MASTER'S THESIS

The influence of technostress on learning and Psychological Safety

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The influence of technostress on learning and Psychological Safety.

De invloed van technostress op leren en psychologische veiligheid.

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Abstract

Organisational ICT use may also have detrimental effects such as increased stress levels of employees. This research adopted a data analysis method (Path Least Squared Structural Equation Model (PLS-SEM)) based on the steps described by Hair et al. (2016): specify the structural model, specify the measurement model, and examine the data by means of determining statistical significance. When using PLS-SEM the research' data analysis accounts for and maximises the amount of variance not explained by other variables.

The key contribution of this research is the influence of technostressors on psychological safety and learning by means of PLS-SEM analysis. A model was constructed based on the findings in the literature. The reason knowing the influence is enabling and enhancing learning. In regard that some of the hypothesis do not adhere to results described in the literature this research rejected the hypothesis. There was no measurable influence of technostress on psychological safety and learning.

Key terms

Technostress, Psychological Safety, and Learning.

Summary

In this day and age, information and communication technology (ICT) is omnipresent in organisations (Kravchenko & Cass, 2018; Maurseth, 2018; McDowall & Kinman, 2017). The use of ICT is known to enhance the productivity and efficiency of organisations (Ayyagari et al., 2011). However, organisational ICT use may also have detrimental effects such as increased stress levels of employees (Ayyagari et al., 2011). Stress caused by ICT use is often referred to as technostress (Ayyagari et al., 2011) and consists of a known set of stressors: overload, invasion, complexity, insecurity, uncertainty, and unreliability (Fischer & Riedl, 2015). Stress itself is not easily definable as multiple definitions and explanations exist. This thesis follows the definition given by Ayyagari (2011): "Stressors are the stimuli encountered by the individual, and strain is defined as an individual's psychological response to the stressors."

The pervasive use of ICT in modern workplaces raises some interesting questions about the relationship of technology and employee behaviour. On the one hand, several stressors associated with information technology (technostressors) can improve employee learning as they challenge the employee to find new ways of working. On the other hand, other stressors associated with technology use, such as privacy invasion, can be detrimental to learning as they decrease psychological safety, thus creating an environment that is unfavourable for learning. This basic tension in the relationship between technostress and learning led to the following research question:

What is the influence of technostressors on learning and psychological safety?

The following subquestions where formulated based on the research question:

- What is the effect of the technostressors on learning?
- What is the effect of the technostressors on psychological safety?

Psychological safety is described as a belief among employees that their organisation is safe for interpersonal risk-taking (Carmeli, Brueller, & Dutton, 2009). This belief is described as tacit: it is taken for granted and never discussed openly (A. Edmondson, 1999). It is described as a sense of confidence that colleagues will not embarrass, reject, or punish someone for speaking up. This confidence stems from mutual respect and trust among team members and colleagues (Carmeli et al., 2009; A. Edmondson, 1999). However, psychological safety extends beyond trust. It can be considered a working climate characterised by interpersonal trust and mutual respect in which people are comfortable being themselves (A. Edmondson, 1999). It impacts several behaviours that are associated with learning, such as seeking feedback, sharing information, asking for help, talking about errors, and experimenting (A. Edmondson, 1999). Employees perform these behaviours to detect changes in the environment, learn about customers' requirements, improve employees' collective understanding, or discover unexpected consequences of previous actions as part of collaboration among colleagues (A. Edmondson, 1999).

Psychological safety is about the perception of employees (Carmeli et al., 2009; A. Edmondson, 1999). (Techno)stress is also about perception (Ayyagari et al., 2011). A survey is a tool for that determines perception (Alan Bryman & Bell, 2015; Saunders, 2011). With a survey, a larger population results in better data (Alan Bryman & Bell, 2015; Nowack, 1990; Saunders, 2011). Thus, to have as large a population as possible, an Amazon gift card of $200 was raffled among the participants of the survey who completed the survey (Church, 1993). The downside of a reward is that participants may not be telling the truth (intentionally or not) (Stecklov, Weinreb, & Carletto, 2018). A survey is considered an appropriate way to conduct this research.

This research adopted a data analysis method that is based on the steps described by Hair et al. (2016): (1) specify the structural model, (2) specify measurement model, (3) examine the data by means of determining statistical significance. By using PLS-SEM, the data analysis accounts for and maximises the amount of variance not explained by other variables. Therefore, PLS-SEM allows for the estimation of complex cause-effect relationship models with latent variables (Hair et al., 2016). PLS-SEM is considered appropriate for analysing the data from this research.

The key contribution of this research is the influence of technostressors on psychological safety and learning by means of PLS-SEM analysis. A model was constructed based on the findings in the literature. In regard that some of the hypothesis do not adhere to results described in the literature of stress, psychological safety and learning, this

research rejected the hypothesis. There was no measurable influence of technostress on psychological safety and learning.

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1. Introduction

In this day and age, information and communication technology (ICT) is omnipresent in organisations (Kravchenko & Cass, 2018; Maurseth, 2018; McDowall & Kinman, 2017). The use of ICT is known to enhance the productivity and efficiency of organisations (Ayyagari et al., 2011). However, organisational ICT use may also have detrimental effects such as increased stress levels of employees (Ayyagari et al., 2011). Stress caused by ICT use is often referred to as technostress (Ayyagari et al., 2011) and consists of a known set of stressors: overload, invasion, complexity, insecurity, uncertainty, and unreliability (Fischer & Riedl, 2015). Stress itself is not easily definable as multiple definitions and explanations exist. This thesis follows the definition given by Ayyagari (2011): "Stressors are the stimuli encountered by the individual, and strain is defined as an individual's psychological response to the stressors."

Experiencing stress in the work environment can have both positive and negative consequences for employees and the organisation (Joëls, Pu, Wiegert, Oitzl, & Krugers, 2006) because stress influences learning (Joëls et al., 2006; Smeets et al., 2009). Learning is important for productivity (Carmeli et al., 2009; A. Edmondson, 1999) and as such is seen as a contributor to organisational performance. Related to its effect on learning, stress also influences the degree to which employees feel safe for interpersonal risk-taking in the working environment (A. Edmondson, 1999; Joëls et al., 2006). Interpersonal risk-taking is referred to as psychological safety (A. Edmondson, 1999).

Psychological safety is coined by Edmondson (1999) as a belief among employees that their organisation is safe for interpersonal risk-taking (Carmeli et al., 2009). This enables learning as it allows the employee to experiment without fearing repercussions (A. Edmondson, 1999). Learning is defined in this thesis as a process in which people interact with their environment to determine what needs improving and how to make these improvements (Carmeli et al., 2009). Edmondson (1999) coined the term "learning behaviour", which is considered to be a process to adapt to change, gain a greater understanding, or improve performance (A. Edmondson, 1999).

The pervasive use of ICT in modern workplaces raises some interesting questions about the relationship of technology and employee behaviour. On the one hand, several stressors associated with information technology (technostressors) can improve employee learning as they challenge the employee to find new ways of working. On the other hand, other stressors associated with technology use, such as privacy invasion, can be detrimental to learning as they decrease psychological safety, thus creating an environment that is unfavourable for learning. This basic tension in the relationship between technostress and learning led to the following research question of this thesis:

What is the influence of technostressors on learning and psychological safety?

The following subquestions where formulated based on the research question:

- What is the effect of the technostressors on learning?
- What is the effect of the technostressors on psychological safety?

The influence of technostressors on learning and psychological safety provide some guidance for organisational management to carefully manage technostress by means of its stressors. When some technostressors inhibit learning, these technostressors should be reduced. When some of the technostressors strengthen learning, these technostressors should be carefully managed to promote learning and increase psychological safety. When there is no relationship between learning and technostressors, there is no need for organisations to address them. From a scientific point of view, this thesis contributes to the knowledge of the effects of stress in working environments.

Technostress is a relatively new scientific topic and much research is needed to investigate the effects of the dark side of technology on the work environment. In some circumstances, the dark side may not be so dark after all. The ability to differentiate between types of stressors by context and identify the positive and negative effects of stress can enhance the scientific understanding of stress in the workplace. Stress may not always be negative and may even be useful in some cases.

