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PROCESS IMPROVEMENT

Case R&D, IEC LV Motors

School of Technology
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ABSTRACT

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This thesis was created for Research & Development department at IEC LV Motors and it was initiated alongside with an internal development project. Mechanical design team had a need of their processes to be mapped, regarding the tasks of mechanical design engineer. Project aim was to map processes in “as-is” form. This would give an opportunity to improve the flow of these processes in the future by applying “as-is – to-be” model.

This thesis was limited to map the processes of product development and mechanical design. As an addition a guideline package for mechanical design engineers was created. It is in a form of cross-functional flowchart combined with process description and an instruction directory. The guideline package was created for local use for the mechanical design team.

Project team consisted of 12 employees. Every employee had their own role. Project team was sharing their knowledge and gave guidance in our weekly meetings, concerning the project and thesis.

Requested process maps and process descriptions are now ready and available in the case company’s local database. The instruction directory was created in close cooperation with a documentation engineer. It is a collection of instructions related to mechanical designer’s tasks in R&D department.

As a conclusion, the created guideline package was a success and it is a good basis for continue further development of how to manage instructions and processes in the future.

Keywords: product development, process mapping, and process improvement

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TIIVISTELMÄ

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Tämä opinnäytetyö toteutettiin IEC LV Motorsin tuotekehitysosastolle ja se aloitettiin samanaikaisesti sisäisen kehitysprojektin kanssa. Mekaanisella suunnittelutiimillä oli tarve saada heidän prosessejaan kartoitettua, koskien mekaanisen suunnittelijan tehtäviä. Projektissa oli tarkoitus kartoittaa prosessit nykymuodossaan. Tämä antaisi mahdollisuuden tulevaisuudessa kehittää prosesseja käyttämällä ”as-is – to-be” mallia.

Tämä opinnäytetyö rajattiin kartoittamaan tuotekehityksen sekä mekaanisen suunnittelun prosesseja. Lisäksi mekaanisille suunnittelijoille luotiin ohjepaketti. Ohjepaketti on prosessikaavio yhdistettynä prosessikuvaukseen sekä ohjehakemistoon ja se luotiin mekaaniselle suunnittelutiimille paikalliseen käyttöön.

Projektitiimi koostui 12 työntekijästä, joista jokaisella oli oma rooli projektissa. Projektitiimi jakoi tietoaan ja ohjeita viikoittaisissa palavereissa koskien projektia, sekä opinnäytetyötä.

Vaaditut prosessikaaviot ja prosessikuvaukset ovat valmiita ja käytettävissä toimeksiantajan paikallisessa tietokannassa. Yhteistyössä dokumentointi-insinöörin kanssa luotiin ohje hakemisto. Hakemisto on kokoelma ohjeista, jotka liittyvät mekaanisen suunnittelijan tehtäviin tuotekehitysosastolla.

Loppupäätelmänä, opinnäytetyö ja luotu ohjepaketti onnistui hyvin ja ne ovat hyvä pohja jatkaa lisäkehittelyä, kuinka hallinnoida ohjeita ja prosesseja myös tulevaisuudessa.

Avainsanat tuotekehitys, prosessin kartoitus, prosessinkehitys

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ABBREVIATIONS AND TERMS

CHTET	ABB Switzerland Ltd, Group Technology Management
GPM	Global Product Maintenance
IEC	International Electrotechnical Commission
LVM	Low Voltage Motors
PG	Product Group
R&D	Research & Development

1 INTRODUCTION

The main objective of this thesis was to map and improve the processes of mechanical design team at Research & Development unit of IEC LV Motors. This thesis was a part of an internal development project and it was performed in cooperation with a project team. During this thesis I was working as a mechanical design engineer trainee at the case company and more specifically in the mechanical design team, which commissioned this thesis.

The improvement was achieved by creating a guideline package, using process mapping as a main tool. The guideline package is a combination of cross-functional flowcharts, process descriptions and an instruction directory. The directory contains instructions, which are related to mechanical design engineer’s tasks at R&D unit. Processes were mapped in “as is” form. “As is – to be” model can be applied for the processes in the future for further development. The guideline package was tailored for the mechanical design team and it was created in a point of view of a mechanical design engineer.

This thesis contains introduction of the case company, background and aim of the related internal development project and thesis, my responsibility areas in the project, and theory of process improvement. Communication during the project and creation of the guideline process are both presented in their own chapters. Conclusion and development ideas for the future are presented in the last chapter.

