Czech University of Life Sciences Prague

Faculty of Economics and Management

Department of Information Engineering

Diploma thesis

Knowledge base analyse

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CZECH UNIVERSITY OF LIFE SCIENCES PRAGUE

Faculty of Economics and Management

DIPLOMA THESIS ASSIGNMENT

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Systems Engineering and Informatics
Informatics

Thesis title
Knowledge base analyse

Objectives of thesis

Diploma thesis is focused on problem of knowledge base. The main objective is analyse and comparison of selected knowledge base solutions. Partial goals of this work are:

- characteristics of knowledge base,
- feedback from company to help choose the best knowledge base,
- processes in knowledge base (addition, updates and usage),
- improvement of the current knowledge base or implementation of the new one.

Methodology

Methodology of the diploma thesis is based on study and analysis of specialized information sources. The practical part is focused on analyse and comparison of selected knowledge base solutions based on selected criteria with the subsequent implementation of the sample output. Based on a synthesis of theoretical knowledge and the results of own solution, the conclusions of the thesis will be formulated.

The proposed extent of the thesis

60 – 80 pages of text.

Keywords

knowledge base, kb, information, FAQ, implementation

Recommended information sources

ABITEBOUL, S., Richard HULL a Victor VIANU. Foundations of databases. Reading, Mass.: Addison-Wesley, c1995. ISBN 0201537710.

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Expected date of thesis defence

2019/20 SS – FEM

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Electronic approval: 14. 10. 2019

Ing. Martin Pelikán, Ph.D.

Dean

Prague on 04. 02. 2020

Affidavit

I declare that my bachelor work "Knowledge base analyse" was elaborated independently under the guidance of the bachelor thesis supervisor and using specialized literature and other information sources quoted in the thesis and listed in the list of used resources at the end of the work. My bachelor thesis further declares that I did not infringe the copyrights of third parties in connection with its creation.

In Prague on

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Acknowledgement

I would like to thank Ing. Pavel Šimek, Ph.D. willingly providing the necessary information, advice for preparing. As well I would like to give him my thanks for the time what he did dedicate to me.

Also, I would like to give my thanks to co-workers from IT department of SPORTISIMO s. r. o., who have willingly shared their time to provide needed feedback during the process of the thesis.

Knowledge base analyse

Summary:

The main subject of this diploma thesis is to provide a comparison between Knowledge base solutions and analysis.

The theoretical part describes the historical factors which were the basis of the development for nowadays solutions of the knowledge base, as well as explaining various aspects that are influencing the specific concepts and ways how the given knowledge within the company is being built and maintained. As the development in the past shown to companies that the subjective experience of their workers is showing the intangible wealth of the given company.

In the practical part, we focus on the specific solution and providing analysis of the current knowledge base of the company, such as evaluating various processes in the already implemented knowledge base to assess the significant flaws and gaps which need to be improved. As well as collecting the feedback from the company to choose the most optimal solution which can be either used to improve the current knowledge base or to help implement a wholly different and better option in the future.

Keywords:

Knowledge base, kb, information, FAQ, implementation, improvement, comparison, feedback

Analýza databáze znalostí

Souhrn:

Hlavním cílem této diplomové práce je poskytnout komparaci mezi databázemi znalostí, jejich řešením problémů a analýzu.

Teoretická část popisuje historické faktory, které byly základem vývoje pro dnešní řešení databázi znalostí a vysvětluje různé aspekty, které ovlivňují konkrétní koncepce a způsoby, jak jsou dané znalosti v rámci společnosti budovány a udržovány. Jak vývoj v minulosti ukázal společnostem, že subjektivní zkušenost jejich pracovníků je nehmotné bohatství dané společnosti.

Praktická část se zaměřujeme na konkrétní řešení a poskytujeme analýzu současné znalostní báze společnosti, jako je vyhodnocení různých procesů v již implementované znalostní bázi k posouzení významných nedostatků a mezer, které je třeba zlepšit. Stejně jako shromažďování zpětné vazby od společnosti zvolit nejoptimálnější řešení, které lze použít ke zlepšení stávající znalostní báze nebo k pomoci při implementaci zcela jiné a lepší možnosti v budoucnosti.

Klíčová slova:

Znalostní databáze, kb, informace, FAQ, implementace, vylepšení, srovnání, zpětná vazba

Table of Contents

1. Introduction

Knowledge, as it is, has always been recorded in the past via various means such as by words from person to person, papers books, scripts, later even transformed into data. Those can be found on the internet and are near the term eternal, compared to books and other means which have been used in the past.

In the past, it was way more common to hire someone based upon the knowledge that has been given to him through school, high-schools, universities, or college. Yet this shifted in the last few decades where the main attribute to be hired has been to have experience and so, knowledge which can be useful and used for the given company. Ideally, even recorded to the internal knowledge base to provide the understanding of the given member to be registered and so, strengthening the competitiveness and effectiveness.

In today's hectic world, where there are countless companies, it is easy to find the overall information on how to use the knowledge that has been recorded by someone. Yet, the knowledge base of any company is one of the main strengths compared to other companies, which can be used to increase competitiveness. Knowledge of what does the company can be used in numerous ways, from the simplest tasks such as solving an issue that can be solved by mostly anyone within the given company, to the most complex matters where studying could take countless hours of the specific worker. Yet, the knowledge base of the internal company, once built, can help with such tasks to make it much more comfortable and less demanding for the worker to study the functions which have been given to him and make his time much more effective.

As it stands, the knowledge base might go in-depth in some specific fields. Yet, it is usually not required as the straightforward solution for the given task is often enough for the employee to understand how to solve some issue or how to provide a permanent solution for the task given.

If the company is not having any knowledge base and it is working based on a word-to-word basis even during these years, the given company is not only loosing on the competitiveness and effectiveness. This can lead to the fact that other companies might have but also on potential margin and profit on the field. Yet, the building of the knowledge base without any proper basis is a rather hard task to do as there needs to be provided enough support from the higher hierarchy members, as this task might be a long term goal that does not yield immediate results, which are usually aimed for.

2. Objectives and methodology

2.1   Objective

The diploma thesis is focused on the problem of the knowledge base. The main objective is to analyze and comparison of selected knowledge base solutions. Partial goals of this work are:

- Characteristics of the knowledge base
- Feedback from the company to help choose the best knowledge base
- Processes in the knowledge base (addition, updates, and usage)
- Improvement of the current knowledge base or implementation of the new one.

2.2   Methodology

The methodology of the diploma thesis is based on the study and analysis of specialized information sources. The practical part is focused on analysis and comparison of selected knowledge base solutions based on chosen criteria with the subsequent implementation of the sample output. Based on a synthesis of theoretical knowledge and the results of its own solution, the conclusions of the thesis will be formulated.

During the analysis, the primary method for comparison was the measurement of performance and feedback from the responders for the current solution, comparing the current most essential steps and their performance which is used on day to day basis to provide the most optimized result with a financial standpoint to give an overview how expensive is the given solution for the specific case scenario within the company.

3. Theoretical part

The goal of the theoretical part is to define and explain the main and mostly used terms related to knowledge and knowledge base. As well it teaches various options and theoretical fundamentals which have been used and are used in nowadays knowledge base. Aspects of the theoretical part are based on a comparison of multiple literature authors.

3.1 Types of knowledge
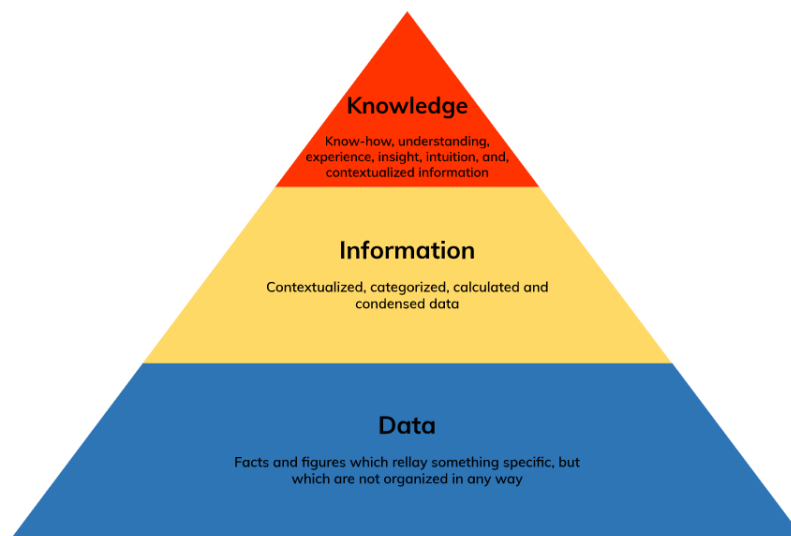
Figure 1 - The knowledge pyramid (Hajric, 2018)

3.1.1 Data

It is represented as an unorganized specific relay of sets and figures. Data can be described as a sound, numbers of given numbers, letters, audio, anything that can be identified by human senses.

As senses are purely objective, those can be strictly individual on the basis that each person can reflect those in a different manner, which may result in different results which are personal on case to case basis. (Truneček, 2004), (Chris & Parcell, 2005)

Data are split into two categories:

- Structured: Data, which can be distributed and adequately organized, filtered, and worked with to be correctly transformed into a piece of information. As an example, structured data can be represented by some object or plain facts.

- Non-structured: Data, which are posing a flow at the given moment, such as a set of numbers, letters, video, or audio recording. (Sklenák, 2001)

3.1.2 Information

Information is a transformed set of data to which does have a specific role to the given user, as well as having some particular and already establish a relationship with the user. As the user is already working with information and no longer with data, the user can determine the redundancy and ability to use the specific information for the given task. This leads to creating relevant and non-relevant information that can be individual to a particular user, as well as showing if that information is potential, information what is not immediately useful and might be used in the future, or immediate, which can be transformed to immediate action based on this information. (Sklenák, 2001), (Truneček, 2004)

For the user, information is able to tell a more refined picture of the adequate weight for relevance and purpose.

Information is representing the day-to-day basis to questions such as Who? What? Which? When? How? Where? Why? (Truneček, 2004)

3.1.3 Knowledge

Knowledge can be represented by an interconnection between various information that has been interconnected by the user via multiple values, their skills, facts, processes, and ways how to treat each specific information. Interconnecting those means to build knowledge, a how-to-do a given task in a way, which has been made up by the user. The experience varies as the information is made individually, so two users may not have the same process of how to treat their knowledge. Yet, the output remains similar if the knowledge is correct and not false.

There are two types of knowledge, explicit and tacit. (Chris & Parcell, 2005) (Polanyi, 1966)
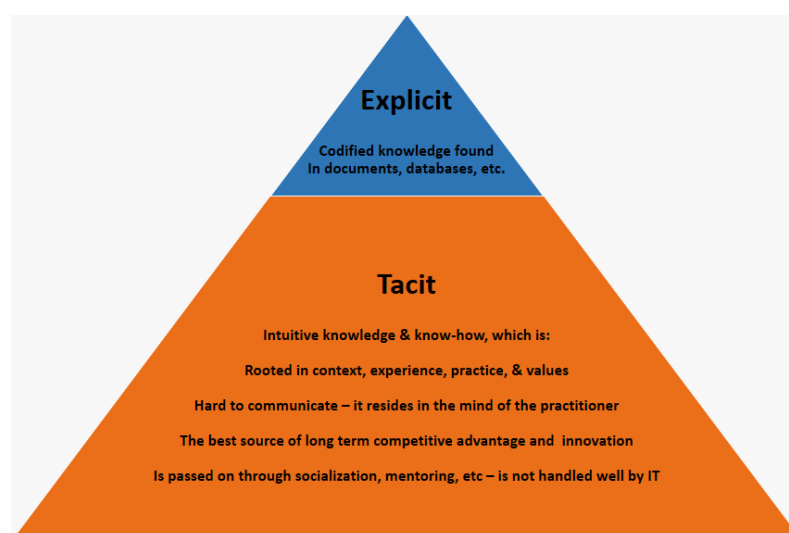
Figure 2 - Tacit and explicit pyramid (Hajric, 2018)

3.1.3.1 Explicit knowledge

Explicit knowledge is the knowledge that can be transferred, recorded in a way that those data can be given to the user without this knowledge to learn it without any knowledge of the specific problem or task whatsoever.

This type of knowledge is always easily explainable, as the explicit knowledge shall not be individual and based on the scenario, which is not changed on the user's specific actions. It can also be easily changeable, organized, and they are given to the user as information to build their ways how to treat the task.

