# COMPETENCE-AS-SKILFUL-COPING IN INFORMATION SYSTEMS DEVELOPMENT

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## Abstract

*With the advancement of technology organizations are becoming increasingly dependent on successful deployment of information systems. To deal with the IS complexity, developers require competence. However, the question "What is competence?" is still a topic of further deliberation in general, and in IS field in particular. Contemporary research critiques the concept of competence as confined to a narrow and instrumental view, for instance just as application of skills and knowledge. The narrow and instrumental view of competence does not give full attention to the information systems developers nor to the situations where the competence is enacted. To enhance the understanding of competence, we critically analyze the prevailing concepts of competence in general and in particular within the IS field. Based on the results of our analysis we propose an expansion of the concept competence to include 'competence-as-skilful-coping' based on a holistic perspective where developers 'being-in-the-world' act appropriately in unique and complex contexts. Such contexts may involve the developers of the systems, the users of IS-es to be developed, related information systems, manual routines, and the technology used. We present and analyze a case searching for the suggested concept of 'competence-as-skilful-coping'.*

## 1. INTRODUCTION

Organizations are offering and are dependent on offering more complex services to their customers. The goods and services offered require more and better equipment and technology further fueling a quest for more competence for handling the development of goods and services. As information technology (IT) and information systems (IS) are indispensable for the development mentioned the IS field requires competence for a successful development of information systems especially aiming at solving complex tasks through advanced technology and an enormous increase in interconnected systems through networks in situations with incidents of disruptive technological changes (Lyytinen et al, 2010). As information systems are analyzed, designed, tested, implemented and deployed by human beings, information systems developers and information systems users need to enact their competence both in the information systems development processes and related to using the systems. We may question if the increase and diversification of competence has kept pace with the increase in complexity of the technology?

The question, what is competence (Hager and Gonczi, 1996; Le Deist and Winterton, 2005) persists both in general and in the IS context. The research literature both in the IT/IS field, in other fields, and in general present different answers to the question. In the following paragraphs, we will present some perspective on the concept of competence and argue for redefining the concept.

The word competence appears to be a homonym in different professional areas, but with different connotation. Meta competence, as an example, is a special dimension of competence as "it is concerned with facilitating the acquisition of the other substantive competences" (Le Deist and Winterton, 2005, p. 39) versus Meta competence is a low level broad competence (Nordhaug, 1998).

Research on competence suggests that competence is being split in more and more atomic parts prescribing specific competencies to identify and solve increasingly specific problems. One consequence of such views of competence is that just by adding more specific competencies may solve ISD problems. However, if the problems to be solved are wide and challenging in complex situations more specific competences may not suffice. A consequence of this view is an instrumental understanding of competence where competence is regarded as an instrument in itself, apart from the person that has the competence. Furthermore, research on competence is often mixing competence, skills, and knowledge challenging even more an understanding and a possible definition of competence.

One definition of competence is "the ability to…" (Peppard et al., 2000) perform some action. This definition does not consider the results of the actual enactment of competence in complex situations and contexts. Some research suggests the concept of competence as competence-in-action (Omland and Nielsen, 2009) stating that competence is more than "the ability to…" (Peppard et al., 2000).

Furthermore "the ability to …" (Peppard et al., 2000) conceptualization of competence may be linked to the terms tacit and explicit (Nonaka, 2008) suggesting that developers may have both tacit and explicit competence. Developers may enact their competence without having a conscious understanding of their competence or without explaining what competence they enact. In other situations, actors may be able to explicate what competence they enact or at least think they enact.

Such understanding of competence contradicts the Heideggerian expression "being-in-the-world" used to describe how the actors are entwined with the world through engaging in specific tasks with the competence they may have, also known as skilful coping (Dreyfus, 2014). Actors cannot step outside of being-in-the-world and cannot separate themselves from their competence. The entwinement with the world is only achieved through the lived body in the actual actions in the world (Sandberg and Dall'Alba, 2009). Summarizing the above discussion, one challenge with understanding competence is that competence is enacted in some given situation and in some given context. Could there therefore possibly be different types of competence? Could there be different layers in any specific competence depending on the context where the competence is enacted, related to the specific task, and if the enactment of competence is done alone or in connection with others? To clarify the notion of competence we derive the idea of skilful coping (Dreyfus, 2014) for including both the actor and his competence, the tasks to be performed by enacting the competence, the situations and contexts where the competence is to be enacted.

We therefore aim at seeking for a deeper understanding of competence and suggest that competence may be understood as skilful coping in everyday life and particularly in an IS context through our research question: "What is competence-as-skillful-coping in an information systems development context?"

In the next section, we review the research literature on competence in general and in an information systems development (ISD) context. Thereafter we present and analyze three examples of enactment of competence. Then we suggest an expanded understanding of competence before we conclude the paper.

