

Just-In-Time Access to Implicit Knowledge with Peer-to-Peer Community Systems

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Abstract. Just-in-Time Knowledge Management (JITKM) is a paradigm that brings together the benefits from traditional Knowledge Management (KM) with the Just-in-Time (JIT) manufacturing concept. Knowledge, when seen as goods, needs to be accessible if it is needed for knowledge work. Therefore tedious retrieval processes need to be replaced with ad-hoc communications with those persons that best match the demanded expertise.

Peer-to-Peer (P2P) systems offer real-time solutions for the management of pieces of explicit information. But also the access to the important, implicit part of knowledge that is bound to humans can be supported by P2P applications: the paper proposes tools that support the search for the optimal communication partner. The choice is based on a match between the content of the question and the profile of the expert. Only few prototype implementations of this new type of KM system are currently available. The paper explains the concept of the *iK^{now}* P2P system.

1 Introduction

Knowledge as one of the important resources of an enterprise needs to be managed efficiently. One approach considers knowledge to be goods. Therefore similar goods related concepts as in other industries can be applied to it. The JIT concept that is predominantly known from car manufacturing, is based on strong linkage of the vendor to supplier and client. Upcoming demand for goods is communicated down the supply chain to have the goods ready to be used "just in time", that is exactly when it is needed.

In service industries, the demand for information often occurs suddenly and demands for ad-hoc answers. Not each answer taken from existing knowledge repositories fits optimal to the question. In many cases asking an expert helps to find a better answer, in KM theory this is an access to the implicit knowledge of the expert. Depending on the underlying problem, different restrictions occur for the solution. Frequently, searching the answer for a considerable amount of time detracts the workers attention from the main task to other fields that come up during the search. Providing search tools that point to adequate knowledge sources on a just-in-time basis is key to efficient Knowledge Management (KM) and consequently to superior business performance.

Such tool should help to connect to the best (in relation to the question) matching experts. These experts have to match both the difficulty of the question (not too easy, not too difficult) but also need to be online at exactly that time. These demands prevent from taking "simple" yellow pages directories who also offer contact information of experts. There is a good chance that the chosen expert is currently not available or does not want to be disturbed. Asking the chosen expert at a later point of time is not an acceptable solution in many situations. Furthermore searching in yellow pages is generally too time consuming. So persons tend to ask the same few already known experts even if that choice is not optimal.

Traditional KM systems support the management of commonly general knowledge. As the traditional publishing processes are costly, providing special focused information seems to be not beneficial. Instead systems that are based on the P2P paradigm offer some desired features and thus their use seems to be beneficial for just-in-time knowledge management (JIT KM).

The JIT paradigm is a concept known from car manufacturing [1]. The concept of straightening the supply chain mainly leads to much smaller interim storage at the cost of better communications and stronger ties to supplier and client [4]. Demand for goods is communicated instantly to the supplier who in turn prepares to deliver the needed parts "just in time" for being used in the production process. In particular the drastically reduced storage leads to significant economical benefits. The production fits much better to dynamic changes of the business. But on the other hand lower redundancy and reduced storage demand for stronger cooperation with the supplier: the manufacturer is dependent on the accurate work of the supplier and the whole logistics chain.

In general *Just-in-Time* signifies that supplier goods are produced on demand. As motivated before this is also desired in parts of the knowledge management business. In traditional KM systems, knowledge is gathered and pre-checked in tedious processes before it is put into the knowledge repository. This prevents from having redundant, unimportant or even false information in the repository, but at the cost of providing the information with some delay and not helping people that look for immediate answers. This up-to-date information can only be found at experts by using a direct communication. Ad-hoc, interpersonal communication is commonly not supported by existing knowledge repositories and can only sub-optimal be reached by using existing communication means like instant messaging or chat rooms.

The paper is structured as follows: a short introduction into the particular part of knowledge management is given in the next section. The notion of Low-Impact Information is introduced as this is the type of knowledge that commonly is not supported. The succeeding part explains the relevant general concepts of the P2P domain and leads to Peer-to-Peer Knowledge Management (P2PKM). Some characteristics and their relevance for KM are explained. The section on JITKM is dominated by the description of a P2P based JITKM tool. iK^{now} represents a new kind of application that match the particular demands from ad-hoc KM in communities. A summary and discussion end the paper.