Explicit knowledge is easily preserved, as there is minimal need for individual interaction as this information is the knowledge that is being mainly used within the knowledge base. As if the user who made up this explicit knowledge could leave the given company or change position, explicit knowledge shall remain the same with no longer needed action of the user who recorded it. (Collins, 2012)

3.1.3.2 Tacit knowledge

Opposite of explicit knowledge, tacit knowledge is a mainly individual way how the user is treating the interconnection between the explicit knowledge, the user's personal experience, and means how the knowledge is utilized.

Tacit knowledge leads to progress within the company as the individual input is a way how to make the breakthrough, new ways of how to solve tasks or problems, which can lead to better effectiveness and utilization.

Compared to explicit knowledge, it is highly personalized and individual in a way that some users might never proceed and make the given explicit knowledge a breakthrough, improving it and making progress within this field. Or, one user can look at explicit knowledge in a way that it was never treated ever before and making an immediate breakthrough. (Polanyi, 1966), (Collins, 2012)

3.1.4 Knowledge breakthrough

Knowledge breakthrough is the primary goal of the company as the well-made knowledge base might lead to those. This breakthrough might increase the efficiency of any given recorded task within the knowledge base, which leads to better results in the future.

Breakthroughs are established and emphasized by providing explicit knowledge to the user and letting him build his tacit knowledge. This leads to building up of the own personalized and individual inputs, which can lead to those breakthroughs via finding a gap, utilizing the user's personal experience or knowledge. (Chris & Parcell, 2005)

3.2 Knowledge base

A knowledge base (KB) is a set of organized knowledge, which has been recorded by a different person. The user of the given knowledge base can find the needed information to provide him help with the given task. Data within the knowledge base are organized in the way that even a user who does not have experience within the knowledge base will find a solution without any issue and struggles with the needed help or assistance of the different users.

Contributors of the database are usually the different users who are tasked to manage and organize the data, which has been distributed by the other users, who are allowed to add new data to the knowledge base. Those contributors are as well allowed to change the non-relevant information with or without the supervision of the administrators of the knowledge base or even delete the no longer relevant information, which could hinder the progress of their goal.

Content within the knowledgebase can be oriented around one shared field or can be more complex, including various areas of the given company. All the content still needs to be organized and kept up in a way that any new potential user can use it whenever and however they want.

Knowledge bases were usually kept as the library of the information which can be browsed with the usage of the computer, or sometimes even printed out for the new users to read through. Yet, the development of artificial intelligence (AI) is now offering ways how to make it even more straightforward than ever before. Automated answers through artificial intelligence, a conversation to find precisely what they are looking for, or also offering an option to report missing information within the knowledge base to help and develop it.

It is in the company's interest to build the knowledge base with explicit knowledge with minimal tacit knowledge as that can hinder future development and prevent the potential breakthrough. (Wiig, 1996), (Trochim, Donnelly, & Arora, 2015), (Abiteboul, Hull , & Vianu, 1994)

3.2.1 Knowledge base concepts

The main two factors used in the knowledge base are like sets that can be found on the service desk. We differentiate users of a user, who is demanding the knowledge kept by knowledge base, a requestor. And the opposite side, a contributor, who is referred to as responder. Those two users have a closer connection via a knowledge base.

The interaction between the requestor and the responder shall be minimized to a minimum, as the main goal is to provide the requestor of the knowledge base maximum information needed without a need to have them wait for a responder to add the required information.

It is possible to establish the connection between requestor and responder to enhance the knowledge held within the knowledge base, which might lead to a breakthrough. This breakthrough might as well cause the swap between the responder or requestor or have the cooperation manner where the requestor will become a responder and responder might remain responder. (Statdlober, 2017), (Bell, Bryman, & Harley, 2019)

3.2.1.1 Requestor

The requestor is the user who is unknowing, in need of help or seeking expanding his overall knowledge. This user does not need to yield and knowledge of any manner that is kept by the knowledge base, yet it might be possible to have some basic understanding.

Requestor as well can be a user who might have some retain knowledge from the past, yet the instruction given from the knowledge base might have been updated by the responder or wholly changed, and thus, that is why advanced requestor might have incorrect data. This could have been caused by the implicit change of knowledge by some other user, which had an impact of the explicit data within the knowledge base.

In case of missing information, the requestor is putting a request for a responder to update or create the knowledge that shall be used to solve the task or problem at hand. (Statdlober, 2017)

3.2.1.2 Responder

The responder is a contributor to a knowledge base who has already inserted a knowledge within the knowledge base. This knowledge is explicit, not implicit, in providing the implicit options for the requestor.

The data which are inserted by responder is confirmed to be correct and the best current solution for the given task, without any suggestions what shall be improved, changed or added, as the knowledge within the knowledge base provided by responder shall be exact and correct to minimize the interaction with the requestor. (Statdlober, 2017)

3.2.1.3 Administrator

The administrator might be as well the responder, yet it could be a sole person who is maintaining and organizing the knowledge base and its integrity. The development and implementation of the new ways how to find and work with the knowledge within the knowledge base are up to the administrator. As it is, the administrator needs to be in touch with the requestor and responder when any significant change within the knowledge base is done, to either test if the change is beneficial for the other parties or not. (Hector, 2013), (Hajric, Knowledge Management: A Theoretical and Practical Guide for Knowledge Management in Your Organization, 2018)

3.2.2 Knowledge base creation and administration rules

The building of the knowledge base is not an easy task depending heavily on not only the user's willingness but various other factors such as time to build such, funding of the knowledge base, allowance of the administration of the knowledge base, and many other factors. Those factors might even discourage the development of breakthroughs if users are forced not to provide any feedback on the given knowledge base. This might also result in creating a mostly tacit knowledge base, which might be used only by one or few users of the team, which could result in lost potential efficiency gain and progress of the company.

Administration shall always be allowed with cooperation with the option to provide

breakthroughs as those might improve the overall knowledge base by a considerable margin of any given company. Not allowing the administration will not only hinder the efficiency yet might have the company stuck with some knowledge base that is not even followed. The users will instead use their implicit ways of handling things, rather than using the knowledge base provided by the company.

Start-up companies or new companies usually start without any creation of their disposal. Often, this company either creates the knowledge base without even realizing it, yet the non-systematic nature might hinder the process in the long run.

Already established companies do have a knowledge base in one form or the other, someone in charge which can administrate and check the given information. The main problem which might those companies run into is the fact that the platform of the knowledge base is not well supported and taken cared of might not be ideal for the user, enforcing the creation of different one. The diverse knowledge base might be yield even better outcomes than the one that the company is supporting, yet there is a risk that the information within might not be explicit enough. (Levesque & Lakemeyer, 2001), (Truneček, 2004)

Knowledge base creation has several steps that need to be accounted for during production. Those steps are like project-based lifecycle yet alternated to fit the role of the knowledgebase.

Those steps would be:

- Initiation phase: Define the main goals of the knowledge base

- Planning phase: Mainly decision of which platform the knowledge base will be held and if the knowledge base will be one-user made or team-based made

- Integration phase: Integration, based upon the planning phase

- Monitoring phase: The knowledge base is getting developed, monitored and maintained

- Closing phase: Closing phase during the knowledge base is the phase where the administration of the knowledge within takes hold (Pathak, 2018), (Project Management Institute, 2017) (Weiss & Wysocki, 1992)

3.2.2.1 Initiation phase of knowledge base creation

The initiation phase is set when one knowledge base is either developed within the company or workspace where there is not existent knowledge base or some, which is not reaching the requirement of the environment. As the goals of knowledge base among the various situations, companies, departments, or teams might always be different, it is still to set up which goals the knowledge base needs to fulfill.

Those goals can vary, yet the principal basis of which goals this knowledge base needs to fulfill needs to be already decided before the planning phase occurs.

The main question during the initiation phase of the knowledge base shall be who will be corrected using the knowledge base. This question is helping the people who are integrating the knowledge base maintain the knowledge base and adjust the scope and overall goal of it. This means to have some global knowledge of what the knowledge base shall help with, who is the target audience, and how much it can help the department, company, or such to improve the performance. (Project Management Institute, 2017), (Westland, 2007), (Weiss & Wysocki, 1992)

3.2.2.2 Planning phase of knowledge base creation

During the planning phase, there must be already established as the primary goal and scope of the knowledge base. It shall be already established even if it will be any help and given benefit to the company, team, or department.

Answers which shall be answered during the planning phase:

- How much will the knowledge base be used?

    o It is essential to explain how often people who will be using it will rely on it. This might have a direct impact on integration or people using this knowledge base.

- How will the knowledge base be integrated?

    o The integration of the knowledge base is an essential part of the planning phase, as some knowledge base can fulfill requirements even written on the paper. Yet some others, more utilized needs to be delivered in digital form.

- How will the knowledge base be distributed?

    o If the knowledge base will be used on a broader scope than just one department, will there be some usage of distribution among the whole company? Or will word-to-word basis be enough?

- One-user made or team-based knowledge base?

    o Usually, the knowledge base can be maintained by one person, yet sometimes it is recommended to have a team distributing it, maintaining it, and developing it. Each of those options is bringing various risks and benefits.

- How much support the company/team/department will be given?

    o It is given that some places are not supporting the knowledge base as it should, so it is crucial to establish how much time and money will be dedicated to the integration phase. (Project Management Institute, 2017) (Westland, 2007), (Weiss & Wysocki, 1992)

3.2.2.2 Problems with one-user made knowledge base

Knowledge base might be created even by one of the users who want to record his knowledge and information what did he/she collected over the years in the company, the

methods and such and this often leads into development of the knowledge base based upon one's knowledge. This leads to the fact that the tacit knowledge is being distributed among the members as this knowledge has been created with the personalized mindset of the user.

This again leads to the lack of explicit information as the process recorded by the original user is usually not recorded in a way that they can be exact enough for the other users.

If the knowledge base is funded by the experienced user, who is able to provide explicit knowledge and ready to distribute this knowledge to the other users, this used is becoming an administrator of the database, holding the right to coordinate the contributors and validating the knowledge contained within the knowledge base.

Another disadvantage of this style of knowledge base might be the amount of work that is put to one user. This, in the long term, might result in the fact that the knowledge base is not supported enough and slow down the progress of the development if the one user is not dedicated to the event. The main decisive factor with one user-development is the fact that the integrity of the knowledge base will always be the same; the structuration and way of how each knowledge is handled will remain the same. (Ullman J. D., 1988), (Statdlober, 2017)

3.2.2.2 Problems with a team made knowledge base

Building the knowledge base as a team might result in a better outcome than solo-based creation if the team can provide enough feedback among them. As more than one user reviews the knowledge shared within the knowledge base, it can make the more explicit result. As this results in a more precise effect, it might hinder the breakthrough if the team will be continually building up the knowledge base together, always trying to satisfy everyone's preference to have the way as it has been made.

As the knowledge base is made as a team, there will always be a team of administrators of any given knowledge base, which might result in positive and negative effects.

The positive effect is that there will always be supported and fast development of the knowledge base, yet the integrity and structuration might start to fall apart if the team is not coordinated well enough. (Ullman J. D., 1988), (Statdlober, 2017)

3.2.2.3 Integration phase of knowledge base creation

This phase is already working with planned goals from the previous phase, able to answer the essential answers such as who will be the primary users of the knowledge base, how often it will be used as well as things such as how it will be distributed and how it will be integrated.

Those questions are required to start with the integration phase, as those have a significant impact on the result.

The integrator of the knowledge base might be given by various means, such as a paper as the paper knowledge base might be an excellent start to base the digital knowledge base during the implementation. Yet, having the paper knowledge base is already outdated and is resulting in a lost performance at places even where the computers are not used that much, so the development of the knowledge base shifted to tablets or even mobiles to help the users with their tasks.

The integration might result in a simple text file, which cannot be remotely controlled to results such as remotely controlled and monitored knowledge base, which might be even connected to various servers to provide the speed of the knowledge base and not to cause resource-demanding knowledge base.

During the integration, either one user or team shall be in touch with a small group of users who will be using the knowledge base. This will result in faster integration and the option to easier manipulation of the knowledge base during the next phase, monitoring phase. (Ullman J. D., 1988), (Statdlober, 2017)

3.2.2.4 Monitoring phase of knowledge base creation

During the monitoring phase, it is recommended to allow all the users, who are the target audience, to use the knowledge base and provide the feedback.

