

# A Situated Learning Design Framework for Competence Development Systems

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## Abstract

The objective of this paper is to inform the design of information systems that support competence development in a work context. The paper builds on an action research study which followed the logic of (1) developing a general design framework mainly based on situated learning theory, (2) developing design concepts based on the design framework, and (3) evaluating the design concepts, and thus the underlying design framework, through applying them in action research projects intended to develop project management competence. On the basis of this 30 months effort, the paper presents a situated learning design framework for competence development systems. This design framework contributes to operationalising situated learning theory and improving the design of competence development systems.

**Keywords:** competence development systems; design; situated learning; project management competence.

**Suggested track:** G. Practice-based perspectives on knowledge and learning

## 1 Introduction

Contemporary organizations are viewed to be increasingly dependent on skillful individuals and informal practices (Wenger, 1998), i.e. knowledge is the key resource for organizational performance and competitiveness (Drucker, 1988; Prahalad & Hamel, 1990). However, claims of increased knowledge-intensity have been questioned in favor of other descriptors such as ambiguity-based performance (Alvesson, 1993). Nevertheless, there is no doubt that advanced human expertise is crucial for skilled performance in a wide variety of modern work practices (Chaiklin & Lave, 1993; Barley & Orr, 1997; Schultze, 2000). One such class of work practice is project management which embodies the complex and ambiguous problems faced by knowledge workers, requiring expertise that is largely developed in the course of extensive engagement with the area of practice.

Project management is typically considered to be a complex and problematic endeavor in most organizations (White & Fortune, 2002). A vast number of projects are perceived to fail in some major way and information technology development projects in particular suffer from low success rates (Lyytinen & Hirschheim, 1987; Sauer et al., 1997). The financial losses of the most spectacular examples of such development failures are often counted in millions of U.S. dollars (see e.g. Keil & Montealegre, 2000). One promising approach to improve project management practices is through learning, i.e. development of project management competence. It has been argued that organizations should “learn from their own and from others’ experiences and to use this knowledge to change their development process [i.e. project management practices]” (Lyytinen & Robey, 1999, p. 86).

On a general level, competence development in a work context can be understood as the process in which organizational members develop the knowledge and expertise needed for skilled performance (Torraco, 1999). While competence development typically occurs informally as an integral part of everyday work practices, it can also be deliberately supported through structured learning interventions (e.g. courses, forums, manuals) that may or may not utilize information technology. According to Alavi and Leidner (2001, p. 2), structured learning interventions are “situations in which one individual intentionally tries to influence the learning of another by structuring the environment of the learner in such a way that the latter individual will achieve a desired [learning] outcome”. In this paper, information technology supported learning interventions are referred to as competence development systems (CDS), i.e. a particular class of information systems. Following Alavi and Leidner (2001, p. 2), we define CDS as an “environment in which the learner’s interaction with learning materials (e.g. readings, assignments, exercises), peers, and/or instructors are mediated through advanced information technologies”.

This paper addresses the issue of how to design CDS for project management so that effective support of competence development is achieved. Design is central to the IS discipline (Hevner et al., 2004; Lindgren et al., 2004) and the action research method, with its iterative hypothesis development and testing, is particularly appropriate for design theory development (Walls et al., 1992; Markus et al., 2002). The research presented here builds on an action research study (Baskerville & Wood-Harper, 1996) that took 30 months and involved researchers from the Viktoria Institute and practitioners from Ericsson Microwave and Volvo Parts (all organizations based in Sweden). Conducted as a collaborative research effort, the study included numerous

qualitative data collection methods (participative design work shops, interviews, observations, and focus group prototype evaluations) and interventions such as prototypes. The main contribution of this paper is a design theory for systems that support development of project management competence. Consistent with recommendations for IS design theory development as asserted by Walls et al. (1992) and Markus et al. (2002), our CDS design theory consists of (1) a set of user requirements derived from kernel theory, (2) principles governing the development process, and (3) principles governing the design of a system. The kernel theory used in this work is a cultural perspective on learning that includes situated learning theory (Brown et al., 1989; Brown & Duguid, 1996; Lave & Wenger, 1991).

The design theory for systems that support 'development of project management competence' (DPMC) as developed in this paper is important for at least two reasons. First, our work can be seen as a response to recent calls for more and improved IS research on technology-mediated learning (Alavi & Leidner, 2001). Arguing that technology-mediated learning (i.e. CDS) is a relevant topic for IS research due to a great interest in its application in both academic and corporate settings, Alavi and Leidner (2001) highlight the paucity of theoretically grounded and rigorous research that can guide the development of such learning environments. In doing this, they assert that future research on technology-mediated learning needs to address the issue of how technology can enhance learning and consider "technology features in relation to the instructional methods that employ them and as they interact with the psychological processes required for learning in a given [organizational] context" (Alavi & Leidner, 2001, p. 7). Second, our work can also be seen as response to calls for research efforts that operationalize situated learning theory into design frameworks (Brown & Duguid, 1996; Torraco, 1999; Herrington & Oliver, 2000). Whereas the comprehensive and usable design framework developed by Herrington and Oliver (2000) is customized for a school context, our CDS design theory targets a work context. On a more general level, efforts to use situated learning theory as a design rationale in CDS construction for work contexts can also add to the clarification of misconceptions in existing research on situated learning (see e.g. Tripp, 1996).

## **2 Theory**

The kernel theory used as the basis of our CDS design theory is firmly centered on situated learning theory (Lave & Wenger, 1991), which is reflected by referring to the design theory as a situated learning design framework. However, the kernel theory has

been strengthened by a number of related theories. First, the theories of tacit knowing (Polanyi, 1958) and social constructionism (Berger & Luckmann, 1966) provide a natural addition to what in whole can be labeled a cultural perspective on learning. This perspective highlights the situatedness, tacitness, and socialness of knowledge and learning. Second, aspects of CDS design which could not find sufficient guidance in the cultural perspective triggered the inclusion of selected insights from constructivistic learning theory (Leidner & Jarvenpaa, 1995) and organizational learning theory (Senge, 1990). In the following subsections, some of the main messages of the theories outlined above are summarized.

### **Situatedness of knowledge and learning**

Situated learning theory is a theory of social practice, i.e. focusing on human activity in society as participation in the practices of social communities. Knowing and learning are integral and inseparable aspects of all human activity (Lave & Wenger, 1991; Brown & Duguid, 1991; Chaiklin & Lave, 1993), i.e. are not isolated and independent activities. In other words, learning is a feature of practice. This means that our knowing and learning depends in essential ways on the context of action, i.e. "...insofar as actions are always situated in particular social and physical circumstances, the situation is crucial to action's interpretation" (Suchman, 1987, p. 178). Furthermore, social communities are the social definers and containers of knowledge, and the landscape of such social configurations is profoundly central to processes of knowledge creation, preservation, and sharing (Wenger, 1998). Some key concepts in this perspective are communities of practice, community membership, legitimate peripheral participation, story telling, and distributed cognition.

