Toward an agile knowledge connection of employees with regard to business processes

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Abstract
Employee knowledge is a valuable and thus very important asset of a company. However, employees are often not aware of existing knowledge within their organization. As a result, wheels are reinvented continuously within organizations and employees spend unnecessary time learning processes in a cumbersome way on their own. To deal with this problem, databases containing explicit knowledge are often built, but they are rarely used – mainly due to the immense effort of keeping them up to date. In this paper we present a new approach aiming at socially connecting employees – an internal social knowledge network. A major novelty is the use of the organization’s business processes as a starting point. Employees can connect to each other by indicating their process-related areas of expertise. The aim is to enable sustainable sharing and distribution of knowledge within an organization.

1. Introduction

Employee knowledge is critical to the success of an organization [11]. However, employees lacking the necessary information for their daily work is a common problem. Some examples are non-existent documents, missing contact persons or incomplete information. The documentation of the required knowledge is often insufficient to perform the work correctly. Thus, there is a lack of tacit knowledge built on individual experience and intuition [22]. As a result, the efficiency of the organization suffers because its resources are not optimally used [31].

Hence, organizations are facing the following problem. In comparison to explicit knowledge, which exists in various forms such as databases and process models [10], tacit knowledge [20] is not documented and needs to be acquired by employees [29]. Tacit knowledge means an individual’s specific behavior and practical knowledge [22]. Such knowledge often leads the daily work of employees without them noticing [32]. In comparison to explicit knowledge, tacit knowledge is difficult to transfer from one employee to another [25, 26].

An organization’s business processes (also simply termed processes) are critical to its success [9]. Business processes can be seen as the DNA of an organization. Certain parts of the DNA, the genes, contain genetic information. Applied to organizations, the genetic information is contained in the business processes. These describe how the employees, machines and information systems are combined to produce services and goods [42]. Thus, business processes are the basis for the operability of the whole organization and enable employees to execute the business model.

Therefore, the following research question arises: How can employees be provided with the necessary knowledge for their daily work? To answer this question, we develop a framework for the introduction of a process-oriented social knowledge system; that is, enabling employees to connect with each other with regard to business-relevant knowledge. This should especially enable the exchange of tacit knowledge between employees and facilitate its management by the organization. The novel aspect of the framework lies in the use of business processes as a major connecting element, and the enabling of a systematic social knowledge network between employees.

In Section 2, the research methodology used in the paper is described. This is followed by the theoretical foundation in Section 3. On the basis of existing approaches from the literature, the research gap is identified in Section 4. Section 5 contains the description of the framework and its elements. The article closes with a discussion in Section 6 and an outlook in Section 7.

2. Research methodology

The research methodology applied follows a design science approach, based on the ideas of Venable [38] and Hevner et al. [12]. Design science provides a procedure for creating new approaches (also called
3. Knowledge in business processes

Within a business process, an input is transformed into an output (process result) in various sub-processes by the necessary resources, for instance employees, machines and information systems [39]. The transformation is performed on process instances, which can be a car, an insurance claim or a house-building permission [35]. The resources of a process are connected by the possible links between the sub-processes involved [23]. Every process instance passes the net of sub-processes, which can be either standardized or individual [18].

An important attribute of the process-oriented perspective is the execution of business processes across organizational units. As a result, the knowledge necessary for the production of goods and services has to be connected in a process-oriented way. An isolated analysis of function-oriented organizational units is not sufficient [9].

Applying the idea that business processes are the basis for the production of goods and services within an organization, the management of process-oriented knowledge becomes a key factor for success. If this knowledge is not captured, stored and applied, a company is likely to fail [24, 28]. In the context of business processes, three types of knowledge can be identified [10]:

1. Explicit knowledge in the form of process documentation. Such documentation shows how resources should be combined for the production of goods and services in the organization. The documentation contains information concerning, for example, the necessary tasks, their chronological order, the employees who are responsible and the necessary IT systems and machines. The method for capturing knowledge can vary between organizations. Diverse methods can be applied, ranging from Excel-based task inventories to extensive documentation with the help of professional software using standard notations such as Business Process Modeling Notation (BPMN) or the Event-driven Process Chain (EPC) [3].

