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Challenges for Knowledge Communities in Technical Work Domains

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ABSTRACT

By drawing on the specific lessons learned from one case study, this paper will discuss collaboration, and issues upon knowledge communities in technical work domains. The results are based on a case study in a manufacturing process, thermal spraying, which can be characterised as very complex and technical. In order to understand the concept of knowledge communities in technical work domains I argue for an elaborated approach by going across different collaboration levels and organisational cultures, into issues of communities of practice. The discussion ends up with three main challenges for forming and supporting knowledge communities. These challenges might inspire an adequate work milieu, cultivated by both shared meanings and technology support.

INTRODUCTION

Fostering and supporting knowledge processes is the vital interest of knowledge intensive organisations. This is of special importance in technical work domains where highly skilled employees approach complex problem solving and specialized work arrangements. Knowledge intensive organisations are composed of multiple communities with highly specialised technologies and knowledge domains (Cook & Brown, 1999; Scarbrough et al, 1999). The process of managing knowledge is tricky. The reasons for this can be numerous and of different types: organisational, technological, cultural etc. There may be a lack of resources to pursue a strategy, there may be unwillingness among the employees to share knowledge due to cultural issues and self recognition, or there may even occur difficulties in technological implementation and adoption. It is interesting to analyse the various reasons for this problem. Some argue that these reasons can be related to more cultural aspects that draw upon collaboration patterns and organisational cultures. Probably, there exists something else, more deeply rooted in the engagement of work that makes good sense of knowledge work. A key to sustain knowledge processes is the organisational culture that forms the environment in which information and know-how can flow. Shein (1996) notes that organisational culture is a key to collaboration and community building in technical work domains. Thorough discussions about the real practice as well as cultural aspects that underlie the activities related to the management of knowledge are needed. Consequently, it should be of relevant concern to analyse such conditions in more detail and therefore case studies are needed.

Several approaches among IS people have for many reasons tried to understand the organisational and business needs in order to design ICT support for knowledge management activities (Kirn, 1997; Carstensen & Snis 2000). Improvements in such IS research and development have made it easier to understand the design and use of systems and technologies for supporting knowledge work. However, this challenge proved to be a real difficulty, as it was faced in a real-work setting of a technical domain. In this study it is shown how an existing knowledge handling tradition had to be extended by going beyond organizational sub-cultures and initiate a community building process in which to strengthen a social cohesion. Developing a community is important and the quality of work and motivation are directly connected to the degree of engagement in the social work activities. Hereafter, it is possible to find implications for ICT support and perhaps start leveraging knowledge and knowledge processes by its use.

RESEARCH APPROACH

This paper investigates the challenges of moving towards knowledge communities in technical domains. By trying to complement the prevailing approaches to the field of KM and IS, I argue for an additional aspect that has not been so considered earlier; the cultural aspect when discussing the knowledge work and ICT support. The aim of this study is to analyse and discuss what the main challenges are for forming and supporting knowledge communities in technical domains. The particular context where these challenges are faced and explored is in a highly technical domain where knowledge is managed in many different ways. Therefore in one part of the paper a case study from the activities performed in work practice: the work conducted in the *thermal spraying department* at a large jet engine production company, is presented. For related studies on this research project, see for instance Sorensen & Snis (2001) and further in.Lundh Snis (2002).

The empirical work was carried out as a case study method (Yin, 1989). In order to collect material from the manufacturing process, qualitative studies were performed. The empirical material was collected from 12 interviews, several meetings, observations and workshops together with the people involved. Initially, there were vague understandings about the problem domain but an explorative investigation was initiated before outlining the issues of concern.

As a supportive framework for the analysis and discussion I used studies about how to understand organisations as communities of practice and how knowledge and culture could be understood in such communities. Computer support for collaborative work has played an important role as a framework for collaboration and engagement in work practice and how this might be supported by ICT. In this perspective, it is assumed that people have different interests, hold varied viewpoints and make diverse contributions to the work activities. While trying to traverse communities this assumption is not an easy task to deal with. However, for that reason we ought not to disregard this challenge. In my view, participation at multiple levels is of crucial importance when elaborating knowledge communities, especially in technical work domains, where human actors play important roles in an evolving socio-technical environment.

