# On the Relationship between the IT Artifact and Design Theory: The Case of Virtual Social Facilitation

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**Abstract.** Both the IT artifact and design theory are fundamental elements of a design science project. While literature provides an extensive discussion on why IT artifacts and design theory can be regarded as two sides of the same coin, an operational detailed model on how to actually decode and translate the one into the other is not yet to be found. In this paper, we address this important issue taking the example of social facilitation, a theory perspective that informs us about how the integration of social media features in IT-based routine work can increase task performance. With the help of this example we are able to demonstrate how a lack of discussion regarding the relationship between the actual implementation (IT artifact perspective) and corresponding variables (design theory perspective) can create significant issues of scientific rigor. In order to overcome this gap, we develop a design theorizing framework that differentiates between the structural model (inner model), the measurement model, and the design model (both outer model components). Based on our findings, the paper concludes with discussing potentially fruitful avenues for future research and theory development in design science.

**Keywords:** Design theory, Framework, Artifact-Theory Relationship, Instantiation, Virtual Social Facilitation.

## 1 Introduction

The design science research paradigm is highly relevant to information systems research. In recent years, there have been several efforts to bring design research into the IS discipline because it addresses the perceived lack of practical relevance (Hirschheim & Klein 2003) as well as the need to focus on the IT artifact (Hevner et al. 2004). While the importance of the latter within the design science research paradigm has been discussed controversially, it today appears to be generally accepted that a pure focus on the IT artifact is too narrow for a socio-technical discipline (McKay & Marshall 2005; Carlsson 2010). It has been proposed that the phenomena of interest for design research in IS should also include, on a more abstract level, theories (Gregor & Jones 2007). Thus, in addition to the need to increase practical relevance by developing useful IT artifacts, theorizing can be considered an important aspect of design research as well. Design theories, as a specific theory type, define how to do something, i.e. are prescriptive in nature and concern the principles of form

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and function as well as methods and justificatory theoretical knowledge that are used in the development of IS artifacts (Gregor 2006).

However, while the interdependencies between kernel theory and design theory are widely discussed, not much attention has yet been given to the relationship between design theory and the IT artifact. Generally, artifact instantiation from theory is important to demonstrate feasibility of both the design process and the design product (Hevner et al. 2004). However, literature on specific design problems in IS shows that the principles developed by a certain design theory may be instantiated in different ways (e.g. Hardless, Lindgren, & Schultze, 2007). With this paper, we seek to show how the absence of this discussion leads to issues of scientific rigor and support our argument with the help of an example: virtual social facilitation. Based on our findings, we then develop a design theorizing framework that integrates the discussed aspects.

The remainder of this paper is structured as follows. Section two outlines related work on design science and identifies achievements as well as gaps with regard to the relationship of design theory and IT artifact. In Section three, the case of virtual social facilitation is presented and evaluated with respect to specific design choices and their motivation. Section four then builds upon this analysis and derives implications for design theorizing.

## 2 Related Work in Design Science

There are different views on what constitutes design theory and how it relates to the implementation of an IT artifact.

*Design theory is non-existent.* In an early work on design science in IS, March and Smith (1995) stated that the term theory should be preserved for natural sciences and could not be applied in a design context. They point out that "an appropriate framework for IT research lies in the interaction of design and natural sciences. IT research should be concerned both with utility, as a design science, and with theory, as a natural science" (March & Smith 1995, p. 255). Nevertheless, they briefly refer to the relationship between general IS theories and the IT artifact by stating that "theorizing in IT research must explicate those characteristics of the IT artifact operating in its environment that make it unique to IT and require unique explanations" (March & Smith 1995, p. 259). For design science in general, they identified four major outputs: constructs, models, methods and implementations. Here, they argued that design science – similar to natural science – would need a basic language of concepts (constructs) which could then be used to describe tasks or situations in terms of models. In addition, design researchers would also develop certain practices of performing design activities (methods) which may be instantiated in a particular implementation. This argument is developed further by Hevner et al. (2004). However, while recognizing the importance of the other products, they see the "purposeful IT artifact created to address an important organizational problem" (Hevner et al. 2004, p. 82) as major output of design science. Again, the relation between theory and implementation is only addressed on a very abstract level and only refers to IS theories in general and not IS design theories. It is stated that behavioral science addresses the development and justification of theories that explain or

predict phenomena related to the identified business need whereas design science is concerned only with building and evaluating the artifacts.