2. Explicit knowledge as a result of monitoring and analyzing process execution [36]. This knowledge is mainly necessary for the management of an organization in order to achieve the targeted process performance. Additionally, it contains information concerning any improvements to the process that are not necessary for its basic execution.

3. Process knowledge, which contains the tacit knowledge of the employees executing the process [14]. This tacit knowledge is a combination of cognitive processes and factual knowledge, and regulates the way in which an individual completes tasks and solves problems. Hence, tacit knowledge can also be termed experience or intuition [5]. It is possible that one employee’s work is characterized by a higher quality than another’s, although they are both working under the same conditions.

The knowledge of an organization mainly consists of tacit knowledge [10]. However, this knowledge is exposed to variations caused by job changes within the organization, as well as terminations. This leads to the disappearance of tacit knowledge, which has to be recaptured using various resources. In order to avoid this, the organization can try to transform tacit knowledge into explicit knowledge to a certain degree [21]. Processes are visualized and employees are able to understand their activities, business processes and information systems better than before. However, problems can emerge during the procedure of explicating tacit knowledge [25]:

- Explicit knowledge remains abstract because documentation is limited in its ability to illustrate reality. The execution of the processes is not directly tangible.
A high degree of effort is required to keep explicit knowledge up to date. The environment of an organization changes rapidly, which affects employees and processes. Consequently, the processes and documentation have to be checked continuously for validity, and updated if necessary. This is usually not done in organizations due to the high resource use involved.

- **Tacit knowledge** is hard to learn from explicit knowledge sources. The experience of an employee develops from a daily work routine and cannot be learned in the short term. Hence, relying only on explicit knowledge is not sufficient for acquiring the necessary tacit knowledge of an employee. This is also supported by social exchange theory, which highlights the way in which employees in companies are connected to each other [4]. Employees tend to build social relationships with mutual support. These connections lead to a better result than explicating knowledge and consuming this explicit knowledge [6]. However, such connections rely on the attitude of employees to see colleagues as supporters and not as rivals [7].

Thus, conditions granting the best possible access to the necessary knowledge have to be created. Existing approaches for the provision of such knowledge are provided in the form of knowledge maps in the next section.

### 4. Related work

Approaches trying to capture and connect knowledge within organizations are usually termed knowledge maps. Knowledge maps are visual representations of knowledge carriers, stocks, sources, structures and applications within an organization [30]. This mapping enables knowledge management [17].

Existing approaches can be structured as follows:

- **Explication of tacit knowledge**: Approaches in this area try to explicate tacit knowledge in organizations in general. For example, Howard [13] promotes the mapping of tacit knowledge on a knowledge map. Regarding the type of knowledge, the approach additionally focuses on cause-and-effect diagrams in order to illustrate knowledge relations. The approach of Wexler [40] extends the previous approach by covering different roles as well. These roles include, for instance, map designer, user and manager, with their various needs.

- **Explication of process-oriented tacit knowledge**: Such approaches start with gathering information about the business processes in order to capture the necessary knowledge. Tacit knowledge is then explicated and knowledge maps are created that are no longer connected with the processes and no longer contain the knowledge carriers and their tacit knowledge. According to Tuggle and Goldfinger [33], for example, the externalization of tacit knowledge takes place in four steps derived from the organization’s key processes. Based on a repository of business processes, an attempt is made to externalize the tacit knowledge of the processes concerning employees, detailed process steps and communication. The approach of Kim et al. [19] goes further. Starting from process maps, explicit knowledge (from documents and information systems) as well as tacit knowledge (generated by expert interviews) is gathered and externalized.

- **Implementation of knowledge maps in organizations**: Vail [34] suggests a method of creating the basic conditions for implementing a knowledge map. This should be the basis for “live” and extendable knowledge maps that close the gap between knowledge of the functional organization’s employees and the supporting IT. The details of implementation remain open, which is more the focus of Eppler [8]. On the basis of a priori, defined quality criteria, he develops a five-step method for the implementation of knowledge maps in an intranet. In order to identify knowledge-intensive tasks, the value chain and business processes of an organization are considered and experts are interviewed.

