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How to get into flow with it: measuring the paradoxes in digital knowledge work

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HOW TO GET INTO FLOW WITH IT: MEASURING THE PARADOXES IN DIGITAL KNOWLEDGE WORK

Research Paper

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Abstract

Digitized knowledge workers are exposed to various technology-, individual- and work-related factors resulting in multiple paradoxes that may promote or hinder their capacity to work. This paper elaborates on how emerging paradoxes of IT usage impact the flow experience for daily planning tasks of knowledge workers. To study the impact beyond effective use of IT on flow, we conducted a survey study with 336 participants in a mixed-method approach combining PLS-SEM and fsQCA. Our results show that the digital working method could positively influence the flow experience overall. A full mediation of perceived behavioral control, representing the paradox control and chaos, and representational fidelity, representing clarity and ambiguity, on flow, was confirmed. Our fsQCA results support the conclusion that increasing IT penetration alone is insufficient to experience work flow. It depends on how knowledge workers interact with the IT in their specific task environment, balancing the dialectical tensions at work, with some differences between genders and within specific industries. We discuss the study's implications for research and practice.

Keywords: flow; knowledge work; digital work; paradoxes; IT usage; effective use

1 Introduction

Knowledge workers are facing different enablers and constraints in times of digitalization. The challenge for organizations is to improve the effectiveness of increasingly digitized knowledge workers (Acsente, 2010; Burton-Jones and Grange, 2013; Porto Bellini, 2018), which are exposed to various technology-, individual- and work-related factors (Matt et al., 2019; Turel et al., 2020). These factors can result in multiple paradoxes at the digital workplace (Schneider and Kokshagina, 2020) that may promote or hinder the capacity to work (Vuori et al., 2019). The digital working environment can have a twofold influence on the workflow: On the one hand, the increasing presence of IT may challenge the familiar experience of getting fully immersed into a task (Colbert et al., 2016). On the other hand, IT usage also can improve information access and support cognition (Breu et al., 2005; Davern et al., 2012). Particularly, a purposeful digital work design is crucial to maximizing the benefits of IT at the workplace (Richter et al., 2018).

The underlying problem is a historically well-known IS research problem, which various forms of fit have captured. Numerous studies focusing on task performance refer to this concept, such as theories of cognitive fit (Vessey and Galleta, 1991) or task technology fit (Yang et al., 2013). Yet, there is little research on individuals' digital working methods at the workplace. A conceptual study highlights that the engagement of knowledge workers might be increased by IT and fostering flow (Califf et al., 2020). The psychological concept of *flow* explains the positive effect of IT on the user (Mahnke et al., 2014), a cognitive state where knowledge workers feel completely concentrated. The experience of accomplishing a task is perceived as autotelic in a flow state (Moneta, 2020). However, IS research has rather neglected the view of psychological states such as flow and the role of IT to achieve or get into the flow, especially through quantitative analyses.

Against this background, we explore the impact of digital technology use on the flow perception of knowledge workers while accomplishing daily planning tasks. To achieve this, we surveyed 336 knowledge workers on emerging paradoxes of IT usage and contextual factors of their work. We use a mixed-method research design: We first analyze the symmetric direct, mediating, and moderating effects on flow with partial least squares structural equation modeling (PLS-SEM) and then the asymmetric interplay of the technology-, individual- and work-related factors with fuzzy set qualitative comparative analysis (fsQCA). The paper's outcome sheds light on the linear, mediating and moderating effects on flow at the digital workplace. It also derives a set of non-linear configurations that either lead to flow or hinder the perception of flow in the entanglement of the various factors. Conclusions are drawn on how knowledge workers should be supported to improve the outcomes of their work.

The paper is structured as follows: In the next section, we elaborate on the theoretical background based on the literature and develop the research model. In the third section, we introduce our methodology, i.e., data collection and data analysis. We present the results in the fourth section. In the fifth section, we discuss our findings, provide implications for research and practice, and point to further research.

2 Theoretical Background

2.1 The Flow Concept within Knowledge Work

The concept of flow examines the psychology of optimal experience (Csikszentmihalyi, 1990). When people are in a state of flow, this refers to a situation in which they are absorbed in what they do (Snyder & Lopez, 2002), feeling completely concentrated, and the experience of accomplishing a task is perceived as autotelic (Moneta, 2020). The author Cal Newport points to the similar concept of *deep work*, describing "professional activities performed in a state of distraction-free concentration that push your cognitive capabilities to their limit" (Newport, 2016, p. 2). Regarding the use of IT, technology may affect the experience of the so-called "techno-flow" (Califf et al., 2020). Autotelic experience represents an important aspect of techno-flow in the context of digital work (Rissler et al., 2017). The concept of cognitive absorption explains that flow antecedents can be technology, control and perceived flexibility (Agarwal and Karahanna, 2000). We are interested in the impact of using IT on flow perception in *knowledge work*. The activities of knowledge workers can be described by different roles and actions, such as the roles of the organizer, controller, learner, and linker (Reinhardt et al., 2011). We focus on the role of the organizer in this paper. Its main task is to plan activities with characteristic actions such as analysis, information organization, monitoring and networking. The typical knowledge worker needs to create, for example, a daily schedule or project plan, a to-do list based on e-mails, messages or notes. These planning tasks should ensure a structured flow of job activities from the perspective of the organizer role. Different information from different sources must be consolidated, while pure processing activities without planning would not adequately represent the complexities we want to study. Knowledge workers typically have these tasks recurring in their everyday lives as they do initial task planning, which makes it a proper context to investigate the impact of IT on flow at work.