## 2. THE NOTION OF COMPETENCE IN RESEARCH LITERATURE

We start this section with a broad literature review searching for a generic definition of competence. Searching for a concise answer to the question "What is competence?" (Hager and Gonczi, 1996; Le Deist and Winterton, 2005), may be challenging due to the definitions of competence differ depending on the contexts it is studied, and the perspectives chosen for the study. Differences and similarities

between the understanding of competence in the US, UK, France, Germany and Austria resulted in a general conception of competence in three dimensions: knowledge, skills, and social competences that are necessary for particular occupations (Le Deist and Winterton, 2005). These three dimensions, however, do not provide a full description of competence. Hence a typology consisting of four competences, namely cognitive, functional, social, and meta competence was suggested and categorised along two dimensions, occupational/personal and conceptual/operational (Le Deist and Winterton, 2005, cf. Table 1). Cognitive competence captures knowledge and understanding, functional competence resembles skills while social competence includes behavioural and attitudinal aspects. Meta competence is a special dimension of competence as "it is concerned with facilitating the acquisition of the other substantive competences" (Le Deist and Winterton, 2005, p. 39). Le Deist and Wintherton's (2005) four-dimensional competence model may be represented as a tetrahedron, reflecting the unity of competences and the difficulty of separating the four types of competence. The sides of the tetrahedron may represent practical competences combining "elements of the dimensions of competence in varying proportions" (Le Deist and Winterton, 2005, p. 40).

|  | Occupational | Personal |
|---|---|---|
| **Conceptual** | Cognitive Competence | Meta Competence |
| **Operational** | Functional Competence | Social Competence |

*Table 1. Typology of competence (Le Deist and Winterton, 2005)*

The literature review shows that competence has been researched from/with a wide variety of characteristics (cf. Table 2).

| Conceptions/dimensions | References |
|---|---|
| Narrow vs. integrated view | Hager and Gonczi (1996) |
| One- vs. multi-dimensional | Le Deist and Winterton (2005) |
| Specificity vs. non-specificity | Nordhaug (1998) |
| Context vs. context-free<br>Macro vs. micro | Boyatzis (1982); Prahalad and Hamel (1990); Simpson (2002) |
| Domain vs. generic | Hager and Gonczi (1996); Le Deist and Winterton (2005) |
| Core competence | Prahalad and Hamel (1990) |
| Individual vs. organisational | Nordhaug (1998) |
| Learning vs. unlearning<br>Formal vs. informal | Le Deist and Winterton (2005) |
| Levels of competence | Benner (1984); Bloom (1956) |
| Meta competence | Nordhaug (1998), Le Deist and Winterton (2005) |
| Cognitive vs. constructive | Garavan and McGuire (2001) |
| Qualified vs competent | Eraut (1998) |
| Competence as politically and socially situated | Eraut (1998) |
| Competence as individually situated | Eraut (1998) |
| Tacit vs explicit | Nonaka (2008) |

*Table 2. Characteristics of competence (adapted from Omland, 2013)*

Competence in organisations appears to be divided along disciplinary lines (Lindgren et al., 2004). Combining the dimension of task specificity with the dimensions of firm specificity and industry specificity gives a framework that has three dimensions: task, industry, and firm specificity with a low and high scale (Nordhaug, 1998). Nordhaug's conceptualization (1998) may result in the above mentioned challenge of atomization of competence as the task view of competence holds that "competency standards are often thought of as simply a series of discrete task descriptions" (Hager and Gonczi, 1996, p. 15).

Competence exists both on a micro and a macro level in organisations (Boyatzis, 1982; Prahalad and Hamel, 1990; Simpson, 2002). The micro level relates to the individual knowledge and may partly be viewed as personal traits allowing for "inclusion of the dimensions of behaviour that lie behind competent performance when discussing competence" (Bassellier and Reich, 2001, p. 163). The macro level relates to an organisation's unique combination of core competencies (Simpson, 2002). The two levels of competence, micro and macro, are related in that it is the individual actors in the organisations that perform the tasks needed to get an organisational result (Nordhaug, 1998). Ontologically, the concepts of micro and macro level understanding of competence suggests that competence is something separate from human beings since it is possible for an organization to possess competence.

A strand of research on competence concerns the objectives of enacting competence, what the organization wants to achieve through the enacting of competence. Competence is used for gaining a competitive advantage (Prahalad and Hamel, 1990). "Core competencies are the collective learning in the organization, especially how to contribute diverse production skills and integrate multiple streams of technologies" (Prahalad and Hamel, 1990, p. 82) for organising work and delivering value.

