-reaching contents—this is also of particular importance for top-down communication.
6. Teams should agree on technologies for digital communication that are as rich and versatile as possible. At the same time, not too many different technologies should be used. Teams should adopt a good meeting culture for (digital) meetings and meetings should generally not be scheduled too tightly, even if there is no travel or commuting time in between.
7. The use of digital technologies opens up completely new possibilities. These should be used in a targeted manner and deployed sensibly to improve workflows as well as informal and formal communication.
8. It should be ensured that employees have very good ergonomic equipment at home. For mobile working, equipment should be procured that improves working on the move from an ergonomic point of view.

## **5.4 Inferences for Operational (Crisis) Management**

During the pandemic, many companies and organizations benefited from the ability to flexibly adjust their service portfolio and flexibly deploy employees within or between

departments and this ability can generally be valuable for a very uncertain environment. Additionally, the introduction of a crisis team proved very helpful for many companies and organizations—which should also be the case for any other crisis situation.

Overall, a transparent, comprehensive and barrier-free, synchronous and asynchronous communication of changes and decisions can be seen as a key success factor when dealing with a crisis situation or, more generally, with upcoming far-reaching changes. Additionally, immediate, clear and complete communication of information and decisions has been considered important during the pandemic. This is also likely to be important regardless of COVID-19. In (crisis) management it is important that uniform, clearly coordinated and comprehensible rules and structures apply and that these are introduced in a well-coordinated manner. The employees should be involved in decision-making processes wherever possible and appropriate, and their feedback and requests should be taken into account.

Flexible work environments, which have been omnipresent during the pandemic and are expected to increase in the future, require very good digital (administrative) processes and place high demands on data security and technical equipment. The prerequisite for such a flexible environment is the appropriate technical equipment in hardware and software as already mentioned.

### **Recommendations:**

1. In times that are strongly characterized by uncertainty companies or organizations should organize their service provision and the deployment of employees in different departments as flexibly as possible to maintain performance. However, attention must be paid to the personal well-being of employees.
2. Regardless of the nature of the prevailing crisis, a crisis management team should be established to make quick and targeted decisions. If a crisis management team is generally designated (even if there is no crisis), the response can be even faster.
3. Important and far-reaching information, such as introducing or adapting measures or when incisive processes of change are imminent, should be provided barrier-free, synchronously and supplementary asynchronously. Decisions and changes should be communicated regularly, transparently, directly, and unambiguously, and ideally decisions should also be justified in a comprehensible manner.
4. When introducing drastic measures, the consistency of decisions or measures and the reliability and traceability of their introduction and implementation are of great importance. In addition, uniform, clear and well-coordinated regulations and structures should apply throughout the company/organization. Employees should be involved in such decisions and if active participation is not possible, at least their feedback should be asked for and considered.
5. Any form of flexible concept requires suitable and comprehensive technical equipment as well as well-coordinated and functioning digital (administrative) processes, while data security must be guaranteed.

To conclude, we should now avoid simply reverting to a state ante corona, and above all we should avoid combining the worst of both worlds—for example, forcing everyone to be back on-site while expecting to maintain meeting frequency, which has increased as

a result of digital communication. If informal communication has come up short during the pandemic, we should make time for it, even if this is supposedly at the expense of productivity in the short term. Considering the task-related function or productive area of informal communication, however, this is likely to be a fallacy, anyway.

Instead, we must try to combine the best of both worlds to respond flexibly to the VUCA world by implementing more flexible working concepts. But to do so, we absolutely need digital (administration) processes and data protection, we need to improve the technologies for remote and mobile working in terms of hardware, software, compatibility and stability. And we need to empower employees and the management to cope in a flexible environment. Otherwise, we will return to the past and we will not be able to use the potential of the crisis to create positive momentum for the future. Returning to the introductory thoughts, we are in the midst of a crisis. This crisis has triggered a process of change that companies and organizations are currently undergoing, and at the same time it holds enormous potential for innovation. Companies came under pressure to change, introduced new measures and ways of working, and are thus drawing on the source of the new while trying to regain stability. The current change process is characterized by enormous speed, by high dynamics and by extreme reach. Through the crisis we have learned a lot to bring about the current change for the better.

CHAPTER 6  

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FUTURE DIRECTIONS

The COVID-19 pandemic has been testing companies and organizations on how well they cope in extremely volatile, uncertain, complex and ambiguous times. The lessons we have learned from the last two years can be used to survive in a VUCA world independently of the pandemic and future crises.

What else is there to do at this point? Within the scope of the dissertation, only initial insights into this extremely extensive topic of changes in the world of work due to the COVID-19 pandemic could be gained. The actual verification of the suitability of the results and recommendations for the post-pandemic period can only occur when the situation has actually eased. Even if we have to assume that we will live with COVID-19 in the future, we can also presume that the state of emergency and the crisis mode will dissolve sooner or later. Only then will it become evident which forms of work, measures and impulses we will take with us and whether they are adequate for a time beyond the pandemic.

The scenarios developed in the first empirical investigation do not claim to be exhaustive, but they do provide a broad overview of measures and frameworks for different types of work during the pandemic. The classification into these work types needs to be reviewed in future research for its suitability in mapping the world of work and as a starting point for data collection. In order to assess the contents of the scenarios for their future relevance and applicability, a Delphi study was conducted in which experts from business, politics and research evaluated and discussed individual projections from the scenarios (Adam, Bengler, Berger, et al., 2022). It has been shown that many of the measures introduced short-term as a result of the pandemic can be transferred to a period beyond the crisis and may also help to improve working conditions and increase value creation in the future. Apparently, the pandemic has initiated a long-term process of change in the industries under consideration (Adam, Bengler, Berger, et al., 2022).

However, as the pandemic is still ongoing, we cannot predict the future and should therefore take advantage of the current situation to continue research. Future research should focus on the various types of work identified in the first empirical investigation and should pay particular attention to the recording and understanding of well-being and job satisfaction in a time of crisis. Some of the measures introduced in companies and organizations are likely to have contributed to increased job satisfaction (such as the increase in flexibility), or at least have prevented a greater deterioration in job satisfaction, and this phenomenon should be investigated in a more differentiated way in future research. Additionally, we should take a closer look at the changes by using larger samples and including more industries and we need to address how to enable employees and employers to deal with the new and future challenges. Especially when considering changes in communication, we should consider more industries and additional communication partners in more detail and expand research on informal communication with various interlocutors (horizontal and vertical) in remote areas. A particular focus should be on the development and systematic introduction of hardware and software for digital and remote work, with special emphasis on data protection and data security. Last but not least, companies and organizations should quickly secure, establish and firmly anchor flexible working concepts

and digital (administrative) processes that were introduced pragmatically in the short term due to the pandemic. Finally, they should be encouraged to consider established knowledge from ergonomics and human factors, as well as the various dimensions of the HTO concept, even when introducing (supposedly) short-term measures.

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## APPENDIX A

### A1. Interview Guideline I

*Note:* The guideline was translated, interviews were conducted in German.

#### **General questions**

##### *Company/Organization*

- Industry, products: WZ2008
- Size of the company/organization: Number of employees, sales figures in categories
- Employee representation: Works council/staff council, other forms if applicable

##### *Person*

- Please describe your position in the company/organization.  
*Inquiries:* Demographic data, role in the company, tasks, personnel responsibility

#### **Status quo ante**

##### *Work systems*

- What were or are the central effects of the Corona crisis for your company/organization?  
*Inquiries:* Services, products, location (if several operating sites or larger departments)
- What measures have you taken to respond to the impact of the Corona crisis?

##### *Human*

- Please describe the workforce.  
*Inquiries:* Demographics (age structure, gender), skills, competencies (digital), needs, flexibility

##### *Technology*

- Please describe the key technologies and working resources that were used in the workplace.  
*Inquiries:* Automation, digitalization
- What were the spatial conditions like?  
*Inquiries:* Hall, office, shop floor, generous space available

##### *Organization*

- How were working hours and work location organized?  
*Inquiries:* Fixed vs. flexible working hours, shift schedules, mobile working, home office
- How was the division of labor between employees organized?  
*Inquiries:* Team structures

- What were the communication structures and forms?  
*Inquiries:* Bottom-up communication, top-down communication, internal communication channels (formal/informal), external communication channels, decision-making processes

### **Process of Change**

#### *Analysis of the preconditions externally*

- Which challenges triggered by the pandemic should be addressed by the measure?  
*Inquiries:* Lockdown, social and physical distancing, hygiene concept, problems with supply chains, changes in demand, influences from the private environment, difficulty in interacting with customers

#### *Analysis of internal requirements*

- What aspects did you have to consider when developing measures?  
*Inquiries:* Financial resources, number of employees, occupational health and safety, company agreements, ordinances, making cooperation within the company more difficult due to Corona

#### *Conception and implementation of measures*

- How did you go about designing and implementing the measure?  
*Inquiries:* Persons involved, coordination with environmental factors, alternative approaches, favoring factors, obstacles

#### *Testing and evaluation of the measures*

- How was the measure introduced?  
*Inquiries:* Communication of the change—Evaluation, supporting offers
- How was the measure tested?  
*Inquiries:* Evaluation (systematic, criteria), discontinuation criteria

#### *Iteration of the measure*

- What steps of change did the measure go through and what prompted each adaptation?  
*Inquiries:* Important points in the process, current status of the measure (post-lockdown), decline to normality

#### *Evaluation of the change process*

- What factors helped or hindered the process of introducing the measure?  
*Inquiries:* Competencies of employees, interest of employees in participation, forms of work, organizational structures, characteristics of the company, evaluation

#### *Evaluation of the measure*

- How do you evaluate the measure at the current time?  
*Inquiries:* Economic efficiency, cooperation, job satisfaction, occupational health and safety, influence and possibility to shape, compatibility of work and life, ecological sustainability

**Status quo post:***General*

- How have the measures affected the employees in your company?
- How have the measures affected the technologies and work equipment used?
- How have the measures affected the organization of work in your company?  
*Inquiries:* Working hours, division of labor, communication

*Conclusions/sustainability of the solution*

- Which measures would you like to continue in a post-pandemic period?  
*Inquiries:* Positive effects, expansion to other areas of the company planned
- Where do you still see a need for action?  
*Inquiries:* How would you like to address this? Further measures

*Adaptation of measures*

- To what extent do the changes caused by the pandemic overlap with changes in society as a whole that have influenced your company in recent years?