2.2 Digital Working Method

The optimal degree of technology use might differ between individuals, making a needs-based assessment of IT usage necessary (Ghani and Deshpande, 1994). The daily planning task could be done manually, in a non-digital way (e.g. by writing things down into a notebook) or via digital tools (e.g. electronic calendars in software such as Lotus Notes or Microsoft Outlook). Bloom's digital taxonomy describes different categories needed to meet the work requirements. The categories range from remembering, understanding, applying, analyzing and evaluating to creating (Churches, 2008). We use the proper types to measure how digital the participating knowledge workers prefer to work. It seems natural that planning tasks can be done more easily in an IT-supported environment and that workers can more easily get into a productive flow state. As the use of IT may have a direct positive influence on the perception of flow at work, we hypothesize first:

H1: Digital working method has a positive effect on flow.

2.3 Paradoxes of IT Usage

Different IT-related perceptions of work might mediate the relationship between the digital working method and work outcomes. These perceptions can point to opposing extremes, constituting paradoxes. A paradox can be defined "as a persistent contradiction between interdependent elements" (Schad et al., 2016, p. 10). When paradoxes occur, they may cause ambivalence, chaos, or conflicts, while their successful management often implies positive effects on the outcomes of interest (Schad et al., 2016). Paradox theory was already used in IS research to emphasize the contradictions while using IT (Ciriello et al., 2019). We further derive emerging paradoxes of IT usage from the literature (e.g. Johnson et al., 2008; Mick and Fournier, 1998; Schneider and Kokshagina, 2020; Warschauer, 2007). Dealing with different paradoxes of IT usage leads the users to positive feelings, such as delight or empowerment, and negative feelings like frustration or anger (Jarvenpaa and Lang, 2005). Technologies can enable them to work more efficiently and lead to negative effects like technostress (Schneider and Kokshagina, 2020). As each knowledge worker perceives the usage of technologies individually, the paradoxes help to explain the relationship between the digital working method and flow.

In particular, we draw on four critical phenomena to consider in the digital workplace: technology, individual, and work-related factors. The first phenomenon, *freedom and captivity,* explains the potentials and dependencies of using IT at the digital workplace. IT might help to establish outside-the-box thinking with the freedom to choose the appropriate technology. However, users might feel restricted in switching to another technology once they got used to the interface (Ciriello et al., 2019). This feeling can cause users to develop an aversion, or even their performance can suffer (Johnson et al., 2008). In this regard, the concept of *autonomy* describes the freedom to decide about work scheduling, decision-making and work methods (Morgeson and Humphrey, 2006). The presence of IT at the workplace might help access information easier and more flexibly, supporting out-of-the-box thinking (Cijan et al., 2019). However, it could also result in captivity, as digital tools may restrict thinking within the boundaries of the IT system. We hypothesize that the digital working method influences autonomy to positively impact flow (Ciriello et al., 2019; Mick and Fournier, 1998).

H2: Autonomy significantly mediates the effect of the digital working method on flow.

The second phenomenon, *control and chaos,* arises when a worker can or cannot influence the process or outcome while using IT. The feeling of chaos can be increased when technologies do not work as expected (Mick and Fournier, 1998), while increasing control can foster trust in the technology (Johnson et al., 2008). The control a user feels over IT while performing its work task is measurable by *perceived behavioral control* (Venkatesh, 2000). When employees feel they need help from others, productivity is influenced negatively, as they feel or think they lose control over technology (Elie-Dit-Cosaque et al., 2011). We suppose that knowledge workers who use more digital tools at the workplace and perceive a greater feeling of control will experience more flow.

H3: Perceived behavioral control significantly mediates the effect of the digital working method on flow.

The third phenomenon, *clarity and ambiguity,* occurs when producing and consuming information at the same time. Clarity is crucial for the planning and decision-making of knowledge workers, particularly when using IT. Misunderstandings may arise when a knowledge worker interprets information ambiguously (Ciriello et al., 2019). *Representational fidelity* describes that users receive appropriate information via digital tools (Burton-Jones and Grange, 2013; Gregory et al., 2015; Haake et al., 2018). Thus, IT should be perceived to display information completely and correctly (Eden et al., 2020). We suppose that increased usage of IT can facilitate representational fidelity, which can also influence flow in a positive way.

H4: Representational fidelity significantly mediates the effect of the digital working method on flow.

The fourth phenomenon, *scarcity and abundance,* may emerge when interacting with IT (Ciriello et al., 2019). Knowledge workers who experience this may either improvise to deal with missing features or use IT too extensively to accomplish their tasks. Knowledge workers who have only access to a limited set of features might still ensure a high quality of work. On the contrary, knowledge workers experiencing *technology overload* might not be able to concentrate on their tasks fully. While technology overload may lead to a loss of productivity, an optimal technology load helps maximize task productivity (Karr-Wisniewski and Lu, 2010). We argue that flow perception is affected by technology overload negatively.

H5: Technology load significantly mediates the effect of the digital working method on flow.