Researchers of competence seldom explicate philosophical and epistemological tensions (Iivari and Hirschheim, 1996) related to competence, especially assumptions about the nature of work, the individual and the organisation (Garavan and McGuire, 2001). Taylorism (Taylor, 1911) with its one best "way" is the root of the competency movement (competency used here since the text we refer from use that expression) and the functional view of management. Competency models seek at a simplistic level "to identify the ideal combination of skills, knowledge, attitudes and experience, the possession of which enables employees to become high performers with the potential to add value to the organization" (Garavan and McGuire, 2001, p. 145). Applied on an example from the IS field we find that ontologically the functional view makes the developer and the information systems development into two separate entities treating employees in a rational and quantitative way. Separating developer and information systems development is challenged by developmental humanism positing that employees should be provided with a broad degree of self-control and self-regulation on the basis that this will empower the employees to actively work towards fulfilling the aims of the organisation (Garavan and McGuire, 2001). Separating developer and information system development does open for a dualist ontology where the developer and the development are viewed as two distinct separate entities.

The competency literature generally espouses a rationalistic, positivistic perspective and makes some important assumptions about work and behaviour (Garavan and McGuire, 2001). One important assumption is therefore the strong bias towards considering competence in a context-free way where competencies are atomistic, mechanistic, and bureaucratic, and that the use of such competencies will yield high performance irrespective of the organisational context in which they are used (Garavan and McGuire, 2001). Many of these descriptions of competence do not consider the characteristics of the human agent and offer little consideration of when the competencies are used, how they are used and the moderating influence of personal characteristics on their usage (Sandberg, 2000). Not considering the characteristics of the human agent opens for challenges in the epistemological view of competence for example related to how competence is to be learnt and eventually enacted by the human agent.

## 3. COMPETENCE, METHODS, AND PRACICE IN ISD

Taylor (1911), with his scientific management (early in the 20th century), noted that the most competent workers accomplished their work faster and with better quality than the less competent workers (Sandberg, 2000). Taylor therefore suggested specific training in standardised tasks in order to increase the workers' competence and thereby effectiveness in organisations. A result of Taylor's view of competence may be seen in some information systems research on competence where competence is atomised, i.e. broken down into small pieces that are suggested for solving specific problems. Examples of the atomisation of competence are the conceptualisations proposed by Green (1989), who suggested 21 different competencies for information systems developers to relate to users. Peppard et al. (2000) suggested three broad categories of competence, divided into 6 macro

competencies that are furthered divided into 25 micro competences. The micro competencies are then used to solve specific development problems. The atomisation of competence makes competence generic in that it is fitted to the task without considering the context of the task and the developer that enacts the competence suggested to solve the specific problem. However, the continual development of the understanding of competence has, in recent years, led to criticism of the atomistic and generic conceptualisation of competence (Hager and Gonczi, 1996; Le Deist and Winterton, 2005; Sandberg, 2000). The criticism becomes even more serious as systems development in itself consists of complex processes carried out in complex environments.

Research shows that the utilization of the technology is challenging, and that development of information systems are hampered by failures, delayed projects, and delivery of less functionality then originally envisioned (Lacity and Willcocks, 1998). One reason for the problems may be that methods represent "an ideal, perfect world to which the 'real' world has to conform" (Ciborra 1998, p. 11). Learning methods in itself, or becoming aware of methods or espoused theories (Schon, 1983) will not in itself lead to new behaviour (Ciborra, 1998). Even if there has been a great leap in designing and developing methods since Ciborra wrote the above lines, methods in themselves still have some characteristics that views the world in an idealised way. Methods may also be used as rituals (Robey and Marcus, 1984) that may divert attention to following a method instead of acting skilfully in the given situation and context. The results of such focusing is exemplified in the "Invisible Gorilla" experiment where half of the viewers of a video did not notice the appearance of a gorilla because they were given instructions to count the number of basketball passes in the video.

In ISD competence, methods, and practice influence each other (cf. Figure 1). However, influences did not necessarily go directly between two of the three elements. Figure 1 shows that no direct link between competence and practice was found in the project studied. The development practice was influenced by the developers' enacting their competence through deploying internalized methods (Omland, 2009).
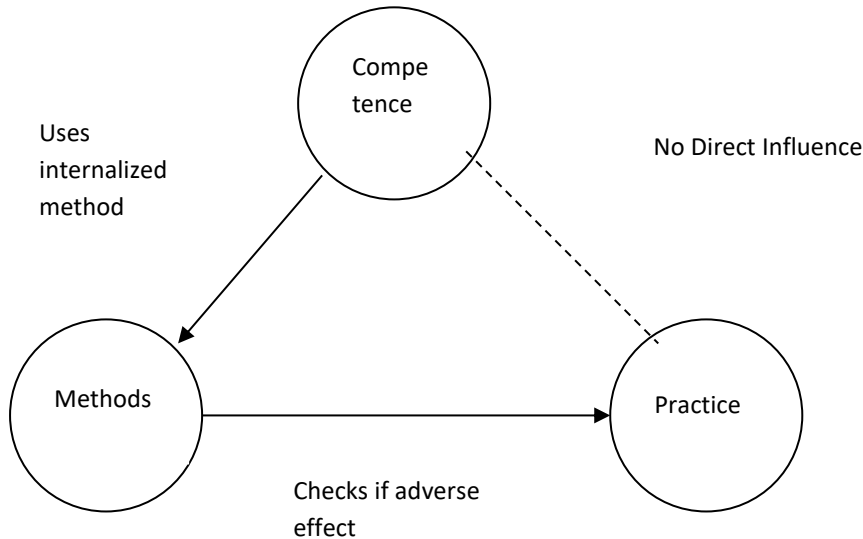
Uses internalized method