KNOWLEDGE WORK: ABOUT COLLABORATION, COMMUNITIES AND CULTURES

Much literature upon what the concept of managing knowledge really tries to approach concerns, for instance, the full utilisation of information and data, coupled with the potential of people's skills, competencies, ideas, intuitions, commitments and motivations (Scarbourough et al, 1999). Robertson et al (2000) as well as Swan et al (2000) further develop this concept when they argue that knowledge management is about connecting people with people and people with information to make way for collaboration and community networking. However, in order to understand the practice of knowledge work we may want to consider how work is organised from a collaborative viewpoint.

From General Awareness to Community Building

By going beyond administrative office work into industrial production we can bring the aspects of collaborative work to production. We need to identify and understand how the involved actors can communicate their work and how to coordinate and co-operate in the manufacturing process. Schmidt & Simone (1996) at an early stage proposed that communication imply supporting actors independent of time and place. It also meant allowing several persons to interact. A coordinative function has the role of monitoring the process and the workflow. Its purpose is to give the different actors information concerning different aspects of the process, working together in a goal-oriented collaborative work.

From an organisational viewpoint knowledge is known or legitimised through a social process where knowing and thinking are relations among people in activity. According to Brown & Duguid (1991) the social relations among people within a community change through their direct involvement in activities. In such a process understanding and knowledgeable skills develop. Here, knowledge work relates to community characteristics as it often requires that people make sense out of the collaborative workspace and have the ability to share common values of what counts as knowledge in their specific work practice (Cook & Brown,1999).

Gaver (1991) recognises different levels of collaboration and claims that when it comes to collaboration in organisations there are four levels of collaboration (see figure 1).

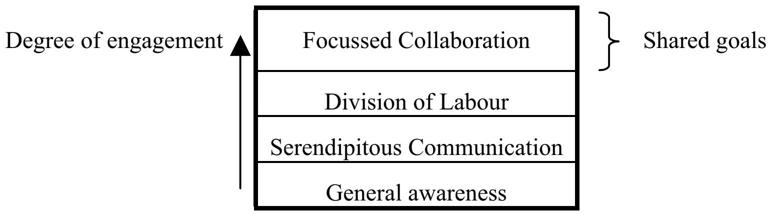

Figure 1. Different levels of collaboration, according to Gaver (1991).

General awareness is a state where the colleagues are aware of who is around and knows a little about what they are doing. The next step is *serendipitous communication* where colleagues meet informally simply because they know that they all benefit from exchanging experiences. You give a little and you gain a little. When on the two top levels the groups are all *sharing the same goal*, but *division of labour* is characterised by the fact that the shared goal is the reason they are working together and the work is divided within the group. *Focussed collaboration* is a more intense form of collaboration where people work closely together with activities like brainstorming. People can move among all four levels of collaboration depending on the phase of the project and how it affects the participants' role and engagement at a given time. (Gaver, 1991)

While knowledge is often thought to be the property of individuals, organisational knowledge is inevitably of a strong, social nature. Such knowledge is generated when people work together in tightly connected groups known as communities of practices. Viewing collaboration as a means for moving up to the organisational level of treating knowledge means at the same time that we call for a participatory way of coming to know the community.

> ”Viewpoints from which to understand the practice evolve through changing participation in the division of labour, changing relations to ongoing community practices, and changing social relations in the community.” (Lave & Wenger, 1991, s 96)

We have moved up from the relatively loosely coupled and impersonal collaborative workspace (see Figure 1) to the more inter-personal level of community building where loyalty and trust help to motivate people to act properly and engage more in the collaborative work practice. Within communities one can recognise knowledge, which is deeply embedded in its work practice and requires that it is put into practice and therefore contextualised in its own community. From another viewpoint Brown & Duguid (2001) argue that knowledge is in the first place, relatively decontextualised from its social relations, as much work itself is divided into divisions (in terms of Gaver this is labelled *division of labour*). This also means that such divided knowledge is not only separated by its explicit content but also the implicit shared practices and knowledge that help produce it.