2.4 Adaptive System Use

Knowledge workers may approach digital tools differently, meaning more virtuously or within relatively narrow bounds. *Adaptive system use* describes how knowledge workers use digital tools to cope with possible barriers and constraints (Sun, 2012). Four behaviors can be observed: Trying new features, feature substituting, feature combining, feature repurposing (Sun et al., 2019). Increased usage of these behaviors may improve or diminish work outcomes (Sun et al., 2019). Being more in the flow could, for instance, be reached by exploring helpful features which are available in the digital tools. The impact of adaptive use on the paradoxes of IT usage might depend on the digital working method, measuring how digital the work is.

H6: Adaptive system use moderates the relationship between the digital working method and the emergence of paradoxes.

2.5 Cognitive Load

Every knowledge worker perceives their computer-mediated work tasks differently. The cognitive load theory is being used to describe the human cognitive structures bound to the task's nature and complexity. Cognitive load is considered to understand better how the paradoxes might be transferred to a flow experience. Especially when knowledge workers are executing new tasks, the goal is that the working memory load is held low. Being productive can only be reached if knowledge workers range between being under- and over-challenged. Through productive learning, all the further information can be transformed into long-term memory so that the knowledge can be used in the future. The result is that knowledge workers can use this knowledge automatically (Sweller, 2012). Ilany-Tzur and Fink have observed a moderating effect of cognitive load between the usage of devices and cognitive performance (Ilany-Tzur and Fink, 2019). Getting into the flow experience might require an appropriate level of task complexity interacting with the paradoxes to produce flow. Therefore, we hypothesize:

H7: Cognitive load moderates the relationship between the paradoxes and flow.

We included additional variables to control for personal distress, gender and age of the participants. Personal distress is part of a personality questionnaire and measures in our study if people feel uncomfortable in stressful situations (Koller and Lamm, 2014). We measure the general stress propensity and not technology-specific factors.

3 Methodology

We conducted a quantitative survey study to elaborate the interplay between the technology-, individual- and work-related factors on the perception of flow at work. A questionnaire was developed to test the different hypotheses. The definition of the planning work task was necessary to measure the flow state appropriately within the survey design. After initial screening questions, the participants were introduced to a hypothetical planning scenario representing the typical tasks of a knowledge worker. The planning task of a schedule was presented based on different e-mails and notes as an example. Another important factor was that the evaluation of flow was separated from the task when users interacted with IT. By separating the task from the tool or medium, influences on flow can be better identified (Finneran and Zhang, 2005).

3.1 Data Collection

A pre-test with 98 respondents was conducted to ensure the time to complete the survey was acceptable, and the questions were clear and understandable. The main survey was conducted online with a market research firm. We collected data from 507 individuals; 171 responses had to be removed due to incomplete or inconsistent answers, leading to a final sample of *336 respondents*. The decision to exclude answers was based on a concentration check. For example, when participants filled out the survey in a short amount of time combined with always the same answer, their data was eliminated. The sample demographics were relatively evenly distributed: 49.11 percent were female, and 50.06 percent were male. The 26-35-year-olds were mainly represented. We surveyed knowledge workers from different industries. Most of the respondents were workers from commercial services (101), followed by business, law or administration (55), health, social affairs or education (39) and natural sciences (32).

3.2 Operationalization

The digital working method is a self-developed formative construct based on Bloom's Digital Taxonomy (Churches, 2008). The construct was measured formatively with different composite aspects of IT use in planning (Hair Jr et al., 2017). We used a 5-point Likert scale from "analog" to "digital." We decided to use Mode A, which is recommendable if the sample size is medium and the composite items are potentially correlated. As our data set is lower than 500, this method can be applied (Becker et al., 2013). Also, adaptive system use was measured this way. The higher-order adaptive system use construct was operationalized as a formative first-order construct, a common approach in IS research (Petter et al., 2007), representing the four items on a 5-point Likert scale: trying new features, feature substituting, combining and repurposing (Sun et al., 2019). All the other constructs were measured reflectively, also using the 5-point Likert scale. The flow state scale from the literature combines nine different factors reflectively. Each aspect is represented by one item, such as clear goals or autotelic experience (Jackson and Marsh, 1996). The corresponding scales to measure the paradoxes of IT usage were reflective as well. The construct of autonomy represents the paradox of freedom and captivity, measured by four items from the work design questionnaire (Morgeson & Humphrey, 2006). Perceived behavioral control, referring to the paradox control and chaos, was measured using a four-item scale (Venkatesh, 2000). The paradox clarity and ambiguity was measured by the construct of representational fidelity with four items (Haake et al., 2018). Three items were used to measure technology load to describe the paradox of scarcity and abundance (Karr-Wisniewski & Lu, 2010). Cognitive load was measured with five items, retaining three (Leppink et al., 2014).

3.3 Data Analysis of the Structural Equation Model

The data is analyzed based on PLS-SEM in SmartPLS (Hair Jr, Hult et al., 2014). When evaluating the structural equation model, the measurement models are evaluated first. We examined the reliability and validity of the reflective constructs. Cronbach's alpha is used to measure the internal consistency reliability (ICR), exceeding the recommended value of 0.7 for all constructs. Another suitable approach relates to the outer loadings of the items to calculate the composite reliability. Ideally, the value is between 0.7 and 0.95 (Hair Jr, Hult et al., 2014). As represented in Table 1, our constructs are within the desired range. Each latent variable should explain a substantial part of each indicator's variance to ensure indicator reliability.

