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ON HOW TO DEVELOP DESIGN THEORIES FOR IS USE AND MANAGEMENT¹

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Abstract

Design science research is an essential part of IS research since the field should not only try to understand how the world is but also how to change it. We argue that the aim of IS design science research should be to develop practical knowledge not only for the design and improvement of IS but also for IS use and management. Whereas substantial methodological support exists for researchers engaged in behavioural IS research, only limited methodological support exists for researchers with the ambition to develop new IS design theories and new IT artefacts. For the development of design theories for IS use and management the methodological support is even weaker. To overcome this shortcoming we suggest an approach for design research on IS use and management. We give two examples of the proposed approach in use by applying it to the areas of knowledge management systems and e-learning.

Keywords: Design science research, Design theory, Knowledge management systems, E-learning

¹ This is a co-authored paper with equal contributions.

1 INTRODUCTION

Research can be classified in different ways. Herbert Simon (1988), in his book *The Science of the Artificial*, distinguishes between “natural sciences” and “artificial sciences”. Natural sciences focus on how natural and social “things” are, while artificial or design sciences focus on how to design artefacts to fulfil certain goals. Recently, IS design science research has received increased attention in the IS community. IS design science research is concerned with theory for action, i.e. “how to do something” (Gregor, 2006). Van Aken (2005) argues that the core mission of a design science is “to develop valid knowledge that can be used by professionals in the field in question to design solutions to their field problems” (p. 22). Scholars argue that IS design science research should be an essential part of IS research since the field should not only try to understand how the world is but also how to change it (Iivari, 2003).

Two major IS design science research schools have emerged (El Sawy, 2006): 1) design science research (Cao et al., 2006; Hevner et al., 2004; March & Smith, 1995), and 2) IS design theory (Walls et al., 1992). Regarding what should be included in IS design science research, and consequently in IS design theory and IS design knowledge, it is clear that the schools focus the IT artefact. They exclude the non-technological context by excluding people and organizations (Carlsson, 2006; McKay & Marshall, 2005). Given, the schools’ focus, and what they exclude, the schools might better be named IT design science research schools (Carlsson, 2006). Some scholars (e.g. Carlsson, 2006) argue that if we follow Simon’s view on design science it can be more than IT artefact design knowledge that the IS field should develop: “*Everyone designs who devises courses of action aimed at changing existing situations into preferred ones*” (Simon, 1988, p. 129). Unless we have a technologically deterministic view, the aim of IS design science research should be to develop practical knowledge not only for the design and improvement of IS and IT artefacts, but also for IS use and management. Our view parallels that of van Aken (2005), who proposes that management research should develop “*field-tested and grounded technological rules*” to guide practice. Gregor and Jones (2007) argue that design science research should not only concern prescriptions for designing technological products and applications but also for designing methodologies and interventions. Baskerville, Pries-Heje and Venable (2007) argue that much of current design science literature and practice is strongly influenced by engineering approaches, “hard” system views and positivist research methods: “*...such an approach invites serious difficulties in the IS domain since it has such a strong organizational and social component.*” (p. 19). Therefore, the authors propose that the boundaries of IS design science research should be extended to include organizational and social aspects of IS to create a soft design science research approach taking into account adoption of systems and evaluation of IT artefacts in use in natural organizational settings.

When conducting traditional IS research based on behavioural sciences, a substantial basis of methodological support is available to assist the researcher in developing descriptive and explanatory theories (e.g., Kaplan et al. 2004; Whitman & Woszczyński, 2004). Design science, with the ambition to develop IT artefacts (c.f. Hevner et al., 2004), may similarly rely on techniques and methods for product development, including the well established techniques for prototyping in the field of human-computer interaction. However, for design research with the ambition to improve IS use and management, methodological support is sparse. The process of developing knowledge for IS use and management is different from the process of developing an IT artefact in that the effects of knowledge for IS use and management is harder to isolate. Such knowledge is deeply embedded in the context, which makes evaluation complex. As a consequence, approaches such as the one suggested by Hevner et al. (2004) need to be complemented by approaches for developing knowledge for IS use and management. We are lacking sound approaches and methods for how to develop design theories for IS use and management. In other words, we need knowledge and methods that can support the development of such design theories. This paper seeks to overcome the current lack of support by presenting an approach for the development of design theories for IS management and use. We do so by integrating and elaborating the existing contributions on this type of IS design science. As the pile of works on the subject is rather meagre, we also turn to IS design research with an IT artefact focus

