Masaryk University

Faculty of Economics and Administration

Field of study: Business Informatics

THESIS AS A PROJECT

AOMA Seminar Work

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1 Introduction

The seminar work covers the topic of writing a thesis. The approach is towards the project as a whole and focus is made on the different aspect. The relevance of the paper is based upon the Master's Thesis which is to be submitted in 2016 on the topic XRM and ERP Systems Integration in Corporations.

The theoretical part contains the basis for the practical part in that it describes the methods used. The following sections contain a Balanced ScoreCard analysis, Theory of Constraints (TOC), Critical Chain Project Management (CCPM) approach to managing the project and Thinking Tools diagrams.

The practical part contains several sections. The first section describes the application of TOC and CCPM for the planning of the thesis project. The main risks and obstacles are specified, as well as ways to reduce these risk factors. The second section searches for the personal bottleneck and describes the effects of using a Drum-Buffer-Rope during the project and the evaluation of its metrics. The third section depicts Thinking Tools diagrams. The fourth section makes use of the existing Undesirable Effects (UDE) in the Ishikawa Fishbone Diagram. The fifth section describes how the thesis project can be improved.

2 Theoretical Part

The theoretical part is divided into 3 sections. The theory underlying the practical part encompasses the Balanced ScoreCard, the Theory of Constraints, and Thinking Tools.

2.1 Balanced ScoreCard

The vision for the thesis is to create a piece of work that is relevant to my field of study of Corporate Information Systems. The thesis should satisfy the requirements of the academic faculty at the faculty of Economics and Administration who are in charge of the state exam. The work should interest me, help me gain a greater insight into my field of study and allow me to be more useful in my field of work. Using the Balanced Score Card allows a balanced presentation of all aspects for the managers, in this case my thesis supervisor and me.

The financial perspective shows how the project of writing the thesis needs to be run in order to be financially successful. Since the project is not meant for financial gain in terms of money, instead a metric of time and effort will be used. How much time and effort should be spent on creating the thesis?

The customer perspective shows how the work should satisfy users, namely the state exam committee and Navertica, the company based on who's data the thesis is being created. The company should also be able of making use of the results of the thesis as a basis for their further decisions, strategic and/or operative. The state exam committee should be able to quickly understand the topic and goal of the work, as well as easily evaluate the results and determine whether the work as a whole is sufficient in order to give the student a Master's diploma.

The internal processes perspective shows which processes should be perfect in order for the work to satisfy customers and users. These processes include mainly the planning of the work and contrasting the plan to reality. When faced with deviations, adjustments must be made to refrain from distancing from the plan.

The evolution perspective shows how improvements should be made in order to improve the entire effort. This means that feedback must be collected from various sources and all feedback must be incorporated in the further decisions.

2.2 Theory of Constraints

The following section is an extract from the Bachelor's thesis of Martin Lofaj. The Theory of Constraints (TOC) is a management methodology that focuses on augmenting the output of the production process. The theory defines terms such as critical path, critical chain, and the various elements determining the production process.

2.2.1 Critical Path Method

Each project consists of a given sequence of tasks which have a pre-determined length. These tasks can be represented in a graph of points connected by arrows indicating their order. Each point represents one task and is also labeled with the number of units of time it takes to complete (e.g. hours/days/weeks etc.). The graph precisely shows the prerequisite tasks necessary before the following task can commence.

The time required for carrying out the entire project is determined with the "Forward Pass" method which traverses the project task-outline from the first point to last. Each task is given the earliest possible start time (the first task starts at time 0). Forward Pass enables the project manager to find the total required time for the project, assuming that tasks follow each other immediately without delay. Due to the possibility of multiple prerequisite tasks, there are cases when a task does not need to start at its earliest possible start. The latest possible start of a task without the risk of increasing the duration of the entire project is determined by the method "Backward Pass", which traverses the graph of ordered points from the last task to first.

The time interval when a task might be commenced is referred to as "Float" or "Slack". The largest interval, expressing how long a task can be delayed, is called "Total Float" and is determined as the difference between the earliest and latest possible start. If the Total Float equals 0, the task is "critical", meaning that it must be started as soon as it becomes available. A stricter interval measurement is the "Free Float", which does not delay the earliest possible start of following tasks.

In connecting all critical tasks, a "Critical Path" is created, connecting the first task to last. Any one of these tasks that takes finishes later than planned leads to the delay of the entire project (Goldratt, Critical chain, 1997, p. 127). The critical path thus represents the technological continuity of tasks as well as the pre-determined length of the project.

2.2.2 Critical Chain Project Management

In TOC, Critical Chain Project Management (CCPM) is the longest path in the graph of planned activities of a project (e.g. Gantt Diagram), which takes into account not only the technological sequence of tasks but also the resources' capacity. In the case of no resource constraints, the critical chain would be identical to the critical path. Due to the constraints in resources the order and synchronization of tasks must be adjusted, leading to the prolongation of the duration of the project. These constraints create areas called "Drums", which are the focus point of TOC (Goldratt, Critical chain, 1997, p. 74).