Organisational Cultures

Shared meanings, assumptions, norms and values that govern work-related behaviour have been of particular concern when discussing knowledge work. Wenger (1998) adds the notion that the field of knowledge management has not considered the concept of knowledge as a dynamic process of making sense of what counts as knowledge in work practice. She proposes that shared participation is the stage upon which the conflicts are being resolved in a continued discussion and negotiation between the different stakeholders that might come from different cultures. Kunda (1992) argues that organisational cultures are generally viewed as the shared rules governing cognitive and affective actions in an organisation, and as the means by which these actions are shaped and expressed. Shein (1996) complements this view by arguing that organisational culture is based on deeply held and often unconscious beliefs shared by employees. Furthermore, he enriches this concept by defining different levels of cultures. According to Schein there are three different major occupational cultures in organisations that do not really understand each other very well. The three major occupational cultures can be defined as the operator culture, the engineer culture and the executive culture (Schein, 1996). The operator culture is based on human interaction consisting of a high degree of communication and teamwork. The engineering culture represents a group in an organisation that have the knowledge of basic technology underlying the work and how the technology is to be utilised in the organisation. In the design of products and systems they prefer a technical and automated solution rather than relying on the human operating the system., They design socio-technical systems primarily as technical ones, without considering the human interaction. Engineers often feel that scarcity of time as much as possible need to be invested in technology and engineering. The communication and collaboration can then be seen as only inefficient and time-consuming activities. The executive culture has, as the engineering culture, a predilection to see people as impersonal resources that generate problems rather than solutions.

TECHNICAL WORK PRACTICE: ONE CASE

The organisation in this study develops, produces and maintains jet engines for military as well as civil use. In order to assure the highest quality in new engine concepts, which must withstand increasing pressure and temperature, they have developed high-tech competence in thermal spraying. The technology is based on years of experience within the domain of jet engines. Today it is a widely used technique to provide coatings with appropriate functional properties in jet engines.

The techniques in thermal spraying

In thermal spraying a material, usually a powder is partially melted in a flame and thrown onto a substrate where a coating is built up by the condensing particles. The application and the desired properties of the coating determine possible spraying methods and materials. Metals, alloys, cremates, carbides, plastics and composites can be applied by thermal spraying. The build up of a coating is made when the powder is put into the source of heat. Then the particles are accelerated and heated simultaneously and thrown onto the surface where these "splashes" land on each other and form a coating.

The process itself is very complex because of the amount of parameters that influence the coating quality. The strength and adhesion of the droplets depend on many different factors such as the temperature in the flame, the velocity of the particles, the duration particles have been in the flame, the conditions of the surface and other known and unknown factors. In thermal spraying about 50 microscopic parameters need to be adjusted. The set point determination of the process parameters is often a matter of trial and error and is time consuming. Moreover, the coating process, which is determined by the cooling conditions of the droplets on the surface and of the successive deposited layers, varies as the coating grows due to changes in the local thermal field. In state of the art thermal spraying, the set point parameters are determined for the entire spraying duration and do not take into account the changing conditions at the coating's surface during spraying. All these facts lead to coatings with limited performance due to the lack of control of defects such as cracks, porosity, or lack of reproducibility etc. and thereby limiting thermal spraying market share and increasing manufacturing costs.

How work is organised

The department of thermal spraying performs jobs with different components for various customers. There are both external and internal customers requiring different coating properties and spraying techniques depending on the environmental strains on the products. Through the shop floor flows 150 parts of which 40 are highly frequent. With present human and technical capability the parts pass through the shop floor in a time of two days. There are three automated machine cabinets and one manual spraying cabinet.

One key group involved in the work of producing high quality products of thermal spraying is the operator group. Operators are able to supervise and control the spraying process. They need to identify problems that may occur and make decisions about future actions. One operator will put a large job on the production line and, later on, take a break or even leave it to another operator to complete the job. During this shift it is essential to communicate problems and incidents for effective and smooth operation of the spraying process.

