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Conditions for an efficient innovation process:

The Complementarity between new HRM practices and Suggestion Schemes

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Abstract

The specific and tacit knowledge of shopfloor employees are vital sources for innovative work behaviour. Firms can use these skills to increase the efficiency of process innovation in the stages of idea generation and implementation of new processes. This study examines the necessary conditions for harnessing employees' innovative capabilities. The first condition is the emphasis on the human resource practices that support the formation, utilization and transfer of specific knowledge. As a second condition, organizations must adopt continuous improvement practices which capitalize on the developed specific knowledge. I use the "Changing Employment Relationships" survey to test for the complementary relationship between such a specific set of human resource practices and the existence of a suggestion scheme. The results confirm that organizations which provide the framework for their employees to acquire inventive skills will be more likely to establish a suggestion scheme. Secondly, the more practices are utilized the more attractive the suggestion scheme is for the employees to submit proposals. One reason therefore is due to greater efforts in the design of the suggestion scheme.

Keywords: suggestion schemes, innovative work behaviour, user innovation, organizational learning, tacit knowledge, kaizen, continuous improvement

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1 Introduction

For many organizations innovation is one of the crucial functions for success. However, research and development (R&D) departments are very costly and do not necessarily provide targeted solutions and inventions. I argue that R&D departments cannot ensure efficiency throughout the entire innovation process. At some stages in the process other agents can contribute to achieve process innovations efficiently. In this paper I will identify, which conditions organizations must fulfil to capitalize on this innovation potential.

Maintenance workforce, shopfloor and other hierarchically lower level employees as users of newly developed processes, are these agents because they gain different experiences than engineers and researchers. Their insights into the new and the former processes help them to develop specific inventive skills that are based on their detailed knowledge about these processes and their experiences with them. Due to the tacitness of this "knowledge of experience", users are the only ones who posses these skills. These abilities are the source of the users' advantage in innovating and improving the new process (see NONAKA 1994; COOKE 2002: 126; AXTELL 2000: 265). In the very beginning and at the end of the development of a new process innovation, the users' contribution may be particularly valuable. Although the economic literature recognizes importance of users as source for inventions concentrates rather on customers than on employees (see SUNDBO 2002; HIPPEL 2005; HIPPEL 1988; LUNDVALL 1988; KRISTENSSON ET.AL 2004).

Organizations that seriously involve the users in the innovation process must first support users in building such specific skills and second in sharing their insights and ideas. Both strategies are complementary and absolutely necessary for improving the efficiency of the innovation process (see MICHIE/SHEEHAN 1999; SHIPTON ET.AL 2005; LAURSEN/FOSS 2003). Therefore, organizations that establish a specific set of practices to develop users' inventive capabilities, will adopt suggestion schemes with a higher probability.

In order to identify this set of practices one can analyse organizations that stress the importance of tacit knowledge. LAM (1997) identified such an "organizational model" in Japanese firms. This model reveals necessary practices that support the formation, utilisation and transfer of tacit knowledge in an innovative context. British firms, or at least parts of them, could learn from these practices. Structures and practices in the "organizational model" support acquisition of knowledge and skills more by experience rather than by theoretical and formal training (see LAM 1997: 976ff.).

The practices of the "organizational model" are only the first condition for improvement of the innovation process. Second, the organization must provide the opportunity and incentives for users to share their abilities and convert their knowledge into usable inventions.

Such a method to capitalize on tacit knowledge can be a suggestion scheme, which is "an administrative procedure for collection, judging and compensating ideas, which are conceived by employees of the organization" (EKVALL 1971). Without a suggestion scheme, organizations will not be able to access the developed skills of the employees, and consequently they would waste invested resources. Hence, suggestion schemes are one important way to capitalize on the investment in employees' inventive skills.

In an empirical analysis I will investigate the link between an organization's efforts in developing the innovation potential of its employees' and the existence as well as the structure-quality of a suggestion scheme. For that purpose I will use the "Changing Employment Relationships" survey. The analysis is based on a dataset of 2,132 employee interviews from different organizations in Great Britain. It contains information on participation rates and the existence of a formal suggestion scheme, as well as data on human resource practices in the organization. The results confirm a significant higher probability for the existence of a suggestion scheme in case where practices and structures of the "organizational model" are used to build up the users` inventive abilities.

The first task of this paper, in chapter two, will be to explain, why and when exactly users have an innovation potential. In chapter three the "organizational model", as set of practices for building employees' inventive skills, will be analyzed. The implementation of suggestion schemes and other complementary practices will be examined in chapter four. In the last section, I will explain the results and draw conclusions for British firms.

2 Users' innovation potential

This chapter analyses under which circumstances the employees as users can contribute to improve the efficiency of an innovation process. A closer look to the different learning categories and knowledge types of users and developers is necessary to detect why users can provide better solutions than R&D professionals. The insights about knowledge differences between users and developers will be used in the next section to identify practices that can further increase the users' innovation potential.

2.1 Knowledge asymmetries between user and developer

The potential for improving the efficiency of an innovation process is based on knowledge asymmetries between users and developers. Due to different learning categories users acquire other knowledge types. Besides from their formal training users gather new information from learning-by-doing and learning-by-using (see ROSENBERG 1982). These learning categories applied to manufacturing activities offer employees opportunities to gain extensive experiences with the production process and acquire use-context and process-specific information (see ROSENBERG 1982: 112; HIPPEL 2005: 70). This information is particularly important in determining the optimal characteristics of new, highly complex technologies (see BOERNER ET.AL 2001: 102). In contrast developers build their knowledge by scientific learning and learning-by-searching. These categories of learning increase the developers' analytical thinking and problem-solving capabilities in searching out the optimal design of a new process (see ROSENBERG 1982).

If the only differences in the knowledge of users and developers were characterized by various types then asymmetries could be reduced easily. In face of the high absorptive capacity of developers they could easily acquire the additional users' knowledge. Knowledge asymmetries can only persist if the knowledge of users is hard to transfer. Polany (1966) used the term tacit knowledge to describe knowledge that is nearly impossible to transfer. Tacit knowledge as opposite to explicit or codified one can be characterized as personal, difficult to articulate fully, experience based, contextualized and task specific. Jensen and Meckling (1998) distinguish specific from general knowledge. Specific knowledge is not impossible to transfer but very costly. The difficulty aggregating some knowledge or transferring specialized knowledge raises transmission costs, even if information is not tacit (see JENSEN/MECKLING 1998: 106f). If knowledge asymmetries exist then the question arises at what stages of the innovation process what kind of knowledge is relevant.

In order to identify when users have an advantage in inventing, one must first analyze the different stages of an innovation process. A review of the literature reveals many attempts to describe innovation processes from 1910 till today (see MEIßNER 1989: 61; ALWIS ET AL. 2003: 11). Although no dominant model can be identified, many models share common phases.

2.2 Stages of an innovation process

The *first innovation phase* is initiated by recognizing a problem, having an idea, introducing new technologies or researching results from outside (see: SUNDBO 2001: 136; UTTERBACK 1971: 78; LEONARD/SENSIPER 1998: 117). For the *second step,* problems must be solved, ideas developed and research done. This problem-solving or development stage is often seen as an iterative process containing a loop, which beginns with building prototypes, testing and adapting them and so on. (see CORSO 2002). In the *final stage*, the invention is fully developed to an innovation and must be implemented into practice. New products are produced or new processes get implemented. Back-loops including improvements and adaptations are again necessary elements in the innovation process. Some models add the diffusion of the innovation as another phase of the process. The diffusion can then trigger the beginning of new innovation processes by generating new inventions and problems (see ALWIS ET AL. 2003: 12). The common element of all newer models is that they reject linearity and emphasize the dynamics and complexity of innovation models.

Leonard and Sensiper (1998) describe the dynamics of innovation process as a cycle of each other alternating phases of divergent and convergent thinking. Divergent thinking means exploring and searching for new options, while convergent thinking is their selection or synthesis (see figure 1). Innovation processes begin with the *first stage of idea generation* by divergent thinking. This is needed to create as many potentially creative alternatives as possible. The more options are offered the more likely it is that the breakthrough perspective will be available for selection. At this stage both knowledge types are needed: the process-specific information of users and knowledge about the relationship between design and performance. The participation of both users and developers would be necessary to achieve efficiency in this phase.