To research the influence of technostressors on learning and psychological safety, the literature of the two concepts were explored. From this literature research, several hypotheses were deducted. These hypotheses were operationalised in a survey utilising previously validated and tested survey instruments.

The thesis consists of several parts. Chapter 2 describes the theoretical basis for this research is explained in detail. Based on this theoretical framework, a set of hypotheses are presented. Chapter 3 describes the methodology used to investigate the hypotheses is presented. This part holds elaboration on the chosen research method as well as a discussion on reliability and validity. Finally, chapter 4 the results of the quantitative analysis are reported and discussed in context of the hypotheses and prior research.

2. Theoretical Framework

This section provides the theoretical framework of this thesis. From researching the literature, all the major concepts were identified and their possible relations. First, the literature research process is discussed. Next, the findings of the literature review are presented, including the different forms of technostress. Then, this manuscript elaborates on how these stressors potentially relate to the two outcome variables, psychological safety and learning.

2.1. Research for Framework

The aim of the literature research was to investigate the relationships between the concepts technostress, learning, and psychological safety. To do so, a structured search was conducted using the keywords “psychological safety”, “technostress”, “dark side of technology”, and “performance”.

The scientific databases (ABI/Inform, Academic Search, Google Scholar, JSTOR, ScienceDirect, and Scopus) and Academia.edu were queried with the chosen keywords. More than a million articles were found while querying. Subsequently, a search strategy based on keyword pairs was utilised (Vom Brocke et al., 2015). This strategy relied on the assumption that if two concepts are related, this relationship will also be manifest in the scientific literature. As such, a search was performed for each possible combination of keywords. From all the articles (sorted by relevance), the first 50 were explored. Table 1 shows the results.

Table 1. Search results

Keywords	Academia.edu	Scientific databases	Relevant
Technostress AND learning	0	362	0
Technostress AND stress	45061	583	>50
Stress AND learning	150556	58045	4
Psychological safety AND learning	194411	101100	>50
In total, 44 publications were relevant: 39 journal articles, 2 books, 2 conference papers, and 1 book chapter.			

2.2. Resulting Framework and Concepts.

The seminal theory on how stressors influence human behaviour was developed by Lazarus and Folkman (1984). From their theory, two major concepts emerge: appraisal and coping. Coping is defined as individuals' efforts in thought and action to manage specific demands (R. S. Lazarus, 1993). Lazarus and Folkman (1984) defined stress as "a particular relationship between the person and the environment that is appraised by the person as taxing or exceeding his or her resources and endangering his or her well-being". Importantly, stress is not a product of the balance between a person and the environment but a perception. The perception of the person experiencing stress is that the consequences of failure to cope with the situation is negative. Lazarus and Folkman (1984) placed emphasis on the appraisal of the events (that cause stress), and as a result, the objective elements in the environment, emotions, and resources are secondary (Richard S. Lazarus & Folkman, 1984).

Based on the model of Lazarus and Folkman (1984), a simplified model was constructed that describes stress as stressors that cause strain (Ragu-Nathan, Tarafdar, Ragu-Nathan, & Tu, 2008). Fischer and Riedl (2015) explored how technostress and technostressors are related to strain. The work of Lazarus and Folkman (1984), Ragu-Nathan et al. (2008), and Joëls et al. (2006) indicates that technostresssors cause strain and, therefore, alter behaviour and actions. Stress as it is defined in this thesis refers to psychological stress in the working environment (Ayyagari et al., 2011). This is often referred to as job stress (Ayyagari et al., 2011).

Technostress is stress caused by ICT (Ayyagari et al., 2011). Fischer and Riedl (2015) identified several stressors related to technology that are thought to have the potential to create strain in individuals: overload (too much information at once and multitasking), invasion (being always online), complexity (users find it difficult to use and or learn information systems), insecurity (feeling insecure about their jobs or they feel insecure about others knowing more), uncertainty (users of ICT feel unsettled by continual changes of ICT), and unreliability (users of ICT experience malfunctions) (Fischer & Riedl, 2015).

2.2.1. Technostress and Psychological Safety

Psychological safety is described as a belief among employees that their organisation is safe for interpersonal risk-taking (Carmeli et al., 2009). This belief is described as tacit: it is taken for granted and never discussed openly (A. Edmondson, 1999). It is described as a sense of confidence that colleagues will not embarrass, reject, or punish someone for speaking up. This confidence stems from mutual respect and trust among team members and colleagues (Carmeli et al., 2009; A. Edmondson, 1999). However, psychological safety extends beyond trust. It can be considered a working climate characterised by interpersonal trust and mutual respect in which people are comfortable being themselves (A. Edmondson, 1999).

Psychological safety may be decreased by the unreliability dimension of technostress because it decreases the belief that a context is safe for risk-taking. This is because the outcome of an activity involving technology may not be guaranteed due to unreliability (A. Edmondson, 1999; Fischer & Riedl, 2015). Edmonson (1999) wrote that trust is the expectation that others' future actions will be favourable to one's interests in such a way that one is willing to be vulnerable. In the case of unreliability, the stressor influences this expectation in a negative way. From this research, the following hypothesis was formed:

Hypothesis 1. *The degree to which information technology is perceived as unreliable decreases perceived psychological safety.*

Trust is conceptualised as individual attributions about the behaviours of others (A. Edmondson, 1999). These behaviours are governed by intentions and motivations towards an individual. Trust is considered to be a willingness to be vulnerable (Mayer, Davis, & Schoorman, 1995). Trust is an important aspect of psychological safety, and reduced trust means less psychological safety (A. Edmondson, 1999). Psychological safety is expected to be decreased by the perceived insecurity of information technology because it could decrease the belief that a context is safe for risk-taking. This may be the case when employees do not believe it is safe to perform work-related activities with ICT (A. Edmondson, 1999; Fischer & Riedl, 2015). The stressor insecurity is based on job insecurity. Job insecurity is the perception of powerlessness to maintain desired continuity in a threatened job situation (Greenhalgh & Rosenblatt, 1984). The higher the job insecurity, the lower the trust (Ashford, Lee, & Bobko, 1989). From this research, the following hypothesis was formed:

Hypothesis 2. *The degree to which information technology is perceived as insecure decreases perceived psychological safety.*

Psychological safety and trust are descriptions of intrapsychic states related to intrapersonal experiences (A. C. Edmondson, Kramer, & Cook, 2004). Psychological safety is seen as a group-level construct, whereas trust is seen as an expectation of the individual (A. C. Edmondson et al., 2004). Both describe psychological states involving perceptions of risk or vulnerability (A. C. Edmondson et al., 2004). Perceptions of risk or vulnerability are associated with job sustainability and job security, and the use of information technology increases the perception of risk or vulnerability (Nam, 2019). This leads to uncertainty in job security (Vieitez, Carcía, & Rodríguez, 2001).

The relationship between trust and uncertainty is of a complicated nature as it is multileveled and complex (Jiang & Probst, 2015). The loss of trust may in turn provide an explanation for the effects of job insecurity (Richter & Näswall, 2019). This means trust and uncertainty are related (Ashford et al., 1989). Edmondson et al. (2004) wrote that trust is likely to be an essential prerequisite for team psychological safety. In addition, trust is decreased by uncertainty (Costa, 2003). Therefore, perceived uncertainty may reduce psychological safety. From this research, the following hypothesis was formed:

Hypothesis 3. *The degree to which information technology is perceived as uncertain decreases perceived psychological safety*.

2.2.2. Technostress and Learning

Psychological safety is about collaboration in the workplace (A. Edmondson, 1999). It impacts several behaviours that are associated with learning, such as seeking feedback, sharing information, asking for help, talking about errors, and experimenting (A. Edmondson, 1999). Employees perform these behaviours to detect changes in the environment, learn about customers' requirements, improve employees' collective understanding, or discover unexpected consequences of previous actions as part of collaboration among colleagues (A. Edmondson, 1999).