and design science in management research to investigate how the methodological discourses in these fields can enhance the development of design theories for IS use and management.

The paper is organized as follows. First, we present the existing suggestions on how to develop design theory for IS use and management, including suggestions extracted from related fields. The existing research and suggestions are integrated into an initial approach for the development of design theories for IS use and management. The approach is then illustrated with two cases in which it has been used to produce design theories on IS use and management. Finally, conclusions, limitations and suggestions for further research are put forward.

2 DEVELOPING DESIGN THEORIES FOR IS USE AND MANAGEMENT

While traditional IS research, based on the behavioural sciences, is relatively well supported when it comes to choosing a suitable research method for empirically investigating a topic, a researcher trying to contribute with IS design theory is left rather unsupported. Below we will argue that IS design science research should also include development of design theory for IS use and management. For this type of IS design research only very limited methodological support exist. We will start with a presentation of our interpretation on where IS design research on IS use and management should aim. Then we present the existing writings on developing design theory for IS use and management. Finally we present the methodological discourse of fields related to design science for IS use and management so as to depict how contributions from these fields can inform an approach for developing design theories for IS use and management.

2.1 The objective of design research for IS use and management

March (2006) argues that “Relevance, rigor and results are the trifecta of academic research” and that they are defined by the constituency that comprises and supports the IS discipline. This IS constituency includes “IS academic researchers, organizations that develop and deploy information technologies (IT), organizations that produce and implement such technologies, IS managers within such organizations and, more and more commonly, general and upper level managers within such organizations.” (ibid., p. 338). Our view is that the primary constituent community for the output of IS design science research is IS professionals and managers responsible for IS/IT-supported and enabled processes and activities. This means primarily professionals who plan, manage and govern, design, build, implement, operate, maintain and evaluate different types of IS/IT initiatives and IS/IT. The design knowledge this community demands includes: 1) knowledge for developing IT/IS-enabled solutions (including improving previous implemented solutions) that primarily address organizational problems, and 2) knowledge for how to implement and integrate the solutions into the context (primarily organizational context). The developed IS design knowledge is to be applied by individuals who have received formal education, or a similar training, for example, in the IS field. An IS professional can be defined as a member of a fairly well-defined group who solves real-world IS problems with the help of skills, creativity and scientific and non-scientific IS design knowledge.

IS design science research should develop practical design knowledge to be used to solve classes of IS problems. This means the development of abstract knowledge that can be used in designing and implementing IS initiatives. The knowledge is abstract in the sense that it is not a recipe for designing and implementing a specific IS initiative for a specific organization. A user, for example, an IS professional, of the abstract design knowledge has to “transform” the knowledge to fit the specific problem situation and context. By an IS initiative we mean the design and implementation of an intervention in a socio-technical system where IS (including IT artefacts) are critical means for achieving the desired outcomes of the intervention. Following Pelz (1978), we distinguish between conceptual and instrumental use of science and research output. The former involves using knowledge for general enlightenment on the subject in question and the latter involves acting on research results in specific and direct ways. Both types are relevant for the IS field, but design science research addresses primarily the development of design knowledge for instrumental use.