- Knowing cannot be abstracted from experience; knowing is situationally-specific.
- Social communities are the locus for learning.
- Skilled performance of practitioners is artful and reflective.
- Meaningful information can be interpreted to make sense in the context of authentic work practices.
- Narration is essential for most practices.
- Consciousness of collective enables individuals to interrelate heedfully and coordinate skillfully.
- Knowledge is a socially distributed resource and social systems have a certain knowledge distribution which is linked to the nature of their practices.
- Access to authentic practices is a key to learning.

- Learning is demand-driven, i.e. knowledge stealing.

### **Tacitness of knowledge and learning**

The theory of tacit knowing (Polanyi, 1958) shows that knowledge is located in the individual mind, is tacit, and can partially be explicitly represented. Further, it clarifies the relationship between knowledge, representations, and knowledge sharing, highlighting the role of interpretation. The relationship between knowledge and knowing is as follows. Our knowledge is a collection of fundamental beliefs that are held to be true and taken for granted. We have knowledge about the world which is used by our knowing to heuristically generate a comprehensive understanding of every experience, i.e. to make sense of the world as we interact with it by assigning meaning to objects and actions. Our knowledge is our interpretive framework (at a fundamental level), and our knowing gives us the interpretations of every particular situation. The interpretive framework of beliefs dictates our assimilation of experiences and is also continuously adapted to incorporate new experiences.

- Knowledge cannot be explicit; knowledge is tacit.
- Knowledge cannot reside outside the individual mind; knowledge resides in the individual mind.
- Knowledge is never known as a static and fixed object; it is dynamically and heuristically integrated by the tacit knowing of our mind.

### **Socialness of knowledge and learning**

Knowledge can only reside in the individual mind. However, the social context has a profound influence on the individual's knowledge. The theory of social constructionism (e.g. Berger and Luckmann, 1966) accounts for the social context of our knowing and the social processes of knowledge construction. The relationship between the subjective reality (constructed by individual) and objective reality (constructed by individual and shared) is a dialectical process, i.e. they are a duality which affect each other. While objectivations are socially constructed, the objectivations have a strong influence on subjective thinking. Society exists by humans participating in this ongoing dialectical process which can be portrayed by the three simultaneous aspects of externalisation, objectivation, and internalisation (Berger and Luckmann, 1966: 129). Externalisation refers to how individuals, through all their intentional actions such as using language, driving, and eating, manifest their subjective reality and thereby produce the constituting elements of the social world. Objectivation refers to how

individuals perceive the social world to exist independently of themselves and particular individuals, i.e. the social order which emerges from externalisation becomes an objective reality that affects appropriate human action in everyday life. Internalisation refers to how individuals accept and adopt the socially defined objective reality by living and acting in accordance with the social order of the objective reality.

- Knowledge cannot be constructed in isolation from society; knowledge is socially constructed.
- Society is a human product (externalisation); society is experienced as an objective reality (objectivation); humans adapt to the objective reality, i.e. are products of society (internalisation).

### **Constructivistic learning**

It is noted that constructive learning theory (Leidner & Jarvenpaa, 1995) belongs to a cognitive perspective on learning. This perspective has been heavily criticized in the situated learning discourse (e.g. Lave & Wenger, 1991). Therefore, we must stress that we have only adapted parts which do not conflict with the theory of situated learning. Because of the paradigmatic differences between the cultural and cognitive perspectives, a note on the reinterpretation of the cognitive perspective is needed. The cultural perspective has been preoccupied with descriptive studies of how 'natural' learning is manifested in social practice and therefore does not explicitly offer constructive guidance about how to facilitate learning interventions, i.e. instruction. Here the cognitive perspective, which focuses on the role and relevance of instruction, can be useful. Further, the conventional cognitive perspective is useful to understand conventional workplace education in terms of information delivery and absorption. When it comes to theories constituting the cognitive perspective, our reinterpretation reduced the emphasis on information delivery and absorption, and kept insights such as learner-orientation, perspective sharing, and effects of examination criteria. The difference in the reinterpretation is that the conditions for these elements and activities are significantly different, focusing on practice-specific knowledge, skilled colleagues, authentic practices, etc.

- Aim for learner-oriented sensemaking and avoid teacher-orientation. Specifically, we adapted instructor principles endorsing a shift from 'sage on the stage to facilitator on the side', as well as instructional materials principles highlighting a shift from 'memorization of fragmented information to sensemaking of information for understanding'.

- Utilise problem-solving as the focus of activities.
- Utilise collaboration for perspective sharing.
- Avoid learning assessment procedures that conflict with learning.

### **Organizational learning**

Organizational learning theory distinguishes between single-loop learning and double-loop learning (Argyris, 1991). Whereas single-loop learning does not question the underlying ways of thinking, double-loop learning does. The cultural perspective of learning has largely focused on single-loop learning. From a learning intervention perspective, these are relevant issues since competence development can lead to or create preconditions for organizational change (Rosenorn & Kofoed, 1998; Drejer, 2000, p. 219). In other words, learning interventions supporting double-loop learning can mediate organizational change (Schön, 1983). Deliberately aiming for large organizational change, in addition to developing individual expertise, can grant learning interventions greater value and legitimacy. In other words, improving both individual and organizational performance. For instance, if the organization and routines of work systematically lead to certain misunderstandings, conflicts, and failures, then a worker's skill improvement will have little effect on the total output of the system. Torraco (1999, p. 264) argues for "systematic linkages between employee development and the ultimate purpose of the business", i.e. learning interventions should target both work-related goals and broader business objectives.

- Support single-loop learning, i.e. development of individual skills.
- Support double-loop learning, i.e. self-insight that questions underlying assumptions and fundamental ways of thinking and acting. Overcome defensive reasoning.
- Double-loop learning leads to large organizational change.

Outlined above is the initial definition of organizational learning used in this research work. However, it should be noted that this conceptualisation of organizational learning and associated concepts was challenged and redefined in light of the empirical findings of this thesis work. Whereas the initial definition associated double-loop learning with 'deep/large' rethinking (measured in terms of an individual), i.e. questioning and shifting of personal assumptions, the reinterpretation defined double-loop learning as being unaligned with social order (measured in terms of a collective), i.e. concern organizational change rather than organizational maintenance.

### 3 Method

The research presented in this paper builds on an action research study (Baskerville & Wood-Harper, 1996) that took 30 months and involved researchers from the Viktoria Institute and practitioners from Ericsson Microwave and Volvo Parts (all organizations based in Sweden). This study included numerous qualitative data collection methods and interventions such as prototypes.

