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Ritva Ruostepuro

RESOURCE ALLOCATION IN PROJECT AND PORTFOLIO MANAGEMENT

– a case study of workload assessments

TURKU AMK
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MASTER'S THESIS | ABSTRACT

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RESOURCE ALLOCATION IN PROJECT AND PORTFOLIO MANAGEMENT

- a case study of workload assessments

The client company wants to develop its project portfolio management and the Thinking Portfolio® tool, which was recently introduced in the company. The company's supply chain management team was interviewed about acute development targets. The aim of the present Master's thesis is to explore the accuracy of the current workload estimates in the client company. In addition, the factors that affect the accuracy of estimates are studied.

The literature review briefly explains the importance of resourcing in the project portfolio management and strategy implementation. In addition, the methods for estimating the workload and the duration of project activities are presented.

A sample of four active projects was selected for the study. The selected projects have a project management tool in active use. The resource assessment required by the project was recorded on a monthly basis. The actual workload of the projects was monitored for one month and compared with the planned workload. Factors influencing the evaluations were clarified through semi-structured interviews with the team members of the projects selected for follow-up.

The realized workload of the projects monitored in the study was about 30 per cent more than the planned workload. Possible causes are e.g. the incorrect assessment of the workload and changes in the implementation schedule. Based on the interviews, the development targets were related to clarifying the responsibilities and improving transparency.

Since the portfolio management tool was relatively new to the company, the development in the tool usage was re-examined after six months. The monitoring revealed that, partly, the realized resources corresponded well the estimated ones. On the other hand, in some projects the difference between the estimated resources and the actual implementation was relatively large.

KEYWORDS:

Project portfolio, resource allocation, activity duration estimation

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RESURSOINTI PROJEKTIEN JA PROJEKTIPORTFOLION HALLINNASSA

- tapaustutkimus työkuorman arvioinnista

Toimeksiantajayritys haluaa kehittää projektiportfolion hallintaa ja hiljattain yrityksessä käyttöönotettua Thinking Portfolio® -työkalua. Yrityksen toimitusketjun johtoryhmää haastateltiin akuuttien kehityskohteiden hahmottamiseksi, jolloin resursoinnin ja resurssien käytön tehokas seuranta ja läpinäkyvyys osoittautuivat yhdeksi isoimmista haasteista. Opinnäytetyön tavoitteeksi valikoitui selvitys toimeksiantajayrityksen tämän hetkisten työkuorma-arvioiden paikkansapitävyydestä. Lisäksi tutkittiin arviointien tarkkuuteen vaikuttavia tekijöitä.

Kirjallisuuskatsauksessa selvitetään lyhyesti resursoinnin tärkeyttä projektiportfolion hallinnassa ja strategian toteuttamisessa. Lisäksi esitellään yleisimpiä menetelmiä projektiaktiviteettien työkuorman ja toteutuksen keston arvioimiseksi.

Tutkimukseen valittiin neljän käynnissä olevaa projektia. Valituilla projekteilla oli aktiivisessa käytössä projektihallinnan työkalu, johon projektien arvioitu resurssitarve raportoitiin kuukausikohtaisesti. Projektien työkuorman toteumaa seurattiin yhden kuukauden ajan ja verrattiin suunniteltuun työkuormaan. Arviointeihin vaikuttavia tekijöitä selvitettiin seurantaan valittujen projektien jäsenten puolistrukturoiduilla haastatteluilla.

Tutkimuksessa seurattujen projektien toteutunut työkuorma oli n. 30 % suurempi kuin suunniteltu. Mahdollisia syitä olivat mm. työkuorman virheellinen arviointi ja muutokset toteutusaikataulussa. Haastattelujen perusteella kehityskohteet liittyivät vastuiden selventämiseen ja läpinäkyvyyden parantamiseen.

Koska portfolion hallinnan työkalu oli yrityksen käytössä suhteellisen uusi, kehitystä työkalun käytössä haluttiin seurata vielä n. puoli vuotta ensimmäisen tutkimuksen jälkeen. Seurannassa havaittiin, että toteutuneet resurssit vastasivat osittain arvioituja. Toisaalta osassa projekteja ero arvioinnin ja toteuman välillä oli suhteellisen suuri.

ASIASANAT:

Projektiportfolion hallinta, resursointi, työkuorman määrittäminen

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LIST OF ABBREVIATIONS

PPM	Project portfolio management
PMO	Project management office
RAP	Resource allocation process
WBS	Work breakdown structure
TO	Technical office
PLM	Product Lifecycle Management
EHS	Environment, health and safety
CATS	Cross-application time sheet
SAP	Systeme, Anwendungen und Produkte
COCOMO	Constructive cost model
ACAP	Analyst capability
PCAP	Programmer capability
PCON	Personnel continuity
APEX	Applications experience
PLEX	Platform experience and language
LTEX	Tool experience

1 INTRODUCTION

1.1 The case company and background

The case company is a Finland-based pharmaceutical company which operates worldwide. At 2020 the company's the net sales was 1.08 billion euros and it employed over 3 300 persons across the world. Strategical focus areas are

- Quality and safety
- Competitive product portfolio
- Strong corporate culture of working together
- Partnerships
- Productivity and flexibility

The study concerned organization of Global Operations which is located in six sites in Finland. The organization has a strong development culture aiming to find high-quality and cost-efficient practices.

The thesis subject raised from the need to develop practices related to recently introduced project portfolio management tool, Thinking Portfolio®. Initially the top management of the case company's Global Operations was interviewed to find out expectations and wishes set for the management tool. The main issue raised from the several interviews was related to resource management of projects and project-like daily operations. Need to develop resource management process raised a question about the current status of the human resource allocation.

1.2 The purpose of the study

The purpose of the study was to investigate accuracy of the resource estimations at current state and find out the supportive practices for resourcing trough-out the project lifecycle. Estimations of project resource demands rely mainly to the knowledge gained from the previous projects and expert assessments. Therefore, it was find out to be crucial to investigate the status of the current evaluations.

Since Thinking Portfolio® was already implemented and resource planning feature taken to use at some extent, the existing data was exploited for this study. The research questions were lined as follows:

> "What is the level of accuracy of activity duration estimations versus realized work load?"
>
> "What affects on the accuracy of activity duration estimations?"

The study was carried out as semi-structured interviews and utilizing hour recordings and activity duration estimations recorded to portfolio management tool.

2 LITERATURE REVIEW

The project portfolio management (PPM) differs fundamentally from the project and process management. It focuses on the selecting and managing the right projects at the right time. At the best the project portfolio management adds in business value by aligning the projects with company's strategy, developing combined actions between the projects and making the best out of the scarce resources. (Oltmann 2008)

2.1 Benefits of project portfolio management

Benefits of the PMM are described by several authors. Shortly they can be summarized as follows (Verzuh 2016, 451)

- Balancing overall risks of the portfolio
- To implement company's strategy by focusing on the right projects with strategic fit
- Allocating the resources across the portfolio

One of the main benefits and tasks is linked to the resource allocation. PPM enables resource division across the portfolio in the way that the high priority projects can be fully resourced to avoid shortages and resource-related constraints. In addition, PPM is connected to improved agility and flexibility to respond changed environment and reallocate the recourses according to the prioritization. (Lock & Wagner 2019, 25–27)

Well-maintained PPM aligns the projects according to the strategic goals and improves understanding of future needs. Future resource requirements in long and short terms can be identified by the managers across the portfolio. Improved understanding allows the more detailed planning of staff capabilities and skills development and recruitment. (Lock & Wagner 2019, 25–27)