- **Technical level of knowledge maps**: On the level of workflow-management systems, Kang et al. [16] present an approach for the technical realization of knowledge maps. Hence, the concept focuses on explicit knowledge within processes and does not take tacit knowledge concerning individual persons within an organization into account. Irani et al. [15] use the technique of knowledge mapping in order to assess generic knowledge flows within organizations. The purpose is to discover where information systems support the acquisition and diffusion of knowledge within an organization. This approach does not refer to specific knowledge. Thus, it is not suitable for mapping concrete tacit knowledge.

The approaches analyzed are reasonable concerning their individual purpose. Nevertheless, a concept for mapping tacit and explicit knowledge referring to business processes is missing. Furthermore, the approaches presented focus on the explication of tacit knowledge. This requires an immense effort to implement a knowledge map, exacerbated by the need for continuous updates. Additionally, continuous use by employees is not taken into account. This is due to the fact that these approaches focus on abstract overview maps addressing the organizational
management. For the purpose of providing process-related knowledge to and for employees in an organization, the following requirements can be derived from the previous approaches:

- The approach has to provide the relevant knowledge and connect various sources of explicit and tacit knowledge.
- The approach has to be structured clearly with regard to business processes and has to be usable in the day-to-day routine.
- The approach has to be accepted by employees to ensure integration into the day-to-day routine.
- For continuous use, the approach has to be able to be kept up to date without a large effort.

As described, these requirements are only addressed partly by existing approaches, but will be taken into account by the framework described in the following section.

5. Framework for the knowledge connection of employees

The tacit knowledge of an organization is located in the minds of its employees. This knowledge should not be transferred into the knowledge map. The purpose is, rather, to record which employees own knowledge concerning certain processes. Thus, we adopt Davenport’s general understanding with regard to gathering tacit knowledge [5, p. 72]: “A knowledge map – whether it is an actual map, a knowledge ‘Yellow Pages,’ or a cleverly constructed database – points to knowledge but doesn’t contain it. It is a guide, not a repository.” In consequence, we are not trying to explicate tacit knowledge as most of the other approaches propose. Such a transformation is an immense effort, will be done once and the results will not reflect ongoing changes in reality. In contrast, we propose an internal social network system that is closely linked to the processes of an organization and does not contain the tacit knowledge itself. The idea is to motivate employees to indicate their areas of expertise and to claim expert status toward other employees.

The starting point for the introduction of such a social knowledge network lies in the organization’s business processes (Figure 1). The processes define the business-related connections between employees. Such a process architecture is provided to employees within the social knowledge system. Employees can reference their relevant areas of expertise, as well as sources for explicit knowledge. Thus, they provide the necessary information individually. The system is available for the relevant recipients – that is, management and employees – for their use in day-to-day business as a software tool. Using the social knowledge system, employees can connect with each other. In order to ensure sustainable application and widespread use of the social network, an incentive system is recommended. This is necessary to avoid the insufficient participation of employees which is otherwise likely to occur [2]. An overview of the elements of the framework is provided in Figure 1. The individual elements are explained in the following section.

5.1. Setting up the process architecture

Processes provide the basis for assigning relevant knowledge in an organization. Nevertheless, recording processes in detail is not the objective of this step, as only the processes and their main activities are relevant for the purpose of the social knowledge system. The purpose of a process architecture is to describe the basic structure of an organization and the main connections between its processes and sub-processes [27].

If a significant number of processes is mapped, the illustration should comprise multiple levels. In this way, the core processes can be mapped on the top level, the more detailed processes (macro processes) on the middle level and the micro processes on the lowest level. An example is the core process “conference organization” of a scientific association. This core process can contain macro processes such as “room booking” and “participant registration.” For the latter, a micro process could be “provision of conference materials.” How exactly these processes are executed in terms of instructions is not within the focus of the process architecture. The three levels simply describe the necessary outcomes that are needed to offer the relevant products and services.
Thus, for usability reasons, further differentiation should not take place. The process architecture would become confusing for employees and searching certain parts would consume too much time or would not be done at all. Figure 2 provides a generic example of how the processes on the different levels are linked with each other.

![Figure 2. Generic example of process architecture](image)

The process architecture should be imported directly from electronically documented process models, if possible. Here, process mining, for instance, can be helpful [37]. This avoids redundant and incorrect process acquisition. Otherwise, manual gathering of information from the process owners has to take place. In this way, the process architecture of the organization is determined; that is, which processes are linked for which part of production and service delivery [41].

