LAPPEENRANTA UNIVERSITY OF TECHNOLOGY
LUT School of Energy Systems
LUT Mechanical Engineering

Joona Juntunen

IMPROVING OF THE JUMPLIFT ENGINEERING DESIGN PROCESS

Examiners: Docent Harri Eskelinen
Professor Juha Varis

TIIVISTELMÄ

Lappeenrannan teknillinen yliopisto
LUT school of Energy Systems
LUT Kone

Joona Juntunen

Jump-hissin suunnitteluprosessin kehittäminen

Diplomityö

2017

63 sivua, 20 kuvaa, 9 Taulukkoa ja 2 liitettä

Tarkastajat: Dosentti Harri Eskelinen
Professori Juha Varis

Ohjaaja: DI Jari Mälkki

Hakusanat: Prosessikehitys, RACI-matriisi, Jump-hissit

Tässä työssä hyödynnetään RACI-matriisia jota käytetään Jump-hissien suunnitteluprosessin nykytilan arvioimisessa ja kehittämisessä. Työn alussa perehdytään suunnitteluprosessien kehittämisen vaiheisiin ja erityisesti RACI-matriisin käyttöön. RACI-matriisia käyttämällä tuotetaan kaksi erillistä matriisia, joista toiseen listataan haastatelluissa koostetut eri työtehtäviä hankaloittavat tämän hetkiset puutteet ja toiseen suunnitteluun liittyvät tehtävät työvaiheittain. Tulosten pohjalta suurimmat puutteet tällä hetkellä löytyvät suunnitteluohjelmista, dokumentaatiosta ja kommunikaatiosta. Suunnittelutehtävissä suurimpia puutteita ovat epäselvä vastuunjako, tiedonkulku ja monimutkainen hyväksyntäprosessi. Tutkimus oli hyvä alku Jump-hissien prosessin kehittämiselle, koska kokonaiskuvalle saatiin aiempaa läpinäkyvämpi muoto. Tuloksia hyödyntämällä suunnitteluprosessia voidaan kehittää ja tahtotila olisi saada Jump-hisseistä suunnittelu-ja toimitusmielessä standardituote. Kehitys on kesken ja resurssit rajalliset, tästä johtuen tuotteen standardoiminen tulee ottamaan aikaa vielä joitakin vuosia.

ABSTRACT

Lappeenranta University of Technology
LUT school of Energy Systems
LUT Mechanical Engineering

Joona Juntunen

Improving of the jump-lift engineering design process

Master's thesis

2017

63 pages, 20 figures, 9 tables and 2 appendices

Examiners: Docent Harri Eskelinen
Professor Juha Varis

Advisor: M.Sc. (Tech) Jari Mälkki

Keywords: Process development, RACI-matrix, Jumplift

The scope of this study is to exploit RACI matrixes to improve existing jumplift engineering process. RACI matrixes gives benefits to list all the essential activities of the engineering process and at the same time indicates the main errors of the different tasks. Theory of the RACI matrixes are presented in literature review and later based on theory RACI matrixes are created and used in experimental section. Aim of this study is to bring up main lacks of the current jumplift engineering process and show potential areas to improve. Jumplift products are under development and there are several areas to develop. This study and the results can be used to tackle most urgent development targets. In the result point of view transparency of the overall jumplift engineering process is more visual, responses of the activities can be seen and main development arear are found. This study is only a beginning for the engineering process development but the results gives good benefits to continue work. Hopefully someday jumplift product are part of the Kone standard elevator selection and supply performs as any other elevator delivery.

ACKNOWLEDGEMENTS

One step of my engineering career will soon be reached. This study is performed in Hyvinkää Kone Major Project organization. RACI-matrixes are utilized improving of jumplift engineering process.

This journey has been like an ordinary athlete marathon. During the first kilometers all goes well and feeling is good. Since the mid race the reality is encountered and lot of work are still needed to do before the end. The last third of the race is the most difficult and despair threatens to take the advantage. Still the last kilometers are the best and the racer can really feel to achieve the goal. I can honestly say that this thesis has really been a marathon. Many thanks for all who have encouraged me during this marathon. Special thanks to whole jumplift engineering team and Doc. Harri Eskelinen about the great support and feedback.

Joona Juntunen

Joona Juntunen

Hyvinkää 19.5.2017

TABLE OF CONTENTS

LIST OF SYMBOLS AND ABBREVIATIONS

MP	Major Project
CTU	Construction time use
Cathead	Temporary machine room arrangement that moves up during each jump
HJ	Location of hoist beam
BH	Thickness of cathead bottom structure
MH	Top of machine beams
EH	Entrance height
HFL	Floor height at lower deck
HFU	Floor height at upper deck
RACI	Responsible, Accountable, Consult, Inform

1 INTRODUCTION

The introduction section of this study is divided into five separated part. Background part disclose the working environment where this study is going to be perform and what is the research object. Scope and objectives part presents what is the company's ongoing situation with the engineering design process and what are the research limitations. Research method part presents how the research is planned to perform and introduce the research techniques. Fourth part explains the research problem and questions. Final part is structure of the thesis.

1.1 Background

Kone Oyj is a Finnish technology company and one of the biggest supplier in the world in elevator and escalator area. Kone is highly focused to provide people flow solutions for the all-time urbanizing world. Kone has functions all over the world and one of the unit is located in Hyvinkää Finland. In the Hyvinkää area Kone has elevator factory, different kind of function units including innovation and research department. Kone (MP) Major Project is one of the unit and this study is performed to MP's jumplift engineering team.

Jumplift is one of the Kone's elevator innovation and in the very first time it's launched in early 70's. Use of the jumplift is presented more detailed latterly in this study. Currently Jump-lift products are very hot topic in the elevator business. Kone is using lot of effort to improve the products and safety all the time. In order to achieve the targets also this study is needed. Aim of this thesis is to explore existing jumplift engineering process, recognize main lacks of the engineering process if there are any and finally give benefits to improve the engineering process. Practical part of the study is performed by using RACI-matrix (Responsible, Accountable, Consult, Inform) which is useful and handy for this type of research. Target is to clarify existing way of work inside the jumplift team and if possible achieve savings.

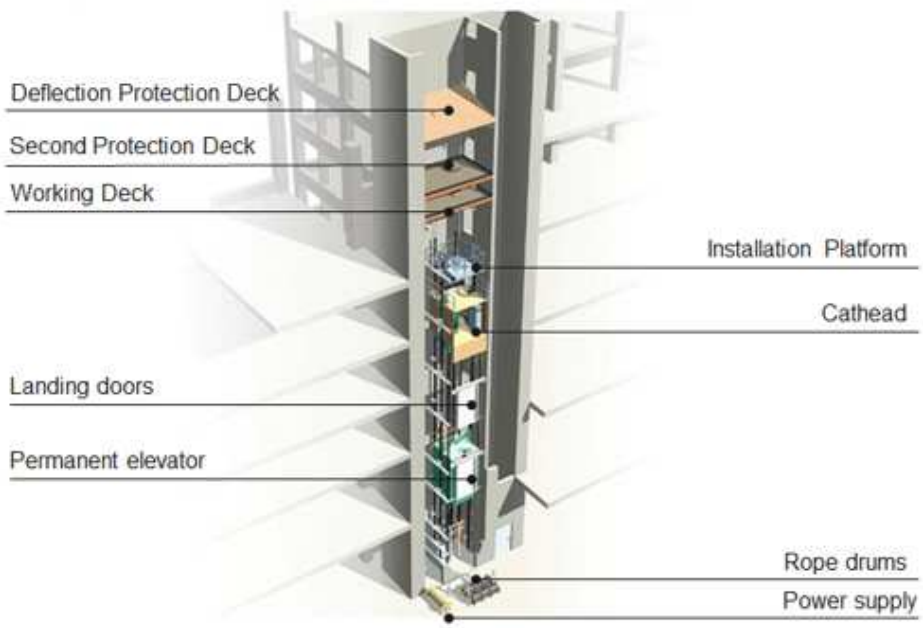


Figure 1. Principle drawing of jumplift (Quality document, 2016, p. 2).

1.2 Scope and objectives

The scope of this research is to improve Kone MP's jumplift engineering design process. By the advantage of the RACI-matrix responsibilities of the jumplift engineering activities will be clarified and later on complied in tables. The engineering process is similar for all the jumplift products and the results can be used generalized. This study includes theoretical part of the process improvement and development and further theory portion of RACI-matrix. Overall research is combination of engineering process theory and practical part of RACI-matrix.

Activities to improve existing jumplift engineering process is the main object of this study. To achieve the objectives is essential to understand how the engineering processes are created, how to focus and select substantive targets and how to use RACI-matrix tool in a proper way. RACI-matrix with the created responsibility charts will be shown main role of the research and the final results will be based on the excel-files. By using the RACI-matrix existing responsibilities of the activities can be easily demonstrate. This study is the very first time when the RACI-matrix is performed in MP's engineering process development and if the benefits are proper enough this same method can be used in the future with other process improving actions.

1.3 Research methods

Research method for this study is literature review for how to create product engineering processes, how to improve and develop product engineering processes and RACI (Responsible, Accountable, Consult, Inform) matrix. Aim of the literature review is to collect previous studies related how to improve product engineering design processes. The literature review is based on public scientific articles and publications connected to industrial technology company's product and engineering design processes. Core of the literature review is achieve clear understanding how the process-driven way of working really perform. RACI-matrix is optimizing tool to recognize how the organization uses resources while performing the activities. If there appears conflicts RACI-matrixes gives benefits to make correction actions for the process. In this study RACI-matrix is used to research jumplift engineering process and engineering activities. Responses of the engineering activities will be clarified and compared to the existing jumplift process. If the results are unambiguous and easily identified improvements for the existing engineering process model can be done. RACI Exel based-matrices will present essential role in this study and the matrices are created based on RACI-matrix theory and collaboration with jumplift team.

1.4 Research problem and question

There are existing engineering process model for the Jump-lift products. Goal of this study is to clarify how well the existing jumplift engineering process model can perform the asset engineering activities. Research problem can be solved by using the following measures: existing engineering activities will be gathered to RACI-matrix, determine the cause of connectivity's and compere the results afterwards between old engineering process model and new founding's. The research problem of this study is detected of a question:

"*Can the RACI-matrix give benefits to improve jumplift engineering design process and if can what are the main improving actions?*"

In the first phase it's essential to get deep understanding how the jumplift engineering design process works and clarify the strengths and weaknesses of it. Features of the processes cannot be recognize and find only in theory due to that interviewees by the labor of jumplift team is shown significant role.

For to be able to answer research question selected sub-questions are also resolve.

- What kind of measures are available to improve engineering process work?
- What phases in the jumplift engineering work are the least effective and what are the benefit if those can be avoided?
- How the employee can serve the jumplift engineering process improvement?

1.5 Structure of the thesis

Structure of this thesis consist of theoretical introduction for the techniques how to improve jumplift engineering process and introduction for the main phases how to create new jumplift engineering processes. User interfaces based on the RACI-matrixes are created and main theory of the use of RACI-matrixes is also shown in the theory section. Last part of the thesis is focused to describe research problem, how the research is performed, how the RACI-matrixes are utilized and what are the main results and plans for the future studies.

2 PROCESS IMPROVEMENT

Before the planning of process improvement it is important to understand basic rules how the improvement of the processes consist of. Kone organization have a number of processes in different areas of the business. All the processes are based on general known theory and for example symbol language follows universally known form as presented later in this study. Martinsuo and Blomqvist (2010, pp. 4-5) clearly illustrates the process theory in text and picture format and due to that this reference shows bigger role as a reference than other references.

The objective of this paragraph is to clarify the main stages of the process improvements. Major Project's jumplift engineering process improvement consist the same principles as examined sub-chapters below. The process for the jumplift already exist and the target is not generate new engineering process. Focus of this thesis is for improvements and find the weaknesses of the current jumplift engineering process. Core of this research attends to RACI-matrix basics how the processes are created is important to internalize.

2.1 Introduction of engineering processes

Primary issue of processes is customer. Processes starts and ends to customer. The process is a set of repetitive tasks and activities related to each other together with the link between them. Normally the process throughput is product or service. Process is body of functions that must be executed to fulfill the customer needs. Processes are connected to organizations strategy and vision and there is the purpose behind. Typically processes are defined that they have structure and functions which are possible to measure and produce asset output to market. In simplified process tells how the work is done inside the organization. (Davenport 2013, pp. 28-31; Johansson 2007, p. 27; Pisano 1997, pp. 7-8.)

Essential features of process thinking are systematic thinking, customer-orientation, target preference, focusing valuable functions, developing by feedbacks and continuous process improving. Core parts of the process thinking are efforts to enhance and reduce non valuable actions. Process thinking consists of several modules like; tools, documentation and information systems and the target is to improve existing process. Type of the process

determines how accurate the process is reasonable to model. Uncertain processes are not sensible to model unnecessary precisely. A Significant role of process thinking present also process innovation. Process innovation means combination of a process perspective of the business with operation of innovation to precious processes. Process innovation gives advantage to achieve reduction in every process aspect. (Martinsuo et al. 2010, p. 6; Davenport 2013, pp. 28-31; Pisano 1997, pp. 1-3.)

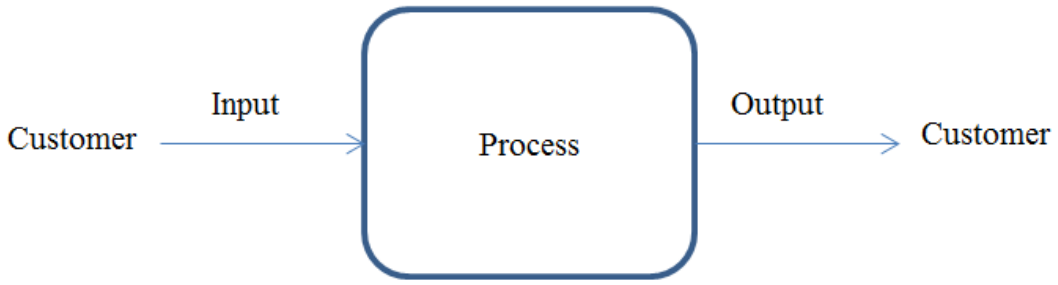


Figure 2. Simplified process picture (Martinsuo et al. 2010, p. 6).

Processes are functions that creates added value for customers and organizations that uses resources to achieve customer needs. Customer can be internal or external but it definitely affects the processes. The added value associated with customer demands and expectations and as an output it can mean product, solution or service. Basic demands of processes are resources. Characterized by the resources are that there is the cost impact and limitations behind. (Davenport 2013, pp. 28-31; Martinsuo et al. 2010, pp. 6-7.)

Processes are major part of organizational structure through the resources and purposes. Organizational structure determines what the roles of processes in overall business are. The role of the processes can be essential or secondary depending on the model of management. (Davenport 2013, pp. 28-31; Martinsuo et al. 2010, pp. 6-7.)

2.2 Development of processes

Improving the profitability has driven organizations to use process-based mode in operations. This means implementation of new processes, renew existing processes or in a smaller scale different type of reforms of the processes. There are number of options to

improve the practices witch organizations use and the basic steps are shown in figure 2. (Davenport 2013, pp. 28-31; Martinsuo et al. 2010, pp. 6-7.)

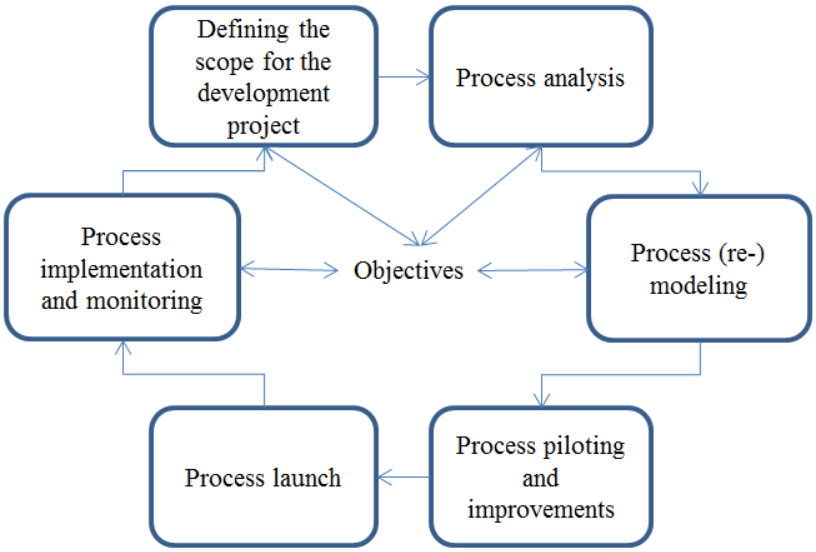


Figure 3. Basic steps in process development (Martinsuo et al. 2010, p. 8).

