



1. Introduction

Introductory sections to scientific or popular literature covering issues of health and safety at work often begin with explanations about the much acclaimed so-called changing nature of work, or the increasing relevance of, in this case, psychosocial factors at work regarding adverse health effects. Even though these are facts that are surely not to be neglected throughout this thesis – they will even be explained further –, one should rather put the question if such an introduction is still necessary. The reason for this thought is that mental stress constitutes a factor the working population is exposed to in the same way as with any other physical hazard, not indicating the need for further justifications any more. Since we are today much better capable of assessing both the negative and positive impact of work and its complex and sometimes reciprocal relationships with a variety of health-related and organizational outcomes, the cause-effect chain attains a new quality. Current knowledge indicates that psychosocial factors at work are responsible for increasing proportions of variance in outcomes like accidents and injuries (Cooper, Liukkonen, & Cartwright, 1996; Leitão & Greiner, 2016), absenteeism and presenteeism (Caverley, Cunningham, & MacGregor, 2007; Darr & Johns, 2008), or musculoskeletal disorders (Angerer, Siegrist, & Gündel, 2014), than previously assumed or even detectable. Taking this into account, the Directive 89/391 EEC and the guidance on risk assessment at work by the European Commission (1996) oblige employers to analyse, evaluate and deal with work-related hazard in the scope of occupational risk assessment. In 2013, psychosocial factors at work were specifically incorporated into the German Occupational Safety at Work Act (Bundesministerium der Justiz und für Verbraucherschutz, 2013).

Risk assessment is a systematic step-by-step process to combat potential hazards arising from work, encompassing the three major phases of hazard analysis, evaluation (assessment of risks, design of interventions and corrective or preventive strategies), and reduction (implementation of measures, monitoring, reviewing and documenting) (Clarke & Cooper, 2004). Risk assessment is thus a process rooting in the discipline of applied science, as it is composed of elements of job and stress analysis, as well as interventional research, forming a wide-ranged multiple hazard-multiple outcome model with organizational and job stress interventions as the central mediator. However, several studies suggest that the actual level of application of risk assessment is insufficient (Beck, Richter, Ertel, & Morschhäuser, 2012; Ertel

et al., 2010; Iavicoli et al., 2011; Leka, Jain, Iavicoli, & Di Tecco, 2015). A major barrier in conducting psychosocial risk assessment seems to be a lack of methodological expertise (Eurofound, 2012). Therefore, the present thesis provides, besides a sound theoretical introduction to occupational stress research, three empirical analyses that aim to support organizations and applied science in how psychosocial hazards can be investigated and evaluated by the example of a large European steel manufacturing company with seat in Germany.

To begin with, the **second chapter** elucidates the role of work and health within social change and gives an overview of the terminology used in research, since meanings of terms such as workload, stress, mental stress, strain, and many further, are sometimes confusing and moreover used inconsistently. The **third chapter** provides a detailed but nevertheless concise introduction to the many existing theories in occupational stress research. Following, the **fourth chapter** describes the psychobiological pathways of the stress response and the pathophysiology of stressful conditions. Furthermore, the current state of research regarding the short- and long-term effects of the broad construct of psychosocial factors at work is described to emphasize the role of mental stress as an occupational risk and its impact on health and well-being. The **fifth chapter** finally covers the topic of psychosocial risk assessment. Here, legal and normative requirements are described as well as how psychosocial hazards can be integrated into general risk assessments, also by elucidating possible procedures and methods for investigation and evaluation. Lastly, methodological issues with respect to different methods of analysis are discussed. **Chapter six** comprises the three empirical analyses. As this thesis is publication-based, each analysis is presented in the style of a manuscript for publication with its own introduction, results and discussion section. The **seventh chapter** of this thesis then provides a general discussion linking the findings and implications of all three analyses. Furthermore, implications for applied science, discussing the impact of the analyses and research opportunities emerging from the results above what has already been elucidated in the manuscripts, are presented. A final conclusion, not again summarizing the empirical results but rather briefly outlining the future relevance of the topic and its significance for legislative as well as labour market policy, concludes this thesis.