Using van Aken’s (2004) classification we can distinguish three different types of designs an IS professional makes when designing and implementing an IS-initiative: 1) an object-design, which is

the design of the IS intervention/initiative (incl. the design of an IT-artefact), 2) a realization-design, which is the plan for the implementation of the IS intervention/initiative, and 3) a process-design, which is the professional's own plan for the problem solving cycle and includes the methods, techniques, and design theories to be used in object- and realization-design. IS design science research should produce knowledge that can be used by the professionals in the three types of designs. It can be argued, based on the IS implementation and IS failure literature, that realization-design knowledge, of which a typical example is design theory for IS use and management, is critical for successful IS use.

The rationale of developing design theory for IS use and management is that such theory can support practitioners to understand mechanisms that may lead to desired outcomes. Figure 1 is adapted from Pawson and Tilley's (1997) model of realist casual explanation. The arrow labelled "design proposition" has been added to emphasize that the likelihood that mechanisms leading to "beneficial" outcomes can be increased if practitioners are given guidance based on what is currently known. However, the success of mechanisms is limited by contextual constraints (Pawson, 2006). Design propositions should therefore aim to address contextual constraints, although the purpose should be to develop general and abstract knowledge rather than recipes. Thus, it is possible to take contextual variables into account, such as media use in groups of different sizes, but it is not possible to give guidance for every specific context. Instead, practitioners are suggested to design based on experience, the specific problem situation and context, and on the knowledge of the design propositions (Carlsson, 2006; van Aken, 2006).

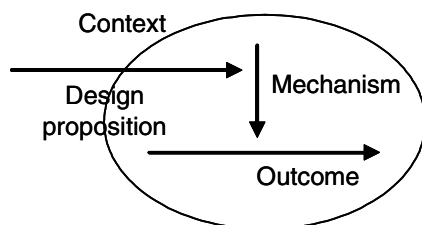


Figure 1. Guiding "beneficial" outcomes (adapted from Pawson, 2006)

The output of design science can be expressed in several ways. The above term "design proposition" is a term used foremost in management research (Romme, 2003; van Aken, 2005) that follows the logic of a technological rule: "In situation S, to achieve consequence C, do action A" (Bunge, 1967). In the field of IS it may be more appropriate to use the term *design proposition* instead of technological rule since the latter term may suggest a technical, rather mechanistic approach (Hrastinski et al., 2007a). Although the design proposition follows the structure above, the "A": one or a set of actions or mechanisms can be presented as a drawing, picture, a report or a whole book (van Aken, 2005). It should also be noticed that, just as claimed by Pawson (2006) for evidence-based management, design propositions for IS use and management will always be of a heuristic character, rather than absolute truth. The contextual dependency and the condition that design propositions must be interpreted in a specific setting also indicate that design proposition is a more suitable label than technological rule.

2.2 Methodological considerations for design science research for IS use and management

We still know little about methodological consideration for conducting IS design research for IS use and management. In the remaining part of this paper, we will address the lack of methodological guidance by providing guidance on how to develop design theory for IS use and management.

Van Aken (2005) proposes that management research should develop "*field-tested and grounded technological rules*" to guide practice. Technological rules could be seen as solution-oriented knowledge and should be grounded, which means that it is known why the intervention proposed by the rule gives the desired effect. In design theories for IS use and management, we propose that the technological rules should take on a *heuristic* nature. Opposed to the algorithmic technological rule, which can be used by the practitioner as an instruction, the heuristic technological rule could be described as "if you want to achieve Y in situation Z, then perform action X." (Van Aken, 2005, p. 23). Typically, the solution embedded in the heuristic technological rule has a qualitative format. It is therefore difficult to prove its effect, but field-testing can produce supporting evidence.

The key of methodological considerations should be *how to provide a rigorous and trustable path from a kernel theory to a design theory*. In traditional IS research based on behavioural science this path is supported by methodological suggestions (e.g. Yin, 1994; Eisenhardt, 1989). If IS design research should be considered as rigorous as behavioural research, the same demands of trustworthiness should be achieved in IS design research. Although the potential of increasing relevance of IS research is one of the drivers behind IS design research, it should not be on the expense of rigour. In the next section we give guidance to researchers interested in developing design theories for IS use and management.