Before commence of the process development it's important to make limitations and determine what process or processes the reform will affect. Based on organizations objectives, limitations has essential role to achieve the goals. (Davenport 2013, pp. 28-31; Laamanen & Tinnilä 1998, pp. 48-49; Martinsuo et al. 2010, p. 8.)

After limitations are asset valid information related to existing process are important. There are several methods to collect information for instance interviews, teamwork, process modeling tools, simulation tools and especially measured and analyzed data is valuable. Aim of the information is to manage how the process works, is the performance good as organization has asset it to be and if not, identify the main defects of the process. (Martinsuo et al. 2010, p. 9.)

When the conceptual model of process is complete, piloting is the next important phase. Meaning of the process piloting is to test, observe, support and refine it. Piloting defines the meaningful information whether the new process is useful or not. Without asset benefits there are no reason to launch new model. (Martinsuo et al. 2010, p. 9.)

If the requirement for the new process model are achieved means it change for mindset according to new process. This means change for the whole process chain for labor of the organization, to customers and other stakeholders. Implementation includes training, new measuring systems and connections between the other systems that organization uses must be transparent. Major issue of the success is that inside the organization obtains open communication and organization management support realization of the new process. (Laamanen & Tinnilä 1998, pp. 48-49; Martinsuo et al. 2010, p. 9.)

After the new process has launched continuous improvement is essential. Process executing and tracking must cover the whole chain from customer to customer. Feedbacks must be collect systematically and make correction if needed. Conducting and managing of the process is a continuous task and designated persons are responsible of the constant development. (Martinsuo et al. 2010, p. 9.)

Aim of the organizations development work is not constant transformation. Key issue is to find solutions how to advantage labors potential to create new innovations, services and products. Changes that based only on management decisions are not the most effective way to renew. Objectives of the process management can listed according to (Laamanen et al. 1998, p. 49):

- economical result
- customer satisfaction
- high productivity
- labor activity, motivation and discipline

2.3 Modeling of processes

Challenges for the modeling of processes are the number of variants. Without proper variable management process controlling may indicate hard to understand, analyze and develop. Important is to separate main process and keep it as whole, without belonging any larger process. Sub-processes unite to main process and the functions must be clear to avoid decomposition. (Milani et al. 2016, pp. 55-56.)

Operating environment and value chain are in key role while process modeling is current. Basics of the modeling new process is that the existing process is identified in organization

larger process map. Perceiving the overall process map the customer is an issue and important to identify what kind of value chain structure the organization has. Figure 3 present a typical business value chain (Martinsuo et al. 2010, p. 8.)

Figure 4. Example of a process as part of an extended value chain (Martinsuo et al. 2010, p. 11).

Since the complete customer chain and value chain has been recognized, it's possible to define the processes that are relevant for the company which increase properly value for the customer (Core processes). Focus is to recognize direct customers, how the process is connected to wider value chain and what added value the process produces. It's important to comprise what are the resources and support that process needs for to be effective? In figure 5 is shown organizations core process structure. (Davenport 2013, pp. 28-31; Martinsuo et al. 2010, pp. 11-12; Milani et al. 2016, pp. 55-56.)

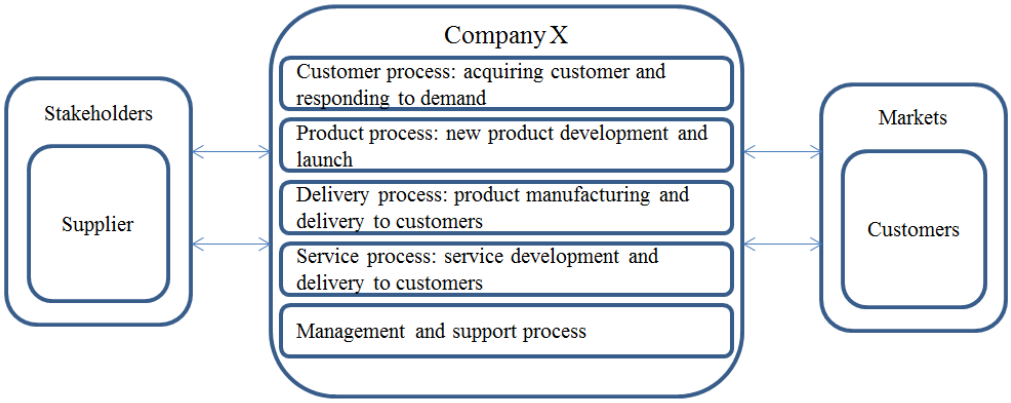


Figure 5. Example of a company's core processes and their value-adding purposes (Martinsuo et al. 2010, p. 12).

As shown in figure 5 nominations of the processes during the construction of process map is constituent part of the work. Essential is to decide logical way for naming and unambiguously depicts the core purposes of the processes. (Milani et al. 2016, pp. 55-56; Martinsuo et al. 2010, pp. 12-13.)

2.3.1 Raw process model

In addition that process survey means functions producing added value it also contains links to identify and describe information flow and material flow. In the first phase inputs and outputs of the process must be identified. Together with inputs and outputs process can be limit by describing the interfaces in a general level. General interfaces are added value, subtasks and resources. Limitations for the core process are shown in figure 6. (Martinsuo et al. 2010, p. 13.)

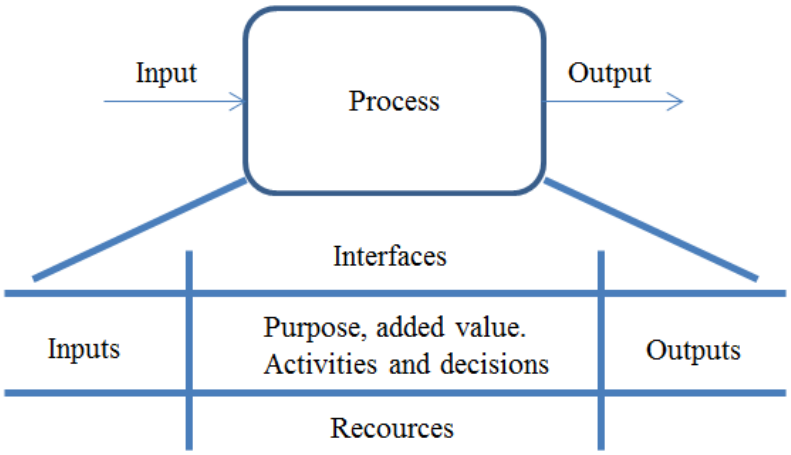


Figure 6. Delimiting the core process and its rough description (Martinsuo et al. 2010, p. 13).

Describing the current situation of the process it is possible to progress to beginning to the end by following value added tasks as information flow and material flow like they exist in practice. In target process the situation is normally opposite, it's reasonable instead proceed to end to the beginning. In practice process description is possible to get more accurate by using phase and sub-process levels as shown in figure 7. The figure illustrates the rough description of the core process and contents of the core process. (Martinsuo et al. 2010, p. 13.)

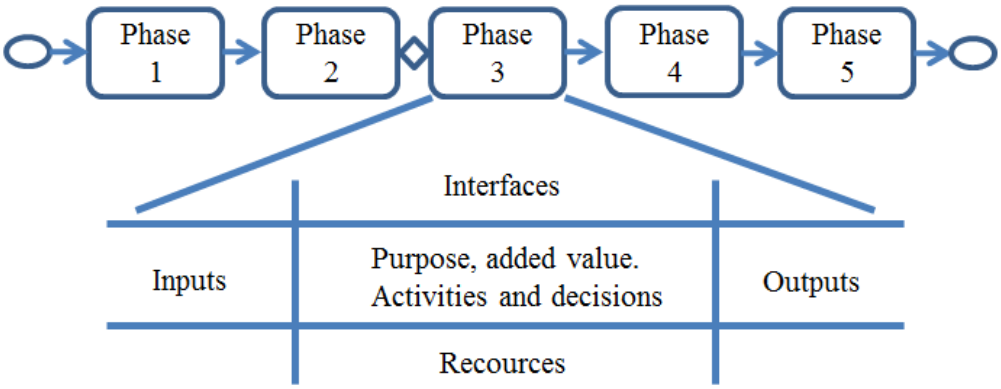


Figure 7. Rough description of the main phases and their content in a core process (Martinsuo et al. 2010, p. 13).

2.3.2 The exact process model

As illustrated above process models are possible to review more accurate way. Especially for process critical aspects are important to give better attention, this conduct that the functions allocated to the resources required for them. For to get better understanding how to perform exact process models various of chart and diagrams are needed. In precise description of the process is relevant to separate measurable and instruct tasks, the interdependence of tasks and roles and responses. Some cases it is possible to expand the description and take with devices and information needed in process (Martinsuo et al. 2010, p. 13; Georgakopoulos, Hornick & Sheth 1995, pp. 321-322.)

There do not exist any standard way to describe process model. Below are shown four different types to demonstrate how the process model symbols are possible to describe. The types are flowchart, task matrix, process flow diagram and text-form instruction. The process models include different styles and symbols how to do natation. Common known symbols and meanings of them are shown in figure 8 (Martinsuo et al. 2010, p. 15.)

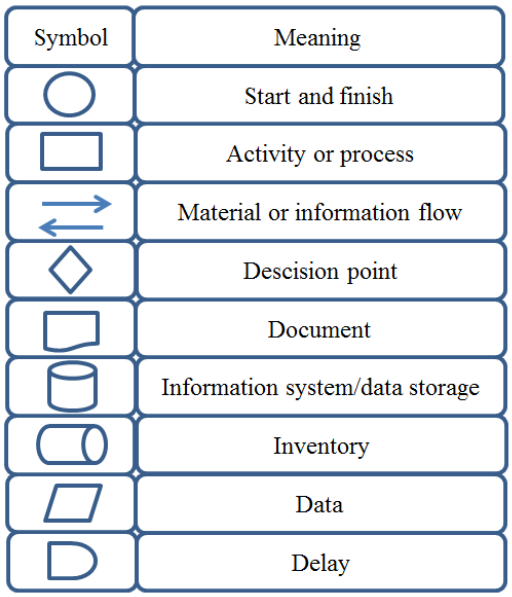


Figure 8. Key symbols used in process mapping (Martinsuo et al. 2010, p. 15).

Figures 9 and 10 as well as table 1 are illustrating detailed descriptions of the process models. Supplementing the options by adding a text has a more visual impact to understand the contents (Martinsuo et al. 2010, pp. 15-17.)

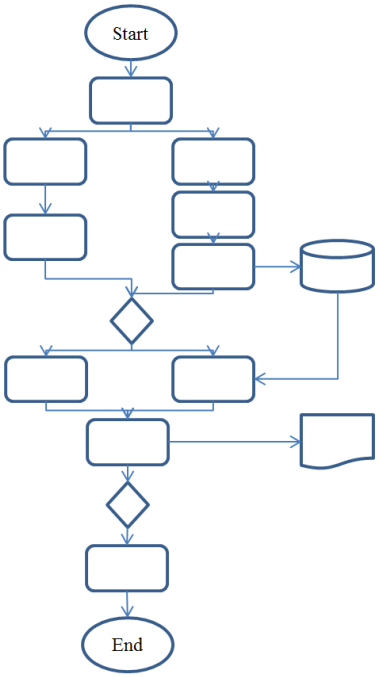


Figure 9. Example of a process or sub-process in the form of flowchart (Martinsuo et al. 2010, p. 16).

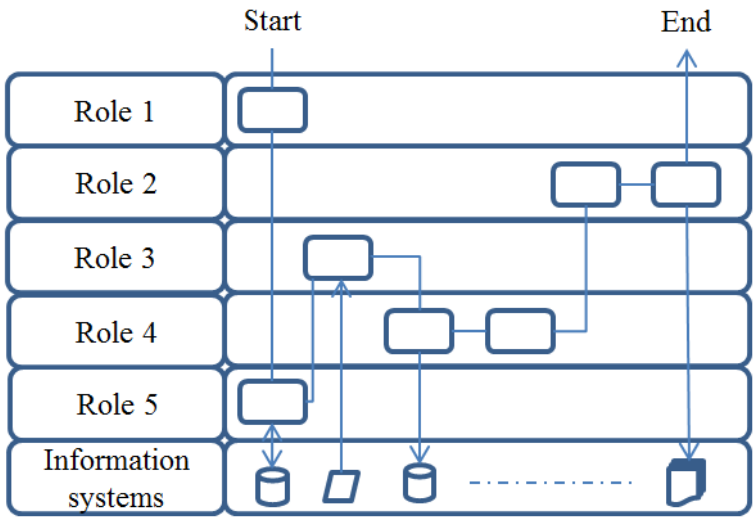


Figure 10. Example of a process or sub-process in the form of a process flow diagram (Martinsuo et al. 2010, p. 16).

Table 1. Example of a process or a sub-processes in the form a task matrix (Martinsuo et al. 2010, p. 17.)

	Phase 1	Phase 2	Phase 3	Etc.
Role 1	Tasks, which Role 1 should completed in this step, OR outputs which must be generated before a certain decsion point or milestone			
Role 2				
Role 3				
Role 4				
Etc.				

One of the key issue in the early phase while process model is completed is to have awareness that model is not complete. The model can be observed but the main task of the process modeling is to find shortcomings and identify the development objects. Important is to be aware of the current state and to commit to the development of process with labor in a one unit. Process model intrinsically must be unambiguous and viable. Task that do not

increase added value for customer must remove and also the need for main resources inside the organization must be sufficient (Martinsuo et al. 2010, pp. 17-18.)

There are number of software's and programs available in markets to simplify process modeling. Organizations need to identify own needs and make renewal by supporting operations in a most effective way. Essential is that the change will do by one and the target is transparent (Dumas et al. 2005, pp. 14-15; Georgakopoulos et al. 1995, pp. 119-120; Milani et al. 2016, pp. 55-72.)

2.3.3 Piloting of processes

Before launching of the new process in use, the pilot testing is supremely essential to proceed in limited and supported circumstances. Practical way to carry out the piloting process is to test it in a smaller scale and operate it in a test section keeping the focus on asset targets. Complex processes piloting may not always be possible by the behalf of labor and due to that expert's involvement and open information is crucial. If the adjusting is needed during the piloting it's possible to proceed (Martinsuo et al. 2010, pp. 18-19.)

Major part of the piloting is to improve employee's competences and renewing the systems to respond new process. Introducing a new process communication and its allocation for all the different members is essential. Normally lots of gabs are existing in communication and information due to deficient introduction plans. Process is not in use if the performing organization and customer are not involved in (Pisano 1997, pp. 1-3; Martinsuo et al. 2010, pp. 18-19.)

Key issues to take into account modeling of process are listed below (Martinsuo et al. 2010, pp. 19-20):

- Process is a clear and logical entity
- Process is a consistent and simple
- Process is described and functions observe according to it
- The process requires guidance to achieve asset goals

2.4 The measurement of process

Process features are possible and essential to measure and monitor. Functioning of the process it is important to know how the throughputs, input and process itself works. Collected data may not be real time because for example customer feedbacks are available in afterwards. Requirements for continuous improvement of the process demands that process indicators are asset. Conventional process indicators are shown in table 2. There are often shortcomings related to indicators while process developing is ongoing. Process developing is then based on testing and analyzing of received information (Martinsuo et al. 2010, pp. 20-21.)

Table 2. Example of process metrics (Martinsuo et al. 2010, p. 21.)