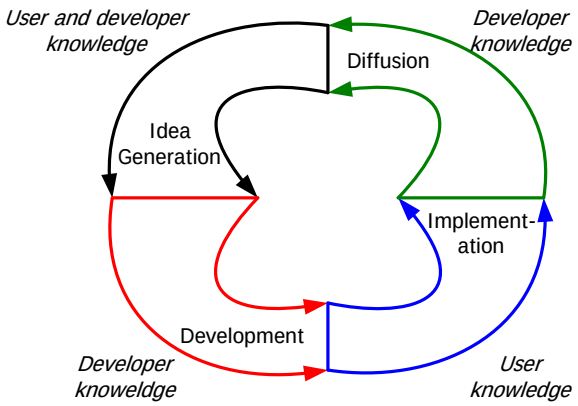
After this divergent thinking phase a convergence of ideas follows. At this convergent thinking stage, the organization focuses efforts on the *development* of one idea or the synthesis of few. In this case the high problem-solving abilities of the developers in different fields of competence are required to succeed in the development stage.

Once the prototype reaches a certain maturity level the *implementation phase* starts. The first attempt for implementation is accompanied by adjustments, further testing and continuous improvement. These adjustments require once again divergent thinking to consider all possible ways of improvement and test different scenarios in practice. Without the use-context and process-specific information from the users the developer will not be able to adopt the

process for all necessary conditions. Employees collect such information while working with the newly implemented, former, or similar processes. This knowledge is acquired through the daily work and the set of tasks carried out within an organizational function. Their formal training and organizational experience complement their process-specific knowledge to that what I call "function-specific knowledge".

During the *diffusion process* best practices are established, which combine many small steps improving the innovation. These incremental improvements require detailed knowledge about the design-performance relationship of the process. Therefore, the expertise of professionals plays a more important role. Furthermore, the diffusion can contribute to the creation of new ideas and new inventions and initiates new innovation cycles. (see LEONARD/SENSIPER 1998: 116; SUNDBO 2001: 154).

Figure 1 : Stages of the innovation process



Source: Adapted from Leonard/Sensiper 1998: 117

2.3 Evaluation of the users' innovation potential

From the literature review above it seems to be a reasonable assumption that returns from proposals of a user (I_U) are higher than those of a R&D professional ($I_{R\&D}$) in the implementation phase. To evaluate the efficiency of users' inventive ability one has to consider the costs as well. If we count labour costs as the only expenses, it is plausible to conclude that professionals ($C_{R\&D}$) have higher costs than average employees (C_U) due to their higher education. The gross hourly earnings for associate professional and technical occupations are 20% higher than the average and 57% than for process, plant and machine operatives (see NATIONAL STATISTICS 2005: 43). The conclusion from these two statements is the following equation:

$$\frac{I_U}{C_U} \geq \frac{I_{R\&D}}{C_{R\&D}} \qquad \textit{Equation 1}$$

The user group has an additional advantage from their group size. Consider the following equation with N_U as the number of employees that are using similar or the new developed process innovation. These employees have the potential for quantitative and qualitative higher inventions than their R&D colleagues ($N_{R\&D}$). From N_U users only a fraction of them (p_U) will participate in the improvement process.

$$p_U * N_U * \frac{I_U}{C_U} \geq p_{R\&D} * N_{R\&D} * \frac{I_{R\&D}}{C_{R\&D}} \qquad \textit{Equation 2}$$

In most organizations the user group will be significantly larger than the group of professionals. In contrast we will expect participation rates of professionals ($p_{R\&D}$) near 100%, since they are paid for submitting inventions, finding problems and solving them. The user participation rate to invention becomes crucial for the efficiency of the innovation process. Given the relation from equation 1, the higher the difference between $p_U*N_U - p_{R\&D}*N_{R\&D}$ the more superior the innovation potential for the user group will be.

In the next two chapters, organizational structures and practices are analyzed, which first support the development of the employees' inventive ability (I_U) and which secondly ensure a high number of participants (p_U*N_U) from the user group.

3 Building up inventive abilities

This section uses particular aspects from Lam's (1997) "organizational model" to explain how organizations facilitate the formation of the knowledge structure described above.

Before analysing the necessary structures at the organizational level, we need to consider the institutional framework at the macro level. LAM (2000) investigates the link between knowledge types, organizational forms and societal institutions. Considering the training, education system and labour markets, Anglo-Saxon countries follow a model called "professionalism". A bias towards academic education characterizes this "professionalism" model. A complementary system of training, education and labour markets at the macro level creates the domination of general, transferable knowledge over practical and firm-specific knowledge at the micro level (see HALL/SOSKICE 2001; LAM 2000: 501; MAURICE ET.AL 1980: 78). Abstract and theoretical knowledge is acquired by academic education that is organized around intellectual boundaries and concepts. Training programmes are structured around scientific objectives constructed outside the work context. Even if skill development occurs

inside the firm, it will rely on inter-firm occupational standards. This academic bias and skill development outside the firm is reinforced by occupational labour markets (OLM). Occupational labour markets offer a high scope for job mobility and inter-firm careers but require in exchange general and transferable skills. Therefore, such "professionalism" provides disincentives for the development of problem-based techniques and practical, function-specific knowledge (see LAM 2000: 501).

Due to the emphasis of theoretical skills, British organizations face a lack of function-specific knowledge among R&D professionals. This lack can cause inefficiencies in their innovation process. Therefore, British organizations would need even more the contribution of employees. Thus the innovation potential of users could be even larger than in countries like Japan and Germany, in which professionals already make extensive use of practical and function-specific knowledge.

I intentionally use the expression "it could be", because there is one major obstacle. The emphasis of theoretical and formal knowledge in labour markets leads to a link between higher status and academic education. Vocational training and practical skills become neglected. MAURICE et.al (1980) compares similar British, German and French organizations and finds out that even 42% of the supervisory staff in the chemical industry in Britain had no formal qualification (see MAURICE et.al 1980: 79). This "academic bias" results in a polarization of the use of human capital. A well-developed higher education system creates elites, while the majority of the workforce is relatively poorly educated (see LAM 2000: 501). The "professionalism" model erodes the basis for the innovation potential of the users and therefore impedes an efficient innovation process.

Until now, this section shows that Anglo-Saxon organizations need employees' innovation potential more than firms from other countries. Unfortunately the education and training system as well as the labour market do not support the development of the employees' inventive abilities.

British organizations that seriously strive for an efficient innovation process must compensate the effects from the national education and training system. They need to implement practices that support the formation, utilisation and transfer of practical and function-specific knowledge and its tacit component. Prototypes of such organizations can be found in Japan. Their "organizational model" presents the opposite of the British way. The "organizational model" offers the conditions needed for building up the inventive skills of users. The following analysis of the „organizational model" emphasizes the organizational practices and structures without explaining the Japanese societal institutions.

An internal labour market (ILM) builds an ideal framework for an organization to allow employees to acquire, utilize and share function-specific knowledge. This knowledge is one part of the knowledge structure needed for an innovation potential. In contrast to the occupational labour market, ILM provides incentives to acquire such knowledge. Internal career opportunities are related to seniority and extraordinary function-specific skills. Thus, employees are protected from competition from outside and inside. Without threat of replacement from inside mentors will transfer their firm-specific knowledge to younger employees.

In ILMs skills are mainly formed through on-the-job training (OJT) on a long-term basis. Due to internal training programs the acquired knowledge fulfils the specific requirements of the organization's functions. The context bound aspect of the training supplies the users with context-use and process-specific knowledge. This type of information is the first condition for the knowledge asymmetry between the employees and developers. The second condition is the difficulty to transfer such knowledge. Learning-by-doing or using involves the improvement of skills through observation, imitation and practice. Even if senior employees are not able explain all causal relationships younger employees can acquire such tacit or specific knowledge through shared experiences. Senior employees with much experiences play an important role in the transfer of tacit knowledge (see LAM 1997: 976ff.; NONAKA 1994: 19).