3 AN APPROACH FOR SUPPORTING THE DEVELOPMENT OF DESIGN THEORIES FOR IS USE AND MANAGEMENT

In this section, we suggest an approach for design science on IS use and management. The approach integrates the existing proposals on how to develop this kind of design theory with methodological suggestions from IS design science that focus on IT artefact development (e.g. Hevner et al., 2004) and management design science (e.g. van Aken, 2005; 2006).

For design science on IS use and management we identify four major research activities, depicted in Figure 2 (Hrastinski et al., 2007b). As noted in Section 1, our approach has a broader focus than the two major IS design science research schools. For example, Hevner et al. (2004) write: "... we do not include people or elements of organizations in our definition [of the IT artefact, the purpose of design science research] nor do we explicitly include the process by which such artifacts evolve over time." An important part of our research approach is to continuously test design theories. This includes testing of theories' applicability in practice, which Rosemann and Vessey (2008) have labelled *applicability checks*. We will argue that another key characteristic of design science research is that it should draw on what we already know, i.e. kernel theories and previous research. We have identified four key research activities, which are discussed below.

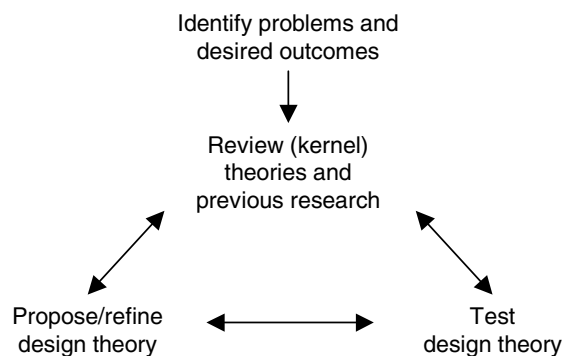


Figure 2. Design theory development

3.1 Research activity: Identify problems and desired outcomes

Design theories aim to support solving practical problems in such a way that desired outcomes are reached. Hence, such theories are goal and outcome-oriented, which means that they should when used increase the likelihood of reaching stated goals (outcomes). In the next section, we give examples of two design theories and the practical problems that motivated the need for these theories. The design theories were developed to guide practitioners in how to use technology in order to achieve "beneficial" outcomes. As for design science research in general, the problems and desired outcomes are primarily driven by business needs (cf. Hevner et al., 2004).

3.2 Research activity: Review (kernel) theories and previous research

Design theories should be enhanced through grounding in previous research. A design theory should be enhanced by continuously interacting with what is currently known, that is, grounding in kernel

theories and previous research. Gregor (2006) distinguishes five interrelated types of theory (see Figure 3). The figure reveals that all other classes of theory can inform design theory: “Knowledge of people and information technology capabilities informs the design and development of new information systems artefacts” (p. 629). As illustrated in the figure, Gregor argues that design theory, and explanatory and predictive theory, are strongly interrelated. More specifically, van Aken (2005; 2006) maintains that design propositions can be developed through cross-case analyses of previous case studies – for a detailed presentation of how policies (initiatives) can be developed through cross-case analyses, see, George and Bennett (2004). Moreover, it is well-agreed upon that kernel theories, i.e. theories from natural and social science, should govern design research (Hevner et al., 2004; Walls et al., 1992).

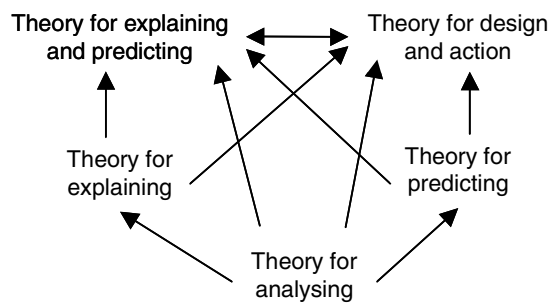


Figure 3. Interrelationships among theory types (Gregor 2006)