*Design theory is informed by kernel theories.* In contrast to this view, there has been the notion of a design theory in IS research as initially developed by Walls et al. (Walls et al. 1992) based on the idea of a "science of the artificial" proposed by Simon (1981). Here, not only the IT artifact is considered the core research objective of the IS discipline in general and IS design research in particular (as in e.g. Benbasat & Zmud 2003; Hevner et al. 2004) but also a theory on how to design these artifacts. This information systems design theory (ISDT) is defined as a "prescriptive theory based on theoretical underpinnings, which says how a design process can be carried out in a way which is both effective and feasible" (Walls et al. 1992, p. 37). In this context, Gregor and Jones adopted the concepts of March and Smith stating that "'constructs, models and methods' are all one type of thing and can be equated to theory or components of theory, while instantiations are a different type of thing altogether" (Gregor & Jones 2007, p. 320). Thus, they emphasize the need to differentiate design theorizing from implementing a particular instance of the developed theory in terms of an IT artifact. For the theorizing function, kernel theories, i.e. theories from natural and social sciences that govern design requirements, have been identified as core components. Walls et al. (1992) state that their utilization can be considered essential for both design product, i.e. the actual artifact, and design process. Iivari (2007) even sees the "danger that the idea of a 'design theory' will be (mis)used just to make our field sound more scientific without any serious attempt to strengthen the scientific foundation of the meta-artifacts proposed" if no kernel theories are used within the design theorizing process. Thus, in this view of design science, it is recognized that there has to be a relationship between the underlying kernel theory and the instantiated artifact. The exact structure of this relationship, however, is not elaborated in further detail. It is described on a rather high level and not analyzed with respect to the constructs of the kernel theories in-depth. Furthermore, in this understanding, it is assumed that kernel theory only informs the design, but is itself not systematically refined or further developed by the findings of the design research.

*Reciprocal relationship between kernel theories and design theories.* Gregor (2006) sees design theories as being strongly related to all other theory types (theories for analyzing, theories for explaining, theories for predicting, and theories for explaining and predicting). More specifically, she sees a strong interrelationship between theories of explanation and prediction (EP) and design theories stating that "knowledge of people and information technology capabilities informs the design and development of new information system artifacts" and that "these artifacts can then be studies in terms of EP theory" (Gregor 2006, p. 629). Kuechler and Vaishnavi (2008) add the concept of a mid-range theory and argue that that kernel theories can both inform design science and in turn be refined and developed by it.

It can be noted from this review that there has been a comprehensive discussion in literature about the outputs of design science, the general distinction between design theory and the IT artifact and the relationship between kernel theories and design theory. However, not much has been published yet on the exact relationship between design

theory and particular instantiations of this theory in terms of IT artifacts. Design theories are normative theories, i.e. they are prescriptive and evaluative rather than only descriptive, explanatory, or predictive (Markus et al. 2002). Kuechler and Vaishnavi (2008) state that design theories consist of prescriptive statements where a prescribed action is intended to lead to a certain goal. The relationship between prescribed action and goal correspond to the cause-effect-relation within the underlying kernel theory. However, one could argue that a design theory may include alternative prescribed actions i.e. alternative design choices that are aimed towards the same goal. One concept that points into a similar direction is that of a design theory nexus by Pries-Heje & Baskerville (2008). Referring to Carrol and Kellog (1989) they state that a "design theory nexus extends the deductive view of the relationship between theory and artifact to a reciprocal relation between the articulation and rearticulation of theoretical claims and iterations of design" (Pries-Heje & Baskerville 2008, p. 3). Here, however, alternative solutions do not concern particular design choices but competing design theories and, thus, are aimed towards different goals. Therefore, to our knowledge, there is no theoretical view that includes a discussion of the relationship between alternative prescriptive statements, i.e. prescriptive designs and the implemented artifact.