2 Knowledge Management

This section will focus on only few parts of the broad field of Knowledge Management. In particular the often neglected, but important part of implicit knowledge and a new notion, called Low-Impact Information (LI^2) are presented.

2.1 Management of Implicit Knowledge

The distinction between explicit and implicit knowledge is among the basics of KM [8,9]. Only a smaller part of the knowledge exists in explicit format [6] and is managed well. In contrast, immediate access to implicit knowledge is seen as the major enabler of innovation and competitive advantage. Phone, Instant Messaging (IM) and other communication systems are related tools [7]. While supporting discussions among people, they foster accessing the knowledge of these persons.

But the choice of the person to communicate with often is not optimal. The bigger the community of possible experts, the bigger is the overall amount of knowledge, but the less probable it is to find the optimal conversational partner. Optimality is meant in the sense that the expert is able to answer the question correctly but that he is not held up by too easy or too difficult questions. As example, IM applications only work with smaller groups of buddies because you need a fair amount of knowledge about the buddy (skills) to correctly choose from the list.

Some tools are able to support this search process. A Yellow Pages directory offers information on experts and their skills. Selecting the "best" experts is tedious and often the expert is not available at that time. An automatic match maker that uses real-time awareness information could overcome such problems.

2.2 The Concept of Low-Impact Information (LI^2)

Traditional knowledge management concepts rarely employ characteristics of the exchanged knowledge to choose the appropriate KM tools. E.g. immediate need for information commonly is not distinguished from a permanent or strategic demand. Content is not taken to determine if a completely correct, well-founded answer or just a reference to the approximate direction is asked for. Using at least hints or unsharp information helps the knowledge worker not to spent too much time to find the answer on his own. Being at a foreign place and asking for the way (e.g. to the station) commonly does not demand neither for an exact answer nor for a particular expertise. In general any passer-by with a vague knowledge about the surroundings can provide a rough estimation of the direction to follow.

Thus the provided information helps to continue with one's own work without long delay. When the information was incorrect, asking another person again will identify the error. We call this "Low-Impact Information" (LI^2) as its (non-) availability has only low impact on the current work. Having access to this type of information helps to perform better than searching on one's own.

It needs to be mentioned that asking somebody actually disturbs this person and should be avoided. But not helping the asker results in a worse performance of the overall community (e.g. a company), therefore helping the colleagues is encouraged even if the own work force is reduced by a certain amount. Suppressing questions that could also be answered by less skilled workers helps to avoid stoppage of experts. Therefore, some means of fine-tuning the amount and type of interruptions is required.

In contrast to LI^2 , other information has a high impact on future work. Commonly there is more time to collect the information and check the correctness and trustworthiness of the data. Tools to support the management of this type of information have different characteristics.

The disturbance of the expert remains the same in both cases. Only an automatic service that is based on explicit knowledge can avoid this.

2.3 Peer-to-Peer Knowledge Management

Applications based on the P2P paradigm provide characteristics that can be of particular interest for the KM domain - they look for the targeted information in real time and use a direct exchange of the information [3]. Typical P2P tools are small applications with a limited functionality that are set-up on an ad-hoc basis. They benefit from small resource contributions of all users (storage, processing power). Massive parallel offers guarantee that the service is independent from the single peer (autonomy of the peer). The biggest advantage of P2P tools is the avoidance of central units for the data/message transmission as they become bottlenecks in high traffic situations. These characteristics make P2P tools a good basis for JITKM tools.

When talking about P2P systems, it is important to distinguish between tools that are team oriented and community oriented systems. In small groups or teams, the users know the other users and their skills. Such teams benefit from avoiding central IT infrastructure (e.g. with the tool Groove.net). In contrast community-oriented systems take into account that all members of the community contribute to the provided service. Such systems offer access to a bigger variety of contributors with their knowledge at the cost of not exactly knowing the knowledge sources. This matches with the needs of LI^2 . Thus P2P systems offer similar benefits like public news groups with the advantage of the real-time communication.