Another key group is the production engineers. They serve as a communication channel to customers and suppliers. They do calculations on offers for internal as well as external customers. After receiving orders they create informative, operational instructions such as drawings and specifications. Each time a component is to be sprayed, the production engineers conduct a quality analysis of the process. This means a thorough test of the settings for powder rate, gas flow, gun distance, temperature etc. Close contact with the operators on the floor, material engineers and laboratory personnel is of major importance when giving advice and answering questions.

The laboratory personnel perform tests to evaluate the coating properties such as mechanical properties, erosion, hardness, microstructure, porosity etc. A sample cut will be sent to the laboratory where they carry out tests before the real component will be in process. Test data will be generated and statistical models are used to analyse the correlation between setting parameters and test results in coating properties. A conclusion will be reached to take the right action, if needed. With this procedure they will assure that the chosen spraying parameters are right for the required coating properties. If the evaluation test shows that the coating was not good enough, or within the requirements of the customers, the laboratory personnel contact the production engineers, the operators or the material engineers to discuss the problem and to find out a solution. This will minimise manufacturing errors and assure process and product quality and a new, redesigned process will start.

Material engineers have a crucial role in the process. Being experts on materials, they give advice and answer questions about various materials and their properties. Often they can diagnose a problem when discovering a symptom in the coating. They are highly consulted when evaluating the sample test in the laboratory.

The executive staff allocates the jobs to shop floor workers. Their main task is to register the job being processed.

How problems are approached

The process seems to operate efficiently and the main objective is to spray coatings with the highest quality. However, the spraying process causes unexplainable variations without patterns and tendencies. Many complex parameters have to be considered and there are uncertainty and complexity that is hard to handle. Problems have to be solved in order to avoid effects that would require costly and complex redesign. The main purpose of the problem solving is to reduce the number of manufacturing defects through continuous testing and evaluation. The process generates numerous production data collected for further documentation and analysis. A lot of studies have been carried out in order to achieve reproducibility. Analytical as well as statistical modelling techniques have been used. However, the development of sprayed coatings is, to a large extent, a trial-and-error process in which domain experts often use "rules of thumb" and knowledge that cannot always be quantified and handled by traditional modelling tools. Another goal is to reach better understanding of the process and accordingly take the right actions for good reproducibility.

When facing a problem an ad hoc behaviour is recognised. In this process many people are involved and different tasks has to be done. A variety of information is required, human expertise must be available, and there is a need for models and evaluation techniques. All these requirements derive from various functions with people of different viewpoints and cultures. Management considers the process to be "out of control". Operators are able to observe problems, which engineers and executives do not observe. The operators develop a work practice, worth considering in problem solving. The owners of the problem should also be involved in the solutions. Engineers have their own proposals and solutions to the problems, and they were highly disappointed when these proposals and solutions did not work in practice. Some of them may have made statistical analysis of defects and errors logged; others come with their spontaneous reactions and personal knowledge and experience from the shop floor. Consequently, there exist different approaches derived from the traditions of the various organisational cultures.

ANALYSIS

The analysis of our case can be characterised as a very technical problem domain, which takes place in a complex manufacturing process. It is a complex system of humans, machines, routines and materials co-ordinated to achieve a common goal. A number of people are involved in activities related to the goal and they perform individual work as well as collaborative work. A collaborative process is a reciprocal one involving a dual flow of information so the attention has to focus on a complex set of modes of interaction (Schmidt & Simone, 1996). Mistakes or problems in one part of the complex work process can have disastrous, unanticipated consequences.