Construct	**Cronbach's alpha**	**Composite reliability**	**AVE**
Autonomy	0.874	0.874	0.635
Cognitive load	0.873	0.873	0.698
Flow	0.875	0.875	0.453
Perceived behavioral control	0.916	0.916	0.733

Personal distress	0.928	0.928	0.764
Representational fidelity	0.902	0.902	0.699
Technology load	0.878	0.878	0.706

Table 1. Reliability and convergent validity of the reflective constructs.

Table 2 shows that most of the outer loadings are above 0.663. The convergent validity is represented by the average variance extracted (AVE) and the outer loadings of the items (Hair Jr, Sarstedt et al., 2014). This value should be higher than 0.5 to ensure that the construct explains more than half of the variance of its indicators (Hair Jr, Hult et al., 2014). Table 1 indicates that all the reflective constructs fulfill the criteria of convergent validity, except for flow. The flow construct reaches a value of 0.453, slightly below the recommended threshold. Therefore, the outer loadings of each item have to be tested if outer loadings are above 0.70 (Hair Jr, Hult et al., 2014). As the item FSS8 is below 0.40, this item was deleted. We refrained from removing the reflective items FSS2 and FSS7 as the deletion of the items had no impact on the measures. However, as the flow construct relies on an established scale from the literature, we argue that the convergent validity is adequate on this level. The discriminant validity check considers the cross loadings and the Fornell-Larcker criterion. The Fornell-Larcker criterion makes sure that the construct shares more variance with its indicators than with any other construct, which was the case (Hair Jr, Hult et al., 2014). All indicators are higher than the cross loadings. Therefore, discriminant validity is given.

Regarding the formative constructs, the indicator validity must be ensured by measuring the indicator weights. We examine whether the items represent a relevant construct dimension (Urbach and Ahlemann, 2010). All indicator weights except for ASU4 were significant at a level of 0.001. Table 3 shows that the values except for ASU4 are above the threshold of 0.200 (Urbach and Ahlemann, 2010). However, the outer loading of ASU4 was significant. Hence, all indicators were kept based on their established constructs (Hair et al., 2011).

Items	**Description**	**Outer Loading**
AU1	When I use IT, I can decide how to get my planning tasks done.	0.814
AU2	When working on my planning tasks with the help of IT, I feel free.	0.827
AU3	I feel forced to use IT for planning tasks more than necessary. *(reverse)*	0.755
AU4	I feel restricted in using IT in planning tasks. *(reverse)*	0.786
CL1	I perceive such planning tasks as very complex.	0.748
CL2	I perceive the topics connected with the tasks as very complex.	0.825
CL3	The task includes activities that demand a lot of my mind if I want to find a good solution.	0.924
FSS1	I feel competent enough to deal with the situation.	0.747
FSS2	I do things spontaneously and automatically without having to think.	0.526
FSS3	I have a strong sense of what I want to do.	0.842
FSS4	I have a good idea about how well I am completing the task.	0.784
FSS5	My attention is focused entirely on my task.	0.663
FSS6	I feel in control of my task.	0.797
FSS7	I am not worried about my performance.	0.549
FSS8	The way time passes seems to be different from normal. *(deleted)*	0.262
FSS9	I find the experience extremely rewarding.	0.687
PBC1	As a user, I have control over the IT tools when performing planning tasks.	0.732

PBC2	I have the necessary internal resources to use the available IT tools for planning tasks optimally.	0.898
PBC3	I have the necessary knowledge to use the available IT tools for planning tasks optimally.	0.888
PBC4	It is easy for me to use the IT tools optimally for planning tasks regarding the available possibilities and knowledge.	0.895
PD1	In stressful situations at work, I feel anxious and uncomfortable.	0.887
PD2	I tend to feel helpless when I am in the middle of a very tense emotional situation at work.	0.891
PD3	When I am in a tense emotional situation at work, I am scared.	0.897
PD4	I tend to lose the overview in stressful situations at work.	0.820
RF1	The information provided by the IT tool usually seems very clear to me.	0.893
RF2	When I use an IT tool, I'm confident that the content delivered by the IT tool will provide an optimal representation.	0.833
RF3	When I use the IT tools, I find that the content is understandable.	0.911
RF4	The use of some functions of IT tools often results in ambiguous content.	0.690
TL1	I am often distracted by the excessive amount of information from the IT tools available to me for my tasks.	0.859
TL2	I often notice that I am overwhelmed by the amount of information to process on IT.	0.884
TL3	Usually, I have the problem that I don't find enough information within the IT tools to master my tasks optimally.	0.775

AU = Autonomy, CL = Cognitive load, FSS = Flow State Scale, PBC = Perceived behavioral control, PD = Personal distress, RF = Representational fidelity, TL = Technology load

Table 2. Reflective construct items and outer loadings.

Secondly, the collinearity among the indicators of the formative constructs was evaluated by the variance inflation factor (VIF). This value has to be less than 5 (Hair Jr, Hult et al., 2014). Table 3 shows that there are no critical levels present. Lastly, the construct validity must be assessed. Digital working method and adaptive system use can be distinguished from other constructs if the correlations are less than 0.700 (Urbach and Ahlemann, 2010). The correlation matrix of our model showed that this is the case. Thus, both indicator and construct validity could be verified for both formative constructs.