2.2.3 Evaluation of the production process

The subject of TOC is the determination and improvement of the performance of sequences of tasks. The theory suggests that the performance of the process depends on its weakest element (Goldratt, Critical chain, 1997, p. 75). This element then reduces the "Throughput", thus restricting the system in fulfilling its purpose on an unlimited scale. The most important terms in evaluating the TOC are "Inventory", "Operating Expenses", "Drum", "Buffer", and "Rope".

Throughput is the amount of money generated by the system through sales. It is defined by the amount of necessary raw materials, secondary materials, and finished goods that pass through the system during one cycle (work day/week/trimester etc.). Throughput is expressed as the difference of sales and totally variable costs. These costs arise uniquely at the moment of creating the product proportionally to its quantity. Their value is variable and they represent the complement to the fixed costs in the set of all costs. Inventory describes all the money invested in purchase of items that enable the creation of a throughput, namely materials supply, fixed and intangible assets such as machines, buildings, patents, licenses, software, etc. Operating expenses are all the expenses used for transforming the inventory into throughput; they include fixed costs, salaries, and other costs related to running the company (Scheinkopf, 1999, p. 15).

In determining the different tasks in the process, the Drum is the bottleneck of the production process that determines the movement of the entire process. The Buffer is a time reservoir protecting operations critical to the project's timeline in the case issues arise during any activity (Goldratt, Critical chain, 1997, pp. 127-130). It is incorporated into the project and its main objective is to guarantee the delivery of the final product. The buffer can be of several types. A Constraint Buffer or Drum-Feeding Buffer prevents the drum from depleting all its resources and therefore makes sure the buffer stays supplied. A Finished Goods Buffer protects the deliveries to clients in guaranteeing a sufficient supply of finished goods. A Raw Material Buffer ensures an adequate supply of raw materials to prevent an unexpected shortage in case of shortfall from suppliers. The final type of buffer, the Assembly Buffer is a reserve on every stage of the production line, thus allowing an uninterrupted production process. The last important element in the process is the Rope. This tool allows the synchronization of the rhythm of the production process with the resource constraint. It is a link assuring that the constraint is always supplied with the right amount of work. As Youngman describes in his Guide to Implementing the Theory of Constraints, "the rope makes sure that work that is supposed to be done is done and that work that is not supposed to be done is not done" (Youngman, 2003). The drum is thus protected from running out of work as well as it prevents of the creation of too much work in progress.

In applying TOC, 5 steps must be taken. The first is the identification of the bottleneck – the drum. The second step is exploiting the constraint. In the third step, the entire process must be subordinated to the decision to fully use the drum. In the fourth step, the constraint should be improved or even removed, to allow a greater throughput. Lastly, once the constraint has been removed, the process should start over again in searching for a new drum in the production process. By following such a sequence of steps, continuous improvement of the production process allows the constant increase of throughput. The theory should not be subject to inertia and therefore improvement of the production process is always possible (Goldratt, Theory of constraints, 1990, s. 5-7).

The greatest difficulty in applying theory to practice is the ever-existing difference between the two. Applying new methods can often be met with resistance and the process of change requires an important commitment from the management (Russell-Jones, 2006). An even more significant commitment is necessary when dealing with projects that are resistant to change in their nature itself (Lofaj, 2014, s. 15-17).

2.3 Thinking Tools

Thinking Tools is a set of methods used in applying and overseeing a change in a company. The tools allow modelling of all elements of the change, starting with the current state and the initial problem that needs to be solved all the way to implementing new processes and to model the ideal situation after the change is implemented. The models used in this work areCurrent Reality Tree (CRT) and Prerequisite Tree (PT) (Montgomery, 2012).

2.3.1 Current Reality Tree

The CRT represents the current state of the company. It identifies the source causing the problem (yellow) and Undesired Effects (UDE) (blue). The UDEs develop into the final problem, which is represented in red (Scheinkopf, 1999 p. 144).

2.3.2 Prerequisite Tree

The PT is a tree representing intermediary goals (light green) before advancing to the final goal (dark green). Every goal is preceded by the obstacle (red) which has to be surmounted in order to continue. At the bottom of the tree is the initial state, the need for change (yellow) (Scheinkopf, 1999 pp. 194-196).

Thinking Tools diagrams represent an elaborate means collecting and understanding the process of change. The diagrams allow via simple visualizations to communicate the management's thinking process and intentions, thus allowing easier co-operation with the other involved parties, what consequently ensures the smoother transition. Finding a tranquil way to improve requires a solid foundation based on progressive hypotheses (Lofaj, 2014, s. 29).

3 Practical Part

3.1 TOC and CCPM

The main problem of the project is its uniqueness. I have written some larger works in the past (Internship report, Bachelor thesis, some larger papers in High School), but these have been within a larger timeframe between each other. For smaller processes which happen on a regular basis, it is much simpler to optimize the process, as the experiences are fresh and it is vital to improve the flow. With such a rather unique project the experiences are scarce and often work happens on unchartered territory. Confusion or a blockage often have considerable effect on the project and are not easily foreseen. Since much of the project depends on how things turn out, it is difficult to estimate how much time and effort each part will take. It is therefore vital to plan as much as possible and to measure and improve the processes. Recording such information in a concise matter can help in the future when planning a similar project. Anyhow, planning the unprecedented trains a mind to think differently, to search for more connections and relations between entities and to make predictions as well. When contrasting these with the reality that happens later on, it is possible to re-adjust the planning and prediction process, as you have direct feedback. It is impossible to view the future, but every single moment of our life is the future of some earlier time period. In a sense we are constantly travelling to the future and once this notion is understood and accepted, it becomes much easier to consciously create a specific future. The Critical Chain of the project is depicted in Figure 4 as the intermediary goals of the Prerequisite Tree.