All the created flowcharts, process descriptions and directory files are concealed because those contain internal information of the case company and it cannot be shared with third parties. Also some parts in this thesis cannot be explained in detailed level because it would reveal internal information of the case company.

2 ABB

2.1 ABB Globally

ABB is a global leading technology company which operates in over 100 countries worldwide. The company has approximately 105,000 employees and it has revenue of nearly 28 billion dollars (2019). The company headquarter is located in Zürich, Switzerland. ABB has a vision to achieve carbon neutral and energy self-sufficient ecosystem for industry, homes and cities. ABB focuses on four different business areas: Electrification, Motion, Process automation, Robotics & Discrete automation.

Electrification business offers innovative solutions for wide range products for different segments, such as solar inverters, modular substations, distribution automation, power protection, wiring accessories, switchgear, enclosures, cabling, sensing and control /1/.

Motion business is globally the largest supplier of motors and drives, providing customers with the complete range of electrical motors, generators, drives and services. It also provides mechanical power transmission products and integrated digital powertrain solutions. Motion business also serves a wide range of automation applications in transportation, infrastructure and discrete and process industries /1/.

Process Automation business is second largest in the market globally and it offers a broad range of solutions for process and hybrid industries, also including industry specific integrated automation, electrification and digital solutions, control technologies, software, and advanced services. The business has also Measurement & analytics, and marine and turbocharging offerings /1/.

Robotics & Discrete Automation business provides value-added solutions in robotics, machine and factory automation. This unit is leading the robotics market at China, it also is investing in a new robotics factory in Shanghai /1/.

2.2 IEC LV Motors – Vaasa factory

IEC LV Motors factory is located in Vaasa and it employs approximately 600 highly educated professionals. IEC LV Motors is responsible of developing and manufacturing of tailored IEC-low voltage motors and generators for all industries and applications worldwide. Low voltage motors with frame size of 80-500 and with voltage less than 1000 volts are manufactured in Vaasa /2/.

2.3 IEC LV Motors Division - Research & Development

R&D functions vision is to innovate trough focus and collaboration towards profitable business growth, while fostering out of the box thinking. Their mission is to devise novel products with world-class competencies, application and new technologies /3/. R&D Hubs are located in six countries around the world (**Figure 1.**)

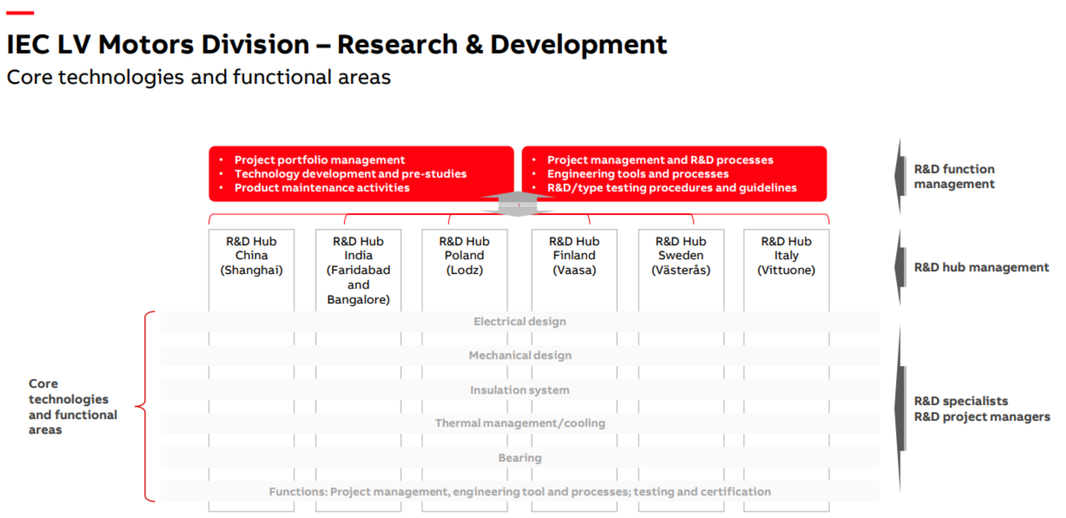

Figure 1. Core technologies and functional areas /3/.