**A2. Materials of the Workshop**

*Note:* The materials were translated, the workshop was conducted in German.

**Scenario selection**

For the evaluation of the scenarios, all participants were assigned two scenarios. Please always refer to one scenario in the following evaluation. Existing interactions and connections between the scenarios should be addressed in the subsequent group discussion. Please indicate which scenario the following evaluation refers to:

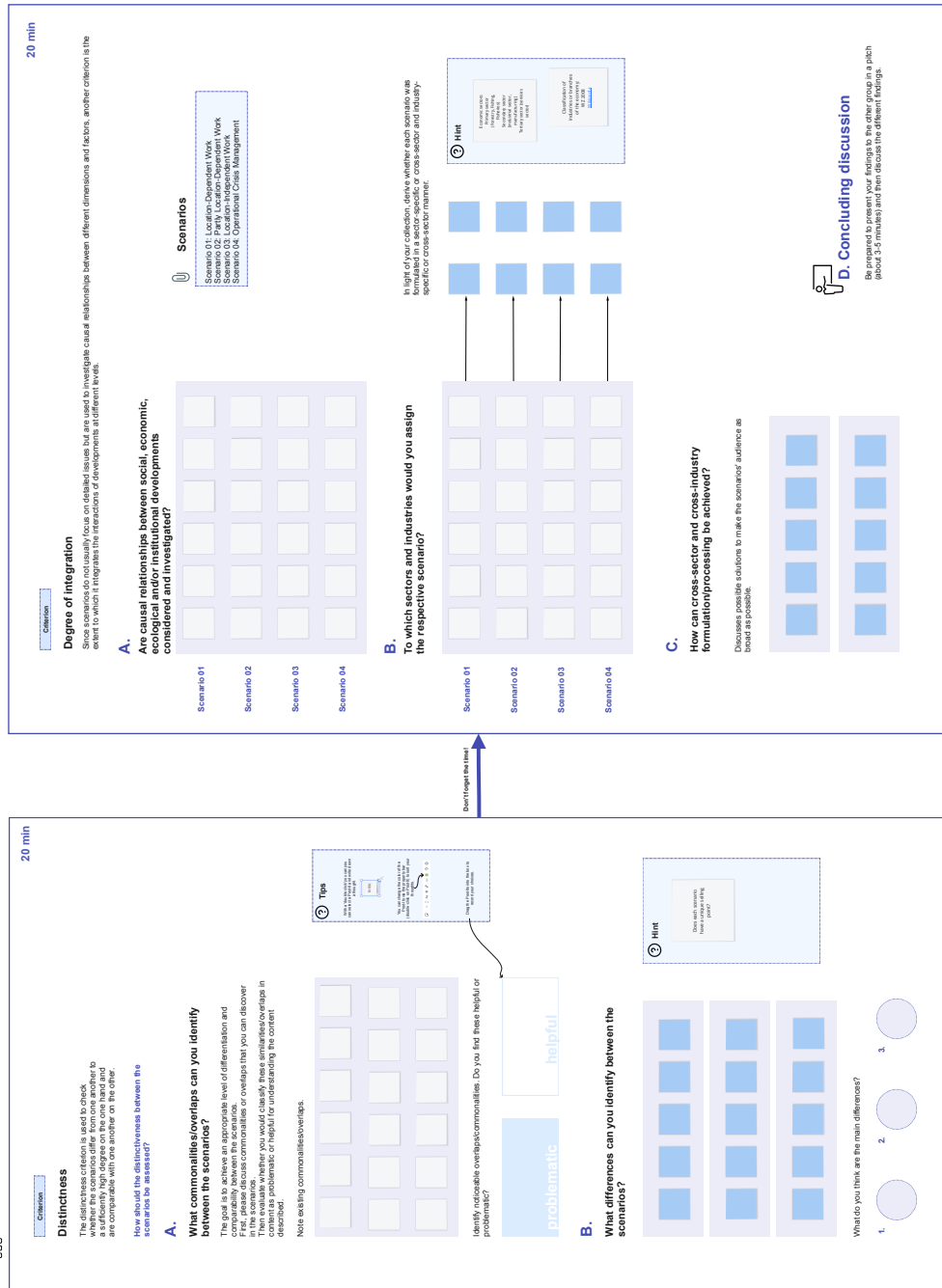
- Location-Dependent Work
- Partly Location-Dependent Work
- Location-Independent Work
- Operational Crisis Management

**Plausibility**

The plausibility criterion checks whether the scenarios are regarded as a conceivable development in the future and not as impossible. The assessment does not include the evaluation of whether the targeted goal is desirable.

Please rate the factors of the quality criterion plausibility mentioned below.

- Feasibility (strongly disagree, disagree, rather disagree, rather agree, agree, strongly agree)  
If necessary, you can explain your choice of feasibility in bullet points here (optional).
- Credibility (strongly disagree, disagree, rather disagree, rather agree, agree, strongly agree)  
If necessary, you can explain your choice of credibility in bullet points here (optional).



**Figure 1** Workshop template for evaluating the criteria of distinctiveness and degree of integration between scenarios.

### Consistency

The criterion of consistency is intended to check whether the scenario is coherent in itself and whether the contents do not logically-plausibly exclude each other. Please rate the factors of the quality criterion consistency mentioned below.

- Consistent structure (strongly disagree, disagree, rather disagree, rather agree, agree, strongly agree)  
If necessary, you can explain your choice for a consistent structure in bullet points here (optional).
- Stringent progression (strongly disagree, disagree, rather disagree, rather agree, agree, strongly agree)  
If necessary, you can explain your choice for a stringent progression in bullet points here (optional).

### **Comprehensibility**

The comprehensibility criterion tests the comprehensibility of the scenario on several dimensions (e.g. complexity and readability). The developed scenario should be formulated in a way that is understandable and comprehensible for the respective addressees. Please rate the factors of the quality criterion comprehensibility mentioned below.

- Understandable design (e.g., abbreviations, format) (strongly disagree, disagree, rather disagree, rather agree, agree, strongly agree)  
If necessary, you can explain your choice for an understandable design in bullet points here (optional).
- Readability (e.g., language level, syntax) (strongly disagree, disagree, rather disagree, rather agree, agree, strongly agree)  
If necessary, you can explain your choice for readability in bullet points here (optional).
- Appropriate level of complexity and detail (strongly disagree, disagree, rather disagree, rather agree, agree, strongly agree)  
If necessary, you can explain your choice for an appropriate level of complexity and detail in bullet points here (optional).

### **Distinctness and Degree of Integration**

The criteria distinctness and degree of integration were evaluated in two groups using the template in Figure 1.

## **A3. Scenarios**

The following is the English translation of the scenarios.

The scenarios are formulated as fictitious company cases and reflect working life with implemented measures. The measures listed have been compiled from various concrete company cases. This condensed presentation is intended to illustrate the breadth of the measures implemented and to provide suggestions as to which measures should also be considered in comparable situations.

In addition to the actual scenario, core aspects are listed that can be used by readers as a guide. The letters P (primary sector), S (secondary sector) and T (tertiary sector) were used to identify the sectors in which the respective measure was mentioned during the interviews. In this way, similarities and differences between the economic sectors under consideration are made visible. In the corresponding passages of the fictitious company case, the embedding of the measure in the work context as well as essential success factors and effects of the measures are described.

### Scenario 1: Location-Dependent Work

**Company/organization references:** Manufacturing companies, inpatient/outpatient care, public administration with mandatory customer contact, cultivation/harvest of agricultural/forestry products.

**Specific objective:** A service provision of the company/organization is only possible with the physical presence of the employees. This fact results either from technological necessity or from mandatory personal contact in the delivery of the service.