Learning is very important in organisations because work is becoming highly interdependent. Coworkers often need other coworkers for information and to help them with various issues (Carmeli et al., 2009). Joëls et al. (2006) found several relationships between learning and stress. Stress has a physical component. A large part of stress is governed by hormones that affect the body, including the mind. Experiencing stress changes hormones that influence learning (Joëls et al., 2006). When the stressors are related to the subject that is to be learned, they enhance learning (Joëls et al., 2006). The two aspects that are moderating factors in regard to learning that Joël et al. (2006) identified as enhancers or inhibitors of learning are the *context of learning* and the *timing aspects of learning.*

Learning for employees is an activity and consists of learning tasks (Joëls et al., 2006). These tasks can be invaded by technostressors that are context bound. Context-bound technostressors originate with or are the information technology to be used (Fischer & Riedl, 2015). Joëls et al. (2006) also wrote that when stressors are more frequent, the level of stress hormones increase. These stressors enhance learning (Joëls et al., 2006). As a result, work-related invasive information may increase learning (Fischer & Riedl, 2015; Joëls et al., 2006). From this research, the following hypothesis was formed:

Hypothesis 4. *The degree to which information technology is perceived as invasive enhances the perceived learning.*

Joëls et al. (2006) wrote about timing and learning tasks. When stressors are present in high amounts either before or a considerable time after a learning task (Figure 1), they inhibit learning. This is because a high amount of stress hormones is known to impair learning. This could affect employees with a perception of overload to a degree that learning is affected. Overload means that employees receive too much information and multitask regularly (Ayyagari et al., 2011). This implies a timeless relation due to the omnipresence of information technology (Kravchenko & Cass, 2018; Maurseth, 2018; McDowall & Kinman, 2017). From this research, the following hypothesis was formed:

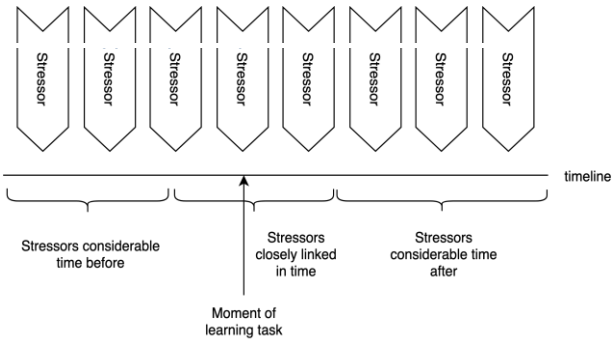

Figure 1. Timing aspects.

Hypothesis 5. *The degree to which information technology is perceived as an overload inhibits the perceived learning*.

When something is perceived as complex, it increases the possibility for errors (Klein, 1996). When an employee does not have valid handling strategies for dealing with the errors, it can be a source of stress (Michie, 2002). When these stressors converge in space and time (with the information technology to be learned), the stress hormones increase

(Joëls et al., 2006). Thus, the information technology to be learned and its degree of complexity may increase learning (Fischer & Riedl, 2015; Joëls et al., 2006). From this research, the following hypothesis was formed:

Hypothesis 6. *The degree to which information technology is perceived as complex enhances perceived learning.*

Based on the literature above, a conceptual model was created. In this model, the relation between the concepts and the direction is depicted. These relations and directions are based on the literature review above. Figure 2 presents the conceptual model.

Testing Hypotheses 1, 2, 3, and 5 will contribute to the understanding of which technostressors reduce psychological safety and learning. Testing Hypotheses 4 and 5 will contribute to the understanding of which technostressors promote psychological safety and learning.

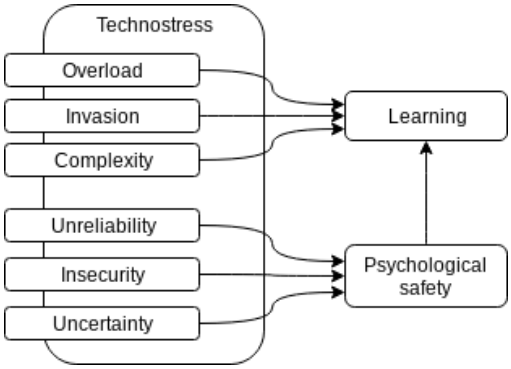

Figure 2. Conceptual model.

3. Methodology

In this section, substantiation for the empirical research is presented. This research was cross sectional and explanatory of nature (Saunders, 2011). The reason for this is that the hypotheses are not explicitly researched in the literature. Research methods that can be applied to complete this research are questionnaires, experimentation, and observation (Saunders, 2011).

Psychological safety is about the perception of employees (Carmeli et al., 2009; A. Edmondson, 1999). (Techno)stress is also about perception (Ayyagari et al., 2011). With a survey, a larger population results in better data (Alan Bryman & Bell, 2015; Nowack, 1990; Saunders, 2011). Thus, to have as large a population as possible, an Amazon gift card of $200 was raffled among the participants of the survey who completed the survey (Church, 1993). The downside of a reward is that participants may not be telling the truth (intentionally or not) (Stecklov et al., 2018). A survey was considered to be an appropriate way to conduct this research.

This research sampled a population of people working in an organisation and using ICT. The sample was obtained from the users of Reddit and Linkedin and, thus, can be considered a convenience sample (Saunders, 2011; Shatz, 2017). One advantage of this sample was that the participants were demographically dispersed (Bogers & Wernersen, 2014; Mills, 2018; Shatz, 2017). As a result, no cultural, age, or gender bias was expected. Shatz (2017) considered Reddit.com to be a viable source for participants. A second advantage was that the participants were ICT users and, as users of social media, may have experienced technostress (Bucher, Fieseler, & Suphan, 2013; Carr & Hayes, 2015). To counteract socially desirable answers, the questionnaire was web based and anonymous.

The disadvantage of obtaining participants from reddit.com and linkedin.com is that they may not be part of the targeted population (Duggan & Smith, 2013). Thus, filtering questions were needed and are discussed later in the text. The users of Reddit and LinkedIn are not ideally demographically dispersed (Duggan & Smith, 2013). In general, users of social media are young (approximately 25 years of age) and are slightly more likely to be male than female (Bogers & Wernersen, 2014). By contrast, the average social media user is 40 years of age and the average male-female participation rate is 50% ((ilo), 2018). This means the number of female participants was expected to be higher than average labour participation (the population).

3.1. Survey Questions

A table of survey questions is shown in Table 2. These questions are sorted by topic (psychological safety and technostress). Each question had a corresponding code that could be traced back to the topic and concept. The reference column in the table depicts the source of the question.