#### Action research projects

In this study, three action research projects were conducted (these are presented in table 1). The aim of each project was to develop design concepts through exploratory design work. An improved understanding of the design concepts and the underlying design theory was generated through the realisation of design concepts in the form of prototypes and real-use evaluations of those prototypes. Consequently, these action research projects provided a basis for developing the IS design theory further. The suitability of action research for IS design theory development has been noted by for example Walls et al. (1992) and Lindgren et al. (2004).

**Table 1.** Overview of action research projects

Action study	E-roleplay 'Global'	E-roleplay 'RICE'	E-discussion 'LetsTalk'
<b>Research site</b>	<ul style="list-style-type: none"> <li>Volvo Parts</li> </ul>	<ul style="list-style-type: none"> <li>Ericsson Microwave</li> </ul>	<ul style="list-style-type: none"> <li>Volvo Parts</li> </ul>
<b>Design concept</b>	<ul style="list-style-type: none"> <li>E-roleplay</li> <li>The design concept 'e-roleplay' is an idea about IT-supported role-playing in small groups in a face-to-face setting. The prototypes 'Global' and 'RICE' were instances of e-roleplay.</li> </ul>	<ul style="list-style-type: none"> <li>E-roleplay</li> </ul>	<ul style="list-style-type: none"> <li>E-discussion</li> <li>The design concept 'e-discussion' is an idea about IT-supported discussion in small groups in a face-to-face setting. The prototype 'LetsTalk' was an instance of 'e-discussion'.</li> </ul>
<b>Prototype</b>	<ul style="list-style-type: none"> <li>'Global'</li> </ul>	<ul style="list-style-type: none"> <li>'RICE'</li> </ul>	<ul style="list-style-type: none"> <li>'LetsTalk'</li> </ul>
<b>Development method</b>	<ul style="list-style-type: none"> <li>Participative design workshops</li> <li>Initial prototype evaluation (3 participants in 1 group)</li> <li>7 interviews</li> <li>Document review</li> </ul>	<ul style="list-style-type: none"> <li>Participative design workshops</li> <li>Initial prototype evaluation (4 participants in 1 group)</li> <li>Document review</li> </ul>	<ul style="list-style-type: none"> <li>Participative design workshops</li> <li>Initial prototype evaluation (4 participants in 1 group)</li> <li>Document review</li> </ul>
<b>Evaluation method</b>	<ul style="list-style-type: none"> <li>Final prototype evaluation (84 participants in 11 groups)</li> <li>84 surveys</li> <li>68 surveys</li> <li>Seminar discussions (11 groups)</li> <li>9 interviews</li> <li>Follow-up meetings</li> <li>Document review</li> </ul>	<ul style="list-style-type: none"> <li>Final prototype evaluation (14 participants in 2 groups)</li> <li>14 surveys</li> <li>Seminar discussions (2 groups)</li> <li>Follow-up meetings</li> </ul>	<ul style="list-style-type: none"> <li>Final prototype evaluation (99 participants in 22 groups)</li> <li>97 surveys</li> <li>10 interviews</li> <li>26 surveys</li> <li>Follow-up meetings</li> <li>Document review</li> </ul>



## Research process

**Table 2.** Overview of the research process

	<b>Study</b>	<b>Rationale</b>	<b>Method</b>	<b>Result</b>
Theory studies	<b>Kernel theory selection</b>	Select useful kernel theory among theories about learning.	Theoretical investigation informed by our previous research about CDS in a school context.	A cultural perspective on learning was selected.
	<b>Kernel theory examination</b>	In the kernel theory, a number of unclear definitions needed examination.	Theoretical investigation.	Kernel theory definition focused on the tacitness, situatedness, and socialness of knowledge and learning.
	<b>Initial IS design theory</b>	Based on kernel theory, develop initial IS design theory used as a basis for design work.	Theoretical investigation.	Characteristics and requirements of DPMC as well as design and development principles were outlined.
Action research projects	<b>E-roleplay 'Global'</b>	Design and evaluate the e-roleplay design concept.	Explorative design work and evaluation of the 'Global' prototype within an action research project.	'Global' supported individual learning but did not promote organizational change. The conception of organizational learning was challenged.
	<b>E-roleplay 'RICE'</b>	Explore design space and generality of the e-roleplay design concept.	Explorative design work and evaluation of the 'RICE' prototype within an action research project. The aim was individual learning, not organizational change.	'RICE' did not work well. The failure of 'RICE' contrasted with the success of 'Global' and provided knowledge about key features of the e-roleplay design concept.
	<b>E-discussion 'LetsTalk'</b>	Overcome failure to promote organizational change. Design and evaluate the 'e-discussion' design concept.	Explorative design work and evaluation of the 'LetsTalk' prototype within an action research project.	'LetsTalk' supported individual learning but did not promote organizational change. The conception of organizational learning was challenged.
Theory studies	<b>Organizational learning theory examination</b>	The conception of organizational learning needed examination.	Theoretical investigation informed by empirical results from 'Global' and 'LetsTalk'.	Redefinition of organizational learning and associated concepts.
	<b>IS design theory</b>	Develop final IS design theory in light of empirical findings.	Interpretive analysis of the whole thesis work.	Revised IS design theory for support of DPMC.

The first step towards an IS design theory was the selection of a kernel theory to be used as the basis for characterising the process of DPMC and deriving a set of user requirements to be addressed by design. This selection involved conducting a broad literature review, identifying potential theoretical perspectives, and adopting one such theoretical perspective. The result of this theory study was that the primary theoretical perspective underlying CDS for a work context should be a cultural perspective on learning (including situated learning theory). Further, there was a specific need for research to operationalise the situated learning theory into design frameworks (i.e. an IS design theory).

The selection of a cultural perspective on learning as the kernel theory was followed by a thorough theoretical examination of its constitutive theories (i.e. theories about knowledge and learning). This was triggered by (1) the need to develop a comprehensive and in-depth understanding of the kernel theory as a basis for characterising DPMC and (2) the need to address and resolve unclear and conflicting definitions in the associated literature. One dimension of this theory study was the aim to uncover relationships between different theories and research areas with tentative commonalities, e.g. situated learning and social constructionism. Such work would serve to build a broader and stronger theoretical perspective, through contrasting and challenging conceptualisations within the theories and through extending the initial cultural perspective (i.e. situated learning theory) with 'missing' conceptualisations. The result of this theory study provided a comprehensive and coherent outline of key conceptualisations and the relationships among them, as well as critique of various misconceptions in the literature.

The kernel theory examination was followed by a theoretical investigation aiming to generate an initial IS design theory for support of DPMC. Based on the kernel theory, the process of DPMC was characterised and a set of user requirements to be addressed by design was derived. This was followed by proposing an initial set of design principles (concerning the product of design) and development principles (concerning the process of design) that met the requirements. The resulting initial IS design theory was subsequently tested and developed further through three cycles of prototype construction and evaluation (i.e. design work).