Laura and her colleagues must always be on site for their work activity.

| Topic   | Core aspect   | Description of work execution in the context of implemented measures   |
|---|---|--|
| Initial situation   | Laura works on site at the company  | Laura is going by bus to work. All the passengers are wearing their masks. This whole situation surrounding the pandemic is by now afflicting her heavily. For more than a year now, this virus COVID-19 has been accompanying us and the constantly recurring new virus variants reported by the news scare her. She is glad that she at least works in a job where she has to be on site. "At home I would definitely get cabin fever!" she thinks, "Especially since my significant other has been working in the apartment continuously since the first lockdown." After 6 stops, she has arrived. How lucky, a short breather from the mask between the bus and the workplace, she takes a deep breath.   |
| Hygiene concept: personal protective equipment                | FFP2 mask, if 1.5-meter distance cannot be maintained (P, S, T)<br>FFP2 mask, when leaving the workplace (S, T)<br>Sufficient masks are provided by the company (S, T)                                    | Before Laura goes into the building, she puts her <b>FFP2 mask</b> back on. By now she's gotten used to them, and since they allow her to continue going to work, she's even happy to put up with them. Still, wearing the masks all the time is also an additional burden. "Luckily, I can <b>take them off</b> when I'm at my <b>workstation</b> ," Laura thinks. This is because her colleagues at the other workplaces are more than <b>1.5 meters</b> away and the hall door is frequently opened. Laura likes the fact that her employer <b>provides enough masks</b> and that she no longer has to use the one she sewed herself or bought privately.   |
| Hygiene concept: Disinfection of hands, surfaces and premises | Disinfectant dispenser (S, T)<br>Training of cleaning staff on disinfection guidelines (T)<br>Surface disinfection/disinfection of the premises (T)   | While disinfecting her hands, she notices once again that all the dispensers with <b>disinfectant</b> were initially set up during the pandemic. "That was way overdue!" thinks Laura, "especially in winter during the cold season, when everyone is constantly sneezing and blowing their nose, or for all those diseases that are transmitted via smear infection. If that remains, at least <i>something</i> good came out of the pandemic." The other day, someone on the <b>cleaning team</b> told Laura that they even got an extra training on <b>facility disinfection guidelines</b> .   |
| Hygiene concept: ensuring distance between persons present    | Minimum distance 1.5 m (P, S, T)<br>One-way street regulation (S)<br>Checks for compliance with the regulations (S)<br>Shielding by Perspex panels (P, S, T)<br>Spatial separation of workstations (S, T) | On the way to her workplace, she always makes sure to keep the <b>minimum distance of 1.5 meters</b> from others, even despite the protective mask that must always be worn when leaving the workplace. To Laura's surprise, the <b>one-way rule</b> in the corridors is even accepted by almost all her colleagues. She wouldn't have thought that; however, this costs a detour or two. Maybe it's because of the <b>controls</b> that were carried out at the beginning to ensure that all the new regulations are actually adhered to.<br>Laura arrives at her workplace and puts down her things. The first thing she has to do is get her work utensils. The <b>Perspex panel</b> behind which her colleague sits is new, as is the <b>large distance between the workstations</b> . |



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|   | Spatial separation of company divisions (S)<br>Involvement of works/staff council in implementation of measures (S, T) | She has to hurry; her supervisor wants to discuss next week's work schedule. To do this, everyone has to put on their masks again and prick up their ears, because otherwise they'll only understand half of what's being said. "I hope someone doesn't start another fundamental discussion about wearing masks. Our <b>works council</b> has clearly stated in its e-mail that it supports the management's determination and also any consequences," Laura thinks.   |
| Hygiene concept: reduction of contacts in all company divisions | Division into small, fixed teams (S)   | "Good morning, everyone!" calls Tim, her supervisor. He has made it a habit to always briefly ask how everyone is doing. That's important in such uncertain times, he says. Tim explains that the <b>fixed shift composition</b> that was introduced a while ago has yet to be maintained. Laura thinks this is a pity, as it means she <b>always works with the same colleagues</b> . It is nice to get to know these few colleagues better, but she has always enjoyed working with Richard. She hasn't seen him in ages. She will suggest that the teams rotate again soon. Of course, she also finds it understandable that the teams are no longer changed daily or weekly as they used to be, because that would lead to many people having to be quarantined, especially with the incubation period, if there were ever a case of infection. Tim ends the meeting and everyone goes back to their workplace. |
|   | Avoiding the splitting of teams (S)  |   |
|   | Reduction of people on site (P, S, T)<br>Staggered breaks (S)<br>Distance markings on the floor (S)                    | While Laura is still thinking about the issue of distances between people, she remembers that there are in total <b>fewer people on site at the same time</b> and that there are now also <b>staggered breaks</b> . Therefore, there is less congestion during the lunch break. The long lines used to be a real pain. Even though the food distribution works much better now (there are even <b>distance markings on the floor</b> ), she regrets that it is no longer allowed to eat together. At some point, you have to talk to the colleagues on the other machines about how they approached the errand.   |
|   | Online appointment scheduling (T)  | She likes the fact that the representatives of customer companies now come to the offices at individually agreed appointments. This not only reduces the number of people, but also the waiting times. And the online calendar is no longer a problem for most of them.<br>Laura also wanted to ask her colleague Peter from HR how the <b>online application interviews</b> for filling the recently advertised position went.   |
| Hygiene concept: reduction of contacts in all company divisions | Food to go (S)<br>Spatial equalization and provide additional break rooms (S).   | For a while now, there is only food to go and everyone eats alone at their workplace. Especially during the break, the social contact is already very lacking! Laura remembers that they are considering <b>providing more break rooms</b> so that she and the team no longer have to eat at the workplace. That would be a good thing, Laura thinks, because she believes that the sense of togetherness has suffered quite a bit in the meantime.   |
| Identification of suspected cases                               | Testing possibilities (S, T)<br>Body temperature measurements (S)  | Laura settles in at her workplace for the day. Just before she goes home, she will get tested again. The <b>testing service</b> is available all day, it has become established that everyone who is on site goes at different times. At the beginning of the pandemic, there were partially even <b>temperature measurements</b> in the entrance area. However, the great panic of the beginning is now over. In the test centers, both rapid tests are carried out and swabs are taken for PCR tests. It is worthwhile <b>cooperating with the general practitioner from the local family practice</b> .  |
|   | Close cooperation with company/general practitioners (S)   |   |

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| Systematic handling of suspected cases                            | Establish a standard procedure for suspected cases (S)   | Also, because he immediately takes care of the <b>suspected cases</b> . "It's good when the management clearly tells you how to behave if you're worried that you've been infected. Then you don't have to worry about looking like a quitter. It would be bad for our delivery if several people were to miss work at the same time," Laura thinks.  |
| Regular communication of the company status                       | Regular communication of the company's status by the management (S, T)   | Since the pandemic, there is a new routine. Every Monday at 9 a.m., the management contacts us. In the meantime, these are usually only very <b>brief status updates</b> . But especially in the early days of the pandemic, all the major changes were announced here and, above all, it was also explained why certain measures and processes had been introduced and adapted. In addition, employees had the <b>opportunity to ask questions</b> so that everyone could understand the current procedure. That helped Laura a lot, because she was already quite insecure and also a bit scared.   |
| Regular communication of the company status                       | Provide information synchronously and asynchronously (S, T)  | These <b>status updates are recorded and then available throughout the day</b> in case someone has an appointment at that time or starts late. The status updates also run all day on large screens for anyone who doesn't have digital devices. This has actually improved top-down communication. Otherwise, someone from management would have to stand up and announce the information ten times to smaller groups.   |
| Co-determination should be the focus of decision-making processes | Alternative activities when the normal working day cannot be pursued (S)<br>Investment in training and further education when orders are low (T) | Shortly after the first lockdown, Laura had to <b>clean up the warehouse or archive</b> because they couldn't work normally. That was in dire need, but it kept her from her actual work tasks. Now, at least, regular work is back on the agenda. This constant back and forth with the reduction of overtime and then also the short-time work ... "This time could have been used very well for <b>training and further education</b> instead of sending us into short-time work. That would have been a reasonable investment," Laura reflects.   |
|   | Participation in shift work and working time (S)   | In the past, it wasn't a problem to leave a little early or arrive a little late. But now, with the fixed shift disposition, that's no longer possible because everyone in the team always has to be on site at the same time or leave the building before the others arrive. That's a bit annoying, especially when you also have important private appointments in the context of childcare. In shift work, it is of course always difficult to introduce flexible working hours, but a small degree of <b>flexibility</b> and, above all, <b>co-determination</b> as to which shift you work is great. But now it's time for the evening routine test and then it's already closing time. Laura puts on her mask and heads home. |

## Scenario 2: Partly Location-Dependent Work

**Company/organization references:** Processing, management, administration.

**Specific objective:** A service provision of the company/organization partly requires physical presence, especially for coordination processes. The specific task processing is not location-bound and can also be carried out remotely.