Input-related indicators	Process-related indicators	Outcome-related indicators
• Resources: workforce, labor hours, material, expences, capasity • Consistency of the inputs to the process	• Throughput time, time to market • Schedule and exence accuracy • Yield • Efficiency • Returns and complains • Accuracy in resource consumption and cost • Amount of deviations and changes • Share of ner products of total sales • Quality of planning design	• Output volume • Output-generated income • Quality of output • Product launch timing

Proper monitoring system observes inputs and throughputs and the existing process functions related to asset objectives. Reliable indicators produce vital information about the process performance and offers necessary data for the continuous improving. Mark of the good indicator system is that it’s effective and easy to use and it does not consume process resources. Indicators are also part of the organization strategy and objectives (Martinsuo et al. 2010, p. 21.)

Main task of the measuring system is to contribute process control and continuous improving. The core is that “what are measured it will modified”. Role of the indicator is to facilitate and enhance activities. Overall understanding about the process is essential to have, without that optimization leads in wrong direction. (Pisano 1997, pp. 1-3; Martinsuo et al. 2010. p. 21.)

2.4.1 Objectives and development targets of processes

Processes are instruments for organizations to achieve the goals and must observe the organizations strategy and vision. Due to this the main focus of the processes is to create added value for the customers, organizations performance targets and optimized use of resources. The targets must be concrete and the achievement of them must be possible to manage in sub-processes. Essential is to identify strategy, customer needs and asset organizations performance needs. (Pisano 1997, pp. 1-3; Martinsuo et al. 2010, pp. 22-24.)

Focus of the improving is to identify functions that create value. Main lacks are with unprofitable investments, waste of capital and miscalculations. If the resources are estimated incorrectly this normally causes downtimes for the processes and it undermine the overall process. Waste of the capital can cause over resourcing, wastage and unnecessary waiting. For whatever the reason is, it weakens the process performance. Miscalculations affect to organizations targets and functions. There is possibility that the whole process must disposed or in the opposite it can create new innovations and practices. (Pisano 1997, pp. 1-3; Martinsuo et al. 2010. pp. 22-24.)

Object of this part was to collect basic theory of process improvement into one chapter and give comprehensive understanding for reader what the processes development includes and what kind of functions complex products consist of. The same principles can be utilized also with jumplift engineering process improvement. Next chapter clarifies the main functions to create new processes in jumplift engineering process point of view.

3 STEPS TO CREATE NEW ENGINEERING PROCESS

This chapter takes into account the most common functions that are needed to know while process development is topical. There are significance role in cost, timeline, introduction and competitive success in how quickly an organization can develop and implement process for new product. This aspect means that core is the product but importance of proper process around the product and its performance cannot never ignore.

Central issues in process development are that it gives for organization ways to create, manage and integrate knowledge. Proper process combined with complex product and manufacturing can be organizations molar tooth and mode of the operation may be impossible to benchmark. In literature can found several examples about the companies whose product and process is transcendent related to other.

Aim of the chapters 2 and 3 is to clarify the main steps how the engineering process can be created and what kind of benefits process can offer for organization. Some cases where product design is based on prototypes and 0 series there are no reason to develop any processes for low volume products. The chapters 2 and 3 gives theoretical support to understand processes and helps to create RACI-matrix in a proper way. If the RACI-matrix and the results gives benefits to update existing jumplifts engineering process the theory presented in the beginning is important to dominate.

3.1 Process development capabilities

There are number of studies related to engineering process development. The prevalent issue in these papers is to show how to reduce manufacturing costs and how to reduce new product releasing time to markets. As a process aspect lead times has essential role to measure process performance. Lacks of the leadings means costs, delays and weak use of resources.

Implementing of process development is possible to perform by using different methods. Depends on organization interest product and process development are possible to manage parallel but then the overall management is critical. Standard way is to use sequential approach. Major benefit to use sequential approach is that while the product is complete all

the main specifications are already known. Reverse of this method is that pressure to finish the process is higher and this can cause changes for product itself.

3.2 Diversity and framework of process development

Rapidly changing technical environment poses challenges for organizations to stay on top of the development. Due to this processes must design and prepare to be flexible and ready for renewal. Innovations lead organizations to change product, manufacturing and processes. Organizations with strong experience related to process leading work have better capabilities and options to conform the changing environment. Changing environment and technical innovations increase the overall product life cycles. This aspect is well identified but its complex to transfer and take into account directly in process development. This affect pressures to get product on market soon as possible.

Process development capabilities affects for number of different functions like organizations strategy and vision, location related to research and development enter and manufacturing and finally the competitive status in markets. Complexity of new process development increases the multiple elements like technical laboratories, piloting, commercial environment and resources to perform this entirety. Core of the development is that both product and process development are basically problem-solving tasks. Findings and gaps in product development can implement to new process. Main task is still to increase added value for customer and reduce the production costs.

In literature contexts product and process development are running at the same time. Both must support one by another and for the outcome of overall result either cannot isolate. This function is already well identified through the organizations different engineering levels. In figure 11 is shown principle of process development in context. The idea is to observe different variables and operations. Success of this means proper coordination and resource integration for development.

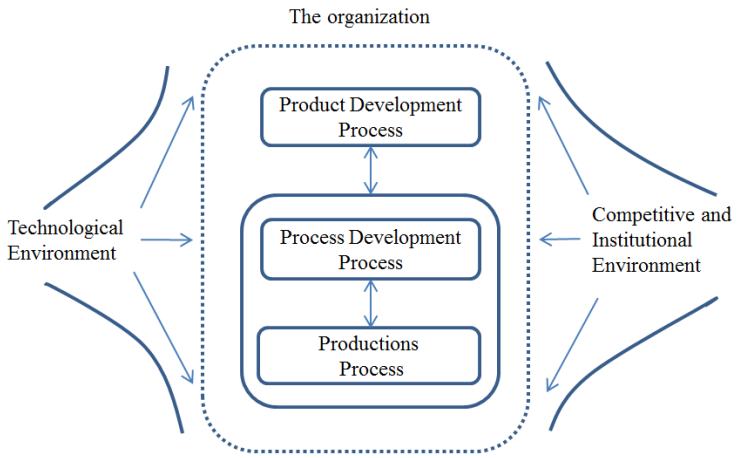


Figure 11. Process development in context (Pisano 1997, p. 31).

Ways to manage process development strategies based on organizations depth and maturity of technological knowledge availability. Process development main task is to clarify how to create the product. Process development generates a product design into the technological information, firm capabilities and operational processes. Workforce must be aware of the things which are operationally feasible and the elements what are hazardous or difficult to carry out is process design. New knowledge will occur during the production process but how to implement it improve the process technology is a complex task.

Figure 12 generates information about the framework for viewing process development. The figure also helps to determine different roles of process development and output practices in deepening organizations capabilities. Process development attends to identify problems that might appear in real production. Figure 12 can be divide in two different section lower half and upper half. Lower half concentrates to describe on two avenues through which production capabilities improve. The first is process development and the other is production experience. Base of the upper half of figure illustrates the role of process development and production in enhancing. One important feature of the figure is that it demonstrates the congruence. Process development and production both have twin roles as users and producers of capabilities.

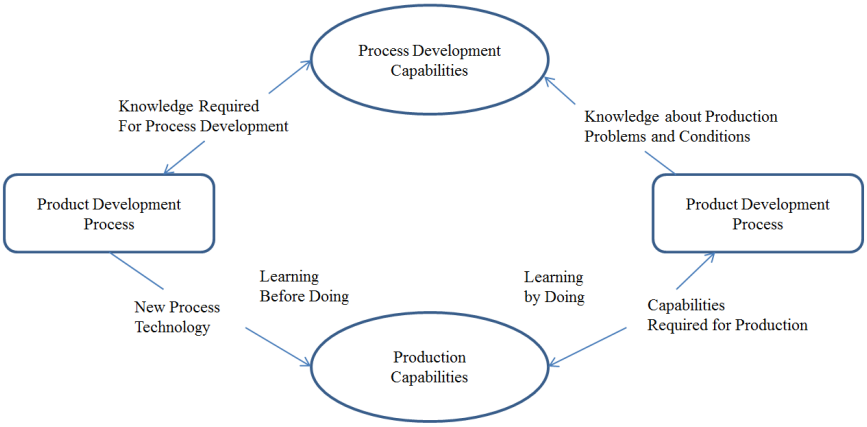


Figure 12. A capabilities-based perspective on process development (Martinsuo et al. 2010, pp. 22-24; Pisano 1997, p. 34).

3.3 Methods to collect data in process development

According to Strauss and Corbin (1990. pp. 3-6) in literature can be found several different methods to collect data. Typically while doing qualitative research scientifically articles, books, interviews and internal date gathered by organization itself. Collected data is processed for more visual form by using diagrams, flowcharts or process maps. (Ungan 2006, pp. 403-405; Martinsuo et al. 2010, pp. 22-23.)

Core motivations to progress working by using commonly known ways are the benefits that organizations strategy, vision and product can be shown in understandable form. Identifying the entirety of the process is the aim of process development. While all the variables and functions are recognized date is possible to modify in flow chart form. (Herzog, Tonchia & Polajnar et al. 2009, pp. 967-978; Chen et al. 2011, pp. 9-10; Bevilacqua, Ciarapica & Giacchetta 2009, pp. 13-22; Davenport 2013, pp. 28-31.)

The task of data collection is to identify different personnel responsible for individual assignment of the process. At the first phase organization must have a transparent understanding how the existing process work and discriminate functions around the process, how to evaluate the process and have knowledge what are needed to upgrade. Information inside the process is inputs and outputs. Help with process modeling is possible to seek benefits improving existing process and generate more profitable way to work. Basically the

methods are easy to execute and it gives organization advantage to identify shortcoming, clarify the use of resources and finally get exact information to redesign process. Managing data collection open share of information, the right people and responsible person's commitment is essential (Ungan 2006, pp. 400-401; Martinsuo et al. 2010, pp. 22-23.)

Data for flow chart can be collected using different methods. The most common techniques are team method and interviewing, in this study the used method is RACI-matrix what is based on existing data and interviews. The principle of the interviews consist of data collected from group of members or either individual employee and describe the interviewer by their own words how the process works. Answers are used in process survey and members are directly taking part in process renewal. Flow charts are built by based on gathered information during interviews. While the flow chart of process flow is transcribed following activity for interviewer is to organize a second round of interviews and verify if the flow chart is correct (Biazzo 2000, p. 110-111; Nesbitt 1993, p. 34.)

Essential requirement before introducing flow chart is that organizations objects are defined. For complex processes interviewing technique is not the best one. If the number of interviewees is large it is complex to end up in a single result. Lack of the interviewing technique is that it binds a lot of time to perform. Depend on number of interviews it is possible to speed up the process by using group method and then try to abbreviate the processing time. The persons who are responsible for development and flow charting process must document their information and gather further details if needed. Next phase is to expand the process to macro view and clarify complex parts in micro view. When the knowledge is in adequate level time and cost functions are possible to add in the final analysis. After all needed variables are gathered process flow chart is possible to describe. (Nesbitt 1993, p. 34; Ungan 2006, pp. 402-403.)

3.4 Implementation of process

Process flow chart is a map for organization and its labor to perform activity in the most efficient manner. Process flow chart consists of inputs and outputs and combines all the factors around the process. To achieve desirable output interfaces, tasks and resources must be identified around the process and to be modeled. The process flow chart should be as coherent and transparent as possible for organization to execute and to fulfill customers'

expectations and needs. Important function of flow chart is to standardize roles, systems and tools that are needed to complete the process. (Martinsuo et al.2010, p. 24.)

Key role in implementation process is a proper process team. The members of the process organization and team have to be motivated, open minded and willing to take risks. The background of the members must be different to achieve different kind of perspectives and angles. Essential is to fulfill needs of organization strategy and vision to execute process good as possible. (Nesbitt 1993, p. 34.)

To achieve the best possible result of the process must be understandable and clear for all the participants who are using it. Accurate level of released data must be qualified enough and all the symbols in standardized form. While the flow chart is complete overall work to improve process is not complete. The work will continue by refining the lacks and bottlenecks. Achieving the best possible result more detailed information is possible to add in flow chart. Adding cost and time functions to the flow chart it will help members to identify improving objects of the process more easily without forgetting optimization. The final and one important task is process flow chart visual appearance. The format can be presented in one page or separated to multiple pages. The goal is that all needed data is available, readable and understandable form. (Nesbitt 1993, p. 34; Vergidis, Tiwari & Majeed 2008, p. 72; Grigori et al. 2004, p. 325.)

Chapters 2 and 3 are shown theoretical background of the engineering processes. These chapters are utilized in this study to perform for the reader a transparent understanding about the main phases of the engineering process improvement and how to create new engineering process. In this study similar principles are used. In the processes there are different roles for the labor and for the organization. Compiled theoretical background introduced in chapter 2 and 3 gives benefits to analyze RACI-matrixes in more diversely manner and perform improving actions by using several perspectives of sources.

4 MEASURURING PROCESS PERFORMANCE AND RACI-MATRIX

The goal of process performance measurement is to conduct operations towards strategic targets. According to Laitinen (1998, p. 2): “Organizations performance can be defined capabilities to achieve throughputs by mounted dimensions against the objectives”. Performance can be viewed at least two different aspect. One the throughput is in a key role while viewing the success and achievements. Another aspect is to study organization capability to do things and ability to cope asset targets. Throughput measurement focus on pass and performance measurement can be focused on future. (Laitinen 1998, p. 3; Martinsuo et al. 2010, p. 18; Rantanen 2005, pp. 2-3.) The most common indicators to measure performance are related to economic aspects but efficient, productivity and quality indicators are rising up (Tenhunen & Ukko 2003, p. 18). Competiveness indicates the organization success compared to competitors. Competiveness can be defined organizations capability to participate and stay on market. (Ukko et al. 2007, p. 6.)

4.1 Uses of the engineering process performance measurement

Operating environment, tightening competition and easy access to measure processes have asset pressures for organizations to invest in performance measurement systems. Continuous information flow and effective use of resources are in essential role of success. Previously it was common to focus only economic indicator but those may have short-sighted affect for the overall situation and the real needs of organization. Alongside of the traditional indicators organizations are started to use indicators more diversely. (Ukko et al. 2007, p. 9)

The goals of the measurements are to ease management for making decisions and achieve the strategic objectives. In a process work team and single members tries to achieve asset personal and team targets and the same time support organization overall objects. Achieving asset objects, personnel management shows key role in success. Important is to know how to manage motivating, commitment, interaction, communication and inspiring of personnel. Personnel are organizations most important capital and they are performing all the activities and for result point of view right use of resources and proper management are essential. (Ukko et al. 2007, p. 12.)

Measuring the performance of the organization should be part of standard way of working and the true target is to support long term success. In figure 13 has presented main stages of performance measuring. Main stages can be seen as a continuous chain and different entities of the stages are highly reflecting people, processes, culture and infrastructure. (Ukko et al. 2007, p. 12.)

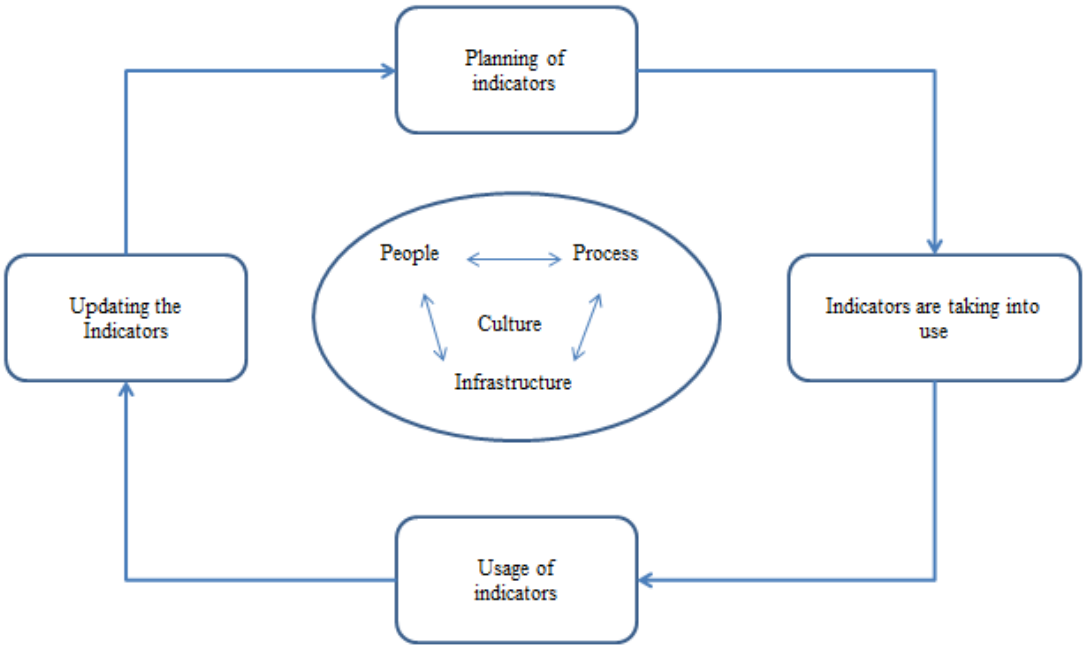


Figure 13. Main stages in performance measuring (Neely et al. 2000, p. 1143).