Compe tence

No Direct Influence

Methods

Practice

Checks if adverse effect

*Figure 1. Competence influences Practice via Method (Omland, 2009)*

However, the model suggested in Figure 1 (Omland, 2009) lacks an understanding and a description of competence enacted in context. Therefore, the model only clarifies the understanding of competence partly.

Sandberg (2000) studied "what constitutes human competence at work" (p. 9) and found that the engine optimisers' conceptions of engine optimising influenced their enactment of competence and concluded that "…. worker and work form one entity through the lived experience of work"

(Sandberg, 2000, p. 11). Sandberg's study was done in a rather technical environment where humans interacted with tools to optimize an engine. Still the optimizer's attitude to his work influenced the results of the optimizing efforts.

ISD takes place in much more complex environments than optimizing engines. ISD environments normally include human beings, their changing attitudes both to the tasks to be performed using technology and the learning that takes place in the development situations, the politics and fights for power, improvements and resources to mention a few elements in the development situations. Competence is therefore more than sets of attributes "used in accomplishing work" (Sandberg, 2000, p. 20). The rationalistic approach to competence based on a dualistic ontology that divides "…. competence into two separate entities, namely, worker and work" (Sandberg, 2000, p. 11) is strongly criticised since "human competence at work is seen as constituted by a specific set of attributes, such as the knowledge and skills used in performing particular work" (Sandberg, 2000, p. 9).

Identifying competence through job analysis based on scientific principles from rationalistic research tradition result in three attribute-based approaches to competence: the worker-oriented, the work-oriented, and the multimethod-oriented (Sandberg, 2000). The *worker-oriented* approaches focus on the worker and make competence more generic and context-independent. The *work-oriented* approaches try to overcome the criticism of worker-oriented approaches by making the work their starting point through identifying central activities needed to perform the actual work. The activities are then transformed into personal attributes needed by the developers fitted to the work at hand. The *multimethod-oriented* approaches also view competence as a specific set of attributes drawing on both the worker-oriented and work-oriented approaches to formulate the multi-method approaches. All three approaches describe competence indirectly, assuming that the worker and world are distinct entities with an "… objective reality independent of and beyond the human mind" (Sandberg, 2000, p. 11). Worker and work are divided into two separate entities where it is possible to describe competence as being independent of the worker, thereby making competence generic and applicable independent of the worker, the context and the tasks to be solved by the worker.

The above criticism is also directed towards the objective epistemology in which work is objective and knowable to a degree after which work is independent of the workers who accomplish it (Sandberg, 2000). In contrast, workers' experiences of work give meaning to and constitute their competence rather than a specific set of attributes (Sandberg, 2000). The worker and the world are inextricably related, implying that the attributes used by the worker when working are context-dependent or situational where workers will frame their understanding of problem situations through their experience of work. Workers' experiences of work are therefore "more fundamental to their competence than the attributes themselves" (Sandberg, 2000, p. 11). The actual enactment of competence in accompanying work are therefore preceded by and based upon the workers' conceptions of work.