The monitoring phase shall last as long as it is required and monitor if the users are not looking in other ways to find a knowledge of what is already recorded in the knowledge base. If the experience is not recorded, it shall be monitored as well, if the users are encouraged to use the record their newly obtained knowledge within the knowledge base. All of this is the primary

goal of the new knowledge base to promote the users of using it, instead of creating their notes and knowledge, which can lead to distribution among other users. If this would be the case, it is recommended to have direct feedback from those users, such as those that might be essential in the long term. Such users might be providing critical feedback, which might lead to discouraging other users from doing as they did. These users shall not be taken negatively by the integrators, as they found a gap within the knowledge base that shall be taken care of immediately to prevent long-term issues.

The feedback can be delivered by directly showing the current state of the knowledge base and already teaching the users how to use it, or even having a tester who will be encouraged to use the newly integrated knowledge base to provide the needed feedback. This directly depends on the given resources to integrate and develop a knowledge base.

It is proven that the more feedback is, the better in the scenario of the knowledge base, yet the input shall come only from those who are directly using it and not those. It is not required to get feedback from those who will not be using it or might use it in the future, as the requirements of users, using it after integrations might not be met. (Ullman J. D., 1988), (Statdlober, 2017)

3.2.2.4 Closing phase of knowledge base creation

The last phase during the knowledge base is the closing phase directly leads to the administration phase, as the knowledge base cannot be completed. During this phase, it is already established how all the knowledge will be recorded, how the knowledge base is used, and each user who is using the knowledge base knows how to use the current one. Feedback of the change is still provided, yet any critical parts like restructuralization of the knowledge within the knowledge base can be done; it shall not be done in the short-term period after the integration and monitoring phase.

The overall change of the knowledge base is now within the data held within, not the platform it is being used and distributed. The knowledge is monitored by the responder or responders, depending on if it will be a one-user made knowledge base or team-made knowledge base, and the users, now requestors, are able to find the knowledge within the knowledge base to help them with their tasks. The information within the knowledge base and its structure is already established and shall not be changed dramatically, as the dramatic changes might cause the destabilization of the knowledge base. That would directly lead to users be discouraged from

using the knowledge base that has been implemented and create their own, what is not wanted. (Ullman J. D., 1988), (Statdlober, 2017)

3.2.3 Administration of the knowledge base

It does not matter if the knowledge base has been established recently or if the knowledge base is already maintained for the long term. The main goal is that the administration is done well enough that the knowledge within is maintained, structured, easy to read, and is explicit sufficient for the requestor.

Requestors might as well distribute the newly obtained knowledge, and it is the responder's or administrator's job to transfer this tacit knowledge to explicit, so there is not the tacit impact of how the things are done and maintained. This task is recommended to be done with more than one user as the responder might change the tacit knowledge of the requestor to the tacit understanding of their own, what is not wanted

The experience is then passed among the requestors and just maintained to be organized and kept structured, as the requestors might be inputting the understanding as they find ideal, yet not suitable for others.

Administration of the knowledge base is not a hard task for whoever can differentiate the difference between tacit and explicit knowledge. Yet, the overall development of the knowledge base from the knowledge perspective is not encouraged by the responders or administrator, but by the requestors. Responders can add the knowledge within, yet if there is not enough feedback on what requestors might want to know or learn, the responders can keep the administration of the knowledge base static for a while. Yet the development shall shift to dynamic the very moment as the responders find some gap or improvement the knowledgebase.

Overall development platform wise depends if it is required as if the requestors are providing occasional feedback, and the responders with administrators are able to change those quickly, there is no need for the overall development of the platform. Yet, the development of the platform shall be done from time to time with seeking new ways of how the knowledge is treated and allowing the users new ideas on how to seek knowledge.

New ways of finding the knowledge within the knowledge base might be simple things as finding specific text through the search bar, through the usage of AI, which might be

implemented within the platform or developed with the platform, to options such as chatting with the living person who might offer help. Yet the opportunity to have a chat with the living person is close to direct contact with the administrator or responder, which is not a goal of the knowledge base as it is. (Cooper & Schindler, 2013), (Ullman D. J., 1982), (Statdlober, 2017)

3.2.4 Knowledge base platform

As with any knowledge base, it must be integrated on some platforms. The knowledge was firstly recorded on the paper and then transformed into digital form. Paper versions are now almost redundant as the computers are available virtually at any working space. The digitalization of the data allowed to back up any given data, safely store it and prevent the security breach and leak of that information.

Different platforms are offering not only better usability yet various ways how to help the users utilize the knowledge base as a whole product.

Many platforms can be used freely, yet the options are in a much smaller margin than those, which are usually paid. But it is not true that the free one is the worse and the paid one is better as many free options offered to companies might be enough for the knowledge base, yet it is usually common that the paid platforms to host knowledge base offer more utilization and abilities to help the administrators, compared to free variants. (Statdlober, 2017), (Hajric, Knowledge Management: A Theoretical and Practical Guide for Knowledge Management in Your Organization, 2018)

Paid versions compared to free versions are often offering:
- Multiple language databases of the knowledge base
  - o This might be helpful in the case of international companies. Some multilanguage knowledge base are offering separated database for different countries
- Faster support in case of knowledge base problems
  - o Some problems or needed help by administrator(s) might be provided faster

- More users

    o Free knowledge bases are usually limited to a small group

- More space to store the knowledge

    o Able to store more knowledge

- Various roles among users

    o Different roles might have different pricing, so the company might find various options to fund the knowledge base

- Backups

    o Backup of the whole knowledge base with various options of backup and how often the knowledge base is backed up

- Removing advertisement

    o Free knowledge bases are usually funded by advertisement, which might be distracting for the users

- Custom HTML/CSS

    o Various ways how to adjust the style and look of the knowledge base

- Private and public knowledge base

    o Knowledge base might be offered to the third party with specific roles and options on how to manage these scenarios

- Connection of knowledge base to active directory

    o Directly connecting through a domain of active directory user without a need to make second registration

- Various added utilities to knowledge base users

    o These utilities might help each user differently, increasing their efficiency

3.2.5 Added utilities to the knowledge base

Added utilities to the knowledge base are aiming at improving the user's efficiency and capabilities on the implemented platform. The more available and more utilized the services are, the more efficient the knowledge within the knowledge base can be.

For requestor, it can just as simple as a search bar, allowing the user search for the knowledge what has been recorded, fully utilizing the fast-search option among the whole knowledge base, or more complicated utilities, like chat with AI, recommended searches, direct requests for updates of the knowledge base for requestors and so on.

Requestors could be provided better utility by the integrated platform with more accessible ways to edit the knowledge within the database, speed up the process of the updates, to have the updates with a history in case of human mistake or keeping track of the most used fields and topics.

The administrator could have in-detail fields, which are used, how much the requestors are active, who accurately edited what, how the knowledge base is utilized, direct feedback from the users for improvements, and much more. (Schiuma & Carlucci, 2015), (Statdlober, 2017)

4. Practical part

The practical part is focused on the analysis and development of the knowledge base with the added comparison of selected knowledge base solutions based on given criteria. It is already concentrated on points on how the experience or so-called knowledge shall be handled by the employees within the knowledge base to help to develop the company's intangible knowledge within the knowledge base. The practical part has been done with the cooperation of SPORTISIMO company during the employment time.

Based upon of theoretical part is focusing on highlighting the mistakes, flaws, and strong points that have not been or have been implemented within the current knowledge base.

Comparison between the other options of competitors of the knowledge base as the other options might show up as better long term solutions or establishing sets of points which shall be added to the current knowledge base to help in the future development, offering better responsiveness, effectiveness, and performance within the company as this practical solution might be later on developed in any other company of the similar size as this, or used to create the knowledge base in the much larger scheme than on small scheme.

4.1   Basic information regarding the company

SPORTISIMO s.r.o (later referred to as well as the company) is a retail shop with the main focus on selling sport-related equipment, goods, and clothing. The first shop was created in 2001 in the OC Futurum in Brno, yet the company exists from the age of 1999.

At this very moment, SPORTISIMO is within five countries with over 150 of the shops, with three central warehouses in Czech countries with more than 4000 workers.

Its range of goods has well-known brands, such as Adidas, Nike, Vans, Reebok, Puma, Atomic, Fisher, Blizzard, Alpine Pro, Loap, Kappa, and so on.

Recently, in the year 2020, they even developed their brand, which has been designed by the company for its customers. Those brands are Crossroad, Lewro, Arcore, Reaper, Zealot, and Fitforce.

4.2 Knowledge base development over the years

Knowledge base analyse has been started within the year of 2018, where the primary and only official source of SPORTISIMO and the IT department, where the analysis has been done, was provided by the Requestor, which main's focus has been to offer employees the Helpdesk solution. As the knowledge base has been a secondary thing for the users, it caused many inconveniences, which were not resolved immediately, as the focus had to be shifted to the ticketing tool developed over the knowledge base for the users of the Helpdesk.

This has caused many issues as the year shifted, as many users found out that this knowledge base solution is not what they would like to use and utilize. And so, one of the users who has been working on their own knowledge base offered the option to provide theirs. This moved the focus on development from the knowledge base from Requestor to utilized OneNote solution where the user's knowledge base has been created.

At the end of 2019, there has been an official statement that the central knowledge base will be shifted from the Requestor's to OneNote. Yet, the Requestor's knowledge base will be maintained, This has been done as many information there has been still valid, and some users preferred to use them there over the OneNote.

Early 2020, mostly everyone in the IT department is using the knowledge base in OneNote and developing it and rarely using the Requestor's solution. Still, some tasks are done with the help of Requestor's solution despite the fact that all of the knowledge within it has been shifted to OneNote knowledge base.

Future development and options will be explained within this diploma thesis to provide the company and IT department mainly options and view on things how they were developed and what can be added, changed, removed, or if newly implemented.

One of the company's goals in the future is to provide solution of the knowledge base widely across the company, as in early 2020, there has been feedback from the area managers that they would like to get some Knowledge base solution as well to provide and distribute the knowledge within the company for the regular workers much more accessible.

At this moment, it is provided through various videos that are uploaded on the website, which is a sub-optimal cause of the hard management and high resource cost.

4.3 Criteria for the knowledge base comparison

For each knowledge base, the current solutions and possibilities of the implemented, there are several criteria where is described what exactly knowledge base is, what are they about, and necessary results on each what is the feedback from the currently implemented knowledge base. The sample will be used for testing the performance with a similar setting to provide non-influenced input based on a number of articles and other factors.

Described criteria for comparison:

- Basic information regarding the platform

- The knowledge base of the platform

- Features of the platform

    o Creation of new article within that platform

    o Article management within the platform

    o The search feature within the platform

- o Sample of the knowledge within the platform

- o Performance of the given knowledge base

- o Feedback from the users

- Knowledge base cost

- Knowledge base cost of the given platform

4.4 Requestor

4.4.1 Basic information about Requestor

The Requestor was and is providing the Service Desk / Helpdesk for many companies over the world. For the SPORTISIMO, it is being used for those purposes with constant development, which is mainly towards the Helpdesk over any other features which it is providing.

For IT Helpdesk within the company, it is mainly used as ticketing service for the users, which are mostly anyone within the company, store manager, head of the departments within the warehouse, and so on.

Regular users as employees at the shops or within the warehouse are not allowed to use this Helpdesk as the only current solution is to either call Helpdesk or contact the superior who has the option to make the ticket.

The Requestor is providing not only the ticketing tool but the ability to store documents on their server, management of customers, reports which can be then used for BI departments, inventory, calendar, and time tracking for any activities held within their platform.