R&D function's main focus and responsibilities:

- Manages overall development portfolio and roadmap (product and technology)
- CHTET financial controlling, footprint and capacity management
- Secures the common design platforms, enablers and guidelines for global product platform
- Ensures technical knowledge and competence transfer within the Division
- Develops, maintains and manages global R&D and type testing procedures and guidelines for all production units.
- Drives and secures results and deliverables from cross-divisional technology team (advanced calculation/engineering tool, material and insulation lab)
- Drives and coordinates with PU product implementation managers and global product implementation managers to ensure on-time product launches
- Secures the global coordination of product maintenance activities
- Cross-division collaboration /3/.

2.4 R&D Hub Finland

R&D Hub Finland at Vaasa is part of a global group and it consists of five different functions. Main missions and responsibilities are explained in this chapter.

Product Development function is responsible for developing new products, which include designing of new components, assembly drawings, prototype testing and documentation for sales force, production and central stocks.

Global Product Maintenance function is responsible for keeping existing catalogue products technically in shape in the databases and tools. GPM function covers product technical documentation, new features to existing products, variant codes, necessary updates initiated by other functions.

Technology function’s mission is to leverage PG Technology organization and activities securing that ABB PG IEC LVM will gain a market leading position based on Cost, Quality and Functionality. Technology function has overall responsibility for PG R&D activities and strategy, secures that the different functions are well coordinated to secure synergies and good cooperation.

Engineering Tools & Processes function is focusing on global design and sales processes and also development and maintenance of the tools. It is important to recognize the needs for future in advance, in point of view of designing, certification, and sales because developing tools, datamodels and processes is long-term work.

Certification function’s mission is to secure the compliance of the products, validity and availability of certificates, approval and documentations for the product platform of PG IEC LV Motors.

3 DEVELOPMENT PROJECT BACKGROUND

An internal development project called “Mechanical process mapping” was launched at the same time with this thesis in January 2022. After the project, all the created material was planned to be transferred to continuous improvement unit at ABB for further development.

3.1 Project objective

The main objective of the project was to map various processes, which includes tasks of mechanical design team of R&D unit. Processes were to be mapped in “As Is” form. This would clarify the current status and flow of the processes as well as give an opportunity to develop the processes to be more efficient in the future. All instructions related to mechanical design engineer tasks needed to be discovered and investigate which instructions were in a need of an update or were completely missing. Before this thesis work started, databases were inspected and it was stated, that many of the critical processes such as product development process or mechanical design process do not exist in the databases.

3.2 Main issues

In the case company many of the tasks and processes are executed based on the tacit knowledge of the employees jointed with instructions. Employees who are specialized for some specific area of expertise, might occasionally be the only one with know-how on that area of expertise. Periodically this causes delays to projects and processes due to various reasons; sick leaves, holidays etc.

Case company’s work-instructions, documents and document templates are located in many different databases and websites. In consequence of this, finding the right instruction for different work phases is occasionally time-consuming. A single design engineer must often rely on co-workers and ask if they know where the right instruction for some specific work phase is located. In this situation, working is not always as efficient as it could be.

Update of the instructions is not now optimal due to various reasons; multiple databases for instructions are difficult to manage, responsible person/function of a specific instruction might be unclear, instruction is created by a person who is not working at the company anymore.

One database which the case company use, has a reminder feature built in the application. It automatically reminds the responsible person/function of the instruction after a specific amount of time. However, this feature is not integrated in other applications.

3.3 Approaching the issues

As there are already instructions for most of the critical work phases concerning the tasks of a mechanical designer at R&D unit, process mapping can be used as a tool to split the processes into pieces. By using this method, searching area and the keywords for searching can be narrowed down, when searching the correct instructions for a specific work phase from the databases.

It was stated that a guideline should be created. Clear guideline would make the work processes more efficient and it would support employees to perform more efficiently in their job. Guidelines would also help employees to adapt faster to their tasks in projects. The workload of the unit would also be reduced as employees could work more independently by using clear guidelines, instead of using time for searching the right instruction and asking advice from co-workers.

All the needed instructions and websites for the process phases should be gathered and be easily accessible in one place. This would solve the problem of the time-consuming phase of finding the correct instruction for work phases as well as updating process of the instructions would be more easily manageable.