OJT as narrow specialization on the technical aspect of just one specific domain bears the risk of destroying innovation potential. A variety in individual's experiences provides a broad range of metaphors and analogies for the creation of heuristics and ideas for improvements. The mere variety of experiences is not enough. Nonaka (1994) emphasizes the necessity of "high quality experiences". This means that the various experiences need to be related to each other. "If the individual finds various experiences to be completely unrelated, there will be little chance that they can be integrated to create a new perspective" (Nonaka 1994: 21).

Another problem related to narrow specialization and to limited routine operations lies in the decrease of N_U and p_U in equation 2. As N_U is defined as the number of employees with an innovation potential, specialization to certain tasks will lead to a reduction of the user group size. In addition, monotonous and repetitive tasks will tend to lower commitment and participation rates (see NONAKA 1994: 21f.).

Organizing skills and training to narrow and specialized jobs corresponds to a task-centred approach to work design. Due to a one-to-one link between work posts and workers, each

employee is responsible for only his job with a limited range of tasks. (see MARSDEN 1999: 37f.).

In order to allow employees to make "high quality experiences", flexible and fluid utilization of skills and knowledge is required. The function-centred approach, as the opposite concept to task-centred, offers an ideal work design to achieve an increase of the cognitive component of tacit knowledge. Once work is organized according to the function-centred approach groups of employees have the responsibility for fulfilling certain functions within the organization. Within the function there are flexible and inter-changeable roles. Worker's roles are not inter-changeable by accident but by careful planning of job rotation and training. Thus, planned job rotations can ensure that individuals undertake a wide range of related task (see LAM 1997: 977; MARSDEN 1999: 38; KOIKE 1994: 49).

Organizing jobs around functions inflates and overlaps job boundaries. This offers individuals a possibility to develop a broad range of skills and knowledge outside their specialized task. In addition, overlapping job boundaries facilitate transmission of knowledge between the employees. Particularly, tacit knowledge requires the shared experience of same tasks (see LAM 1997: 977).

A further facilitation of utilization and transfer of knowledge makes intensive and extensive interaction necessary. Within an organization, team work provides a "field of interaction" facilitating group learning and collective sharing of knowledge. For the ideal composition of teams, the organization needs to consider a combination of variety and it has to ensure that of the members' skills overlap. Overlapping work roles and common experiences reduce social distance between team members and enable them to develop a "common code". Once a common language is established, knowledge can be transferred rapidly. But complete overlapping of skills and knowledge makes no sense, since there would be nothing new to learn. The principle of "requisite variety" permits the use of the "common code" to absorb new knowledge (see NONAKA 1994: 23; LAM 1997: 978).

These practices and structures support the development of function-specific knowledge and its tacit dimension. The tacit dimension involves major problems of transfer and communication. Inaccessible via written documents or explicit expositions, tacit knowledge is only available by converting employees' tacit knowledge into explicit. In the following chapter the spiral model is used to explain this conversion.

4 Accessing inventive abilities

The costs involved with such a set of practices as described before are immense. In order to amortize these costs, an organization must find ways to access the tacit knowledge of its users. The first section of this chapter will therefore answer the question if there is a possibility to retrieve tacit knowledge. The second section will present appropriate organizational practices to realize this.

4.1 Conversion of tacit into explicit knowledge

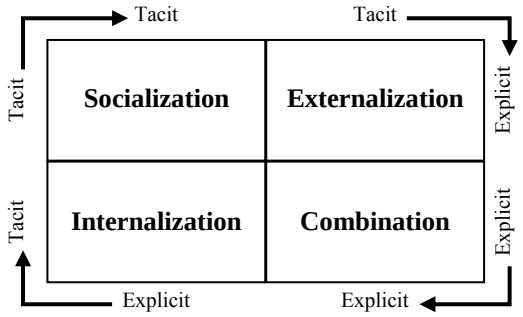
The only model that addresses the creation of new knowledge is the spiral model of NONAKA (1994). Most other models are dominated by information processing and problem-solving activities. The creation of information and problems is neglected (see NONAKA 1994: 14). In his model, the creation of new knowledge can be explained by a dialogue and conversion between tacit and codified knowledge. In case of users the conversion of their codified function-specific knowledge and its tacit dimension plays an important role.

NONAKA (1994) postulates four modes of conversion presented in figure 2. In the first mode, called *"socialization"*, interactions between individuals allow the direct transfer of tacit knowledge between them. Closely related to "socialization" is the "*internalization*" process. Analogue to learning, "internalization" occurs through the conversion of explicit into tacit knowledge (see NONAKA 1994: 19).

From an individual perspective, "socialization" and "internalization" contribute indeed to creation of new knowledge. From an organizational perspective, "socialization" and "internalization" rather describe the transfer of already existent knowledge to other members of the organization. Hence, these two conversion modes describe the function of the practices and the structures of the "organizational model". They are providing the framework for users to increase their stock of function-specific knowledge and its tacit dimension.

The next two modes of conversion actually create new organizational and individual knowledge. One mode is the "*combination*" of existent explicit knowledge to a new one, which is closely related to information processing. The other conversion mode is from tacit to codified knowledge and is called "*externalization*". NONAKA (1994) emphasizes that this important source of new knowledge creation has been neglected in the existing literature (see NONAKA 1994: 19).

Figure 2 : Modes of knowledge conversion



Source: NONAKA ET AL. 2000: 12

The externalization mode is triggered by an inner dialogue at individual level. In this dialogue, metaphors are used to articulate perspectives, and thereby reveal hidden tacit knowledge that is otherwise hard to communicate. Metaphors are a way of translating tacit knowledge using common experiences as language. The first advantage of metaphors is that they allow an efficient information process because one can use them as symbols and prototypes. The second benefit is due to their intuitive nature. They provide more scope for free association. In this step towards conversion or codification, individuals relate concepts that are far apart in their memory. New meanings and creativity can be the result from comparing related concepts and discern the contradiction and inconsistency between them. As codified knowledge is characterized by a consistent and systematic logic, individuals need to solve those contradictions and inconsistencies in a second step. To do this, individuals must recourse to other existing and already codified knowledge. Employees may need first to acquire this considerably specialized knowledge in related disciplines. Analogies then provide an instrument for the next step towards codification. In contrast to metaphors, associations through analogies are more structural and functional and are carried out through rational thinking. Analogies are references to systems that are already understood. They reduce ambiguity by highlighting the commonness of two different things. The focus on the commonness helps to solve the contradictions (see NONAKA 1994: 20f; COWAN ET AL. 2000: 219f.). It has been pointed out that metaphor, analogy, and model are all part of the process of scientific discovery (see LEATHERDALE 1974; TSOUKAS 1991).

The following example will illustrate the steps in the externalization process. Every swimmer knows how to keep him buoyant, but only a few can say why. Polanyi (1967) uses the skills of a swimmer as an example for tacit knowledge. A metaphor for a floating object is a ship. If we have the knowledge about ships and shipbuilding, we know that the surface of the ship provides enough buoyancy in water to prevent ships from sinking. The inconsistency or contradiction of the metaphor is that the individual can under certain circumstances either

swim or sink. This contradiction can be solved by an analogy about rubber boats. Rubber boats can also under certain circumstances either swim or sink. As a rubber boat is only buoyant when it is inflated, one can conclude that swimming is a matter of respiration regulation. Under recourse to explicit anatomic knowledge we can formulate an operation rule like "never empty your lungs fully" (see COWAN ET AL. 2000: 220).

The description of the four conversion modes between tacit and explicit knowledge for the creation of knowledge has revealed two important aspects about the building up and harnessing inventive abilities.

First, the "socialization" and "internalization" process transfer knowledge between members of the organization. This transfer provides the necessary knowledge stock and its tacit dimension for successful improvements. Second, once the inventive abilities are built, "combination" and "externalization" conversion modes need to be triggered in order to capitalize on the inventive abilities.