Competence is therefore primarily constituted by the professionals' understanding and enacting of their work as opposed to only knowledge and skills (Sandberg and Pinnington, 2009). When Marx, Wittgenstein and other authors point to practice as the centre of professional competence, the practice-based approaches "*do not really explain how these aspects of professional practice become integrated into and form a specific competence in work performance*" (Sandberg and Pinnington, 2009, p. 1143 italics by the authors). Sandberg and Pinnington (2009) offer an integrative conceptualisation of competence in work performance using Heidegger's existential ontology suggesting that "work performance can be conceptualized as constituted by three interrelated ontological dimensions, namely human way of being, *others* in human way of being, and *things* in human way of being" (Sandberg and Pinnington, 2009, p. 1144). The human way of being includes the relationship between what the actors are and what they do as distinguished from something they possess. *Others* in human way of being points to the social constituting of professional competence defined by those with whom the actors are engaged in some specific human way of being. The third dimension, *things* in human way of being is important, not in terms of what the things are in themselves but by their usefulness in a particular human way of being. Sandberg and Pinnington (2009) suggest a model for distinct forms of competence in work performance (cf. Figure 2) adding a specific understanding of work to the three dimensions mentioned above.
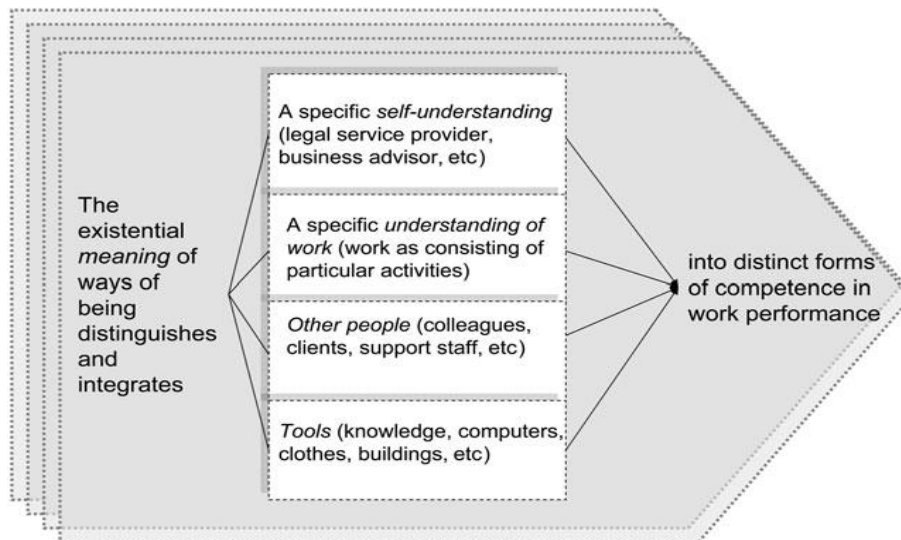
*Figure 2. Professional competence as ways of being (Sandberg and Pinnington, 2009)*

Sandberg and Dall'Alba (2009) suggest adopting a life-world perspective viewing practice from a relational perspective where practice is constituted through "the entwinement of life with the world" (p. 1351). The entwinement perspective of practice includes entwinement with others and with things in the world. In that view the individual actor is not the most central, as social order is needed to bring shared meanings to the world in which the actors are living and working. The entwinement of life with world questions the various forms of dualism, such as subject and object, mind and body, thinking and performance that appear in many social theories (Sandberg and Dall'Alba, 2009). The dualism may be overcome by considering relations between, instead of the separateness of for example mind and body, thinking and performance

Sandberg and Dall'Alba (2009) use the Heidegger expression "being-in-the-world" to describe how the actors are entwined with the world through engaging in specific tasks. Actors cannot step outside of being-in-the-world. The entwinement with the world is only achieved through the lived body in the actual actions in the world (Sandberg and Dall'Alba, 2009). Competence understood as skilful coping can resolve the criticism that has been raised against an atomic and instrumental view of competence where the actors enacting their competences are not given full attention. The entwinement between the actor and the world forms the basis for how the relationships between competence, methods and practice are viewed in this paper. So far, we have used actor in singular form. As most systems development includes multiple actors, actors will also be entwined with each other in complex development situations. This research therefore seeks to introduce the above-mentioned understanding of the relationships between workers and work into the information systems field. The Sandberg and Pinnington model (2009) of Professional competence as ways of being focuses on the individuals' ways of being in the world but lacks the extended focus on the context and tasks and therefore does not lead to a full understanding of competence-as-skilful-coping in an ISD context. The literature review shows that research about competence is criticized for suggesting concepts of competence that are too atomistic and do not consider the actual contexts where competence is used. Omland (2009) suggests relationships between competence, methods and practice but lacks, or at least do not clarify the context where the three elements in ISD takes place. The model of Professional competence as ways of being (Sandberg and Pinnington, 2009, cf. Figure 2) consider both the professionals, in this case systems developers, their understanding and attitude to work. However, the model does not suggest competence from the perspective of skilful coping. In the following we will present a case and use the case as an element in answering our research question: How can competence be understood as skilful coping in ISD?

# 4. PRESENTING A CASE OF COMPETENCE IN AN ISD CONTEXT

In this section we will describe and discuss three situations in an ISD project (Omland, 2004) and analyse them preparing for a discussion to clarify the term "competence-as-skilful-coping".

## 4.1 Breakdown in an IS project

A Norwegian company needed an information system to keep track of loans, down payments, lack of down-payment, changes in loans, loan guarantees, insurances, payments, and reimbursements for the same when down payments are made later than scheduled, all transactions to be registered both in Norwegian and foreign currencies. The information system contains four interrelated modules (one for each department in the company) and was developed under a fixed price contract by the systems development company here called BICT. The initial information systems requirements were developed by a consultant company and used in the negotiations between the company needing the IS and BICT.