3.4 Restrictions for the guideline

As the case company is a global company, there are some restrictions for the global instruction creation. If the instructions were to be created for global usage, the language of the instructions must be English and it must conform global rules for instructions. A lot of instructions have been created for local use over the past years, which does not fulfil the requirements of the global instructions but are efficient for daily tasks at local level of work tasks.

Locally used instructions are not as restricted as global instructions and for this reason local instructions are more flexible to update and can contain more specific information. It was decided to create a local guideline for the mechanical design team due it's flexibility and conveniency.

3.5 Project scope

Rough scope of the project was discussed in the kickoff meeting of the project. Kickoff meeting was held in January with the project team. The scope became more precise as the project progressed. It was decided that the flowcharts will be created in a form of a cross-functional flowchart. Cross-functional flowchart structure is explained in the theory part of this thesis. The final scope of the project is presented at table 1.

Table 1. Project scope.

All identified development areas to be listed
R&D flowchart with process description to be created (As-is)
Main and sub-processes of product development to be identified (Mechanical design aspect)
Main and sub-processes of mechanical design to be identified

	Product development process (Mechanical) flowchart with process description to be created (As-is)
	Mechanical design process and its sub-processes flowcharts with process descriptions to be created (As-is)
	Global product maintenance flowchart with process description to be created (As-is)
	All the instructions, documents and document templates, which are related to the work phases to be discovered and listed
	Minutes of meeting and project diary to be updated throughout the project

3.6 Thesis scope

I was leading the core team during this thesis. Core team included me, my thesis mentor and MS Visio specialist. I was also responsible of the guideline package creation for mechanical design team. Guideline package was created with support of the core team. The entire task list is presented at Table 2.

Table 2. Thesis task list.

	Lead the core team
	Creation of R&D flowchart and process description in cooperation with the GPM-thesis author
	Creation of product development process (Mechanical) flowchart & process description
	Creation of mechanical design flowchart and process description

Creation of the directory in cooperation with documentation engineer
Write minutes of meeting & update project diary
Present the status of the project in meetings

3.7 Resources for the Project

3.7.1 Project team

12 employees were resourced for this project and they had 5-60% of their work time engaged for this project. Every employee had a role in this project and in various stages each member interacted and gave input for the project. Project team roles are presented in table 3.

Table 3. Project team roles.

Title	Role
Team leader	Gives guidance and direction for the project team. Managing the resources for the project.
Coordinator/Process improvement thesis mentor	Books the meetings. Mentoring process improvement thesis author and being a member of the core team which creates the guidelines.
MS Visio (software) specialist	Teaches and gives insight for process mapping. A member of the core team, which creates the guidelines.

Quality Engineer	Responsible of the quality. Gives guidance about the structure of instructions and databases
Documentation Engineer	Main responsible person of creation of the directory. Works in cooperation with thesis authors.
3 advisors	Gives insight, guidance and direction for the guideline as a whole
GPM-thesis mentor	Mentor of the GPM-thesis. Works in close cooperation with the GPM-thesis author.
GPM-process thesis author	Creates the GPM-process thesis.
Process improvement thesis author	Creates the process improvement thesis. Thesis limited for product development and mechanical design processes. Presents the status of the project in meetings.
Continuous improvement responsible	Responsible of the continuous improvement of the project after project deadline.

3.7.2 Software

All the software needed for the project and thesis already existed in our work computers and contained all the necessary tools for the task. Guidelines were created in electronic form and MS Office 365 was suitable for our needs. The most used programs, which are connected to the objective of the thesis are presented in this chapter.

Microsoft Teams is a hub for teamwork in Microsoft 365. It was primarily used for communication with all stakeholders, as most of the personnel of Research & Development department were working remotely from home during this thesis.

Microsoft OneNote is a digital notebook and the notes of the meetings can be easily shared with the team with this application. This software was used to write minutes of meeting notes after every weekly and monthly meeting. Project diary was also written daily, after every meeting with the core team.

Microsoft Visio is software for drawing a variety of diagrams and it can be used to organize complex ideas and processes visually. It has hundreds of templates, including cross-functional flowcharts, flowcharts, timelines, floor plans etc. In this thesis, this program was used to create cross-functional flowchart.

Microsoft Word was used to write process descriptions and for the creation of the instruction directory.

4 PROCESS IMPROVEMENT THEORY

The theory part of this thesis is presented in chapter. Theory part contains theory of the methods which were used during this thesis and project. Process mapping was main method in the creation process of the guideline package. Digital project management was also topical, as whole project team was working remotely during the project.