The Theory of Constraints is used to maximize throughput and will thus be applied on two sub-processes, which are often repeated during the project.

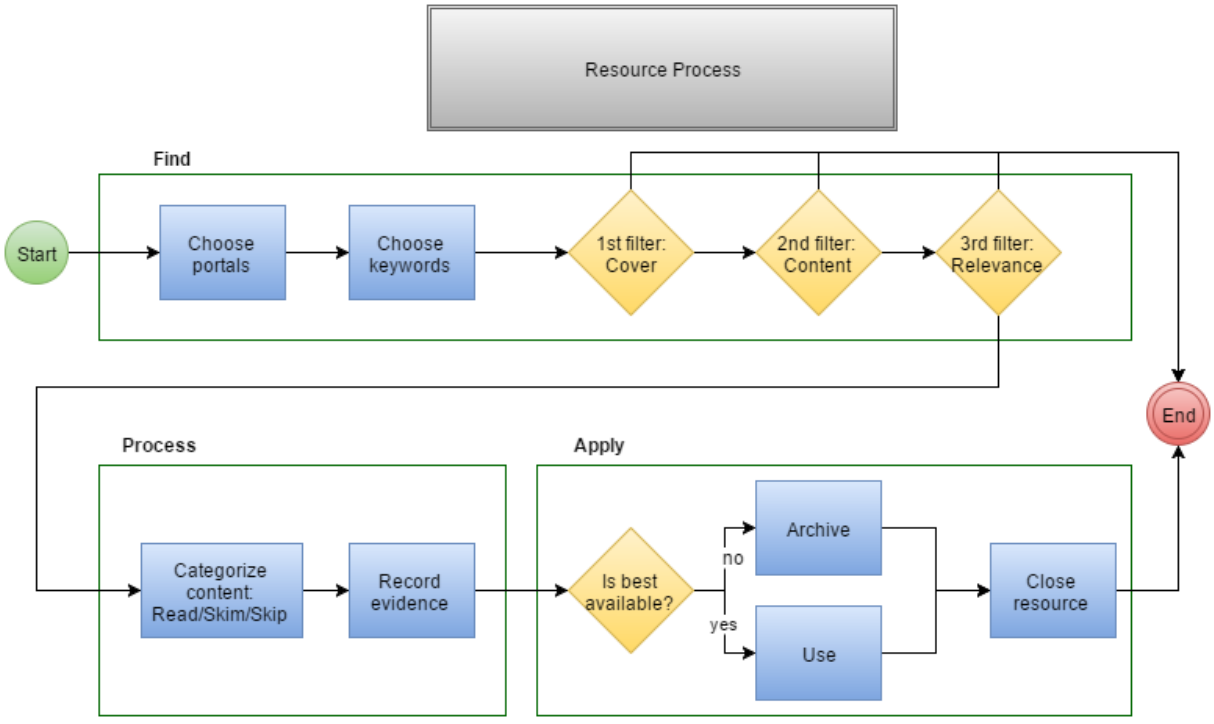

Figure 1: Processing a Resource (Author)

Processing a resource (Figure 1) is a repeated process within the thesis project. It requires several steps. The first step is to find the resource, then process the resource and lastly apply the resource. When finding the resource, specific key-words must be used on a specific portal that will bring up