Guided by the initial IS design theory for support of DPMC, the design concept 'e-roleplay' was evaluated through the development and implementation of the prototype 'Global' within an action research project (Hardless et al., forthcoming). The implementation of 'Global' aimed to (1) support individual learning and (2) promote organizational changes concerning project management practices through organizational learning. This first empirical evaluation generated an improved understanding of the 'e-roleplay' design concept and feedback on the guidance given by the initial IS design theory. The evaluation showed that 'Global' supported competence development at the individual level but failed to promote organizational change.

The design concept 'e-roleplay' was successfully evaluated through the use of 'Global'. In order to learn more about the general applicability of 'e-roleplay' and the associated

design space, an exploratory study was conducted focusing on developing and implementing a new instance of 'e-roleplay' (i.e. 'RICE'). In this second action research project, there was not an aim for organizational change through organizational learning. The empirical evaluation of the prototype 'RICE' was a failure in terms of achieving the intended learning support and outcome. The failure of 'RICE' contrasted with the success of 'Global' and provided knowledge about key features of the 'e-roleplay' design concept. This generated an improved understanding of the 'e-roleplay' design concept and feedback on the guidance given by the initial IS design theory. Concerning the latter, the 'RICE' prototype evaluation confirmed a number of principles through either (1) the positive outcome resulting from following a principle or (2) the negative outcome resulting from a failure to follow a principle. In other words, the failure of 'RICE' did in fact confirm the value of the IS design theory.

The evaluation of 'Global', based on the 'e-roleplay' concept, did not lead to significant organizational changes which was expected. This puzzling result implied a need to further explore organizational change promotion through CDS. Guided by the initial IS design theory for support of DPMC, the design concept 'e-discussion' was invented and evaluated through the development and implementation of the prototype 'LetsTalk' within an action research project (Hardless, 2004). The implementation of 'LetsTalk' aimed to (1) support individual learning and (2) promote organizational changes concerning project management practices through organizational learning. The empirical evaluation of 'LetsTalk' generated an improved understanding of the 'e-discussion' design concept and feedback on the guidance given by the initial IS design theory. The evaluation showed that 'LetsTalk' supported competence development at the individual level but failed to promote organizational change. This, together with the 'Global' evaluation, provided a serious challenge to the conception of organizational learning within the kernel theory. Consequently, there was a need for a critical examination of organizational learning theory.

The results of the evaluations of 'Global' and 'LetsTalk' presented an interesting paradox in that they were a success in terms of learning and a failure in terms of change. They seemed to effectively support both single-loop and double-loop learning (as initially defined). However, the anticipated long-term effects in terms of organizational change remained absent. Consequently, the initial conception of organizational learning and associated concepts (part of the kernel theory) needed examination. More specifically, this challenged the initial assumptions about the relationship between learning interventions, learning, action, and change. The

examination was carried out through a theoretical investigation of the 'organizational learning' literature informed by the empirical results from 'Global' and 'LetsTalk'. The result was an exposure of flawed conceptualisations and proposals for redefinitions of organizational learning and associated concepts (Hardless et al., forthcoming). The reconceptualisation of organizational learning theory was subsequently incorporated in the revised and final version of the IS design theory for DPMC.

The results of the empirical work and theoretical investigations formed a basis for the final revision of the initial IS design theory for DPMC. A final theoretical investigation was conducted involving an interpretive analysis and synthesis of the research done, i.e. reviewing the initial IS design theory in light of the empirical findings. The IS design theory revisions were relatively few, given that the empirical studies provided more confirmation than disconfirmation of the initial IS design theory for support of DPMC.

#### **4 CDS Design Theory**

According to Markus et al. (2002), work that is to be supported by IT is generally described in terms of the characteristics of users and their work context, users' information requirements, and the characteristics of the process by which work is performed. The design theory outline is first categorised into these three aspects of work. Subsequently, the design theory is reorganised into other categories more intuitive for design work.

In the context of this research, the target work that is to be supported by IT is the work of 'developing project management competence' (DPMC). It is not the work of 'project management' per se that is to be directly supported. However, since learning is an integral and inseparable aspect of all social practices, the work of 'project management' forms in different situations either the detached background of DPMC (e.g. attending project education) or the actual activity context of DPMC (e.g. acting as project manager). An understanding of DPMC therefore incorporates an understanding of project management work. This understanding of both DPMC and project management practices is implicitly reflected in the design theory although it centers on DPMC.

Deriving this understanding about the target users' practices and support requirements, based on the kernel theory, was the first step of a theoretical investigation aiming to generate an initial IS design theory for support of DPMC. This step was followed by proposing an initial set of design principles (concerning the product of design) and

development principles (concerning the process of design) that met the requirements. The resulting initial IS design theory was subsequently tested and developed further through empirical design work and evaluations. The final IS design theory presented in table 3 is the main contribution of this paper and primarily addresses the need to operationalise situated learning theory (e.g. Herrington & Oliver, 2000). In table 4, design and development principles are reorganized into categories more intuitive for design work. Thereafter, table 5 outlines how the design principles were manifested in the empirical design work and how the empirical findings influenced changes to the initial IS design theory.

**Table 3.** IS design theory for support of DPMC

<b>Users and their work context: The principle of different types of actors and multiple perspectives.</b>	
<b>Characteristics and requirements of DPMC</b>	<b>Design and development principles</b>
<ul style="list-style-type: none"> <li>Project managers are a central role, but efficient project management also depends on the competence of project workers, steering group members, and business managers. The competence trajectory of practitioners may involve becoming skilled at any of these roles.</li> <li>A project is a temporary organization that often is a boundary practice requiring collaboration and coordination across borders. Participants in projects may therefore have different competence specialisations and community perspectives.</li> <li>Relationships between users may form networks of practice, networks of interest, or personal networks. For example, common belonging to a division, collaboration in projects, or occupying similar roles across corporations, may create common interests and understandings.</li> <li>Relationships between users can be characterised by issues of trust, power, and politics.</li> </ul>	<ul style="list-style-type: none"> <li><b>Design for different types of project actors.</b> Design should consider different roles, competencies, and organizational belongings. Such considerations reflect the various network and power relationships between users.</li> <li><b>Develop customised user groups through participative selection,</b> based on relevant interrelations. Learning group configurations may span from a heterogenous mix of participants to a largely homogenous mix. Groupings should be based on common interests and understandings, and afford access to relevant perspectives. Group configuration needs to ensure appropriate group size and participant competencies with regard to participation, sharing, and negotiation. Selection of participants can be supported by people who know the practitioners' experiences and interests. For example, the human resource department and business managers.</li> </ul>
<ul style="list-style-type: none"> <li>Users' participation in learning interventions (activities separated from project management practices) may depend on provider interests, personal interests, and organizational interests (typically their manager's opinion). Managerial users can be expected to have considerable autonomy.</li> <li>Technology driven codification efforts are likely to fail. When IT is an actor, its use needs to be socio-technically balanced. There needs to be a willingness to use systems, based on cultural fit, knowledge sharing incentives, etc.</li> </ul>	<ul style="list-style-type: none"> <li><b>Design to cater both individual and organizational relevance criterias.</b> This means to balance learning needs, achieving cost-value efficiency, and being non-disruptive for everyday business.</li> </ul>
<ul style="list-style-type: none"> <li>One particular type of actor is the facilitator which may have an affiliation internal or external to the target organization. The facilitator is an outsider to project management practices and therefore participation is more or less peripheral. The facilitator should afford learner-oriented interventions.</li> </ul>	<ul style="list-style-type: none"> <li><b>Design for unobtrusive facilitation,</b> i.e. rather subtle and passive.</li> </ul>
<b>Users' information requirements: The principle of local definitions and global inspiration.</b>	<b>Design and development principles</b>
<b>Characteristics and requirements of DPMC</b>	<b>Design and development principles</b>