4.1 Process mapping

Process mapping is one of the most common methods for documenting processes, both existing and newly designed and it is argued of being the best practice in process improvement. Evidence have been found that the use of process mapping has increased over time and process mapping provides transparency benefits for participants in business process improvement efforts /4/.

Process mapping is a powerful tool to define and also visually give an overall view of the processes. Creating a process map often reveals previously unidentified gaps between the processes. This tool is made for helping the management to improve the processes, but when using this tool, the management should often include everyone who is involved in the process. This may reveal some of the uncovered time lags of a single person's part of the process. Also, more uncovered additional problems may come up once the team gets started, which in the other hand can expand the project scope unexpectedly /5/.

4.1.1 As Is – To Be model

In this chapter the As Is – To Be model is explained and arguments are given of what kind of situations this model would be essential to use.

The "As Is" presents the current state and flow processes of the organization. "To Be" is a proposal of improved version of the process flow and if accepted it is a solution for current issues. This model can be used as a tool for continual improvement of the processes. First, the business processes have to be mapped as they are in the current state (As Is) and then the improved future state of processes has to be modeled (To Be). This can be repeated for continual improvement /6/.

As-is process reveals spots in the processes what could be improved, but it does not always cover the answer for how it can be fixed. However, it points out the weak spots and this way it is easier start modeling the To be proposal.

It is essential to include every employee who is involved to the processes for identifying the gaps and flaws and creating the proposal of future process flow. This way the proposal will cover as many aspects of the process as possible and the effects of the changes for each stakeholder will be taken into consideration.

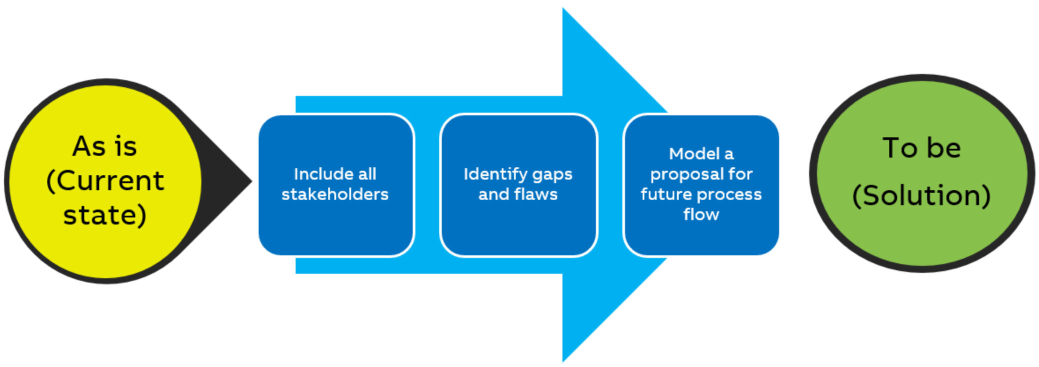

Figure 2. As is – To be model

Examples of when As is – To be model process mapping should be considered in organizations:

- It has been acknowledged that there is some lags, gaps or issues in the current state of processes. Usually discovered by employees or customers
- Organization is interested of automating some current processes
- The documentation of processes is not functioning properly
- Streamlining between various units and departments is not working

4.1.2 Cross-functional flowchart

A cross-functional flowchart illustrates workflow from the beginning to end of the process. Workflow consists of different work phases in the process. Swimlanes are used to separate the different functions/entities in the organization. It is needed when the work process “crosses” from one function to other function. Rectangles describes a task in the work process (**Figure 3.**)

