

Knowledge Management in Service Desk Environment: An Overview of Methods, Tools and Techniques

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Keywords: Knowledge Management, Service Desk.

Abstract: Knowledge management and Service Desk are both important topics for successful companies. Good knowledge management practices in Service Desk can improve the quality of delivered service and therefore improve the competitiveness of the company. Based on the literature research followed by analysis we describe and propose methods, tools, and techniques that are or could be used in the Service Desk environment. The methods, tools, and techniques are described according to the phase of knowledge management and the Service Desk activities. This research paper presents a part of work-in-progress research and represents a good base for follow-up research on this topic.

1 INTRODUCTION

Knowledge management is a vital part of a prospering company environment. This discipline connects and impacts many departments and activities in the company and if done successfully, it can improve the competitive power of the company. Service Desk is one of the areas in the company which also benefits from implementing good knowledge management practices. This position paper focuses on the knowledge management methods, tools and techniques that are or could be used in the Service Desk environment. We take into account the knowledge management phases and types of Service Desk activities performed by the Service Desk staff.

As (Aradati et al., 2019) notes, there are not many academic studies concerning knowledge management in the domain of IT support. This paper presents a part of work-in-progress research on the knowledge management methods in the Service Desk environment and involves research of possible ways of their optimization.

2 METHODOLOGY

The research presented in this paper is based on literature research and analysis. Through literature research, we were able to overview knowledge manage-


ment methods, tools and techniques, which were then analyzed for their suitability to be used in the Service Desk environment. As knowledge management has certain phases, we divided the methods according to those and the types of activities that they relate to.

3 STATE OF THE ART

There are many reasons why managing the knowledge in the Service Desk is important. According to (Davenport and Klahr, 1998) knowledge is the real factor that separates companies, thus it has an impact on their competitive power. By managing knowledge of their support the company can improve customer loyalty and satisfaction. This means fewer calls to the Service Desk but also reducing the service costs.

Service Desk, as defined in Information Technology Infrastructure Library (ITIL), is a single point of contact between the customer (or user) and IT support. (Long, 2012) Within the ITIL framework service lifecycle, Service Desk belongs in the Service Operation part. In the Service Operation, there are certain subcategories of processes, which the Service Desk attend to:

- event management,
- incident management,
- request fulfilment,
- access management,

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- problem management,
- IT operations control,
- facilities management,
- application management and
- technical management.

Through Service Desk a user can place queries, requests, or tickets about incidents. The requests can be related to any process listed above.

It is also important to note the difference between the Service Desk and Help Desk as they may seem to mean the same thing. Cambridge dictionary (Cambridge, 2020) defines help desk as “a service that provides information and helps to people, especially those using a computer network”. Service Desk is more complex and provides more complex services to its users and customers. It is usually a part of its afters sales service complementing the product. There are certain levels of IT support in the Service Desk. (Windley, 2002) describes five levels. In the first one, there are customer support and help desk, which resolve only simple and non-problematic tasks, queries, and requests. The rest of the requests are escalated to higher levels. On the second level is technical support with more technical and more complex knowledge needed for incident resolution. On levels 3–5 are specialists such as systems engineers, administrators, network admins, or database admins. An interesting addition is a 0 level of IT support, which (Hertvik, 2015) defines as self-help or trying to resolve the request or query by oneself - through documentation, FAQ (Frequently Asked Questions) or service catalog.

There are many definitions of knowledge management in the literature. We present some of them. (Becerra-Fernandez and Sabherwal, 2010) have a simple definition: doing what is needed for getting the maximum from the knowledge sources. (Dalkir, 2013) then defines knowledge management as a mix of strategies, tools and techniques of working with knowledge.

Knowledge management is described by so called knowledge management cycle, which according to (Dalkir, 2013) has 3 phases:

- knowledge creation and codification,
- knowledge sharing and dissemination,
- knowledge acquisition and application.

(Cerchione and Esposito, 2017) defined different classification of the knowledge management phases:

- knowledge creation,
- knowledge storage,
- knowledge transfer.

4 THEORETICAL FOUNDATIONS

In this chapter the foundations and list of knowledge management methods, tools, and techniques are laid out. The corresponding methods, tools, and techniques are grouped according to knowledge management cycle phases, which are based on the classifications made by scientists in this research field. The individual phases of the knowledge management cycle are listed after each other in a corresponding logical order.

4.1 Knowledge Creation

The creation of new knowledge may come from within or outside of the organization. The knowledge creation within the organization may be induced by learning, research and development, experience accumulation, and learning by doing (Dalkir, 2013).