5.2. Social knowledge system

The social knowledge system is the core of the framework. The implementation of the system should take place via the use of software-based tools. This enables unlimited scalable use within the organization, as well as shared editing. Each employee should have easy access to the available but distributed knowledge in the organization. Consequently, information concerning knowledge should be available in a decentralized way in order to be usable directly in day-to-day business.

Users can be provided with four main features.

**User page:** Each employee has a user page (Figure 3), as typically used in social systems like Facebook or LinkedIn, for example.

Initially, every employee is registered on the basis of their profile information on an existing intranet. If this does not exist, employees have to indicate the basic contact information on their own. Every employee indicates their knowledge for their own profile. For this purpose, the process architecture is provided so that employees can choose the relevant processes. They can also differentiate between processes in which they are currently working and those they have performed in the past. Additionally, employees can add links for additional sources of explicit knowledge. The chosen areas of expertise will be visible for every employee. Figure 3 gives an example of such a user page.

![Figure 3. Exemplary illustration of a user page](image)

Moreover, a further connection of knowledge can take place. Thus, indicated individuals can be directly linked with the contact information from the intranet. In this case, the employee is able to contact the required person directly by an internal messaging system, email, telephone or office number with the aid of hyperlinks. It is possible to reference explicit knowledge, as well leading the employee directly to the required database and document.

**Process-oriented knowledge map:** The knowledge map illustrates the knowledge sources with regard to the organization’s processes. The main difference in comparison to a process map is that a knowledge map does not contain the knowledge itself. It includes information regarding its location; that is, which databases or documents contain or which persons possess the knowledge needed for the particular process. Figure 4 shows schematically how the connection and the illustration of knowledge in an organization can be realized.
Figure 4. Exemplary illustration of a knowledge map

The knowledge map provided should be limited to the essentials and characterized by a user-friendly interface. The idea is not to create a map containing as much knowledge as possible. The map should provide an overview of where to find knowledge with regard to a particular process. Consequently, the interface should contain the process architecture and indications of which employee, database or document can provide knowledge. Users should be able to indicate their areas of expertise directly by clicking on a business process.

Connection with others: An employee can see their connection to others with regard to the indicated areas of expertise. It should be possible to make the connections visible to colleagues with the same areas of expertise, as well as to colleagues in the process flow.

Search engine: As all the information added is tagged by the respective business process, as well as by employees, a quick search for specific tasks is possible. Employees can easily search for colleagues by a chosen process or a name.

In order to create user acceptance for the social knowledge system, easy and direct access has to be guaranteed. Therefore, the intranet or an internally available website can be used. There should be the possibility of looking things up very quickly; this must be the case to ensure the social knowledge system is integrated into day-to-day business for situations in which knowledge is needed or problems occur.

Beyond the indication of knowledge, employees can also indicate changes with regard to the process architecture. In this case, every other employee connected to the affected process is informed.

5.3. Usage of the social knowledge system

The social knowledge system can be used from employees’, as well as from management’s, perspective. The primary recipients are the employees. They should be supported by the system in their day-to-day routine. The system can be searched quickly and systematically for information about where potentially necessary knowledge can be found, for instance in which databases, documents and employees. In this way, a random search for information can be improved and becomes less dependent on employees’ individual informal networks. Since there is often insufficient time for initial training, and knowledge acquisition is not institutionalized, this guarantees access to a systematic overview concerning relevant knowledge carriers and so on. New employees have the possibility of acquiring the necessary knowledge by contacting relevant colleagues (and also those who are responsible for other processes).

The knowledge management system would be integrated into the desktop of workstations. It would be at the same place as every software program. However, an automated link would be provided if an employee works on a specific business process. Thus, direct integration into operating systems should be enabled whenever possible. Furthermore, every employee can look up their status in the knowledge management system in real time.

Nevertheless, clear rules for communication between employees have to be established. There could be a situation in which a particular employee has knowledge of a critical business process and is receiving frequent inquiries that prevent them from doing their daily work. Thus, employees should define a maximum number of inquiries per week that is allowed by the system. Furthermore, a ranking of knowledge should take place. Employees working in a business process should be ranked at the top level. Other employees indicating areas of expertise they have gathered in former times will be displayed below. For each area of knowledge the central department should define a maximum timespan for which employees are displayed on the knowledge map for a particular business process in which they are no longer working. The aim is to ensure a mapping of experts that can provide useful and up-to-date knowledge for the employees who are inquiring.