Construct	**Items**	**Description**	**Outer weights**	**VIF**
DWM	DWM1	Remembering (e.g. taking notes, bullet pointing)	0.272	1.471
	DWM2	Understanding (e.g. taking notes, making sketches)	0.190	1.425
	DWM3	Applying (e.g. creating concepts)	0.424	1.940
	DWM4	Analyzing (e.g. re-linking content, reorganizing, rethinking)	0.401	2.032
ASU	ASU1	I often try out new IT tools.	0.421	2.158
	ASU2	I often replace used IT tools with others.	0.217	1.808
	ASU3	I often combine different IT tools to get the job done.	0.531	1.600
	ASU4	I use IT tools for my tasks that are not really intended for that.	0.012	1.273

ASU = Adaptive system use, DWM = Digital working method

Table 3. Evaluation of the formative constructs.

3.4 Data Analysis Using the fsQCA Method

The symmetric, linear PLS-SEM analysis results are complemented with set-theoretical analyses based on the fsQCA method. The combined multi-method approach gained importance in management more recently (e.g. Rasoolimanesh et al., 2021). We elaborate on the asymmetric, non-linear combinations of the latent variables that lead to the outcome of interest (i.e. flow). The fsQCA method is established in IS behavioral research (Liu et al., 2017). The analysis reveals the different configurations as causal recipes (Park et al., 2020) that reflect the particular combinations of present and absent conditions that lead to flow. All possible combinations of the included variables are collected in a truth table along with their outcome. Each respondent is considered as a case that either confirms or contradicts that the outcome will be achieved. The researcher then has to set a particular inclusion (or consistency) threshold that must be surpassed to regard a specific configuration as consistent leading to the outcome. All combinations that do not exceed this threshold are considered "0", not leading to a flow state (Rasoolimanesh et al., 2021). The specific composite latent variables scores are extracted out of the PLS-SEM analysis first. The latent variable scores are then calibrated to transfer the 5-point Likert scale to fuzzy scores between 0 and 1. We set the upper and lower boundaries of the Likert scale as the full inclusion and exclusion criteria and "3" as the crossover. We further specify the minimum frequency threshold of cases present for each row in the truth table. We set this value to "2" first, meaning two cases had to be present at least under the 336 respondents for every combination of the variables in the truth table to be included in further minimization. We used the QCA package in R for the calculations. Typically, the literature recommends a minimum consistency threshold of 0.75 that must be met (Ragin, 2009; Fiss, 2011). We set the value slightly higher to 0.8 to increase the solution quality. The truth table then is reduced using Boolean algebra leading to a parsimonious solution set that entails one or more essential configurations. Hence, the parsimonious solution reflects the minimum of conditions that lead to the outcome of interest but does not distinguish between core and peripheral conditions (Baumgartner & Thiem, 2017). The raw coverage shows how much of the outcome is explained by a set (Ragin, 2009). The unique coverage shows the explanation uniquely attributed to a set (Duşa, 2019).

3.5 Common Method Bias

Since the data was collected from a single source, it is necessary to elaborate on the common method bias. Measures were taken to minimize common method bias by survey design. Therefore, the predictor variable was measured on a semantic differential as the criterion variable (Podsakoff et al., 2003). The participants' guaranteed anonymity helped reduce social desirability bias (Podsakoff et al., 2003). To reduce item ambiguity, we conducted a pre-test, followed by feedback interviews. At this, we were able to make sure that all items were clear to the participants (Podsakoff et al., 2003). Another possible method is to review the variance inflation factor of the latent variables. Following the full collinearity approach, we assume the common method bias is not present as the values are less than 3.3 as recommended (Kock, 2015). The Harman single factor test was also accomplished. In sum, we suppose that common method bias is not an issue.

4 Results

4.1 PLS-SEM Analysis

Table 4 shows the descriptive statistics for the analyzed constructs. The mean value and the standard deviation provide first valuable information about the data distribution. On average, the participating knowledge workers reported being rather in flow during their planning tasks, using a somewhat more digital than analog working method, with above-average autonomy, perceived behavioral control and representational fidelity.

Construct	**Mean**	**SD**	**Definition**
Adaptive system use	2.61	0.61	"a [worker's] revisions of which and how system features are used" (Sun, 2012)
Autonomy	3.67	0.44	"a [worker's] freedom to decide about work scheduling, decision-making and work methods" (Morgeson and Humphrey, 2006)
Cognitive load	3.19	0.38	"[the task complexity that determines a worker's] used amount of working memory resources" (Sweller, 2012)
Digital working method	3.21	0.72	"a [worker's] use of digital tools in the task areas of remembering, understanding, applying and analyzing" (Churches, 2008)
Flow	3.94	0.55	"a situation in which [workers] are absorbed in what they do feeling completely concentrated, the autotelic experience of accomplishing a task" (Moneta, 2020)
Perceived behavioral control	3.71	0.37	"the degree to which a [worker] believes that he or she can perform a behavior" (Venkatesh, 2000)
Representational fidelity	3.63	0.36	"during use, the extent to which a [worker] is obtaining representations from the system that faithfully reflect the domain represented by the system" (Burton-Jones and Grange, 2013)
Technology load	2.42	0.39	"the level of information overload of a [worker]" (Karr-Wisniewski and Lu, 2010)

Table 4. Construct descriptive statistics (mean, standard deviation)

We test for the direct, mediation and moderation effects in the following. We used bootstrapping procedure with 5,000 subsamples to calculate the significance levels. The coefficient of determination (R^2) of the flow construct has a value of 0.569 in the moderated mediation model, which shows the good explanatory value of the model. Figure 1 shows the results of the structural equation model.