Other benefits include improved monitoring of the work and transparency in project approval and greater visibility to improve governance and decision-making. Formal prioritization and approval process made by a committee prevents funding decisions, which are not challenged and reviewed. A transparent process helps to understand business priorities and strategic goals across the organization. Unified view of the portfolio status helps to ensure that the approved projects deliver planned benefits. On

the other hand, potential problems can be identified earlier and, therefore, corrective actions or project termination decisions can be taken timely to avoid increased expenses. The review process outlines the project value relative to the cost and insufficient and unimportant projects can be rejected or added to the backlog. Criteria for consistent evaluation reduces ambiguity in project authorization and eases the comparison between the projects. In addition, deployment practises can be evolved due consistent data delivery and thus evaluation of the practises across the portfolio. (Lock & Wagner 2019, 25–27; Martinsuo 2013)

Since the resources are often limited, PPM role is to execute company's strategies and goals. PPM needs to have an authority to select the projects align with strategy and reject the one's which don't. Figure 1 present the PPM as system where up-to-date data about the on-going projects and needed resources, are required to handle complexity, ranking the projects and balancing the portfolio. (Verzuh 2016, 452)

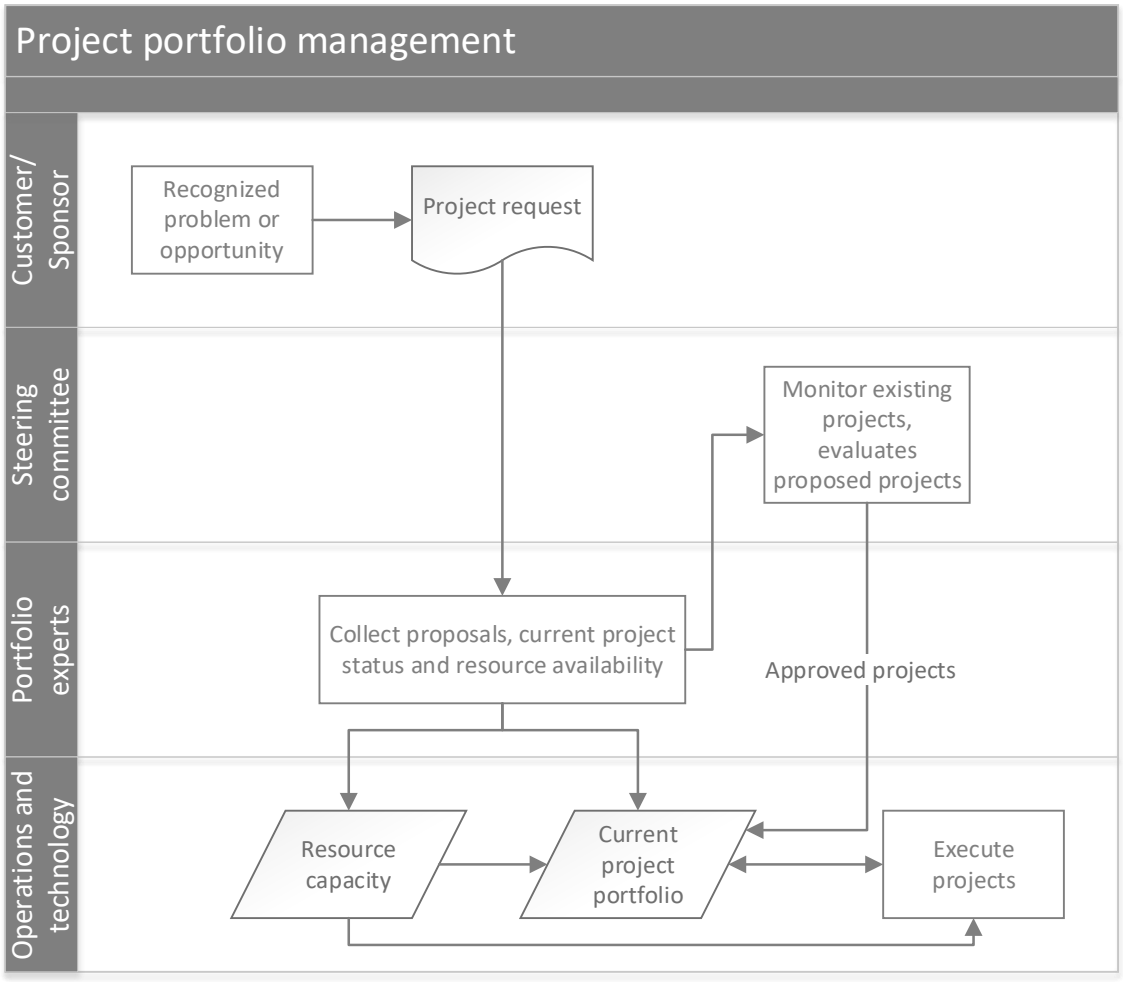

Figure 1. Project portfolio management as a system (adapted from Verzuh 2016).

2.2 Project portfolio management and resource allocation

Kerzner (2019) divides usable resources into four categories: organizational resources, non-human resources, financial resources and human resources. Organizational resources gives a structure for all the other resources. It includes such systems as project management office, reporting structure, planning and scheduling, controlling and supportive operations. Non-human resources include a plant(s), equipment, sourcing and distribution networks; and availability of raw materials. Financial resources are related to company's economical capability such as credit rating, cash generating

capability and relationships with investors. Companies with good financial resources are capable to borrow money with lower rates or fund growth project out of the cash flow.

Human resources consist of a skills, capabilities, knowledge and a talent of a company's employees. The top management is responsible for defining the strategy which is accepted by the shareholders. Decision-making ability is the main utility of senior management which can be exploited in the project planning phase to avoid re-planning efforts. Senior management also defines its own managerial values. Therefore, the change in the senior management can lead to quick changes in the management methodology. Management of core competencies relies on a middle and lower management. Developing a well operative core organization benefits the process and project execution. (Kerzner 2019, 15–17)

Resource managing needs a systematic and proactive approach for allocation and re-allocation of the resources. PMO aligns project efforts with corporate strategy and optimizes the efficient use of the resources (Thiry 2007). Dynamic evaluation of the surrounding environment is essential to prioritize projects and resources throughout the portfolio (Abrante & Figueired, 2015).

Modern portfolio management tools are able to connect human resources to the projects and, therefore, integrating the personnel constraints into the portfolio management process. Verzuh (2016) sees three major benefits of the modern tools:

1. *Avoid overloading the people*. Working simultaneously in the daily operations and multiple projects can easily supercharge the personnel and lead to the workload which is not accomplishable with a reasonable time-frame.
2. *Prioritizing projects by available skills*. One of the two equally prioritized project may need to put on-hold until the required expertise is available.
3. *Identifying expertise needed to accomplish strategic goals*. Cost-effective staffing is possible when the shorthanded and over-staffed expertise areas are recognized.

The resource allocation is a key issue for the success in the organizations managing several overlapping projects. Therefore it is a critical aspect to consider when seeking the ideally balanced portfolio. (Lock & Wagner 2019, 326)

2.3 Resource allocation process model

The resource allocation process (RAP) model was introduced by Bower at 1970's. It recognizes three parallel processes existing at the same time: definition, impetus and structural context (Table 1) (Bower & Gilbert 2005, 26).

In the definition process, basic technical and economic characteristics are defined for the investment. Operational managers who have a specialized role and access to required knowledge often have a response to a perceived problem or opportunity. Operating managers have an interaction to functional stakeholders such as customers and suppliers. General Managers in the middle have a product, geographic and functional perspective. Specific features of general management roles may impede to view corporate strategic perspective in the project definition:

- Knowledge is likely local, specialized and context-dependent
- This specialization is fortified by the roles and measurements
- Self-interest may influence the outcome

Also corporate level managers' abilities reflects the substance of knowledge. Their broader network and understanding about other companies produce proposals such as mergers and acquisitions. At the best, actions of operating managers reflect corporate strategy. General Managers invest in the education and communication to help operational management to understand the strategic purposes of the top management. (Bower & Gilbert 2005, 28–30)

Impetus is the force that moves the project towards funding if the general manager is willing to support the project proposal in the review board. On the corporate perspective analyzing a risk/reward trade-off is a main role of the general management. (Bower, Gilbert, 2005, 30–32)

The structural context of the organization influences the definition and impetus processes. The knowledge required for the strategic decisions and power to make them is dispersed across the all levels and over the organization. Therefore, the structure shapes the strategy by influencing the operations and shaping the resource allocation. It should be noted the since the small decisions may trigger the sequence important ones it is not clear what in the end is strategic. (Bower & Gilbert 2005, 32–33)

Table 1. The original RAP model (adapted from Bower & Gilbert 2005, 34).