The usual objective of management is effective organization of the existing (especially tacit) knowledge. The knowledge map of the system provides an overview of the existing sources of explicit and tacit knowledge in the organization. Knowledge loss is often not discovered and is only noticeable after a delay, when problems occur in the relevant processes. In this case, employees from other departments who possess process knowledge from a former position can help in the short term. If an employee leaves the organization, it will be easier to discover in which processes knowledge is being lost.
Additionally, proactive management of tacit knowledge can be implemented. For this purpose, the knowledge map is evaluated to discover how many individuals in the organization own knowledge about the particular processes and activities. Thus, knowledge transfer can be arranged for activities that are known only by one employee. One indicator for important knowledge can be the number of inquiries. If a particular person is contacted frequently, management should think about training another employee with regards to the specific process knowledge. However, the knowledge system exists, data in an existing performance system can be directly linked to employees’ personal goals. Thus, the core question is why employees should actively participate in such a system.

To ensure the best possible participation, employees have to be rewarded for their effort using incentives [1]. Thus, we propose an incentive structure using bonus points. These bonus points can be linked directly to employees’ personal goals. If the goal is fulfilled with regard to bonus points, additional benefits in terms of money, free time, sponsored activities and so on will be available. Employees receive bonus points for every social network activity. Such activities can be as follows.

**Completeness of profile:** The more information added by the employee, the more bonus points that employee will receive. This also holds true for the validity of the information. Employees either have to update their information regularly or confirm that nothing has changed.

**Answering inquiries:** If an employee is contacted by a colleague, they can decide whether they have the time available to help. Answering a question or transferring information takes time, preventing the employee from doing their own work. Thus, if the inquiry is handled, bonus points will be the compensation.

**Rating of colleagues:** If an employee gets information from a colleague, they can rate the specific expertise. This should be possible in the form of a “Like” button. Metrics are likely to lead to problems. Therefore, an employee can just click on the area of expertise to indicate a person who provides helpful knowledge with regard to a specific task.

Finally, one should not underestimate the effect of social status. On Facebook, for example, users are proud to present themselves and happy to receive recognition. However, to avoid misuse, inquiries should be limited to a certain number, as stated above.

### 5.5. Technical implementation

The proposed knowledge management system should be implemented as a modular system. It should be connected to as many existing IT systems in the company as possible. Thus, it can be seen on a top layer above the operating systems and existing knowledge repositories. However, the use of possible interfaces is dependent on the company’s existing IT architecture.

Firstly, business processes that are already documented in existing software should be used. The required levels of the processes should be directly imported. Regular updates assure an up-to-date process repository. In case of changes, notification should be sent to employees who indicated knowledge about the respective business processes.

Secondly, if business processes are implemented in workflow management systems, the knowledge management system can be directly connected to these operating data. This connection will lead to a more precise representation of the business processes. Employees can also be supported in their daily work by providing a direct link within the operating systems. Additionally, process mining can be used to analyze process-execution data and to check the validity of the to-be process model with the as-is one.

Thirdly, existing knowledge databases and documents can be linked by employees to specific business processes. This link should be enabled independently from the database of knowledge. An automatic link checker should be implemented to check whether these databases or documents are continuously available.

Fourthly, if a performance system exists, data in the knowledge management system can be integrated with it. The bonus point status can be directly linked to the individual performance status of the respective employee. This, however, requires an adaption of the existing performance system.

Fifthly, the knowledge management system can be integrated into an existing intranet. In this case the user interface, personal information about the employees, and an existing internal messaging system can be used.

The modular characteristic of the knowledge management system allows for a connection to all of the systems described, as well as to only some of them. If none of the information systems is available, the knowledge management system can be implemented on a stand-alone basis. In this case the effort is higher, as a process model and reports have to be set up.
6. Discussion

Using the framework presented, a sustainable implementation of a process-oriented social knowledge system can be set up within an organization. The system provides an overview of the sources of explicit and tacit knowledge for process execution. It allows social connections between employees with regard to the knowledge they need in their daily work routine.