results. Therefore, portals must be found (Aleph, ebrary, Web of Science, etc.) and a list of key-words must be created. Then the results must be filtered on several levels. The first level filters out resources that are off-topic based on their title, brief description and/or their year of release. For example, resources that are from before 2000 are highly likely to be irrelevant to the topic of my thesis. They would be considered old and out-dated in terms of the topic which covers information systems development, which is a rapidly advancing field. After this first filtration, the resources must be filtered a second time. While the cover information tells a lot and can be easily evaluated, the second filter looks inside the resource - at its contents. This requires of course, closer inspection. However, it should not take too much time, because the resource still may not be relevant. Upon examining the table of contents, there must be at least one section that is interesting, in that is relates to the topic or sub-topic of my thesis. The third filter is the most important, because it actually selects the resources that will be read and processed. This filter compares the selected resource to the other available resources that would cover the same topic. It is important to have many sources, however, the emphasis is on the best resource available. Ideally, the Kepner-Tregoe table with weighted criteria would be used. This would, however, require a great deal of bureaucratic effort, therefore often a more instinctive approach is used based on empirical evidence of usefulness of such a resource. Once the resource receives this third "go ahead", the resource is inserted into the queue of resources to be processed. The processing part of the process firstly looks more deeply at the table of contents. Based on the topics of chapters and their sections, they are divided into three categories - read, skim, skip. While reading or skimming, important information is sought for that will enhance the thesis, either in the theoretical part or in the practical part. These sections are then duly noted, along with the information on the speific resource (its citation). As it is often not possible to possess each resource during the entire time of the project, a "best effort" approach is maintained. In case further information needs to be extracted, the resource can later on be found again and re-used. The last part of the process covers applying the resource. This is done when writing the thesis in the relevant section. From among all the resource evidence the most relevant is used. It is possible that much of what has been collected will not be used, but this approach allows the most relevant use of evidence. At any point, it is possible to go back to any point in the process and either look for more key-words, search on a different portal, or find different resources (even re-select from those that were filtered out) and of course re-use used resources. While this approach could be used individually for each resource, it would be very time consuming to start each part multiple times. Each resource must be examined and read individually, but their selection is a process that is ideally done collectively, or rather in larger bulks. The university library contains many resources, but the Internet contains many more and in order not to lose track of the bigger picture, it is necessary to spend the least amounts of time possible with each unverified-if-useful resource. This approach comes from experience with previous projects, where the amounts of available resources were so large it was exhilarating, leading to frustration and inability to select the best resource based on "best effort". The drum of this process lies in spending the least amount of time with unverified-if-useful resources. The buffer allows for some more time to be spent on processing the resource, and the work is organized in such a way that only one resource is processed at a time. The rope maintains the other parts of the process together and in-line with what the activities and status of the drum are, therefore allowing for a prolonged use of a resource that is considerably more valuable. With inertia, the process continues its improvement, thus finding the next drum-buffer-rope.

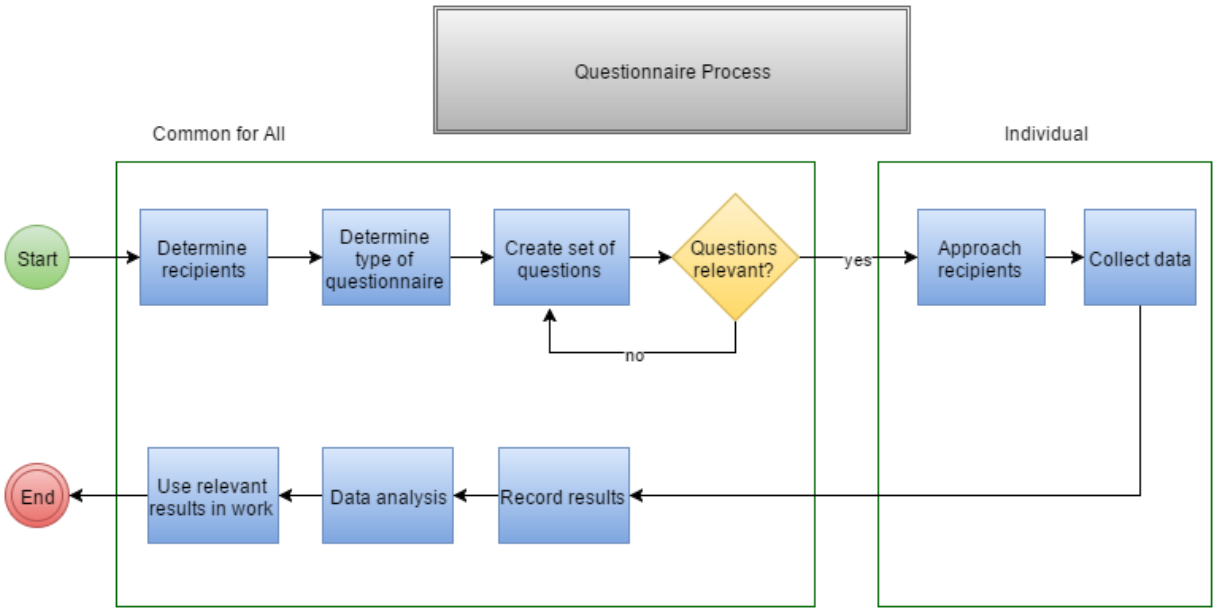

Figure 2: Questionnaire Process (Author)

The process of filling out a questionnaire (Figure 2) also contains a common part for all filled out questionnaires and an individual part. The first part decides on the recipients of the questionnaire, that will be targeted. Secondly, the type of the questionnaire is determined - quantitative, qualitative or mixed. Third, the questions must be put together. This part is the most vital and presents the drum, for if the questions are too vague or irrelevant, they will hinder the evaluation of the results, which will not be pertinent to the work. In the following step, the individual recipients are approached, based on the choice of the recipient base and questionnaire type. Once the data is collected, the results are collectively analyzed using different techniques, either statistical, or data mining, or grouping ideas together and finding relations with diagrams in case of a qualitative question. The results are then recorded and the most interesting and relevant results are used in the thesis. The buffer for this process is not only of time, but also of a multiple re-improvement of the questionnaire questions, not only on my own, but with the co-operation of the thesis supervisor and potentially as well as with some key recipient, who is knowledgeable of the subject and thesis topic and can provide insight with a global picture in mind. The rope makes sure that there is no blockage and that the work that should be done is done and that the work that should not is not done.