The creation of knowledge from the external source can be absorbed by interaction with suppliers, customers, and competitors.

(Nonaka, 1994) suggested that the knowledge creation is gained via the interaction of implicit knowledge and explicit knowledge.

(Gray and Meister, 2006) stated some knowledge sourcing methods:

- published knowledge sourcing (publication, manuals, knowledge repositories, intranet, etc.)
- dyadic knowledge sourcing (e-mail, telephone, mentoring) - based on the person to person communication
- group knowledge sourcing (electronic discussion, meetings, communities of practice)

(Rollett, 2003) describes knowledge creation as “development of genuinely new knowledge” connected with terms such as creativity, problem-solving, and innovation. All of these are a part of the knowledge management process of knowledge creation. According to (Rollett, 2003) there are several factors, that influence this process or stage of the knowledge management life cycle. He states, that “mistakes must be treated as learning opportunities” and that “creativity is the bottleneck of the knowledge creation”. He also lists several methods, that are supporting KC: checklists, synectics, assumption smashing, brainstorming and brainwriting, concept mapping, thinking hats, dialogue. The technologies he lists are retrieval tools, brainstorming tools, idea processors, expertise locators, groupware, visualization tools, simulation tools, artificial intelligence, and authoring tools.

(Kaba and Ramaiah, 2017) listed IT tools and techniques used for content creation: authoring tools, templates, annotations, data mining, expert profiling, blogs, and mashups. They also listed IT tools for content management, which include: taxonomies, folksonomies, metadata tagging, classification, archiving, and Personal Knowledge Management. In their paper, they analyzed the usage of tools listed above and their results show, that the most used tools are Personal Knowledge Management (e-mail, portals, news aggregators), authoring tools, and templates.

Other scientists (Cerchione and Esposito, 2017) presented a taxonomy for the knowledge management tools and the practices. To the knowledge creation phase belongs: data mining, data visualization, expert systems, social data mining, text mining, collaborative filtering, crowdsourcing systems, mash-up, idea markets, syndication systems, trust and reputation systems. Practices used for knowledge creation consist of brainstorming, ideas, competition, knowledge elicitation, interview, benchmarking, knowledge filtering, and rating.

4.2 Knowledge Capture

Capture of knowledge also belongs to the first part of the knowledge management cycle. The methods for capturing knowledge, as listed by (Dalkir, 2013), are: structured interviewing protocol, talk aloud analysis, observation, or simulations. Those are methods for capturing the tacit knowledge - the knowledge stored inside the worker's heads and the one which is the hardest to capture. Other methods and techniques are road maps, learning histories, e-learning, learning from others through business guest speakers. To capture the explicit knowledge one could also use techniques such as cognitive mapping, decision trees, knowledge taxonomies, or task analysis.

(Dalkir, 2013) describes three key knowledge capture phases: identification, conceptualization, and codification. In the identification phase, it is determined, what knowledge would be beneficial to capture. In the next phase, the knowledge is modeled in order to conceptualize it. In the last phase, the knowledge is organized and also externalized.

4.3 Knowledge Organization

The base purpose of knowledge organization is to organize the knowledge in such a way, that is most beneficial for later use. (Rollett, 2003) lists out the benefits of knowledge organization: it raises the effectiveness of later retrieval of the knowledge; it enables displaying context with other documents through sub-

ject headings and related materials; it enables intelligent processing such as reasoning or automatic ontology building; and it facilitates communication with the usage of controlled vocabularies so that everyone uses the same terminology and everyone knows what is talked about.

(Rollett, 2003) then declares types of structures in which the knowledge could be structured: thesauri, semantic networks, taxonomies, ontologies, or knowledge maps. It is then important to make a series of decisions when implementing knowledge organization: Do we use existing knowledge organization structures or is better to implement new ones? Do we use multiple structures or do we stick to just one? Do we use manual or automatic approaches? Each of these aspects, that we must consider has its advantages and disadvantages and we must carefully decide, what is best for our current situation in the context of our knowledge management strategies.

4.4 Knowledge Integration and Transfer

The process of knowledge integration is built upon the aim of "making existing knowledge available to an organization" (Rollett, 2003). We can take two approaches based on the type of knowledge we need to integrate into our organization: internal and external knowledge.