Design theories can be enhanced through systematic reviews of previous research. Several scholars (e.g., Pfeffer & Sutton, 2006; Bennis & O’Toole, 2005; Pawson, 2006) have argued for the development of evidence-based or evidence-informed management knowledge, including evidence-based design knowledge. This approach is characterized by “an unrelenting commitment to gather the facts and information necessary to make more informed and intelligent decisions” (Pfeffer & Sutton, 2006, p. 14). In our IS design science research cases presented in Section 4, the reviews of previous research was inspired by Pawson’s (2006) suggestions on how to conduct systematic reviews to make sense of a heterogeneous body of literature (see also Tranfield et al., 2003). Reviews should be driven by a focus on *outcome* and how outcome can be *produced* or *enhanced*. Using Pawson’s approach means that it is possible to move away from the many one-off studies and instead learn from fields such as medicine and policy studies on how to develop evidence-based IS design knowledge. In order to guide practitioners, researchers should analyse previous research based on the assumption that we can draw more powerful conclusions from the collective wisdom of previous research.

3.3 Research activity: Propose/refine design theory

When proposing a design theory, in the form of design propositions, it is important to provide “thick descriptions” to aid the reader in understanding the theory, which may support practitioners in translating a theory to specific contexts and situations (van Aken, 2005). As said above, van Aken (2005, 2006) suggests that prescriptive design knowledge follows the logic of the “technological rule” (Bunge, 1967): “if you want to achieve Y in situation Z, then do (something like) X”. A technological rule can be seen as a *design proposition*. As acknowledged by van Aken, “the term ‘technological rule’ may suggest to some a technical, rather mechanistic approach” (2005, p. 30). We use design proposition since the term describes the aim of the research presented here, i.e. to develop knowledge that can be used by practitioners when they design IS interventions, for example, for beneficial use and management of knowledge management systems and e-learning environments. The core of a design proposition is the X, the general solution concept, which can be an action or a set of actions. The logical structure of a design proposition is as above, but the actual form can be a drawing, picture, a report or a whole book. A heuristic design proposition does not guarantee success, but it supports the development of a successful system or action. The theories we present in Section 4 comprise heuristic design propositions.

3.4 Research activity: Test design theory

After having formulated an initial design theory, the next step is empirical tests, which include the selection of appropriate data collection methods (Carlsson, 2006). In doing this, it can be examined whether the design theory may be used as support when trying to “change” reality. Based on the results, the outcome may be reflected on and the design theory may be refined. Through multiple studies one can accumulate supporting evidence iteratively and continuously move towards “evidence saturation”. We can say that the tests of a design theory go through alpha, beta, and gamma testing. Alpha testing concerns further development by the originator(s) of the design theory. Beta testing concerns further development by other researchers. Gamma testing concerns testing the design theory in practice, and includes testing whether practitioners can use it and if the use of the theory leads to the desired outcome(s). Further guidance on how to conduct gamma tests are provided by Rosemann and Vessey (2008), who use the term applicability checks to describe this type of testing. They suggest that applicability checks can be made through focus groups, which we have used with appealing results (see section 4.2). However, it should be recognized that it can be practically unfeasible to, as suggested by Rosemann and Vessey (2008), gather IS managers to conduct an evaluation. For the future we see a need for a discussion on different techniques for testing design propositions and their applicability. Gamma-testing may be conducted in many other ways, including for example, Delphi-studies (Linstone & Turoff, 1975) and Q methodology (Andersson & Brown, 2004).

3.5 Summary: An approach for developing design theories for IS use and management

We have argued that design theory development for IS use and management include at least four key research activities. It is assumed that our approach can support researchers in developing design theories of high quality for IS use and management. We suggest that the developed theories should fulfil Greogor and Jones’ (2007) eight components of information systems design theory (see Table 1).