## 3 The Case of Virtual Social Facilitation

### 3.1 Background and Motivation

Looking at the developments within the 20th century, it is observable that information technology has been primarily used to capture and structure data within organizations and to streamline business processes by means of automation. There has been a plethora of studies focusing on how IT can contribute to more efficient processes (Broadbent et al. 1999; Bala & Venkatesh 2007). Innovations in IT were introduced by the global players and have then been adopted by smaller businesses before arriving at a consumer level. Recently, however, there has been a turnaround regarding this trend (Moore 2011). Now, IT innovations are oftentimes induced on a consumer level and then diffuse into organizational context. The systems of record, i.e. core IT systems of the companies that support their daily routines, are "no longer a source of competitive differentiation for organizations" (Moore 2011, p. 3). They are increasingly complemented by systems of engagement, i.e. systems that allow for communication and collaboration across enterprise boundaries. In a world of complex supply chains and a plethora of stakeholders involved in each business process, this concept of boundary spanning has been outlined as one key aspect for competitiveness (Levina & Vaast 2005). In this context, Web 2.0 in general and social media in particular are often seen as enabling technologies (Kaplan & Haenlein 2010). Research and practice calls for the Enterprise 2.0 that extends and complements existing systems of record with Web 2.0 technologies thereby integrating social media into the organization.

In this context, social psychology in general and social facilitation theory in particular may assist in determining and explaining possible effects these implementations have with regard to work performance. Moreover, researchers have argued that the latter may be a suitable foundation for research on emerging technologies (see Aiello

& Douthitt 2001; Feinberg & Aiello 2006) and, thus, may also be utilized in a social media context. Therefore, within this case, we will use (virtual) social facilitation (VSF) theory to analyze the effects social IT-features may have on simple task performance.

### 3.2 Social Facilitation Theory

In its core, social facilitation theory is concerned with the impact of social presence on the performance of a particular task (Aiello & Douthitt 2001). It can be traced back to early studies by Triplett (1898) who observed that bicycle racers performed better when racing against others than when being alone on the track. The term itself was coined by Allport (1924) who defined it as "an increase in response merely from the sight or sound of others making the same move". Later studies moved away from the coaction principle and showed that social facilitation could also be achieved by means of a passive observer (e.g. Dashiell 1935). In his milestone article on drive theory, Zajonc (1965) suggested, that the mere presence of others increases arousal which in turn leads to a higher level of individual drive towards the investigated task. However, it was found that this only applies to simple and well-learned tasks. Performance on complex or novel tasks, on the other hand, is impaired by the presence of other individuals (Bond & Titus 1983; Zajonc 1965; Feinberg & Aiello 2006). In addition, Cotrell et al. (1986) suggested, that only an audience who has the ability to evaluate the task will stimulate arousal. In their study, the presence of blindfolded individuals did not yield a significant effect on task performance. Taking up this view, Carver & Scheier (1981) postulated that the feeling of being observed will lead to an increased awareness of differences between actual and anticipated behavior. They used this feedback-loop as explanation for the observable increase in task performance.

**Table 1.** Overview of related studies on VSF and their variables

| ***Authors*** | ***Description*** | ***Treatment*** | | ***Implementation*** | |
|---|---|---|---|---|---|
| | | *Name* | *Origin* | *Description* | *Origin* |
| (Aiello & Kolb 1995) | Experiment study on the impact of electronic performance monitoring on productivity and stress by using a data-entry task and group brainstorming. | Monitoring | Prior work (e.g. U.S. Congress 1987) | Data-entry transmitted to controlling client | The author(s) do not provide specific information |
| (Kolb & Aiello 1997) | Experiment study on the effects of computer-based performance monitoring on work productivity by using a data-entry task and a moderate vowel/consonant identification task. | Monitoring | Prior work (e.g. U.S. Congress 1987) | Screensharing | The author(s) do not provide specific information |
| (Davidson & Henderson 2000) | Laboratory experiment on the effects of electronic performance measurement on performance, mood state and stress levels by using an anagram-solving task. | Measurement | Prior work (e.g. George 1996) | Rotating icon indicating performance measurement | The author(s) do not provide specific information |