Initially the project was staffed with 6 developers, including three senior systems developers. After some time two of the senior systems developers were substituted with younger systems developers. The remaining senior systems developer became the project leader. He had a record of delivering projects on time and with good quality. After nine months, he left the project and one of the initial senior systems developers re-entered the project group as project leader. Later the person responsible for the design of the solution left the project. This position was not filled as the project group considered his task to be fulfilled since a solution had been chosen before he left the project. During the busiest part of the design and programming faces round 15 people worked on the project. At the time of the interviews 5-6 people worked on the project. The project was originally estimated to take one year, but had, at the time of the interviews, lasted for two years with an overrun of 100% for man hours. The information system was not approved by the customer at the time of the interviews.

In the following we present how the developers worked within three competence areas in the project, Domain competence/knowledge/skills, Analytical competence/skills, and Prototyping competence/skills.

### Domain competence/knowledge/skills

The domain, where the information system was to be used, was perceived to be complex in at least two ways, the tasks to be performed, and the use of terminology in the four departments at the customer's side. "There is a reason that a lawyer sits together with a political scientist, together with an economist, together they manage to cover the field."

The project leader tried to introduce an understanding of the basic process in the company as more or less like a process in a bank: "It is that they make a number increase from one side and decrease from the other side". However, the project leader did not succeed in getting a mutual understanding with the users on the basic process that the information system should help them to control.

The information system had four modules serving four different departments. Some functions were common for all four departments and therefore included in all four modules. But the vocabulary to describe these functions was not necessarily the same across departments. It took time before the developers understood the differences in use of vocabulary. The lack of common use of terminology complicated the development process leading to delays, a complex development process. One developer commented: "Consequently they continue with different views in this matter and get a complicated system, as opposed to that we got to simplify their view…we did not manage to change their view in this matter". Better understanding of the users and their needs at an earlier stage could have led to a better understanding of the information system and a clearer mutual understanding of the business processes in the company. One developer commented that the users were very good at solving their tasks, but he felt they lacked the deeper understanding of the processes related to the information system.

**Analytical competence/skills**

The interviewees all knew that they should use RUP as development method in the project. However, the data report that RUP was not used as an overall method in the project. Wall graphs, use cases, UML, prototyping, and NIAM were used. Use cases were intended to be developed from the wall graphs. However, to save cost most use cases were written by the users with some initial assistance from the systems developers resulting, in some cases, in descriptions of existing routines.

Developers reported that some use cases were very clear with accurate descriptions while others were very superficial. The initial reaction at the developers' side was that the superficial use cases seemed easy to implement. They discovered later that the use cases were not good enough for designing the information system and they had to analyse more to get a good understanding of how the users worked. This proved to be a challenge as the developers had problems understanding the domain specific language of the users. "… you know that since you do not completely understand what she is saying; it is not only a question that I do not understand these things. But then there is probably something else I haven't understood, something else that I haven't got hold of……."

As time pressure increased an interface designer was employed to design interfaces to shorten the development process by providing ready designed interfaces for the developers. The designer did not know the project well. When the developers started to implement his interface designs they discovered that the designs were not consistent and did not fulfil the systems requirements. They had to make their own analysis leading to change in the proposed design. "I did not participate in writing that specific design document, because at that time we started to run out of time, so it was somebody else that should write the document when we did something else. And then the design documents fell on my lap as a starting point for develop it further."

Even though the developers had competence in writing use cases things happened in the project. The major reasons for the lack of quality or clarity in the use cases seem to be that the users did not give exact explanations of their work and that the developers did not know enough about the field to be able to ask questions. "We discovered that it was a little bit difficult to write the use case, because, especially the lady that knew about this said: 'I am doing many things'. They [the use cases] were very thin. So, one gets a signal, yes, here we are more uncertain than." Even if the developers had analytical competence they failed in getting the information they needed for developing the information system or it took a long time to get hold of it.

**Prototyping competence/skills**

Prototyping is reported used in the wall-graph process, in making paper-based interfaces, and in making the interactive interface. Prototyping was used basically for getting information and understanding during the analysis activities, as in the wall-graph sessions and interface sections. The data, therefore, indicate that the developers had competence in prototyping, but that the prototype was developed too late in the ISD-process. "It is certain that it would have been useful for us to get the prototype earlier, it came too late in that phase". The anticipated use of a prototype at an earlier stage is stated by one of the developers: "The prototype had certainly helped the users as well to see the relations between the things and that, in a way; we had got a common picture of how things really were connected"

The users became much more active in their feedback to the developers when they could press buttons on the interactive prototype. The case data suggests that the prototype helped the developers in their understanding of the domain knowledge in the project creating a mutual understanding between the participants in the development. Since the results of using prototyping are reported as very positive, why didn't the developers use it earlier in the process? The data does not answer this question. Developers reported that even though prototyping was used, only one to two cycles were used in most cases mainly due to lack of time.