(Kraaijenbrink and Wijnhoven, 2008) defined external knowledge integration as "the identification, acquisition and utilization of external knowledge". They also defined three levels of knowledge integration heterogeneity: within the organization, within the environment, and finally between the organization and the environment. There are some characteristics of external knowledge: external knowledge can be valuable, but can also be a source of uncertainty in the company; ownership of the knowledge must be considered - can be public or private; and borders of knowledge entities (open, closed, their heterogeneity).

(Rollett, 2003) states some methods and tools supporting the integration of external knowledge. For example buying knowledge products, which includes purchasing research reports, market analyses, or access to commercial databases. One of the tools is skills management, through which are the skills levels of employees monitored and managed. Thanks to skills management the company can decide, which employees will attend which training courses or the HR department can determine which key skills are missing in the company and therefore what new staff need to be recruited.

(Rollett, 2003) argues that a lot of knowledge exists in some form, but it is really not available to all employees who would benefit from it. So the aim of integrating the internal knowledge is to make all the kinds of knowledge available to whoever is in need of that type of knowledge. It is important to consider what to capture and define what is valuable. It is also important to capture the context of the knowledge, e.g. to be able to pass it through some automatic processing later.

Knowledge transfer, according to (Argote and Ingram, 2000), is the process through which one unit (e.g. department, group, team,...) is affected by the experience of another unit. The transfer of knowledge in the organization is manifested through the changes in the knowledge or, in its final consequence, in the change of the performance of the units. (Rollett, 2003) then describes two types of knowledge transfer methods: knowledge pull and push. In the first case, the transfer of knowledge is initiated by the seeker of the knowledge. This can be done in the form of knowledge fairs, where staff from different departments are brought together and through informal interaction encouraged in the knowledge transfer. Transfer of knowledge through knowledge pull is often facilitated through knowledge retrieval from electronic sources: searching and browsing.

Knowledge push is of a different nature. The transfer is initiated by the system, other person, or group - not the receiver. (Rollett, 2003) defines two types of knowledge push according to the participants of the knowledge transfer: person-person or person-computer. The former is supported by periodic meetings or internal training courses. The latter can be supported by internal portals, e-mail, or institutional instant messaging.

4.5 Knowledge Acquisition and Application

The application of knowledge is the next step after all the knowledge management phases of the cycle. After the knowledge is either created or captured, it is codified and organized, and then made available to the company. Now the knowledge is available and can be applied. The knowledge application aims to effectively find the best combination of the knowledge and the right user of that knowledge (Dalkir, 2013). (Dalkir, 2013) also states some knowledge management tools and methods that support the knowledge application process: learning taxonomies, task support systems, personalization, or expertise location systems.

5 KNOWLEDGE MANAGEMENT METHODS IN SERVICE DESK

The aim of the knowledge management in the Service Desk environment is to maximize the availability of information and knowledge to the employees of Service Desk communicating directly with the users. Users, in this case, could be customers of the company using their product or employees of the company, who are seeking some information, help, or fulfillment of their request. Each group of users has its specific types of requests. Customers are receiving support, included with the product they purchased, in the form of answering queries, resolving incidents, or fulfilling specific requests. Employees or internal users are often contacting the IT Support in cases that something they need for successful completion of their work is not working correctly - the printer stopped working, their internet connection is slow, the computer does not turn on, etc. To successfully resolve all the tasks that are aimed at the Service Desk staff, it is crucial they have access to the right knowledge and preferably at the right time to ensure, that the quick resolution and user satisfaction are achieved.

As is pictured in the previous section, knowledge management consists of many methods, tools, and techniques that can be assigned to a specific phase of knowledge management. In this paper, we divide the methods and tools into three phases - a combination of classifications from (Rollett, 2003), (Dalkir, 2013) and (Cerchione and Esposito, 2017):

- Phase I: knowledge creation, codification, organization and knowledge capture.
- Phase II: knowledge sharing, dissemination and transfer.
- Phase III: knowledge acquisition and application.

Methods chosen for its possibility to be used in the Service Desk environment are categorized by the phases listed above. This categorization is pictured in the Table 1 and the methods are later analyzed in this article. Analyzed methods are chosen based on their current usage in the Service Desk or their possible usage there, and in that case, a proposal on how they could be used is included. Methods and tools are analyzed from the following aspects:

- digital form - is it already used in digital form or could be used it that way?
- user experience - for both staff and the customers
- potential of enhancement by employing artificial intelligence
- difficulty of implementation

Table 1: Knowledge management methods in Service Desk according to knowledge management cycle.