	Definition of content	***Impetus for commitment***	***Structural context***
Corporate	Corporate mission, financial goals, aggregate policies; may include technical and economic strategy	Commitment of funds and other resources	Designs formal organization of business and managerial performance, incentives and the work environment
General Manager in the Middle	Integrates corporate and business unit thinking, translates	Sponsors projects and plans that fit, slows or rejects those that don't; competes for resources	Interprets and adopts to business-unit needs
Operating	Business-unit/functional activity and policies. Proposes business-unit strategy, new investments	Champions proposals for new business, new capability, new capacity	The rules of the game

Capabilities of the company are based on the quality of the available resources and the allocation of the resources shapes strategic outcomes – not paper nor policies. Therefore, to implement company's strategy it is crucial to allocate the resources with supportive manner. The operating managers have a significant role in possessing strategy implementation due prioritization and arranging the resources. (Bower & Gilbert 2005, 29)

2.4 Resource allocation strategies

Since different project call for same resources, the resource allocation is a core activity for managers of project portfolios. Some of the studies suggest that resource allocation to broader range of innovation projects predicts better outcomes regarding to new product markets (Sorenson 2000). It is suggested that same mechanism could be applied on decentralization (Laursen 2006; Leiponen 2011) and product variety (Lancaster 1990; Sorenson 2000; Bordley 2003). On the other hand, literature suggest that there may be disadvantages in the broader resource allocation throughout the innovation project portfolio. The drawbacks include reduction of strategical focus, diminishing managerial attention to individual projects, increasing organizational complexity and lowered stimulus for project completion (Klingebiel 2010; Boudreau

2011). In addition project managers' motivation may vary together with competition of resources (Garcia & Tor 2009).

Klingebiel (2014) studied relationship between the performance of innovation projects and the allocation of resources across the projects. The study concluded that the breadth of resource allocation increases the likelihood that at least some of the innovation projects are successful. Spreading resources across a wide range of projects at early development phase and being more selective at later phases lead more likely to higher performance. This might be due lower resource demands, higher uncertainty and unclear viability on early stages of the development. Klingebiel (2014) states that the high performances in the field of new product development combine resources allocation with selectiveness at the later stage.

2.5 Estimating activity durations

The activity durations and work load affect greatly to the project's costs and schedule which are in the crucial role when decision of go or no-go is made. Duration estimates consist of an actual work hours needed for complete the task (effort) and the number of days required from start to finish (duration). Estimates are done in the project planning phase and the accuracy tends to increase when the more detailed information is available. Flow chart for the activity duration estimates are presented in the Figure 2. (Stackpole Snyder 2013, 68)

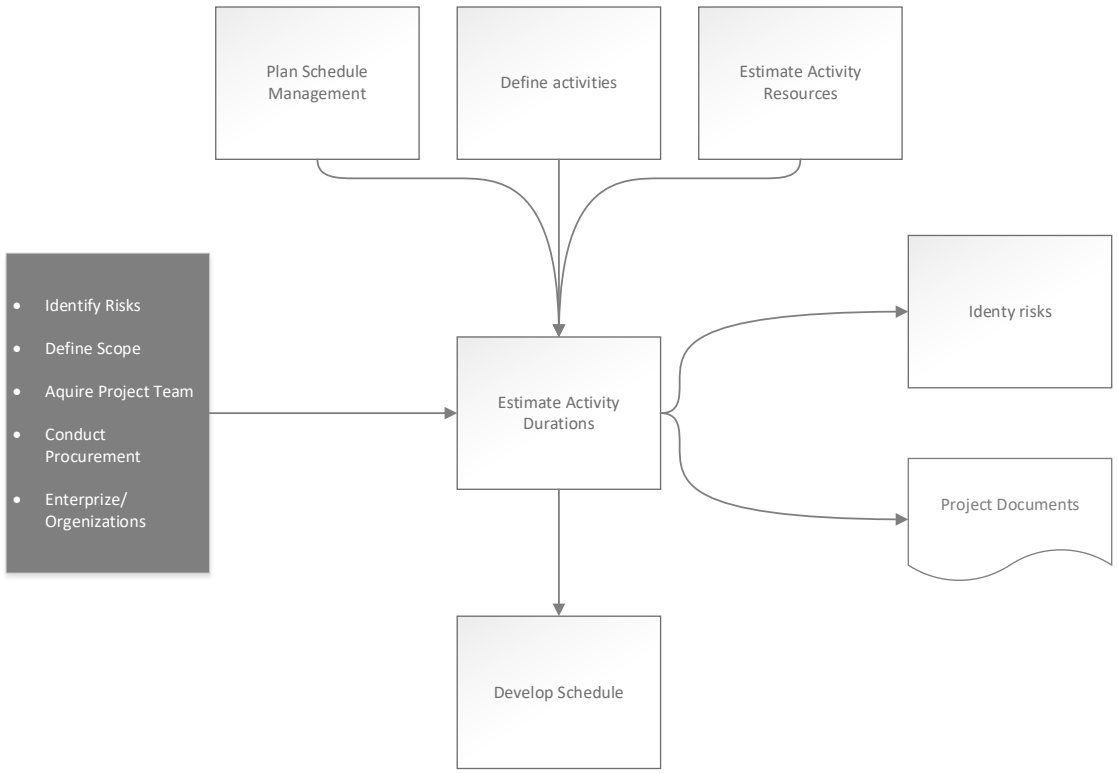

Figure 2. Flow chart of activity duration estimates (adapted from Stackpole 2013, 69).

2.5.1 Inputs

The activity duration estimation is based on the schedule management plan which determines the level of accuracy and the method of the estimation. Activities needed to complete the tasks are listed. The resource requirements define the types of needed resources such as skill level and the equipment type. These inputs related to time management are presented on the top of the Figure 2. (Stackpole Snyder 2013, 69)

On the left in the Figure 2 are other aspects to be considered at the duration estimation. These aspects include the project scope statement, environmental conditions and contractual requirements. The risk register may contain information related to resource availability, required skill sets or other information affecting to the effort or duration of the activities. The environmental factors may have databases for the estimating and independent business control units for cost estimations. Historical data about realized

durations in the similar projects and lessons learned reduces likelihood of repeating mistakes. (Stackpole Snyder 2013, 70)

2.5.2 Tools and outputs

Analogous time estimate

Analogous estimation uses the historical data gained from the similar conducted previously. It can be done for the overall project level or for the deliverables and is often used when knowledge of details is minimal. Estimates are based on the similarities and differences of the former projects. Disadvantage of the analogous estimates is that the two project only appear to be similar but in the fact they differ greatly. (Stackpole Snyder 2013, 70)

Parametric time estimate

Parametric estimation determines the duration by mathematic relationship and is useful when the actions are iterative, for example on the production environment. The known duration of the prior activity is multiplied by the number of units needed for the present project. (Stackpole Snyder 2013, 70–71)

Three-point time estimate

Three-point estimation takes uncertainty and risks into account. Estimates are calculated on the base of the best case scenario, worst case scenario and the most likely scenario. In the popular modification the most likely scenario is weighted more heavily than the worst and best cases. The formula is described

$$\frac{Best\ case + 4 \times most\ likely + worst\ case}{6} = three - point\ estimation$$

Equation 1. Three-point estimation formula (source: Stackpole Snyder 2013).