The current version of the integrator is 4.7.2. And there are about 80 articles which are on the more advanced level of knowledge, implemented as the website. Majority of the articles has been done in the Czech language

Figure 4 - Requestor platform

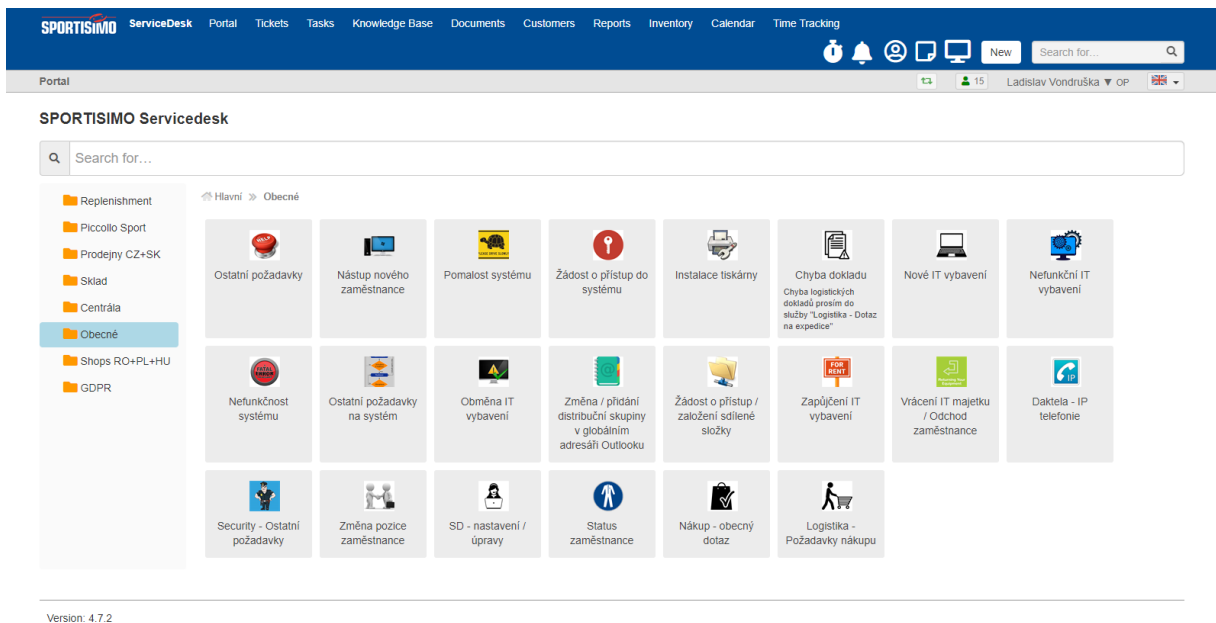## 4.4.2 Knowledge base of Requestor

The focus of the Requestor is to maintain the Service Desk/Helpdesk as the provider of the platform. The knowledge base within has been implemented and is usable, yet as the analysis found out, far from optimal. The development of the whole integrated platform over the years has been noticeable, yet the growth within the Knowledge base part has been close to negligible.
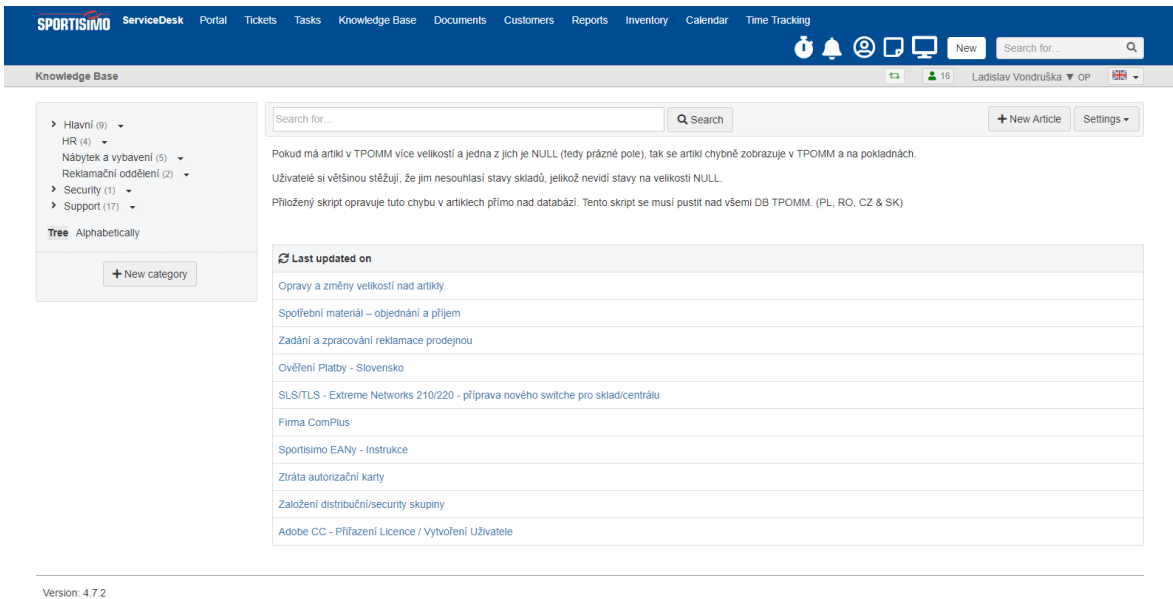
Figure 5 - Requestor knowledge base

4.4.3 Features of the knowledge base

Like any other knowledge base, Requestor is offering basic features such as the creation of the new Article, browsing through the administrator-structured knowledge base, editing, and other basic options. Within the more advanced utilities is the basic AI search across the knowledge base, which is offering the user to write down the question and wait for the system's response. This is not fully implemented, yet there is a basic implementation of this utility.

Further on, there is the management of tags that users can add to the given article to help search of the knowledge, as the knowledge within the knowledge base does not need to be searched only within the knowledge base, but across the whole search bar of the entire platform.

4.4.3.1 Creation of new article

Figure 6 - Requestor article creation

The creation of the new article on the platform is rather straight-forward as it can be. The user who can create the knowledge within the knowledge base picks up the name of the title—followed up with the specific title for the tree. Then, this is followed up with the semi-advanced text editor, which is using the right editing tool, which is user-friendly.

Among those, user can directly preview and print the article which has been just created. With that, many other options, such as the addition of the text, hyperlinks, formulas, or even direct source code, can be added.

After the text is done, there is an option to attach a file that is offering the opportunity to the user to pick data from the computer.

Categories are already established and can only be picked, not created, as those needs to be done separately before the creation of the article.

Flags work as a primary tag for the given article, yet they can be created. Those flags are only within the knowledge base and not shared across the whole platform, which could be handy.

The user can then be able to pick out of the options, which is if the knowledge will be made as Concept or as Public source.

- If the Concept is selected, the user is the only one who will see this knowledge, and only the user and administrator can see those.
- If the Public is picked, the article is published without any approval of the administrator and immediately shared for any user who can view the knowledge base

Permissions are either inherited or changed here. Options are:

- Public – This can be seen even at the public center. This means that even the users who are not able to log-into the platform can see this knowledge if they are given the hyperlink
- Everyone – All users who are not also able to see knowledge base, yet those users need to be users of the Requestor's platform
- Only operators – Operators, which can maintain and view the knowledge base
- Custom rights – Offering ability to pick precisely who will be able to see what out of the operators to users, which are not on the platform

Related articles are offering the option to link this with something else, which is then displayed during the search of the other article.

Recommend works in a way that this is featured on the knowledge base yet recommended to all the operators within the knowledge base, not only a specific user.

4.4.3.2 Article management

Management of the article is straightforward, and the offering is the information that created the article with a specific time.

Further options are the option to have a button that will copy the hyperlink for the feasibility to share faster, deletion, export to PDF, and editing the file.

The deletion and editing are possible by any user who can view knowledge, which could lead to many cases of knowledge loss as there is no backup for this knowledge. This is one of the significant flaws as the reserve is of the whole ServiceDesk and not only the knowledge base that could cause some significant issues in case the article would be edited without the correct information.

The modified article is recorded with information who was the last user who changed the article. There is no backtracking for the original version or during editing, requesting approval from the administrator.

Editing as it is entirely the same as the creation, able to change the whole article from one field to another if the user deems so.
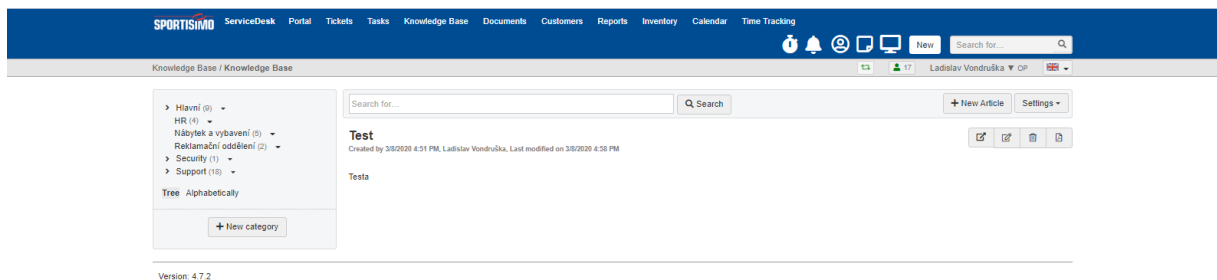

Figure 7 - Requestor article management test

4.4.3.3 Search feature

The search feature of the platform works as the full-text search without any priority. As most of the articles do not have any flags or tags, the search engine is looking for the word that has been searched within all the articles.

The main issue is that this search is not prioritizing the Title of the article. It is not based on when the item has been created or relevant for the user. It is searching based on how often this article has been open, which might be useful in some cases, yet most of the time, the user is then stuck with going through over 40+ items were the given the word has been found to look for the knowledge.

There is no option to order the search result by name, relevancy, or any relevant information, as it shows all of the given articles which have the given word which has been found within them.

4.4.3.4 Sample of Requestor's knowledge base

For the performance testing, there has been developed a sample of the knowledge base within the requestor. The structuration has been dramatically reduced yet offering enough place for potential use and improvement for the implementation and restructuration. These changes would be needed to make the knowledge base easy to use and faster to navigate than it is right now.

The main advantage is that the knowledge base is presented with an overall view where the user can orientate what they can see and how they can use it. On top of that, the knowledge base is allowing the files to be directly uploaded into the knowledge base and then enables them to view them on the website through the web-browser without any additional software required.
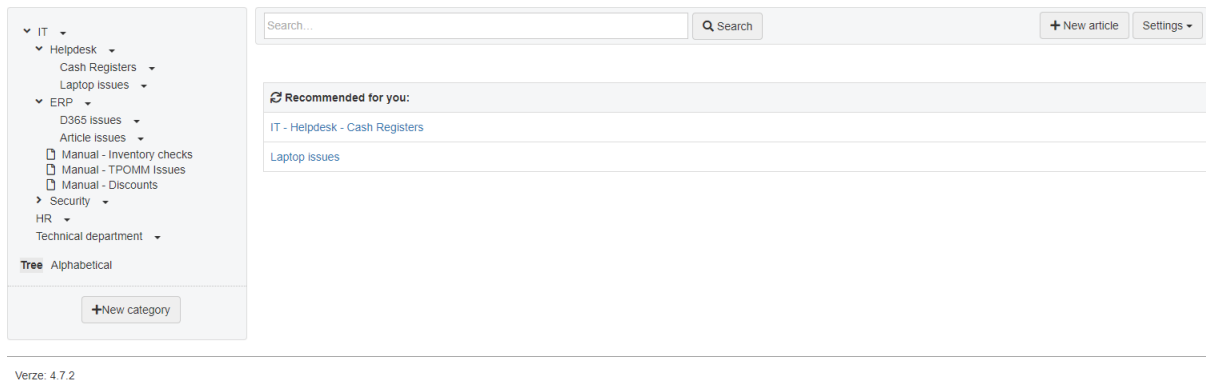
Figure 8 - Requestor sample

4.4.3.5 Performance of Requestor

The overall performance has been profoundly affected by the load from the users. Several tests have been run out of the time when the platform is being used, and the other has been run when the users have been using the whole platform during peak hours.

Both tests were run at various times, yet still within the margin of "Peak hours" and "Off Hours."

- Peak hours were within the time period: 9:00 to 11:00 and 13:00 to 15:00

    o This time period has been chosen as most of the departments are already working at 9:00 within the company. The two-hour break between 11:00 to 13:00 has been decided to measure the option that many users might be using this time period for the lunch break.

- Off-hours were within the time period: 22:00 to 6:00

    o Off-hours were within the period of the time where the ServiceDesk has minimum users on the platform to affect the test

Each test had at least 30 minutes break between the next to measure the deviations within the time period correctly.

All tests have been run after the user has been acknowledged and aware where is what, to provide the needed unbiases towards the next analyses.

Both tables were measured in seconds, on various machines to prevent hardware bottleneck or internet bottleneck.