4.2 The accuracy of the process information

Huge numbers of data are available while indicators are set. Due to this it's important to select the right ones and understandable indicators. There must be capability to analyze the measured data in a proper way and the targets are needed to be really achievable. Analyzed data have to be based on facts and then managers must have proper tools to make decisions and improving actions. To achieving the goals indicators cannot be asset to control personnel for the purpose of the indicators is to do things more efficient way in addition to increase communication and improve working motivation. (Ukko et al. 2007, p. 13; Neely 1999, p. 1143.)

One of the most essential tasks of business is to meet the needs of stakeholders. Simplifying this topic it means profitable business. Typically key figures includes financial statements

but these figures describes principally past operations. Indicators that are reflecting to forecast are modernity. Combination of traditional and modern indicators gives benefits to improve activities the most efficient way. While selecting indicators and targets it's essential to achieve first lower point targets and then move to upper level targets. Following the chronological order the process stays in consistent. (Lönnqvist 2002, p. 15; Lönnqvist & Mettänen 2003, p. 20 ; Ukko et al. 2007, p. 14.)

4.3 The role of the organization during the introduction

In every organization there are asset targets to achieve. The targets are needed to be asset and then organizations have something to pursue. Strategy and vision defines the management goals but for personnel point of view management goals can be difficult to understand. Vision is a fantasy how the organization imagines the future. Strategy is principle how to achieve the goal. In figure 14 is shown main stages of performance measuring. The figure illustrates how the lower level targets are formed and leads to upper level targets. (Niermeyer & Seyffert 2011.)

Figure 14. Main stages in performance measuring (Niermeyer et al. 2011).

4.4 The role of the employee during the introduction

According to studies employees are well known about personal targets and how those are reflecting to organization targets (Ukko et al. 2007, p. 28.) For this situation is reasonable to

strive. Motivation to work increases while employee knows work and goals related to overall activities of the organization. The goals are easier to embrace if the employees can participate on the decision process in early phase.

If the managers thought that personnel only function is to maximize their own advantages may it lead that personnel cannot affect to targets. Employees related to decision process have better understanding about the organization and its position on market. Based on researches personnel involvement to decision and targets are in mediocre level. Team work perspective this situation is not effective because the purpose is to head decisions near the work and competence. (Bourne et al. 2000, p. 756.)

4.5 Benefits to measure the process

General clichés can be stacking up when talking about process measurement "what get measured gets done" and "if you cannot measure it, you cannot manage it". Despite the huge number of available indicators and potential measuring objects there must be plan and purpose behind. Measuring activities ties up resources, affects implementation and preserve costs. Without having proper overall picture of the process can measuring systems reduce the efficient of the process. (Robson 2004, p. 514.)

Robson (2004, pp. 513-519) has studied process measuring and presented a substantial questions and answers to manage the theme:

- *How can individual process measures be aligned with organizational objectives?*

Sometimes strategically high-level measures for organizational activities can be identified but the later on ignored behalf of management. This may affect that one essential indicator customer satisfaction gets off dis-compiled. Products and services are highly indicated but internal activities perceived too difficult to control and measure. Services of internal performances that are essential to operational performances should be treated as any other processes. After identifying the supply chain measures it can be reported to upper management of the process. (Robson 2004, p. 514.)

- *How can a minimum set of measures be identified for an individual process?*

In the first phase is important to identify unproductive functions not creating value for process. Identifying the unproductive functions errors can be then avoided. Excessive or minor number of measuring is complicated to define. Identifying minimum set of measures means overall understanding of process and what in the process are unacceptable. Recognizing the critical-to-error measures is a effective way to recognize the minimum set of measuring systems. (Robson 2004, pp. 515.)

- *How can the overall performance of a complete supply chain of processes be improved*?

While management and employees are trying to improve the process performance the lacks can be found due to used measuring systems which are not fit to improve the overall process performance. The selected indicators has been the easiest one and not useful at all in process aspect. To succeed with proper measuring system should the entire different aspect take into account initial process, service process, customer satisfaction, stakeholders, suppliers and also strategy and vision. As listed above the chain with different functions and variations is huge. Taking all into account is major process and needs lot of effort to manage. (Robson 2004, pp. 516.)

4.6 RACI-matrix

Function of the process mapping is to discriminate the assignments that are being completed and the actors who are doing the work. Theory and practice usually doesn’t match and due to that ambiguities will occur. Generally process ownerships, responsible, hierarchies and roles in the process are loss. A RACI-matrix gives benefits to clarify responsibilities of the process. According to the name of RACI individuals of the process can be identified who are Responsible, Accountable, Consulted and Informed. Together with process mapping and RACI-matrix can misunderstandings be eliminated, build better consensus, use resources more efficiently and give visible role for each person. (Jacka & Keller 2009, pp. 255-256; Cabanillas, Resinas & Ruiz-Cortes 2012, p. 60; Cabanillas, Resinas & Ruiz-Cortes 2011, p. 172.)

Ambiguities of the ownerships of the process cause managerial damages for overall fluency of the process. Conflicts may exist while the one activity has two or more owners and every

have different view how to perform the task. This situation leads situation that person doesn't recognize his or her role in processes and no one take response of the activity. In cases were roles are observe, it's unclear who makes and where the decisions are made, if the approval process is tedious and time-consuming and if the persons outside the process map are making decisions is RACI-matrix reasonable to use. (Jacka et al. 2009, p. 257; Cabanillas et al. 2012, p. 61; Cabanillas et al. 2011, p. 173.)

RACI-matrix is a exel based user interface to manage personnel resource responsibilities in process. RACI-matrix is performed by using tables were rows illustrates tasks related in a company. Columns represent personnel resources and each of have zero or more responsibility of resource activity. Meanings of the letters are revealing according to (Cabanillas et al. 2011, p. 174; Jacka et al. 2009, pp. 258-259; Smith, Erwin & Diaferio 2007):

- Responsible (R): The person who performs the task and is response of it until the activity is completed and approves by accountable.
- Accountable – Approver (A): The person who approves the task after responsible person is completed it. Is responsible of the activity after approval and it's mandatory to have only one accountable person in each activity.
- Consulted (C): The person whose opinion is needed to perform the activity. Normally expert of the certain area. Two-way communication
- Informed (I): The person whom controls the progress of an tasks and the outcome of the work. One-way communication. One or more person can be informed related to task.

There are number of variants how the RACI-matrices can be performed. Connections for the roles can be based on for example numbers or letters. In table 3 is shown basic principle of the RACI-matrix were the connections are demonstrated by using letter functions. In table 3 can be separate the activities in rows and the resources in columns and moreover the responses related to activity and resource are illustrated by using letters. This technique gives benefits to simplify the process interdependencies and indicate possible shortcomings and duplications. (Cabanillas et al. 2011, p. 176; Jacka et al. 2009, p. 260.)

Table 3. The principle of RACI-matrix (Jacka et al. 2009, p. 262).

	Project's PhD Student	PhD Thesis Supervisor	Project Coordinator	Project's Administrative Assistant	Research Group's Clerk
Submit Paper	R/A				
Fill Travel Authorization	R		A/C		
Sign Travel Authorization	I		R/A		
Send Travel Authorization	I				R/A
Register at Conference	R/A	I	C/I	I	
Make Reservations	R/A	C	C	C/I	S

4.7 Performance of the RACI-matrix

RACI-matrix analysis can be separated two different part vertical and horizontal analysis. Role of the vertical analysis is to demonstrate roles and responsibilities of an individual or position. Vertical analysis demonstrates evaluation of whether employee has sufficient and enough involvement. Frist phase is to clarify number of responsible and accountable tasks under a worker. If the number of responsible tasks for one worker is large is reasonable to rethink is that really necessary. Then breaking the activities in smaller, better manageable functions is a proper option. The number of accountable activities is important quantity. If the result is large sufficient separation of the tasks should be exists. If all the approvals goes thru the one person may it be the predominant bottle neck for the process. (Cabanillas et al. 2011, p. 178; Jacka et al. 2009, p. 163.)

While studying the functions under position it is possible to make conclusion whether the situation is proper or not. If there are existing lots of empty spaces under one worker may it be that role is not needed anymore. If there are no empty spaces then it's reasonable to think if the worker is member in too many activities. Some cases considering updating the role of consult to inform is sensible. One potential benefit in this is possibility to abandon the role of Inform. (Cabanillas et al. 2011, p. 178; Jacka et al. 2009, p. 164.)

Manager's role is important to plan carefully. It's the lack use of resource if the manager is involved in every level of the activity. Depending on the level of the approval is the use of management involvement think carefully. Some cases the approval can be handled inside the team or working group. (Cabanillas et al. 2011, p. 179; Jacka et al. 2009, p. 164.)

The role of the horizontal analysis is to indicate analyzed view of the tasks being performed. Reviewing the activities and the responsible and accountable roles of it the task will not be completed if there is no responsible person. Without accountable person there is no one to ensure if the activity has done right. There is no ownership if responsible or accountable person not exist. Too many people are involved if the number of responsible in one activity is large. (Cabanillas et al. 2011, p. 180; Jacka et al. 2009, p. 165.)

It's essential to have only one accountable person. If there are more may it be difficult for response person to select right one. "Shared responsibility is no responsibility". Situations were only one worker is responsible for the task may it be the bottleneck in the process. Activity is too highly controlled if there are many tasks for consult or inform person. Consults position affect delay and extra investment for the process. If there are possibility to intensify the task and free the resources and the remove the consult and inform roles. Importance the situation of boxes is cannot be ignored. Whether the boxes are full of responses or totally empty there are then option to adjust the dependencies. (Cabanillas et al. 2011, p. 180; Jacka et al. 2009, p.167.)

As a process aspect every person has an individual role and response area to perform the work. Viewing the role can be notified that there are different thoughts and expectations between the employees what the role really contains. One role can be separated to three different assumptions. The first one is role conception. This conception views how the employee thinks what the work is and how the activity is planned to perform. Independent thinking may lead to several false presumptions. The second assumption is role expectation. Organization and the other employees have a own expectations how the a person should carry out the responsibilities. The other member of the organization may affect the decisions that are needed to perform the work and the information can be incorrect. Outputs of the role are related to expected results of the role. The last one is role behavior. This illustrates what the employee actually makes to performing the activity. (Smith et al. 2007.)

RACI-matrix is a responsible chart and one of its functions is to combine role conception with the role expectation. In generally the employees expectations related to work, what are the others expectations to the work and how the activity is in really performed are all the same issue. One of the managerial key roles is to set right resources to perform the works.

Normally this is a challenging task and symptoms can exist. The symptoms are the ones that managers should avoid and in practically recognize. (Smith et al. 2007.)

The symptoms of role confusion according to Smith et al. (2007) are:

- "Concern over who makes decisions
- Blaming of others for not getting the job done
- Out of balance workload
- Lack of action because of ineffective communications
- Questions over who does what
- A "we-they" attitude
- A "not sure, so take no action" attitude
- Idle time
- Creation of and attention to non-essential to fill time
- A reactive work environment
- Poor morale
- Multiple "stops" needed to final and answer to a question"

4.8 Realization of the RACI-matrix

Preparing process of the responsibility chart consist of five important step to take into account. Starting phase the work process must be identified carefully. If there are already known that process will change soon then there are no reason to chart it. Number of listed activities is also important observation. In a manageability aspect sufficient number on activities are between ten and twenty five. Another point is to qualify decisions and activities to chart. Adding unclear or to obvious activities is waste of time and that's why consideration before listing is essential. Feature of proper activity is that it starts with effective verb as evaluate, operate, prepare etc. Resources for the activities can be separated to roles. Direct naming should be avoided and stay on roles due to continuous changing in personnel inside the organization. Then can be ensured that chart is still valid notwithstanding if the employees changes. Developing of the RACI-matrix based on the R, A, C and I indicators and those must be determined for each activity. Continuous improving is essential and to achieve the best results and for the participants should collect feedback and make corrections and accuracy actions. (Smith et al. 2007.)

Interviewing is common and effective way to gather information on functions, decisions or activities. Questions are useful way to determine objectives for the activities and verifying can include inputs and outputs of the work. Interviews are possible to write down or record. Recording gives benefits to return the questions are upgrading them afterwards if needed. Interviewing's are possible to perform one-to-one technique or gather group of the participants related to process work. (Smith et al. 2007.)

4.9 Analysis of the RACI-matrix

The important findings are to study the number of R's (Response) and A's (Accountability). If there are too many R's in the chart the concern is that will the activity get completed or can the resource handle many activity at the same time. Accountabilities should be designed the way where each activity has only one approving person. If there are several approval needed delays are common and expected.

Consulted (C's) and Informed (I's) should be used were needed and avoid if possible. Consulting is related to experts work and it causes increasing for costing and timing. Due to this consulting must be rationalized and used deliberately. Informing has essential role of the chart and work but only needed people is necessary to inform. Analyzing of the RACI-matrix performed two directions vertical and horizontal. Arrows in table 4 are demonstrating the analyzing directions.

Table 4. Analysis of the RACI matrix (Cabanillas et al. 2011, p. 59).

	Project's PhD Student	PhD Thesis Supervisor	Project Coordinator	Project's Administrative Assistant	Research Group's Clerk
Submit Paper	R/A				
Fill Travel Authorization	R		A/C		
Sign Travel Authorization	I		R/A		
Send Travel Authorization					
Register at Conference	R/A	I	C/I	I	
Make Reservations	R/A	C	C	C/I	S

This chapter 4 is core of the RACI-matrix theory. Based on the theory shown in this chapter 4 jumplift engineering process related RACI-matrixes are created and analyzed. Chapter 4

generates essential information for the researcher how to create RACI-matrixes, how to perform RACI-matrixes and how to analyze RACI-matrixes. R, A, C and I symbols are shown main role of this study. Without substantive understanding about purpose of the symbols there are no possibility to perform RACI-matrixes effectively. The symbols are needed to be placed properly and precisely in the RACI-matrixes to get accurate results.

5 JUMPLIFT ENGINEERING TEAM, PRODUCTS, PROCESS AND RACI-MATRIXES

Aim of this chapter is to describe existing jumplift engineering team, products and process in addition to demonstrate main use of the RACI-matrixes in this study. One part of this chapter is also to clarify reasons why the RACI-matrix is selected to use in this study and what are the requirements for the study. Target is to get understanding how the specific RACI-matrixes are created and how it can be implement in this study and engineering process improvement.

Based on the literature review shown in chapter 4 RACI-matrix is proper tool to measure current engineering process of jumplift team. Jumplift team works in a one unit and there are clear separated tasks for each members to perform asset activities. To clarify transparency of the engineering activities the activities can be list consistently in RACI-matrix. Core point of RACI-matrix is that it gives simply benefits to compare exciting jumplift engineering process to RACI-matrix results. Based on the received results is possible to modify process if needed.

5.1 Jumplift engineering team

Major project is Kone's supply unit and main function of the unit is to provide people flow solutions for the most challenging construction projects all over the world. Elevator products and services are highly tailored to answer customers demanding requirements. Kone MP is separated different unions and jumplift team is one of the MP's unit. Response of the Jump-lift team is to develop and maintain jump-lift products and processes. Common cases existing jumplift products cannot be used and jumplift team have to modify appropriate solutions. Jumplift research and development is highly associated new received projects and project specific needs.