The interview data also include statements that prototyping could have been used in at least two additional places. The information system was designed with four distinct interdependent modules. These could have been prototyped in a way that would hinder errors moving from one module to the other. One developer reported that prototyping could have been used successfully in the module that

produced letters. The module should produce many different letters. Instead of designing each letter separately the developer was occupied with finding similarities in the letters. "We shall use 90% of the time we are to use on producing letters, shall we use on producing the first letter. If we get a full understanding for producing letters, we will produce the rest in a very short time. I have not been able to implement this idea."

The data reports that prototyping was very useful in the communication process, especially in understanding the users' needs in the interface design process.

## 5. INTERPRETING THE SITUATION AND THE RELATIONSHIPS TO COMPETENCE

The major findings concern domain competence/knowledge, analytical competence/skills, and prototyping skills/competence. We find three factors related to all these three findings, namely communication competence, the decision of letting the users write the use cases, and that the developers state that they did not succeed in their efforts to arrive at a mutual understanding with the users. The developers did not understand the users' domain, nor did they understand that the users did not in fact themselves understand the complexity and lack of coordination between the four different departments. Furthermore, the developers were not able to skilfully cope in the incidents leading to breakdowns.

The decision that the users should write the use cases for the new system had an enormous influence on the whole development process. The decision, though administrative, and with the purpose of saving money may also be due to lack of competence or enacting competence in an unsatisfactory way. The framing of the contract as a fixed price contract without clear enough requirements was also a crucial factor in the project along with unsuccessful attempts of establishing a mutual understanding of the processes that took place in the company. In the following the specific challenges are presented.

**Domain knowledge/skills**

The domain where the company operated was very specialized, one of a kind in Norway. It was therefore not unexpected that the systems developers did not have sufficient domain knowledge/skills in the related domains. The company was in addition found, internally, to have unclear interdomain understanding of its own departments and their competences. Such work environments require an extra sensitivity and attention to making sure that the individual actors understand each other, each other's domains, and the related business processes well enough to make a useful information system. The breakdown within this part of the development process was therefore due both to the lack of clear communication and the complexity of what was to be communicated about.

**Analytical competence/skills**

The systems developers were expected to use a specific method in the development, and they had competence in performing different activities to elicit requirements for the system to be developed. The analytical work was hampered, however, by some decisions, i.e. to save money in the project, leading to "thin use cases" that led the systems developer to believe that the use cases were easy to implement. However, trying they found that the implementation of these use cases broke down and leading to a break down in the project and lots of extra unanticipated work.

**Prototyping skills/competence**

It was evident in the situations described that the developers had the "ability to" prototype. When they finally made prototypes, the project was advanced. However, a major breakdown in prototyping due to not knowing when to prototype had a considerable influence in the project. When the users tested the prototypes, they were able to give better and more accurate feedback to the developers. The feedback led to more work for the developers when they understood the situation better including the business processes for the users. So even if the developers got a better understanding of the users and their use of the system, the project experienced a breakdown in that it had an overrun of 100% both in resource use and time at the time the interviews were taken.

# 6. DISCUSSION

The findings may be synthesized in the following: generally speaking, the developers had knowledge/skills/competence in the different areas of their development situations. For some reasons the developers were unable to enact their competence in some of the situations they encountered without experiencing a breakdown in the situations. However, after some time they were able to recover at least partly, though with large costs and delays. In the following we will discuss the three breakdown situations individually before we suggest an expanded understanding of competence.

In the first situation described domain competence (Hager and Gonczi, 1996; Le Deist and Winterton, 2005) was lacking. It must be noted that the domain for the project was very special, so the developers did not have domain specific competence for the given domain. However, the developers had communication competence also called social competence (Le Deist and Winterton, 2005), but that competence did not help the developers in the complex ISD situation. Even if the developers had many different competences they were not able to coordinate these competences to successfully cope with the challenges they met.

In the second situation described decisions made had a profound influence on the developers work conditions and situations. The economic perspective overran the development perspectives leading to decisions that a competence person should have foreseen. The developers had competence in writing use cases as functional competence (e.g. Le Deist and Winterton, 2005; Nordhaug, 1998). But they lacked the competence to oversee the consequences of their decisions, or at least they did not let such competence influence the decisions made, or as mentioned, the economic perspective blinded the actors in the project.

In the third situation described, the developers also had the necessary competencies both related to cognitive, functional and social competence. However, they were not able to enact their competence relating it to their development situation at an appropriate time.

From the above discussion, we find that the developers did process competence in the different areas needed to fulfill the tasks in the development. However, the developers were not able to enact the competence in a way that solved the problems they faced. They seemed to be on some advanced level in some of the competences while on a more beginners' level in some of the competences or at least in the enactment of the competence. The finding relates directly to some of the critique directed (Omland, 2009; Sandberg and Pinnington, 2009; Peppard et al. 2000) towards the prevailing understanding of competence where the level of enacting the competence and the results of its enactment is not considered as part of understanding competence.