2. Work and Health Within Social Change

Scarcely anything other than Fordism and Taylorism has changed work so radically in the 20th century. Even though both are not directly analogous, they are the epitome of standardized and machine centric industrial mass production. Rapid advances in technology, especially in computer and information technology, organizational restructuring, new management concepts, and globalization are eminent drivers of fundamental changes in work (Blickle & Schneider, 2010; Cascio, 2003). Following Eichhorst, Kendzia, Schneider, and Buhrmann (2013), current changes in work are primarily induced by customer-focussed production, demanding organizations to provide flexible and needs-based production lines and services. A fact nearly everyone experiences positively when going to the supermarket. This need for flexibility is shifted back onto the employees in shape of modified organizational structures (Cascio, 2003; Eichhorst et al., 2013). Participative and self-organizing processes are essential to the functionality of project dependant business or network-based information structures (Blickle & Schneider, 2010), as found for instance in systems with flat hierarchies or multifunctional teams. Increased responsibility, initiative and reflexion through the employees enable systems to develop joint solutions for complex issues (Kruse, 2008). These processes increase workers' control but likewise result in increased responsibility and risk assumption with an extended and dynamic range of performance. According to learning theory, this strengthens behavioural patterns focussing on success or avoiding failure, possibly to the detriment of health and personal life (Cartwright & Holmes, 2006; Sauer, 2012). One could now assume a retrogression from Taylorism, so that workers attain increased control or degrees of freedom, but the sequential completeness of action as initially curtailed by Taylorism and Fordism is not necessarily regained. Management by objectives supersedes simple instructions, whilst focus shifts from valuing mere performance fulfilment to acknowledging success (Blickle & Schneider, 2010; Cascio, 2003; Lohmann-Haislah, 2012; Sauer, 2012). In addition, work and private life are increasingly affected by cognitive demands. Electronic devices such as smartphones, tablets, human-computer interaction and machine control, multifaceted tasks, and heterogeneous goal structures are symbolic for current social change. Especially electronic tools provide resources and helpful assistance in many cases, but likewise exert demands on individual capacity and knowledge, which are mental and not physical in nature (Sharpley & Megaw, 2015). Furthermore, precarious em-



ployment characterized by discontinuous and uncertain life phases, accompanied by social instabilities and inequalities, increased during the last decades (Bosma, 2006; Siegrist & Marmot, 2006). Unequal accessibility to health resources due to social inequalities result in disproportional distributions of health in society in general. Indeed, the quality of health care systems especially in western industrial states has improved. However, there is a shift from combating infectious diseases and mass epidemics to mental and psychosomatic diseases and impairments (Hurrelmann, 2010; Siegrist, 2009). Chronic degenerative diseases like cardiovascular, metabolic, cancerous, and mental diseases occur more and more frequently, perhaps also due to the expanding western life style. This process has been termed coca-colonization by the British novelist Koestler (1976), which according to Zimmet (2000) is characterized by physical inactivity, malnutrition, overweight, and increasing psychosocial stress. In addition, precarious life phases, also caused by organizational restructuring and downsizing, change former loyalty to cynicism and mistrust (Cartwright & Holmes, 2006; Cascio, 2003), and put mental and physical health of organizational members at risk (Blickle & Schneider, 2010; Kieselbach et al., 2009). This is also reflected in the proposed fundamental changes of the psychological contract binding workers and employers, as presented in table 1.

Table 1 Changes in the psychological contract (Cascio, 2003, p. 403)

Old psychological contract	New psychological contract
Stability, predictability	Change, uncertainty
Permanence	Temporariness
Standard work patterns	Flexible work
Valuing loyalty	Valuing performance and skills
Paternalism	Self-reliance
Job security	Employment security
Linear career growth	Multiple careers
One-time learning	Life-long learning

Although changes usually provide chances for new developments as well, a strong impact of work and society on health and well-being of employees can be determined. Evaluating this impact *inter alia* requires investigating the effects of work-related psychological stress on different outcomes on the behavioural, somatic, and mental level (Scheuch, 2011; Wilson & Sharples, 2015a). As work constitutes a major part of life, effects can be expected from this direct proportional relation



(Lohmann-Haislah, 2012) even though factors like personality, dispositional and physical factors, health behaviour, coping style, availability of resources, leisure time activity and others are likely to contribute as well (Frese & Zapf, 1988). The risk status of occupational stress to health and well-being has however been solidly evidenced in the past years (da Costa & Vieira, 2010; Fishta & Backé, 2015; Kivimäki & Kawachi, 2015; Pindek & Spector, 2016; Theorell et al., 2015).