Jumplift team is solid unit and total number of the team members is under twenty (2017). Main frame on the team consist of mechanical, electrical and layout engineers. Jumplift engineering team is presented in figure 15.

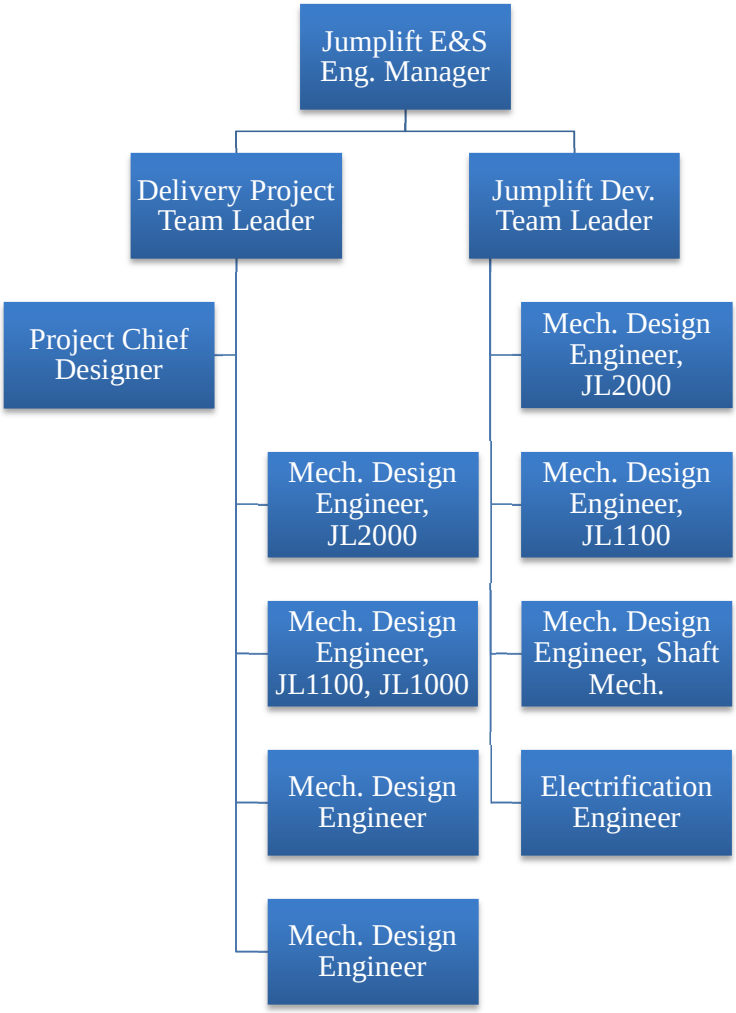


Figure 15. Jumplift engineering team.

5.2 Mode of production

Jumplift engineering team is separated into two section, another section for delivery projects and another for product development as shown in figure 15. Sections are working close together due to project orientation course of the actions. Delivery project team supports supply team both in tender and order phase but if there are no existing jumplift product available development team have to be also involved to create new solutions.

5.3 Jumplift products

Kone jumplift products are designed to (CTU) construction time use: Use of the jumplift depends on construction progress of the building in advance of the agreed plan. After construction work is completed jumplift is then converted to normal elevator.

Jumplifts products can be divided into two parts: Kone jumplift 1000 - cathead supported to guide rails and Kone jumplift 2000 - cathead supported by putlock holes. Range of the products is different and main features are shown in table 5.

Table 5. Kone jumplift product selection (Engineering instruction 2017, p. 10).

JumpLift platforms	JumpLift product	CWT location	Load Q kg	Travel m	Speed m/s	Support Method
JumpLift MX20	JL1000	Side	1000-1600	120	2.5-3.0	Guiderails
JumpLift MX18/NMX18		Rear Side*	1275-1600	210	2.5-4.0	
			1600-1800	180	2,5-3,5	
JumpLift MX18/NMX18	JL1100	Side & Rear	1000-1600	210	2.5-4.0	Support beams
			1600-1800	180	2,5-3,5	
			2000	130	2,5	
JumpLift MX32	JL2000	Side	1000-2000	300	2.5-4.0	
		Rear	1350-2000	300		
JumpLift MX40		Rear	1350-4000 1350-3000 **	400 500 *		
		Side	2000-4000 2000-3000 **	400 500 *		

Maximum speed is limited 4 meters per second and maximum continuous travel is limited 500 meters. The overall range of the Jump-lift products is much wider than shown in table 3 only variations of the different jumplift products are shown.

Figure 14 exemplifies simple model of jumplift system. In the construction time use jumplift is operating as shown in the drawing 16 the temporary machine room (Cathead). At the same time guide rails and landing doors are installed to installation zone above the cathead. After installation the cathead is moved to next position and new floors can be served for construction workers. When all the jumps are completed the next phase is to transfer jumplift to permanent elevator.

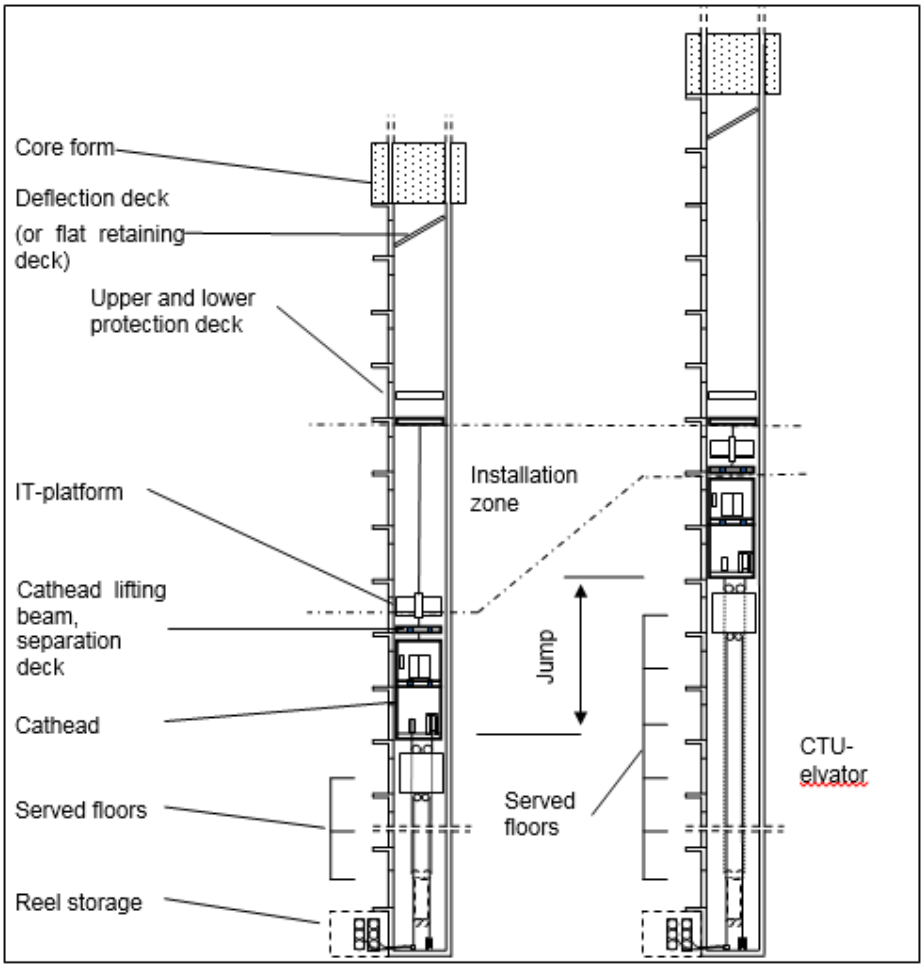


Figure 16. Wireframe of jumplift system (Engineering instruction, 2017, p. 5).

As shown in figure 16 the jumplift system is presented in general way. Achieving the deeper understanding for the requirements also figure 17 is needed. There are number of dimension, tolerance and other building related viewpoints to take into account in engineering phase. Explanations for the abbreviation shown in figure 17 are clarified in abbreviation part earlier in this text. Review for series jumplift 2000 - cathead supported by putlock holes is shown in figure 18. Main difference between jumplift products 1000/1100 and jumplift 2000 is that temporary machine room (cathead) is supported by putlock holes. With the series 1000/1100 putlock holes are not needed and cathead is supported only to guide rails also presented in figure 18.

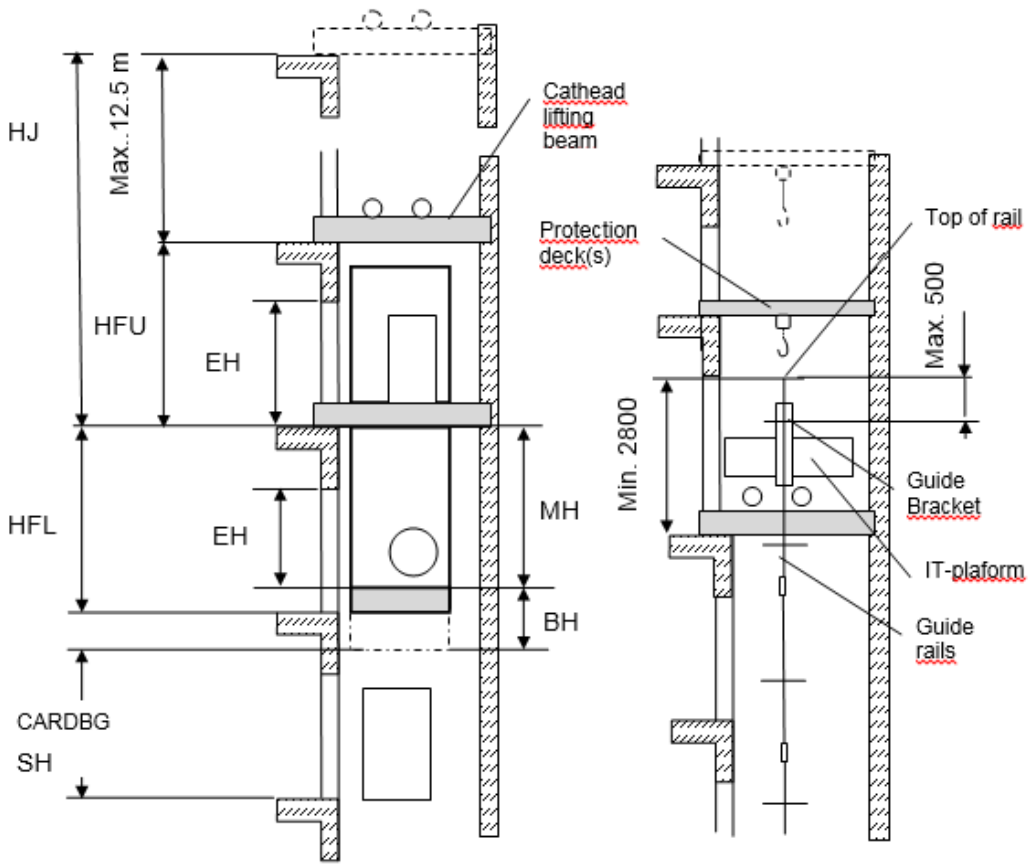


Figure 17. Wireframe of jumplift system restricts (Engineering instruction, 2017, p. 47).

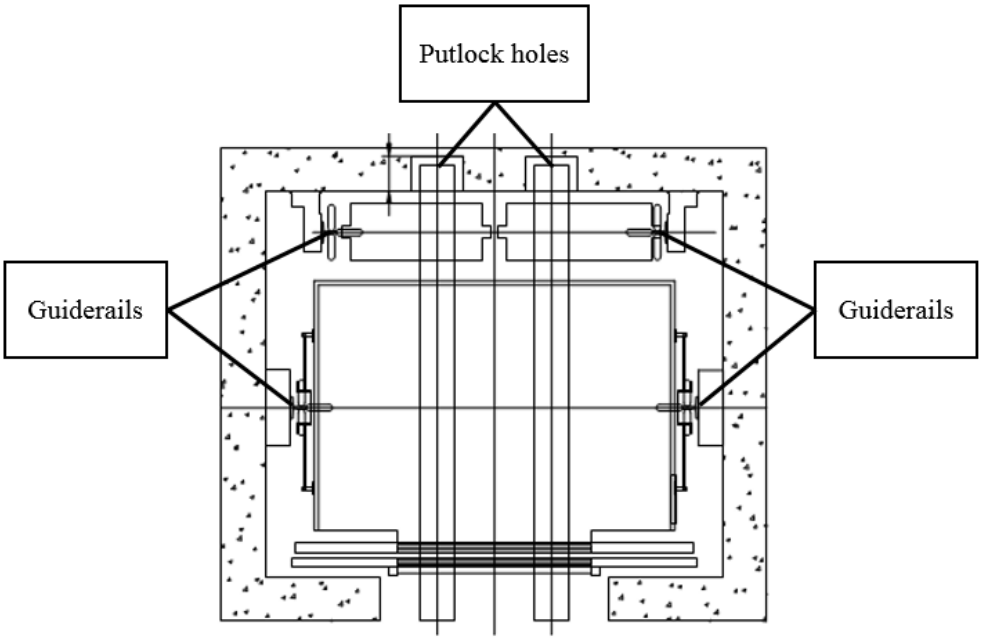


Figure 18. Jumplift 2000 - cathead supported by putlock holes (Engineering instruction, 2017, p. 47).

5.4 The utilization of RACI-matrixes in this study

RACI-matrixes are shown a key role in this study. Utilizing the RACI-matrixes, exel-based user interfaces are created and the user interfaces are shown significant role of jumplift engineering process improvement. User interfaces are consistent with the existing jumplift engineering process and all the jumplift engineering activities are listed in the RACI-matrixes. The current engineering process model is not transparent and presentation is only in text format. Below is presented figure 19 engineering process model for jumplift layout engineering work. All the confidential details are removed from figure 19. Figure 19 is indistinct and uninformative. One important task why RACI-matrixes are used and new user interfaces are created is to get jumplift engineering process model in more transparent format. Work flow of the jumplift engineering process can be present more generalized way as shown in figure 20.