4.2 "Externalization" practices

In order to capitalize on the employees' inventive skills organizations must develop adequate practices und structures to allow employees to participate in the innovation process. In this chapter I will outline practices that are complementary to the described socialization and internalization processes in the „organizational model". Such practices first harness the function-specific knowledge and its tacit components by triggering a process of knowledge externalization. The second objective is to achieve the highest possible participation rate of the total workforce. The practices presented are brainstorming, suggestion schemes and quality circles.

The management of employees' ideas and suggestions for continuous improvement has its roots in the Japanese Kaizen-Philosophy (see IMAI 1992). The different practices can be classified on a continuum from divergent or diversified to convergent thinking.

Brainstorming can be classified as best mode in supporting divergent thinking. It is a popular technique for capitalizing on primary ideas and intuitions. By deferring thinking, intuition can dominate about logic and analytic evaluation, creating wild and divergent ideas. Different perspectives deliver a broad range of vague and superficial ideas from which the best can be chosen. The only constrain of brainstorming sessions is given by a focus on a certain topic (see LEONARD/SENSIPER 1998: 118f.; HELPER 1997: 9).

The next step on the continuum towards convergent thinking is the suggestion scheme. Suggestion schemes provide more convergent thinking than brainstorming because of their restriction not only to find a problem but also to solve it. After the first insight or idea, a solution must follow. Since suggestions are not constrained to a certain process or product, diversified thinking is still ensured.

A suggestion system is "an administrative procedure for collection, judging and compensating ideas, which are conceived by employees of the organization" (EKVALL 1971). It not only gives the employees the opportunity to share their knowledge and ideas, but it also sets incentives to contribute to process innovation. The proposals submitted are traditionally attended to and reviewed by proposal-handling committees. For implemented suggestions the employee, who submitted the proposal, becomes rewarded. Typically the compensation amounts to a particular percentage of the cost savings caused by the employees' idea. Modern suggestion schemes try to improve efficiency through decentralization. Decentralization of the proposal evaluation allows a dialogue between the suggestor and the coordinator of the ideas.

The advantage of a suggestion scheme lies in the number of potential participants. Without terms of reference, organizations ensure the highest possible number of users (N_U), theoretically the entire firm. If the suggestion schemes provide the maximum number of N_U, then the effectiveness depends mostly on a high participation (p_U). In order to maximize p_U*N_U organizations need to encourage most of the employees to submit improvement proposals (see ROBINSON/STERN, 1997).

As the complexity of problems rises, a further convergence of thinking is required. Team suggestions can provide this next step in the continuum towards convergent thinking. Groups have the knowledge and therefore the ability to develop more detailed and complex proposals. Such groups are for example quality circles. They are semi-autonomous project teams installed by the organization to solve certain problems. In these circles a small number of employees develop solutions concerning a given topic for a limited time period, i.e. to deal with certain problems or for improving a process (see ONGLATCO 1988: 15ff.).

Similar to brainstorming and suggestion schemes, quality circles capitalize on employees' function-specific knowledge and its tacit dimension. In contrast to the other practices the topic to deal with is given by superiors. The focus on a specific topic characterizes a stronger convergence in thinking compared to the other practices.

Apart from the team structure and the given topic, quality circles follow a different strategy than suggestion schemes. Quality circles are limited to a small number of employees (< 10), chosen by their function-specific knowledge (see COTTON ET AL. 1988: 12). This constraint

limits the number of users (N_U) to a minimum but tries to maximize their participation. The employers' selection of the quality circle members ensures the commitment and the knowledge required for the task. Additionally, in Europe quality circles are organized during regular working hours. This makes the participation in quality circles to an employees' task and to a mandatory activity (see LORENZ/LAZARIC 2000: 11). In contrast the participation in suggestion schemes is not part of the paid working time, but an additional voluntary activity. The strength of the suggestion scheme lies more in the huge number of users, and therefore potential suggestors.

Although brainstorming provides the most divergent thinking, it might be too superficial to harness the entire function-specific knowledge of the employees. The mere idea of an employee during a brainstorming session does not reveal enough information to recognize his insight. The brainstorming process can only be seen as initiation of an invention. In contrast, quality circles might be too heavily restrained by the focus to a certain problem. Quality circles utilize the function-specific knowledge of the users to find solutions but neglect the ability of the users to find problems as well. Suggestion schemes combine the strengths of both practices. They allow users to deploy their function-specific knowledge to define new problems. The employees use their own heuristics to frame problems and create adequate solutions. By allowing team suggestions even more complex problems can be solved. Therefore suggestion schemes have the highest potential to improve the efficiency of the innovation process in the implementation phase due to their middle position between convergent and divergent thinking.

Nevertheless, the effectiveness of suggestion schemes depends on the employees' ability and motivation to submit improvement proposals. Organizations can enhance the ability by the intensity of the socialization and internalization process. Such processes are based on internal labour market (ILM), on-the-job training (OJT), function-centred approach to work design and team work. An internal labour market provides the necessary incentives for acquiring and transferring function-specific knowledge from senior to younger employees. The formation and transfer of the tacit component is reached by intensive on-the-job training under the supervision of experienced mentors. A function-centred work design allows the employees to gain broad experiences and to create their own heuristics and perspectives. Accumulated skills and perspectives can then be shared and adapted through further team work.

All these practices are the seed for users' innovation potential. In order to harvest this potential, the suggestion scheme is an appropriate instrument. The metaphor from seeding and harvesting illustrates the strong complementarity between the socialization process and the

suggestion scheme. Rational behaving organizations, which invest a lot in the human capital of the majority of the workforce, will recognize the complementarity. These organizations will invest the same effort in designing the suggestion scheme as well as the socialization and internalization process. Even if the quality of the suggestion scheme cannot be observed directly, at least the probability for the existence of a suggestion scheme should be significantly higher. In the empirical investigation I will analyze the following hypotheses about the relationship between socialization and internalization practices and suggestion schemes:

Hypothesis 1: The more intensive the socialization and internalization process is the higher will be the probability that an organization establishes a suggestion scheme.

Hypothesis 2: The more intensive the socialization and internalization process is the higher will be the quality of the suggestion scheme.

5 Empirical Investigation

After a short description of the used data set, the second part of the empirical investigation will contain the selection of variables, which measure the intensity of the socialization and internalization process. The third part will encompass the methods needed to test the hypothesis followed by the results of the analysis.

5.1 Data set

To describe the socialization and internalization process data about employment relationships are needed. Since practices deduced from the Japanese Kaizen-Philosophy are relatively new, the data needs to consider particularly newer trends of human resource management. These requirements are fulfilled by the "Changing employment relationships, employment contracts and the future of work" survey from the year 2000. The survey data covers 2,132 employees and 334 self-employed persons from a nationally representative sample of the employed population in Great Britain aged between 20 and 60. The aim of the survey was the identification and description of changes in employment relationships and their implication during the 1990. The survey was conducted as part of the research program "Future of work" by the Economic and Social Research Council (ESRC) in 2000. In order to permit a comparison with previous large scale surveys of employment issues a national sample of

2,500 employees was aimed (ESCR 2003: 2). The survey data were gained by personal, paper based interviews as well as self-completion questionnaires. The dataset contains the information from 416 managers and 1716 non-managers. The employees' interviews deliver all necessary data about training system, labour markets, work design, different human resource management practices and suggestion schemes in their organization.

5.2 Variables describing the "organizational model"

The "organizational model" described in chapter 3 is a prototype of Japanese organization, which exemplarily provides support for the formation, utilization, and transfer of function-specific knowledge and its tacit component. This model contains an internal labour market (ILM), senior employees as mentors, on-the-job training (OJT), a function-centred work design and teamwork.

The "changing employment relationships, employment contracts and the future of work" survey contains a broad set of variables, which describes such an organizational structure. Two questions about internal careers are describing directly ILM. The first question concerns whether the present job is a step in a recognised career or promotion ladder within the organization. The second one asks whether staying with the same employer or moving around between employers would improve the chance for a promotion. If both questions are answered in the ILM sense than the dummy variable ILM gets a value one.