Paul is working partly from home, but has to visit the company occasionally for his work.

| Topic                               | Core aspect  | Description of work execution in the context of implemented measures  |
|-------------------------------------|--|---|
| Initial situation                   | Paul works partially on site at the company  | Paul puts the prepared lunch into his daughter's school bag. In the past, he would have already been stuck in traffic at this time of day in order to be at work on time. But in the wake of the pandemic and the switch to working from home, the former <b>fixed core time was reconsidered and working time arrangements made more flexible</b> . The fact that he can now spend the time before work with his daughter contributes greatly to his good mood.  |
| Flexibilization of working time     | Flexibilization of core time (S, T)<br><br>Allow exceptions for the working time account (S)<br>Days off to care for children/relatives (S)<br>Individual arrangements with the manager (S, T)   | During the lockdown, in addition to the general flexibilization, his employer has shown increased consideration for parents and employees who care for relatives. To this end, <b>limits on the working time account have been temporarily lifted</b> and the <b>possibility for days off</b> has been created in order to cushion the additional workload. Since the reopening of the schools, Paul has been able to return to work full time, where he, thanks to the good relationship of trust in his department, can continue to organize <b>his working time flexibly in coordination with his boss</b> .<br>After his daughter heads off to elementary school, Paul leaves to work. The staggered start to work means he can get through traffic much better than before and has a shorter journey time overall.   |
| Hygiene concepts                    | FFP2 masks except at the workplace (P, S, T)<br>Reduction of people on site (S, T)<br>Participation in the choice of the place of work (S, T)<br>Greater distances between workplaces (S, T)<br>Partition walls between workplaces (S, T)<br>Ventilation systems (S, T)<br>Disinfectants (P, S, T) | With his <b>FFP2 mask</b> on, Paul walks from the front door to his office. He notices that he encounters fewer colleagues on the way than before the pandemic. While the low attendance at the height of the pandemic was due to the fact that the <b>number of employees on site was kept to a minimum</b> , the opportunity for employees to <b>work from home</b> several days a week <b>by their own choice</b> is now more significant. Even though he can now no longer meet all his colleagues when he comes into the office, Paul is still very happy that he can see at least some of them in person. This is hugely important for socializing and especially networking with colleagues from other departments.<br>Once at his desk, Paul removes his FFP2 mask. The <b>desks were moved</b> further apart during the pandemic and fitted with transparent <b>dividing elements</b> . As Paul settles into his office chair, he hears the <b>ventilation system</b> come to life in the ceiling, which was installed during the pandemic. "They could have come up with this idea earlier," he thinks. His gaze falls on the <b>leaflet</b> on the wall, which reminds him to <b>disinfect his hands</b> . |
| Communication of the company status | Open documentation of introduced measures (S, T)   | As a first task, Paul calls up the company's intranet. Here, especially at the beginning of the pandemic, changes and measures in the company were documented after they had been announced and queries answered in <b>virtual company meetings</b> . In addition, the <b>recordings</b> of the meetings could also be accessed afterwards. By now, the intranet is   |

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|                        | Virtual company meetings including records (S, T)<br>Regular dissemination of news within the company (T) | increasingly being used to <b>regularly disseminate information about new projects and activities</b> within the company. Paul thinks this is a very good development. Especially in his company, where different departments work on very different projects, it used to be hard to see what other colleagues were working on. The new, easily accessible insight option helps to discover synergy opportunities between departments and also promotes team spirit in the company.  |
| Work on-site           | Attendance planning (T)   | Next, a meeting is held with a few colleagues on site. They quickly set the joint appointment with the help of the <b>software used in the company to schedule attendance</b> . During the pandemic, open scheduling of office attendance made it possible for individual employees to come into the office flexibly when needed, while ensuring that only the permitted number of people were on site. In the meantime, Paul uses the tool primarily to ensure that he comes into the office on days when there are colleagues on site with whom he would like to interact in person.   |
|                        | Changed use of space (S, T)   | Even if there are only five of them, the meeting takes place in a <b>larger conference room</b> . This allows them to keep the spacing that is still prescribed. Paul has heard that the management is <b>considering how to organize the use of space in the long term</b> . Some want to create fewer individual workplaces and more collaboration areas like this, just for a case like now where colleagues come into the office explicitly to collaborate. Others think that the overall space can be reduced if some of the employees always work from home anyway. Paul thinks: "There should always be a place for everyone. It doesn't have to be a separate desk or even a separate office." |
|                        | Presence meetings for collaborative work and difficult topics (T)   | Together, Paul and his colleagues design the approach to solving the problem that has been challenging them for some time in their current project. Even though it is possible to work on many things alone from home, and even simple agreements can be arranged wonderfully by means of digital communication, Paul finds that for such <b>creative and collaborative tasks</b> processes, as well as <b>difficult topics for discussion</b> , face-to-face meetings are still the better choice. Here, the interpersonal component simply plays a very large role.  |
|                        | Digital documentation of agreements from presence meetings (T)  | Today, Paul is also very satisfied with the joint result of the meeting. Finally, Paul posts the result achieved and the underlying considerations as well as the next steps in the <b>team chat</b> in RocketChat. This <b>documentation</b> has proven to be important so that colleagues who are not in the office on the respective day still have all the information and are thus included.  |
|                        | Maintain social contacts (S)  | On the way back to his office, he arranged to meet his colleague Martin for dinner the next day after work. Such spontaneous <b>private appointments</b> happen more often if you were in the office together beforehand.  |
| Flexible place of work | Specify regulations in employment contracts (T)<br>Department-dependent structuring of                    | After this productive morning, Paul heads back home to be there when his daughter gets back from school. Before the pandemic, working from home hardly played a role at his employer. But because of the positive experience he has had over the past year, it has become a permanent part of his working life. To this end, central regulations have been recorded in the <b>employment contracts</b> , and the specific arrangements can be agreed with the manager <b>depending on the department</b> .   |

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|                 | <p>working from home (S, T)</p> <p>Flexible choice of workplace if necessary (S, T)</p> <p>Individual organization of working from home (S, T)</p> <p>Suitable working conditions while working from home (S, T)</p>   | <p>During the lockdown, working from home in parallel with homeschooling was very stressful for Paul. At this time, it was harder for him to concentrate on his work, and he is glad that this double burden is now over. It has helped him that his employer has made it possible for employees who care for children to <b>come to the office flexibly for individual days</b>. Similar solutions were available for colleagues who wanted to use the more stable Internet connection at the company for an important customer appointment.</p> <p>Currently, Paul usually works two days a week in the office, two days from home, and one day he alternates between workplaces - as he does today. For him, this is a very good solution that allows him to work on his tasks optimally and at the same time coordinate his work life with his family. In the future, <b>the actual number of days per week that we can work from home will vary from one colleague to another</b> in the department and will be arranged for everyone in a way that is most convenient for working and balancing their private life.</p> <p>Shortly after Paul arrives home, his daughter also comes home from school. They have lunch together and then spend another half hour in the garden in the sun.</p> <p>After lunch, Paul goes to his <b>study</b>, which they have created by clearing out another room. Based on the thoughts from this morning's meeting, he now has to come up with a concrete implementation plan. The <b>quiet atmosphere</b> in his study at home, where he is not distracted by colleagues passing by, helps him in this. "At least as long as my daughter doesn't come by instead," he thinks.</p>  |
| Hybrid meetings | <p>Meetings in a mixture of presence and videoconference (P, S, T)</p> <p>Make face-to-face meetings accessible via additional videoconferencing (S)</p> <p>Data protection and IT compatibility (P, S, T)</p> <p>Companies benefit from long-standing contacts (S, T)</p> | <p>At 4 p.m., Paul dials into a meeting via the <b>video conferencing software</b> used in the company, in which he and three colleagues want to consult with one of their customer companies. The software now <b>integrates all communication channels</b> (e.g. chat, video conference, data exchange) within the company, so that there is always a good overview of incoming messages. It has also become established that it is always possible to <b>join</b> classic face-to-face meetings <b>via video conferencing</b>. As a result, participation in meetings is now almost more complete than before the pandemic. Paul thinks that such an approach would also be particularly beneficial for companies with extensive premises or different locations, in order to avoid long commuting times between appointments.</p> <p>In this appointment, Paul's colleagues are sitting together in a conference room at the company. The representatives from the customer are connected virtually, as is Paul. The term "<b>hybrid meetings</b>" has come into use for meetings of this kind. Paul is relieved that they are now using software that has no <b>IT compatibility issues</b>. In the first few months of the pandemic, there had been repeated problems because employees from other companies were not allowed to use certain software solutions internally, for data protection reasons.</p> <p>There had been a learning curve at first when switching to a new tool, but previous experience with appropriate software, as well as Paul's company's generally high affinity for technology, meant that this challenge was quickly overcome. "Now all that's left is for the Internet connection to remain stable for everyone present!" hopes Paul.</p> |

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|  | <p>Paul is very pleased with how the meeting went. "It helps a lot that we <b>have been in contact with this company for a long time</b> and that I also got to know the contact persons personally before the pandemic. In that respect, the switch to digital forms of communication hardly restricts cooperation. That would certainly be different if it were about acquiring new client companies or networking at a conference," he surmises. "That would offer at least a partial explanation for why fewer new customer contacts were made during the pandemic."</p>  |
| <p>Replace business trips</p> <p>Reduction of business trips (P, S, T)</p> <p>Digitization of support processes (S)</p> <p>Work-life balance (P, S, T)</p> | <p>After the meeting is over, Paul sees that another urgent support request has come in from a customer company in South America. In the past, he or his colleagues would have jumped on a plane at short notice to take a look at it on site. But during the pandemic, they have switched to analyzing such requests first on the basis of documents and in a video conference with the customer company. Paul is happy about the <b>reduced number of business trips</b>, as it saves him a lot of travel time that he can use for other work. "On top of that, it also saves the company a lot of money and is a big win for the environment, too," Paul is sure.</p> <p>Instead of heading to the airport, Paul dials back into a video conference. An employee of the customer's company is <b>filming the problem areas</b> on the defective machine. It would be easier for Paul to assess the situation if he were there himself, because his depth perception is limited by the video image and he can't quickly feel it himself. In addition, it is not always easy for him to explain things as precisely as necessary because of the language barrier. Nevertheless, the advantage that he can make an initial assessment much more quickly outweighs the disadvantage. In this case, the <b>problem</b> can even be <b>solved by the employee herself</b>, following Paul's instructions, and so no one has to go on the business trip. Paul is pleased that he appears to have succeeded in asking the right questions and effectively instructing the on-site employee from a distance.</p> <p>After the meeting is over, Paul shuts down his computer. He realizes that the two customer meetings in quick succession did take a toll on him. By eliminating the need to travel to and from appointments, his work has become much more condensed. Nevertheless, as he descends the stairs to the living room, he is pleased that he will be spending the <b>evening together with his family</b> and not at the airport.</p> |

### Scenario 3: Location-Independent Work

**Company/organization references:** IT services, development/programming, journalism/writing, social media marketing, telephone customer support, consulting activities, municipal administration, design and development department, human resources department.