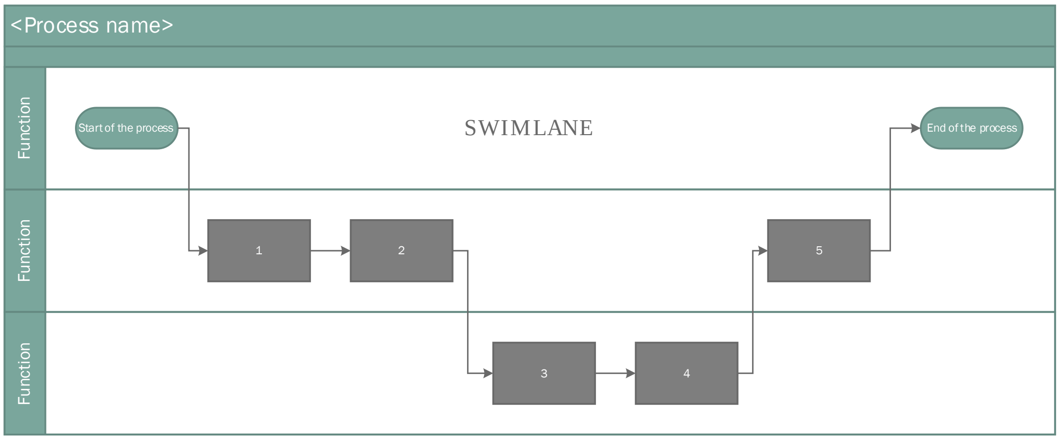

Figure 3. Cross-functional flowchart

4.2 Digital project management

In recent years technology and digitization has advanced progressively. Covid-19 has accelerated these processes even more. It has impacted greatly to project management activities as well. Earlier, remote working was rather rare compared for working at the office. Now this setup has taken a U-turn and it is almost harder to get people work at the office, people have learned new working habits at home and generally human resists changes in their daily working habits /7/.

Colocation for the project teams is generally viewed as the best practice. This especially is highlighted, when the project team is using an agile approach to manage the projects. This setup has now been disturbed by the things happening in the world. Digital tools are now being benchmarked and implemented as team meetings are held online and communication is also taken care of online /7/.

There are benefits and challenges in this setup, both for individuals as well as for the organizations. For example remote working for many individuals can save significant amount of time by not having to commute daily to the workplace. In the other hand, working remotely can bring some downside for productivity, poor motivation is a persistent concern when working remotely without direct supervision or absence of co-workers to talk with. For digital project managers, it would be good to assign more difficult tasks to keep the team members more engaged. When they overcome these difficult tasks and provide good results, project managers should reward them accordingly and this way keep the motivation high /7/.

For organizations there are benefits for both strategical and technical point of views. When geographical location is not a restriction, workforce can be hired from all over the world. It may be cheaper to hire from lower cost regions, which though potentially have its own risks when keeping quality in mind. Organization can also reduce the costs of the scaling down facilities and offices spaces as people are working remotely /7/.

At project level, collaboration between the project members is crucial. This can be a huge challenge while working remotely. This challenge requires a lot of activity from the project manager, online meetings have to be arranged in a daily basis and all the tasks need to be given online. Many of the times if meetings are arranged with too many members involved, the output of many participants can be minimal. This can be prevented by organizing the meetings with different and smaller parts of the team at a time /7/.

5 PROJECT COMMUNICATION

This chapter contains the methods and explanations of how the communication and project progression were managed during the project.

5.1 Project diary

Project diary is a summation of all of the daily activities on a project. Project diary was written after every daily meeting. It was a convenient way of keeping up with the status and progression of the project. Project diary was available for every member of the team. Project diary contained next subjects listed below:

- Date & Time
- Attendees
- List of what has been achieved during the meeting
- Key decisions

5.2 Minutes of meeting

Minutes of meeting are notes that are recorded during the meeting. The created notes will highlight all the key issues discussed and key decisions which were made during the meeting. Minutes of meeting is usually the starting point of the following meeting. It was written after every weekly and monthly meeting and it was available for every team member. Minutes of meeting contained next subjects listed below:

- Title of the meeting
- Date & Time
- Attendees
- Agenda
- Notes/Feedback
- Key decisions

5.3 Team meetings

Communication between the project members was managed by online-meetings and in urgent situations by calling. Meetings were booked by E-mail and were arranged daily, weekly and monthly with different parts of the project team. Team meetings were always arranged in Microsoft Teams, since most of the department was working remotely from home. Meeting notes were available for every team member during the project.

Daily meetings were arranged with core team, which usually included me, thesis mentor and MS-Visio specialist. Occasionally some other parts of the project team were invited to the daily meetings, which gave different insight, compared to our approach for the project. Meeting duration varied between 1-4 hours. In these meetings we built up the cross-functional flowchart and created descriptions for the processes. All the related instructions and websites, which were gathered into the directory to support this guideline, were also found by core team in cooperation with the documentation engineer. At the end of the meeting, it was discussed what I could do for the project and thesis on my own time.