**Table 1.** (*continued*)

| | | | | | |
|---|---|---|---|---|---|
| (Rafaeli & Noy 2002) | Experiment study on the effects of virtual presence (none, text chat, pictures from other participants) and feedback (winner of auction) on behavior and performance in Dutch auctions. | Monitoring | Prior work (e.g. Aiello & Svec 1993) | Displaying number of other bidders, Displaying name and picture of bidders, Text chat with bidders | The author(s) do not provide specific information |
| | | Feedback | The author(s) do not provide specific information | Displaying winner of auction (picture and name) | The author(s) do not provide specific information |
| (Zanbaka & Ulinski 2004) | Experiment study on the effects of virtual human presence on task performance by using a pattern recognition and categorization task. | Monitoring | Prior work (e.g. Hoyt et al. 2003) | Interactive 3D character projected to wall (virtual human) | Haptek Corporation |
| (S. Park & Catrambone 2007) | Experiment study on the effects of presence by virtual humans on task performance by using different tasks: anagrams, mazes, and modular arithmetic. | Monitoring | Prior work (e.g. Zanbaka & Ulinski 2004) | Interactive 3D character on computer monitor (virtual human) | Haptek Corporation |
| Our Study (cp. Authors 2012) | Experiment study of the effect of monitoring, measurement, and feedback dialogs - in a virtual presence setting - on IT-based anagram solving. | Monitoring | Prior work (e.g. Aiello & Kolb 1995) | Screensharing | Prior work (Kolb & Aiello 1997) |
| | | Measurement | Prior work (Davidson & Henderson 2000) | Icon indicating the measurement | Prior work (Davidson & Henderson 2000) |
| | | Feedback | Prior work (Rafaeli & Noy 2002) | Text chat tool and indicating icon | Prior work (Rafaeli & Noy 2002) |

However, with regard to the increasing digitalization of workplaces, researchers started to investigate the effects of virtual social facilitation by replacing the former human facilitator with a virtual equivalent. Here, studies found that e.g. presence of computer monitoring has similar effects on the work performance than that of a physical person (e.g. Aiello & Svec 1993; Aiello & Kolb 1995). However, the actual implementations of the monitoring efforts differed significantly among studies and included screensharing (Kolb & Aiello 1997), virtual humans (S. Park & Catrambone 2007; Zanbaka & Ulinski 2004), or simple icons indicating the observation (Davidson & Henderson 2000). Table 1 shows an overview of relevant variables within the different studies on virtual social facilitation. All of these studies were concerned with low complexity tasks.

### 3.3 Research Model

From literature, we can identify three treatments as being potentially relevant for social applications: monitoring, measurement, and feedback dialogs. These were used

**Table 2.** Experiment variables used in our study

| Category | Variable | Definition | Implementation |
|---|---|---|---|
| Dependent variable | Performance (PERFORM) | Performance is defined as the performance gain/loss in comparison to the control situation, using a combined performance measure, taking into account correct and wrong answers as well as completion times for an anagram puzzle task. | Median over the individual response times of each participant |
| Independent variable | Monitoring (MONITOR) | Monitoring describes the presence of the supervisor. In the virtual presence setting, the participants are told that IT is used to monitor their doings, e.g. via screensharing. | Screensharing and indicating icon on user interface |
| | Measurement (MEASURE) | Measurement describes the fact, that work performance is explicitly measured and evaluated. Within the virtual test setting, performance recording was achieved by means of automated time saving. | Verbal notice and indicating icon on user interface |
| | Feedback (FEEDBCK) | Feedback is used to inform the participants about their performance, while the test is in progress. We define feedback twofold: (1) Continuous feedback of measured performance throughout the experiment at given times and (2) a comparison of the participants performance to a peer group. | Text chat tool (every 25% completion) and indicating icon on user interface. |

as constructs for analysis. The research presented here is part of a bigger study on social facilitation (Niehaves & Tavakoli 2012). While monitoring, i.e. presence of another (virtual) person, can be found in all identified related studies, measurement is specifically addressed within the research of Davidson and Henderson (2000). Feedback, on the other hand, relates to the feedback-loop model as proposed by Carver and Scheier (1981) and has been one aspect in the work of Rafaeli and Noy (2002). The dependent variable (performance) has been measured by calculating the median over the individual response times of each participant. Here, wrong answers have been replaced by a time of 99 seconds. Table 2 gives an overview of the variable definitions within this study.

Based on the described model, we derived three main hypotheses stating that all monitoring ($H_1$), measurement ($H_2$) and feedback dialogs ($H_3$) would have a significant positive impact on simple task performance. In our understanding all three treatments can be seen as instances of virtual presence. Fig. 1 shows a graphical representation of our research model.