**Specific objective:** A service delivery of the company/organization can be done remotely; no physical presence is required. Coordination processes of the agents are digitally supported. The work process can be carried out entirely from home by secure server connections.

Hanna works exclusively from home.

| Topic                           | Core aspect  | Description of work execution in the context of implemented measures  |
|---------------------------------|--|---|
| Initial situation               | Hanna has a new job and works exclusively from home  | Hanna has been in her new job for three months now. It wasn't easy at all to find a new job during the pandemic and then to really arrive there. You can't meet your new colleagues in person and it's hard to learn the new processes, which you can't experience live.  |
| Communication with managers     | Online job interview (S, T)<br>Showing appreciation to employees (T)<br>Relationship of trust (S, T)<br>Face-to-face meeting with supervisor (T)   | She thinks back to the <b>job interview</b> , which also took place online. At that time, the team leader had already emphasized several times that even if you don't run into each other all the time, all employees are shown a <b>high level of appreciation</b> . She was indeed always approachable and tried to build up a <b>relationship of trust</b> even over the local distance through working from home. As soon as the case numbers in the region allowed it, there was then a first <b>personal meeting with the supervisors</b> . That's when Hanna noticed that trust actually builds up a bit more slowly via digital channels. However, Hanna still works entirely from home.  |
| On-Boarding and Human Resources | Digital on-boarding process (T)<br><br>Virtual tour (T)<br>Mentoring program (T)<br><br>High level of personal responsibility (S, T)<br><br>Personal well-being (S)<br><br>Sensitization of managers (S) | At the beginning, Hanna was skeptical about whether the on-boarding process could work in exclusively digital formats, but because the company and the HR department developed a systematic and completely <b>digital on-boarding process</b> , it really didn't make that much of a difference. In the past, of course, there was already a formalized on-boarding process. Because of the pandemic, this was then converted to a digital format.<br>Hanna got an insight into the premises via the new <b>virtual tour</b> . After being given a mentor directly, she also quickly made connections within the team. First and foremost, of course, the <b>mentoring program</b> helps with technical questions and problems. It takes a bit more courage to ask questions when you never even briefly meet the others in the hallway, but Hanna actually finds the fact that a <b>high degree of personal responsibility</b> comes with the whole situation quite good. And it simply takes the willingness of all employees to get involved with the new form of induction.<br>The HR department has already indicated that parts of this process will remain digitalized in the future. "They've done a pretty good job recruiting, too," Hanna reflects, "and now they're also checking in with everyone individually on a regular basis to see <b>how we're doing</b> ."<br>The fact that they ask so often lowers the threshold for telling people that you're not doing so well with your overall situation. Sometimes you feel a bit isolated while working from home. The <b>managers</b> have also been <b>sensitized</b> to this and try to keep an eye on potential problems, such as a <b>lack of connection in the department, and to integrate new employees</b> |

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|                            | Open communication of expectations (S)                         | into the team in a targeted manner. In the beginning, you don't know who you should get to know. Openly communicating <b>expectations to new employees</b> also helps a lot. It is then easier to approach the relevant people. It can happen very quickly, especially when everyone works from home, that employees lose touch.  |
| Equipping with work tools  | Send work materials by mail (T)                                | The laptop and other <b>work materials</b> were sent to Hanna <b>by mail</b> . With remote support, she had to organize everything herself - <b>remote induction</b> , so to speak. But once she was familiar with the VPN access and the entire IT infrastructure, as well as the virtual telephone system, collaboration via the online meetings was quite normal pretty quickly. <b>New technology</b> was purchased because of the pandemic, which Hanna believes would definitely not have been purchased otherwise. Since the private apartment is not primarily designed for working, everyone who wanted to was also <b>equipped with desks and office chairs</b> , and the <b>IT team also supports</b> the individual departments in terms of <b>Internet connection at home</b> , because of course sufficient bandwidth must be available. Even though, in the final instance, you are somehow responsible for being able to work yourself. An Internet or power outage would be pretty bad.<br>"Actually, the only thing that matters when choosing a place to work is that all materials and the necessary communication channels are available," Hanna thinks. Meanwhile, the possibility for <b>working from home is even regulated in the employment contract</b> . She finds this important, especially with a view to the future.<br>In the beginning, however, there were a few other hurdles to jump. "I'll just say <b>data protection and secure connection to the server</b> where all documents are stored." Personal e-mail addresses were also not a given. Until adequate IT equipment was secured, the private PCs were used. The IT administrators didn't like that at all. |
|                            | Remote induction (S, T)  |   |
|                            | Procurement of new technology (S, T)                           |   |
|                            | Equipping employees (T)<br>IT support (T)                      |   |
|                            | Adaptation of employment contracts (S, T)                      |   |
|                            | Data protection (T)  |   |
| Digital business documents | Digitization of processes (S, T)                               | "This digitization push in companies that everyone is always talking about is actually happening. At least in our company," Hanna thinks. Now that all <b>processes have been digitized</b> , i.e. handled paperless and with <b>digital signatures</b> , everything works smoothly and much faster than in the old company, where you always had to wait for signatures and other documents before you could continue working. The availability of documents is also much better now, it just has to be reiterated to everyone that, because of data protection, no documents containing <b>company internals</b> should end up in the household waste. However, since Hanna handles all documents digitally anyway, there is no danger of this happening.   |
|                            | Digital signature (S, T)                                       |   |
|                            | Handling sensitive data (T)                                    |   |
| Flexible working time      | Flexible working time (S, T)                                   | With her coffee cup, Hanna sits down at her desk in the living room because she doesn't have a study. <b>Working hours</b> have been handled very <b>flexibly</b> in the company since the pandemic. Core working hours have become less important; everyone works in a task-oriented, self-organized and independent manner. This works especially well for independent task steps, and as a result the compatibility of work and private appointments has become really good. It is more difficult when activities or tasks require extensive guidance or arrangements. Working at home also leads to a <b>dissolution of work and private life</b> . On the one hand, Hanna already has the feeling that she works significantly more overall because she feels a certain moral pressure. Objectively, the <b>workday becomes much more</b>  |
|                            | Task-oriented, self-organized and independent work (S, T)      |   |
|                            | Dissolution of boundaries between work and private life (S, T) |   |
|                            | Compression of work (S)  |   |
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|                               |   |   |
|-------------------------------|---|---|
|                               | <p>Constant accessibility (S)</p> <p>Announcement of appointments (S, T)</p> <p>Legal framework (S, T)</p> <p>Compliance with occupational health and safety regulations (S, T)</p>   | <p><b>condensed</b> - after all, a lot of ways that have been used to think and reflect disappeared. Sometimes you have to actively remind yourself to take advantage of the nice weather for a break. It took a while for Hanna to get used to the idea of <b>not having to be available all the time</b>. The fact that <b>important appointments are announced in time and with priority</b> helps enormously. Necessary team meetings are held regularly at fixed times. But even though working hours are currently handled very flexibly, everyone is regularly reminded that the Working Hours Act must be observed. "It's not okay if you work longer than 10 hours and after 9 p.m.," Jonas, from the HR department, repeats almost prayerfully, Hanna recalls. The <b>requirements of occupational health and safety</b> must also be adhered to during a pandemic.</p>   |
| Formal communication          | <p>Regular exchange (P, T)</p> <p>Netiquette (S, T)</p> <p>Group chat (T)</p> <p>Non-verbal reactions missing (P, S)</p> <p>Communication and discussion of complex issues difficult (T)</p>  | <p>The <b>morning stand-up</b> is about to take place. This is a short exchange in Hanna's team so that no one loses contact and they can at least see each other briefly and talk about the content for the day. <b>Netiquette</b> for video conferencing has been introduced within the company. Meetings are very tightly scheduled on many days. And what is not yet clarified is quickly discussed via the <b>group chat</b>. Bilaterally, a lot is clarified via e-mail. Unfortunately, compared to Hanna's previous job, where everyone was on site, the informal exchange between colleagues has decreased significantly. A lot of information is also lost in meetings, although the cameras help a bit to perceive <b>nonverbal reactions</b>. You really have to watch out for misunderstandings there. In Hanna's view, the lack of nonverbal communication has also made it more difficult to discuss and communicate <b>complex issues, such as contract negotiations</b>.</p>  |
| Informal communication        | <p>Virtual coffee break (S, T)</p> <p>Use of the camera during video conferences (S, T)</p> <p>Togetherness and connectedness (T)</p> <p>Joint mastering strengthens team spirit (T)</p> <p>Virtual events as team building (T)</p> | <p>To improve the informal exchange, the head of department and the team leader have also motivated Hanna and her team to meet informally from time to time, for example for a <b>virtual coffee break</b>. This works quite well and it's interesting to get an insight into how others are doing while working from home. For Hanna in particular, who has only ever met her team virtually, it's very important that everyone turns on their <b>camera</b>. This helps her to <b>build up a sense of connection</b> and a <b>feeling of togetherness</b> can develop. Even if the team cohesion suffers from the pandemic, it's a very difficult situation for everyone and overcoming this together also <b>strengthens the team spirit</b>. Hanna thinks back to the <b>hackathon</b> that HR organized the other day. "That was really fun!", Hanna thinks, "just working on a completely different project for 2 days with people from different departments." The winning team got tickets to an online escape room - Hanna's team unfortunately only ended up in second place.</p> |
| Internal communication offers | <p>Online offerings (T)</p>   | <p>After the stand-up, Hanna clicks through the company's communications offerings, with a new <b>online offering</b> added every week. There are nutrition guides and instructions on how to take an active break. There are also videos on how to set up your workstation properly and general tips and tricks for working from home. There are many small measures so there is something for everyone.</p>   |
| External communication offers | <p>Online training and information events (S, T)</p> <p>No quality restriction for online</p>   | <p>Hanna is busy today developing a new online format. This is a new offering from her company since the pandemic. <b>Online training and information events</b> are held for customer companies, which works very well,</p>  |