3 JIT Access to Implicit Community Knowledge with the Software iK^{now}

The iK^{now} tool prototype stems from an academic project of the University of Bremen ([2], <http://www.iknow-homepage.ch.vu>). The P2P software offers IM functionality combined with additional tools like P2P file transmission. During the installation few options (e.g. describing personal expertise with keywords) have to be set up to connect to the network. iK^{now} supports the exchange of

LI^2 . Commonly the users do not know each other and the questions are routed to different experts depending on the question content and related keywords.

Once a question occurs, the user provides a subject, the question itself and some describing keywords. The design of the tool is very similar to using an email application. There is a rudimentary list of keywords provided to offer a common choice. In the iK^{now} prototype the choice of the keywords is crucial as the matching algorithm is a simple fulltext comparison. In communities special characteristic languages emerge, this differentiates from other communities. Of course there is potential to enhance the matching algorithm or to support the keyword list by a taxonomy server.

After (only) the keywords have been sent to the P2P network, all peers whose user profiles match with the search keywords, automatically notify the initiating peer. The user gets a list and chooses whom the question to sent to. The experts now receive the question/subject and can answer by using the IM application. In case of extended collaboration, the tool can be used to transmit files or to discuss parts of texts (e.g. programming source code). These are only two examples of how collaboration with community members can evolve, once being initiated.

It is important to understand that this kind of automatic search only returns answers from peers that are online. This is an important advantage over other tools that commonly are not able to distinguish between online and offline status.

The quality and quantity of questions that are routed to the own peer can be adjusted by modifying the own profile. Reducing or changing the set of profile keywords limits the probability that request keywords match with the profile. This is a possibility to control incoming inquiries (content, number). Again it has to be mentioned that more intelligent algorithms and the use of a taxonomy will drastically enhance the performance of the tool (without changing the principles).

The idea that behind the iK^{now} tool has also been implemented in the German Science-to-Science project (S2S, <http://s2s.neofonie.de>). The "interactive" service (discontinued) also provides answers on questions that are spread around the P2P community. Different from the iK^{now} project, S2S uses central services to route the messages. Besides a central web server that processes questions from browser based input, the answers are sent to the users by email. This significantly raises the round-trip time and hence limits the usefulness for the management of information on an ad-hoc base.

4 Summary and Discussion

Just-in-Time Knowledge Management is rising as traditional KM systems often cannot cope with ad-hoc demand for expertise. Instant Messaging and other tools that support ad-hoc communications commonly fail because the selection of the communication partner is not optimized. Always asking the same group of persons will only succeed if incentives for the additional work are given. The P2P principle that every peer contributes to the overall service (in this case:

everybody answers some questions) will guarantee the beneficial use of the application. Lightweight tools like P2P applications match those principles well.

The communication partners are online as only such peers are found during the search phase (implicit awareness). A matchmaking algorithm helps to choose experts with expertise to answer the question. The application searches for keyword matches in question and expert profile. If there is a significant match, the peer is offered as possible communication partner. The tool then is used to communicate what can be seen as transfer of implicit knowledge. Instant messaging communications allow to repeatedly ask until the best answer has been acquired.

iK^{now} is a P2P application that supports JITKM by offering a platform to ask a community for advice. The actually available amount of knowledge in a community (e.g. the employees of a company) becomes instantly accessible by using such tool. Different from other approaches, this tool is easy to install resp. use and offers answers to questions in an ad-hoc way. These are true P2P paradigm characteristics. The user can use it with daily questions rather than having a significant amount of work when traditional knowledge management tools are used. The answer as it is processed by the expert and the questioning peer seems to fit better to the need as general solutions from a common knowledge repository.

In total JITKM will benefit from the Peer-to-Peer paradigm. Simple and fast setup of the tool, ad-hoc knowledge exchange and the possibility to address bigger teams or whole communities of co-workers instantly offers superior performance in some areas compared to traditional KM systems.

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