3.2 Drum-Buffer-Rope

When applying the Drum-Buffer-Rope on the project of writing my thesis the drum lies in the ease of distraction when not following a specific plan.

Once we have the drum, we proceed to add a buffer to it, to make sure the drum does not run out of work and the throughput is maximized. The problem with the throughput of the project of creating a thesis is that it is a one-time project. It is not a repeated production of some product, but as previously mentioned, a unique project with a unique output. The entire process requires a project management approach, but there are smaller sub-processes to which the drum-buffer-rope theory can be effectively aligned. Two processes that will be demonstrated and described are processing a resource and filling out a questionnaire.

The Critical Chain Project Management suggests that within the critical chain buffers should not be placed after each task. Tasks should rather start on an "asap" basis, therefore no time will be wasted to consume a buffer. Instead, all buffers are placed at the end of the chain, thus allowing space for unprecedented delays. Some tasks may have longer delays than a single buffer would expect them to have. However, the tasks which finished either on time or sooner will allow the coverage this proportionately large lost time. In the project of writing my master's thesis the method works in a similar way. Instead of placing buffers after each single task (creation of a questionnaire, finding resources, processing resources, etc.) I will collect all the buffers and put them at the end. This will be done by creating an earlier deadline for submitting the work. The official deadline for submitting the work is May 13th, 2016. My deadline for submitting the work will therefore be March 13th. In case anything happens that should delay my work, I will have 2 more months to cover for it.

3.3 Thinking Tools

The analysis of the project was done using two of the Thinking Tools Diagrams. The Current Reality Tree sets as the source of problems the lack of focus, which leads to Undesirable Effects (UDEs). The first of these is the lack of a plan, because work is done as it happens, without any control of the global picture. This results in another UDE, time wasting, since as time is not effectively used and measured, it goes to waste. Inefficient time consumption during the project manifests itself in two effects. The first is Student Effect, which says that the greatest effort is made towards the end of the project. This costs a lot of effort towards the end of the project and causes great amounts of stress, because of the project size and importance. The second effect is the Parkinson Effect, which causes the time required to complete the project to stretch out over the entire available time period. Since all of the time is consumed and most of the work is still finished towards the end of the project, much time and energy are expended, whereas a greater structure of work and work discipline could be saved. These UDEs lead to the final problem, which is frustration and potentially a lacking in quality final product. Even worse, frustration and stress can cause health problems, thus further hindering future work.

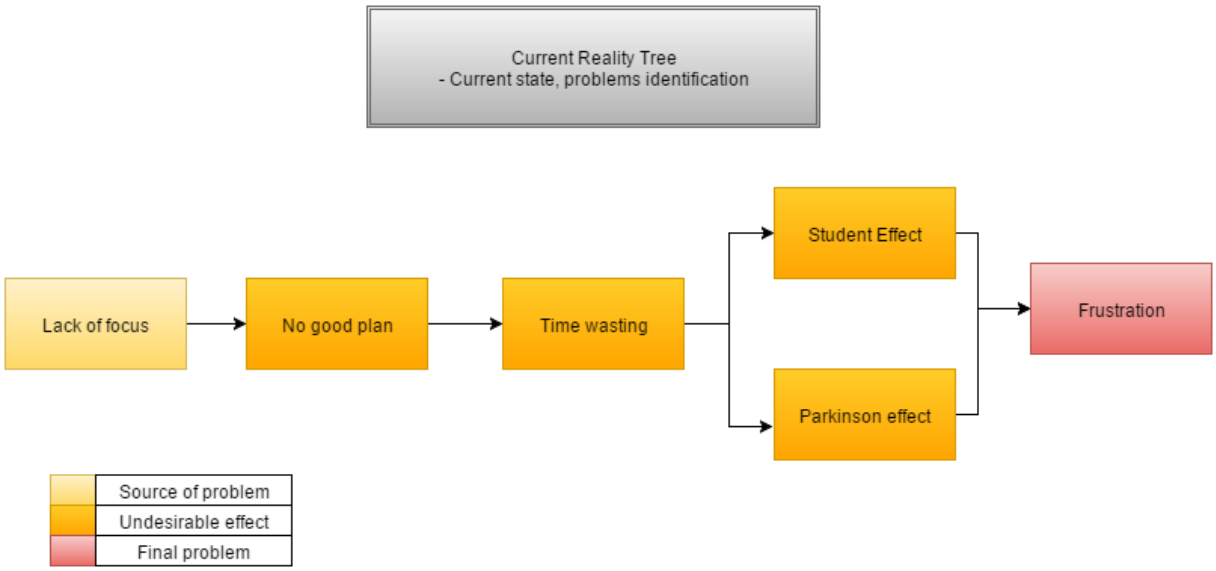

Figure 3: CRT (Author)

The second used Thinking Tools diagram is the Prerequisite tree (PT), which lists the main project risks and obstacles and also suggests ways to overcome them. The initial need for change at the base of the diagram is the need to write a master's thesis in order to complete university studies. The obstacles in the effort are the following. Firstly, there is no subject for work, which must be carefully chosen, in order to fulfill the criteria of the field of study as well as the state exam committee. Furthermore, there must be a supervisor willing and available to supervise such a topic. Secondly, there is little to no free time to do the work, which thus must be allocated. This often presents itself as a challenge, because of work in a company, spending time with the girlfriend, class attendance, work for class, parties, sports, friends, family, travel. There is simply a great deal of distractions, and procrastination is a strong enemy. This is even enhanced by the lack of planning, or a bad plan which can lead off course. That way potential blocks arise during the work. Writing a thesis can get confusing at times and not always is it easy to figure things out – this requires a great deal of structure and discipline from the author. No resources to gather relevant evidence may be an obstacle. Since the author often enters a somewhat at least for them unchartered territory, it is possible they have no idea about parts of the topic, which must be figured out.