|                                 |  |   |
|---------------------------------|--|---|
|                                 | <p>services (T) Establish customer contacts (P, S, T)</p> <p>Network exchange (T)</p> <p>Preparation of content for specific target groups (T)</p>   | <p>especially for software products. In particular, the <b>online services</b> can be provided during the pandemic without any <b>quality restrictions</b>. Hanna's company is trying to <b>establish new customer contacts</b> via these information events, because cold acquisition of customer companies in particular has become very difficult without personal contact. Contact with customer companies has deteriorated a bit overall, Hanna believes. The online events have also shown that networking and informal exchanges work better at <b>live events</b>. In the online formats, you reach a <b>broader audience</b> and also <b>completely new target groups</b>. This offer will certainly be retained for the future. It is significantly more cost-effective than a face-to-face event. In addition, you have additional design options and can work very well with specific target groups.</p>  |
| Positive effects on performance | <p>No limitation of productivity (S, T)</p> <p>More effective use of time (S, T)</p> <p>Increased competence in the use of technology and in self-organization (S, T)</p> <p>Less distraction (S, T)</p> <p>Work location does not have to be the same as home location (T)</p> <p>Improved collaboration across locations (T)</p> | <p>Hanna's overall impression is that <b>productivity</b> has <b>not diminished</b> as a result of working from home, at least in her area. A lot of time has been saved due to the many commutes that have been eliminated, and with the online meetings, <b>time has often been used more effectively</b>. In addition, many of the colleagues have significantly improved their <b>skills in using IT technology and organizing themselves</b> as a result of the pandemic. The change to task-oriented work really suits Hanna and it's also super helpful that you're no longer <b>distracted</b> as much as you would be in an <b>open-plan office</b> or in offices overall, when there's always someone standing in the doorway. You're much more focused on the task at hand. The other <b>new colleague even lives 300 km away</b>, which would not have been possible in the past without a move or second home. In any case, <b>cross-location collaboration has improved</b> and hopefully will continue to do so in the future.</p> |
| Negative effects on performance | <p>Workload and progress of employees difficult to assess (S, T)</p> <p>Creative collaboration more difficult (T)</p> <p>Negative effects on the ability to innovate feared (T)</p>  | <p>Sometimes Hanna feels that it is <b>difficult for managers to assess</b> how much colleagues have to do and how their work is progressing. Better methods would have to be found, says Hanna. <b>Creative collaboration in particular has become more difficult</b>. There are online collaboration tools, but somehow, it's not the same as standing together in front of a whiteboard. Collaboration has also decreased between departments. Hanna is curious to see how the whole pandemic will affect the company's <b>ability to innovate</b>. Some colleagues have already failed with new ideas and projects because there is less space and points of contact for their topics.</p>  |
| Negative effects on well-being  | <p>Fragmentation of days through online meetings (S, T)</p> <p>No adherence to break times (S)</p> <p>Substitution of omitted ways by working time (S, T)</p> <p>Employees feel that they have to do</p>   | <p>Her day today is already totally <b>fragmented</b> due to the successive meetings and Hanna is losing a bit of the overview. The meetings have become shorter overall, but the frequency has increased. She rubs her eyes. The <b>long time spent in front of the screen</b> is already very exhausting, especially when informal communication is also shifted to the virtual world. She has also <b>barely kept to her lunch break</b>, only briefly eating something on the side. Hanna has the impression that she is not the only one who has <b>replaced the commuting time with working time</b>. It's not just the managers who are currently under a lot of strain. Many in Hanna's environment have reported that they <b>feel like they have to do more to show that they are also working effectively</b> at home. This</p>  |

|                                    |  |   |
|------------------------------------|--|---|
|                                    | <p>extra work to show they are working effectively from home (T)</p> <p>Shifting meetings outside of core work hours (T)</p> <p>Diminishing emotional commitment (S, T)</p>    | <p>can't continue in the long run. In particular, the <b>late calls</b>, which are sometimes still taken, are also problematic. That's also where the lack of separation between work and free time becomes apparent. And moving break or not, she used to move more. Hopefully, that will change again soon. The <b>emotional bond</b> within the teams has apparently suffered quite a bit in recent months, as Lara told her, who has been with the company longer. There is much less personal contact. Joachim didn't even get a goodbye from everyone when he changed jobs. That's a real shame. Nevertheless, Hanna also has the feeling that the pandemic has strengthened the team spirit and that everyone is trying to be there for each other.</p>  |
| Positive effects on the well-being | <p>Flexible time management (S)</p> <p>High degree of flexibility with double burden (S, T)</p> <p>Freedom of design, flexibility and self-determination has increased (T)</p> | <p>Despite all the bitter aftertaste, the positive sides outweigh the negative for Hanna. She is very happy that she can <b>organize her time flexibly</b> and that she no longer has to adjust her working hours to traffic, as she used to. She has also heard from colleagues with young <b>children</b> that they are quite happy for the flexibility and understanding with the expected workload, especially with the double burden of simultaneous childcare and homeschooling. The same is true for those who <b>care for their parents</b>, for example. Hanna finds that the <b>high degree of creative freedom, flexibility and self-determination</b> is a great benefit for her. That's it for today - Hanna closes the laptop and moves from her desk two meters away to the couch. "Sometimes it's quite practical," she thinks, and turns her attention to her mystery novel.</p> |

#### Scenario 4: Organizational Crisis Management

**Company/organization references:** Companies and organizations in all sectors of the economy, with the exception of those whose activities have had to be completely discontinued. Measures in connection with short-time work are also excluded.

**Specific objective:** Companies and organizations are required to develop measures to implement crisis-related ordinances in parallel with their day-to-day operations, while at the same time fulfilling their mandatory obligations as a company.

Maximilian is a management consultant. He takes care of the operational management of the pandemic-related effects.

| Topic   | Core aspect   | Description of work execution in the context of implemented measures   |
|---|---|--|
| Initial situation                                 | The work of the management and the crisis team      | <p>Maximilian is hurriedly on his way to the crisis team meeting. He still has to start the video conferencing system, because the consultation is taking place hybrid (partly virtually and partly on site). The management and the chairman of the works council are on site in the huge meeting room. The safety expert, the company doctor and the production manager are all involved in the meeting via the video conferencing system. He briefly thinks back to spring 2020, the early days of the pandemic in Germany.</p> <p>At that time, the crisis team did not yet exist. Off the cuff, the management had to make decisions, according to the country-specific Corona regulations and the SARS-CoV2 occupational safety standard or the SARS-CoV2 occupational health and safety rule, on which offers were still possible for the customer companies in compliance with the hygiene regulations.</p>  |
| Effects due to the reaction of customer companies | Restrictions in the provision of services (P, S, T) | <p>Maximilian looks through the sales manager's table presentation. After an important product was almost <b>completely discontinued</b> last month - probably because end customers went into shock with the first lockdown - the numbers have now jumped. One will probably have to talk about overtime. "But it's good that we were able to avoid short-time work for the most part because the new product continued to be in demand," Maximilian says. "Fortunately, there were only a few difficulties with material deliveries. Hopefully, colleagues will be able to travel to the customer company and enter the company to discuss the details on site."</p> <p>Other companies, mainly retail and food service, that were not deemed systemically important or could not comply with hygiene regulations had to stop working completely. In some cases, they then had to contact their customer companies for reversal.</p> <p>"Even though we were able to continue working, all employees are feeling the effects of the Corona regulations and the occupational health and safety rule in the workplace," Maximilian reflects.</p> |
|   | Additional effort in service provision (P, S)       | <p>"For example, wearing protective clothing and reducing the number of people involved has <b>increased the organizational and time requirements</b> in the company when processing orders. The closure of schools and daycare centers had an extreme effect. That's when everyone who didn't have small children to look after at home had to step in to ensure that processing went according to plan."</p>   |