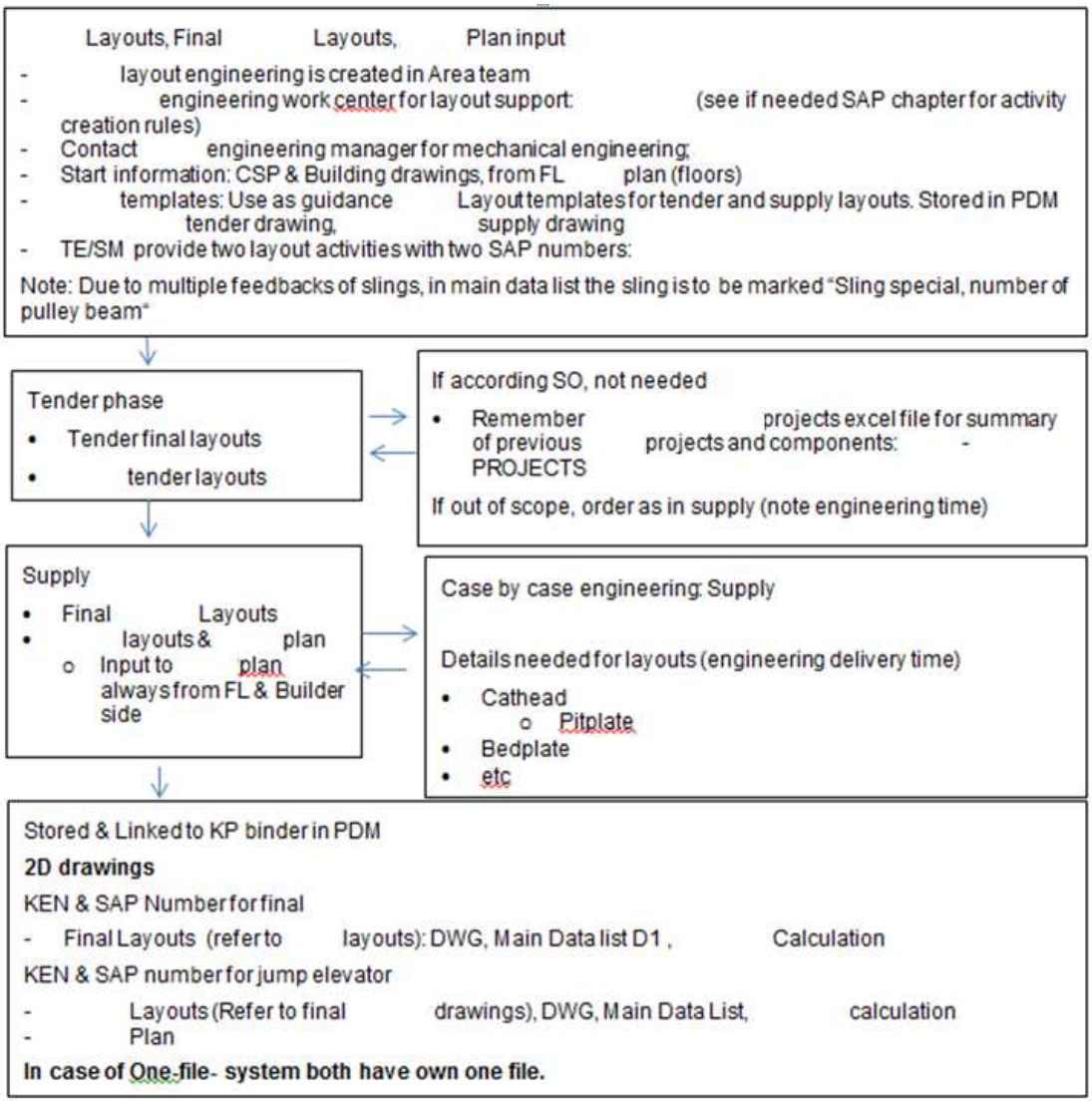


Figure 19. Jumplift layout engineering process. Existing indistinct format of the engineering process (Quality document, 2016, p. 10).

In the figure 19 above the overall process is presented in text format. For the external user the format is not clear and content of the separated activities may remain unclear. Reviewing the figure 20 and phases Oc to 2f major lines of the engineering process model are easier to perceive. In the figure 20 jumplift engineering process is presented in Kone internally language. 0c-stage is presenting tender phase situation and 2f-stage situation when the engineering activities are completed. Generalized the figure 20 is performing Kone way to monitor the current engineering situation and the stages 0c to 2f indicates the existing situation.

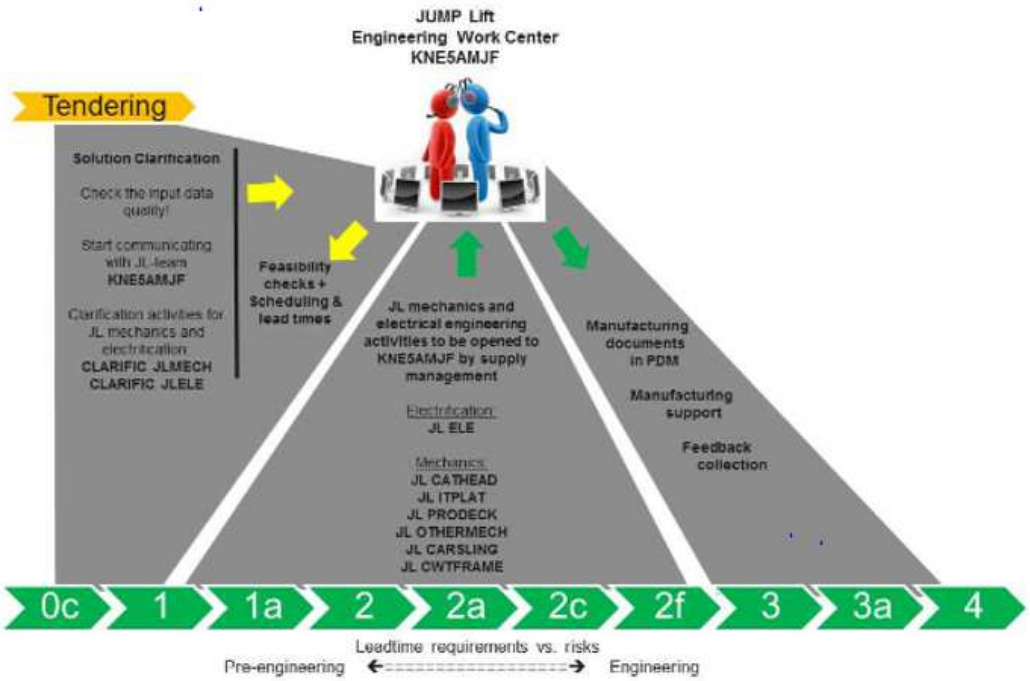


Figure 20. Typical work flow of jumplift engineering. Kone way to monitor existing engineering situation (Quality document, 2016, p. 8).

Figure 20 presents the main phases of the jumplift engineering process in general format. Entities are shown in generally but all of the activities includes number of assignments of work before the activities are completed. Content of the activities are shown later on detailed way in RACI matrixes.

5.5 Specific jumplift engineering RACI-matrixes

Two different RACI-matrix template are created to clarify existing jumplift engineering process situation. The first RACI-matrix includes task specific improving actions and the actions are based on personnel interviews. The second one includes all the jumplift engineering specific actions. Both of the RACI-matrixes are important for improving aspect because while comparing the both is possible to get clear understanding of the jumplift process overall situation. Especially the task specific RACI-matrix is essential because for tackling the lacks of the improving actions gives it benefits to improve overall jumplift engineering work from stages 0c to 2f.

Activities based on the jumplift labor interviews (RACI-matrix) are separated into different engineering entities; tender, layout, supply, engineering specialist, mechanics, listing, process operation and project management activities. Template for jumplift improving actions RACI-matrix is shown in table 6.

Table 6. RACI-matrix based on jumplift improving actions.

RACI matrix

R:	Responsible
A:	Accountable
C:	Consult
I:	Inform

Task: Jump-lift improving actions

PROCEDURE	Task specific improving actions based on interviews
DEPARTMENT	KONE MP
UPDATED	~2017

		Manageral team				Supply team		Engineering Team													
STEP	Activity	Project Manager	Operation Manager	Platform Manager1	Jump Team Manager	Jump Team Leader	Supply Manager	Project Engineer	Engineering Specialist	Layout Engineer	Layout Checker	Mechanical Engineer (Cathead)	Mechanical Engineer (IT Platform)	Mechanical Engineer (Pro Deck)	Mechanical Engineer (Other Mech)	Mechanical Engineer (Car Sling)	Mechanical Engineer (Cwt Frame)	Mechanical Engineer (Pit Plate)	Electrification Engineer	Listing Engineer
1	TENDER																			
2	LAYOUT																			
3	SUPPLY																			
4	ENGINEERING SPECIALIST																			
5	MECHANICS																			
6	LISTING																			
7	PROCESS OPERATIONS																			
8	PROJECT MANAGEMENT																			

In table 6 only the main entities are shown but all the activities includes several improving tasks. Overall list is shown in APPENDIX 1.

Activities based on jumplift engineering actions (RACI-matrix) gathers all engineering tasks. Content of this RACI-matrix is separated to layout engineering, jumplift cathead, jumplift-platform, jumplift IT-platform, jumplift protection deck, jumplift other mechanics, jumplift sling, jumplift cwt frame, jumplift pit plate and jumplift electrification. All of these activities are important for jumplift engineering point of view. Template for jumplift engineering actions is shown in table 7.

Table 7. RACI-matrix based on jumplift engineering actions.

RACI matrix

R:	Responsible
A:	Accountable
C:	Consult
I:	Inform

Project: Jumplift engineering actions

PROCEDURE	Task related RACI matrix
DEPARTMENT	KONE MP
UPDATED	~2017

		Manageral team			Supply team	Engineering Team												
STEP	Activity	Platform Manager	Jump Team Manager	Jump Team Leader	Supply Manager	Project Engineer	Engineering Specialist	Layout Engineer	Layout Checker	Mechanical Engineer (Cathead)	Mechanical Engineer (IT Platform)	Mechanical Engineer (Pro Deck)	Mechanical Engineer (Other Mech)	Mechanical Engineer (Car Sling)	Mechanical Engineer (Cwt Frame)	Mechanical Engineer (Pit Plate)	Electrification Engineer	Listing Engineer
1	Layout Engineering (Jump&Final)																	
1	JL Cat Head																	
1	JL IT-Platform																	
1	JL Protection Deck																	
1	JL Other Mechanics																	
1	JL Car Sling																	
1	JL Cwt Frame																	
1	JL Pit Plate																	
1	JL Electrification																	

In table 7 only main actions are shown and all the engineering tasks related to activities are listed in APPENDIX 2.

Both of the matrixes are fillet together with the jumplift team and are based on existing engineering process shown in figure 19. Created and specified RACI-matrixes gives benefits to see engineering process model in more visual format. Visual format generates transparency and possibilities to make correction actions for the engineering if there appears any.

6 DISCUSSION

Main founding's and the results are compiled in this chapter. The study present the jumplift engineering process and activities in a more transparent format. The results can be used in furthers studies to improve jumplift engineering process and similar type of RACI-matrixes can also be used other engineering areas. Principle is the same and theory to use matrixes are shown in the study.

Main lack of the jumplift engineering process is that it is not transparent for the users. Tasks and activities are not listed clearly RACI-matrix symbols are not used and due to that communication flow between the jumplift process is weak. In the long term it is important to put all the data together and share the substantive information also for other users outside the jumplift team. The most valid result is to underline responsibility issues and get understanding what is needed to be improve. Real update for the jumplift engineering process will be part of the further studies but RACI-matrixes gives proper basis to start the work.

There are number of issues to improve in all the areas. Based on the interviews and listed in the task specific improving actions RACI-matrix the main lacks right now can be found from tools, documentation and information. Jumplifts products are one of the most challenging elevator products and improving work in all the areas is still in progress. RACI-matrixes brings up the main shortcomings and describes the tasks that are needed to be correct.

Two different but highly interdependent RACI-matrixes are created and the results can easily be seen. Features for the challenging products are that design is doing first and afterwards update the documentations. This is characterized also for the jumplift products. Main documentation and tools follows by few step behind. Essential is to describe the most urgent one and develop weak areas.

6.1 Comparison and connections with former research

Due to the unique position of the jumplift product comparison and connections with former research was difficult to perform. There was no previous studies available for the same

product category and this was also first RACI-matrix improvement study for the Kone elevator products. As generalized in prevision research the RACI-matrix results are easy to analyze and lacks can be identified without complex calculations. RACI-matrixes are based on the exact research and contents of the matrixes are tailored based on the existing situation. Used symbols and analyzing methods are the same than in the former research.

6.2 Objectivity

RACI-matrixes are produced together with the employees of the jumplift engineering team. Data used in the RACI-matrixes is based on existing jumplift engineering process model and the description of the existing process model is improved by the interviews. This will ensure that generated RACI-matrix user interfaces are precise and unambiguous.

Analyzing of the results is based on generalized knowledge of the RACI-matrix theory. Jumplift engineering team was involved to collect the data and determine the output data. Noteworthy is also mention that this is situation in 2017 and the overall view can be quickly change.

6.3 Reliability and validity

Improving the jumplift engineering process is performed by using RACI-matrixes in this study. In this study appeared two different RACI-matrixes. The first one based on the interviews for personnel working in different positions around jumplift products. The other was based on directly engineering activities.

Before this study there was no accurate data and information available. Improving the existing jumplift engineering process has been topical for long time but this kind of RACI-matrix study was not done before. Main deficiencies where recognized by individual employees but that data where not assembled together. For to get data for improving actions RACI-matrix eight different employees in different positions are interviewed. Based on the interviews appeared also similarities with the main lacks shortcomings with the existing tools and instructions. For the interviews sampling of eight was sufficient but all the deficiencies cannot be fixed at once or maybe ever. Still identifying of the problems is valid and useful for further improvement.

RACI-matrix based on engineering activities was straightforward. The data was available in text format but all the activities was qualified with the certain response engineer of the activity. Before there was no data available how the process is performed when consultation was needed or what entity to inform at different stages of the activity. The measurements shows that improvements can and are needed to done.

6.4 Assessment of the results and sensitivity analysis

The results are clear and easily exploitable for the use of jumplift engineering process improvement in the future. The relevant persons are known what are needed to be done and what are main matter to focus in the future.

During this study between spring 2016 and spring 2017 several different employees are interviewed; tender engineer, layout engineer, supply manager, engineering specialist, mechanical engineer, listing engineer, process operation manager, platform manager and project manager which indicates that every aspect in all areas is taken into account.

6.5 Key findings

Below are shown two examples of the RACI-matrixes and the results in tables 8 and 9. In table 8 where the improving actions are listed based on the personnel interviews is more valuable for the improving point of view that table 9 where jumplift engineering actions are listed. There are number of activities that are needed to be updated and improved. Improving of the activities is complicated due to complexity of the jumplift product. It doesn’t matter if the jumplift product is in the tender or supply phase if the product is out of the existing product range there are no proper tools to manage engineering and design in simple way. Normally several approvals and new documentations are needed and there also time consuming impact. Jumplift platform manager is mainly the first contact point but also lot of consulting and support from different engineering levels are needed. Also customer and builder involvement for developing work is essential. Typically building requirements are not clear in the early phase of the project and requirements are the one that have to be clarified in the early phase.

Table 8. Updated RACI matrix based on jumplift improving actions.

RACI matrix

R:	Responsible
A:	Accountable
C:	Consult
I:	Inform

Task: Jump-lift improving actions

PROCEDURE	Task specific improving actions based on interviews
DEPARTMENT	KONE MP
UPDATED	~2017

		Manageral team					Supply team		Engineering Team											
STEP	Activity	Project Manager	Operation Manager	Jump Platform Manager	Jump Team Manager	Jump Team Leader	Supply Manager	Project Engineer	Engineering Specialist	Tender manager/engineer	Layout Engineer	Layout Checker	Mechanical Engineer (Cathead)	Mechanical Engineer (IT Platform)	Mechanical Engineer (Pro Deck)	Mechanical Engineer (Other Mech)	Mechanical Engineer (Car Sling)	Mechanical Engineer (Cwt Frame)	Mechanical Engineer (Pit Plate)	Electrification Engineer
1	TENDER																			
1,1	Complete Calculation tool			A/R			C/I	C/I		I										
1,2	Response of installation training			A/R	I	I	I	I	A/R											
1,3	Solve pricing challenges in US			A/R						C/I										
1,4	Technical calculations			A/R	I	I	I	I		I	R	C/I	I	I	I	I	I	I	I	I
1,5	Obtain real prices from orders						A/R	A/R		I										
1,6	Improve marketing	A		R/C	I	I	I	I	C/I	I										
1,7	Improve sales know-how	C		A/R	C	C			C	R/C										
2	LAYOUT																			
2,1	Improve engineering tools			R	R	R			R											
2,2	Complete Manuals			R					R											
2,3	Complete Master lo's			C/I	I	I					R	I	I	I	I	I	I	I	I	I
2,4	Improve the information retrieval from PDM	I	R	R	R	R	I	I	I	I	I	I	I	I	I	I	I	I	I	I
2,5	Improve Main Date List			R			I	I	R		I	I								
2,6	Improve the information flow	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R
2,7	Improve the calculation tool (Eng calc)			R	R				R		R	R/I								

Table 9. Updated RACI matrix based on jumplift engineering actions.