The intermediary goal and thus ways to overcome the obstacles are primarily the allocation of time. Then, the instructions must be studies and a relevant plan must be made. This plan should be often compared to reality and adjusted or revised if needed. This vital step is often easier said than done. Planning is very often underestimated. Then the subject must be specified, book and web resources must be found and processed. All parts of the plan, an outline of the work and a questionnaire are assembled. The questionnaire then represents a large part of the work, as it is the source of the empirical data. The analysis and results evaluation is recorded and incorporated into the work, along with the actual body of the work. Among the final steps is the design adjustment, formal requirements such as citations and once the work is submitted, as the first goal, the author prepared for the thesis presentation. The final goal is then the thesis defense.

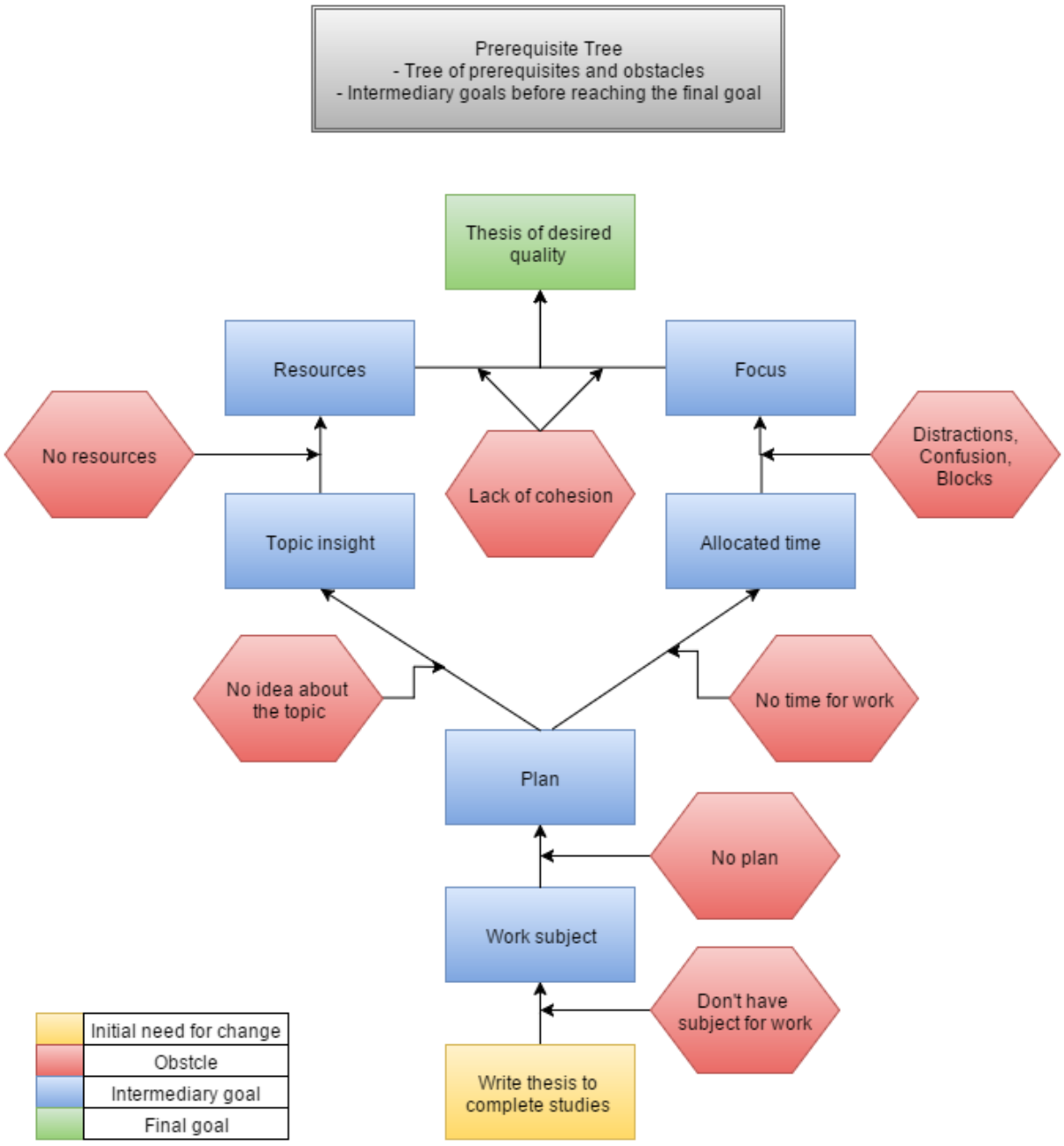

Figure 4: PT (Author)

3.4 Ishikawa Diagram

The Ishikawa Diagram is also called Fishbone Diagram or Cause-and-Effect Diagram. By sorting ideas into categories, it provides possible causes for a problem. It can be used when identifying problems, for example during a brainstorming session **Zadaný zdroj je neplatný.**.