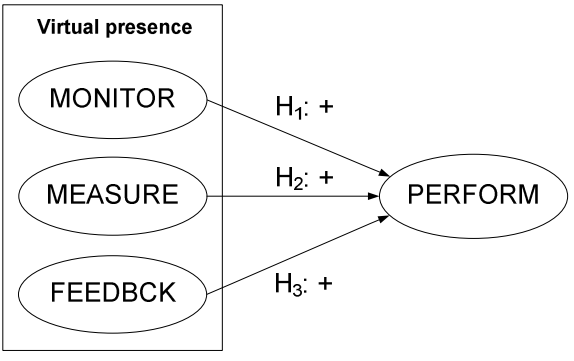


**Fig. 1.** Research Model

### 3.4 Methods and Results

Our study was conducted in 2011 with 40 individuals (average age: 22.75 years, 16 females, 24 males) who received a small monetary compensation for their effort. We measured the simple task performance using an IT-based anagram test thereby tying in with related studies on the subject (Aiello & Svec 1993; Davidson & Henderson 2000; S. Park & Catrambone 2007). Suitable anagrams (160 in total) were determined with help of a pre-study with 14 participants.

**Table 3.** Experiment design

| *Setting* | *Treatments* | | | *N* | *Task performance* | |
|---|---|---|---|---|---|---|
| | *MONITOR* | *MEASURE* | *FEEDBCK* | | *Mean (in Seconds)* | *Standard Deviation* |
| Control Situation | No | No: Participants unaware of measurement | No | 40 | 6.535 | 2.810 |
| Setting 1 | Yes | No: Participants unaware of measurement | No | 40 | 5.561 | 1.934 |
| Setting 2 | Yes | Yes | No | 40 | 5.098 | 1.603 |
| Setting 3 | Yes | Yes | Yes | 40 | 4.186 | 1.198 |

The experiment itself started with introducing the participant to the test tool and an initial solving of 20 anagrams for practicing purposes. Afterwards, four test variants were conducted, divided into two distinct settings: the control situation (CTRL) and the virtual presence setting. An overview of the four variants and their basic performance results is given in Table 3. Within virtual presence setting, monitoring (MONITOR) was implemented by means of screensharing, MEASURE through telling the participant that the system records the results, and FEEDBCK by using a text chat tool after each 25% of task completion. In addition, each treatment was communicated by means of an icon on the user interface. A screenshot of the implemented IT artifact (with all treatments activated) is shown in Fig. 2.

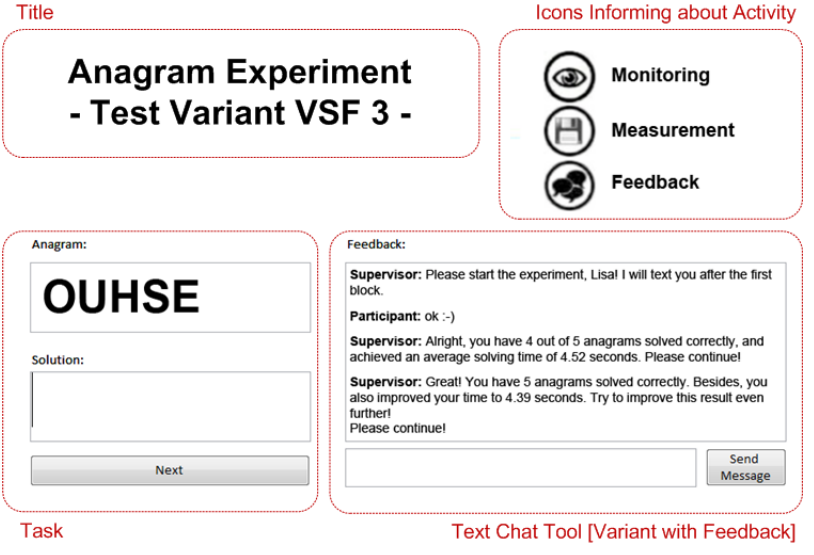


**Fig. 2.** Screenshot of the implemented IT artifact (translated)

In the virtual presence setting, the adjusted coefficient of determination, adjusted $R^2$, shows that around 12% of the variance can be explained with the three independent variables. MONITOR has the highest positive impact on task performance, followed by FEEDBCK. MEASURE shows the lowest impact on task performance and is not significant (see Table 4 for details).