2.1 Terminology

The field of occupational stress research is one that is confronted with a variety of differing constructs and a wide ranged terminology. Prominent approaches in job stress research like Beehr and Newman's (1978) content analysis list an extensive number of associated indicators of stress that are categorized in a total of six facets, comprising 16 constructs with a respective number of 159 variables representing these constructs. Later conducted reviews by Kahn and Byosiére (1992) or Ganster and Schaubroeck (1991) identify constructs like burn out or role ambiguity to be investigated more intensively than others, however with great variations in terminology and operationalization. In view of outcomes, the simple term strain (Darr & Johns, 2008; Frese & Zapf, 1988; Podsakoff, LePine, & LePine, 2007) is used contrarily to similar but rather narrowly or differently held terms like psychological strain (Beehr, 1995) or well-being (Danna & Griffin, 1999). Current terminology in occupational stress research grounds on the ergonomic stress-strain concept (Rohmert, 1986; Rohmert & Rutenfranz, 1975), subsuming all objective factors affecting humans under the heading stress, and its impact on and within humans under the heading strain. Originally conceived as a cause-effect model of stress related to physiological strain, the introduction of constructs stemming from medical, sociological, and psychological research led to inconsistent definitions and use of terms as experienced since then (Cox & Griffiths, 2010; Fink, 2016; Oesterreich, 2001; Ulich, 2011). Stress, (work-)load, stressors, demand, stress reaction, (unfavourable) strain, and strain consequences/reactions are often used synonymously or outside of comprehensive structures (Udris & Frese, 1999; Ulich, 2011). The succeeding subsections address these inconstancies and try to enlighten the current use of terminology in occupational stress research.

2.1.1 *Workload, Stress, and Mental Stress*

Workload is the amount of work employees are required to complete in a stipulated amount of time, including the mental and physical effort to perform (Darr & Johns,

2008). While the quantitative component refers to work pace and volume (Spector & Jex, 1998), the qualitative element of mental effort consists of for instance concentration (Sharples & Megaw, 2015) or willingness to perform (Hockey, 2013). Hence, workload is composed of interacting physical and cognitive elements within a social context (Sharples & Megaw, 2015). This can be conceived exclusively in the scope of pace and volume, or at a general level, which is why workload is also assumed to be an umbrella or generic term describing all kinds of demands exerted on the worker (de Waard, 1996; Hart & Staveland, 1988; Landry, 2012), even disregarding the interactional function. In addition, the term mental workload (MWL) has been proposed (Moray, 1979; Welford, 1978). MWL is likewise inconsistently used and defined, but there is at least some consensus in that it focusses on perceptual and cognitive processes for determining individual information processing capability for performing a task (Brookhuis & de Waard, 1993; da Silva, 2014; de Waard, 1996; Parasuraman, Sheridan, & Wickens, 2008). For Sharples and Megaw (2015), the complexity in defining MWL lies in its different constructs and operationalizations, and hence in a comprehensive validation. Young and Stanton (2002, p. 1018) provide an attempt focussing the attentional component of cognition: “The mental workload of a task represents the level of attentional resources required to meet both objective and subjective performance criteria, which may be mediated by task demands, external support, and past experience.” However, the authors themselves remark that the strong subjective approach with attention being the central cognitive process is insufficient. Wickens (2008, p. 452) and other authors have then proposed more general resource-oriented definitions, describing MWL as “the demand imposed by tasks on the human’s limited mental resources”. The related term cognitive load is also of little help, since its holistic appearing consideration of cognitive aspects originally stems from laboratory-based problem-solving methods with a focus on working memory approaches (Sharples & Megaw, 2015). Lastly, the International Organization for Standardization, 2015, *ergonomic principles related to mental work-load*, does – in spite of its name – not offer a satisfactory contribution in this respect as it simply grasps mental workload as a generic term.

Difficulties in defining stress or stressful conditions are similar to those of workload. In contrast to Selye (1936, 1951) who proposed the terms eustress and distress to clarify good and bad stress respectively, modern psychology conceives stress as a transactional process by appraising an imbalance between environmental demands and individual resources for coping, which is thus a state accompanied by aversive