It is more difficult to describe intensive OJT in an organization. One variable contains whether the employee has received a training provided or paid for by the current employer. The problem is that the question seems to be too general to describe OJT. There was no information about the duration or type of the training. Therefore, except for this dummy variable "training received", two additional uncorrelated variables were considered. One of the variables "mentor" is a dummy describing whether supervisors, foremen or managers help employees to do their work better. Only if employees assess this statement as very true, the dummy variable was coded as one. The second variable expresses the importance of skill development in an organization. If an organization emphasizes skill development then continuous assessments of the employees' skills are necessary. The question whether an employee has undergone one or more assessments of his job skills and competencies at later stage in his job is an appropriate proxy for the importance of skill development.

The variables chosen so far ensure the development of function-specific knowledge and the technical aspect of tacit knowledge. In order to extend the cognitive aspect of the employees,

a narrow specialization must be prevented. A function-centred work design ensures that employees fulfil different sets of tasks and have the opportunity to make "high quality experiences". Unfortunately, there are no variables capturing the existence of job rotation directly. Nevertheless, employees were questioned whether they are trained to perform a range of different tasks when necessary and if they do so in case that they need to cope with pressure. If both questions were answered with yes than the dummy variable for function-centred work-design got the value one.

An acceleration of transfer and acquisition of new broad knowledge is supported mostly by team work. Working in groups helps to build a common language from shared experiences. The recourse to common experiences makes it actually possible to share tacit knowledge even though the team members are not able to explain their knowledge to outsider. Team work was explicitly inquired by the following question: "Excluding any supervisor or manager you work for, do you usually work in a group or team with two or more other people?"

Table 1 : Descriptive statistics of the independent variables

Variable name	Observations	Yes (= 1)	In %	No (= 0)	In %
ILM – OLM	2,126	577	27.14	1,549	72.86
Training received	2,464	1,198	48.62	1,266	51.38
Mentor	2,121	361	17.02	1,760	82.98
Skill assessment	2,129	699	32.83	1,430	67.17
Function-centred work design	2,127	1,133	53.27	994	46.73
Teamwork	2,128	1,241	58.32	887	41.68

Besides these explanatory variables summarized in table 1, the effect of the sector, organization type and size are controlled. The sector is itemized in 38 categories measured as standard industrial classification of the present employer. Considering the high number of observations, there is no necessity to reduce the number of categories. The dataset contains three types of organizations, namely private, public and everything else. Firm size is captured by dummy variables for small size (0-50 employees); medium size (51-99 employees) and large size (> 100 employees) organizations. Small organizations will be used as reference category.

For the test of each hypothesis, I use two different dependent variables. For the first hypothesis the mere existence of a suggestion scheme serves as endogenous variable. The suggestion quality is explained by the second hypothesis.

The dummy variable “suggestion scheme” contains the answer to the question “Does your employer have a formal suggestion scheme”? There are 2,023 observations from which 34.7% (738) answered to the question with “yes” and 60.4% (1285) with “no”.

The indirect indicator for the quality is the answer about the existence itself. Only an employee who knows that his organization offers a suggestion scheme can submit a suggestion through it. If an employee answers with “yes” then it means that the employer was successful in communicating the existence of such a scheme. If an employee answers that his employer has no suggestion system, although there is one in his organization then one can conclude that this system is not fulfilling its function. Maybe, such an employer only has a suggestion box somewhere on a wall in the company. This is an indicator that the organization is not seriously interested in the participation of employees in the innovation process. Therefore “yes” answers are a selection of the better suggestion schemes. This selection is the strength of the employee data set. A data set based on answers from employers could not reveal something about the quality of the suggestion scheme.

Furthermore, there is one question whether the employee has made a proposal about improving the efficiency with which work is carried out in the last year. This question is not necessarily linked to the existence of a suggestion scheme. This proposal could be submitted to people who work with the employee, management but also to the suggestion scheme. This becomes obvious from the underlying dataset because 1,560 employees (73%) confirmed that they have made a proposal but only 585 of them stated that their employer has a formal suggestion scheme. Nevertheless, this variable can be seen as an indicator for the quality of the suggestion scheme if we assume that these 585 employees submitted their proposal to the suggestion scheme or were at least positive influenced by it. These 585 suggestion schemes must have a higher quality than the other 153 that were not used or did not inspire the employees. Thus I build two variables describing the quality of the suggestion scheme: “suggestion scheme quality” with a value of one if there is a suggestion scheme in the organization and the employee has made a suggestion. A more specific variable “suggestion scheme quality ordered” is build containing the value one if there is a suggestion scheme but the employee has not made a suggestion and the value two if there is a suggestion scheme and the employee has made a suggestion. All other cases receive the value zero (see table 2)

Table 2 : Descriptive statistics of the dependent variables

Dependent Variables	Value = 0	Value = 1	Value = 2
Suggestion scheme	suggestion scheme does not exist N = 1,285	suggestion scheme exists N = 738	
Suggestion scheme quality	suggestion scheme does not exist or no suggestions submitted N = 1,435	suggestion scheme exists and the employee has made a suggestion N = 585	
Suggestion scheme quality ordered	suggestion scheme does not exist N = 1,285	suggestion scheme exists but employee has not submitted any suggestion N = 153	suggestion scheme exists and the employee has made a suggestion N = 585

5.3 Methods

The econometric problem is to estimate the conditional probability that a suggestion scheme exists (Y=1) considered as a function of the explanatory variables. The most commonly used regression models for this response case are logit and probit models. In these binary response models the functional form between the independent variable and the dependent variable is assumed as known and as nonlinear. The relationship in the probit model is given by:

$$P(Y=1 \mid X) = \Phi(\sum b_k X_k) = \int_{-\infty}^{\sum b_k X_k} \exp(-u^2/2)/\sqrt{2\pi}\,du$$

where Φ(.) is the standard normal distribution function (see Aldrich/Nelson 1984: 48; Greene 2003: 665). The unknown parameters bk (k = 1 … K) need to be estimated. The condition of statistically independence between Y1 … YN is satisfied by the exclusive nature of the variable about the existence of a suggestion scheme. In addition, multicollinearity between the explanatory variables is nonexistent[1]. The balanced number of cases with Y=1 (34%) makes it possible to use a probit model.

For the estimation of the quality of a suggestion scheme an ordered probit model is used. The endogenous variable is coded between zero and two as described previously.

The difficulty in the estimation of the quality of the suggestion scheme is to consider the different probability of each employee to submit a suggestion. Managers, supervisors and foremen have a higher probability of making a proposal, due to their wide range of experience and training. Instrumental variables are the appropriate method to correct such a bias. Good instrumental variables must fulfil two conditions. First, they must be strongly correlated with

[1] Multicollinearity was examined by pair wise Pearson correlations between the independent variables. The highest correlation is between skill assessment and training received with 0.25 but low enough not to cause multicollinearity. Since multistep variables are not a condition for the Pearson coefficient there is no reason why it cannot be applied to dichotomous variables (see GHISELLI et.al 1981: 116).

the probability that an employee makes a suggestion. Second, they must be uncorrelated with the probability of the existence of a suggestion scheme – especially, with variance in the probability that is not already explained by the independent variables of the „organizational model“. Due to the selection of individual level data as instrumental variables, correlations with variables at organizational level are excluded. By choosing variables that mostly describe the employee it can be ensured that both conditions are satisfied. The position of the employee, his age, weekly working hours, sex, education, satisfaction with the job and variety of work, discretion of his job and the information policy of the organization are variables that effect the probability of making a suggestion (see EKVALL 1971; RUBINSON/STERN 1997) .

5.4 Results

Although there are plenty practitioner's guides about suggestion schemes and descriptive evidence about cost saving through suggestion schemes, there is no empirical analysis about the relationship between suggestion schemes, skill development and transfer practices. The next sections present the results of the two hypotheses about the existence and the quality of a suggestion scheme.