Weekly meetings were arranged with mixed groups, to receive feedback and guidance for our work. Meeting duration changed between 1-2 hours.

Monthly meetings were arranged with the whole team, to update the status of the project and thesis work. Feedback and guidance were also received in these meetings.

6 CREATION OF THE GUIDELINE PACKAGE

The basic idea, overall structure and work phases of the created guideline package are explained in this chapter. Processes were mapped in “As Is” form. “As Is” form describes the current state of the processes. Usually “To Be” form follows the “As Is”, where any gaps or issues with the current mode can be fixed. However, “To-Be” model is not included in this thesis.

The guideline package was created in a point of view of a mechanical design engineer. Some of the process phases do not belong solely to mechanical engineer, but the guideline package will give a good overall view of the whole mechanical design aspect of product development process as well as mechanical design process at the case company.

The guideline package was established for local use to mechanical design team due it’s flexible updating process and it has less restrictions as it would have if it would be for global use. Some phases are not explained in detail level due to it would reveal internal information of the case company, which cannot be shared with third parties.

6.1 Basic idea of the guideline package

Basic idea of the guideline package was to create a convenient way of learning the processes and at the same time for the guideline to be simple and effective instruction library. Guideline should contain as little amount of text as possible. Large amount of text in instruction is not ideal. This was possible by combining all the discovered instructions, cross-functional flowcharts and process descriptions together.

The time-consuming searching process of instructions can be prevented by creating an instruction directory dedicated to mechanical design engineer. This concurrently enhances the effectiveness of a single employee.

Cross-functional flowcharts and process descriptions were mainly meant for new mechanical design engineers to learn the processes overall and the instructions for each step are easily available. More experienced design engineers can directly use the directory, as they know which instruction they are looking for.

6.2 Guideline package creation process

Creation of the guideline package is explained in this chapter. In the cross-functional flowchart (**Figure 4.**), each process is described of how the guideline package was created and compiled during this thesis.

- Rectangles with rounded ends describe start and end in the process
- Blue rectangle describes task in the process
- White rectangle describes task in the sub-process
- Left column states the responsible function

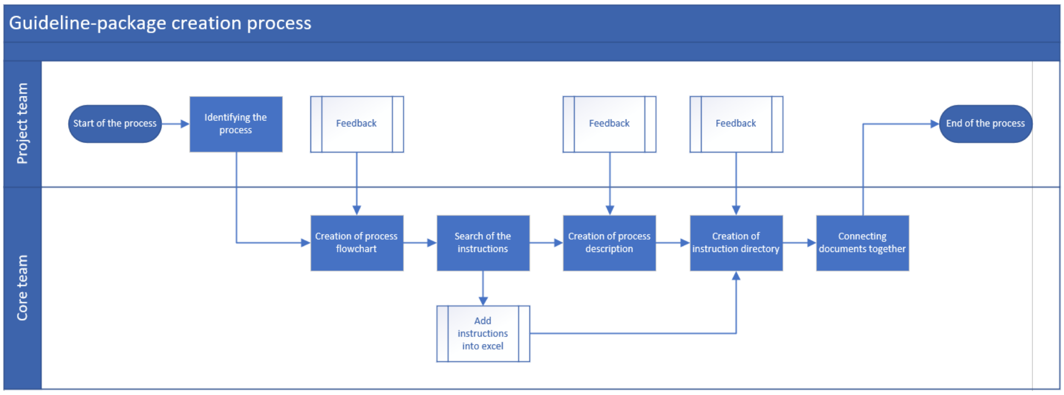

Figure 4. Creation of the guideline package in a form of cross-functional flowchart

6.2.1 Identifying the processes and creation of flowcharts

The work started by identifying and listing the processes of product development and mechanical design with the project team. This list was a good basis to start creating the cross-functional flowcharts. After the rough list was created, creation of flowcharts started next.

New process phases were added to charts during the creation since some of the phases were forgotten from the original list. The order of the processes, responsible persons and functions of the processes was recognized by the project team. Project team gave feedback during the project from the guideline and necessary corrections were made.

Cross-functional flowcharts were built in a way, that employee can navigate between main-and sub-processes.