Task	Test one	Test two	Test three	Test four	Test five
Creation of article	29,5s	24,7s	26,3s	25,4	26,5
Editing of the article	18,4s	14,7s	15,3s	14,6s	14,9s
Search result	3s	2,2s	2,4s	2,3s	3s
Deletion of the article	6,9s	4,1s	4,5s	4,3s	4,7s

Task	Test one	Test two	Test three	Test four	Test five
Creation of article	14,6s	13,3s	10,5s	9,8s	12,1s
Editing of the article	6,3s	5,5s	5s	4,3s	5,3s
Search result	2s	1,8s	1,1s	0,9s	1,7s
Deletion of the article	4,5s	4,2s	3,2s	2,4s	3,8s

- The creation of the article has been done through a copy-paste sample of the test with the same setting for all tests. The overall article has been named and flagged in a way that the search is immediate, and the tester does not need to search through all the results sharing some words within all the articles.

- Editing was done on the sample with some minor adjustments.

- The search was done on the created result and then edited result.

- The deletion was done on the edited sample

Those two tables provided enough feedback to see that the knowledge base actions are heavily influenced by the other users who are using the ticketing tool on the platform. This might have been one of the issues that users might find annoying as the influence of the ticketing tool would solve the overall solving time of the ticket. That could lead to worse performance over all the users.

4.4.3.6 Feedback - Requestor knowledge base

IT department of the company yields over 50 members at the time of this diploma thesis, yet not everyone reported the use of the knowledge base of Requestor. As mentioned, many people reported to dislike Requestor's knowledge base and are either not using it at all or even refusing to use it.

For this, there has been a small questionnaire to provide given feedback on what the users like, what their reasoning is, and what they would like to improve to try using it again.

First, users have been asked to use the Requestor's knowledge base and provide the overall rating. This rating has been rated from 1 to 10, where the one is the lowest and ten is the highest.

Before the questionnaire for the feedback has been filled, all users have been informed what each rating is describing so it can be interpreted similarly across the field.

Ratings were focused on:

- Overall performance
  o Measurement of total satisfaction with the Requestor

- User-friendliness
    - How user-friendly the given knowledge base is for the user
- Speed during peak hours
    - How quickly they can rate the usage during the peak hours
- Speed during off-hours
    - How quickly they can measure the usage during off-hours
- Knowledge fulfillment
    - How much relevant articles within the knowledge base can be found
- Quality of explicit articles
    - How they would rate the overall article explicit quality
- Structuration
    - Rating of how easy it is to navigate within the knowledge base.

Followed up was feedback, which has been added under table 3 in one overall summary.

Feedback was provided by the whole IT Helpdesk department, consisting of those who are regularly using the knowledge base of the Requestor.

Table 3 - Requestor user feedback

Requestor knowledge base	
User friendliness	1,44 / 10
Overall performance	1,94 / 10
Speed during peak hours	1,75/10
Speed during off-hours	3,93/10
Knowledge fulfilment	5,81 / 10
Quality of explicit articles	6,87 / 10
Structuration	1,98 / 10
Rating summary	**2,965 / 10**

Additional feedback has been provided from the feedback contributors. Primary concerns were pointed out at low performance, and responsibility during peak hours is not ideal for the work composition that is being done on a day to day bases. Among those, there was positive feedback, mainly focusing on quality and well-made articles from the past, which has been done at the time when the Requestor's knowledge base was the main knowledge solution.

4.4.4 Requestor costs

As the Requestor was mainly bought as a ticketing tool for support, the cost of the knowledge base is basically negligible as that has been added over the updates as one of the options on how to manage knowledge without any additional cost. This correctly leads to the fact that as long as the company will be using the Requestor as a ticketing tool, the cost of the knowledge base will remain free.

Additional features and added features for the knowledge base part of the platform would come at additional costs as any development of any platform. Those costs are still within the margin of what the company would be able to provide if this would be an option to going forward with the overall knowledge management within.

4.4.5 Result of Requestor knowledge base

Knowledge base is mainly unstructured what is the fault of the first creator of the knowledge base within it as it has not been maintained over the years. The chaotic system within the knowledge base of the Requestor is not allowing the user to find the knowledge as fast as they would like to.

The overall platform is allowing some added features which are not implemented to the required standard and would need rather deep development and focus if this would be the final solution for the company.

Users of Requestor's knowledge base are yet still satisfied with the knowledge that has been not maintained over the last years, yet the not maintained structuration made all the articles hard to find and look for. Even that almost all articles have been valued as explicit, the explicitly of the articles are not view correctly by the answerers who provided the feedback.

4.5 OneNote

4.5.1 Basic information about OneNote

OneNote is one of the many software options from Microsoft, which has been free from the year 2014, and in SPORTISIMO, it has been developed from the year from 2018.

As one of the employees was not satisfied with the state and performance of Requestor, it has been found over the year of 2019, that it will be serving a better purpose as a knowledge base and at the end of the 2019/start of 2020, it has been decided that the primary source of knowledge, serving as knowledge base, will be integrated into OneNote.

This implementation was done with the addition of Requestor's knowledgebase, what was and is still used as a secondary knowledge base, yet the OneNote solution is prevalent and being used much more than the other one.

Currently, OneNote has over 400 articles regarding various tasks implemented through a share point solution with the option to reach the OneNote through either web or desktop application. For both, you are required to have the Microsoft account and allowed to view the knowledge base.

Most of the information is on a more fundamental level than advanced, yet the cause of the sheer number of articles, there is something about 150 more excellent articles. The majority of the articles have been done in the Czech language; some of them were translated to English for English speaking employees.
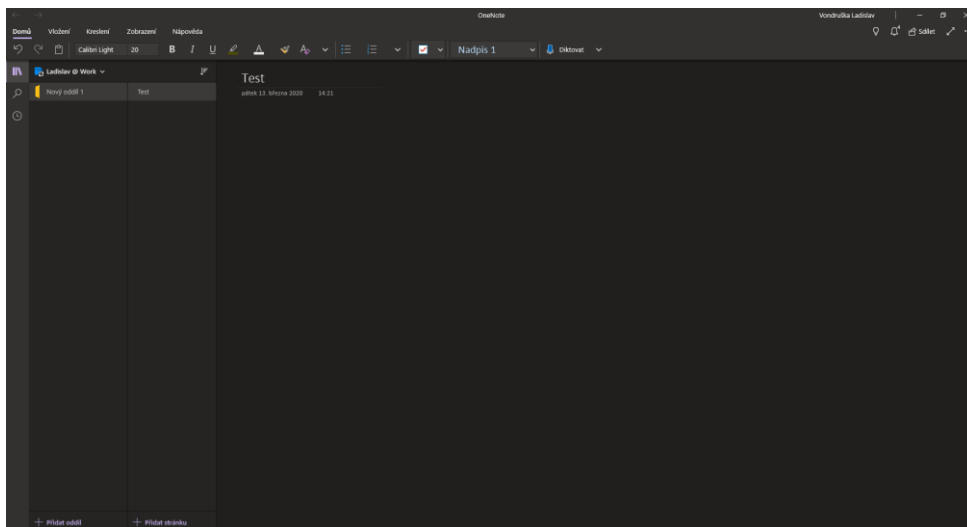

Figure 9 - OneNote platform

4.5.2 Knowledge base of OneNote

The Knowledge base of OneNote has been formed initially by one user who was unsatisfied with performance and offered the option to share their own OneNote with notes to the company to use as an official source of knowledge.

This has caused that the knowledge has been founded on mostly tacit knowledge and so, resulting in the creation of a mostly tacit-based knowledge base, which was not even officially encouraged and supported by the company. As this was non-official yet used by most of the employees on IT, it meant the sharing of the tacit information, resulting in postponing and prolonging the creation of explicit knowledge base and development of each people's knowledge as it is.

At the end of the 2019 and 2020, the OneNote became official knowledge base among the Requestor's one, not making a complete switch. This allowed the creator, who became the administrator of the knowledge base, more options for development, and the slow transition from tacit knowledge to explicit, as that is rather a time-demanding task.

From the moment of 2020, the knowledge within the OneNote has been recorded or attempted to record any knowledge in an explicit way, yet the oldest articles have never been transitioned over.
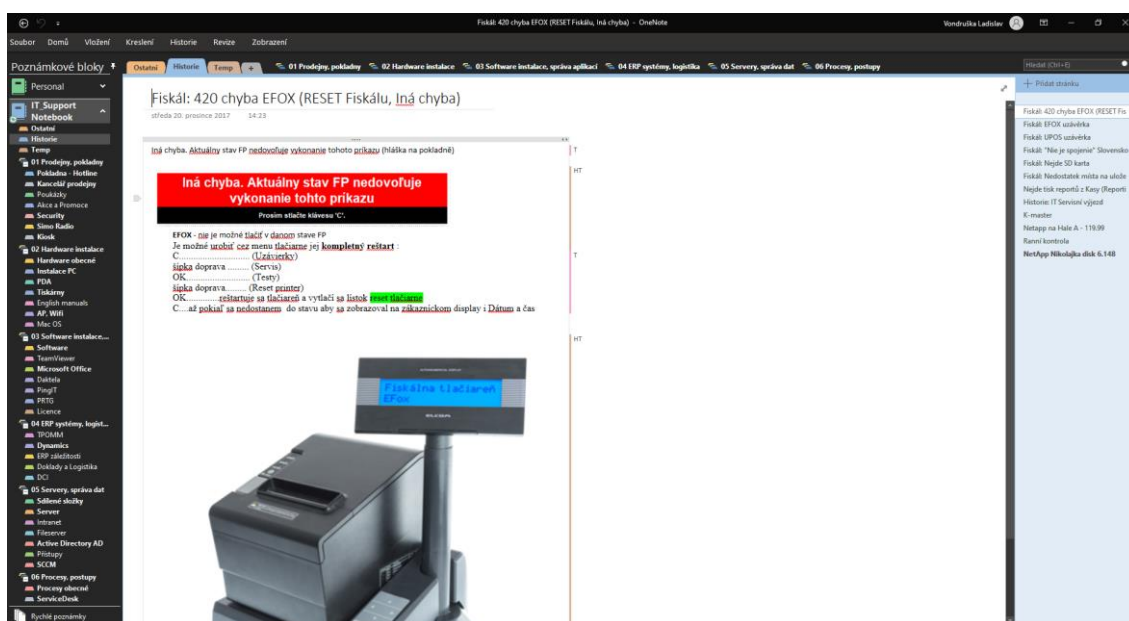

Figure 10 - OneNote knowledge base

4.5.3 Features of the knowledge base

The main strong point of the OneNote knowledge base is its usability, speed, and accessibility. It can create, manage, share, and use the features with the reasonable speed that most users find pleasing. As OneNote has two versions, one on the web and the other on the desktop, both are heavily bound by internet connection and hardware, yet not influenced by the connection of the database and the integrator.

Added features of the knowledge base other than to share and manage not only one application and web, it has an advanced search option that can list results based on the word inserted in the search bar. Yet, there is not any advanced AI search that could help the user with the tasks that they would like to get answered by asking the platform.

Among the other features can be taken more advanced formatting and structuralizing what can be achieved rather quickly without any added knowledge what-so-ever. Options as hyperlinks, pictures are standardized, yet there is an added option to add videos directly into the article. Features as tags are an option too, yet not ideally done.

Central and most important is the fact of backup of any article that has been deleted and changed through the administration of the whole file. This is to prevent sudden loss of edits that were not wanted to the entire knowledge base.

Like any other Microsoft product, there is a lot of free and even paid addons that can be added, realistically adding any room for improvement within the platform.

As the added feature is the option to download the whole knowledge base with all articles for offline usage to the device where the knowledge base is requested.