5.4.1 The "organizational model" and the existence of suggestion schemes

The hypothesis to be tested is that the probability for the existence of a suggestion scheme rises if the organization provides structures and practices that enhance the inventive ability of its employees. The practices and structures according to the described "organizational model" are internal labour markets (ILM), function-centred work design, teamwork and intensive training. The first probit model in table 3 estimates the effect of the mentioned independent variables to the probability of the existence of a suggestion scheme. The 38 sector dummies as control variables are not shown in the table. The reference category for the control variable "type" is private organization. The category "all other types" has a significantly lower existence probability. The reference category for the sector is agriculture, fishing and forestry. Organizations in the following sectors have a significantly higher existence probability of a suggestion scheme: chemical industry, manufactures of transport equipment, electricity and gas supply, retail trade, sales and maintenance of motor vehicles, all transport industries, post

and telecommunications, financial intermediation and public administration and defence. It may be surprising that high-tech manufacturing industries do not use significantly more suggestion schemes than the low-tech industries. The lack of significance can be explained by the low number of 36 observations dispersed over 4 categories. The reference category for the control variable "type" is private organization. The category "all other types" has a significant lower existence probability. This result can be explained by the non-profit organizations included in this category. They are not under such pressure to lower costs compared to the other two types. The size has definitely a strong positive effect for two reasons. In small organizations informal interactions between employees and employers dominate, eliminating the necessity for a formal suggestion scheme. The second reason is the economies of scale of suggestion schemes. The higher the number of potential suggestors (N_U) the more effective it will work. Large organization can use this kind of economies of scale better than small ones.

All variables of interest describing the "organizational model" have the predicted sign and are highly significant. The needed structures, namely ILM and a function-centred work design, have a positive effect on having a suggestion scheme and are significant at 1% level. Variables describing the training – knowledge transfer from senior employees as mentors and received training – are also significant and have the predicted positive effect. The assessment of skills during the employment relationship measures more accurately the importance of skills and skill development in an organization. Therefore the significance at 1% level again confirms the hypothesis.

Due to the use of solely dummy variables as explanatory variables, two types of probability changes are reported in table 3. Usually, "change in probability" statistics calculate the change at the mean of the other variables. As the mean of dummies does not deliver any information, I calculate the change in probability for the discrete change of the variable, in the second column, under the condition that all other variables of interest equal the value zero. In the third column all the other variables take the value one.

The higher values in the third column are caused by complementarity between the variables of interest. I will explain this complementarity exemplarily for the ILM. If an organization has none of the structures and practices of the "organization model" except ILM, than the probability of having a suggestion scheme increases by 6.5% on average. If an organization fulfils all conditions of the "organizational model" than adopting an ILM raises the probability by 8.2%.

The most important variable according to the change in probability is the assessment of skills or skill development with at least 8.3% followed by the ILM and a function centred work design with at least 6.3% resp. 5.4%.

Table 3 : Probit estimates and probability change for the existence of suggestion schemes

Existence of suggestion scheme		dF/dx if all variables of interest equal zero	dF/dx if all variables of interest equal one
38 sector dummies			
Public	0.1313 (1.31)		
All other types	-0.3395 (1.98)**		
Medium size (50-100)	0.2167 (2.59)***	0.064	0.082
Large size (>100)	0.5991 (7.69)***	0.178	0.222
Internal Labour Markets	0.2091 (2.93)***	0.065	0.082
Mentor	0.1626 (1.99)**	0.049	0.063
Training received	0.1670 (2.48)**	0.050	0.065
Skill assessment	0.2660 (3.94)***	0.083	0.105
Function-centred work design	0.1787 (2.79)***	0.054	0.069
Teamwork	0.1247 (1.88)*	0.037	0.048
Constant	-1.5394 (4.97)***		
Observations	1,968		
% of correct predicted cases	71		
Pseudo R2	0.1347		

Absolute value of z statistics in parentheses
* significant at 10%; ** significant at 5%; *** significant at 1%

The goodness of fit of the estimation is measured by Pseudo R^2, which is the appropriate measurement for probit models. The Pseudo R^2 with 0.1347 is acceptably high. As the Pseudo R^2 is not universally accepted, I calculate the percentage of correctly predicted cases. The predictions ($\hat{P}$) are based on the estimated P_i terms. If $\hat{P}(Y=1)$ is greater than 0.5 the prediction of the case is 1. If $\hat{P}(Y=1)$ is less than 0.5, it predicts that Y will be 0 in that case (see ALDRICH/NESLON 1984: 57). If 0.5 is the baseline then 71% of the cases are predicted correctly. The percentage of the accurate predictions remains stable, even if the baseline is shifted to 0.4 or 0.6 (70% resp. 69%). It is worth to mention that the probability of *not having* a formal suggestion scheme is predicted a lot more precisely (85%) than the existence of one (55%). This can be interpreted as followed: The structures and practices of the "organizational

model" are only the necessary but not the sufficient condition for the existence of a suggestion scheme.

Although the employee dataset delivers a wide rage of information about the employees, there are problems involved with the use of individual data. First, the information about the organization structure reflects rather the perception and knowledge of only one individual employee. An employer dataset would deliver more accurate and reliable information. The second difficulty is even more aggravating. The answers of an employee may not be representative for the entire organization but depend on the specific workplace, tenure, position and other variables of the employee. It is possible that employees working as supervisor or foremen would require more training than simple assembly line workers. These responses of supervisors and foremen could lead to a bias in the coefficients in the variables of interest. One possibility to consider these biases is to introduce instrumental variables that correlate with a particular explanatory variable but not with the existence of a suggestion scheme. I tested the position, social class, tenure and hours of work as instruments but none of the estimations exceed a Pseudo R^2 of 0.04. Considering these low values I draw the conclusion that the answers are not such dependent on the measured individual characteristics and that the use of instrumental variables is not adequate. Nevertheless, an employer dataset would be very useful for further analysis to confirm the results from this dataset.

5.4.2 The "organizational" model and the design quality of suggestion schemes

The second hypothesis to be tested is that the design quality of the suggestion scheme rises if organizations invest in the inventive abilities of their employees. This organizational behaviour is mandatory in order to capitalize on the investment in the inventive abilities of the employees. A qualitative suggestion scheme means that the organization is able to encourage the maximum number of employees to share their ideas. The submitted ideas must then be analyzed quickly, evaluated and implemented. As previously described the variables "suggestion scheme quality" and "suggestion scheme quality ordered" will be used as dependent variables in a probit and ordered probit model. The independent variables are the same as in the model above with the exception of the instrumental variable for the probability of submitting a suggestion. This individual probability depends on the employee's position in the organization, hours of work, discretion, responsibility and job satisfaction. The results from this probit model are reported in the annex in table 5. 4.

Table 4 : Probit estimation for making a suggestion

Suggestions submitted	
Usual hours worked per week	0.0120 (5.13)**
Manager	0.6750 (6.21)**
Supervisor / foreman	0.4295 (4.69)**
High responsibility	0.3439 (4.69)**
High discretion	0.2198 (3.12)**
High overall job satisfaction	-0.0059 (0.07)
Constant	0.3283 (2.39)*
Observations	2082
Pseudo R^2	0.1018

Absolute value of z statistics in parentheses
* significant at 5%; ** significant at 1%

With exception of job satisfaction all variables are significant and have the predicted sign. The reference category for manager and supervisor/foreman are the employees. With a Pseudo R^2 of 0.102, the quality of the estimation is neither low nor high. Unfortunately, there were no better instrumental variables in the dataset. The estimated probabilities for submitting a proposal are then used in the probit and ordered probit model for testing the hypothesis about the quality of a suggestion scheme.

To analyze the robustness of the estimation both models, with and without instrumental variables, are reported in table 4. The results of the probit estimation are presented in column (1) and (2). The Pseudo R^2 values are nearly unchanged in comparison to the probit estimation for the mere existence of a suggestion scheme but the percentage of correctly predicted cases rises to 74%. As in the estimation above the prediction of not having a qualitative suggestion scheme is far better (83%) than that of having one (53%). The coefficients of the model (1) have the expected signs. Besides the variable “mentor”, as support from senior employees, all variables have a significant positive effect to the quality of a suggestion scheme. At least the z-value for the “mentor” variable is near 10% significance level. The largest influence has the function-centred approach to work-design and the skill assessment. The introduction of either function-centred work design or skill assessment leads to an increase in the probability of a qualitative suggestion scheme of approximately 7% if no other practices are adopted, respectively 12% if all practices are utilized.