Table 2. Survey questions

Topic	Code	Question	Reference
Psychological safety			
Team learning	PST1	We regularly take time to figure out ways to improve our work processes.	(A. Edmondson, 1999)
	PST2	My colleagues tend to handle differences of opinion privately or off-line, rather than addressing them directly as a group.	(A. Edmondson, 1999)
	PST3	Colleagues go out and get all the information they possibly can from others-such as customers, or other parts of the organisation.	(A. Edmondson, 1999)
	PST4	Me and my colleagues frequently seeks new information that leads us to make important changes.	(A. Edmondson, 1999)
	PST5	Among my colleagues, someone always makes sure that we stop to reflect on the work process.	(A. Edmondson, 1999)
	PST6	People in my organisation often speak up to test assumptions about issues under discussion.	(A. Edmondson, 1999)
	PST7	We often invite people from outside the team to present information or have discussions with us.	(A. Edmondson, 1999)
Work psychological safety	PSW1	If you make a mistake at work, it is often held against you.	(A. Edmondson, 1999)
	PSW2	Me and my colleagues are able to bring up problems and tough issues.	(A. Edmondson, 1999)
	PSW3	I or my colleagues sometimes reject others for being different.	(A. Edmondson, 1999)
	PSW4	It is safe to take a risk at work.	(A. Edmondson, 1999)
	PSW5	It is difficult to ask other colleagues for help.	(A. Edmondson, 1999)
	PSW6	No colleagues would deliberately act in a way that undermines my efforts.	(A. Edmondson, 1999)
	PSW7	Working with colleagues, my unique skills and talents are valued and utilised.	(A. Edmondson, 1999)
Technostress			
Techno-overload	TTOL1	I am forced by information technology to work much faster.	(Wang, Shu, & Tu, 2008)
	TTOL2	I am forced by information technology to do more work than I can handle.	(Wang et al., 2008)
	TTOL3	I am forced by information technology to work with very tight time schedules.	(Wang et al., 2008)
Techno-invasion	TTIV1	I am forced to change my work habits to adapt to new information technologies.	(Wang et al., 2008)
	TTIV2	I have a higher workload because of increased information technology complexity.	(Wang et al., 2008)
	TTIV3	I spend less time with my family due to information technology.	(Wang et al., 2008)
	TTIV4	I have to spend a lot of time everyday reading an overwhelming amount of email messages.	(Wang et al., 2008)
	TTIV5	I have to work harder because of delays from hardware, software and network problems.	(Wang et al., 2008)
	TTIV6	I have to be in touch with my work even during my vacation due to information technology.	(Wang et al., 2008)
	TTIV7	I have to sacrifice my vacation and weekend time to keep current on new information technologies.	(Wang et al., 2008)
	TTIV8	I feel my personal life has been invaded by information technology.	(Wang et al., 2008)
Techno-complexity	TTCM1	I do not know enough about information technology to handle my job satisfactorily.	(Wang et al., 2008)
	TTCM2	I need a long time to understand and use new information technologies.	(Wang et al., 2008)
	TTCM3	I do not find enough time to study and upgrade my digital skills.	(Wang et al., 2008)
	TTCM4	I find new recruits to this organisation know more about computer technology than I do.	(Wang et al., 2008)
	TTCM5	I often find it too complex for me to understand and use new computer technologies.	(Wang et al., 2008)
	TTCM6	I feel constant threat to my job security due to new computer technologies.	(Wang et al., 2008)
	TTCM7	I am threatened by co-workers with newer computer technology skills.	(Wang et al., 2008)
Techno-insecurity	TTIS1	I do not share my computer knowledge with my co-workers for fear of being replaced.	(Wang et al., 2008)
	TTIS2	I feel there is less sharing of computer knowledge among co-workers for fearing of being replaced.	(Wang et al., 2008)
	TTIS3	I believe that ICTs make it easier for other people to perform my work activities.	(Ayyagari et al., 2011)
	TTIS4	I am worried that new ICTs may pose a threat to my job.	(Ayyagari et al., 2011)
Techno-uncertainty	TTUC1	There are always new developments in the computer technologies we use in our organisation.	(Wang et al., 2008)
	TTUC2	There are constant changes in computer software in our organisation.	(Wang et al., 2008)
	TTUC3	There are constant changes in computer hardware in our organisation.	(Wang et al., 2008)
	TTUC4	There are frequent upgrades in computer networks in our organisation.	(Wang et al., 2008)
Techno-unreliability	TTUR1	The features provided by information technology are dependable.	(Ayyagari et al., 2011)
	TTUR2	The capabilities provided by information technology are reliable.	(Ayyagari et al., 2011)
	TTUR3	Information technology behaves in a highly consistent way.	(Ayyagari et al., 2011)

3.1.1. Data collection, filtering, and examination

In this section, the methods used for collecting, filtering, and examining the data is explained. The questions in the survey have been used in several questionnaires in relation to both psychological safety and technostress (Ayyagari et al., 2011; Carmeli et al., 2009; A. Edmondson, 1999; Wang et al., 2008).

As some of the questions reflect a collegial working relationship, the survey asked participants about company size. The survey also included questions about colleagues (e.g., questions PST3, PSW2, and PSW3), which implied a minimal of two colleagues. In question PST3 there are references to 'other parts of the organisation', this implies that there should be multiple parts in the participants organisation and subsequently gives the need for filter questions.

Bryman and co-authors (1983) wrote about a minimum of 25 employees for specialisation to manifest in organisational parts. Child (1973) accounted for hierarchical structures combined with specialisation, resulting in an organisational size greater than 7 –8 employees. The respondents of the questionnaire were filtered using these criteria. Several other filtering questions in the survey were used to select the appropriate participants: working, older than 15 years of age (minimal working age according to the European Union), sex: female, male, will not tell, or other, and able to read English. These are measures to support the predictive validity of this research (Alan Bryman & Bell, 2015).

3.1.2. Control variables.

The control variables for psychological safety were age and tenure of employment (Carmeli et al., 2009). The control variables for technostress were age and computer confidence (Ayyagari et al., 2011). Computer confidence (I feel confident when it comes to working with computers) was added to the questionnaire because it has a strong relationship with computer self-efficacy (Khorrami-Arani, 2001) and is known to influence technostress (Shu, Tu, & Wang, 2011).

3.2. Data Analysis

This research adopted a data analysis method that is based on the steps described by Hair et al. (2016): (1) specify the structural model, (2) specify the measurement model, and (3) examine the data by means of determining statistical significance. By using PLS-SEM, the data analysis accounts for and maximises the amount of variance not explained by other variables. Therefore, PLS-SEM allows for the estimation of complex cause-effect relationship models with latent variables (Hair et al., 2016). PLS-SEM is considered appropriate for analysing the data from this research.

3.3. Reliability

The hypotheses of section 2.2 have been tested, and therefore, several measures were needed to ensure the results would be scientifically significant and reliable. These measures are described by Wasserstein, Schirm, and Lazar (2019) as follows: "**A**ccept uncertainty. Be **t**houghtful, **o**pen, and **m**odest. (ATOM)". ATOM is reflected in this thesis by (1) a strong statistical significance and (2) a method that accounts for variance and (3) models the conceptual model.

This research accepts uncertainty by being statistically valid. In order for the statistical testing to be valid, a large sample size is needed, so extra effort was made to obtain as many participants as possible (Hair et al., 2016; Nowack, 1990). With a global labour population of more than 3 billion, the minimum sample size of 1039 was calculated (J. Cohen, 1992; Marcoulides & Saunders, 2006; *World Employment and Social Outlook: Trends 2016*, 2016).

This research expects a small effect size and a significance criterion of .01 due to the exploratory nature. Because this research assumed low quality indicators, more participants is considered better. A higher number of participants increases the likeliness of noise in the data (Wasserstein et al., 2019). This noise can be the effect of errors in the survey, errors made by the participants, or other variables (Alan Bryman & Bell, 2015). The aspect of Wasserstein et al. (2019) *accepting uncertainty* results in the selection of PLS-SEM as the scientific method to process the data. PLS-SEM helps in accepting uncertainty by maximising variance of other variables (Hair et al., 2016). Also having a

sufficient level of power, say equal to .80, should be upheld to mitigate the differences in population and participants (see section 3) (Marcoulides & Saunders, 2006).

Another aspect that influences reliability is that the age of consent for research is different than the minimum employment age. The age of consent for research is usually 18 years (Saunders, 2011). Employees between 15 and 18 years of age are part of the population and should not be excluded. The statistical validity of the research could be negatively influenced by a population that is restricted because these employees have been exposed to technostress all their working lives and could have developed coping mechanisms (Richard S. Lazarus & Folkman, 1984).

The last aspect that influences reliability is that in the survey the questions are slightly altered to reflect not working in teams but working in organisations. The consequence of this is that the internal validity should be tested for the individual questions. For the internal consistency, Cronbach-alpha for each question in the survey was calculated, and the composite reliability was determined. To investigate and test whether the theory and the data are in coherence, convergent validity was used (Hair et al., 2016).

3.4. Ethical concerns of the Research

To conduct this research ethically, an ethical framework was constructed. Bryman and Bell (2015) discussed four areas to consider in examining ethical principles for business research. These areas inspired four questions to be answered when dealing with ethics in research in a business context. The ethical framework stated earlier was used to investigate ethical aspects of the method described above. For this, the four questions were answered:

1. Is there harm done to participants? Research of this nature should not or minimise harm (physically or mentally) to people or animals (Alan Bryman & Bell, 2015): No harm was directly done to the participant. One can argue that the topic of psychological safety could trigger emotions due to a realisation that feelings of not feeling safe exists (Alan Bryman & Bell, 2015).
2. Is there lack of informed consent? Research of this nature should not be executed without informed consent (Alan Bryman & Bell, 2015): Participants were briefed about the nature, purpose, and theme of the research at the start of the questionnaire. Participants were asked to mark if they understand the nature, purpose, and theme of the research and subsequently asked explicitly for consent. Appendix 2 contains the covering letter wherein the survey is introduced and its purpose is explained.
3. Is there an invasion of privacy? The privacy of people should not be invaded, all results should be anonymous (Alan Bryman & Bell, 2015): There is an invasion of privacy, but data will be processed anonymously. The data needed for the raffle will only be used to determine the winner among the participants. Appendix 2 contains the covering letter wherein the privacy aspects are explained.
4. Was there any deception? Deception can only take place when related to the concepts in the conceptual model but should be minimalised (Alan Bryman & Bell, 2015): No deception was needed as it was considered not helpful for this research. Instead, participants were provided with clear instructions (Alan Bryman & Bell, 2015).