emotions (Lazarus, 2001; Sonnentag & Frese, 2003). Conceptions of stress have strongly varied in the past decades (Väänänen, Anttila, Turtiainen, & Varje, 2012), and a uniform consensus in operationalization does still not exist (Kahn & Byosiore, 1992). The distinction of Selye can be considered as outdated (Hasselhorn & Portuné, 2010). The given explanation of stress however reveals a further major conceptual confusion, namely in how conditions resulting in stress are to be named. A demand is at first, what is implicitly reflected in the presented explanation, a value-free description of some external or internal influence affecting an individual and taxing his performance prerequisites (Hacker & Richter, 1984). A stressor however is conceived as a demand with an increased likelihood to have impairing effects, thus defined on a population based level (Semmer, McGrath, & Beehr, 2005). Hence, high job demands can also be grasped as a stressor. Mental stress however is a term stemming from German engineering approaches (Rohmert, 1986; Rohmert & Rutenfranz, 1975) that has gained general acceptance in terminology. International Organization for Standardization, 2015 defines mental stress as the “total of all assessable influences impinging upon a human being from external sources and affecting the person mentally” (International Organization for Standardization, 2015, p. 3). It is consequently value-free and exclusively focusses on the totality of external influences. Another word of frequent use combining psychological factors and surrounding social influences is the term psychosocial. Psychosocial factors however likewise describe the impact on victims of catastrophes or disasters, also at community level, or public and political phenomena including aspects of culture, health care, or various social contexts in human development (Woodward, 2015). Considering work-related contexts, a psychosocial hazard can be any occupational stressor possibly impairing workers’ health and well-being and determining work-related stress (Cox & Griffiths, 2015; Hupke, 2013; International Labour Organization & World Health Organization, 1986; Leka & Jain, 2010).

2.1.2 Resources and Mental Strain

According to Wieland-Eckelmann (1992), the meaning of the term mental stress can only be seen in its relation to individual prerequisites. Richter and Hacker (2014) therefore describe this relation as Anforderungs-Ressourcen-Wechselbeziehung (translation of the author: demands-resources-interrelation). The experience of mental stress is consequently determined by resources available to the individual (Lazarus, 2001). Bamberg, Busch, and Ducki (2003) describe resources as factors promoting growth potentials and health, and supporting action regulation, self-



organization and the impact of stress on a situational or personal level. Financial security, positive social relationships, control and social support are exemplary resources on the situational level, whilst self-efficacy, locus of control and problem-solving competence are respective personal resources (Bamberg et al., 2003). There is a certain degree of ambivalence in the stressor-resource relation, since for instance control must be recognized as such and be used deliberately before it can be perceived as a resource, whereas social relationships might as well become stressors in case of mobbing or conflicts. Irrespective of this, the availability of commensurate resources determine the impact of stressors on individuals, what is described as strain. Mental strain is the “immediate effect of mental stress within the individual depending on his/her individual preconditions” (International Organization for Standardization, 2015, p. 4). Psyche and physique react with (reversible) short-term somatic, psychological, and behavioural effects (Kahn & Byosiére, 1992; Scheuch, 2011) as for instance increased heart rate, elevated levels of epinephrine, mental fatigue or errors (Udris & Frese, 1999), while (limitedly reversible) middle to long-term effects such as psychosomatic complaints or dissatisfaction are above all chronic or lasting (Udris & Frese, 1999).

2.1.3 Health, Disease, and Well-Being

Conventional medicine divides health and disease into the dichotomous category of being either healthy or ill, each excluding the respective other (Knoll, Scholz, & Rieckmann, 2017). This understanding is analogous to engineering perspectives in that the functionality of human physiology is grasped as a system consisting of several machine components. Illness occurs when one or more components malfunction, why prevention strategies primarily focus on somatic complaints and harmful environmental influences. Sociologist perspectives on the contrary consider illness to be the absence of health, determining the value of being healthy as the potential of assuming responsibility to society with pursuant tasks and roles (Hurrelmann, 2010). Indeed, society largely determines which conditions constitute health and illness in everyday life. In psychiatry, the term disorder has been established to avoid the rigid classification of being ill. Clearly and ultimately diagnosing mental problems as illnesses is problematic. A mental disorder is defined as a significant departure from the existing norm in experience and behaviour related to thinking, feeling, and acting, associated with mental suffering experienced by affected individuals (Dilling, Mombour, & Schmidt, 2015). This reflects the idea of a continuum, albeit focussing pathogenesis. The approach of Antonovsky (1997) contrasts