|   |  |   |
|---|--|---|
| Adjustment of the service portfolio                                   | <p>Service cancellation (P, S, T)</p> <p>Service conversion (P, T)</p><br><p>Close interaction with suppliers (P, S)</p> <p>Alternative service offers (P, T)</p>  | <p>Everything that was <b>not considered essential for the survival of the company or systemically relevant</b> from the point of view of the customer companies in the early stages of the pandemic <b>was suspended</b> for the time being. Fortunately, many of the employees could be <b>reassigned to other areas</b> of activity, so that short-time work only had to be resorted to for a short time. Some of the work could be done from home, or customer contact was switched to e-mail, telephone or video conferencing. However, the switch to making appointments in advance using the ticket system also worked well for mandatory customer contacts in presence. There were a few difficulties with customer companies that do not have such good computer access, but this number was still manageable. <b>Contact with suppliers</b> was <b>intensified</b> in order to improve planning reliability and avoid stagnation in production. Maximilian thinks that this close cooperation was actually long overdue. In some cases, there was an additional switch to alternative service offerings. "I don't think so many people had ever used the <b>online video portals</b> for sports activities, moving breaks and similar before," Maximilian reflects.</p>   |
| Determination of measures for operational management by a crisis team | <p>Formation of a Corona crisis team (S, T)</p><br><p>Broad composition of the crisis team (S, T)</p><br><p>Organizational instruction (S, T)</p><br><p>Flexible adaptation of measures to the specific situation (S, T)</p><br><p>Enforcement of measures (S, T)</p><br><p>Crisis plan (S, T)</p> | <p>The <b>crisis team</b> in its current constellation meets regularly. In the meantime, however, the frequency has decreased significantly. In the beginning, it met daily.</p> <p>Maximilian thinks how good it is that the <b>management</b> does not determine the measures alone. The expertise of the <b>company physician</b> and <b>safety specialist</b> are very important for the specific event. And before the pandemic, the <b>human resources manager</b> wasn't present at every management meeting either.</p> <p>Maximilian is not at all pleased to think back to the discussions at the beginning of the pandemic on a wide variety of proposals, when no one knew what would be best to do in this situation. Everyone had ideas or information from other companies, all of which had to be examined. In addition to the decision, the relevant <b>organizational instructions</b> also had to be formulated and agreed with the works council. This was sometimes a time-consuming undertaking, because conditions were constantly changing and the measures had to be <b>adapted to the current status</b> again and again. In the meantime, a certain routine has taken hold, because there is experience of how well which measures work.</p> <p>Maximilian thinks back to the first template he prepared for the management, which was used to <b>announce</b> the regulations on the mask issue and the changed break issue <b>to the employees</b>. The reaction spectrum of the colleagues is always very broad: some wait neutrally for the management's determinations, others don't think they go far enough, and still others think they are nonsense. In this case, the respective managers have to show a lot of stamina and communicate the decision-making processes transparently in order to increase acceptance and thus ensure compliance with the regulations.</p> <p>Before the meeting begins, Maximilian quickly loads the file with the company's current <b>crisis plan</b> into the video conferencing tool. It was good, he thinks, that someone had thought about this before, even if no one had really thought about a pandemic in the plan. The idea of linking measures to risk levels was particularly effective. This makes the discussion process more effective and allows for a quick reaction when the</p> |

|                                |   |   |
|--------------------------------|---|---|
|                                | Personal initiative of employees (T)  | <p>number of infections skyrockets or changes in the law are passed at short notice.</p> <p>At the last meeting, the executive director once again praised the <b>activities of the employees</b>, who got together to tinker with concrete solutions for their workplaces. "Let's just think about the plastic parts for opening doors that prevent you from touching the handle," she said again the other day. "And also, the app for reading office occupancy has already been excellent in helping organize the workday. We need to make sure to give these initiatives another proper credit."</p>  |
| Communication on the measures  | Use of different communication forms and -channels (S, T)   | <p>After the first, somewhat difficult appearance in front of the workforce at the beginning of the pandemic, the crisis team decided to use different <b>communication channels</b> to disseminate information. Of course, official information is important, but personal information, preferably from the immediate manager or the works council, is also well received. They can also translate the measures into the specific area and justify them, which improves comprehensibility for the individual. For those who want to read everything, it is also available on the company intranet.</p>   |
| Participation of the workforce | <p>Transparent communication of the company's economic situation (S, T)</p> <p>Feedback from employees (S, T)</p> | <p>In addition to <b>announcing the measures</b>, the company also always reports on its <b>economic situation</b>. "The acceptance of the hygiene measures by the employees probably also depends on the fact that we can continue to produce," Maximilian reflects.</p> <p>It would have been nice if the <b>measures could have been discussed with the employees</b> before they were implemented. But there simply wasn't enough time. At least the employee surveys were able to identify all the modifications that were absolutely necessary. Especially how spontaneous working from home, which was not really desired by all, affected the psyche must be kept in mind. As the company doctor, Dr. Leistner is right about that.</p> |

## APPENDIX B

### B1. Questionnaire

#### Your Current Work Situation

- How many days do you currently work from home?  
1 day, 2 days, 3 days, 4 days, 5 days, other
- How often did you work from home before the change in situation caused by COVID-19?  
Never, max. once a month, max. once a week, several times per week
- What equipment is available in your "home office environment" (multiple selection possible)?  
Laptop, desktop PC, external monitor, external keyboard, computer mouse, desk lamp, office chair, other
- In which room do you mainly work?  
Study, bedroom, living room, dining room, 1-room apartment, room in flat-sharing community, other
- Please indicate the housing situation you are in (multiple selection possible).  
I live by myself, I live with other adults, there are children (under 13 years old) living in my household, other
- Working hours:  
Please indicate how many hours per week your employment contract covers.  
Please indicate how many hours per week are currently agreed with your employer.  
Please indicate how many hours per week you work in home office.

#### Communication Tools

Please list the five most important tools that you currently use for teamwork. This includes mail, chat, video conferencing tools, collaboration tools, etc. (e.g. Outlook, Asana, Skype, Slack, Github, ...). Please do NOT include the telephone.

- First name the tool you use most often and all others in descending order. If you use less than 5 tools please enter N/A.
- Please rate the tools mentioned below. I find it ... to work with:  
1 = very difficult, 2, 3, 4, 5 = very easy, N/A
- Please rate the tools below according to how you feel when you use them.  
1 = I don't like using it at all, 2, 3, 4, 5 = I use it with great pleasure, N/A
- For each tool, please indicate when you introduced it and whether you intend to continue using it in the future (2 answers per tool).

I already used this tool before the change in situation caused by COVID-19.

I started using this tool because of the change in situation caused by COVID-19.

N/A

I do NOT want to continue using the tool after the change in situation caused by Covid-19.

I want to continue using the tool after the change in situation caused by COVID-19.

N/A

### **Communication**

The following is a series of statements in which the respective person has been omitted and replaced by three points (...). As you can see in the answer field, each statement refers to your superior(s), your colleagues and your subordinates. Each statement therefore actually contains three statements. Please decide to what extent you agree or disagree with each statement and click on the appropriate answer. Please consider the answers in the context of your current work situation. (Please click "no answer" only if one of the dimensions does not apply to you, e.g. because no one is subordinate or superior to you).

The German version of the items can be found in Sperka and Rózsa (2007). The English versions of the items were kindly provided by the authors upon request, with the agreement not to publish them.

### **Satisfaction**

- Mark the face that shows how you feel right now.  
The faces can be found in Maddox (1985)
- In general, I like working for this company.  
1 = strongly disagree, 2, 3, 4, 5, 6, 7 = strongly agree
- In general, I don't like my job.  
1 = strongly disagree, 2, 3, 4, 5, 6, 7 = strongly agree
- All in all, I am satisfied with my job.  
1 = strongly disagree, 2, 3, 4, 5, 6, 7 = strongly agree
- Currently, I like working for this company.  
1 = strongly disagree, 2, 3, 4, 5, 6, 7 = strongly agree
- Currently, I don't like my job.  
1 = strongly disagree, 2, 3, 4, 5, 6, 7 = strongly agree
- Currently, I am satisfied with my job.  
1 = strongly disagree, 2, 3, 4, 5, 6, 7 = strongly agree
- If you could wish for something, what would you like to change about your current work situation? (optional)

### **Concluding Information**

- Gender: Female, male, diverse, no answer
- Please enter the year of your birth (yyyy).



- Please indicate your highest educational level.  
No degree, secondary school with diploma, intermediate school-leaving certificate, higher education entrance qualification (A-levels), (specialised) technical college, university degree, PhD, other
- Please indicate your position or, respectively, your job title (e.g. Head of Finance, Research Associate, Software Engineer, Specialist Employee for Media and Information Services, CEO, etc.)
- Please create your individual code in the following. Since you should always be able to reproduce this code (e.g. in case you want the data to be deleted), please create it according to the following scheme:  
The first two letters of your mother's first name: e.g. Miriam  
Your mother's year of birth: e.g. 1954  
The last two letters of your father's first name: e.g. Joel  
Code in the example: mi54el
- Do you have any other comments?