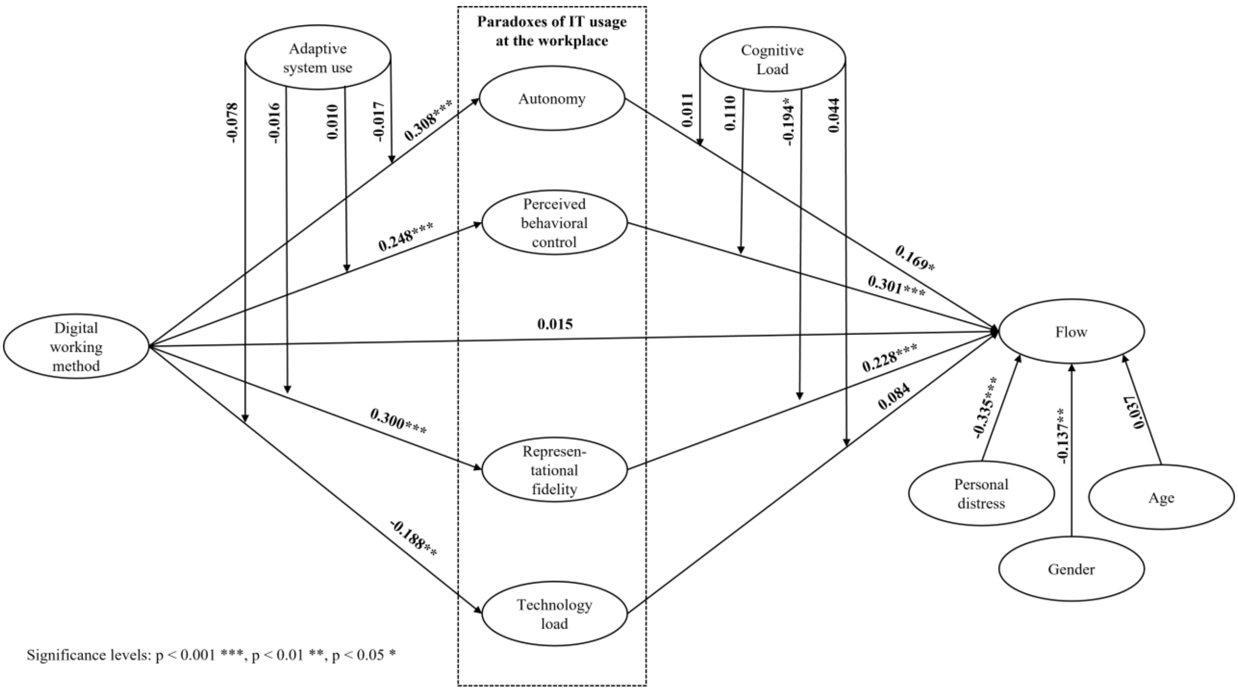

Figure 1 Structural model results (n = 336).

When analyzing the direct effect of the digital working method on flow, the model shows that this effect is significant ($\beta = 0.188$, $p < 0.001$), supporting our first hypothesis. The significance of the direct effects of the digital working method on flow is one of the main requirements for examining potential mediation effects (Hair Jr, Hult et al., 2014). Table 5 gives an overview of the specific indirect effects of the mediated model.

Specific indirect effects	**Path coefficient β**
Digital working method → Autonomy → Flow	0.051
Digital working method → Perceived behavioral control → Flow	0.095**
Digital working method → Representational fidelity → Flow	0.088**
Digital working method → Technology load → Flow	-0.017

Significance levels: p < 0.001 ***, p < 0.01 **, p < 0.05 *

Table 5. Specific indirect effects of the mediated model

Hypothesis 2 states that autonomy significantly mediates the effect of the digital working method on flow. The relationship in the model between the digital working method and autonomy is significant ($\beta = 0.404$, $p < 0.001$). The path between autonomy and flow is not significant ($\beta = 0.126$, $p < 0.001$). Comparing the direct effect of the digital working method and flow without the mediator to the mediated model, the values changed from 0.188 ($p < 0.001$) to -0.014, and the relationship is no longer significant. The indirect effect of the mediated model is also not significant. A barely significant effect becomes visible when adding the moderators to the model ($\beta = 0.052$, $p < 0.05$). The variance accounted for (VAF) must be calculated to determine whether a full or partial mediation exists in the moderated mediation model. The VAF value for this mediation is 77.63 percent. As the value is between 20 and 80 percent, a partial mediation exists (Hair Jr, Hult et al., 2014). Therefore, we reject H2 for the mediated model.

In hypothesis 3, we suppose that perceived behavioral control significantly mediates the effect of the digital working method on flow. The relationship between the digital working method and perceived behavioral control is significant ($\beta = 0.380$, $p < 0.001$). Also, the path between perceived behavioral control and flow is significant ($\beta = 0.242$, $p < 0.01$). As the direct effect of the digital working method and flow changes from a significant value to a non-significant, the hypothesis is supported. The indirect effect of the meditated model is significant ($\beta = 0.088$, $p < 0.01$). The VAF value is 87.15 percent. As the value is above 80, this value indicates a full mediation. Hence, we support H3.