<ul style="list-style-type: none"> <li>• Users need networks of practice, networks of interest, and personal networks.</li> </ul>	<ul style="list-style-type: none"> <li>• <b>Design for the formation and maintenance of social networks</b> through providing information about people and opportunities for networking.</li> </ul>
<ul style="list-style-type: none"> <li>• Overlapping knowledge distribution, i.e. common project management competence, facilitates collaboration and heedful interrelating. Heedful interrelating requires common ways of working (e.g. manifested by project models) and understanding others' perspectives (e.g. understanding the competence and needs of other roles or having awareness of cultural differences).</li> <li>• Project manager competence involves a broad and holistic view rather than focusing on details. This involves understanding all relevant functional areas and their interrelations (i.e. project area content).</li> </ul>	<ul style="list-style-type: none"> <li>• <b>Design for the development of overlapping knowledge distribution</b>, concerning people, tasks, tools, and organization. Users need to understand own (tasks) and others' perspectives (interrelations). They need to acquire knowledge about local practices, as well as knowledge about global practices, i.e. 'big picture', through sharing local interpretations across borders. Further, develop common ways of doing project work (note, this may conflict with innovation theory).</li> </ul>
<ul style="list-style-type: none"> <li>• Users need practice-relevant local definitions, i.e. interpretations and structures from local practices in order to understand the locally defined standards by which competent behaviour in project management practices is judged. Users need to enact such socially constructed ways of interacting, concerning e.g. appropriate attitudes, judgements, language, artifact use. This concerns both project structures (e.g. project models) and processes (human behaviour). Within an organization, there can be multiple project cultures, both across divisions and types of projects.</li> </ul>	<ul style="list-style-type: none"> <li>• <b>Design for local knowledge sharing</b> concerning locally relevant issues. This implies a need for customised content, perceived by users to be relevant.</li> <li>• <b>Develop customised content through participative design and prototyping</b> for practice-relevance. Practice-relevant content can be developed through participative design bringing in practice-specific perspectives, i.e. content should reflect and be anchored in authentic local practices. Systems should be customisable through prototyping in order to iteratively add practice-specificity. Customisation of content rather than structure means more predictable outcomes.</li> <li>• <b>Design for customisable IT architecture.</b> Technology applications need to be flexible enough to afford iterative changes in development.</li> </ul>
<ul style="list-style-type: none"> <li>• Users need explanations of local definitions, i.e. the meaning of both written and spoken information. Definitions are based on tacit understandings that can only be acquired through full exposure to others' interpretations.</li> </ul>	<ul style="list-style-type: none"> <li>• <b>Design for local interpretation of local definitions.</b> Design should focus on interpretations rather than documentation. Even locally situated documentation will be abstract and requires discussion to provide a full context for interpretation. This implies to design for group interaction through providing questions rather than answers. Developers need to carefully judge when documentation can be relevant and useful.</li> </ul>
<ul style="list-style-type: none"> <li>• Users need an awareness and repertoire of organizationally situated problems and solutions. This means information about both specific cases and typified cases. For example, the way pre-studies are carried out and associated pitfalls.</li> </ul>	<ul style="list-style-type: none"> <li>• <b>Design for the provision of various forms of stories</b> about locally situated problems and solutions.</li> </ul>
<ul style="list-style-type: none"> <li>• Locally planned ways of working are vague resources for action. Users need to understand situationally contingent work strategies, i.e. context variations and adaptive responses.</li> </ul>	<ul style="list-style-type: none"> <li>• <b>Design for access to contingent reasoning</b> and decision making. For example, how plans break down and how to resolve such situations.</li> </ul>

<ul style="list-style-type: none"> <li>Users need an awareness about unskilled performances in order to change them. Such performances concern cognitive, behavioural, and structural aspects, and their scope ranges from individual (single-loop) to organizational (double-loop).</li> </ul>	<ul style="list-style-type: none"> <li><b>Design for critical reflection upon local practices.</b> This involves the provision of reason and input for reflection, and the provision of believable insight about weaknesses and strengths in existing practices. This can be done through focusing attention on aspects of practice, or providing extreme information or experiences. Solutions should support double-loop learning through challenging ways of thinking, triggering reflection upon experiences, and creating environments for undefensive reasoning.</li> </ul>
<ul style="list-style-type: none"> <li>Users need interpretations and structures from contexts external to local practices in order to gain background understandings, tips, and inspiration. For example, general overviews of project management, scientific theories about human behaviour, and local perspectives from other organizations. However, the value (i.e. practice-relevance) of such global definitions depends on the way they can be made specific to local practices, i.e. actionable and applicable.</li> </ul>	<ul style="list-style-type: none"> <li><b>Design for local interpretation of global definitions.</b> Solutions providing abstractly general (global) definitions should afford translation to the specificities of local practices. Issues can be general and theory generated, but should always reflect the characteristics of local practices. Solutions can use media to add experiential dimensions in order to support imagined connections to authentic practices.</li> </ul>
<p><b>The process by which work is performed: The principle of participation in authentic practices. Characteristics and requirements of DPMC</b></p>	
<ul style="list-style-type: none"> <li>Everyday project management practices (e.g. enacting project manager) afford integrated opportunities for DPMC. This involves both solving specific problems and networking. The structure of everyday work may be designed to afford learning, i.e. a form of learning intervention (however, in this paper 'learning intervention' typically refers to solutions separated from everyday work).</li> <li>Another form of learning intervention is more separated from everyday project management practices (e.g. courses). The focus of such activities spans from providing abstract and general information to providing opportunities for local networking. This means more or less detachment from authentic project management practices.</li> </ul>	<p><b>Design and development principles</b></p> <ul style="list-style-type: none"> <li><b>Design for degrees of integration with everyday project management practices</b> rather than complete detachment. This contributes to the authenticity and relevance of interventions. While striving for authenticity, one design option is to offer learning opportunities not readily available in everyday practices.</li> </ul>
<ul style="list-style-type: none"> <li>Doing project management practices, i.e. solving authentic problems in authentic contexts, gives relevantly situated experiences.</li> </ul>	<ul style="list-style-type: none"> <li><b>Design for authenticity-rich problem solving.</b> Solving authentic problems gives authentic experiences, but solving semi-authentic problems can give relevant 'simulated' experiences.</li> </ul>
<ul style="list-style-type: none"> <li>Increasing participation in project management practices involves moving from peripheral participation to full participation. Inexperienced practitioners need reduced task complexity (e.g. guided problem-solving, mentorship). For experienced practitioners, tasks with low complexity will be trivial.</li> </ul>	<ul style="list-style-type: none"> <li><b>Design for affording participation through having an appropriate level of task complexity</b> with regard to required competence. Solutions can provide reduced complexity through forms of guidance, e.g. mentorship.</li> </ul>
<ul style="list-style-type: none"> <li>Legitimate access to practices (e.g. observation of skilled performances) and forms of mentorship (e.g. guidance) afford opportunities for demand-driven knowledge stealing.</li> </ul>	<ul style="list-style-type: none"> <li><b>Design for access to practitioners, actions, and artifacts of authentic practices,</b> rather than detached teachers and instruction. This affords on-demand knowledge stealing rather than supply-driven. Solutions may elicit practitioners' thinking in order to provide access to reasoning underlying actions.</li> </ul>