The diagram is used for determining relations of cause and consequence. It is used for managing quality, especially in the production industry. I will use it to evaluate the weaknesses of the project of my thesis and compare its results to the TOC CRT. The Ishikawa diagram can have different axis, I will use Man, Material, Methods, and Mother Nature (Figure 5).

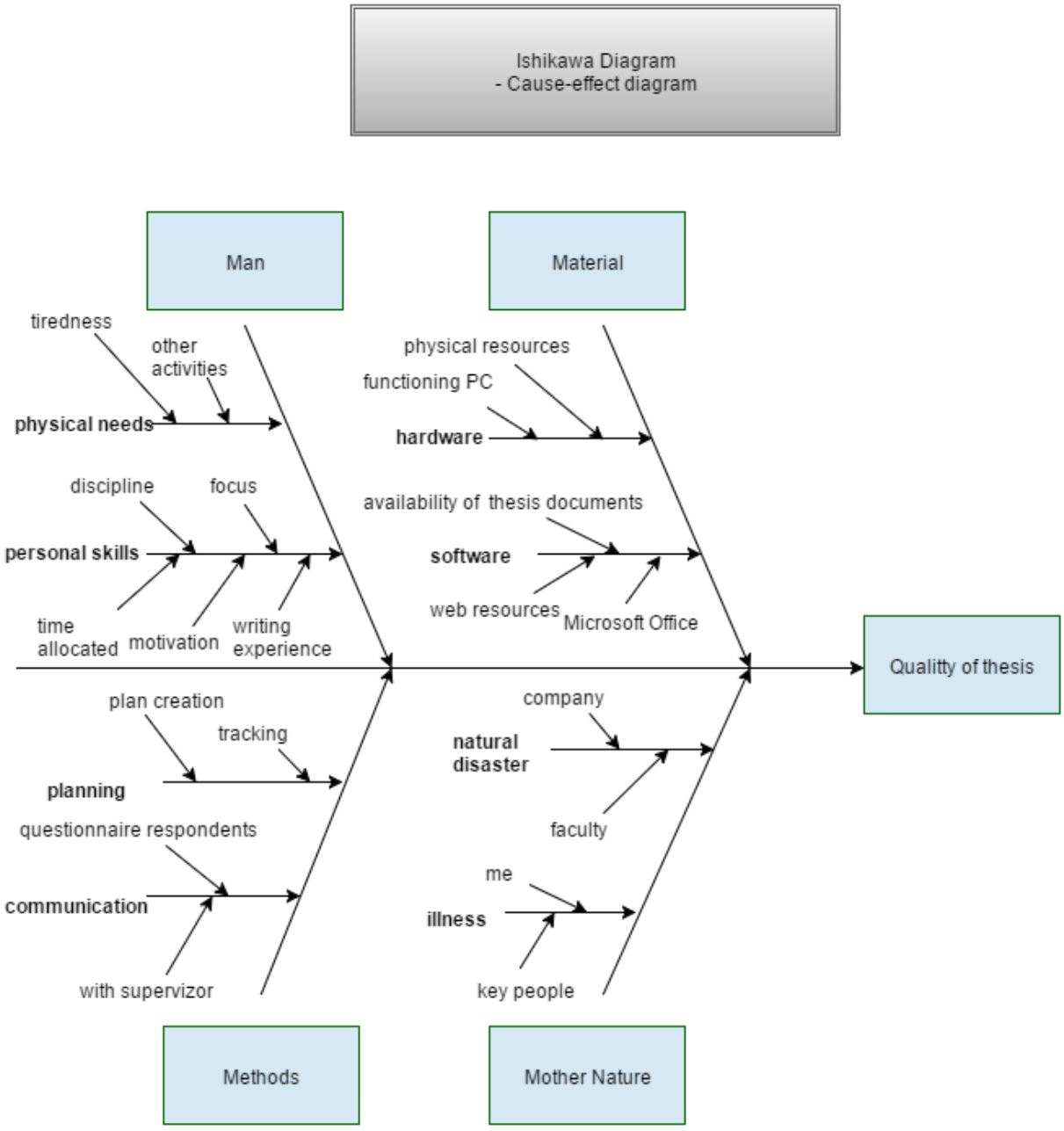

Figure 5: Ishikawa Fishbone Diagram (Author)

The Man section describes factors that influence the final quality of the thesis. Among these are most important my personal skills: discipline, focus, amount of time allocated, experience in writing, motivation. physical needs: tiredness, other activities. The Material section describes the factors of the tools I use. Among the most important are properly functioning PC, installed Microsoft Office, availability of my thesis documents, resources that I use for the work and their quality and availability. Among the Methods, there are the problems of Planning, Tracking, Communication with the supervisor. In my Ishikawa model the last section covers Mother Nature, which influences the work from outside sources that can only hardly be influenced, for example illness or grave trouble at the company or at my faculty.