Table 5 : Probit and ordered probit estimates for the quality of the suggestion scheme

	suggestion scheme quality (1)	suggestion scheme quality with IV (2)	suggestion scheme quality ordered (3)	suggestion scheme quality ordered with IV (4)
38 sector dummies				
Public	-0.0512 (0.50)	-0.0291 (0.28)	0.0502 (0.52)	0.0703 (0.72)
All other types	-0.3897 (2.17)**	-0.4237 (2.33)**	-0.3613 (2.18)**	-0.4025 (2.37)**
Medium size (50-100)	0.1766 (2.01)**	0.1908 (2.13)**	0.2013 (2.47)**	0.2233 (2.70)***
Large size (>100)	0.5199 (6.43)***	0.5153 (6.28)***	0.5687 (7.54)***	0.5730 (7.52)***
ILM	0.2679 (3.70)***	0.2478 (3.38)***	0.2287 (3.34)***	0.2126 (3.07)***
Mentor	0.1297 (1.55)	0.1569 (1.84)*	0.1490 (1.90)*	0.1606 (2.01)**
Training received	0.2397 (3.44)***	0.2136 (2.98)***	0.1950 (3.00)***	0.1954 (2.94)***
Skill assessment	0.2915 (4.22)***	0.3014 (4.31)***	0.2799 (4.30)***	0.2920 (4.45)***
Function-centred work design	0.2969 (4.46)***	0.2728 (4.02)***	0.2256 (3.66)***	0.2108 (3.35)***
Teamwork	0.1312 (1.91)*	0.1291 (1.86)*	0.1301 (2.04)**	0.1293 (2.01)**
Pr(submit suggestion)		0.9356 (3.85)***		0.4229 (1.90)*
Constant	-1.8134 (5.36)***	-2.4926 (6.39)***		
Observations	1966	1928	1968	1930
% of correct predicted cases	73	73		
Pseudo R2	0.1262	0.1358	0.1052	0.1083

Absolute value of z statistics in parentheses
* significant at 10%; ** significant at 5%; *** significant at 1%

If these coefficients were strongly biased by the different probability of the questioned employee to submit a suggestion, then we would expect that some of the variables will loose significance in model (2) with instrumental variables. On the contrary, the "mentor" variable becomes significant and none of the others turns insignificant. Besides the "mentor" and "skill assessment" variable, most of the coefficients are smaller than in model (1). As expected, the probability of submitting a suggestion has a positive and significant effect on the endogenous variable. These results confirm that there are different probabilities for employees to make a suggestion but the effect is only small. The quality of a suggestion scheme depends more on the intensity of the internalization and socialization process of the organization.

In model (1) and (2) the dependent variable distinguishes only between high quality suggestion schemes and all others. Organizations that have a suggestion scheme but the employee has not submitted an idea are treated the same way like organizations that do not have a suggestion scheme at all. The information about having a suggestion scheme but the

employee has not made any proposals remains unused. In models (3) and (4) this additional information is used for an ordered probit estimation by using the variable "suggestion scheme quality ordered" as dependent variable. The cases with the value zero for the variable "suggestion scheme quality" are split into those organizations that do not have a suggestion scheme at all and those that have one but the questioned employee has not submitted a proposal (see table 2).

The coefficients show again a high robustness. There are only minor differences between the models (3) and (4) and in comparison to the other probit models. The greatest differences are the lower significance of the instrumental variable and the Pseudo R^2. These two distinctions are linked with each other and caused by the higher variance in the dependent variable. The "suggestion scheme quality ordered" variable contains more information than the variable "suggestion scheme quality". Since the instrumental variable cannot explain this additional information the significance and also the Pseudo R^2 decay. For clarifying why the instruments cannot explain this new information one needs to take a closer look to the instrumental variable and to the "suggestion scheme quality ordered" variable. The former measures the probability of an employee to submit a suggestion. This means that it can only explain the value "two" in the "suggestion scheme quality ordered" variable. For value one and zero no suggestion was submitted. Since the instrument can only explain the probability of submitting a proposal it is not able to explain the difference between the values zero and one.

Besides this effect, the significance and influence of the "mentor" variable is higher than in the other probit models.

The results fully confirm both hypotheses. First, the intensity of the internalization and socialization process influences the existence probability of a suggestion scheme. Furthermore, the intensity also affects the quality of a suggestion scheme. Organizations that invest in employees' human capital establish more sophisticated suggestion schemes in order to encourage the personnel to participate and to harness their inventive ability.

Aside from complementarity between suggestion schemes and the intensity of the socialization and internalization process, the results show a complementarity between the structures and practices that provide socialization and internalization. The probability of having a suggestion scheme is higher if all analyzed structures and practices are utilized in comparison to the separate introduction of the practices. Therefore, if other structures are already established then the introduction of another practice will increase the probability more than if no other practices were adopted.

6 Conclusion

Employees, who utilize new implemented inventions and have experiences with prior or similar technologies, posses the ability to contribute their tacit knowledge to increase the efficiency of the innovation process. Their suggestions can be of high value particularly during the implementation stage of an innovation cycle. Organizations that seriously want to involve these users into the innovation process can enhance the inventive abilities further by providing intensive socialization and internalization processes. This set of practices is the first condition for an efficient innovation process. The second condition concerns the motivation and opportunity of users to contribute to innovation. Complementary practices, like suggestion schemes, provide the incentives and opportunity for a maximum number of participants to share their ideas. Without such a practice, organizations will not be able to capitalize on their huge investments in the inventive abilities of their users. The empirical analysis confirms that organizations that provide the framework for acquiring inventive skills, namely internal labour markets, on-the-job training, mentors, teamwork and a function centred work design will be more likely to establish a suggestion scheme. In addition, the more practices are utilized for socialization and internalization the higher is the design quality of the suggestion scheme.

Although the results are very robust, their interpretation is limited by the employee dataset. The accuracy and representativety of the answers of only one employee per organization can cause a bias in results. Nevertheless, I tried to account for such a bias by using instrumental variables. The similar coefficients and significance levels in the models with and without instruments confirm the hypothesis and the robustness of the results. A replication of this analysis with an appropriate employer dataset like the “Employers' Workplace Policies in an Environment of Change 2002” or WERS would be desirable to complete these findings.

Another limitation involves the measurement of suggestion scheme quality. The indirect measurement reduces the quality of the variable. Thus, measured suggestion scheme quality can only be seen as a crude indicator and motivation for further analysis of the relationship between the quality and practices for building inventive abilities. Although organizations can save costs up to 160 million Euro (i.e. Siemens in Germany) due to suggestion schemes, a literature review reveals a lack of theoretical foundation and a domination of practitioners’ reports and guides (see DIB 2005). For example, although incentive structures are in the focus of economists, the incentive structures of suggestion schemes are mostly neglected.

What can British organizations learn from this paper? As British organizations are engaged in competitive global markets and turbulent sectors, they require continuous innovation, improvement and cost saving. Therefore British organizations can not neglect the absolute advantage of their employees, as users, in the implementation of process innovations. The absolute advantage results first from their inventive skills due to their function-specific knowledge and second from their lower costs. Due to the "academic bias" and occupational labour markets, the advantage of users in comparison to professionals is even larger than in other countries. In order to remain internationally competitive the organizations might increase the efficiency and effectivity of the innovation process. Although the emphasis of theoretical knowledge creates an opportunity, the British training and education system does not provide the conditions to realize the innovation potential. As long as the majority of the workforce does not have the necessary function-specific skills and its tacit component the potential advantage remains unrealized. Therefore, individual organizations should provide the necessary investments in human capital. If this socialization and internalization process is provided, then complementary systems for capitalizing on these investments are needed. Such complementary systems are suggestion schemes, brainstorming and quality circles. The results confirm first that organizations have recognized this relationship and that the higher the intensity the more probable is the adoption of a suggestion scheme. Secondly, these organizations invest symmetric efforts in their skill development and transfer programs as well as in the design of the suggestion scheme. In other words the more intensive the socialization and internalization process is the higher is the quality of the suggestion scheme.