Delphi technique

Delphi technique is usable when the project activities are leading-edge and available historical data is minimal. The project manager can set a group of experts to develop the estimate. Individuals submit their estimation including the assumptions they are based. The project manager collects and arranges the estimated and send them for the second round for the whole group. Rounds can be repeated three or more times until the estimates are stabilized. To minimize "name recognition", people providing the estimates remain anonymous. (Stackpole Snyder 2013, 72)

WBS method

Time and effort can be estimated by the WBS method (work breakdown structure). The hierarchical decomposition of project divides core activities into a smaller units. The smallest units are activities (Korytkowski & Malachowski 2019). Since all the projects are unique, the logic of decomposition varies project by project. The common forms to decompose project are by

- Function
- Role
- Method
- Deliverables (components)

The functional breakdown groups project deliverables by business unit and the deliverable orientation is retained. Functional and similar role-based forms support facilitating the communication of responsibilities to the stakeholders. To help facilitate understanding of projects outcomes, the project's deliverables can be grouped by methodology or delivery process. The deliverables-based breakdown is independent of project organization and execution method and, in many cases, keeps the WBS straightforward. (Norman et al. 2008, 29)

The WBS usage is often extended from project to program, portfolio and enterprise levels. It follows the same rules as a single project WBS. It critical aspect is that the WBS decomposition logic meets the needs of a business. The programs and portfolios are considered as higher level deliverables which are divided to individual projects. (Norman et al. 2008, 30-31)

COCOMO and COCOMO II

IT projects may use the project definition by the program size that is number of code lines. The COCOMO model was first introduced by Barry Boehm at 1981 and was further developed into COCOMO II (Boehm et al. 2009). It consists six personnel-related attributes which are defined at five proficiency levels describing capability and experience of personnel assigned to the project: analyst capability (ACAP), programmer capability (PCAP) personnel continuity (PCON), applications experience (APEX), platform experience and language (PLEX) and tool experience (LTEX) (Korytkowski & Malachowsk 2019).

As an output the activity duration estimates can be expressed by effort and duration. The estimation can be included with the basis of the estimate, confidence level and the range of the estimate. (Stackpole Snyder 2013, 72)

2.5.3 Risk assessment and risk-derived resource allocation

After project lifecycle selection at planning phase, needed resources are estimate to accomplish the work in every phase. However, the resource allocation is rarely done in risk mitigation point of view (Donaldson 2007). Donaldson defines the risk reduction as acts to reducing likelihood of late, over budget and out of scope deliveries. For risk reduction a five-step risk-assessment process is supported:

1. Decide the number of risk level (*e. g. risks are categorized as high risk, medium risk and low risk)*
2. Define risk criteria for each risk-level
3. Define the number of matches required to assign the project to the risk level
4. Define the default risk level if the matches are insufficient
5. Decide recommended resource allocation percentages for management, development and quality assurance.

Flow chart of an example risk assessment and risk-derived resource allocation process is presented in the Figure 3. The authors suggest that if the assessment falls between the risk-levels, the resource allocation percentages for each group should be fixed

somewhere between. In addition, the risk assessment can be applied at the subtask level and throughout the project. (Donaldson 2007)

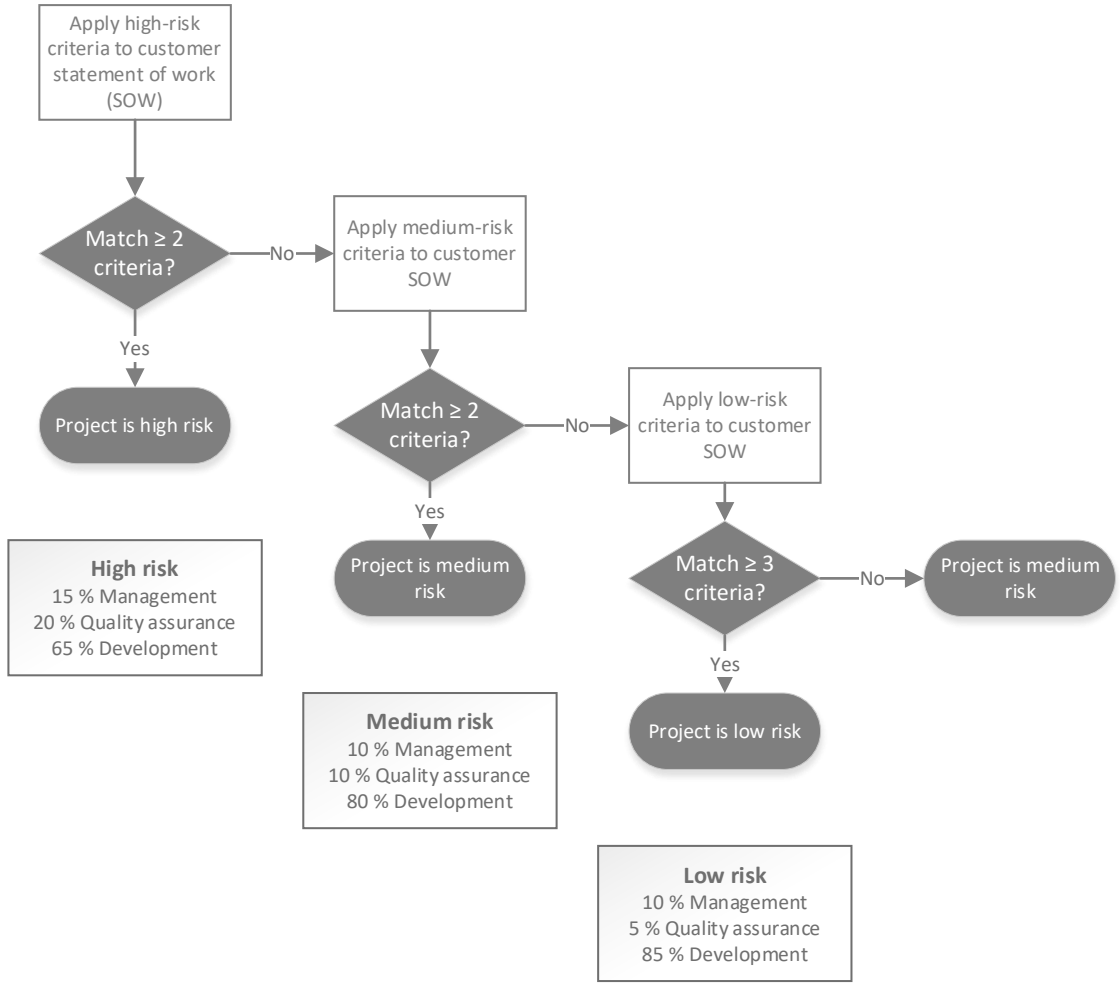

Figure 3. Risk assessment and risk-derived resource allocation process (adapted from Donaldson 2007).

3 THE CURRENT STATE STUDY

3.1 Methodology

For the current state study four on-going projects were selected for the follow-up. The aim was to get an idea, how activity duration estimates planned for the month at issue conformed to the realized work-load. Portfolio management tool (Thinking Portfolio®) was used for the project selection. Selection criteria for the follow-up projects is presented below.

1. Project was on execution phase
2. Projects had planned resources for the follow-up period
3. Project status was updated within 2 months
4. Project included resources at least three different departments
5. Responsible department is different for all the projects included

The study consisted of two sections: follow up of the realized activity durations and semi-structured interviews. Human resource usage was followed for one month for all four projects. Project team members were instructed to daily recording of the activities dedicated for the project. The follow-up period of one month was chosen to correspond resource planning period in the project portfolio management tool in use. It should be noted that all the team members included do not usually have regular working hour recordings. Obligation to record working hours is department-depended. The follow-up period was chosen to be long enough to demonstrate the planning outcomes without overloading the project team members in question.