**Analyzing the case situations from competence-as-skilful-coping**

If we revisit and analyze the three situations described from the perspective of competence as skilful coping we get the following results: some of the competences we described were in fact more related to knowledge and skills than to competence, example may be prototyping skills. The totality of the prototyping done is on the contrary related to competence as skilful coping. The developers had the skills to prototype, but they were not able to enact their competence in a skilful way in the totality of prototyping as they were unable to find the best time to do the prototyping.

Analyzing anew the analytical competence reveals that the developers had skills in using methods, they had a designated method they were supposed to use. However, they managed to use only some of the techniques in the method or related to the method. Furthermore, they did not manage to foresee, or at least did not have competence to analyze the consequences of some of their decisions. So, again, the developers did have skills and methods when working in a development situation, but they were not able to skilfully cope in that they did not understand the whole situation and did not act skilfully to solve the challenges they met.

# 7. EXPANDING THE CONCEPT OF COMPETENCE

The above discussion opens for suggesting an expansion of competence-as-skilful-coping to get a deeper understanding of competence. In the following we discuss how the concept of competence-as-skillful-coping may contribute to a deeper and enlarged understanding of competence in three of the concepts of competence referred in the literature study, namely meta competence (Le Deist and Winterton 2005), competence in relationships to methods and practice (Omland 2009), and Professional competence as ways of being (Sandberg and Pinnington 2009).

Our findings contribute to Le Deist and Winterton (2005) (cf. Table 1) by suggesting expanding Meta competence to be more than just learning the other three competences. Our contribution adds to the concept of meta competence by suggesting that meta competence includes handling both the learning part of the "sub-competences" (which might also be considered skills/knowledge) in their model, understanding more of the context, and enacting competence so that the developers are able to cope skilfully in development situations.

Our contribution also suggests changes to Omland (2009 cf. Figure 1) adding skills and knowledge to the method element in the model and then viewing competence as deploying the skills/knowledge and methods in practice in a skilful way included interacting with the situations that develops or occurs in the context and course of ISD. Competence-as-skilful-coping may then be understood as including skills/knowledge, methods, and practice, the three elements in the model (cf. Figure 1) adding the actual development situations and their contexts also being represented as a tetrahedron, reflecting competence-as-skilful-coping as a unity of skills/knowledge, methods, and practice, related to and interplaying with the actual IS situations and their contexts.

Our contribution to the Professional competence as ways of being (Sandberg and Pinnington, 2009, Figure 2) is that competence also must include understanding the context and situations where ISD take place.

From all the three above mentioned models the common thing missing is that the context and the actual situations are not included in the understanding of competence. The main focus of competence seems to be on the actors thereby creating a dualistic view of the relationships between actors and work.

Sandberg and Pinnington (2009) are closest to understanding competence-as-skilful-coping. However, their model does not explicitly include the Heideggerian expression "being-in-the-world" (Sandberg and Dall'Alba, 2009) in their model (cf. Figure 2). Their model states that four elements and the relationships between them "distinguishing and integrates … into distinct forms of competence in work performance" (cf. Figure 2). What lacks in the model is a clear description of the relationships between the four elements mentioned, and a discussion about the relationships between "the distinct forms of competence in work performance" (cf. Figure 2) and the relationships between this type of competence, the developers enacting the competence and the situations and contexts where the competence is enacted.

As mentioned above Sandberg and Dall'Alba (2009) use the Heidegger expression "being-in-the-world" to describe how the actors are entwined with the world. However, "being-in-the-world" still lacks the element of action that must be included in the understanding of competence. Competence without action, without being enacted does not fully explain competence.

Concluding therefore on the understanding of competence, the concept of competence, includes an understanding of "being-in-the-world" with "acting-in-the-world" as an element. When we suggest competence-as-skilful-coping for better understanding of the concept of competence we then relate the understanding of competence with Dreyfus' (2014) and Bloom's (1956, referred in Brenner, 1984) taxonomies suggesting that the understanding of competence must include some kind of measurement for more or less successful enactment of competence, in the terms we discuss, levels of skilful coping in IS including the elements that are present in IS situations and contexts.

From the above discussion we conclude that the concept of competence should be elaborated. The discussion we have presented opens an enhanced understanding of competence where competence

also may be understood as skilful coping. Competence-as-skilful-coping further challenges competence as "… the ability to" (Peppard et al. 2000) and the other shortcomings of the term competence discussed in Chapter 2 The Notions of Competence in Research Literature.

# 8. CONCLUSION

Our quest for an enhanced understanding of the concept of competence results in a critique of the prevailing understanding of competence as atomic, specialized and independent both of the developer and the situations in IS revealing a dualistic understanding of competence and the developer. Our contribution to a deeper understanding of competence is to view competence as-skilful-coping. The view as skilful coping includes both the developer, his or her personality, skills, knowledge of methods and the actual exercising of the tasks in a given situation viewing all the elements mentioned and other elements as one entity in IS as skilful coping.

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