Component	Description
Core components	
1) Purpose and scope (the <i>causa finalis</i>)	”What the system is for”, the set of meta-requirements or goals that specifies the type of artefact to which the theory applies and in conjunction also defines the scope, or boundaries of the theory.
2) Constructs (the <i>causa materialis</i>)	Representation of the entities of interest in the theory.
3) Principle or form of function (the <i>causa formalis</i>)	The abstract “blueprint” or architecture that describes an IS artefact, either product or method/intervention.
4) Artifact mutability	The changes in state of the artefact anticipated in the theory, that is, what degree of artefact change is encompassed by the theory.
5) Testable propositions	Truth statements about the design theory.
6) Justificatory knowledge	The underlying knowledge or theory from the natural or social or design sciences that gives a basis and explanation for the design (kernel theories).
Additional components	
7) Principles of implementation (the <i>causa efficiens</i>)	A description of processes for implementing the theory (either product or method) in specific contexts.
Expository installation	A physical implementation of the artefact that can assist in representing the theory both as an expository device and or purposes of testing.

Table 1. *Eight components of an Information Systems Design Theory (Gregor and Jones, 2007).*

4 EXAMPLES OF HOW TO DEVELOP DESIGN THEORIES FOR IS USE AND MANAGEMENT

In this section we illustrate how we have used our approach when developing two design theories. For each theory, we will briefly describe the activities of the four research activities. We do so partly to illustrate how the approach can be used, but also to illustrate that studies based on the approach has

been peer reviewed and accepted for publication by the IS community (for more detailed discussion of the design theories, see Carlsson & Kalling, 2006, 2007; Hrastinski et al., 2007a, 2007b).

4.1 Example 1: Developing a design theory for turning KMS use into profit

Identify problems and desired outcomes. An underlying assumption of KM (incl. KMS) is that a firm's competitive advantage to a large extent flows from its unique knowledge and how it manages knowledge. Unfortunately, little empirical evidence exists to show that this assumption is true. Even less knowledge on how to manage KMS-initiatives to increase financial performance exists (Edwards et al., 2003).

This project aims at producing theoretically and empirically grounded KMS design knowledge. The KM/KMS-literature is clear on that failures are unacceptable high. The literature suggests also that *The Field of Dreams* approach—"if you build it, they will come"—usually fails. The primary cause is the failure to adequately predict and manage the organizational impacts of KM/KMS investments. The project aims at developing a KMS design theory for how to manage KMS investments. Specifically, we focus on how to manage adoption and exploitation of KMS. A general goal when designing and implementing a KM/KMS-initiative is that it should lead to improved performance. The construct "improved performance" forces attention to the dependent variable(s). This research focuses on organizational "Net Benefits" in terms of financial performance.

Review (kernel) theories and previous research. The review of previous research was inspired by the work of Pawson (2006) and Tranfield et al. (2003) on systematic reviews. The review was driven by a focus on outcome (profit improvement through KMS use) and how the outcome can be "produced". We tried to identify how KMS management had been used for turning KMS use into profit improvement. The literature on this was very sparse, which meant that we not only focused on success factors and processes but also on failure factors and processes. Underlying kernel theories included primarily knowledge sharing theories, for example, the work of leading KM researchers like Nonaka, Takeuchi, von Krogh, Davenport, Prusak, and Patriotta.

Propose/refine design theory. In the multiple case studies conducted for generating the design theory we addressed the research question: Why and how is it that a knowledge sharing initiative works? The design propositions were generated based on a multiple case study (Carlsson & Kalling, 2006, 2007). Van Aken (2005, 2006) suggests that design propositions can be developed through cross-case analyses. The design propositions were also theoretically grounded, primarily in knowledge sharing theories.