**Table 4.** Results of the regression analysis (n=160)

| ***F / Sig.*** | *8.001 / .000* | | | |
|---|---|---|---|---|
| **R2 / adjusted R2** | .133 / .117 | | | |
| **Var** | *B* | *β* | *t* | p-value (sig.) |
| MONITOR | .975 | .182 | 1.995 | .048 |
| MEASURE | .463 | .100 | .946 | .345 |
| FEEDBCK | .912 | .170 | 1.865 | .064 |

*p-values below .1 can be considered as significant.*

The regression formula thus looks as follows:

*PERFORM = -3.858E-15 + 0.975 * MONITOR + 0.463 * MEASURE + 0.912 * FEEDBCK*

As a result, hypothesis H2 cannot be confirmed as MEASURE has not proven to exert significant influence on performance. However, both MONITOR and FEEDBCK impact significantly on simple task performance in the virtual setting, thus, leading us to confirm hypotheses H1 and H3.

### 3.5 Discussion of Findings

We found that certain virtual social facilitation treatments are able to increase performance on simple IT-based tasks. On the one hand, our study revealed that monitoring by means of digital features may yield a positive effect on completion time. Screensharing, i.e. the way we implemented the construct, can be one possible way to stimulate the monitoring effect through IS design. However, we have to acknowledge that the implementation of such monitoring efforts outside an experimental setting may come along with certain barriers and negative connotations. Feedback dialogs, however, are usually not associated with these downsides, but also exerted a positive influence on task performance in our study. Thus, our design choice of a text chat tool may be a suitable addition to existing IT-based task systems. Against this background, the presented study can be understood as a step towards a design theory of virtual social facilitation trying not only to explain the relationship between the variables but also to provide guidance for the design of a specific IT artifact (Gregor 2006: theory type V; see also Kuechler & Vaishnavi 2008). By selecting screensharing as instantiation for monitoring and a text chat tool for feedback, we undertook two distinct design choices that turned out to positively impact performance of the investigated tasks. However, alternative design choices (for instance, audio-visual approaches to implement monitoring (by web cam) and feedback dialogs (by video chat)) may equally or even better stimulate relevant social facilitation effects and thus need to be subject to further investigation.

## 4 Conclusion

*Implications for Design Theorizing.* The current debate in design science has put great effort into discussing the relationship between kernel theories and design theory. It appears to be widely acknowledged today that theories not only input into design activities (for instance Hevner et al. 2004; Gregor & Jones 2007; Peffers et al. 2007; Iivari 2007), but that (design) theories are a highly desirable output of a design science project themselves (for instance, Gregor 2006, Gregor & Jones 2007, Pries-Heje & Baskerville 2008). In addition, literature provides arguments that design science projects should even feed back into the original body of social science theory

(for instance, Kuechler & Vaishnavi 2008 on mid-range theories). Here, the IT artifact is commonly regarded as an instantiation of a design theory (Gregor & Jones 2007). With the help of an IT artifact, design scientists demonstrate the feasibility of their arguments and put their theories to a test. So far, however, the discussion in this area stays on a rather abstract and general level in the sense that, habitually, the relationship of the one entity "design theory" and the other entity "IT artifact" is discussed. With the further conceptualization of design theories as a system of prescriptive statements and the exploration of design theory variables on a more detailed level (for instance, Gregor & Jones 2007, Kuechler & Vaishnavi 2008), the question arises of what this more detailed and differentiated view of design theory implies for the theory-artifact relationship. Taking the example of Virtual Social Facilitation (VSF), we draw from social psychology and adapted social facilitation as our kernel theory. Our review of this body of knowledge shows a gap between the very rigorous approach to conceptualize theory variables (such as MONITOR, MEASURE, or FEEDBCK) on the one hand, and the rather "careless" approach to select or to develop actual implementations of these theory variables in terms of the IT artifact on the other hand. One might say that the literature in that field does not appear to show primary interest in the actual IT implementation of the basic theories. With the prominent calls, however, for building our design science efforts on kernel theories (for instance, Iivari 2007, Gregor & Jones 2007), we will possibly run into significant issues here. As design scientist, we may have a genuine interest in the way things are implemented in terms of the IT artifact. With the help of virtual social facilitation, we were able to demonstrate that the design theory variables and corresponding IT artifact characteristics are not equating with each other. For instance, we discussed alternative audio-visual approaches to implement monitoring (web cam instead of screensharing) and feedback dialogs (video chat instead of text chat). Why is it crucial then to differentiate between the abstract design theory variable and a concrete IT artifact characteristic?