Within business research, the research design should adhere to the ethical framework discussed above because it is a research study in a business context.

4. Results

This section describes the implementation of the research, including how this research was performed and exceptions to the plan of action. In order for this research to be reliable, 1039 respondents are needed (J. Cohen, 1992). However, the number of participants using LinkedIn.com and Reddit.com only yielded 83 respondents. To improve the validity of this research, it was decided to solicit additional participants from Amazon Mechanical Turk (MTurk). Thus, the two datasets were combined to analyse the responses and form conclusions. MTurk is considered a valid source of participants for surveys (Behrend, Sharek, Meade, & Wiebe, 2011; Goodman, Cryder, & Cheema, 2013). The total number of valid responses was 925, which was 114 responses short of the goal (11%). It took respondents 10 minutes and 43 seconds to complete the survey. In the next section, the respondent profile is discussed.

4.1. Respondent Profile

In accordance with previous research, the respondents in this sample varied (Bogers & Wernersen, 2014; Duggan & Smith, 2013; Goodman et al., 2013). The age of the respondents are listed in Figure 3. The top 12 industries of respondents are listed in Figure 4.

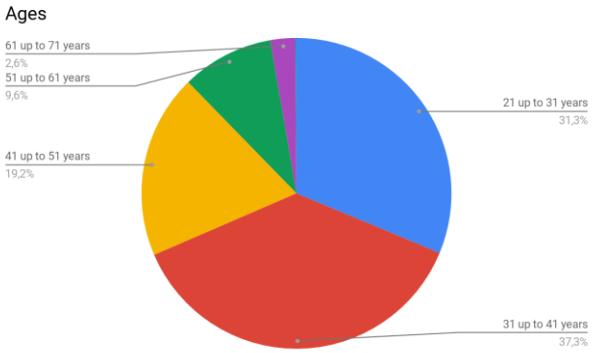

Figure 3. Age.

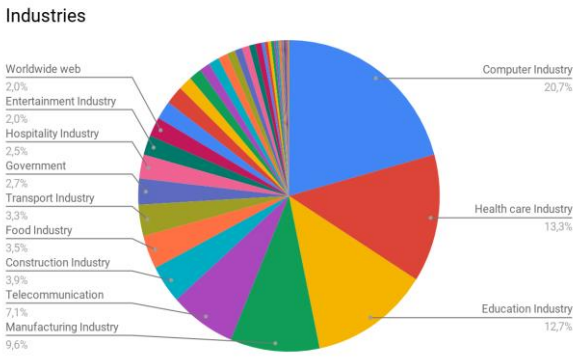

Figure 4. Industries.

Most of the respondents self-identified as male (50% male vs. 49% female); 5 did not want to disclose their sex. Most also (21%) worked in the computer industry; 13%, in healthcare industry; and 13%, in the education industry. The responses were aggregated towards appropriate industries. Only 7% of the respondents worked less than a year in their current job; the rest of the sample reported working longer. Most respondents were employed full time (94%). Most also worked 32 hours or more (90%), while 10% worked part time.

The highest education of the respondents was as follows: 53%, bachelor level; 22%, master level; 12%, secondary education; and 13%, other. Regarding work time, 27% of the respondents spent 30–50% of their time with ICT; 26%, 50–70%; 25%, 70–100%; 17%, 10–30%; and 5%, less than 10%. Therefore, the sample was considered to be varied. Table 3 shows the statistical data as described above in a tabular fashion.

Table 3. Statistics

		n
Age		
	15-21 years old (1)	8
	21-31 years old (2)	286
	31-41 years old (3)	342
	41-51 years old (4)	176
	51-61 years old (5)	88
	61-71 years old (6)	24
	>71 years old (7)	1
Employment		
	Full-time	869

	Other	56
Educational level		
	None (1)	5
	Primary education (2)	17
	Secondary education (3)	108
	Tertiary education (4)	82
	Bachelor (5)	490
	Master (6)	200
	Doctoral (7)	23
Number of Employees		
	11–25	128
	>25	797
Working hours per week		
	0-8 hours per week (1)	9
	8-16 hours per week (2)	21
	16-24 hours per week (3)	13
	24-32 hours per week (4)	19
	32-40 hours per week (5)	285
	40-48 hours per week (6)	452
	48-56 hours per week (7)	81
	56-64 hours per week (8)	27
	64-72 hours per week (9)	8
	72-80 hours per week (10)	4
	>80 hours per week (11)	6
Confidence in computing	Range: I completely agree (1)…. I fully disagree (7). Median of 2	925

The individuals in this particular study are a representative sample of the target population for generalization purposes. Most of the participants in the sample work fulltime (>32 hours per week) and so does the world labour force ((ilo), 2018). The median of the age in the sample is 31-41. The median of the world labour force is 40 ((ilo), 2018). In the population participation rates among women remain well below those for men. Our population does not reflect this fact ((ilo), 2018), the distribution of participants is almost equal between men and woman. The sample is considered representative for the population.

4.2. Data Analysis

There are several options for processing PLS-SEM. This thesis processed the data using the programming language R, R-studio, and the packages semPLS and matrixPLS. The programme used to process the data was constructed as described by Monecke and Leisch (2012). The program can be viewed online at https://rstudio.cloud/project/368472. This thesis follows the reporting suggestions of Hair et al. (2016) to first evaluate the outer measurement model and then evaluate the inner structural model.

4.2.1. Evaluation of the outer measurement model

The evaluation of the outer measurement model was aimed to calculate the reliability, internal consistency, and validity of the observed variables (as measured by the questionnaire) together with unobserved variables (Hair et al., 2016).

4.2.1.1. Reliability

The measurements used to investigate reliability are Cronbach's alpha (CA), composite reliability (CR), and average variance extracted (AVE). Most of the CA values and CR values were very close, except for work psychological safety and techno-complexity. These values were expected to be close to one another.

Cronbach's alpha is a measure of internal consistency. It shows how closely related a set of items are as a group. It is also considered to be a measure of scale reliability. However, a "high" value for Cronbach's alpha does not imply that the measure is unidimensional, so CR and AVE were also calculated. All the measurements (as shown in Table 4) indicated internal consistency (Hair et al., 2016).

CR is used to assess the shared variance among observed variables. In this research, it was used as an indicator of a latent construct. CR was calculated by means of Dillon-Goldstein's rho. The CR values were shown to be of the same range as the CA values. For techno-complexity, these values were not in the same range. In Table 4, these values are marked in red (Hair et al., 2016).

AVE is a measure of the amount of variance that is captured by a construct in relation to the amount of variance due to measurement error (Fornell & Larcker, 1981). AVE has its limitations according to Henseler et al. (2015); however, it is included for completeness. A value of greater than 0.4-0.5 is considered acceptable in social science (Hair et al., 2016). For techno-complexity, the values were considered not valid; in Table 4, these are marked in red.