One crucial knowledge activity concerns problem solving, which usually requires different areas of competence. In technical work, problems are generally considered from a technical point of view. Fairly often it is difficult to solve the problem from this viewpoint only. The sole test of thermal spraying is whether it produces solutions to problems. In general, when a technical community encounters problems, it will interpret them as technical in its sense. That is to say that the description and understanding of the problem situation is limited to their existing domain. More often, this domain is described as a model of parameters, which relations are extremely complex and are consequently the only focal parameters subjected for experiments. Much of the work of thermal spraying lies precisely in the astute choice of models for each purpose. Enormous amount of effort is put into development of models of computation. A model is an interpretation of the phenomenon it represents. Several technical proposals are designed to capture, what they believe, is the most essential data to apply advanced mathematical or statistical techniques on. Beneath the everyday practice of such modelling, reasoning, and negotiations a vast array of tacit commitments lies unexamined. The complex process of model building needs to be understood as a process. Between the model and the putative reality is a technical community engaged in a certain amount of activities ranging from interacting with the process as well with the other members of the community (see the different collaboration levels, according to Gaver, 1991, figure 1). Technical communities negotiate ceaselessly with the practical reality of their work, but when their conceptions of that reality are mistaken, these negotiations do not necessarily suffice to set them straight. The point of departure for technical practice takes sustained and sophisticated thought.

The prevailing approaches when facing a problem have had a lack of collaboration between the actors. The discrepancies between the model and the practice are obvious. One reason could be the different cultures known in the organisation (Kunda, 1996). An interesting result was that the cultural differences were not taken for granted. People within their own culture have a more effective way of collaborating than people from different cultures collaborate. Therefore, technical people need to continually discuss non-routine problems and integrate several bits of information and expertise. Doing so requires ongoing collaboration and coordination that may not be necessary in other work conditions (e. g. administrative). Viewing knowledge processes like this implies that we must consider the actors taking part in a social configuration. For instance, more often a knowledge worker needs advice, sometimes on the basis of obtaining advice from someone else. Therefore, they relate both to other individuals or groups, and more importantly, to existing information. Coming to know the practice must lead the thermal spraying people to know the human operators that usually monitor the process. They will have an immediate knowledge of the quality of the coating they are producing. They are trained for several months for operating the spraying process. To become a skilful manual spray operator it might even take longer time, especially if the manual spraying is of irregular character. This learning period is of great importance and it is a period in which operators are becoming members of the community. They need to deeply understand the previous process of treating the components correctly and to configure and adjust the necessary parameters for the robot and the material being sprayed.

To summarise the analysis, thermal spraying is an organisation that dynamically deals with a changing environment and ought not only collaborate efficiently but also create new information and knowledge about the problem domain. An organisational unit with a core competence, such as thermal spraying, needs knowledge processes that link and leverage the diverse resources and cultures that exist in the department. The members of the organisations need the ability to recognise and develop new ways and tools to act knowledgeably and accomplish their work. In this sense, people might themselves be aware of the matter of knowledge and knowledge work, and thus be able to develop forms and mechanisms for working with it both implicitly and explicitly, as a knowledge community.

TOWARDS KNOWLEDGE COMMUNITIES IN TECHNICAL WORK DOMAINS

By viewing technical practice from a community level it appears a need to reconstruct existing structure and move beyond the traditional levels of collaboration (that *per se* is important to identify, but not sufficient in this case). However, in order to go beyond this level and to make much more cultural sense out of this, there is a need for a genuine attempt of facing these challenges. Challenges of climbing higher up on the collaboration ladder, where the degree of engagement reaches the meaning of shared values and an understanding of their cultural contributions, arise. What would such an approach look like? Based on the findings presented above, several implications and conditions for supporting knowledge communities can be derived. There may exist several approaches to increasing interdependencies and facilitating and strengthen the relations between different members in technical domains. In this discussion I will outline some of the challenges that I argue are necessary to address when climbing higher up on the collaboration ladder in order to form and support knowledge communities (see figure 2). The challenges that might lead us towards knowledge communities in technical domains are:

- Increasing the level of engagement in collaboration
- Crossing cultures and communities of practice
- Making use of different information resources