conventional medicine by offering such a continuum-based approach, however to health and disease in a comprehensive manner. The dynamic concept of salutogenesis expects health to be a volatile process on an interval-like scale, which must be constantly maintained or restored. Absolute health or illness are the final points of this continuum which are never totally reached. The core of the concept lies in its resource-oriented perspective. Meaningfulness, manageability, and comprehensibility are key factors in the “aetiology of health”, constituting a programmatic contrafactum to pathogenesis (Knoll et al., 2017). However, even though Antonovsky’s approach has overcome the rigid classification of health and illness, the de facto conception of (mental) health is psychiatric: individuals are either healthy or ill (Keyes, 2005). This is also reflected in practice research, where relations between stress and strain are operationalized in a simple stimulus-response scheme. The complex aetiology and pathogenesis of different disorders and diseases according to current knowledge however leads to the inevitable conclusion that a biopsychosocial understanding of health is needed to adequately assess all levels of human health and well-being. This thought is also reflected in the probably most popular definition of health as outlined by the World Health Organization (WHO) in 1946 and in its current state of 2014: “Health is a state of complete physical, mental and social well-being and not merely the absence of disease or infirmity” (Preamble to the Constitution of the World Health Organization as adopted by the International Health Conference, New York, 19-22 June 1946, 1948; World Health Organization, 2014). Notably, the WHO definition outlines well-being as the key determinant to health. The construct of well-being in the workplace subsumes an enormous variety of outcomes such as job and life satisfaction, mental health (often anxiety, frustration and/or depression), physical complaints (musculoskeletal or comprehensive index scores), emotional states, happiness, job security, sleep quality, and many more, as well as their antecedents (Danna & Griffin, 1999; Sparks, Faragher, & Cooper, 2001).

2.1.4 Resilience, Detachment, and Work-Engagement

Positive approaches in work assessment have gained increasing attention in recent years, most of all the constructs of resilience, detachment, and work engagement. Psychological resilience has been grasped in many ways, but is most usually described as a kind of capacity or stability to successfully cope with or recover from significant aversive conditions (Lee & Cranford, 2008; Leipold & Greve, 2009). Much early research on resilience has been conducted in the field of child psychia-



try or consequences of disasters, shifting from investigating protective factors for coping, especially in young people, with stressors such as poverty or parental mental illness, to the process of overcoming such events (Fletcher & Sarkar, 2013). Since poverty, parental care, family function, social/school environment and intelligence/cognitive skills are still grasped as the main factors fostering resilience (Levine, 2003), the concept thus grounds on factors that cannot be influenced by workplace management. Hence, the increasing attention resilience has also gained in Occupational Safety and Health Management (Pecillo, 2016) is probably doubtful. In general, even researchers like Hobfoll (2011) have warned against romanticizing such constructs. Instead, a description such as organizational resilience characterizing the need to respond to changes in business environment (McAslan, 2010) might be more fruitful as resources are provided by job design, safety management, and organizational culture (Adolph, Lafrenz, & Grauel, 2012; Hollnagel, Woods, & Leveson, 2006). However, the concept of resilience has also been criticized, as Kaplan (2005, p. 39) for instance remarks the “deceptively simple construct of resilience” to be “rife with hidden complexities, contradictions, and ambiguities”. According to Kaplan (2005), it is not clear whether resilience is similar or different to related concepts such as hardiness or mastery, or whether there is a distinguishable opposite of non-resilience or vulnerability. Especially the latter criticism is reflected in an imprecise definition of resilience given by the European Commission (2012, p. 5): “Resilience is the ability of an individual, a household, a community, a country or a region to withstand, to adapt, and to quickly recover from stresses and shocks”. Providing resources by means of legislative directions to improve living standards on a large scale however has an entirely different meaning and impact, wherefore the development of international standards to resilience (Pecillo, 2016) appears in a different light. If a new term is necessary for this purpose is however arguable.

Recovery from work during leisure time includes feelings of psychological detachment, relaxation, mastery experiences, and control (Sonnentag & Fritz, 2007). Recovery from work can be seen as a counter-effect to the experience of strain (Meijman & Mulder, 1998; Sonnentag & Fritz, 2007), while relaxation can reduce complaints induced by occupational stress (van der Klink, Blonk, Schene, & van Dijk, 2001). Off-job activities distracting from work and offering opportunities for learning and development through mastery experiences are related to increased recovery abilities (Fritz & Sonnentag, 2006; Rook & Zijlstra, 2006; Sonnentag & Fritz, 2007), while control in this case is defined as the degree individuals can determine themselves which leisure activities to pursue (Sonnentag & Fritz, 2007). Psychologi-