Hypothesis 4 states that representational fidelity significantly mediates the effect of the digital working method on flow. The relationship between digital working method and representational fidelity is significant ($\beta = 0.365$, $p < 0.001$). Also, the path between representational fidelity and flow is significant ($\beta = 0.242$, $p < 0.01$). The indirect effect of the mediated model is significant ($\beta = 0.088$, $p < 0.01$). The VAF value is 86.32 percent. This value represents a full mediation. Thus, we support H4.

In hypothesis 5, we assume that technology load significantly mediates the effect of the digital working method on flow. The relationship between technology load and flow is not significant ($\beta = 0.082$) and the indirect of the mediated model ($\beta =-0.017$). The specific indirect effect of the moderated mediation model is also not significant. However, the relationship between the digital working method and technology load is significant ($\beta = -0.207$, $p < 0.001$). Hence, we reject H5. As indicated, the paradoxes help explain a larger share of the variance of the outcome variables. After adding the mediators to our model, the explained variance of flow increased by 49.69 percent.

Hypothesis 6 posits a significant interaction between the digital working method and adaptive system use on the different paradoxes of IT usage. Our results indicate that this is not the case. Hence, we reject H6. Hypothesis 7 finally states that the different paradoxes interact with cognitive load on the outcome of flow. Both moderators were measured as moderators before and after the paradoxes. Our results indicate that this is only the case for the negative interaction between representational fidelity and cognitive load (ß = -0.194, $p < 0.05$). Hence, we find only partial support for H7. The simple slope analysis indicates that a particular cognitive load level must be present and is beneficial at low and medium levels of representational fidelity to get into the flow (Holland et al., 2017). This result suggests that cognitively more demanding (i.e. more complex) tasks could positively affect flow. Furthermore, we found a strong significant effect of the control variable personal distress on flow (-0.335, $p < 0.001$). This finding confirms that the perceived work stress also has a strong negative impact on flow. Different measures have to be taken into account to evaluate the inner structural model (Hair Jr, Sarstedt et al., 2014). The coefficient of determination (R^2) measures the predictive accuracy of the model. R^2 values of 0.75, 0.5 or 0.25 for the endogenous constructs can be described as substantial, moderate and weak (Hair Jr, Hult et al., 2014). The outcome variable flow has a moderate predictive accuracy. The cross-validated redundancy describes the predictive relevance of the model. We used blindfolding to calculate the Q^2 value. The smaller the difference between predicted and original values, the greater the Q^2 and the model's predictive accuracy. When Q^2 is higher than zero, an endogenous reflective construct can be predicted (Hair Jr, Sarstedt et al., 2014). The corresponding values of the constructs are between 0.023 and 0.202, which indicate a medium relevance. Finally, the effect size (f^2) was evaluated. The f^2 value explains the effect size of an exogenous construct on an endogenous construct (Hair et al., 2011). We found small effect sizes for autonomy (0.027), representational fidelity (0.049) and perceived behavioral control (0.071) on flow.

Furthermore, we conducted several *multigroup analyses*. The industry-specific multigroup analysis results show that the non-technical factor of personal distress significantly affects the flow experience for knowledge workers from commercial services. Personal distress is an even more decisive negative factor for workers from this industry. Moreover, we find that knowledge workers from healthcare and education need more adaptive IT usage to perceive behavioral control.

Furthermore, we identified gender and age differences regarding some construct relationships. In our sample, representational fidelity was a higher prerequisite for female than male knowledge workers to experience flow (0.36 to 0.08). Overall, the female gender makes a slight but significant difference toward a better flow perception (-0.126, $p < 0.01$), while age does not significantly affect flow overall. However, splitting the participants into two groups of up to 45 years old and older than 45, participants of the second, older group experienced less impact of the autonomy paradox on their flow experience (the path difference amounts to 0.09, the *p*-value to 0.07). Overall, none of the moderators significantly changed any specific indirect effects reported in Table 5.

4.2 fsQCA Procedure

The parsimonious solution set for the positive outcome of flow entailed eight configurations depicted in Table 6. We found two configurations (1 and 2) eligible for even a higher minimum frequency of 11 cases. The most parsimonious solution to get into flow combines the digital working method in IT usage behavior, the paradoxes of IT usage from their positive side and a low-stress task environment with high cognitive loads. The overall solution set consistency is 0.994; the solution coverage is also high (0.684).

Firstly, we can distinguish two solutions for a *primarily digital working method*. Thus, solution 1 involves digital work under the absence of the paradoxes, i.e. perceived behavioral control is present, autonomy is felt in IT, and the system users perceive a high representational fidelity. At the same time, the perceived technology load is low, and the perception of stress in planning tasks, in general, is lacking. This configuration describes a desirable IT usage in planning that leads to flow, regardless of the level of cognitive load involved. This configuration has the highest empirical significance; it covers most cases overall. Solution 3 is only marginally different from the first. Primarily digital work leads to flow amongst the non-emergence of the paradoxes of IT usage. The perceived technology load in planning is not relevant for these individuals, and the general perception of stress in planning tasks is low.