In second section project team members were interviewed about the current state of project resource management and activity duration estimations. Altogether 17 people participated to the interviews. Project managers (4) from each project were interviewed and other 13 team members were selected randomly. Interviewed team members were pharmaceutical experts from Product Lifecycle Management (PLM) department; validation engineers, automation engineers and production engineers from Technical Office (TO) and production and EHS personnel. The aim of the interviews was to gather

operating level information about the current status of projects' resource management and development suggestions. Due on-going COVID-19 pandemic interviews were done remotely in Microsoft Teams. Notes were made but the interviews were not recorded to ensure privacy.

Semi-structured interview is also known as focused interview. Typical characteristics for the semi-structured interviews are (Hirsjärvi & Hurme 2008)

- the interviewee has experienced the situation at issue
- the researcher has a baseline knowledge about the structure, processes and complex of the topic
- the interviewer establish a frame for the discussion
- the interview concerns a subjective experiences about the topic

Results of the interviews and realized resources were combined and are presented in the following sections.

3.2 Results

3.2.1 Estimated and realized resources

As seen in the Figure 4 activity duration estimation for all projects was 60 days. The amount of realized days was 79 which exceeded planned by 19 days which is 30 %. Figure 5 shows planned and realized working days per project. The greatest difference between planned and realized resources was found in the Project 1 where the consumed days was 5-fold compared to the planned. Resources used by Project 2 were 2.2-fold when compared to the planned. Project 3 used human resources 6 days less than planned and Project 4 estimated usage was 10 days more than realized. When compared by department, realized days by Technical Office and Product Lifecycle Management were underestimated (Figure 6).

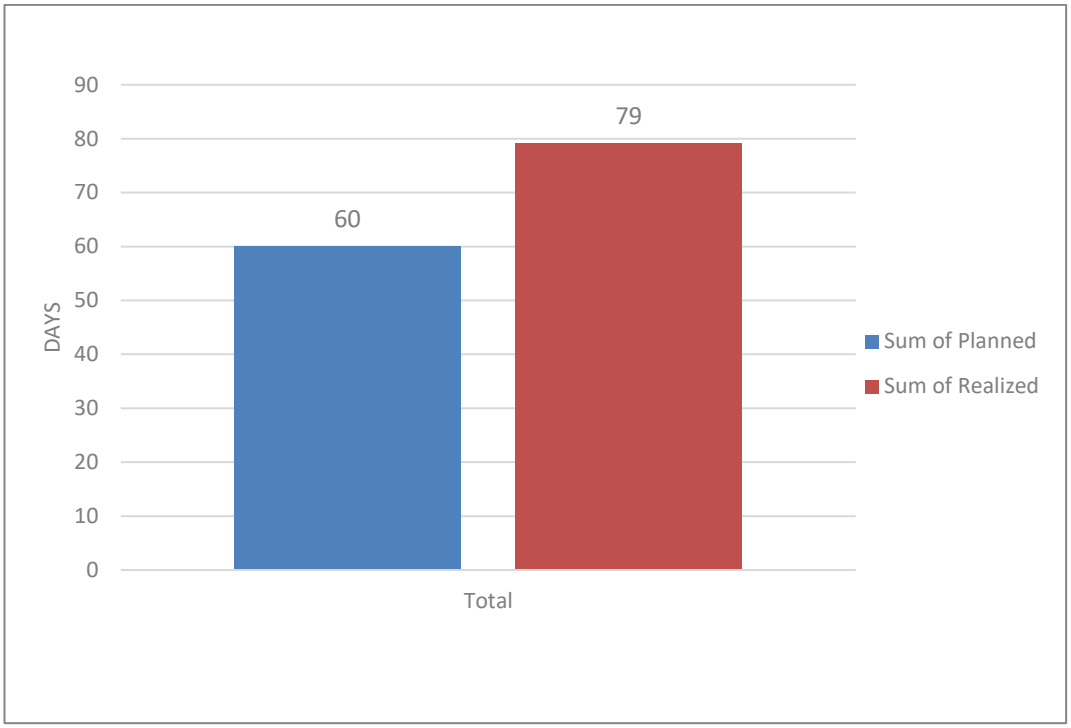

Figure 4. Total planned and realized resources..

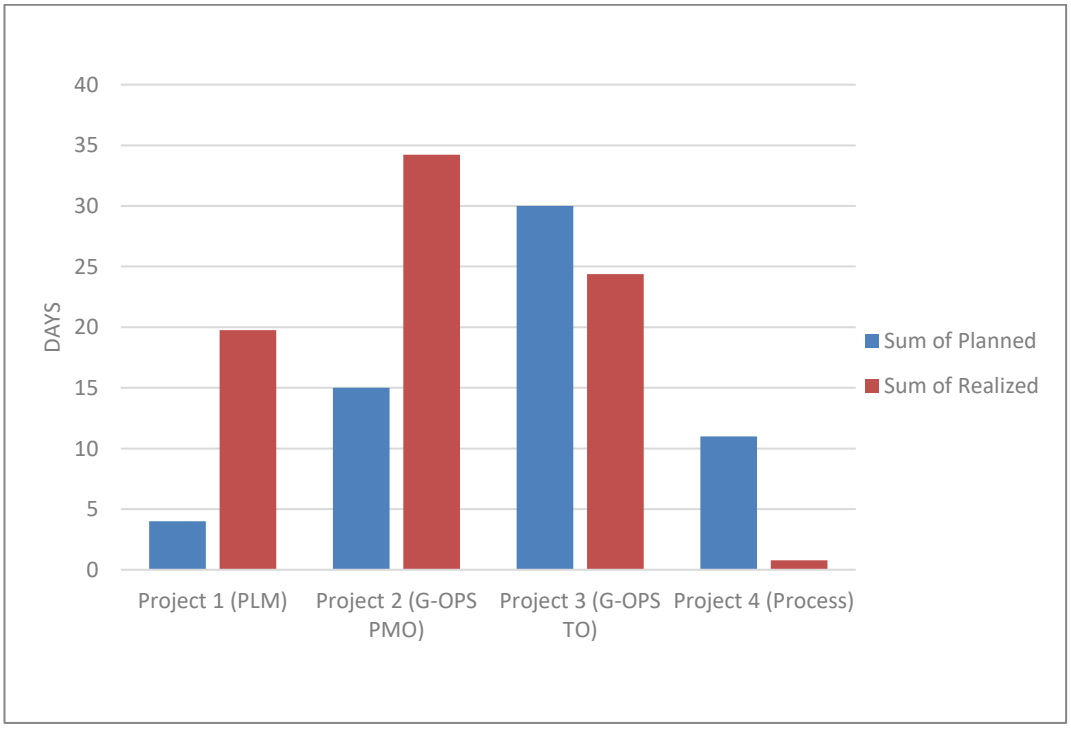

Figure 5. Realization of resource estimation by project. Responsible department of the project is presented parentheses.