## B2. Complementary Data from the Survey

**Table 1**

Test of normality (Shapiro-Wilk). Paired samples:  $n = 38$ .

| Dimension ( $t_1$ vs. $t_2$ ) |              | W     | p      |
|-------------------------------|--------------|-------|--------|
| Access to Information         | Superior     | 0.853 | < .001 |
|                               | Colleagues   | 0.827 | < .001 |
|                               | Subordinates | 0.889 | 0.001  |
| Lack of Information           | Superior     | 0.977 | 0.595  |
|                               | Colleagues   | 0.896 | 0.002  |
|                               | Subordinates | 0.827 | < .001 |
| Accuracy of Information       | Superior     | 0.871 | < .001 |
|                               | Colleagues   | 0.899 | 0.002  |
|                               | Subordinates | 0.893 | 0.002  |
| Communication Relationship    | Superior     | 0.966 | 0.304  |
|                               | Colleagues   | 0.950 | 0.090  |
|                               | Subordinates | 0.863 | < .001 |

**Table 2**Test of normality (Shapiro-Wilk). Independent samples:  $n_{t1} = 140$  and  $n_{t2} = 99$ .

|                            |              | $t_1$ |        | $t_2$ |        |
|----------------------------|--------------|-------|--------|-------|--------|
|                            |              | W     | p      | W     | p      |
| Access to Information      | Superior     | 0.806 | < .001 | 0.901 | < .001 |
|                            | Colleagues   | 0.699 | < .001 | 0.776 | < .001 |
|                            | Subordinates | 0.807 | < .001 | 0.795 | < .001 |
| Lack of Information        | Superior     | 0.847 | < .001 | 0.903 | < .001 |
|                            | Colleagues   | 0.788 | < .001 | 0.868 | < .001 |
|                            | Subordinates | 0.833 | < .001 | 0.849 | < .001 |
| Accuracy of Information    | Superior     | 0.900 | < .001 | 0.940 | < .001 |
|                            | Colleagues   | 0.842 | < .001 | 0.879 | < .001 |
|                            | Subordinates | 0.856 | < .001 | 0.856 | < .001 |
| Communication Relationship | Superior     | 0.901 | < .001 | 0.943 | < .001 |
|                            | Colleagues   | 0.844 | < .001 | 0.885 | < .001 |
|                            | Subordinates | 0.836 | < .001 | 0.849 | < .001 |

**Table 3**Test of equality of variances (Levene's). Independent samples:  $n_{t1} = 140$  and  $n_{t2} = 99$ .

|                            |              | F     | df | p     |
|----------------------------|--------------|-------|----|-------|
| Access to Information      | Superior     | 6.126 | 1  | 0.014 |
|                            | Colleagues   | 3.919 | 1  | 0.049 |
|                            | Subordinates | 0.290 | 1  | 0.591 |
| Lack of Information        | Superior     | 0.205 | 1  | 0.651 |
|                            | Colleagues   | 0.217 | 1  | 0.642 |
|                            | Subordinates | 5.365 | 1  | 0.021 |
| Accuracy of Information    | Superior     | 2.423 | 1  | 0.121 |
|                            | Colleagues   | 2.173 | 1  | 0.142 |
|                            | Subordinates | 2.001 | 1  | 0.159 |
| Communication Relationship | Superior     | 1.828 | 1  | 0.178 |
|                            | Colleagues   | 0.379 | 1  | 0.539 |
|                            | Subordinates | 4.832 | 1  | 0.029 |

**Table 4**Test of normality (Shapiro-Wilk). Paired samples:  $n = 38$ .

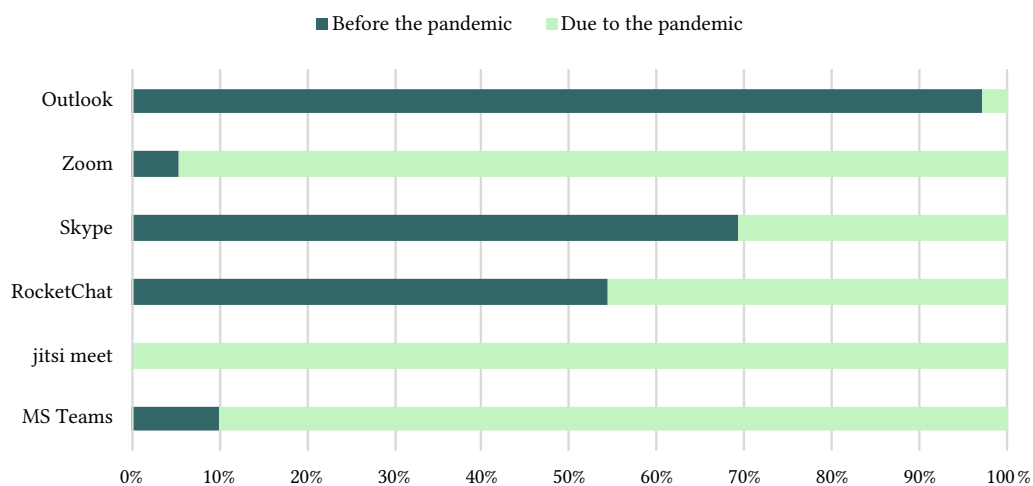
| Dimension ( $t_1$ vs. $t_2$ ) | W     | p      |
|-------------------------------|-------|--------|
| General Satisfaction          | 0.727 | < .001 |
| General Job Satisfaction      | 0.906 | 0.004  |
| Current Job Satisfaction      | 0.949 | 0.084  |

**Table 5**Test of Normality (Shapiro-Wilk). Independent samples:  $n_{t1} = 140$  and  $n_{t2} = 99$ .

|                          | $t_1$ |        | $t_2$ |        |
|--------------------------|-------|--------|-------|--------|
|                          | W     | p      | W     | p      |
| General Satisfaction     | 0.847 | < .001 | 0.833 | < .001 |
| General Job Satisfaction | 0.812 | < .001 | 0.907 | < .001 |
| Current Job Satisfaction | 0.827 | < .001 | 0.891 | < .001 |

**Table 6**Test of equality of variances (Levene's). Independent samples:  $n_{t1} = 140$  and  $n_{t2} = 99$ .

|                          | F     | df | p     |
|--------------------------|-------|----|-------|
| General Satisfaction     | 1.467 | 1  | 0.227 |
| General Job Satisfaction | 8.125 | 1  | 0.005 |
| Current Job Satisfaction | 8.575 | 1  | 0.004 |

**Figure 2**Percentage of participants indicating whether they had already used the respective means of communication before the pandemic or had started using them because of the pandemic ( $t_2$ ).

### B3. Interview Guideline II

*Note:* The guideline was translated, interviews were conducted in German.

#### General Information

- First of all, can you please briefly describe your job and your areas of responsibility?  
*Inquiry:* Main activity, teaching, project acquisition, project processing, supervision of students/student assistants?  
*Inquiry:* What is the approximate percentage breakdown of activities?

#### Formal Communication

- Can you tell me how the formal communication, i.e. work-related communication was like with different interlocutors at the chair before the pandemic?  
*Inquiry:* Supervisors/professors, colleagues, post docs, students, external scientific partners, industry partners  
*Inquiry:* How were key decision-making processes communicated by supervisors before the pandemic?  
*Inquiry:* Which communication channels did you use primarily for formal communication in the past (e.g., e-mail, telephone, face-to-face)? And which one most often?
- How has formal communication with your interlocutors changed over the course of the pandemic?  
*Inquiry:* Main activity, teaching, project acquisition, project processing, supervision of students/student assistants?  
*Inquiry:* Were there differences between the phases? (Communication change process: Lockdown I, phase of loosened restrictions, lockdown II)  
*Inquiry:* How was important crisis information communicated by superiors during the pandemic?  
*Inquiry:* How satisfied are you with the crisis communications by your supervisors? (pandemic-related issues, e.g., timely transmission of information?)  
*Inquiry:* How have communication channels changed as a result of the pandemic?  
*Inquiry:* What technologies/tools are currently used for formal communication?  
*Inquiry:* Has there been a change in the technologies/channels used during each phase of the pandemic?
- How have meetings changed in your opinion in the course of the pandemic?  
*Inquiry:* Meeting duration, number of participants, frequency of meetings, problems/limitations with digital meetings  
*Inquiry:* Are there differences compared to the past?  
*Inquiry:* Can you please describe how the meetings were before the pandemic?  
*Inquiry:* How efficient do you think digital meetings are in general versus face-to-face meetings (e.g., nutritional value of meetings, opportunity for discussion)?
- What advantages do you generally see in increased virtual communication?
- In your opinion, are there any general disadvantages to the increased use of virtual communication?  
*Inquiry:* Can you describe the impact of increased virtual communication on your team or the work at the chair as a whole?

### **Informal Communication**

- Can you please describe how informal communication, i.e., exchanges on topics that are not related to work, occurred at the chair prior to the pandemic?  
*Inquiry:* Did you use tools/technologies for informal communication?
- How has informal communication changed over the course the pandemic?  
*Inquiry:* Maintaining small talk?  
*Inquiry:* How has contact with particularly close people changed?  
*Inquiry:* How satisfied are you with the current informal communication situation with your colleagues?  
*Inquiry:* Were there or are there measures/initiatives for better exchange opportunities at the workplace despite working from home and physical distance?
- How do you think the proportion of formal and informal communication has changed as a result of the pandemic?

### **General Information on the Way of Work**

- What were the rules regarding working from home prior to the pandemic?  
*Inquiry:* How many days per week? If 0 % working from home: Why? Are there any reasons for this?
- How did your home-based work situation change over the course of the pandemic?  
*Inquiry:* Can you tell me something about your working conditions? Location (study, environment, housing situation, sources of disturbance e.g. noise)  
*Inquiry:* What does the equipment of your workplace look like?
- Have your working or break times changed?  
*Inquiry:* Has your productivity changed as a result of working from home? What about your concentration and distraction?  
*Inquiry:* How do you rate the compatibility of work and leisure time while working from home due to the pandemic compared to a time prior to the pandemic?  
*Inquiry:* How do you yourself feel about the current work situation during the pandemic?

### **Conclusion**

- If you could make a wish. What do you want your work situation to look like beyond the pandemic?
- Are there any other aspects to the topic of communication and the pandemic that we haven't touched yet that still seem important to you?