KM cycle phase	Categories of methods	Methods
Phase I	Knowledge creation, codification, organization and capture	theory of inventive problem solving, expert profiling, lessons learned, best practices, surveys, questionnaires
Phase II	Knowledge sharing, dissemination and sharing	apprenticeship, on-the-job training, lectures, best practices, searching, browsing, knowledge inventories, expert interviews, knowledge fairs, communities of practice
Phase III	Knowledge acquisition and application	metadata tagging, automated taxonomy systems, expertise location systems, community yellow pages, expert systems, recommender systems, case-based reasoning systems, customization and personalization, e-learning, computer-based training systems

We can also classify the methods, tools, and techniques based on the type of activities in the Service Desk, to which they are related. We divide the activities accordingly:

- on-boarding of new Service Desk personnel
- learning new concepts of processes in the company (new hardware, methodologies or services) which the Service Desk staff needs to understand and be able to help with
- incident resolution and request fulfillment which includes accessing information (knowledge) or looking up whom to escalate the incident or request to
- logging incidents, which could also include their archiving, creation of best practices, lessons learned - in other words, to create a comprehensive entry in the Service Desk knowledge base for future use and reference

5.1 Phase I

Phase I includes knowledge creation, codification, organization, and knowledge capture. If we consider the types of activities stated above, then we can state that incident logging belongs to this phase of knowledge management.

When Service Desk staff performs incident logging, knowledge about the task is either created or captured - depending on the nature of the incident or request. An example of the knowledge creation could

be: User detects an unusual error in the application he is using, so he contacts the Service Desk to resolve this error. As there is no entry of this error in the Service Desk knowledge base and no available knowledge on how to solve this error, the company must find the solution. When the error is solved and the solution is deployed to the user, the Service Desk staff must carefully log the solution into the Service Desk knowledge base.

There could be several knowledge management methods and tools used. When trying to solve a new problem, Service Desk could employ *theory of inventive problem solving*, which provides a set of techniques and strategies of inventive problem-solving. It can also be used to make forecasts and thus used to predict the development in the Service Desk environment. This set of techniques and methods has a pretty high level of difficulty of implementation, as this is a more expert approach and should be used to solve a problem of higher complexity and importance.

When trying to solve a complex problem that requires expert knowledge, it could be also beneficial to utilize *expert profiling*. This should be done digitally and it has good potential to be employed alongside artificial intelligence. While creating expert profiles, artificial intelligence could help with determining the attributes of company staff from their recent successful interactions with users and customers in certain problem domains. Expert profiling should not be too difficult to implement in the existing solutions used in the company. When done right, the user experience - of both user and the Service Desk staff - should in-

crease.

When it comes to logging the incident and its solution, Service Desk could use *lessons learned* repository containing new gain knowledge. In the long term, this process could also include consideration of updating the *best practices*. These days the lessons learned and best practices are best to be kept in digital form.

It is also very useful to consider the feedback from the user or customer on his satisfaction with the resolution of the incident or request. Service Desk then can gain new knowledge on what could be improved and customized to fit the customer's needs. Methods to gain such knowledge are for example *surveys* and *questionnaires*, carefully prepared to get the most valuable information. Surveys and questionnaires sent to the customer or user after the successful or unsuccessful resolution of an incident are mainly sent electronically. Service Desk may use some ready-made solutions for the survey creation and evaluation or develop their own if they wish to include some custom features. It would be possible to employ some artificial techniques to infer useful information from the survey results for the Service Desk management.

5.2 Phase II

Phase II includes knowledge sharing, dissemination, and transfer. If we consider the types of activities in the Service Desk, we can include the on-boarding activities and adaptation to new features and concepts to this phase.

During the on-boarding of the new Service Desk staff, knowledge transfer is always occurring. Based on the type of transfer, certain knowledge management methods and tools could be used. When the company is "pushing" the knowledge to the new Service Desk staff, they may use *apprenticeship*, *on-the-job training*, *lectures* or special internal courses to introduce the *best practices* of the department. When we are talking about apprenticeship in the Service Desk, we are obviously talking about small scale apprenticeship. For example, a new Service Desk employee or more employees are assigned to a senior Service Desk staff member. They are learning all the important things from the senior staff member. The staff member is also considered their mentor. He or she not only helps them with their on-boarding, but also passes on all the tricks and tips learned from years of practice in the area. Question is, could this be digitized? Although the person-to-person contact is better, there may come times, where that is not possible. One option would be to use online communication platforms. Another option could be the automation of the whole process, as all of the knowl-

edge needed for the optimal work performance of the Service Desk staff would be represented in a form, which could some artificially intelligent computer entity, such as virtual assistant, work with and understand. The on-boarding staff could then consult with it.