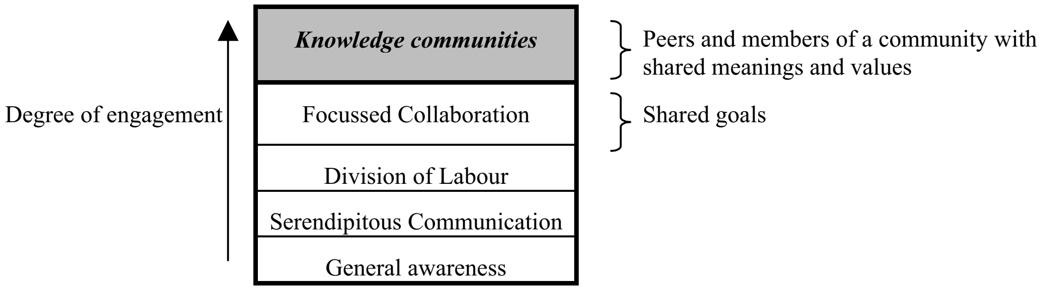

Figure 2. The level of knowledge communities is added to the collaboration levels.

Increasing the level of engagement in collaboration

Overall, the organisational perspective depicts thermal spraying as an organic community with a history, a mission, and partly shared goals (according to Gaver, 1991). Firstly, it was evident that managing the production process is of main interest and the work was organised in an orderly division of labour. Secondly, there was one level of focussed collaboration where individuals do not see a sharp distinction between themselves and the others. Furthermore, the case findings reveal that there are other activities that are not so focussed. For instance, meetings are planned, face-to-face gatherings of members from work groups. Members from different work groups may be present but the explicit goal is work-related, in order to solve the problem in a collaborative effort. Other kinds of meetings occur at all levels of the organisation. Management initiates staff meetings while engineers call for project meetings which are aimed at problem solving, information sharing and joint decision-making activities.

In this technical problem area I have noticed that complex problems require cross-dimensional human interaction. The problems go beyond strict engineering issues, into issues of workgroup collaboration and knowledge communities. Indeed, thermal spraying seems to have achieved over its history a rather strong sense of commitment and involvement with its people. Especially some people are really considered to be important to the company, the so-called experts. People in the process are good at solving problems and also efficient in performing their work. Internal experts bring to the organisation a perspective of practical as well as scientific credibility.

However, problems still emerge. The process of thermal spraying is so complex that the articulation of co-operative work is of an order of complexity. That is to say that thermal spraying stands on a level of collaboration that is far from sufficient. The everyday social and communicational skills need to be structured and understood.

Crossing cultures and communities of practice

As observed, the people in thermal spraying did not work as a community and they did not share a common view. The problem was purely a technical one. This implied that the solution should be found in the technical domain. Attempts to realise that thermal spraying is a socio-technical process proved quite difficult. The attention of the organisation was closely focused on the technical parameters, and a closer inspection of the espoused theories on factors affecting the quality of the manufacturing process demonstrated a rich socially constructed picture of both conflicting and non-technical explanations.

As illustrated by both Schein (1996) and Brown & Duguid (2001) it is important to note that each of the three cultures is valid from its point of view, in the sense of doing what it is supposed to do. It is not a question about determining who is right or who is wrong, but to be aware of different kinds of human perceptions and interpretations. In the operator culture members act under assumptions that the world is to some degree unpredictable and they must be prepared to use their own innovative skills to deal with the work process. They are highly interdependent with the complex activities in the production process. The operator's assumptions are not appropriately supported with the two other cultures. Therefore they in some way subvert their own skill and learning ability and the organisation does not make full use of the operators' competencies and skills. The executive culture is built of necessity to maintain and manage the financial issues of the survival and the growth of the organisation. It is of their interest to seek efficient ways to reach high quality at low costs and to service the customers.

A hypothetical collaborative negotiation process would have had to take into consideration the different perspectives of people involved in various aspects of thermal spraying, such as robot operators, robot programmers, engineering designers, process planners, quality assurance experts, project managers, etc. Deciding which culture has the right point of view does not create a solution, but will create enough mutual understanding between them in order to evolve solutions that will be commonly implemented and understood.

Making use of different information resources

In the case of thermal spraying there existed several sources of knowledge ranging from key process data to both individual and social knowledge embedded in practice. The total quality of information and knowledge may be increased if such hidden knowledge resources could be visible and available for others. It would be effective if all these kinds of knowledge resources are taken into account in the mobilisation of the problem-solving activity. It is particularly important when enabling people to make use of their accumulated knowledge and experience.