Table 4, Reliability

Topic	Question	Loadings	Cronbach's Alpha	Composite reliability	AVE
Psychological safety					
Team learning	PST1	0.77	0.84	0.88	0.52
	PST2	0.37			
	PST3	0.80			
	PST4	0.84			
	PST5	0.76			
	PST6	0.78			
	PST7	0.62			
Work psychological safety	PSW1	0.38	0.74	0.8	0.38
	PSW2	0.83			
	PSW3	0.38			
	PSW4	0.60			
	PSW5	0.47			
	PSW6	0.66			
	PSW7	0.84			
Technostress					
Techno-overload	TTOL1	0.93	0.84	0.93	0.82
	TTOL2	0.89			
	TTOL3	0.91			
Techno-invasion	TTIV1	0.73	0.89	0.90	0.56
	TTIV2	0.79			
	TTIV3	0.73			
	TTIV4	0.79			
	TTIV5	0.69			
	TTIV6	0.72			
	TTIV7	0.74			
	TTIV8	0.79			
Techno-complexity	TTCM1	-0.30	0.89	0.03	0.11
	TTCM2	-0.15			
	TTCM3	-0.23			
	TTCM4	0.61			
	TTCM5	0.09			
Techno-insecurity	TTIS1	0.91	0.88	0.86	0.63
	TTIS2	0.92			
	TTIS3	0.45			
	TTIS4	0.79			
	TTCM6+	0.71			
	TTCM7+	0.67			
Techno-uncertainty	TTUC1	0.89	0.89	0.92	0.75
	TTUC2	0.89			
	TTUC3	0.80			
	TTUC4	0.87			
Techno-unreliability	TTUR1	0.92	0.9	0.94	0.83
	TTUR2	0.92			
	TTUR3	0.90			

Except for the measurements of techno-complexity, all measurements were considered to be reliable. The measurements with plus (+) sign were changed, which is explained further in section 4.2.1.3.

4.2.1.2. Discriminant validity

To investigate whether the constructs expected to have no relationship actually had no relationship, two statistical methods were applied: heterotrait-monotrait analysis (HTMT) and the examination of cross-loadings, the dominant approaches for evaluating discriminant validity (Henseler et al., 2015). Both methods were used to evaluate the outer measurement model.

Heterotrait-monotrait analysis is a method that quantifies the relationships between two measurements of the same construct. The heterotrait-heteromethod correlations quantify the relationships between two measurements of different constructs. This analysis provides evidence of discriminant validity when the monotrait-heteromethod correlations are larger than the heterotrait-heteromethod correlations. A value of 0.90 or greater indicates insufficient discriminant validity (Henseler et al., 2015). All the values were below the threshold of 0.9 (Henseler et al., 2015), except for the value of techno-insecurity and techno-complexity which was close to 0.90 (0.87). This result was in line with previous findings based on CA, CR and AVE. The results are shown in Table 5. Although HTMT can be considered sufficient for investigating discriminant validity, in order to be complete, the next section shows the cross-loadings (Henseler et al., 2015).

Table 5. HTMT

	Insecurity	Uncertainty	Unreliability	Complexity	Invasion	Overload	Psychological Safety	Learning
Insecurity	ns	ns	ns	ns	ns	ns	ns	ns
Uncertainty	0.23	ns	ns	ns	ns	ns	ns	ns
Unreliability	-0.08	0.46	ns	ns	ns	ns	ns	ns
Complexity	0.87	0.18	-0.14	ns	ns	ns	ns	ns
Invasion	0.59	0.45	0.07	0.55	ns	ns	ns	ns
Overload	0.49	0.4	0.05	0.44	0.73	ns	ns	ns
Psychological safety	-0.47	0.19	0.46	-0.39	-0.29	-0.27	ns	ns
Learning	0.01	0.54	0.55	0.03	0.3	0.29	0.62	ns

4.2.1.3. Cross-loadings

In cross-loading, when each measurement item weakly correlates with all other constructs except for the one to which it is theoretically associated with, then that measurement is considered to be discriminately valid. The values of the item correlations are listed in Table 6.

Table 6. Cross-loadings

	Insecurity	Uncertainty	Unreliability	Complexity	Invasion	Overload	Psychological safety	Learning
TTCM7	**0.85**	0.13	-0.08	0.08	0.41	0.38	-0.23	-0.01
TTIS4	**0.80**	0.15	-0.09	0.02	0.40	0.37	-0.20	-0.01
TTIS3	**0.46**	0.30	0.15	0.10	0.37	0.30	0.00	0.16
TTIS1	**0.87**	0.07	-0.10	-0.08	0.32	0.28	-0.30	-0.08
TTCM6	**0.82**	0.12	-0.10	0.04	0.44	0.39	-0.22	-0.01
TTIS2	**0.87**	0.07	-0.10	-0.03	0.37	0.33	-0.33	-0.08
TTUC1	0.02	**0.89**	0.46	0.15	0.37	0.31	0.34	0.46
TTUC3	0.24	**0.80**	0.26	0.11	0.36	0.31	0.15	0.33
TTUC2	0.10	**0.89**	0.34	0.13	0.38	0.33	0.24	0.41
TTUC4	0.15	**0.87**	0.36	0.15	0.35	0.31	0.24	0.43
TTUR3	-0.09	0.37	**0.90**	0.16	0.09	0.05	0.41	0.43
TTUR2	-0.12	0.40	**0.92**	0.20	0.06	0.02	0.44	0.43
TTUR1	-0.10	0.41	**0.92**	0.19	0.09	0.07	0.46	0.46
TTCM3	0.60	0.08	-0.16	**-0.08**	0.42	0.35	-0.19	-0.04
TTCM1	0.72	0.09	-0.14	**-0.13**	0.35	0.31	-0.25	-0.04
TTCM4	0.50	0.19	0.05	**0.75**	0.39	0.34	-0.03	0.13
TTCM2	0.69	0.10	-0.14	**0.02**	0.37	0.32	-0.19	-0.01

TTCM5	0.73	0.10	-0.14	**0.09**	0.38	0.32	-0.21	0.00
TTIV1	0.18	0.45	0.20	0.17	**0.72**	0.59	0.13	0.30
TTIV8	0.37	0.25	0.00	0.08	**0.79**	0.52	-0.14	0.13
TTIV6	0.34	0.29	0.10	0.04	**0.75**	0.44	-0.05	0.18
TTIV7	0.54	0.29	0.05	0.03	**0.77**	0.51	-0.14	0.16
TTIV4	0.31	0.30	0.08	0.13	**0.80**	0.51	-0.01	0.23
TTIV5	0.37	0.25	-0.10	0.07	**0.69**	0.53	-0.08	0.14
TTIV3	0.46	0.24	-0.03	0.03	**0.74**	0.59	-0.15	0.14
TTOL2	0.45	0.29	-0.03	0.09	0.64	**0.89**	-0.13	0.19
TTOL1	0.32	0.34	0.10	0.11	0.63	**0.93**	-0.02	0.25
TTOL3	0.35	0.34	0.05	0.10	0.67	**0.91**	-0.07	0.20
PSW3	-0.50	-0.08	0.08	0.01	-0.33	-0.29	**0.37**	0.03
PSW1	-0.33	-0.11	0.00	-0.02	-0.41	-0.37	**0.38**	0.05
PSW5	-0.51	-0.04	0.13	0.04	-0.33	-0.32	**0.47**	0.11
PSW4	0.03	0.20	0.23	0.02	0.06	0.02	**0.59**	0.43
PSW2	-0.24	0.29	0.39	0.16	0.02	0.01	**0.83**	0.61
PSW6	-0.09	0.16	0.32	0.11	0.03	0.01	**0.65**	0.39
PSW7	-0.21	0.36	0.51	0.19	0.07	0.01	**0.84**	0.65
PST5	-0.01	0.35	0.36	0.16	0.17	0.15	0.47	**0.76**
PST3	-0.05	0.35	0.38	0.16	0.19	0.18	0.53	**0.80**
PST4	-0.12	0.41	0.42	0.14	0.22	0.19	0.60	**0.84**
PST2	0.04	0.15	0.23	0.08	0.19	0.17	0.17	**0.37**
PST6	-0.06	0.36	0.32	0.15	0.15	0.16	0.53	**0.78**
PST7	0.12	0.32	0.23	0.11	0.25	0.20	0.34	**0.62**
PST1	-0.09	0.42	0.43	0.16	0.21	0.19	0.54	**0.77**

The following changes were made to accommodate for measurement imperfections:

- Two of the questions were added to the measurement of techo-insecurity (TTCM6 and TTCM7). These questions are marked with a plus (+) sign in Table 4.
- Questions with code TTCM6 and TTCM7 were removed from the outer measurement model of techno-complexity.

Again, the cross-loading values confirm the previous findings in regard to techno-insecurity and techno-complexity.