In addition, this paper brings up further questions for analysis. Do employees contribute significantly through a suggestion scheme to the efficiency of process innovation? Firms' decision about the introduction of technological change depends on their expected productivity. From this paper I conclude that under certain conditions suggestion schemes can increase the efficiency of the implementation of new processes. If successful suggestion schemes raise the profitability of the introduction of process innovations, then these firms will have a significantly higher probability of implementing technological change.

References

Aldrich, John H.; Forrest D. Nelson (1984): Linear probability, logit, and probit models. Newbury Park: Sage.

Alwis, Ragna Seidler-de; Evi Hartmann; Hans Georg Gemünden (2003): The role of tacit knowledge in innovation management. Lugano University: Working paper for the 19th IMP Conference.

Axtell, C. M.; D. J. Holman; K.L. Unsworth; T. D. Wall; P.E. Waterson; E. Harrington (2000): Shopfloor Innovation: Faciliating the suggestion and implementation of ideas. In: Journal of occupational and organizational psychology 73(2000): 265-285.

Boerner, C.S.; Macher J.T.; Teece D.J. (2001): A Review and Assessment of Organizational Learning in Economic Theories. In: Dierkes, M.; Antal, A. B.; Child, J.; Nonaka I. (eds): Handbook of Organizational Learning and Knowledge. Oxford University Press: 89-117.

Cooke, F.L. (2002): harnessing the firm-specific knowledge of the maintenance workforce for organizational competitiveness. In: Technology Analysis & Strategic Management 14(2002)1: 123-140.

Corso, M. (2002): From product development to Continuous Product Innovation: mapping the routes of corporate knowledge. In: International Journal of Technology Management, 23(2002)4: 322-340.

Cotton, J.L.; D.A. Vollrath; K.L. Froggatt; M.L. Lengnick-Hall; K.R. Jennings (1988): Employee Participation: Diverse Forms and Different Outcomes. In: Academy of Management Review 13(1988): 8-12.

Cowan, Robin: Paul A. David; Dominique Forey (2000): The Explicit Economics of Knowledge Codification and Tacitness. In: Industrial and Corporate Change 9(2000)2: 211-253.

Deutsches Institut für Betriebswirtschaft GmbH (DIB) (2005): Forum Ideenmanagement / BVW. Frankfurt.

Economic and Social Research Council (2003): Working in Britain 2000 – User Guide 1. London.

Ekvall, Göran (1971): Creativity at the place of work. Malmö: Reklamlito.

Ghiselli, Edwin E.; John P. Campbell; Sheldon Zedeck (1981): Measurement Theory for the Behavioural Sciences. San Francisco: W.H. Freeman and Company.

Greene, William H. (2003): Econometric Analysis. 5th edition. New York: Prentice Hall.

Hall, Peter A.; David Soskice (2001): An Introduction to Varieties of Capitalism. In: Peter A. Hall; David Soskice (eds.): Varieties of Capitalism – The Institutional Foundations of Comparative Advantage. Oxford: Oxford University Press: 1-68.

Helper, Susan (1997): Complementarity and Cost Reduction: Evidence from the Auto Supply Industry. Cleveland: NBER Draft Paper.

Hippel, E. von (2005): Democratizing innovation: The evolving phenomenon of user innovation. In: Journal für Betriebswirtschaft 55(2005)1: 63-78.

Hippel, E. von (1988): The Sources of Innovation. Oxford: Oxford University Press.

Imai, M. (1992): Kaizen – Der Schlüssel zum Erfolg der Japaner im Wettbewerb. München: Langen-Müller/Herbig.

Jensen, M.C.; Meckling, W.H.(1998) : Specific and General Knowledge, and Organizational Structure. In: Jensen, M.C. (eds): Foundations of Organizational Strategy. Cambridge: Harvard University Press.

Johnson, Björn; Bengt-Ake Lundvall (2001): Why all this fuss about codified and tacit knowledge? Aalborg University: Working paper for the DRUID Winter Conference January 2001.

Koike, Kozuo (1994): Learning and Incentive System in Japanese Industry. In: M. Aoki; R. Dore (eds.): The Japans Firm: The Source of Competitive Strength. Oxford: Oxford University Press: 41-65.

Kristensson, P.; Anders Gustafsson; Trevor Archer (2004): Harnessing the Creative Potential among Users. In: The Journal of Product Innovation Management 21(2004): 4-14.

Lam, Alice (1997): Embedded Firms, Embedded Knowledge: Problems of Collaboration and Knowledge Transfer in Global Cooperative Ventures. In: Organization Studies 18(1997)6: 873 – 996.

Lam, Alice (2000): Tacit Knowledge, Organizational Learning and Societal Institutions: An Integrated Framework. In: Organization Studies 21(2000)3: 487-513.

Laursen, K.; N. J. Foss (2003): New human resource management practices, complementarities and the impact on innovation performance. In: Cambridge Journal of economics 27(2003): 243-263.

Leatherdale, W. H. (1974): The Role of Analogy, Model and Metaphor in Science, Amsterdam: North-Holland.

Leonard, Dorothy; Sylvia Sensiper (1998): The Role of Tacit Knowledge in Group Innovation. In: California Management Review 40(1998)3: 112 – 132.

Lorenz, Edward; Nathalie Lazaric (2000): The Transferability of Business Practices and Problem-Solving Skills to Japanese Firms in Britain and France: Working paper for the DRUID Summer Conference 2000.

Lundvall, B.-A. (1988): Innovation as an Interactive Process: From User-Producer Interaction to the National System of Innovation. In: G. Dosi; C. Freeman: R. Nelson et al. (eds.): Technical Change and Economic Theory. London: Pinter Publishers: 349-369.

Marsden, David (1999): A theory of employment systems: micro-foundations of societal diversity. Oxford: Oxford University Press.

Maurice, Marc; Amdt Sorge; Malcolm Wamer (1980): Societal Differences in Organizing Manufacturing Units: A Comparison of France, West Germany, and Great Britain. In: Organization Studies 1(1980)1: 59-86.

Meißner, Wolfgang (1989): Innovation und Organization. Stuttgart: Verlag für Angewandte Psychologie.

Michie, J.; M. Sheehan (1999): HRM Practices, R&D Expenditure and Innovative Investment: Evidence from the UK's 1990 Workplace Industrial Relations Survey (WIRS). In: Industrial and Corporate Change 8(1999)2: 211-234.

National Statistics (2005): Labour Force Survey – Quarterly Supplement Winter 2004/05 No. 29. London: Office for National Statistics.

Nonaka, Ikujiro (1994): A Dynamic Theory of Organizational Knowledge Creation. In: Organization Science 5(1994)1: 14 – 37.

Onglatco, Mary L. (1988): Japanese quality control circles: features, effects and problems. Tokyo: Asian Productivity Organization.

Polanyi, Michael (1966): The tacit dimension. New York: Anchor Day Books.

Rosenberg, N. (1982): Inside the Black Box. Cambridge: Cambridge University Press.

Rubinson, Alan G.; Sam Stern (1997): Corporate Creativity – How Innovation and Improvement actually happen. San Francisco: Berrett-Koehler Publisher.

Shipton H.; Doris Fay; Michael West; Malcolm Patterson; Kamal Birdi (2005): Managing People to Promote Innovation. In: Creativity and Innovation Management 14(2005)2: 118-128.

Sundbo, Jon (2002): The Strategic Management of Innovation – A Sociological and Economic Theory. Cheltenham, Northampton: Edward Elgar.

Tsoukas, H. (1991): The Missing Link: A Transformation View of Metaphor in Organizational Science. In: Academy of Management Review 16(1991)3: 566-585.

Utterback, J. (1971): The process of technological innovation within the firm. In: Academy of Management Journal 12(1971): 75-88.