4.5.3.1 Creation of new article
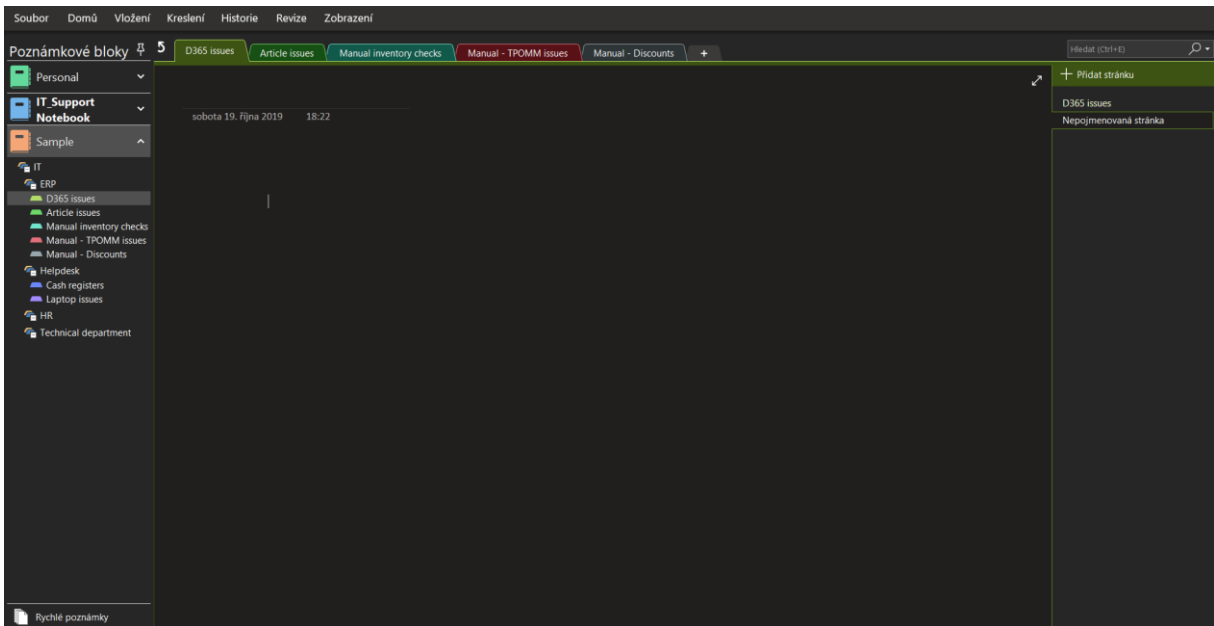
Figure 11 - OneNote article creation

The creation of the new article is done by picking the main topic of the article, followed up with the empty blank sheet with the main topic of the whole article.

Right under the topic, there is room for the article itself, which can be similarly edited as the other product from Microsoft Word. Those options are allowing to customize the text to a very high degree with options such as hyperlinks, pictures, videos, and others.

Among other features, there are basic options to draw or even do a live video that is happening on the screen through the Microsoft implemented recording.

Users might use some other options such as Revision, which might help them to create the article easier and faster in the future. Those options are such as a history of written articles, creating a concept, or suggesting from the other articles. Any article can be linked to any other article to create a suggestion.

4.5.3.2 Article management

Article management within the OneNote text-wise offers the same options as the creation of the new article. The overall management is fast and responsive, and user friendly for the users. Advanced options are allowed for the users, such as see the edit log and old versions of the given article, what can be changed, adjusted, or removed by the administrator. Any article can be amended and deleted by any user with the current rights.

The administrator can directly see what exactly has been changed and what has been deleted. There is a backup option for several months back to prevent any damage to the knowledge base by the user accidentally deleting the whole article.

4.5.3.3 Search feature

The search feature has fully implemented a full-text search with priority. That means that if the article has more relevance with searched words or words, it will prioritize the given article over the others. It has to be noted that there is an added feature of the option to tag various articles, but as there are developed search-options, it is not required.

Other than that, there is not any added feature such as AI or option to "ask" the knowledge base with a question when the search would result in a relevant answer. If the user does not know the correct terminology, the knowledge base will result without any result, what might help the user. This might be added with options of tags, yet it is not correct AI support of the knowledge base.

Search bar as well offers the option to provide user either top 5 options what did the user searched, or articles which has been opened last. Under those results, there are articles with the searched word. This option can be adjusted for more results, yet the knowledge base does not support the option to set recommended topics that shall be shown for some given period of time or permanently.

4.5.3.4 Sample of knowledge base

As the current knowledge base is correctly structured, the sample has been created purely for performance testing. Other than that, there have been added few tags to help the users to contribute to fully utilize the options of the knowledge base on this given platform.

It has to be noted that the order of how groups of articles are managed is alphabetical, and this feature cannot be changed. So, if the user would like to have some management, they have to add numbers in front of the topics. This might cause the issues in case some other user would like to have the topic added in the middle of the numerical series.

Options such as direct upload between each group of articles are not possible, and the only option is to make a group within the group an article that will include the specific file, which can prolong the search as there is no view-file within the OneNote.

There is also not any main page of the notes where there features such as recently added topics could be added, view some navigation, or allow the user to see what and how they can use the knowledge base.
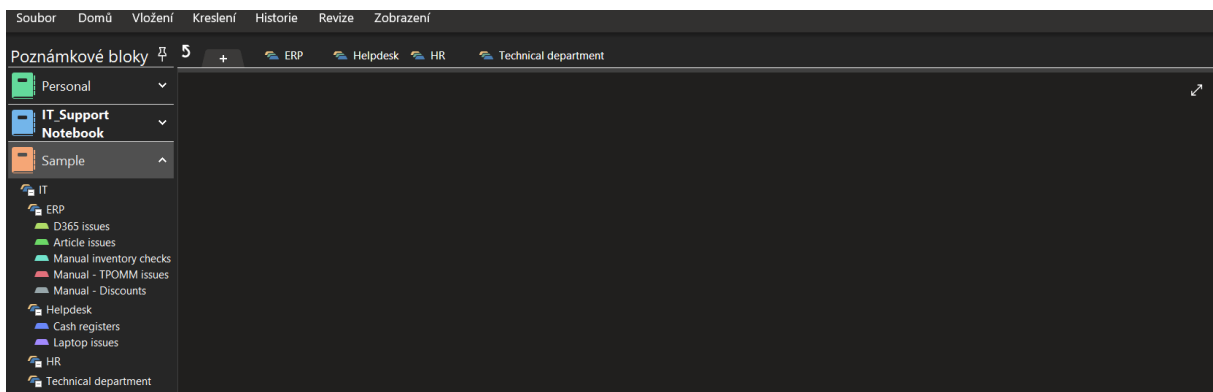

Figure 12 - OneNote sample

4.5.3.5 Performance of OneNote

Several tests have been run out of the time when the platform is being used, and the other has been run when the users have been using the whole platform during peak hours.

Both tests were run at various times, yet still within the margin of "Peak hours" and "Off Hours."

- Peak hours were within the time period: 9:00 to 11:00 and 13:00 to 15:00

  o This time period has been chosen as most of the departments are already working at 9:00 within the company. The two-hour break between 11:00 to 13:00 has been decided to measure the option that many users might be using this time period for the lunch break.

- Off-hours were within the time period: 22:00 to 6:00

  o Off-hours were within the period of the time where the ServiceDesk has minimum users on the platform to affect the test

Each test had at least 30 minutes break between the next to measure the deviations within the time period correctly.

All tests have been run after the user has been acknowledged and aware where is what, to provide the needed unbiases towards the subsequent analyses.

Both tables were measured in seconds, on various machines to prevent hardware bottleneck or internet bottleneck.

Table 4 - Test during peak hours - OneNote

Task	Test one	Test two	Test three	Test four	Test five
Creation of article	7,1s	6,2s	6,8s	7,2s	5,4s
Editing of the article	5s	4,8s	4,5s	5,1s	5,2s
Search result	0,5s	0,4s	0,3s	0,5s	0,4s
Deletion of the article	2s	2,3s	1,8s	1,7s	2,1s

Table 5 - Table 1 - Test during "Off-hours" - OneNote

Task	Test one	Test two	Test three	Test four	Test five
Creation of article	6,9s	7,2s	7s	5,5s	6,2s
Editing of the article	5,5s	4,4s	5,2s	5,3ss	4,2s
Search result	0,3s	0,5s	0,7s	0,5s	0,3s
Deletion of the article	1.5s	2,4s	2s	1,9s	1,6s

- The creation of the article has been done through a copy-paste sample of the test with the same setting for all tests. The overall article has been named and flagged in a way that the search is immediate, and the tester does not need to search through all the results sharing some words within all the articles.

- Editing was done on the sample with some minor adjustments.

- The search was done on the created result and then edited result.

- The deletion was done on the edited sample

Cause of the fact that some of the responses were so quick, especially during a search result, there has been needed a video recording of the research.

Those two tables are showing us that there is not any difference if the knowledge base is being used by potentially only one user or the full team of 20 people at the same time. Fast and responsive design is allowing the user to work faster without any time hindrance by the platform

4.5.3.6 Feedback - OneNote knowledge base

IT department of the company yields over 50 members at the time of this diploma thesis, yet not everyone reported the use of the knowledge base of Requestor. As

mentioned, many people reported to dislike Requestor's knowledge base and are either not using it at all or even refusing to use it.

For this, there has been a small questionnaire to provide given feedback on what the users like, what their reasoning is, and what they would like to improve to try using it again.

First, users have been asked to use the Requestor's knowledge base and provide the overall rating. This rating has been rated from 1 to 10, where the one is the lowest and ten is the highest.

Before the questionnaire for the feedback has been filled, all users have been informed what each rating is describing so it can be interpreted similarly across the field.

Ratings were focused on:

- Overall performance
    - o Measurement of total satisfaction with the Requestor
- User-friendliness
    - o How user-friendly the given knowledge base is for the user
- Speed during peak hours
    - o How quickly they can rate the usage during the peak hours
- Speed during off-hours
    - o How quickly they can rate the usage during off-hours
- Knowledge fulfillment
    - o How much relevant articles within the knowledge base can be found
- Quality of explicit articles
    - o How they would rate the overall article explicit quality
- Structuration
    - o Rating of how easy it is to navigate within the knowledge base.

Followed up was feedback, which has been added under table 3 in one overall summary.

Feedback was provided by the whole IT Helpdesk department, consisting of those who are regularly using the knowledge base of the Requestor.

OneNote knowledge base	
User friendliness	8,39 / 10
Overall performance	9,56 / 10
Speed during peak hours	9,20 / 10
Speed during off-hours	9,16 / 10
Knowledge fulfillment	8,83 / 10
Quality of explicit articles	7,87 / 10
Structuration	8,43 / 10
Rating summary	**8,777 / 10**

Additional feedback has been provided by the users where there has been noted regarding the speed and option to work fast without problems within the platform. As this is the mayor knowledge base to use within the team, it has been noted that it is rare to not find any missing information within the knowledge base with the help of the other, Requestor's solution.

There has been a negative point that the offline version of the notes is taking too much of the space on the device, which was the concern of a few users with smaller storage within their device.

4.5.4 OneNote cost

One of the main features of the OneNote is that it is distributed freely, and only what is required is Microsoft account to use this option. That means if the company supports Microsoft as the primary provider of software solutions as Office package and operating systems Windows, there will not be needed any additional actions on the user's side. And even if there would be necessary to create a Microsoft account, it is still free and readily available on the website.

4.5.5 Result of OneNote knowledge base

Feedback is clearly showing that the users are satisfied with the OneNote solution within the company. Despite that it lacks some optional features, it is shown that the users are not craving the more in-depth and more advanced features which could speed up the process of knowledge management in the future.

It must be noted that most of the information within the knowledge base is not explicit but tacit; the newer and more users are usually made with a more explicit mentality. That is the main reason why newer articles are more used, and it seems that the users do not have issues with it or simply do not realize that a lot of knowledge within the knowledge base is still tacit. This is something that the administrator is aware of and re-creating the old articles into the new one for the better performance of the team.

4.6 Other knowledge base solution

It has been requested by the company to see other options that could be implemented for the IT team. This development could lead to the full implementation of the solution for each retail shop to help the knowledge management within the company.

As the company operates within several countries, it was requested to have multilanguage support as one of the mandatory features.

The next requirement was easy knowledge management and shareability within the workforce to allow mostly the area managers to change the articles, manage them, and distribute them to the workers in each shop. This would help to lessen the stress on an additional administrator who would be above the area managers and manage the knowledge base each time something needs to be added or changed.

As an additional request, there should be more features than the previous two current solutions as advanced search within the knowledge base, utilization of AI within the knowledge base, and feasibility for sharing the files without the need of additional software.

All these requirements shall be fulfilled with the aim for the cheapest and most suitable option among the knowledge base solutions.

Among the other competitors, it has been picked three options that could be implemented in the future as the primary knowledge base within the company.

As there are many knowledgebase solutions, it has been picked top four options which could be used by the company with mentioned requirements.

Those options will be described in what they are bringing other than the competitors, how expensive they would be for the company, and what they lack compared to the other competitors.

The performance part of the knowledge base has been reduced compared to OneNote and Requestor as bigger teams use both platforms, and results with 20 users of the followed-up knowledge base would not have an effect on the knowledge base solutions. Simplified text version of the result has been established. Yet, the results on the performance part need to be acknowledged that it might be misleading of the previous experience with both platforms compared to the new ones.

Feedback from the users has been done, yet then scrapped as the overall feedback would need an implementation of the proper prototype and long testing period. Users would require dedicated time for the testing and probably full transition of the knowledge base, as providing the feedback just from the sample could be misleading.