<ul style="list-style-type: none"> <li>• Talk within communities and across borders provides access to much socially embedded knowledge. Practitioners build social networks for circulation of information and access to distributed knowledge. Much talk can be viewed as story telling to support diagnosis and problem-solving, experience sharing, inspiration, and celebration of identity. Talk is here taken broadly as a communicative process combining personalisation and codification.</li> </ul>	<ul style="list-style-type: none"> <li>• <b>Design for knowledge sharing through talk and documentation.</b> Such sharing should be relevantly situated so that story telling and reasoning is practice-relevant. Participants should have control to shape information sharing to their relevance-perspective. Proper identification and presentation of discussion issues is a key factor. A useful approach is to highlight a few key questions, focusing on 'soft' issues in projects.</li> <li>• <b>Design for unobtrusive IT use</b> in order to gain focus on socialisation processes between people rather than interaction with IT alone. This transparency is achieved through ease of use and a minimal yet effective design, i.e. every element should be well motivated and value adding.</li> </ul>
<ul style="list-style-type: none"> <li>• In all social interactions there is negotiation of culture and socialisation, i.e. social construction of intersubjective meanings. Some practitioners will have more shaping influence, others will be largely concerned with adopting established constructions.</li> </ul>	<ul style="list-style-type: none"> <li>• <b>Design for balanced negotiation of meaning.</b> Negotiation concerns both selection of focus issues and work with those issues. The need to respect everyday power distribution will be traded-off with the need for open participation in the shaping of meaning.</li> </ul>
<ul style="list-style-type: none"> <li>• DPMC involves cognitive, behavioural, and structural developments. Developments can be characterised as evolutionary or revolutionary.</li> <li>• The relationship between learning interventions and organizational development (e.g. DPMC) is weak in terms of changing social order (double-loop) and strong in terms of maintaining social order (single-loop).</li> </ul>	<ul style="list-style-type: none"> <li>• <b>Design for organizational maintenance rather than organizational change.</b> Providers of learning interventions should consider issues of power and politics, and be restrictive in promising organizational changes. Typically, learning interventions lead to organizational maintenance and a focus of organizational attention. Insofar as learning intervention driven change projects can promote revolutionary organizational change, they should (1) incorporate a structured change process, (2) significantly involve the functions concerned by the sought for changes, and (3) involve the functions at the management level appropriate for making decisions.</li> </ul>

Addressing 22 design/development principles at once is difficult in creative design work. To facilitate the design guidance, the categories used have been formulated as summarising principles. However, the 3 categories adapted from Markus et al. (2002) do not give sufficiently usable guidance. Therefore, the principles are reorganised into categories more intuitive for design work, as presented below in table 4. The new categories are generated based on the empirical design work experiences.



**Table 4.** IS design theory for support of DPMC with summarizing principles

<p><b>The principle of customisation through local development</b></p> <ul style="list-style-type: none"> <li>• Develop customised content through participative design and prototyping</li> </ul> <p><b>The principle of relevant group configuration</b></p> <ul style="list-style-type: none"> <li>• Design for different types of project actors</li> <li>• Develop customised user groups through participative selection</li> </ul> <p><b>The principle of balanced IT support</b></p> <ul style="list-style-type: none"> <li>• Design for unobtrusive IT use</li> <li>• Design for customisable IT architecture</li> </ul> <p><b>The principle of authenticity-rich content</b></p> <ul style="list-style-type: none"> <li>• Design for local knowledge sharing</li> <li>• Design for local interpretation of local definitions</li> <li>• Design for local interpretation of global definitions</li> <li>• Design for the provision of various forms of stories</li> <li>• Design for access to contingent reasoning</li> <li>• Design for access to practitioners, actions, and artifacts of authentic practices</li> <li>• Design for the formation and maintenance of social networks</li> <li>• Design for the development of overlapping knowledge distribution</li> </ul> <p><b>The principle of authenticity-rich learning processes</b></p> <ul style="list-style-type: none"> <li>• Design for unobtrusive facilitation</li> <li>• Design for critical reflection upon local practices</li> <li>• Design for authenticity-rich problem solving</li> <li>• Design for affording participation through having an appropriate level of task complexity</li> <li>• Design for knowledge sharing through talk and documentation</li> <li>• Design for balanced negotiation of meaning</li> </ul> <p><b>The principle of organizational integration</b></p> <ul style="list-style-type: none"> <li>• Design to cater both individual and organizational relevance criterias</li> <li>• Design for degrees of integration with everyday project management practices</li> <li>• Design for organizational maintenance rather than organizational change</li> </ul>
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In the following, table 5 outlines how the initial design/development principles were manifested in the empirical design work and how the empirical findings influenced changes to the initial IS design theory.