When the new employees are "pulling" the knowledge, they might use some methods of self-learning through *searching* and *browsing* in available *knowledge inventories*. The materials in those inventories are probably already digitized or it could be easily done so. The user experience for the Service Desk staff members depends on the implementation of the knowledge inventory, which shouldn't be very difficult - it is probably already used in some form.

The second type of Service Desk activity in the Phase II of the knowledge management cycle also includes knowledge transfer. When the company starts to sell new products, use new software, or practicing new methodologies, the Service Desk staff must be adequately prepared to react to new requests and incidents. Because of this, it is essential to transfer the knowledge from competent sources through for example *apprenticeship*, *expert interviews*, *lectures*, and *training*. It could also be useful to organize some *knowledge fair* or *community of practice* events to facilitate the transfer - both in a formal and informal manner. A possible use for artificial intelligence in knowledge fairs or communities of practice would be if they are held online. Based on the participant's profile and the professional interest of the seeker of the knowledge, the system could automatically offer contacts of participants to which one could be interested to talk to.

Lectures and training courses held online offer its participants the possibility to complete the course and get the needed knowledge any time they find suitable. This makes for a better user experience. Also, the implementation is not difficult as it becomes more common to use online training courses and other training tools.

5.3 Phase III

Phase III includes the knowledge acquisition and application. Into this phase, we can include the incident resolution and request fulfillment. We can also, in some form, include part of the on-boarding activities.

When is the Service Desk staff trying to solve some incident or fulfill a request from the user or customer, the knowledge application process is in place. In the example of resolving an incident, the staff uses their current knowledge of the problem or tries to look

up the solution in their knowledge base. There are many tools and methods to help with this process. When looking up the knowledge in knowledge base, a *metadata tagging* practice may come in handy and speed up the process alongside with some automated tools such as *automated taxonomy systems* or *expertise location systems*, which can help with finding the right solution or the right person, whom to escalate the incident or request. To this, we may also add a tool called *community yellow pages* to speed up the process and extend the possibility of finding the right person to consult with. If the knowledge base is structured and organized in a way, that could be understood by the computer, *expert systems*, *recommender systems* or *case-based reasoning systems* may be of great help. Those already function in digital form and use methods of artificial intelligence. The user experience of working with these deeply depends on their design. Their implementation may be a bit difficult and time-consuming as they need to be well designed and programmed to function properly and effectively.

Customization and *personalization* may be also very useful during the incident resolution or request fulfilment. According to (Zaslavsky et al., 2007), personalization in the IT service desk did not yet receive much of the attention that it deserves. If the Service Desk staff has the opportunity to personalize and customize the environment they work with, it enables for faster and more efficient resolution, as the worker is more comfortable using the tools at hand. It could be brought up to another level if the Service Desk employees would be assigned certain types of requests and incidents based on their knowledge domain and level of expertise. For example (Baysal et al., 2009) proposed a framework for effective assignment of the developer who will solve a certain bug. This could also be implemented in the whole scale Service Desk. Their proposed framework takes into account: the level of expertise, problem domain preferences of the employees, and also their schedule to ensure no one is overloaded with the task to solve. With the software personalized for the employee's knowledge domain of expertise, the Service Desk department can optimize the process of resolution. It would be good to employ some artificial intelligence methods in this process. Those methods could help with the process of assignment of the requests and incidents to the right Service Desk staff members.

We also mentioned the on-boarding process. During that the new Service Desk staff may come into contact with some form of *e-learning* or *computer or web-based training system*.

6 OUTLOOK

Thanks to the determination of methods that are used or could be used in the Service Desk environment we will be able to further develop our research in this area. Achieved results pose a good base for future research, which will be focused on optimization of analyzed methods and research of possibilities of improvement and modernization by employing advanced methods of artificial intelligence. Appropriate knowledge management methods, tools, and techniques used in Service Desk could be further described and analyzed to discover possible weak links in the process of their usage in common Service Desk practice.

7 CONCLUSION

In this paper, we presented a part of our work-in-progress research on the topic of knowledge management methods, tools, and techniques used in the Service Desk environment. We described three phases of knowledge management and analyzed the corresponding methods and tools based on the different types of activities performed by Service Desk personnel. We also laid out some possibilities for future research in this domain.

ACKNOWLEDGEMENTS

This work was supported by university-specific research project SGS-2020-1047 Analysis of Advanced Knowledge Management Methods and Tools for Optimization of Service Desk Environment.

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