The existing approaches referenced are extended as follows:

- **Explication of tacit knowledge**: Contrary to approaches such as Wexler’s [40], the framework presented proposes the use of a directory instead of a repository. Both can be used in coexistence, but a company’s main focus should be on supporting the exchange of tacit knowledge in the first place. Thus, our framework delivers the possibility of having an overview of and managing existing tacit knowledge.

- **Explication of process-oriented tacit knowledge**: Approaches like that of Kim et al. [19] are extended by using a dynamic approach for the connection of processes and knowledge. The proposed framework highlights ongoing updating by employees. Thus, centralization should be avoided to cover the relevant tacit knowledge at particular points in time. Rather, employees are encouraged to do this continuously on their own. Starting from process maps, explicit knowledge (from documents and information systems) as well as tacit knowledge (generated by expert interviews) is gathered and externalized.

- **Implementation of knowledge maps in organizations**: Our approach describes how an incentive structure should be designed to support sustainable use of the proposed framework. Thus, the approaches of Vail [34] and Eppler [8] are extended by clarifying their generic steps to implement a knowledge map. Furthermore, their general ideas are applied to a knowledge map focusing on business processes.

- **Technical level of knowledge maps**: We extend the approach of Kang et al. [16] by describing the integration of the tacit knowledge directory with existing IT systems. A major difference to Irani et al. [15] is that we clearly point out process-related knowledge as an object of interest. These knowledge streams are connected with regard to tacit and explicit knowledge. Furthermore, the purpose of our approach is not just to identify knowledge streams, but to provide accessibility to this knowledge for employees in their daily work.

Social exchange theory refers, among other aspects, to the benefits of social connectivity in the workplace. Employees have the tendency to connect with each other socially. However, to ensure that this exchange is focused on a specific purpose, the foundations have to be established. In the present case the framework of the knowledge management system is intended to connect employees with regard to business processes. Hence, the framework describes how business processes can be displayed and how employees can indicate and exchange their relevant tacit knowledge. To ensure an exchange of knowledge, an incentive structure is used. The proposed design provides a surface that is likely to be easily used in daily work. Furthermore, the possible integration into existing systems is claimed to lead to a high acceptance of the knowledge management system.

Despite the assumed benefits of the framework for a process-oriented social knowledge system presented here, some limitations have to be considered as well:

- The social knowledge system will not cover areas of knowledge that are not directly connected to a process. This can be, for instance, how a documentation tool is properly used. However, the social knowledge system allows for a knowledge network between employees with regard to important business processes. Such a network allows for improved systematic knowledge exchange.

- The introduction of a social knowledge system implies a significant effort for an organization. If the existing processes have not yet been recorded sufficiently, this will have to be done first. In an ideal case, information about the processes and activities can be transferred from current process models.

- As the framework does not lead to an externalization of knowledge, it can be seen as a directory rather than a repository. Therefore, a loss of knowledge when employees leave the company cannot be avoided.

- The framework has not been evaluated yet. It is theoretically driven and tries to address the shortcomings of existing approaches.

However, the major advantage of the framework presented lies in the ongoing participation of employees. Thus, the aim is to generate an up-to-date social knowledge system that is related to process execution. As maintenance work is distributed to many people, sustainable use can be expected.

7. Outlook

The next steps in the research will concentrate on overcoming the limitations discussed. Firstly, further analysis is required of how adequate details on the levels of business processes can be identified. Further research has to aim at finding a balance between the
coverage of the necessary details and the reduction of complexity to ensure use of the model.

Secondly, the type of knowledge that is not connected to business processes has to be identified. Once the characteristics are known, analysis should be undertaken of whether and how such non-process-related knowledge can be integrated into the proposed framework.

Thirdly, the connection of the directory with repositories has to be analyzed. A mechanism should be developed allowing the identification of suitable tacit knowledge that can be transferred into explicit forms. Thus, the loss of knowledge when employees leave the company is intended to be reduced.

Fourthly and finally, research will concentrate on the exemplary application of the framework. This should be done under the use of the Action Research method within the context of a case study. This enables parallel monitoring, as well as intervention if problems occur.

8. References


[22] Leroy, F., and Ramanantsoa, B., "The Cognitive and Behavioural Dimensions of Organizational Learning in a