The following shows the attributes assigned to the individual criteria.

Cause	Importance	Importance %	Accumulative %
Discipline	10	10%	10%
Plan creation	10	10%	20%
Tracking	9	9%	29%
Focus	7	7%	36%
Questionnaire respondents	7	7%	43%
Time allocated	6	6%	49%
Writing experience	6	6%	55%
Availability of thesis doc	5	5%	60%
Functioning PC	5	5%	65%
Motivation	5	5%	70%
Supervisor	5	5%	75%
Web resources	5	5%	80%
Microsoft Office	4	4%	84%
Physical resources	4	4%	88%
Other Activities	3	3%	91%
Tiredness	3	3%	94%
Key people illness	2	2%	96%
My illness	2	2%	98%
Company disaster	1	1%	99%
Faculty disaster	1	1%	100%
TOTAL Sum	100		

Table 1: Causes importance - weights (Author)

The table translates itself into a Pareto Chart with a Lorenz Curve (Figure 6), which allows the focus on the things that deliver the most results, using the 80/20 rule.

The chart shows that the greatest focus should be placed on having a good grip on the project, mainly coming fom the “Personal skills” section of the “Man” bone of the Ishikawa diagram. Also important are “Methods” and “Material”, however, focus on “Mother Nature” as the cause of the failure of the project is not so vital.

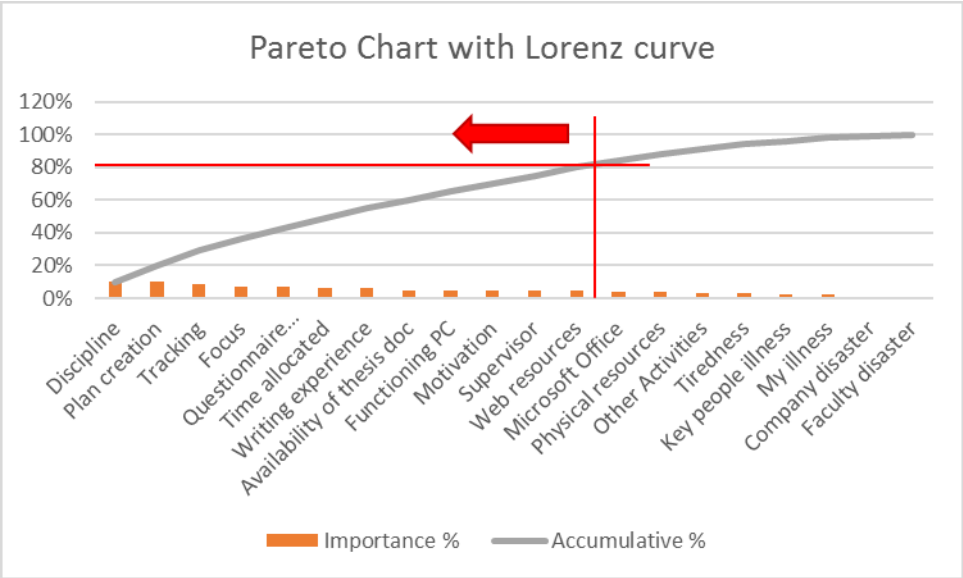

Figure 6: Pareto Chart, Lorenzo Curve (Author)

3.5 Improvements Suggestions

In my opinion, my thesis writing can get better in two steps. The first is following the rules set out in this seminar work and the second one is through practice. Although it is quite unlikely I will be writing more master's thesis in the future, there will surely be some publication that I will contribute to or write myself. In any case, when communicating with clients, documents are always prepared. This experience and any further writing experience enhances the skills and is therefore of considerable value. In addition to that it is important to keep in mind the larger picture and to overcome ignorance, by always educating oneself and continuously improving.

4 Conclusion

The seminar work uses a Project Management approach to look at the creation of a thesis. This approach is very useful in thinking and outlining the thesis project, as the various methods used allow the author to gain a greater insight of the work and manage a better grip on the larger picture.

The most important processes are specified as well as their bottlenecks using the Theory of Constraints. The Undesirable Effects are determined as well as remedies. The most important cause of problems is lack of focus, which translates itself into frustration, all of which are eradicated by this work. The cause-and-effect Ishikawa Diagram with weighted factors combined with the Pareto principle shows how to effectively choose what elements of the project will bring the most results and should be focused on.

Creating such analyses is a great opportunity for me to improve the thesis project that I am currently undertaking. I would suggest not only to the students of Operations Management to undergo such a study but also to all students who are writing a thesis, or even any other large-scale work. In addition to improving the overall project, applying these methods increases critical thinking capabilities. Methods such as TOC and Ishikawa can be applied to many different settings and problems and are great tools to work with when creating a thesis. However, as any powerful tool, they must be mastered. As Norman Vincent Peale states, “Repetition of the same thought or physical action develops into a habit which, repeated frequently enough, becomes an automatic reflex.” Thinking in terms of cause and effect and being able to identify both provides any individual great power over their life which can be used as an incredible advantage in any field they venture in.

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