**Table 5.** IS design theory for support of DPMC – empirical manifestations and feedback

<b>Users and their work context: The principle of different types of actors and multiple perspectives.</b>		
<b>Design and development principles</b>	<b>Manifestation in interventions</b>	<b>Changes due to empirical findings</b>
<ul style="list-style-type: none"> <li>• <b>Design for different types of project actors.</b></li> <li>• <b>Develop customised user groups through participative selection.</b></li> </ul>	<ul style="list-style-type: none"> <li>• 'Global' and 'LetsTalk' targeted a wide range of project roles and composed them into mixed groups. Groups were composed by HR, following guidelines.</li> <li>• 'RICE' targeted novice project managers but the evaluation was conducted with experienced project managers. Groups were composed by project manager group leaders, following guidelines.</li> </ul>	<ul style="list-style-type: none"> <li>• 'Global' and 'LetsTalk' highlighted power issues as a dimension not properly conceptualised in the kernel theory.</li> </ul>

<ul style="list-style-type: none"> <li>• <b>Design to cater both individual and organizational relevance criterias.</b></li> </ul>	<ul style="list-style-type: none"> <li>• All interventions were motivated in terms of both individual and organizational benefits.</li> <li>• 'Global' and 'RICE' required participation in only two half-day meetings. 'LetsTalk' required participation on one half-day meeting.</li> <li>• To ensure participation, HR or group managers were relied upon to be sensitive about how to invite participants.</li> <li>• Research interventions were free of charge, but the cost of time spent in development and use, as well as one site choosing to sponsor the research, meant that the cost was low but not insignificant.</li> <li>• Cost for standard performance IT was relatively low.</li> <li>• Face-to-face discussions meant that knowledge sharing did not encounter incentive problems of codification.</li> </ul>	<ul style="list-style-type: none"> <li>• The understanding of relevance criterias was enhanced by all of the empirical investigations.</li> </ul>
<ul style="list-style-type: none"> <li>• <b>Design for unobtrusive facilitation.</b></li> </ul>	<ul style="list-style-type: none"> <li>• E-roleplays employed a passive facilitator.</li> <li>• Active facilitation in 'e-discussion' was subtle and careful.</li> </ul>	
<b>Users' information requirements: The principle of local definitions and global inspiration.</b>		
<b>Design and development principles</b>	<b>Manifestation in interventions</b>	<b>Changes due to empirical findings</b>
<ul style="list-style-type: none"> <li>• <b>Design for the formation and maintenance of social networks.</b></li> </ul>	<ul style="list-style-type: none"> <li>• Interventions brought together practitioners from across borders. Discussions revealed views and experiences of participants.</li> </ul>	
<ul style="list-style-type: none"> <li>• <b>Design for the development of overlapping knowledge distribution.</b></li> </ul>	<ul style="list-style-type: none"> <li>• The approach employed was to broadly mix different types of actors from different organizational belongings. They shared knowledge about common project issues.</li> <li>• Talking about project work leads to common views. In 'Global' and 'LetsTalk' there were also associated pushes for the adoption of a common project steering model.</li> </ul>	

<ul style="list-style-type: none"> <li>• <b>Design for local knowledge sharing.</b></li> <li>• <b>Develop customised content through participative design and prototyping.</b></li> <li>• <b>Design for customisable IT architecture.</b></li> </ul>	<ul style="list-style-type: none"> <li>• Content reflected local practices, although referred to fictitious projects or abstract project issues.</li> <li>• HR or project management representatives participated in design, but end-users were not involved since that would detract from the learning experience.</li> <li>• 'Global' and 'LetsTalk' employed simple technology and a modular structure which enabled customisation. 'RICE' became large and complex, which made it less customisable.</li> </ul>	<ul style="list-style-type: none"> <li>• The 'RICE' action study highlighted the benefits of customising content rather than structure.</li> </ul>
<ul style="list-style-type: none"> <li>• <b>Design for local interpretation of local definitions.</b></li> </ul>	<ul style="list-style-type: none"> <li>• In all interventions, the aim was for much group interaction. 'Global' employed very little documentation besides scenario information. 'LetsTalk' was similar, but also generated locally based documentation of discussions. 'RICE' employed too much documentation which was perceived meaningless.</li> </ul>	
<ul style="list-style-type: none"> <li>• <b>Design for the provision of various forms of stories.</b></li> </ul>	<ul style="list-style-type: none"> <li>• Stories were told when facing decisions in e-roleplays and questions in 'e-discussion'. The scenario in e-roleplay can be viewed in itself as a kind of story, as can the questions of 'e-discussion'.</li> </ul>	
<ul style="list-style-type: none"> <li>• <b>Design for access to contingent reasoning.</b></li> </ul>	<ul style="list-style-type: none"> <li>• Reasoning was displayed when facing ambiguous decisions in e-roleplays and questions in 'e-discussion', and in follow-up seminar discussions.</li> <li>• In 'RICE', simple decisions in combination with time-pressure invited for quiet and quick decisions, which kept reasoning hidden.</li> </ul>	
<ul style="list-style-type: none"> <li>• <b>Design for critical reflection upon local practices.</b></li> </ul>	<ul style="list-style-type: none"> <li>• 'Global' and 'RICE' highlighted a failing project and key problems along the way. 'LetsTalk' raised questions that concerned problematic project issues.</li> </ul>	<ul style="list-style-type: none"> <li>• The understanding of organizational change and double-loop learning was greatly revised following the outcome of 'Global' and 'LetsTalk'. The interventions did not lead to organizational change, despite seemingly supporting double-loop learning. Hence, organizational learning theory as part of the kernel theory was redefined.</li> </ul>

<ul style="list-style-type: none"> <li>• <b>Design for local interpretation of global definitions.</b></li> </ul>	<ul style="list-style-type: none"> <li>• External materials were not extensive, but when used they were checked for local applicability through organizational representatives in the design team. Questions raised were general in nature, but were customised enough to match organizational specifics. However, sometimes issues were more applicable for one division than another.</li> <li>• E-roleplays used various forms of multimedia to support imagination.</li> </ul>	
<b>The process by which work is performed: The principle of participation in authentic practices.</b>		
<b>Design and development principles</b>	<b>Manifestation in interventions</b>	<b>Changes due to empirical findings</b>
<ul style="list-style-type: none"> <li>• <b>Design for degrees of integration with everyday project management practices.</b></li> </ul>	<ul style="list-style-type: none"> <li>• Interventions were linked to both individual needs and organizational needs.</li> <li>• Knowledge sharing focused on practice-specific issues which made for a conceptual link with everyday project management practices.</li> <li>• Cross-functional discussions were not readily available in every practices.</li> </ul>	
<ul style="list-style-type: none"> <li>• <b>Design for authenticity-rich problem solving.</b></li> </ul>	<ul style="list-style-type: none"> <li>• Questions and decisions put forth to participants reflected typical practice-specific considerations, often based on authentic problematic issues.</li> <li>• Participants commented that some content was not entirely realistic. However, complete realism was not needed for relevance.</li> </ul>	
<ul style="list-style-type: none"> <li>• <b>Design for affording participation through having an appropriate level of task complexity.</b></li> </ul>	<ul style="list-style-type: none"> <li>• In 'Global' and 'LetsTalk' many questions raised were relatively broad and complex. To generate rich discussions some participants needed to be experienced. More inexperienced participants were enabled to participate through the leading and support of other more experienced participants.</li> </ul>	<ul style="list-style-type: none"> <li>• The issue of high complexity tasks for experienced practitioners was highlighted by the 'RICE' action study.</li> </ul>
<ul style="list-style-type: none"> <li>• <b>Design for access to practitioners, actions, and artifacts of authentic practices.</b></li> </ul>	<ul style="list-style-type: none"> <li>• Interventions provided access to practitioners and their thinking through group discussions about authenticity-rich issues.</li> </ul>	