Next, the inner structural model was evaluated. Based on the values of the CA, CR, AVE, and cross-loadings, one can conclude that complexity was not measured properly. Looking at the questions of Wang and co-authors (2008) and AVE, one can imagine that either techno-insecurity is a second order construct of techno-complexity or techno-insecurity and techno-complexity are the same construct in this outer measurement model. As a result, the individual loadings fluctuate among the items, hence the high discrepancy between the values of CA and CR for complexity. Two of the questions asked in relation to techno-complexity that had high loadings on techno-insecurity were added to the measurement model of insecurity. In the next section, the inner structural model is evaluated.

4.2.2. Evaluation of the inner structural model

We confirmed that the measurement model is mostly valid and reliable. To evaluate the inner structural model, the following step was used to measure the inner structural model outcomes: determine the relationship between the constructs and observe the model's predictive relevancy. The coefficient of determination (R^2), path coefficient (β value) and T-statistic value, and effect size (f^2) were used for evaluating the inner structural model.

The model's predictive accuracy is explained by the measures of the overall effect size, whereas variance is explained in the endogenous construct for the structural model. In this study, the inner path model was 0.32 for psychological safety and 0.54 for learning. This indicates in this model the independent variables jointly explain 32/54 percent of variance in the endogenous variables. In addition, a moderate effect can be explained by the change and error of the constructs invasion and overload on learning (Hair et al., 2016).

Through the path coefficient (β value), the significance of the hypothesis was tested. This was completed by a bootstrapping procedure. By means of bootstrapping, this research was able to evaluate the significance of the hypothesis. To test the significance of the β- and T-statistics values, a bootstrapping procedure using 50000 subsamples was carried out. The bootstrap samples were selected using sampling with replacement from the original sample. Thus, the bootstrap replicated sample was the same size as the original sample. Figure 6 shows the density plots after bootstrapping. It visualises the distribution of data over a continuous interval and from Figure 6 the assumption is made that the sample approaches a normal distribution (Monecke & Leisch, 2012).Table 7 shows the path coefficient, T-statistic, and p values.

Table 7. Path coefficient, T-statistic, and p values

Hypothetical Path	β value	T-statistics (ts)	p Values
Insecurity → Psychological Safety (beta_1_7)	0.097	-8.251	0.000
Uncertainty → Psychological Safety (beta_2_7)	0.109	0.600	0.552
Unreliability → Psychological Safety (beta_3_7)	0.138	1.650	0.107
Complexity → Learning (beta_4_8)	0.166	0.922	0.362
Invasion → Learning (beta_5_8)	0.250	1.640	0.110
Overload → Learning (beta_6_8)	0.323	1.224	0.229
Psychological Safety → Learning (beta_7_8)	0.205	7.297	0.000

Of the hypotheses, only Hypothesis 2—*The degree to which information technology is perceived as insecure will decrease perceived Psychological safety*—was confirmed. The relationship between learning and psychological safety as is described in the literature study was also confirmed. The other hypotheses (1, 3, 4, 5, and 6) were not significant.

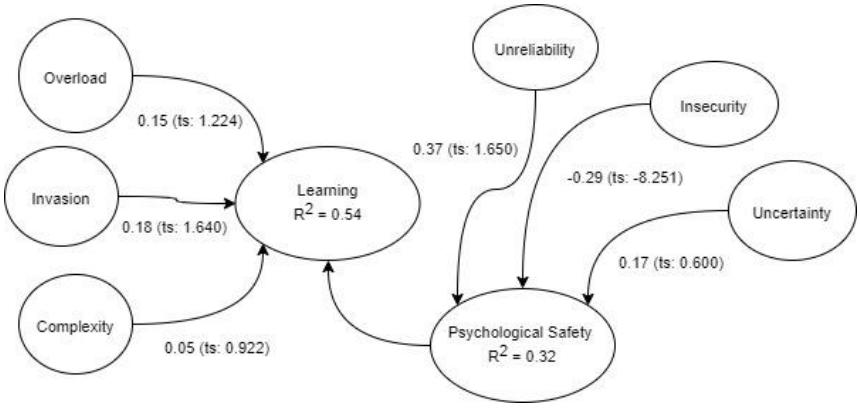

Figure 5. Inner structural model.

A graphical representation of the inner structural model is displayed in Figure 5. Inner structural model. In this model, the path coefficient on errors and the R^2 was reported. The f^2 was the impact of each exogenous latent construct on the endogenous latent constructs. f^2 was 0.86 for psychological safety and 0.75 for learning. These effects are considered strong (Jacob Cohen, 2013). For the other constructs, the f^2 was 0.

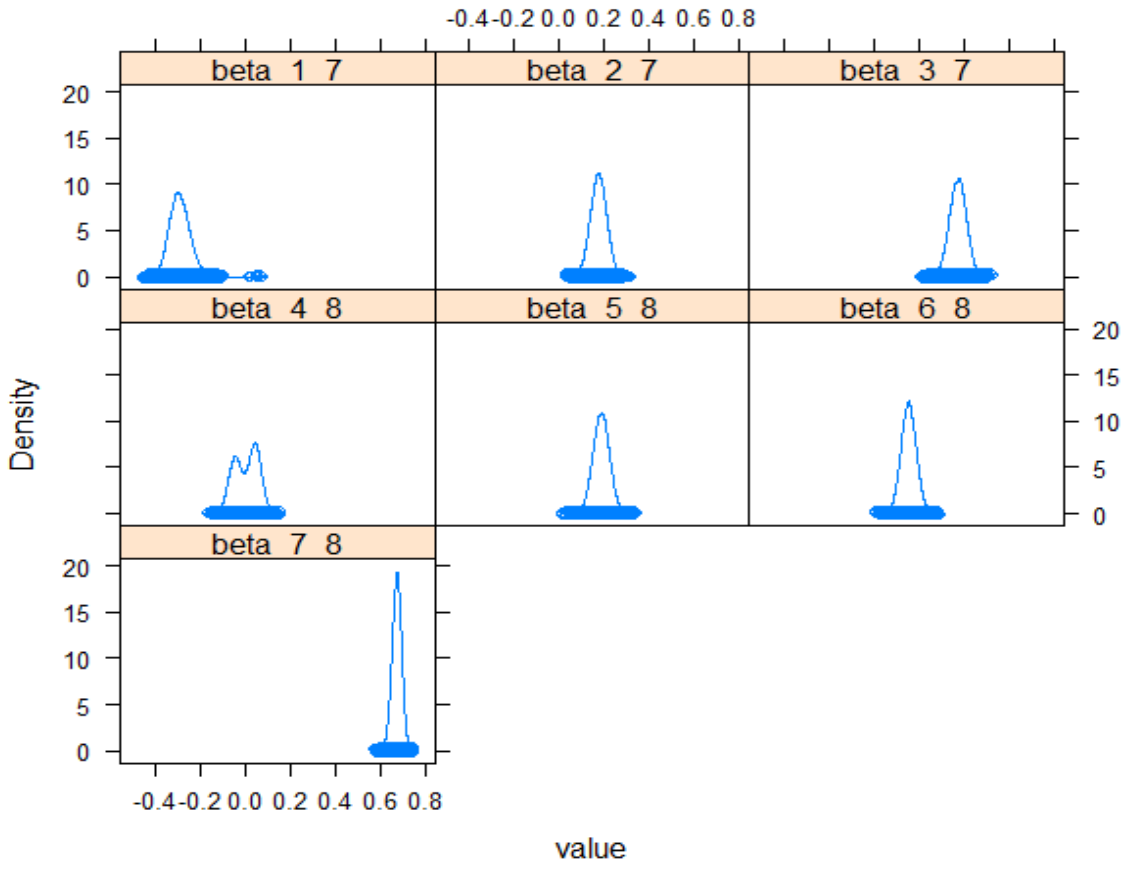

Figure 6. Density plot

5. Discussion, Conclusion, and Recommendations

The key contribution of this research is the influence of technostressors on psychological safety and learning by means of PLS-SEM analysis. A model was constructed based on findings in the literature. The reason knowing the influence of technostressors on psychological safety and learning is that enabling and enhancing learning leads to a higher performance (A. Edmondson, 1999). In most of the literature about the relationship between psychological safety and performance, a positive effect was found (Newman, Donohue, & Eva, 2017).