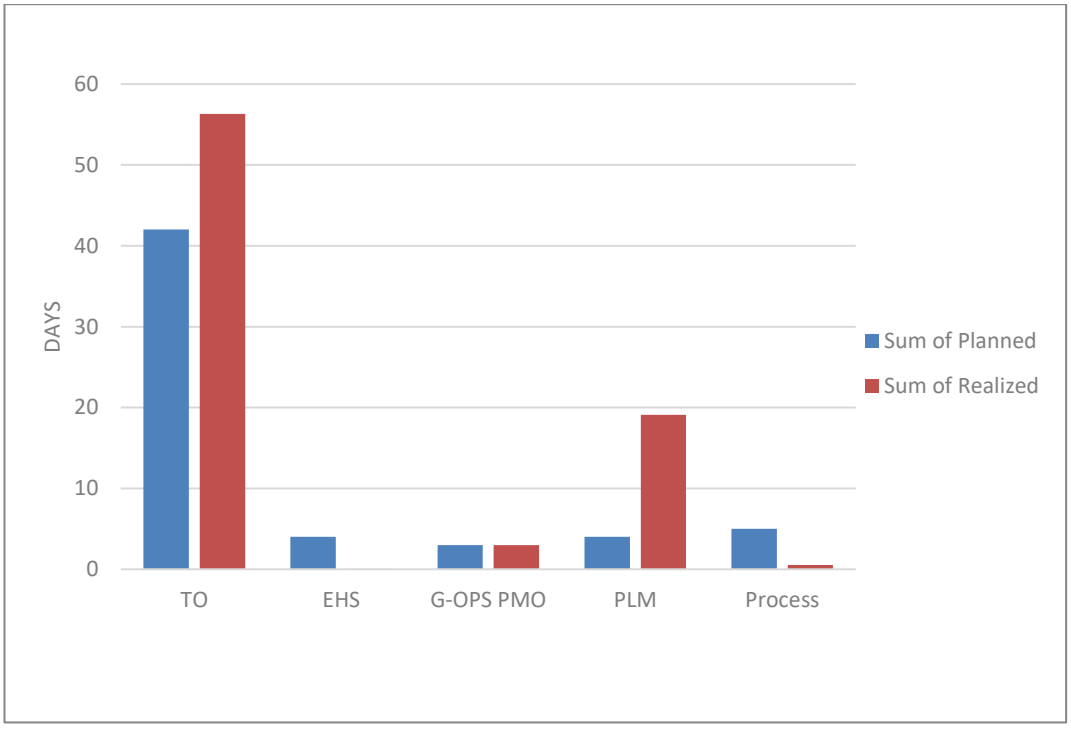

Figure 6. Realization of resource estimation by department.

3.2.2 Resource usage and management methods

This section combines data from the resource usage follow-up and interviews to find out best practices for resource estimation. For resource usage follow up, PLM uses cross-application time sheet (CATS) and TO SAP recordings. Process and EHS do not use human resource follow up at all. Estimates seemed to be most correct in the SAP group differentiating from planned only 1.5 days during the follow-up period.

In addition, seven experts used additional Excel sheets for their own resource usage follow-up prior to entering the recordings to the system. Used hours per project or task were entered daily or weekly. Some of the experts monitored the time consumed to re-occurring tasks in order to make more precise estimates in the future. Figure 8 shows that those who had double "book-keeping" for hours made more precise activity duration estimations than the ones who entered hour-recordings straight to the main system. With

few exception these persons also compared planned and used working hours which shows up as improved accuracy (Figure 9).

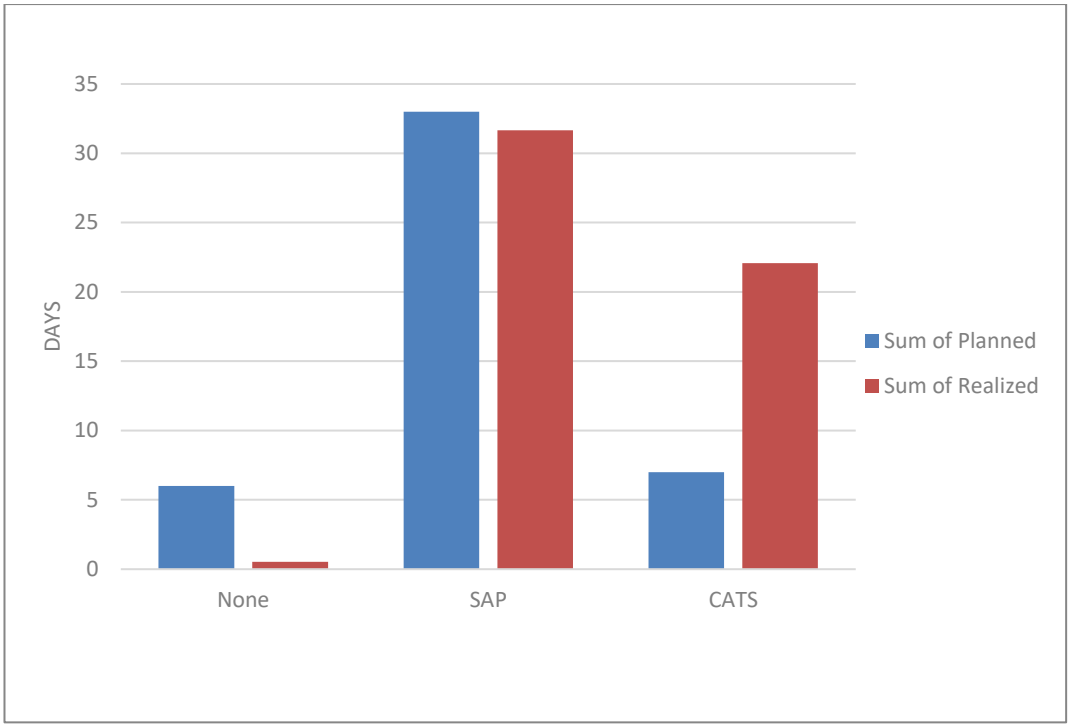

Figure 7. Realization of resource estimation by follow-up tool.

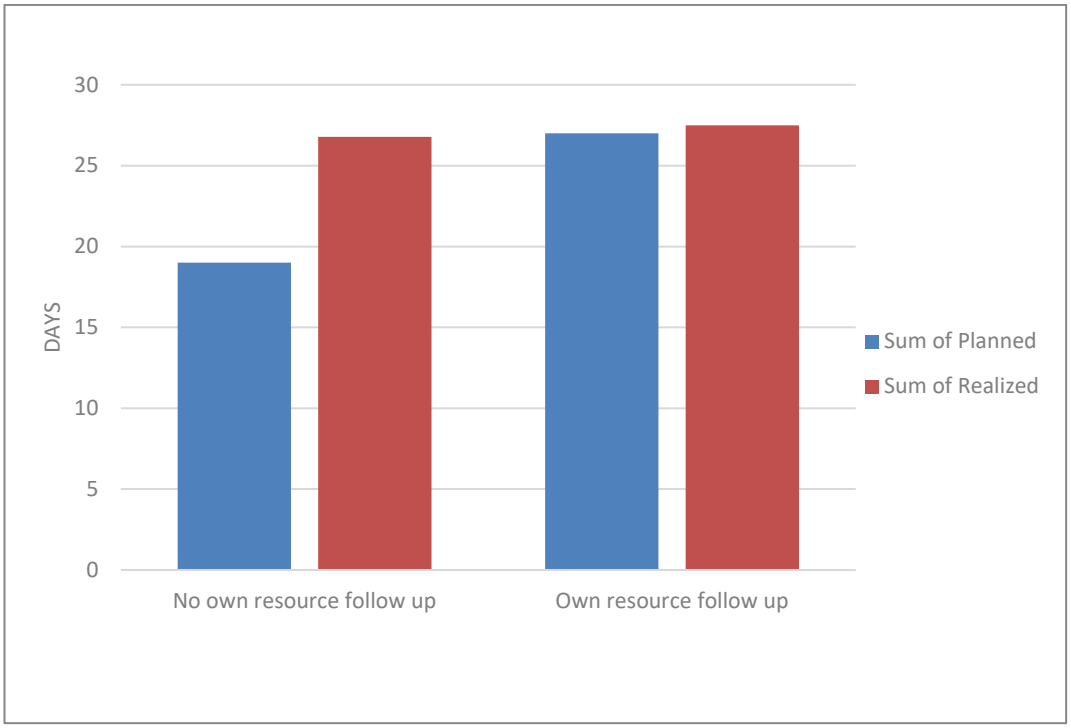

Figure 8. Additional tool (Excel) used for activity duration follow up.