RACI matrix

R: Responsible
A: Accountable
C: Consult
I: Inform

Project: Jumplift engineering actions

PROCEDURE	Task related RACI matrix
DEPARTMENT	KONE MP
UPDATED	~2017

		Manageral team			Supply team	Engineering Team												
STEP	Activity	Jump Platform Manager	Jump Team Manager	Jump Team Leader	Supply Manager	Project Engineer	Engineering Specialist	Tender Manager/Engineer	Layout Engineer	Layout Checker	Mechanical Engineer (Cathead)	Mechanical Engineer (IT Platform)	Mechanical Engineer (Pro Deck)	Mechanical Engineer (Other Mech + Pit plate)	Mechanical Engineer (Car Sling)	Mechanical Engineer (Cwt Frame)	Electrification Engineer	Listing Engineer
1	**Layout Engineering (Jump&Final)**																	
1,1	Layout Start Up	I	C/I	C/I	A/R	R	C/I	C	C/I									
1,2	Resources are allocated and SAP-opened		I	I	A/R	R	C/I		I									
1,3	Component pre-selection				A/R	R		C	C/I									
1,4	Technical calculations								A/R									
1,5	Layout Drawings								A/R									
1,6	Main Data List								A/R									
1,7	Cuw List								A/R									
1,8	Dev List				I	I			A/R									
1,9	Layout Engineering Check								A/R	R								
2	Save Drawing To Vari PDM				I	I			A/R									
2,1	Confirm SAP Activity				I	I			A/R									
1	**JL Cat Head/Drawing number xxxxxxx**																	
1,1	JL Cathead Start Up	C			A/R	R	C		I		I							
1,2	Select & Define charasteristics				I	I			C		A/R							
1,3	Define architechture	C			I	I		C	C		A/R							
1,4	Define Interfaces	C			I	I		C	C		A/R							
1,5	Create 3D model										A/R							
1,6	Get KM Numbers & add metadata										A/R							
1,7	Define Delivery Structure				A/R	R		C/I										
1,8	Cteate Delivery Documents				A/R	R		C/I										
1,9	Engineer your Design										A/R							
2	Finalize 3D model										A/R							
2,1	Create Manufacturin Drawings										A/R							
2,2	Synchronice										A/R							
2,3	Add Attributes and Charasteristics										A/R							
2,4	Finalize 3D model										A/R							
2,5	Create Materials and Classes										A/R							
2,6	Verify correctness								C/I		A/R							
2,7	Save 3D model										A/R							
2,8	Synchronize										A/R							
2,9	Release materials				I	I					A/R							

One of the main improving point is clarify how to get near to the customer in the early phase. Normally construction is already started in tender phase and for the final building requirements are difficult to affect afterwards and that causes lot of challenges for the complex jumplift engineering. This is basically the reason why the jumplift product is out of the existing jumplift product range. This affect the snowball effect for existing engineering tools and manuals. Lead time for engineering increases and similar challenges are also for tender and supply team. Unique design is complex in pricing and delivery point of view.

Existing templates in previous projects can be used as a base but still lot of manual clarification work have to be done. For the Kone if the exiting jumplift product inside the range are possible to use deliveries can be manage successful.

Another important topic is to clarify how to manage information flow in proper way. In the interviews and all the levels of different employees appeared the same issue with communication. Collaboration between the tender and supply phase should be improved. Capability to freeze the design in tender phase is essential. Freezing the design in early phase is major corporation of sales, tender and engineering. If there are possibility to solve and tackle main clarifications in early phase manage delivery stage normally much easier. If all the needed participants are involved in first stage start up meeting can substantive issues be agreed together. With the unique orders what agreed in tender phase and what is reality in order phase doesn't some cases match. That is the reason why communication between whole chain from customer and supplier should be improved.

Communication should also be improved inside the company. There are tasks were response of the activity is split for several recourse. This affect confusing who is the really the accountable and contradictory information may appear.

The RACI-matrixes in response and accountable sense are useful to illustrate where the main lacks are the distribution of the tasks can be clarify to be more transparent and straightforward. Important point is that when the design is freeze in early phase tasks are clear for all and the work can be performed as it stands in standard process model. Challenging part are unique products where existing process model cannot be used.

Jumplift engineering actions RACI-matrix is more straightforward if it is compared to jumplift improving actions RACI-matrix. The engineering process is clear and tasks for the users are visible. In the order phase supply manager is response of the delivery process together with supply engineer. Supply team leads and opens engineering activities for certain engineer and engineer is then response of the activity. If there are any support needed, engineer who is response the activity will highlight errors and send support request for needed persons. If the clarification can be handled quickly there are no need to open support activities but if dealing with complex issues needed clarification actions have to open by

supply manager. The principle is same with all the engineering levels. When the certain engineer has completed the task the next phase is to release materials, close the open activities and inform the necessary parties.

Above description was based on standard jumplift product delivery. If the jumplift product is totally new and there are no reference as a base the engineering activity process shown in table 9 will change. In case of unique jumplift product lot of approvals and consultation work have to be done in engineering phase. When dealing with new unique jumplift product main contacts for approvals are jumplift platform manager and jumplift specialist. Jumplift engineering team have to work close to each other and make collaboration during the research and development process. The base is first to get fit the layout in existing building (both final lift and jumplift) and afterwards continue to mechanical and electrical engineering phase. Unique jumplift products change the existing process model and it is highly time and money consuming.

As shown in table 8 if the standard jumplift product range models cannot be used there appears lot of lacks. Jumplift team have to manage with insufficient instructions, calculation tools and manuals. Positive point of out of range products are that those increase know-how in all the levels and gives benefits to create new and something what can be used for overall product improving work. As customer side situation is not easy. Normally customers are not willing to pay extra and delays from deliveries are not acceptable.

6.6 Novelty value of the results

For the Kone internal use the results are valuable. There are two important aspects of the results. The first one is that now the jumplift engineering process is described in transparent format and the main improving actions are identified. The second one is that company has now capability and understanding how to perform improving actions for the processes by using RACI-matrix user interfaces.

At this point concrete value of the results are difficult to estimate. It will be part of further studies to get measured data for the savings and the results if the new Jumplift engineering process model is perform better than the previous one. Base point is promising because the needed improving actions are identified.

6.7 Generalization and utilization of the results

Results can be utilized in jumplift engineering process improvement. Results are transparent and further actions to manage improvements are easy to implement. As noted user interfaces to utilize RACI-matrixes are simple to perform and measurements can easily be done for the cases that consist of different users and sufficient number of activities. Probably RACI-matrixes will be used in other elevator product improving actions of Kone.

6.8 Topics for future research

Based on this study there are several issues that should be clarified for further studies:

- Improve instruction and manual
- Improve calculations tools
- Improve real pricing know-how between supply and tender phase to achieve accurate price for future cases
- Improve product quality
- Improve communication

Jumplift products are complex products and no matter if the product is inside the standard product range it still requires lot resources and time. Managing all the issues shown above are not possible during the one year or two but at least tackling the one is proper starting point. With unique products tools follows behind but communication can be improved.

*For further studies proper base for improving is to organize brainstorming meeting with the jumplift team members and figure out commonly how to tackle main errors. Continuous improving means open communication in all the levels and valid opinion appears in all the participants as already shown in this study. The engineering process itself should be keep simple and clear but RACI-matrix can be used every now and then to identify latest situation. If something changes or has been solved RACI-matrixes are easy to update.

7 CONCLUSION

The aim of this study is to improve existing jumplift engineering process. For to achieve the goal basic theory of process improvement and RACI-matrixes is used in this paper. The main lacks of the jumplift engineering tasks are identified and the jumplift engineering process is compiled to transparent format. The main improving points are with the new unique jumplift products and it will take several years to tackle all the existing blocks. The most useful information is that blocks are now identified.

The study shows that RACI-matrixes are proper user interface to utilize in process improvement measurements. Creation and use of the RACI-matrixes is simple and user-friendly. Depending of the target matrixes can be created either based on interviews or other relevant data. The results are not reliable if it is carried out only by one person. The results are needed to be checked commonly several times and final decision have to be agreed together.

Weakness of the RACI-matrix is that it only recognize the problems, highlight the different roles of the activities but not give direct answers to solve all the issues. There are number of different programs available inside the company and one of the issue is that delivery people and engineering people are not using the same ones. If something has solved in engineering phase takes it many steps to get same data for delivery programs, manufacturing programs and tender programs. Still the main issues can be found with the communication, by managing that properly helps it working in every level.

RACI-matrixes can be properly used to develop and improve processes in different industrial areas. If the current situation of the process is confusing RACI-matrix gives linear and simple way to analyze the existing situation of the process. This enables to recognize the basics and furthermore make more exact research.

LIST OF REFERENCES

Bevilacqua, M., Ciarapica, F. & Giacchetta, G. 2009. Business process reengineering of a supply chain and a traceability system: A case study. Journal of Food Engineering, 93: 1. pp. 13-22.

Biazzo, S. 2000. Approaches to business process analysis: a review. Business Process Management Journal, 6: 2. pp. 99-112.

Bourne, M., Mills, J., Wilcox, M., Neely, A. & Platts, K. 2000. Designing, implementing and updating performance measurement systems. International journal of operations & production management, 20: 7. pp. 754-771.

Cabanillas, C., Resinas, M. & Ruiz-Cortes, A. 2012. Automated resource assignment in BPMN models using RACI matrices. On the Move to Meaningful Internet Systems: OTM 2012. Springer. pp. 56-73.

Cabanillas, C., Resinas, M. & Ruiz-Cortez, A. 2011. Mixing RASCI Matrices and BPMN Together for Responsibility Management. VII Jornadas en Ciencia e Ingeniería de Servicios JCIS 2011. 1. pp. 167-180.

Chen, W., Xie, S.S., Zeng, F. & Li, B. 2011. A new process knowledge representation approach using parameter flow chart. Computers in Industry, 62: 1. pp. 9-22.

Davenport, T.H. 2013. Process innovation: reengineering work through information technology. United States of America: Harvard Business Press. 352 pp. 27-31.

Dumas, M., Van Der Aalst, Wil M & Ter Hofstede, A.H. 2005. Process-aware information systems: bridging people and software through process technology. pp. 3-403.

Engineering Instruction. 2017. Kone Jumplift Engineering Instruction. Version D. pp. 6-63.

Georgakopoulos, D., Hornick, M. & Sheth, A. 1995. An overview of workflow management: From process modeling to workflow automation infrastructure. Distributed and parallel Databases, 3: 2. pp. 119-153.

Grigori, D., Casati, F., Castellanos, M., Dayal, U., Sayal, M. & Shan, M. 2004. Business process intelligence. Computers in Industry, 53: 3. pp. 321-343.

Herzog, N.V., Tonchia, S. & Polajnar, A. 2009. Linkages between manufacturing strategy, benchmarking, performance measurement and business process reengineering. Computers & Industrial Engineering, 57: 3. pp. 963-975.

Jacka, J.M. & Keller, P.J. 2009. Business Process Mapping: Workbook. Wiley Online Library, New Jersey. 319 p.

Johansson, V. 2007. Prosessien kuvaaminen. Suomen tieteellisen kirjastoseuran julkaisuja 2007. pp. 27-35.

Laamanen, K. & Tinnilä, M. 1998. Terms and concepts in business process management. Helsinki, Federation of Finnish Metal, Engineering and Electrotechnical Industries, 55. pp. 5-150.

Laitinen, E. K. 1998. Yritystoiminnan uudet mittarit. Helsinki, Kauppakaari. 360 p.

Lönnqvist, A. 2002. Suorituskyvyn mittauksen käyttö suomalaisissa yrityksissä. Lisensiaatintyö. Tampereen teknillinen korkeakoulu. Tuotantotalouden osasto/Teollisuustalous. Helsinki: Edita. 147 p.

Lönnqvist, A. & Mettänen, P. 2003. Suorituskyvyn mittaaminen - tunnusluvut asiantuntijaorganisaation johtamisvälineenä. Helsinki: Edita. 147 p.

Martinsuo, M. & Blomqvist, M. 2010. Process modeling for improved performance. Aalto University School of Science and Technology, Department of Industrial Engineering and Management Teaching Material, 1. pp. 1-25.

Milani, F., Dumas, M., Ahmed, N. & Matulevicius, R. 2016. Modelling families of business process variants: A decomposition driven method. Information Systems, 56, pp. 55-72.

Neely, A. 1999. The performance measurement revolution: why now and what next? International journal of operations & production management, 19: 2. pp. 205-228.

Neely, A., Mills, J., Platts, K., Richards, H., Gregory, M., Bourne, M. & Kennerley, M. 2000. Performance measurement system design: developing and testing a process-based approach. International Journal of Operations & Production Management, 20: 10. pp. 1119-1145.

Nesbitt, T.E. 1993. Flowcharting business processes. Quality, 32: 3. pp. 34.

Niermeyer, R. & Seyffert, M. 2011. Motivation. Haufe-Lexware. 4. Edition. Haufe. pp. 5-124.

Pisano, G. P. 1997. The development factory: unlocking the potential of process innovation. Harvard Business Press. pp. 1-94.

Quality document. 2016. Kone Jumplift Process. Version C. QD-02607. pp. 2-24.

Rantanen, H. 2005. Tuottavuus suorituskyvyn analysoinnin kentässä. Lappeenrannan teknillinen yliopisto, Lahden yksikkö. pp. 1-35.

Robson, I. 2004. From process measurement to performance improvement. Business Process Management Journal, 10: 5. pp. 510-521.

Smith, M. L., Erwin, J. & Diaferio, S. 2007. Role & responsibility charting (RACI). [Referred: 10.3.2016]. Available: http://www.pmforum.org/library/tips/pdf_files/RACI_R_Web3_1.pdf

Strauss, A. & Corbin, J. 1990. Basics of qualitative research. Newbury Park, CA: Sage. pp. 1-14.

Tenhunen, J. & Ukko, J. 2003. Yritysyhteistyö ja laskentatoimi päijäthämäläisissä yrityksissä. Lappeenrannan teknillinen yliopisto, Lahden yksikkö, LIITU - Liiketoiminnan tutkimusyksikkö, tutkimusraportti 6, Lahti. pp. 1-64.

Ukko, J., Karhu, J., Pekkola, S., Rantanen, H. & Tenhunen, J. 2007. Suorituskyky nousuun. Hyödynnä henkilöstösi osaaminen.Helsinki. pp. 1-64.

Ungan, M. 2006. Towards a better understanding of process documentation. The TQM Magazine, 18: 4. pp. 400-409.

Vergidis, K., Tiwari, A. & Majeed, B. 2008. Business process analysis and optimization: Beyond reengineering. Systems, Man, and Cybernetics, Part C: Applications and Reviews. IEEE Transactions on, 38: 1. p. 69

RACI matrix based on jumplift improving actions.