At the same time professional skills and competence are hard to articulate they are also costly and irreplaceable. If not having arrangements for managing implicit knowledge we think that valuable knowledge and experiences will be lost. This is also what Carstensen & Snis (1999) found: that knowledge in terms of both information archives (as a space to collect valuable information) and of communication channels (as a space upon which interaction and communication could be further facilitated). In their study the many resources were used in different ways and the integration and combination of various forms of knowledge were needed. Both figures, data, text documents, slides, multimedia productions, drawings and video were forms that even for thermal spraying should be necessary.

Consequently, for thermal spraying, as a technical domain, there is a particular need for establishing communication channels and forums, where individuals can collaborate in the problem-solving process. No single member of the group has all the answers. The information and knowledge can be articulated between interdependent actors in an efficient knowledge community. Different members of the community, regardless of culture, can with their particular expertise enhance the complex problem-solving situation.

CONCLUSION AND IMPLICATIONS FOR ICT SUPPORT

In this work I have tried to argue for how to climb even higher up on Gavers's collaboration ladder (Gaver, 1991) in order to reach the level of shared meanings and cultural goals characterised by knowledge communities. This effort was aimed to foster a complemented view upon how knowledge management can be approached, with or without the cultivation of ICT, but with a detailed understanding of technical and knowledge work practice. I have tried to illustrate what conditions that might be of importance when doing IS research for people in technical domains, where knowledge work and community building together play a vital role. When moving towards these issues, I have summarised three challenges that might be useful for different cultures and their opportunities to collaborate.

After considering these challenges it might be relevant to initiate implications for ICT support for knowledge communitites in technical work domains. Excellent tools and systems referred to as KMS have entered the field and have been successful on the raw technical level of functionality but failed because of not dealing with real issues that constitute knowledge work and therefore not being designed appropriately for the context for which they are aimed. There has been a lack of alignment between the need and goal of the organisational context and the aim and consequences of the technological support. There is a fundamental risk that in the KM field, ICT has been the main tool for organising knowledge into codified, and objectified entities, managed in systems as repositories of ”all-knowing” directories. (see e.g Sorensen & Snis, 2000). Knowledge management systems are different from traditional information systems in how they support different kinds of users. More differently from traditional information systems are their ability to support a wide range of users and collect all the organisational knowledge in one single system. However, this over all system thinking is, due to its complexity, not an easy effort (Snis, 2000, Gunnarsson et al. 2000). What becomes crucial in these systems is the motivation the people find in using them. As Brown and Duguid (2001) noted in their studies, knowledge will not necessarily circulate freely firm wide just because the technology to support such circulation is available.

Consequently, there is a need for ICT support in thermal spraying. There is a need for bringing people together (as proposed by Swan et al, 2000; Carstensen & Snis, 1999) from diverse cultures, who share an interest in collaborative complex technical problem-solving. This will be a way to present different activities carried out in the problem-solving process to make the other members aware of what is going on. It will provide a reminder as to how the activities have been performed, too. We also consider that information technology not only affects how individual activities are performed, it also greatly enhances an organisation’s ability to exploit linkages between various activities and cultures. New linkages can be found, which will produce favourable information enlarging individual as well as organisational knowledge. Technologies and systems that aim to give the workers opportunity to understand a variety of problems and solutions, to communicate experiences, to widen their viewpoint on their own business, to co-ordinate and cooperate over and between boundaries, makes this argument highly relevant. Therefore, ICT can be extended to also be a tool to improve and enhance technical practice by services for knowledge creation and sharing.

Finally, a collaborative problem solving requires more than new communication forums and sophisticated ICT. Cultural norms must also be deeply considered for the common good, as discussed as a condition earlier. The different cultures identified in the department of thermal spraying have to develop a shared view on how work should be arranged. By cultivating the soft human skills the hard engineering tasks will be supported. By this common view individuals in these different cultures would have a far stronger incentive to collaborate and make good use of ICT support in a knowledge community.

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