To research this influence, descriptive statistics were used. This research found that for most of the hypotheses, the relationship was not relevant. In addition, the model did not fit (Henseler et al., 2015). Furthermore, the reliability was not sufficient to confirm any of the hypotheses, taking into account a significance level of 1%. This significance level is based on the evaluation in section 3.3.

- Regarding Hypothesis 1, this research found that the T-statistics value was not significant (1.65). Although there was a weak effect of technostress-unreliability stressor on psychological safety (0.0967), the effect was insignificant for claiming that unreliability of ICT causes less psychological safety as perceived by an employee.
- Regarding Hypothesis 2, this research found that the T-statistics test was significant (-8.251) and had a small effect (0.097) for the degree that technostress-insecurity stressor decreases the perception of psychological safety. The effect, however, was considered to be small (Hair et al., 2016; Henseler et al., 2015).
- Regarding Hypothesis 3, this research found that the T-statistics test was not significant (0.600) and had a small effect (0.109). The effect was insignificant for claiming that uncertainty of ICT causes less psychological safety as perceived by an employee.

- Regarding Hypothesis 4, this research found that the T-statistics test was not significant (1.640) and had a medium effect (0.250). The effect was insignificant for claiming that the invasive nature of ICT leads to enhanced learning as perceived by an employee.
- Regarding Hypothesis 5, this research found that the T-statistics test was not significant (1.224) and had a medium effect (0.323). The effect was insignificant for claiming that the overload nature of ICT leads to decreased learning as perceived by an employee.
- Regarding Hypothesis 6, this research found that the latent construct was not measured properly. Accordingly, the T-statistics test was not significant (0.922) and had a medium effect (0.166). The effect was insignificant for claiming that the overload nature of ICT leads to decreased learning as perceived by an employee.

If 10% significance level was used, Hypothesis 1 and 4 would be significant; however, due to the explorative nature of this research, a 1% significance level was chosen. As a consequence, by definition, there is no meaning in predictive relevance estimates. This research rejected the hypotheses. There is no measurable influence of technostress on psychological safety and learning.

5.1. Reasons for findings

There could be several reasons for not finding a significant relationship. First, it is possible that the model in this thesis (that presumes a relation based on theory) is not as unidirectional as modelled but more of non-recursive and includes a reciprocal effect not taken into account. Second, there could be intermediate constructs that were not measured and created variance. Third, some of the constructs may be (a part of) other constructs that were not measured. Fourth, it may be the case that the sample had issues. A number of reasons are listed below:

5.1.1. Concepts, structure and model

Stress may be reciprocally related to stress in other domains (Rowden, Matthews, Watson, & Biggs, 2011). It is possible that technostress and psychological safety are in different domains (Ayyagari et al., 2011; A. Edmondson, 1999). PLS-SEM does not permit non-recursive models of covariance based structural equation modelling (Hair et al., 2016; Monecke & Leisch, 2012). Because this thesis was time bound, this line of inquiry was not investigated further. Another line of inquiry could be that some of the relationships are formative rather than reflective. The researched literature does not imply a formative relationship. None of the constructs fully captured the content domain under consideration and therefore formative relations are not applicable (Hair et al., 2016)

There could be intermediate constructs that were not measured and created errors in the measurements. These errors could have been created by other work-related stressors. Parker (1983) identified a number of stressors that may influence technostressors. For example, job stress is known to influence learning (Mikkelsen, Øgaard, & Landsbergis, 2005).

5.1.2. Data

The data has shown that some of the constructs may be (a part of) other constructs. In the data, there were issues, for example, with the technostressors insecurity and complexity. Other job stressors may be related to or part of the technostressors (Ayyagari et al., 2011; Parker & DeCotiis, 1983). Further research may shed some light on the relationship between job stressors and technostressors.

The sample of data obtained from MTurk was large. This sample is considered to be a valid representation of the population. Three recommendations by Goodman, Cryder, and Cheema (2013) should be considered when using MTurk-based behavioural research. These recommendations are to include screening questions to gauge attention and language comprehension, avoid questions with factual answers, and consider how individual differences in financial and social domains may influence results. Several screening questions were added as filter questions and MTurk workers were selected as qualified ('MTurk', 2018). Filtering was also done at the MTurk requester website: A filter was applied for part- and full-time employed workers. Workers were the MTurk microworkers. Factuality was

not an issue as the research was focussed on perception. Individual differences in financial and social domains may not be an issue when taking into account this study population.

Another aspect of consideration may be that technostressors are decreasing in stressfulness. Silic and Back found that 80% of employees are using illegal or unauthorised software as a service programmes in their jobs (Silic & Back, 2014). Coping is defined as the individuals' efforts in thought and action to manage specific demands, so perhaps employees are coping by using unauthorised software and experiencing less technostress over time (Ayyagari et al., 2011; R. S. Lazarus, 1993).

Last but not least, the construct technostress may not be measurable due to the fact that the median age of the participants was 31–41 years. The personal computer was introduced in 1981 and most of the participants were born after 1979. Thus, this age group has been exposed to ICT all of their working lives and partly before.

Concluding, assumptions based on literature exist but are not prominent enough to justify concluding an influence. There is enough discussion in relation to the constructs to research the topic by another method other than that used in this thesis. Regarding the research question: *What is the influence of technostressors on learning and psychological safety?* this research shows that there is no measurable influence. Human behaviour is hard to predict (Rubinstein, 2018).

5.2. Recommendations

Several recommendations for future research can be derived from this study. The results indicate that some of the stressors influence psychological safety and learning. Next to that the questions that measure technostress complexity should be revised.

When considering a 10% significance level, Hypotheses 1 (the degree to which information technology is perceived as unreliable will decrease perceived psychological safety) and 4 (the degree to which information technology is perceived as invasive will enhance the perceived learning) would be significant. This may hint at that these latent constructs are composed of other constructs or second-order constructs. In the perspective of this research, this justifies further research into these hypotheses.

The latent construct technostress-complexity stressors was not measured properly. The questions used to investigate complexity and the cross-loadings suggest at a relationship with insecurity. Either the concepts are the same or they are of a second-order nature. These findings also justify further research in creating a new measurement instrument other than that of Wang et al. (2008).

Because most employees have been using ICT for most of their working lives, further research is needed to see if technostress is still a measurable construct. Most employees by now should and could have developed effective coping strategies that could influence the data.

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Appendix 1, cover letter questionnaire

This survey is interested in the influence of technology on workplace behaviour. In order to help us with our research, one of you (who fully completes the survey) will win an Amazon gift card of $200.

In order to research the relation thoroughly, we will ask around thirty questions. All of them will be scored by you (when you agree to participate) between 'I fully agree' and 'Not at all'. This is an example of a question that you will be asked: "I do not find enough time to study and upgrade my digital skills". The whole survey will take around 10-15 minutes of your time.

In order to start the survey you have to state that you consent with the terms of the survey and the use of the data. We will not sell or share your personal data in what form or another. The data will only be used to contact you when you want to participate in winning the Amazon gift card. Please note that only a completed survey will enter the raffle and when you consent in the survey, you agree with these terms.

The survey will end on xx-xx-xxxx, participation after this date will not be possible. Communication about the results is not possible and we will not disclose any information about the winner. The winner of the gift card will be informed by the researcher by means of his or her supplied email address and asked for shipping details.

If you still have any questions please email the researcher: marco.dumont@gmail.com.

Appendix 2, teaser for Reddit.com

Reddit.com

[Academic]Influence of information technology on workplace behaviour, win Amazon gift card of $200. (15+)

This survey is about the influence of information technology on workplace behaviour. One of you (who fully completes the survey) will win an Amazon gift card of $200. The survey will end on 24-11-2019 The winner of the gift card will be informed by the researcher by means of his or her supplied email address.

Yes I want to win $200 Amazon gift card, take me to the survey!

Title and post are formatted according to the rules of Reddit.com/r/samplesize forum.

LinkedIn

I need your help for my thesis. As I'm graduating soon, please fill out this short questionnaire about the influence of technology on learning. This is the link to the survey:
https://docs.google.com/forms/d/e/1FAIpQLSeI7ZqCFD_mZroiv2tZlVMNb0XU50v-ILTSyu1GlHQ8rtCkvA/viewform
One of you will win an Amazon gift card of $200!