Secondly, we found two solutions for people that prefer a *mixed-mode* between analog and digital working in planning tasks (i.e. "don't care" condition). In solution 2, knowledge workers with high cognitive load methods also find themselves in flow due to the non-occurrence of the paradoxes and low perception of stress in planning tasks, with adaptive use not playing a role. Solution 4 shows that more changeable digital users also benefit from less adaptive use of digital tools and low work stress emanating from the task, again assuming that the negative realization of the paradoxes of IT usage is not present.

	1	2	3	4
IT Usage Behavior				
Digital Working Method	●		●	
Adaptive System Use				⊗
Technology Paradoxes				
Perceived Behavioral Control	●	●	●	●
Autonomy	●	●	●	●
Representational Fidelity	●	●	●	●
Technology Load	⊗	⊗		⊗
Task Environment				
Cognitive Load		●	●	
Personal Distress	⊗	⊗	⊗	⊗
Consistency	0.991	0.997	0.997	0.995
Raw Coverage	0.603	0.540	0.511	0.497
Unique Coverage	0.051	0.013	0.018	0.016
Overall Solution Consistency	**0.994**			
Overall Solution Coverage	**0.684**			

Present and absent conditions are indicated with full and crossed-out circles. "Don't care" conditions are not included in a solution.

Table 6. Configurations to achieve flow (promoting flow).

5 Discussion & Conclusion

We contribute to the literature on techno-flow with a quantitative study in the context of knowledge work (Califf et al., 2020). The technostress literature also focused on an improved understanding of the factors promoting positive experiences at the digital workplace (e.g. Salo et al., 2021). We highlighted key factors in the emergence of knowledge worker engagement for daily planning tasks, including characteristics of effective use. These characteristics were combined with the cognitive load of tasks and technology-related factors for knowledge work (Acsente, 2010; Burton-Jones and Grange, 2013; Porto Bellini, 2018). Our results showed that the paradoxes of IT usage need to be managed holistically (Ciriello et al., 2019; Schneider and Kokshagina, 2020), with only two factors having a significant mediating relationship on flow. Our findings point to the necessity to balance the dialectical tensions between freedom and captivity, control and chaos, clarity and ambiguity, and scarcity and abundance while using IT in organizations to reap the maximum benefits of digital work.

Research has already supported that the usage of IT has a positive impact on experiencing flow (Califf et al., 2020). Our analysis connects the research streams on techno-flow with different paradoxes in using IT (Ciriello et al., 2019; Schneider and Kokshagina, 2020) and quantitatively measures the paradoxical effects on knowledge workers. Our study shows that the perception of flow is positively influenced by increased usage of IT and the emergence of positive and negative technology-driven effects while using IT. Three hypotheses were fully, and one was partially supported. Perceived behavioral control and representational fidelity as mediators absorb the largest effect of the digital working method on flow. Hence, the paradoxes of control and chaos and ambiguity and clarity fully explain the impact of the paradoxes of IT usage on the relationship between the digital working method and flow. In our case, the configurational results are supportive but do not contradict the linear regression results. From a theoretical point of view, an essentially linear picture of the nature of the paradoxes on flow thus emerges. More in-depth industry data, such as further contingencies on the task environment, could help carve out the configurational nature of IT-enabled job designs.

We highlight that the *paradoxes of IT usage* are important in their combined consideration. The PLS-SEM analyses showed no moderating relationship between *adaptive system use* and the digital working method on the paradoxes. However, in the fsQCA, we found that the emergence of flow also depends on contingency factors. In this regard, *adaptive system use* might contribute to achieving flow; however, it could also be counterproductive (Sun et al., 2019). It can sometimes be beneficial to identify workarounds when some stressor, like cognitive load, is present. Our results concerning *cognitive load* show that it can also be an essential prerequisite for the emergence of flow, as the most parsimonious solution, not including cognitive load, in fsQCA shows. This insight also became evident in the PLS-SEM analyses' negative interaction between representational fidelity and cognitive load. Plus, our findings showed that the technology plane becomes relatively negligible when *personal distress* is high.

Our findings point to several managerial implications on how to facilitate the work experience of knowledge workers. The results suggest that providing knowledge workers with access to digital work settings may support the flow experience for planning tasks. As the capital of knowledge workers is the knowledge, managers of a company should make sure that their employees have the opportunity to store it unambiguously. Our research also suggests that employees could rely on better configurations of digital working that should be identified to influence the working behavior and experience positively. When knowledge workers do not fully immerse in their tasks, they should be able to select another personally more suitable configuration depending on the individual contingencies.

Despite its strengths, this paper also has limitations. Measuring flow at only one point in time through a survey is problematic because the respondents have to recall their typical daily experiences. Longitudinal study designs with the measurement at different time points can be helpful to detail the results. Experimental studies could elaborate on concrete work design interventions related to the paradoxes. Moreover, the task context could be broadened as planning tasks represent only a fraction of the spectrum of knowledge workers. The various paradoxes of IT usage could be analyzed across different daily bundles of job tasks (i.e., processual orchestrations) in the future. The research could focus more on the balancing aspect of digital and analog work through these processes. Further research could also include coping strategies other than adaptive system use, like engagement or social support (Schneider and Kokshagina, 2020) and study industry-specific requirements of knowledge workers more in-depth.

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