1. The discrepancy between the theory construct (e.g., MONITOR) and the actual implementation (e.g., screensharing) is a potential source of error. Outer model discussions are an integral element of assessing the quality of, for example, a structural equation model (see, for instance, Wetzels et al. 2009; Venkatesh et al. 2003). The measurement items (manifest variables) do not necessary indicate the theory construct (latent variable) sufficiently. Also, actual IT implementation choices may not represent the best possible solution to relate to an abstract design theory variable. Comparing a) screensharing or b) audio-visual surveillance or c) both measures to implement MONITOR, we may argue that the three solutions could represent the theory construct to different degrees. That being said, we call for an explicit discussion of both the abstract design theory construct (normally strong in related disciplines & habitually weak in IS design research) and the concrete IT implementation (habitually weak in related disciplines and their potential "kernel theories" (see the example case of social facilitation) & often strong in IS design research). With an explicit discussion of the theory construct and the implementation, one can better assess the quality of a design theorizing effort. If

these two sides do not match perfectly in one study, this at least opens up for a more mature discussion of design alternatives.

2. An explicit distinction between the abstract theory constructs and the concrete IT implementation characteristics supports artifact and theory mutability (see Gregor & Jones 2007, Pries-Heje & Baskerville 2008). IT artifacts in practice might be subject to constant change (Gregor & Jones 2007) and the design theory should be robust against certain degrees of change. The suggested differentiation between theory constructs and IT implementations is supposed to offer a potentially feasible path. For instance, if an IT system in practice is moving from text chat to a video chat, one could still argue that the two alternative designs do relate to the design theory variable FEEDBCK. However, we can now explicitly discuss the potentially different effects and workings of the two implementation alternatives. This might lead to different variables of a design theory turning out to exert a stronger/weaker influence with different levels of significance. As for the given example of virtual social facilitation, video chats could prove to contribute stronger to creating a virtual presence of a person than text chats. Against this background, artifact mutability is desirable, but it requires an explicit and differentiated discussion in order to avoid potential design theorizing errors (see again point 1).

Addressing this gap, we argue for a novel design theory framework that explicates the discrepancy between abstract, latent design theory constructs on the one hand and concrete, manifest variables and IT implementations on the other hand. We suggest understanding a design theory as entity composed of two major elements, an inner model and an outer model. Fig. 3 provides a graphical model of the proposed design theorizing framework while Table 5 offers definitions and examples of the key terminology used.