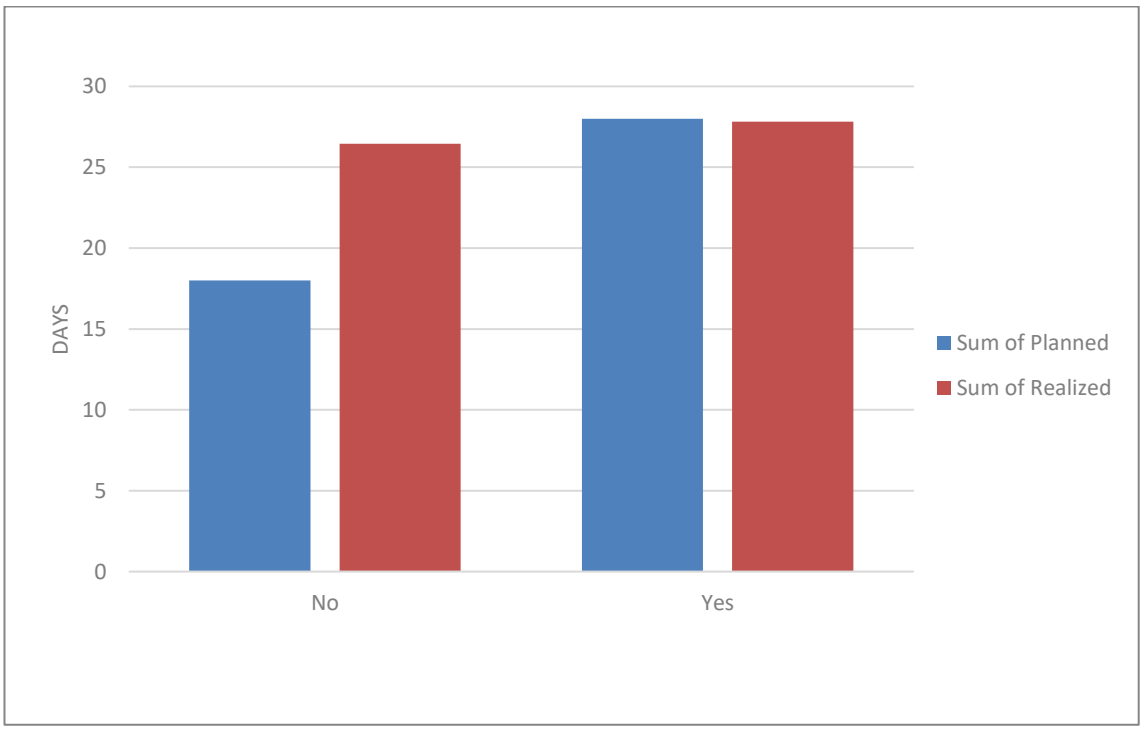

Figure 9. Control of own realized hours.

As seen in the Figure 10 the highest accuracy of the activity duration estimation was gained where employee made the estimation him- or herself or together with other expert, project manager or supervisor. In both cases the estimation differed approx. two days from the realized.

Figure 11 shows an interesting feature about the difficulty of resource planning. Those who found it out be difficult or partly difficult made more precise estimations than the ones who did not know or found it easy.

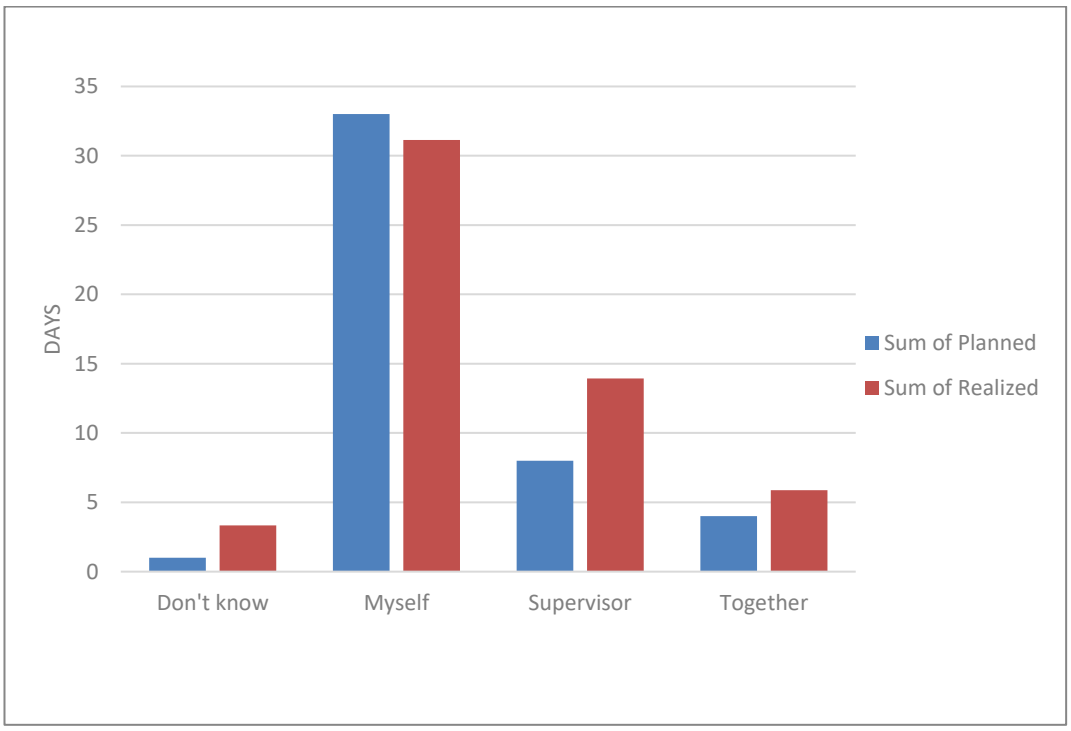

Figure 10. Planned and realized work load by assessor.

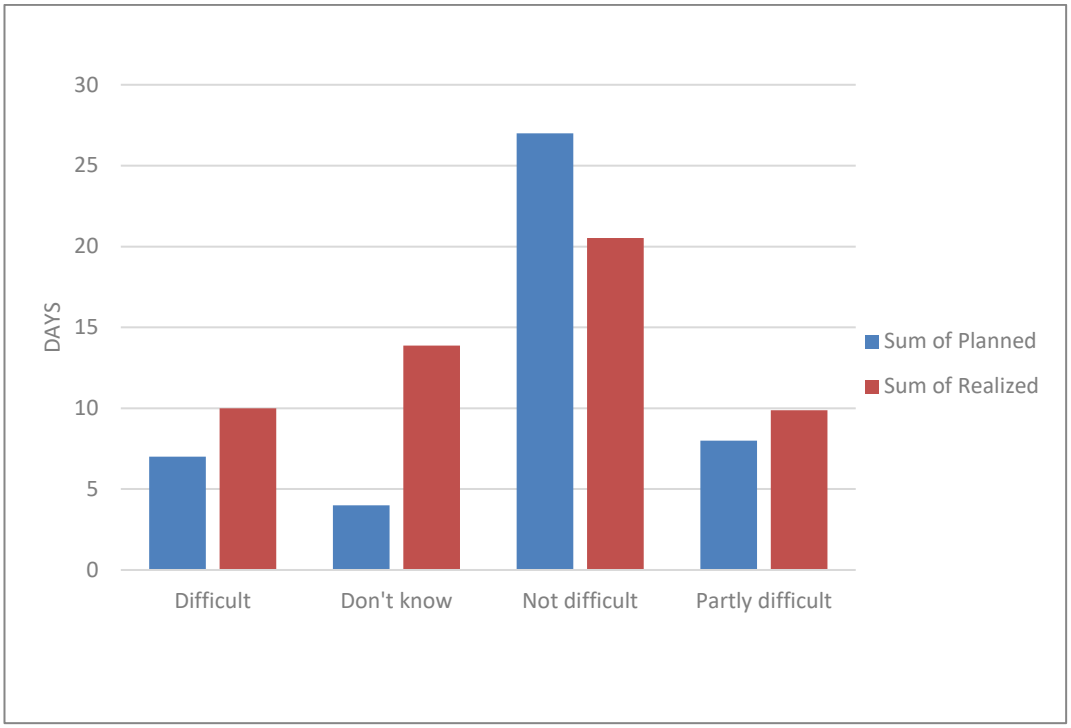

Figure 11. Planned and realized work load by degree of difficulty.