4.6.1 M-files

4.6.1.1 Basic information about M-files

M-Files is a well-known DMS (Document management system), which is allowing the user to share the documents directly. The sharing and management are then allowed through the automation, which can be done through the M-Files platform, either custom made by the M-Files directly or by the administrator within the company.

Automation is helping with workflows between the requestors and responders to support productivity.

M-Files is as well offering three options to deploy the M-Files, varying on the price by each solution. Those solutions are Cloud, On-premise, or Hybrid. It must be noted that On-Premise is usually used in smaller companies over the bigger ones.

M-Files is providing the option to work through web or website options, supporting all operating systems, including Android and iOS.

4.6.1.2 Creation of new article

The creation of the article is done through the option to share the whole file within each group managed by the administrator. There is as well option to comment on various files, but something such as OneNote or Requestor solution is providing; there is not.

As creation is done only through the 3rd party application and then drag-and-dropped or searched on the system, the creation of the "new article" is not possible unless the article is pre-made in 3rd company software.

4.6.1.3 Article management

All of the articles are managed within the 3rd party software, and M-files is allowing the view and edit of those files with accompanying software to create and edit.

That leads to the management of the file that is somehow similar to creation, as to edit the file, the user needs to use the 3rd company software to do such. This might lead to slower performance over the other knowledge base as this could be heavily hardware-based, depending on the file.

4.6.1.4 Search feature

The search feature works similar to what can be found on the Windows system, searching for anything that is related with the added type of file. No AI options, yet there is an option to add meta-data and tags to every document. On top of that, the platform can search through the files, not only the given title of the article.
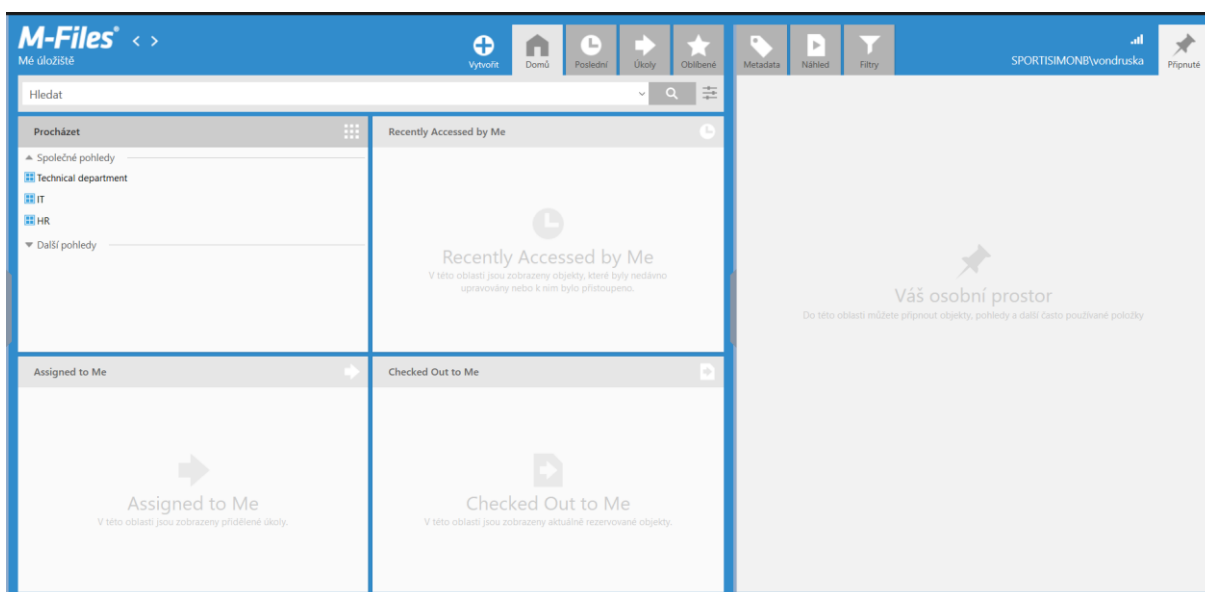
4.6.1.5 Sample of knowledge base

Figure 13 - M - files platform and sample

Creation a structure and managing it within the M-files is easy as it works rather similar to the management of the files within the windows. The management and even sharing works somewhat similar yet is more intuitive and more straightforward than what Windows offers on the larger scale as the whole platform is based on the creation of those views followed up with setting up the specific security measures and restrictions for the particular users

4.6.1.6 Performance of the M-files

The overall performance test of the knowledge base has been done, and upload was done under a second. As the primary test has been done in Microsoft Word, as creation and edition steps were done mainly in that, the results of those two steps are not relevant as it is testing different platform.

Task	Test one	Test two	Test three	Test four	Test five
Search result	0,9s	1,2s	1,5s	1,3s	1,4s
Deletion of the article	0,4s	1s	0,7s	1,1s	0.5s

The search result has been done through searching for the specific file with the type of the file, while the deletion of the article had to be confirmed.

The overall performance of the M-files heavily depends on the hardware, as was already mentioned, like other knowledge bases, as the whole program is a bit heavy. There is as well cloud solution, yet as every file needs to be first opened within the editor, the hard drive is the main driving force of the knowledge base.

4.6.1.6 M-Files Cost

The cost of the whole knowledge base depends on what license the company would like to use and what type of users it would be using. There are various options within the platform.

Those options are:

- Named license – License what will be given to the specific user with full opportunities to manage and do administration

- Concurrent license – A particular number of users can access the knowledge base, yet if the limit is reached, other users are not allowed to enter. This license is enabling the users to do everything as long as they are within the limit

- Read-only license – Licence allowing the read, yet not manage the files within the knowledge base

It has been established that the company would be using ten named licenses for the users who will be doing administration and should have unlimited access at any time. Those licenses would be given mainly to the administrators.

They were followed by concurrent licenses, mainly used by the area managers. It has been decided that there will be a need for 25 licenses.

The last license is read-only, and as we established that the company's goal would be to implement this for each retail shop, we will need over 150 licenses. So the number has been established at 150 licenses.

Each account can be directly connected to an active directory with the full domain support.

After the calculation, the final cost per year has been established at 410 000,- Czk (15000) without VAT, including one M-files server with one backup server.

There have been other options that could be added to the knowledge base at additional costs such as QCR, which would allow the opportunity to create and search through PDF files, the option to data-mining, and recognition of the QR code.

Another option was reporting, which would allow the administrator to see which users are using what, what is used the most. This additional feature would be implemented on an external database using the Microsoft SQL Reporting Services.

4.6.3 Bitrix24

4.6.3.1 Basic information of Bitrix24

Bitrix24 is one of the multiple solutions which is offering not only a knowledge base for the users but many other features for the same price. Compared to different knowledge bases, competitors can provide low pricing for more than just the knowledge base.

The whole platform works on the style of various packages and plug-ins which are installed to the profile and implemented.

Other than the knowledge base provided by Bitrix24, as was already mentioned, the whole website works on the "packages." Some of them are paid, yet most of them are free, and several of them offer even the knowledge base solution for the whole platform.

As a bonus to this knowledge base solution, there are features such as CRM, Tasks and Projects, Communication service similar to Microsoft Teams or Skype, Website creation, and many automation services across the field.

4.6.3.2 Creation of new article

The creation of articles has been intuitive, and for an advanced user, it can be rather easy. Yet, for the user who is not used to editing the websites with features such as directly editing the whole webpage, it could prove a bit harder to use.

The speed of the overall knowledge base is as fast as the internet allows, as there was not any hindrance even with more complex tests and the amount of text and files uploaded.

4.6.3.3 Article management

Editing of the whole sample works like create a webpage without the need to know any code or such. It allows as well to implement various parts of the system, which can then be used to enhance the webpage or use the drag-and-drop feature for less advanced users. This leads to the ability to completely customize the knowledgebase for the users yet leaves the administrator with a deeper need for knowledge how the website shall work and be tested.

4.6.3.4 Search feature

Search option within the Bitrix works rather fast as on any website, and with added features that can be added, it could work even better than any other knowledge base. The structuration works responsively, and also that the search engine allows to "ask a question," short questions are usually picked word-by-word yet more extended questions with some similar words are resulting in not any result what-so-ever.
The main disadvantage is not a full-text suggestion and pre-search what directly leads that the word or sentence needs to be entered, then picked, while other solutions are searching the moment the first letter is inserted.
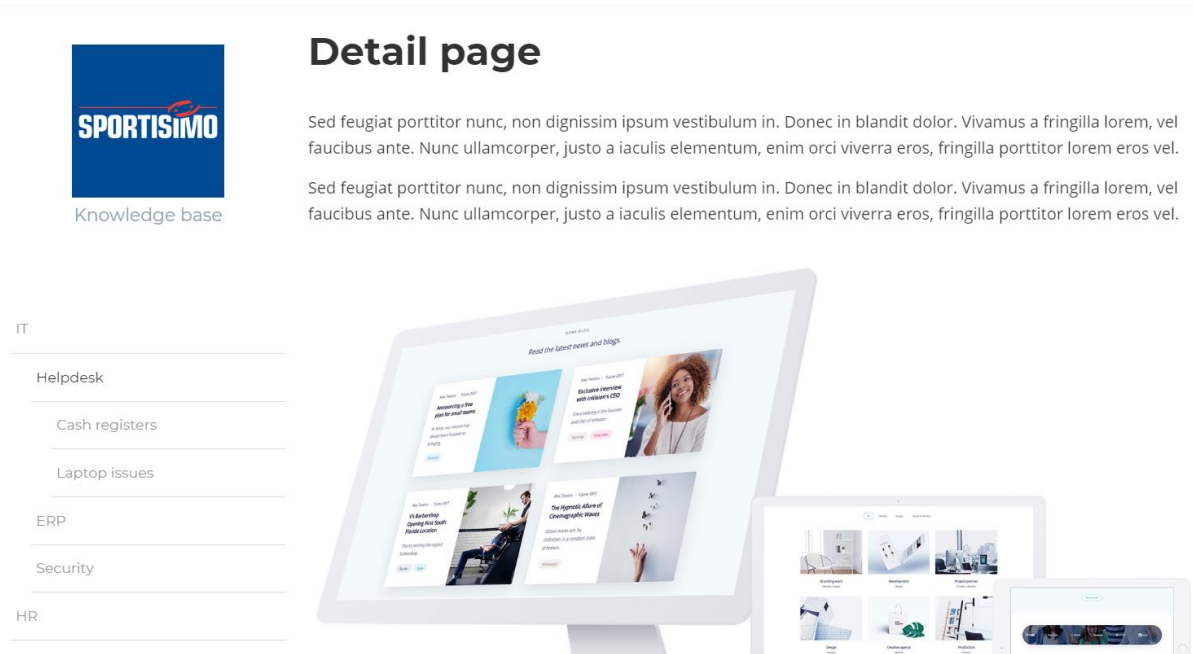
4.6.3.5 Sample of the knowledge base

Figure 14 - Bitrix24 platform and sample

As the whole knowledge base behaves like a webpage, the creation of the sample and distribution of the articles has been easy for the advanced user. The amount of customization is allowing a lot of creativity, yet it is quite clear that users without much knowledge might find this system bit confusing or hard to learn. Compared to other solutions, Bitrix24 is offering the most profound option with the maximum effort to make this vast amount of customization as easy as possible, which allows a lot of ways how to work with the knowledge base.

4.6.3.6 Performance of the Bitrix24

Bitrix24 did now show any effect on the hardware yet shown responsiveness on the connection speed, yet not heavy demand. The test was not affected by the peak hours as the knowledge base was not tested by that many users, yet even the analysis of the small team did not affect the result. Bitrix24 promises low responses even with enterprise-sizes companies

Table 8 - Bitrix24 performance

Task	Test one	Test two	Test three	Test four	Test five
Creation of article	10,1s	8,4s	8,5s	9,1s	7,9s
Editing of the article	6s	5,1s	5,8s	5,4s	5,7s
Search result	1,2s	1,3s	1,1s	0,9s	1,2s
Deletion of the article	4,1s	3,7s	1,8s	1,7s	2,1s

The biggest downside of the Bitrix24 is the creation, yet this is not hindered by the cause of the system or platform, yet the sheer amount of customization of the article can be given. The creation of itself takes less than half of the time, yet the options on how to customize the article could offer a heavy deep of customization.

Editing is a rather simple, simplified version of the creation and much faster because there are not so many options to pick from. Search is responsive with keywords, yet implementation of the full question-based option would be more helpful. The deletion of the article is again rather fast, yet as the removal is done through the editing of the article, it can take a bit longer time.