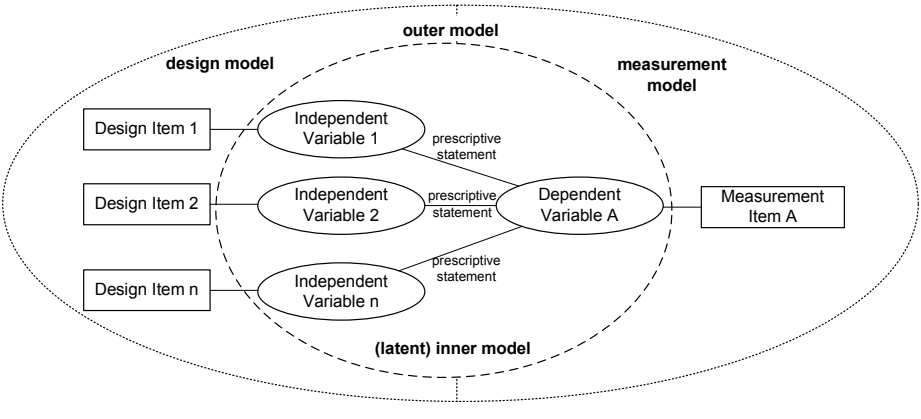


**Fig. 3.** Design Theory Framework (Example with One De-pendent and Three Independent Variables)

**Table 5.** Key Terminology of the Proposed Design Theory Framework (with Definitions and Examples)

| | |
|---|---|
| Inner Model (see, for instance, Wetzels et al. 2009) | The inner model, often synonymously referred to as structural model, is concerned with the relationships between the latent variables (dependent and independent) in a theoretical model. Path coefficients are used to describe the inner model relationships between the latent variables. As for the example of virtual social facilitation, the inner model represents the relationship between the independent latent variables MONITOR (significant), MEASURE, and FEEDBCK (significant) and the dependent latent variable PERFORM. |
| Outer Model (see, for instance, Wetzels et al. 2009) | The outer model is concerned with the relationship between the latent variables and their indicators/items (one or more manifest variables). In our proposed design theory framework, the outer model consists of the two subparts measurement model and design model. |
| Measurement Model (see, for instance, Thompson et al. 2012) | The measurement model is a classic concept of structural equation modeling. In our design theory framework, a measurement model is a subpart of an outer model. Here, measurement items constitute manifest variables and they are utilized to measure a latent variable. As for the example of virtual social facilitation, the measurement model describes the relationship of the only "measured" variable, PERFORM, and its single measurement item. |
| Measurement Items (see, for instance, Thompson et al. 2012) | Measurement items are manifest variables that are utilized to get an understanding of a related latent variable. As for the example of virtual social facilitation, the (only) measurement item is the mean time to solve a series of 20 anagram puzzles in seconds which is used to indicate the participants' performance (PERFORM). |
| Design Model (new concept) | The design model is a subpart of the outer model. It is concerned with the relationship between independent latent variables and its manifest design items. With regard to the example of virtual social facilitation, the design model describes, for instance, the relationship between MONITOR (the abstract concept/latent variable) and screensharing (the concrete implementation/manifest variable). |
| Design Items (new concept) | Design items in the design model compare to measurement items in a measurement model. The difference is that design items don't measure things, but they represent intended manipulations of an IT artifact's characteristics. For instance, screensharing is a design item that corresponds to the latent independent variable MONITOR. With the latent variable being abstract and the design item being concrete, the two things are not equating with each other. As for the given example, MONITOR could be implemented by audio-visual surveillance or keyboard activity monitoring alternatively. |

On the one hand, the inner model is concerned with the relationship between independent and dependent variables which we regard as latent ones. They are latent because they are not directly observed. As for the example of virtual social facilitation, the inner model describes the relationship between MONITOR, MEASURE, and FEEDBCK (independent) with PERFORM (dependent). On the other hand, the outer model is concerned with the relationship between the latent variables and other directly observable variables including IT implementation characteristics. In our proposed design theory framework, the outer model consists of two subparts: the measurement model and the design model. As in traditional research on structural equation modeling (SEM), the measurement model consists of a latent variable that is measured by manifest variables. Taking the example of virtual social facilitation, we find the dependent variable PERFORM the only one to be "measured", in this specific case by the mean time [in seconds] of the individual participants to solve a series of 20 anagram puzzles. In contrast, the design model is not concerned with latent variables that are "measured", but with latent variables that are "designed", meaning that they are related to an intended manipulation of an IT artifact's characteristics.

For instance, screensharing is a deliberate design choice embedded in an IT artifact and it corresponds to the latent independent variable MONITOR. While certain variables of a design theory are not passively measured but actively designed, we argue that a design theorizing framework has to provide a distinction in order to account for the different nature of the two areas.

*Strengths and Limitations*. With this paper, we can make several contributions to the body of knowledge, especially in IS design science. First, we develop an (experimentally tested) design theory for virtual social facilitation that is based on social psychology and social facilitation theory specifically. We deliver a concrete answer to the question of how an integration of social media and IT-based routine work can be designed in order to increase work performance. With the help of this exemplary case, we reveal challenges and potential pitfalls in IT artifact design and design theorizing that is built around kernel theories. We demonstrate that a missing distinction between the abstract design theory construct and the concrete IT artifact characteristic can be a source of error and that it can diminish the scientific rigor of a design science effort. We argue further that such a missing distinction leaves out potential for accounting for artifact mutability in design theorizing. In order to overcome this challenge, we propose a novel design theorizing framework takes into account latency of variables. In order to improve the applicability of our framework, we provide comprehensive definitions as well as examples of key terminology. However, our research is beset with particular limitations. We conducted only 160 experiments to test our VSF design theory and acknowledge that further evaluative research is recommendable. Future research should in fact test the effects of alternative design choices to implement the given theory constructs (e.g., video chat instead of text chat for FEEDBK). Moreover, we have analyzed studies from the field of social psychology to develop our theory. It might be that the design theorizing challenges, especially the underprioritized discussion of the actual IT implementation characteristics, is only found in this body of knowledge. Future research should investigate whether design theorizing challenges are alike in other areas. Finally, we acknowledge that our proposed design

theory framework needs to be tested and evaluated further for feasibility. We have developed it on the basis of the given VSF example. Future research will need to show in how far the design theorizing framework is able to provide constructive guidance if applied in a design science project from the beginning on.

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