The multiple case study was of a KMS-initiative in a large multinational firm. The purpose of the KMS-initiative was to, through the use of a KMS for knowledge sharing, support production improvement decision making. A KMS, with high information (knowledge) and system quality, to be used for knowledge sharing had been developed and implemented in the firm's plants. 38 plants were similar enough to be used for a comparative study. A quantitative study of the 38 plants was done. The study addressed: 1) whether knowledge sharing had occurred, 2) the effects of sharing on cost items and price, and 3) the effects on profit. After having studied the general links between sharing success and financial performance, certain patterns became evident. In order to study them further, six plants with different degrees of success were singled out for onsite case studies. In this qualitative study we identify a process consisting of three phases: 1) knowledge sharing through the use of the KMS, 2) managing the conversion of knowledge, and 3) improving profit margins. We also identify eight critical success factors and linked them to the different phases. Based on the multi-case study our tentative design theory was generated in the form of nine design propositions for turning KMS use into profit (summarized in Table 2).

Test design theory. One important activity in design theory development is tests. As said above, three types of tests should be performed; alpha, beta, and gamma testing. In this case alpha test has been conducted through applying the generated design propositions on a few numbers of cases. The design propositions have been quite informally tested by practitioners (gamma test). This test has been in the form of presenting the design propositions and having practitioners evaluate: 1) are the design propositions understandable, 2) are the design propositions actionable, and 3) is it likely that using the

design propositions will result in desired outcomes. Drawing on the test results, the design theory is currently refined. Further testing of the design theory is needed.

Component	Description
Core components	
1) Purpose and scope (the <i>causa finalis</i>)	The aim is to develop design propositions for practitioners, to manage the exploitation of KMS, especially how to turn KMS use into profit at an operational level.
2) Constructs (the <i>causa materialis</i>)	Perceived and actual measures of KMS use and results of using the knowledge in the KMS for decision making action taking.
3) Principle or form of function (the <i>causa formalis</i>)	KMS used at an operational level.
4) Artifact mutability	Exploitation of KMS has the potential to improve performance (and in the end increase profit).
5) Testable propositions	Nine propositions which may be continuously improved by testing them.
6) Justificatory knowledge	Underlying kernel theories include “general” KM theories and knowledge sharing theories.
Additional components	
7) Principles of implementation (the <i>causa efficiens</i>)	<i>Examples of the first three design propositions:</i> #1: If you want to get a positive perception of a knowledge sharing initiative, then make sure that the initiative is explained, motivated, and supported (management support). #2: If you want the sharing initiative to have a positive impact on operations, then link knowledge use to operational decision-making and action taking. #3: If you are using intra- and/or intra-unit competition and want to achieve a positive impact of the initiative on operations, then make sure that adequate performance measures are implemented and used.
Expository installation	The design theory has been evaluated in alpha- and gamma-tests. IS practitioners have informally evaluated based on their general knowledge, but the theory has not yet been used and evaluated in management of a KMS.

Table 2. *A design theory for managing the exploitation of a KMS, i.e. turning KMS use into profit (adapted from Gregor and Jones, 2007).*

4.2 Example 2: Developing a design theory for synchronous e-learning

Identify problems and desired outcomes. In order to succeed with e-learning initiatives, organizations and educational institutions must understand benefits and limitations of different e-learning techniques and methods. An important task for research is to support practitioners by studying the impact of different factors on e-learning effectiveness. Commonly, two basic types of e-learning are compared, i.e. asynchronous and synchronous e-learning. Up till now, e-learning initiatives have mainly relied on asynchronous means for teaching and learning (Hrastinski & Keller, 2007; Romiszowski & Mason, 2004). However, recent improvements in technology and increasing bandwidth have led to an increasing popularity of synchronous e-learning (Kinshuk & Chen, 2004). Many practitioners are interested in using synchronous e-learning but simply do not know what the benefits and limitations of this type of communication are (Hrastinski, 2007). Thus, this design theory is intended to contribute towards a deeper understanding on a topic where guidance is urgently needed.

Review (kernel) theories and previous research. Our review of previous research was inspired by Pawson’s (2006) suggestions on how to conduct systematic reviews to make sense of a heterogeneous body of literature, which were discussed earlier. The review was driven by a focus on outcome, in our case participation, and how outcome can be “produced” (in our case when synchronous CMC can be used to enhance participation in e-learning settings). Underlying kernel theories included social learning theories that view participation as critical to the learning process (e.g., Vygotsky, 1978; Wenger, 1998) and the cognitive model of media choice (Robert & Dennis, 2005), which aid in explaining when synchronous communication may be preferred.