4.6.3.7 Bitrix24 Cost

Overall pricing is the leading and most influential point why the company would be looking deeper into the Bitrix24, as the pricing for unlimited users is only 5500,- Czk / Month (199€/month), what is a cheaper solution compared to the other knowledge base solutions.

There is an even cheaper option for smaller companies or groups, with unlimited users, with the pricing of 2250,- (99€/Month) with lower options with the knowledge base, limiting them to 5.

The main difference is that the first package is allowing to build numerous knowledge bases, keeping them separated across each department without the need to have one huge

knowledge base, with various roles. This can prove a handy cause of less stress on the whole platform, allowing better traffic and speed when used.

Bitrix is allowing many plugging within the whole platform, and as each knowledge base can be managed through HTML or any script, implementation of AI or more features shall be accessible.

More in-depth administration is possible as can be done on any website, with the option to see the old versions within the pricier page, going back 90 days, on cheaper only 30 days.

4.6.4 Flowlu

4.6.4.1 Basic information of Flowlu

Flowlu is another competitor in the field of lower prices compared to other solutions. As it is, Flowlu is not only a knowledge base solution, as this tool has many other features such as managing projects, tasks, invoicing, finance, CRM, communication options, and so on. All of these options add up to the overall platform.

The knowledge base is different than most, as this one is a mixture of creation of website within the platform, yet doing it topic wise. More in-depth customization is not as deep as other solutions such as Bitrix24. Still, it is enough to provide straightforward options on how to customize the knowledge base as the administrator would deep is correct.

4.6.3.2 Creation of new article

Flowlu is supporting the google drive as many options seem that they were designed to work with google platform as the side-platform. This is a nice added feature.

The creation of the articles was simple with tags creation as the sample was created really smoothly and responsively. This option to add a quick article without many opportunities to think about is handy, yet there is only one way how to do the structure, and that is basically connecting it under some other "main topic". This can be a bit chaotic when there is a lot of topics and branches of different articles.

4.6.3.3 Article management

Editing was ultimately the same as the creation of the new article without any change, just with the option to completely shift and manage the article within the editing part. As the management is on point the same to the creation, this might provide more comfortable usability for the users, yet lack of complexity might be problematic for the administrators.

4.6.3.4 Search feature

As other knowledge bases, the search engine is responsive yet without the option to "ask a question" to get an answer. That is again a missed opportunity for this integrator as those options might be handy for a person unknowing the correct term. Other than that, the main page with a huge search bar is a nice way how to search for a specific article.
An added feature is the full-text search and suggesting from the moment first letter of the word or sentence is searched what prevents the need to enter the looked-for index followed up with searching through all the options, speeding up the process.

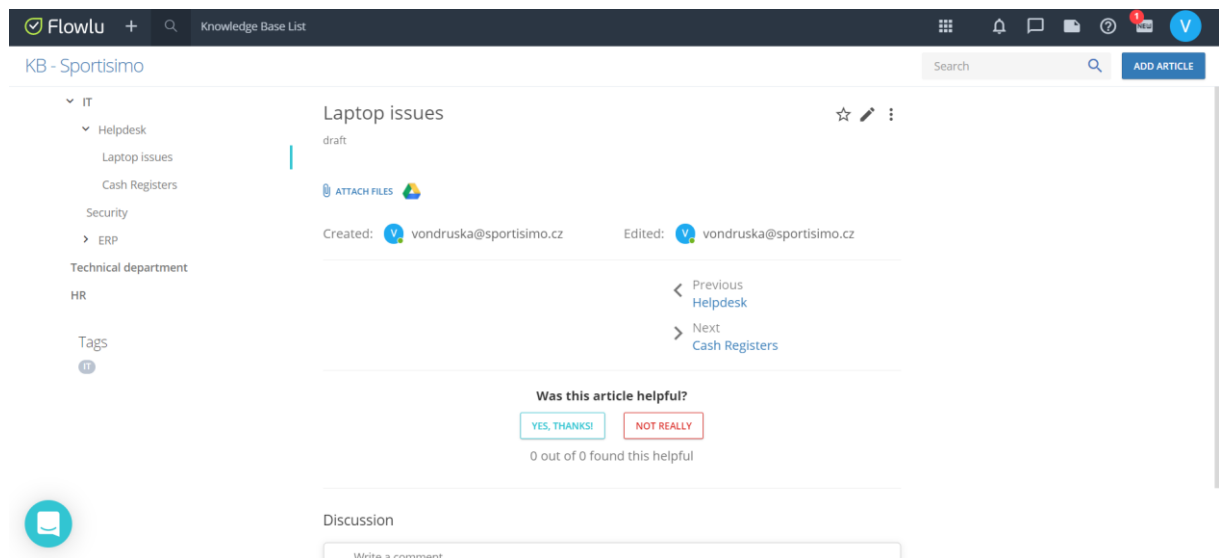### 4.6.3.5 Sample of the knowledge base

Figure 15 - Flowlu platform and sample

As Figure 16 shows, it is quite easy to navigate within the knowledge base with added options such as the direct support of the google drive, the ability to know when something has

been created, discussion of what is a feature that is the unique feature of other knowledge bases.

On top of that, there is a direct button to rate the tutorial what might be handy to provide easily accessible feedback of the users of the knowledge base.

Navigation of the previous article and next could be a handy feature as well yet a bit redundant as the left navigation bar serves that purpose well.

4.6.3.6 Performance of the Flowlu

Similar to Bitrix24, Flowlu was not showing any dependency on hardware, only on the connection to the internet yet, this requirement was not some of the great scale. This leads to fast performance and not bottlenecking on the hardware as the conditions were pretty low. The measurement of the multiple users did not show any effect whatsoever, and Flowlu enterprise solution is promising the no difference in the highest package available with the responsiveness.

Table 9 - Flowlu performance

Task	Test one	Test two	Test three	Test four	Test five
Creation of article	7,4s	8,3s	7,8s	6,4s	6,9s
Editing of the article	4,5s	4,3s	4,9s	3,8s	4,4s
Search result	0.5s	0.4s	0.4s	0.3s	0.6s
Deletion of the article	3,2s	2,6s	3s	2,7s	2,5s

The overall performance of the Flowlu is one of the best what the responsiveness is swift without any need for additional steps. Only the most clunky thing is to pick the main topic of the specific article what within the sample has been proven rather easy and fast. Yet, within the more significant knowledge base as some articles might be named similarly, this might end up being rather clunky and hinder some for some users.

4.6.3.7 Flowlu Cost

As stated, the pricing of Flowlu is the main driving point as an enterprise solution, which is the only solution with unlimited users cost 6000, - CZK (240$/Month).

Added features are the added support for google platform, Zendesk Servicedesk support, API, and many other features, such as payment options for other elements of the Flowlu, server backups, and TLS encryption of the whole platform.

5. Results

During the years of 2018 till early 2020, SPORTISIMO company went through the ideal case scenario for this diploma thesis.

It all started with the Requestor's knowledge base what has been the only platform used by the company. Mainly as Servicedesk yet providing the option and solution for the knowledge base and as the users were encouraged to use the Requestor not only as Servicedesk, the first knowledge base within the team was formed there.

Over the year of 2018 and till late 2019, this was only a supported knowledge base of the company. The main issue was that there was not anyone who would be supporting it and do the administration of the articles, which led to lousy structuration. On top of that, low performance from the whole platform and as the main driving force for the development of the platform was other features than a knowledge base; this resulted in the change across the first level support, where OneNote of one user has been distributed across the member of the team.

This knowledge base solution was not supported till late 2019/2020 with accompanying of the Requestor's knowledge base.

The main issue of the OneNote was that most of the notes were made by one individual for them, not only for anyone else, and that led to the tacit knowledge base foundation that is not ideal.

The development of the OneNote took the priority as in early 2020, and no new manuals are being added to Requestor or to in minimal number compared to OneNote, where the notes are being created in large quantity.

Users have shown that even that the information is tacit and not explicit, they can work with it without any issues, or if there is any struggle, ask the creator directly. Most of the news articles have been founded with an explicit mindset that was requested not only by the top leadership but even the users who are using the knowledge base more than the administrator. This mainly caused of the fact of the sheer amount of questions that were brought when the OneNote solution was supported by the company.

It has shown that among the current solutions, the OneNote is the overall favorite not only performance-wise but even favorable option for the users, which are now more inclined to use

the OneNote solution over the Requestor. Yet, some users are still using Requestor, so to altogether remove the Requestor solution of knowledge base would not be as easy as simply telling the users not to use it or remove the knowledge base page from the whole platform.

This opens an option to either develop the OneNote better in the future and re-warp the current articles to meet the requirements and level of development that has been done over the mentioned period.

Some of the solutions are more revolutionary yet can pay back in the future as they have been developed for the knowledge base purpose for longer than others and had much more budget for development, which is then directly represented in the price of the whole platform. That does not mean that the cheaper version is the worse option, as actually, it brings the different solutions of the issue and can be an even better solution for the specific use-case scenario.

6. Conclusion

The overall test with the sample shown that the users are currently happy and satisfied with the implemented knowledge base, founded on the OneNote platform. As most of the information was either re-created by the explicit articles or the users are not aware that some articles are still made in tacit mindset has been shown with the provided feedback of the users.

The IT department of SPORTISIMO now has three options which could they use in the future for the better development of the knowledge base and prevent the act of what happened with the Requestor platform.

1st option would be to enforce better growth within the requestor. As the Requestor is paid platform and development are within the paid fee, the option would be to fully redesign the platform or the part with the knowledge base.

This would mean that all the knowledge that has been recorded in the past revisited to check its relevancy, make the overall re-structuration, and most likely implement some feature that would prevent the slow performance during the usage of the Servicedesk.

Adding some features would not be hard, and change of the addition of articles, changing and managing was good enough for the users and administrator to work as needed.

The main hindrance was overall performance and clumsy design what was the main driving off point for all the users within the platform. This drives the user of the knowledge base of Requestor to a different platform.

After the changes would be made, adding all of the articles of the OneNote to the Requestor's knowledge base for the future use and establishing one knowledge base that would be supported by the company, not two as it is now, at early 2020. All of the articles would be in need to revisit and remade into suitable options to date done explicitly.

2nd option would be the change of the OneNote platform. As the development is not possible as the OneNote is platform what cannot be adjusted to the single user request, this means that this solution is not an ideal long-term solution.

If this option were the option of what would be decided to go with, all of the articles would be in need to be revisited by a different user than the original creator for the proper explicit

transition. On top of that, the current administrator would need a new member of the team to make the future articles with the explicit background. Even that it is claimed that some articles are explicit, and users do feel that they are explicit, the minority of them are still done tacitly what leads into lower performance knowledge base wise.

3rd option is the implementation of the whole knowledge base on a different platform. This solution would need to be discussed as there are many knowledge base solutions, yet not every solution is fitting for the company, especially budget-wise.

As suggested in the practical part, there are four main options for the company, which could be the final solution for the third option.

M-Files: The most expensive solution yet with the best-integrated platform. The different ways how to manage knowledge than article wise, through files, might be welcomed change for many users as many of the users are keeping their notes or manuals within their computers, and this platform would allow the users to share each file within the platform with their colleagues simply.

Bitrix24: The cheapest yet not the worst solution for the company. Bitrix24 is allowing a lot of customization for more advanced users with many plug-ins and options on how to manage not only the knowledge base but even other personal development. Knowledge base is done with drag-and-drop solution and management or with pure HTML code. It is more complicated than the OneNote or M-files changes, yet the sheer amount of customization and development of the knowledge base is limitless with the lowest price.

Flowlu: Second cheapest solution what offers a solution like Bitrix24, yet with a similarity of the OneNote. Adjustment on the platform is made through editing. Each article with the simple and user-friendly solution is offering the Flowlu provide the users with a necessary platform with many handy features on top of the knowledge base. Implementation of google drive can be for some handy user addition with the rating for the administrators to see how the articles are done a nice added feature. Some of the added features of the Flowlu might end up a bit as a hindrance as they could prove pointless for the use as the knowledge base.

Overall, Bitrix24 seems the best solution out of all of these for the company if the administrator would be given the necessary time to learn and study the proper way how to handle the platform. This would need the given time and in the future deployment for the different departments more time for personal development. This is off-balanced by the cheap integration of the whole platform within the company.

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8. List of Figures

9. List of Tables