6.2.2 Search process of the instructions

After process maps were ready, all the existing instructions related to these subjects had to be found and discover which critical instructions were completely missing or outdated. Dedicated meetings were held with different parts of the project team to find instructions from multiple databases, which are in a use at the case company.

Created process maps were used as one tool for finding already existing instructions. Searching phase of the instructions started off by searching instructions, which were related to each process phase. By this method, the search area of the instructions was narrowed down. Websites and all the found instructions related for product development and mechanical design processes, were added to an excel-file. The excel-file contained information about the instructions. More instructions were added to the list during the project.

Content of the excel-sheet cannot be shared in this thesis, since it contains internal information of the case company. The update need and raw estimation of the update time for each instruction was evaluated and listed into the excel-sheet. Also missing instructions for specific process phases were listed.

6.2.3 Creation of process descriptions

Core team started working with the process descriptions, which were created to be as a wider explanation of each process in the process flowchart. Process descriptions were created to case company's own report template in word-file form. The explanations were short and they contained only the key matters of each process. Short explanations were planned to be combined with the instructions, which were discovered earlier and when the directory is structured.

6.2.4 Creation of instruction directory

A directory was created into a word-document, which contained hyperlinks for all of the discovered instructions related to the processes. Sorting of the instructions was managed by naming the head titles with the main subjects of the processes. All the head titles are planned to remain as they were created, only the hyperlinks of instructions will be updated under the head titles.

This directory was created in a cooperation with a documentation engineer and it was designed to be flexible with the updating process. Most of the instructions are located in multiple case company's databases and are updated by the responsible functions. Most of the instructions are located in a database, that if the instruction is revised, the web-address for it will remain as it was and hyperlinks will remain intact.

As the directory was planned to be used by mechanical engineers in a daily basis, they can leave a note to dedicated place in the directory, if an outdated instruction is discovered or some instruction is missing from the directory. These notes will be checked by a documentation engineer and necessary updates will be done.

In the process description each work task contains a hyperlink, which navigates to correct instruction in the directory. All of the links of related instructions are located in the directory. Even if hyperlinks of the instructions in directory would be updated, hyperlinks which are located in process descriptions do not need constantly be updated, since the head titles of the directory is planned to remain as they are.

7 CONCLUSION

During the project we noticed in practice, that when all the instructions are in many different databases, it is time-consuming to find instructions for various work phases. In organization of this size, it would be good to have unified and well-organized system, particularly when managing documentation and instructions. It makes working processes more efficient. It also helps inducting new workers to their tasks and it speeds up the daily activities of more experienced personnel.

One issue with the created guideline package, which might have to be considered in the future is how to get the hyperlinks working between process descriptions and instruction directory in PDF-form. But as long as mechanical design team will use the directory as how it was originally purposed, it will stay updated and convenient instruction library for daily tasks of mechanical design engineers. Guideline package is now in a local database and there it works with no issues.

Communication is very important and it cannot be emphasized enough, during this project and thesis occasionally the lack of communication meant more work. Communication plan should always be created properly, which in this thesis I did not do. It is one part which I will give more credit and attention in the possible future projects.

If the created guideline package and all of its documents were to be uploaded to product data management software of the case company, few modifications for the guideline are needed.

Hyperlinks between the process description and instruction directory has to be modified in a way, that the hyperlink navigates into correct instruction in the directory. As in current form, if process description word-file is converted into PDF-file, hyperlink opens only the directory file, but not from the correct spot.

Other simple solution for this is to replace the hyperlinks in the process description with key search words, which can be used in the directory to find the correct instruction.

As the most critical processes are now mapped in As Is form, next step could be to apply As Is – To Be model's second part and this way improve the processes. As is – To Be model is presented in the theory part of this thesis and it can be used as a guideline.

Overall this thesis was very educational for me, I learned a lot about project management and the processes which were mapped during the thesis. Even though I have been working at ABB's Research & Development unit for two years, I did not know about product development process as a whole so much. Process mapping was a great way to learn the whole process step-by-step.

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APPENDICES

APPENDIX 1. R&D cross-functional flowchart (concealed)

APPENDIX 2. R&D process description (concealed)

APPENDIX 3. Product development cross-functional flowchart (concealed)

APPENDIX 4. Product development process description (concealed)

APPENDIX 5. Mechanical design cross-functional flowchart (concealed)

APPENDIX 6. Mechanical design process description (concealed)

APPENDIX 7. Instruction directory (concealed)