<ul style="list-style-type: none"> <li>• <b>Design for knowledge sharing through talk and documentation.</b></li> <li>• <b>Design for unobtrusive IT use.</b></li> </ul>	<ul style="list-style-type: none"> <li>• Interventions focused on knowledge sharing through narration, centered on key questions. In 'LetsTalk', discussions were complemented with written documentation of answers. Questions were rather open-ended so groups could to a degree shape discussions to their preference.</li> <li>• The 'RICE' scenario obtrusively dominated the interaction too much, focused on 'hard' issues, and did not trigger rich discussions.</li> </ul>	<ul style="list-style-type: none"> <li>• The centrality of key discussion questions was further emphasised by the action studies.</li> <li>• All action studies, especially 'RICE', highlighted the relevance of 'soft' issue questions.</li> </ul>
<ul style="list-style-type: none"> <li>• <b>Design for balanced negotiation of meaning.</b></li> </ul>	<ul style="list-style-type: none"> <li>• E-roleplays distorted everyday power balances because participants were not self-acting. 'E-discussion' reflected everyday power balance with self-acting, although the intervention purpose and group composition afforded relatively open participation. In 'LetsTalk', top management formed a separate group.</li> </ul>	<ul style="list-style-type: none"> <li>• 'Global' and 'LetsTalk' highlighted power issues as a dimension not properly conceptualised in the kernel theory.</li> </ul>
<ul style="list-style-type: none"> <li>• <b>Design for organizational maintenance rather than organizational change.</b></li> </ul>	<ul style="list-style-type: none"> <li>• 'Global' and 'LetsTalk' aimed for both individual learning and organizational change. They did not employ a powerful change process.</li> <li>• 'RICE' aimed for individual learning only.</li> </ul>	<ul style="list-style-type: none"> <li>• The understanding of organizational change and double-loop learning was greatly revised following the outcome of 'Global' and 'LetsTalk'. The interventions did not lead to organizational change, despite seemingly supporting double-loop learning. Hence, organizational learning theory as part of the kernel theory was redefined.</li> </ul>

## 5 Discussion

The initial IS design theory for support of DPMC was tested and developed further through three action research projects. Following the empirical work, a final theoretical investigation was conducted including an interpretive analysis and synthesis of our 30 months action research study. This involved reviewing the initial IS design theory in light of the empirical findings and making necessary revisions. The findings of the empirical work provided more confirmation than disconfirmation of the initial IS design theory for support of DPMC.

In terms of promoting organizational maintenance, the design theory was largely sufficient. However, in terms of promoting organizational change, the design theory did not provide adequate guidance. The main reason for this was that the initial

conceptualisation of organizational learning and associated concepts was flawed and misleading. The initial definition associated double-loop learning with 'deep/large' rethinking (measured in terms of an individual), i.e. questioning and shifting of personal assumptions. However, the reinterpretation defined double-loop learning as being unaligned with social order (measured in terms of a collective), i.e. concern organizational change rather than organizational maintenance. Further, the relationship between learning interventions and organizational development was assumed to be strong in terms of changing social order (double-loop) but this relationship turned out to be weak.

Our unsuccessful attempt to promote organizational change indicates that the kernel theory lacks elaborate conceptualisations about issues of trust, power, and politics. Even though these issues are highlighted in the revised IS design theory, the revision still comes short of providing proper guidance. Investigations of how relevant theories, such as structuration theory (e.g. Giddens, 1984; see also Coopey, 1995) and actor-network theory (e.g. Law, 1991), can complement our design theory are thus needed. Indeed, this shortcoming has implications beyond ambitions to develop IS design theories for support of DPMC. It implies that research about e.g. situated learning (e.g. Lave & Wenger, 1991) has neglected issues of trust, power, and politics. This conclusion lends support to Contu and Willmott's (2003) argument that situated learning theory is underdeveloped in terms of the power-invested situatedness of learning.

Our IS design theory for support of DPMC may be generalisable beyond the context of DPMC subject to minor adjustments. In understanding this generality, it is relevant to consider that the underlying theories about knowledge and learning have concerned a wide range of e.g. technical work (Barley & Orr, 1997), service work (Lave & Wenger, 1991), and craft work (Chaiklin & Lave, 1993). Hence, it is reasonable to assume that the kernel theory is generally applicable to most work contexts. Furthermore, our empirical work suggests that project management is a form of knowledge work, and therefore other classes of knowledge work may be viable targets of the IS design theory (see e.g. Schultze, 2000; Markus et al., 2002). Targeting another class of work will involve developing a revised set of practice characteristics and user requirements. Following this, the design and development principles need to be updated. In such revision, some parts of the design theory may remain unchanged and thus prove their generality. One way to identify such general elements is to target a significantly different work context than DPMC and learn from the contrasts.

In our action research efforts we have avoided collaboration with learning consultant corporations in order to gain control and exploratory affordance in the early cycles of theory development. However, on the basis of a stable IS design theory, it is relevant to conduct action research with an actor-set configuration involving learning consultant corporations. One aim could be to support the diffusion of the IS design theory into learning consultancy practices. Exposing the IS design theory to learning consultancy practices will enable its adaption to the industrial needs of learning intervention providers.

The kernel theory of this research has advocated that 'learning problems' (i.e. questions) should be relevantly situated, i.e. be locally relevant and embody practice-specificity, rather than be abstract and detached from local practices. However, this conceptualisation has (in the literature) been treated as a simplified dichotomy. This research has introduced (but not fully explored) the notion of levels of balance between practice-specificity and abstract generality (i.e. authentic problems vs. semi-authentic problems). This provides a useful conceptual framework to more systematically reason about different levels of practice-specificity embodied in 'learning problems', and thereby improve the design of such 'learning problems' and associated predictions about relevance for learners.

## **6 Conclusions**

The objective of this research was to inform the design of information systems that support competence development in a work context. Our 30 months action research effort followed the logic of (1) developing a general design framework mainly based on situated learning theory, (2) developing design concepts based on the design framework, and (3) evaluating the design concepts, and thus the underlying design framework, through applying them in action research projects intended to develop project management competence. The final IS design theory for support of DPMC is the main contribution of this research and primarily addresses the need to operationalise situated learning theory (e.g. Herrington & Oliver, 2000). This design theory extends the literature which contains only a few design frameworks, of which all have significant limitations in the context of CDS for project management. Despite this paper adding one situated learning design framework to the existing set in the literature, there is still room to develop more design frameworks. However, the diversity and quality of existing frameworks is increasing and a meaningful research endeavour would be to review, fine-tune, and integrate across the collection of frameworks.

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