Propose/refine design theory. In our previous research, we addressed the following research question: When may synchronous communication be supported as a complement to asynchronous

communication in online education? The question was addressed by developing six design propositions, intended to guide practitioners on when synchronous communication may be used, as a complement to asynchronous communication, in e-learning (see Table 3). Initially, we mainly drew on a series of case studies we had conducted during the recent years, kernel theories and previous research. However, this research activity was revisited many times: The design theory was continuously improved, as lessons were learnt by testing the theory and by analysing previous research.

Component	Description
Core components	
1) Purpose and scope (the <i>causa finalis</i>)	The aim is to develop design propositions for practitioners, to support decisions on when to support synchronous communication, as a complement to asynchronous communication, in online education.
2) Constructs (the <i>causa materialis</i>)	Perceived and actual measures of participation in asynchronous and synchronous communication.
3) Principle or form of function (the <i>causa formalis</i>)	E-learning environments that support both asynchronous and synchronous means of communication.
4) Artifact mutability	Synchronous communication has the potential to enhance participation in online education.
5) Testable propositions	Six propositions which may be continuously improved by testing them.
6) Justificatory knowledge	Underlying kernel theories include social learning theories that view participation as critical to the learning process (e.g., Vygotsky, 1978; Wenger, 1998) and the cognitive model of media choice (Robert & Dennis, 2005), which aid in explaining when synchronous communication may be preferred.
Additional components	
7) Principles of implementation (the <i>causa efficiens</i>)	<i>Examples of the first three design propositions:</i> #1: If you want to enhance participation in smaller groups, then support synchronous communication as a complement to asynchronous communication. #2: If you want to enhance “personal” participation, then support synchronous communication. #3: If you want to enhance task support exchanges, then support synchronous communication.
Expository installation	The design theory has been tested in focus groups with experienced practitioners on fictive cases, but not yet applied and evaluated in actual course development.

Table 3. A design theory for synchronous e-learning (adapted from Gregor and Jones, 2007)

Test design theory. One important aspect of design theory development is the empirical test. Throughout the paper, empirical and theoretical evidence have been used to motivate (and test) the design theory. When having proposed an initial design theory, an empirical gamma test, i.e. a test with practitioner involvement, was conducted. Krueger (1994) argues that focus groups are an appropriate method for evaluating the effect of interventions in social contexts and, thus, seem appropriate for evaluating design propositions by obtaining feedback from experienced practitioners. A brief version of the design propositions was published in a Swedish e-learning magazine. In the article, teachers, managers, administrators and developers with experience of asynchronous and synchronous e-learning were invited to participate in focus groups to evaluate the design propositions of the theory. Drawing on the results, the design theory was refined.

5 CONCLUSION, LIMITATIONS AND FURTHER RESEARCH

In this paper, we have argued that the aim of IS design science research should be to develop practical knowledge not only for the design and improvement of IS but also for IS use and management. Whereas substantial methodological support exists for researchers engaged in behavioural IS research, only limited methodological support exists for researchers with the ambition to develop new IS design theories and new IT artefacts. For the development of design theories for IS use and management the methodological support is even weaker. To overcome this shortcoming we have suggested an

approach for design research on IS use and management. We give two examples of the proposed approach in use by applying it to the areas of knowledge management systems and e-learning.

It should be acknowledged that this paper presents an initial approach for how to develop design theory for IS use and management. It is an important step towards developing an approach that IS colleagues find useful. Further research that test, criticize and further develop the approach, by using it in both similar and different contexts, is needed. A limitation of this paper is that the approach has only been used and tested in the resembling fields of knowledge management and e-learning. We are currently using, testing and further developing the approach by applying it to the field of IS mergers and acquisitions, which will hopefully result in a refined and further validated version of the approach.

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