RACI matrix

R:	Responsible
A:	Accountable
C:	Consult
I:	Inform

Task: Jump-lift improving actions

PROCEDURE	Task specific improving actions based on interviews
DEPARTMENT	KONE MP
UPDATED	~2017

		Manageral team					Supply team		Engineering Team											
STEP	Activity	Project Manager	Operation Manager	Jump Platform Manager	Jump Team Manager	Jump Team Leader	Supply Manager	Project Engineer	Engineering Specialist	Tender manager/engineer	Layout Engineer	Layout Checker	Mechanical Engineer (Cathead)	Mechanical Engineer (IT Platform)	Mechanical Engineer (Pro Deck)	Mechanical Engineer (Other Mech)	Mechanical Engineer (Car Sling)	Mechanical Engineer (Cwt Frame)	Mechanical Engineer (Pit Plate)	Electrification Engineer
1	TENDER																			
1.1	Complete Calculation tool			A/R			C/I	C/I		I										
1.2	Response of installation training			A/R	I	I	I	I	A/R											
1.3	Solve pricing challenges in US			A/R						C/I										
1.4	Technical calculations			A/R	I	I	I	I		I	R	C/I	I	I	I	I	I	I	I	I
1.5	Obtain real prices from orders						A/R	A/R		I										
1.6	Improve marketing	A		R/C	I	I	I	I	C/I	I										
1.7	Improve sales know-how	C		A/R	C	C			C	R/C										
2	LAYOUT																			
2.1	Improve engineering tools			R	R	R			R											
2.2	Complete Manuals			R					R											
2.3	Complete Master lo's			C/I	I	I					R	I	I	I	I	I	I	I	I	I
2.4	Improve the information retrieval from PDM	I	R	R	R	R	I	I	I	I	I	I	I	I	I	I	I	I	I	I
2.5	Improve Main Date List			R			I	I	R		I	I								
2.6	Improve the information flow	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R
2.7	Improve the calculation tool (Eng calc)			R	R				R		R	R/I								
3	SUPPLY																			
3.1	Improve the documents approval			A/R	I	I	I	I	R/C	I	I	I	I	I	I	I	I	I	I	I
3.2	Improve Main Date List			R/C	C	C	I	I	C		C/I	I	I	I	I	I	I	I	I	I
3.3	Improve the China quality			A/R			I	I	R	I										
3.4	Ensure (freeze) tender/order			A/R	C	C	I	I	R/C	A/R	C									
3.5	Improve the information flow	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R

4	**ENGINEERING SPECIALIST**																			
4.1	Improve the OSG (critical component)			A/R	I	I	I	I	A/R	I	I	I	I	I	I	I	I	I	I	I
4.2	Update the manuals			A/R	I	I	I	I	R/C	I	I	I	I	I	I	I	I	I	I	I
4.3	Responsitiveness to feedbaks			A/R	I	I			R		R/C	I	I	I	I	I	I	I	I	I
4.4	Ensure how to be near the builder (early phase)			C/I	R/C	R/C			C	A/R										
4.5	Increase competence in every level			A/R	A/R				A/R											
4.6	Ensure how to get the product known	A/R		A/R	C/I	C/I			C	C/I										
4.7	Improve the information flow	R	R	A/R	A/R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R
5	**MECHANICS**																			
5.1	Ensure that tender/Order are the same			C			A/R		C	A/R	C/I		I	I	I	I	I	I	I	I
5.2	Take mechanics part of tender start ups			C	C				C	A/R	C		I	I	I	I	I	I	I	I
5.3	Improve the information flow	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R
5.4	Improve design tools			A/R					R/C			C/I	C/I	C/I	C/I	C/I	C/I	C/I	C/I	C/I
5.5	Improve the approvall			A/R			I	I	R/C			I	I	I	I	I	I	I	I	I
6	**LISTING**																			
6.1	Obtain KM number for all the components			A/R	C	C	I	I	I	I	C/I	I	I	I	I	I	I	I	I	I
6.2	Obtain equal numbers between the suppliers			A/R	C	C	C/I	I	C/I	I	I	I	I	I	I	I	I	I	I	I
6.3	Improve Main Date List			A/R	R	R/C			C		C/I	C/I	C/I	C/I	C/I	C/I	C/I	C/I	C/I	C/I
6.4	Improve component selection (Final/Jump)			A/R	R/C	R/C	I	I	R/C	I	C/I	C/I	C/I	C/I	C/I	C/I	C/I	C/I	C/I	C/I
7	**PROCESS OPERATIONS**																			
7.1	Stay on schedules			C	C		A/R	A/R	R/C		R/C		R/C	R/C	R/C	R/C	R/C	R/C	R/C	R/C
7.2	Update the QD	I	I	A/R	I	I	I	I	R/C	I	I	I	I	I	I	I	I	I	I	I
7.3	To get more labor to work	A		A/R	R/C	R/C			C/I		I	I	I	I	I	I	I	I	I	I
7.4	Complete Manuals			A/R	C/I	C/I	I	I	A/R	I	I	I	I	I	I	I	I	I	I	I
7.5	Add Attributes and Charasteristics			A/R	C	C			C/I	I	I	I	I	I	I	I	I	I	I	I
7.6	Separate the design and developing team			C/I	A/R	R	I	I	I		I	I	I	I	I	I	I	I	I	I
8	**PROJECT MANAGEMENT**																			
8.1	Stay on schedules			C	C	C	A/R	A/R	C		C		C	C	C	C	C	C	C	C
8.2	Improve the documents approval			A/R	C	C	I	I	A/R	I	C/I	I	I	I	I	I	I	I	I	I
8.3	Reduce the costs			A/R			C/I	C/I	C/I	C/I	C/I	I	C	C	C	C	C	C	C	C
8.4	Determine the benefits			A/R	R/C	R/C	C	C	I	C/I	I	I	I	I	I	I	I	I	I	I
8.5	Offer training and support			A/R	R/C	R/C	I	I	A/R	I	C/I	C/I	C/I	C/I	C/I	C/I	C/I	C/I	C/I	C/I

RACI matrix based on jumplift engineering actions.

RACI matrix

R: Responsible
A: Accountable
C: Consult
I: Inform

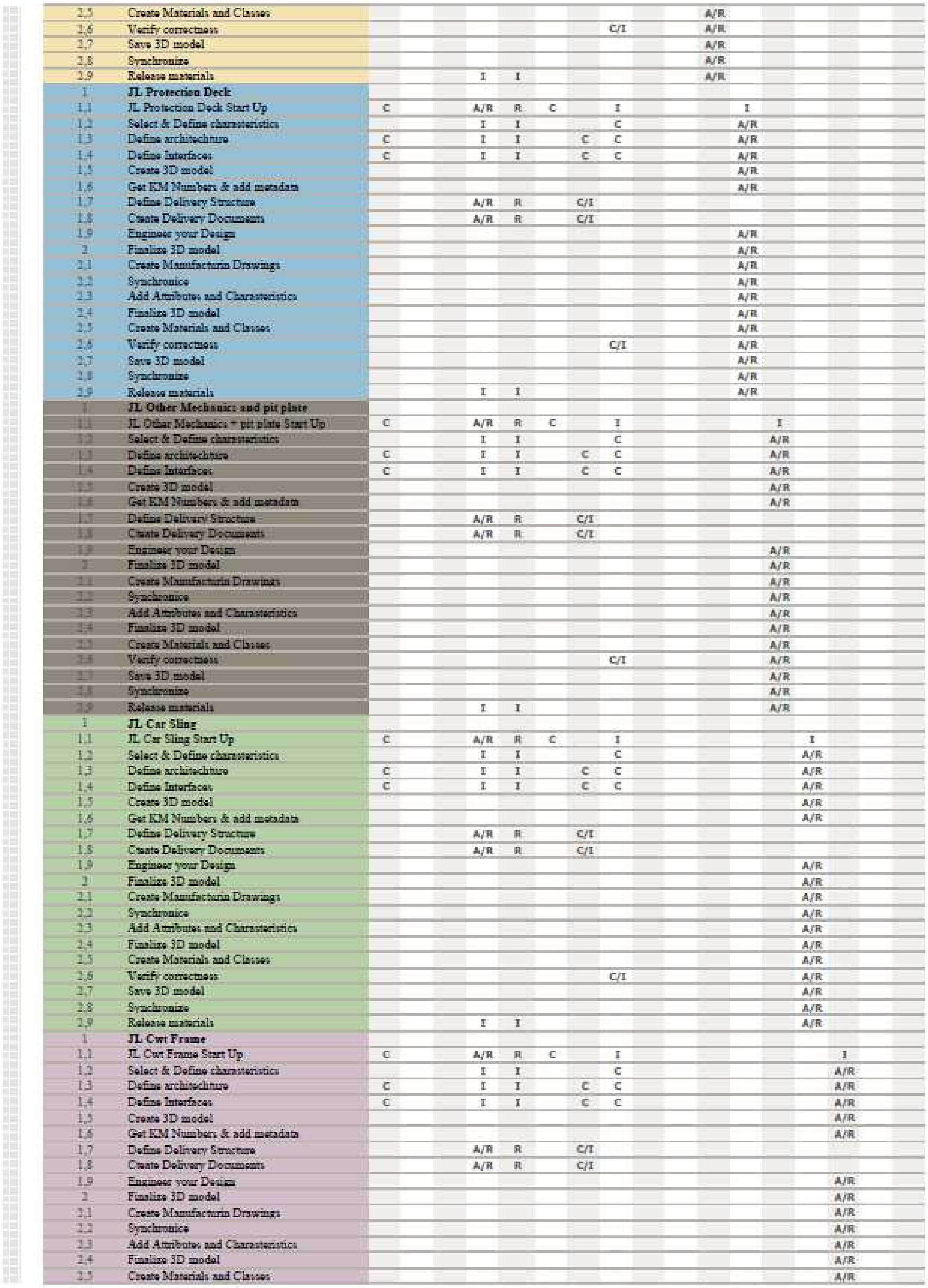
Project: Jumplift engineering actions

PROCEDURE	Task related RACI matrix
DEPARTMENT	KONE MP
UPDATED	~2017

		Manageral team			Supply team Engineering Team													
STEP	Activity	Jump Platform Manager	Jump Team Manager	Jump Team Leader	Supply Manager	Project Engineer	Engineering Specialist	Tender Manager/Engineer	Layout Engineer	Layout Checker	Mechanical Engineer (Cathead)	Mechanical Engineer (IT Platform)	Mechanical Engineer (Pro Deck)	Mechanical Engineer (Other Mech + Pit plate)	Mechanical Engineer (Car Sling)	Mechanical Engineer (Cwt Frame)	Electrification Engineer	Listing Engineer
1	**Layout Engineering (Jump&Final)**																	
1.1	Layout Start Up	I	C/I	C/I	A/R	R	C/I	C	C/I									
1.2	Resources are allocated and SAP-opened		I	I	A/R	R	C/I		I									
1.3	Component pre-selection				A/R	R		C	C/I									
1.4	Technical calculations								A/R									
1.5	Layout Drawings								A/R									
1.6	Main Data List								A/R									
1.7	Cwr List								A/R									
1.8	Dwr List				I	I			A/R									
1.9	Layout Engineering Check								A/R	R								
2	Save Drawing To Vari PDM				I	I			A/R									
2.1	Confirm SAP Activity				I	I			A/R									
1	**JL Cat Head/Drawing number xxxxxxx**																	
1.1	JL Cathead Start Up	C			A/R	R	C		I		I							
1.2	Select & Define charasteristics				I	I			C		A/R							
1.3	Define architechture	C			I	I		C	C		A/R							
1.4	Define Interfaces	C			I	I		C	C		A/R							
1.5	Create 3D model										A/R							
1.6	Get KM Numbers & add metadata										A/R							
1.7	Define Delivery Structure				A/R	R		C/I										
1.8	Create Delivery Documents				A/R	R		C/I										
1.9	Engineer your Design										A/R							
2	Finalize 3D model										A/R							
2.1	Create Manufacturin Drawings										A/R							
2.2	Synchronice										A/R							
2.3	Add Attributes and Charasteristics										A/R							
2.4	Finalize 3D model										A/R							
2.5	Create Materials and Classes										A/R							
2.6	Verify correctness								C/I		A/R							
2.7	Save 3D model										A/R							
2.8	Synchronize										A/R							
2.9	Release materials				I	I					A/R							
1	**JL IT-Platform**																	
1.1	JL IT-Platform Start Up	C			A/R	R	C		I			I						
1.2	Select & Define charasteristics				I	I			C			A/R						
1.3	Define architechture	C			I	I		C	C			A/R						
1.4	Define Interfaces	C			I	I		C	C			A/R						
1.5	Create 3D model											A/R						
1.6	Get KM Numbers & add metadata											A/R						
1.7	Define Delivery Structure				A/R	R		C/I										
1.8	Create Delivery Documents				A/R	R		C/I										
1.9	Engineer your Design											A/R						
2	Finalize 3D model											A/R						
2.1	Create Manufacturin Drawings											A/R						
2.2	Synchronice											A/R						
2.3	Add Attributes and Charasteristics											A/R						
2.4	Finalize 3D model											A/R						

APPENDIX II, 2

RACI matrix based on jumplift engineering actions.



2,5	Create Materials and Classes											A/R						
2,6	Verify correctness								C/I			A/R						
2,7	Save 3D model											A/R						
2,8	Synchronize											A/R						
2,9	Release materials				I	I						A/R						
1	**JL Protection Deck**																	
1,1	JL Protection Deck Start Up	C			A/R	R	C		I				I					
1,2	Select & Define characteristics				I	I			C				A/R					
1,3	Define architechture	C			I	I		C	C				A/R					
1,4	Define Interfaces	C			I	I		C	C				A/R					
1,5	Create 3D model												A/R					
1,6	Get KM Numbers & add metadata												A/R					
1,7	Define Delivery Structure				A/R	R		C/I										
1,8	Create Delivery Documents				A/R	R		C/I										
1,9	Engineer your Design												A/R					
2	Finalize 3D model												A/R					
2,1	Create Manufacturin Drawings												A/R					
2,2	Synchronice												A/R					
2,3	Add Attributes and Characteristics												A/R					
2,4	Finalize 3D model												A/R					
2,5	Create Materials and Classes												A/R					
2,6	Verify correctness								C/I				A/R					
2,7	Save 3D model												A/R					
2,8	Synchronize												A/R					
2,9	Release materials				I	I							A/R					
1	**JL Other Mechanics and pit plate**																	
1,1	JL Other Mechanics + pit plate Start Up	C			A/R	R	C		I					I				
1,2	Select & Define characteristics				I	I			C					A/R				
1,3	Define architechture	C			I	I		C	C					A/R				
1,4	Define Interfaces	C			I	I		C	C					A/R				
1,5	Create 3D model													A/R				
1,6	Get KM Numbers & add metadata													A/R				
1,7	Define Delivery Structure				A/R	R		C/I										
1,8	Create Delivery Documents				A/R	R		C/I										
1,9	Engineer your Design													A/R				
2	Finalize 3D model													A/R				
2,1	Create Manufacturin Drawings													A/R				
2,2	Synchronice													A/R				
2,3	Add Attributes and Characteristics													A/R				
2,4	Finalize 3D model													A/R				
2,5	Create Materials and Classes													A/R				
2,6	Verify correctness								C/I					A/R				
2,7	Save 3D model													A/R				
2,8	Synchronize													A/R				
2,9	Release materials				I	I								A/R				
1	**JL Car Sling**																	
1,1	JL Car Sling Start Up	C			A/R	R	C		I						I			
1,2	Select & Define characteristics				I	I			C						A/R			
1,3	Define architechture	C			I	I		C	C						A/R			
1,4	Define Interfaces	C			I	I		C	C						A/R			
1,5	Create 3D model														A/R			
1,6	Get KM Numbers & add metadata														A/R			
1,7	Define Delivery Structure				A/R	R		C/I										
1,8	Create Delivery Documents				A/R	R		C/I										
1,9	Engineer your Design														A/R			
2	Finalize 3D model														A/R			
2,1	Create Manufacturin Drawings														A/R			
2,2	Synchronice														A/R			
2,3	Add Attributes and Characteristics														A/R			
2,4	Finalize 3D model														A/R			
2,5	Create Materials and Classes														A/R			
2,6	Verify correctness								C/I						A/R			
2,7	Save 3D model														A/R			
2,8	Synchronize														A/R			
2,9	Release materials				I	I									A/R			
1	**JL Cwt Frame**																	
1,1	JL Cwt Frame Start Up	C			A/R	R	C		I							I		
1,2	Select & Define characteristics				I	I			C							A/R		
1,3	Define architechture	C			I	I		C	C							A/R		
1,4	Define Interfaces	C			I	I		C	C							A/R		
1,5	Create 3D model															A/R		
1,6	Get KM Numbers & add metadata															A/R		
1,7	Define Delivery Structure				A/R	R		C/I										
1,8	Create Delivery Documents				A/R	R		C/I										
1,9	Engineer your Design															A/R		
2	Finalize 3D model															A/R		
2,1	Create Manufacturin Drawings															A/R		
2,2	Synchronice															A/R		
2,3	Add Attributes and Characteristics															A/R		
2,4	Finalize 3D model															A/R		
2,5	Create Materials and Classes															A/R		

RACI matrix based on jumplift engineering actions

2.6	Verify correctness							C/I						A/R		
2.7	Save 3D model													A/R		
2.8	Synchronize													A/R		
2.9	Release materials				I	I								A/R		
1	**JL Electrification**															
1.1	JL Electrification Start Up	C			A/R	R	C	I							I	
1.2	Feasibility Check	C			I	I	C								A/R	
1.3	Define Interfaces	C			I	I	C								A/R	
1.4	Select & Define characteristics	C			I	I	C								A/R	
1.5	Engineer your Design														A/R	
1.6	Delivery Documents				I	I									A/R	
1.7	Verify correctness														A/R	
1.8	Release materials				I	I									A/R	
1.9	Create Material in SAP				A/R	R										I