3.2.3 Findings from semi-structured interviews

Collated answers to the semi-structured questions are presented in the Table 2. About half of the interviewees did the resource planning by themselves. Almost same amount thought that the most accurate results are gained when the estimation are done together with supervisor or project manager. For the majority, estimating activity durations appeared difficult or partly difficult. On the other hand, about same percentage evaluated planning to be successful of partly successful. Almost half of the participants did not know if the activity duration estimations are updated during the project execution phase if necessary.

Table 2. Results from the semi-structure interviews.

Specified questions and answer options	***Results***
Who estimates resource usage	
Him-/herself	9 (53 %)
Supervisor	3 (18 %)
Project manager	1 (6 %)
Together with supervisor/project manager	3 (18 %)
Don't know	1 (6 %)
Who should plan the resource usage	
Myself	3 (18 %)
Supervisor	2 (12 %)
Project manager	3 (18 %)
Together with supervisor/project manager	8 (47 %)
Don't know	1 (6 %)
Ease of planning/estimation	
Not difficult	2 (12 %)
Difficult	6 (35 %)
Partly difficult	8 (47 %)
Don't know	1 (6 %)
Estimation success	
Successful	5 (29 %)
Not successful	2 (12 %)
Partly successful	10 (59 %)
Resource estimation update	
Updated	7 (41 %)
Not updated	2 (12 %)
Don't know	8 (47 %)
Monitors and compares own realized hours to planned	
No	10 (59 %)
Yes	7 (41 %)

Due to semi-structured nature, the participants were able to discuss further about all the questions. In addition, interviewees were encouraged to share their thoughts and ideas for the process development. Some of the themes and suggestions reoccurred in several interviews. Main issues raised from the interviews related to the visibility, transparency and follow-up:

- Activity duration estimations should be look through with the project manager and/or supervisor at early project phases
- Improved transparency for up-coming projects and tasks
- Improved visibility and regular follow up for realized resources

Especially long-term resource estimations were considered as difficult, time-consuming and rarely accurate. Also other suggestions and topics were discussed:

- Reservation for slack time for unexpected workloads
- Standard duration estimations for iterative tasks which can be customized project-by-project
- Access to historical data
- Too optimistic estimations are common
- Hour-recordings are time-consuming and might not be very accurate and/or recorded timely

Altogether interviews offered good information about the current status and raised up the development targets and points to be considered.

4 DISCUSSION

4.1 The study results

As seen on the previous section (3.2.1) there was a gap between estimated and realized resource usage. In total realized resources exceeded the estimation almost by third. Estimation accuracy also variated between the projects. The greatest observed difference in the resource usage was five times higher than planned. On the other end, the amount of the estimated days was 11 when only 1 day realized. Neither of the cases is preferred and can lead to resource shortage or overload.

When compared the data from interviews and hour recordings experts who recorded realized hours first to Excel and those who revisited realized hours succeeded better. The most accurate estimation were observed when the estimation was done by interviewee him/herself of together with other expert or (project) manager. In addition, it seems that when the estimation is found to be difficult it was more precise. This might be due to more effort put to planning phase.

Enhancing of visibility, transparency and follow-up in human resourcing is seen as a valuable improvement by operating experts which was also a major topic in the top management interviews.

It should be noted that the amount of the project included to the study was small when compared to the number of on-going projects in the Global Operations. Follow-up period for hour-recordings was also short and gave only pilot-scale information about the current status. However, the study may help to outline the possible scales and effects of inaccurate resource estimation.

Portfolio management tool (Thinking Portfolio®) was introduced quite recently and therefore may not have been fully exploited at the time of the study. Another cause for inaccuracy may be the over- and underestimation of workload. Also it possible that the planned work load is shifted to another time period and is not visible in study period. Figure 12 presents a monthly work load distribution of one expert in the one of the projects included to study. Both, shift in the execution time and under estimation of the work load, are obvious.

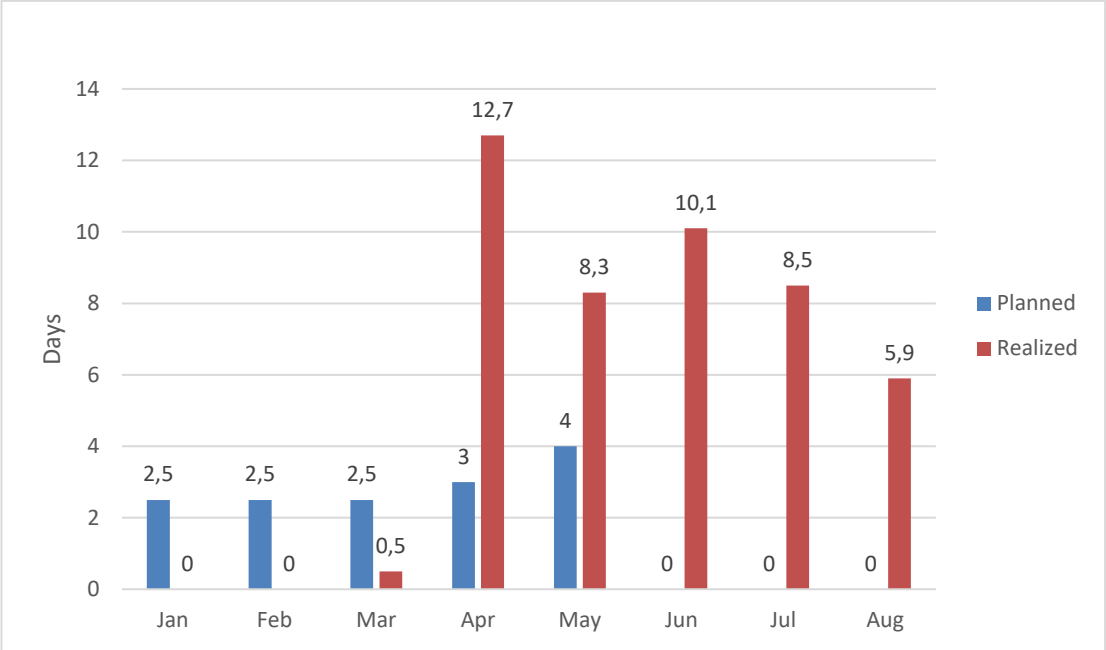

Figure 12. Planned and realized work load distribution.

4.2 Follow up

The project portfolio management tool was introduced on the first quarter of the 2020 and fully implemented during the year. Therefore is was possible that the gaps in the resource estimations were related to the usage of the new tool. For further follow-up hour recordings and planned resources were followed for longer period for teo projects. The data of the planned work load and its distribution was received from the portfolio management tool. For the realized work load SAP and CATS recordings of projects were gained. The resource usage of Project 1 was inspected during the whole project execution phase lifecycle from February 2020 to May 2021. As seen in the Figure 13 human resources were underestimated during the execution phase of the project. Other project followed (Project 2b) was initiated at the last quarter of 2020 and led by Project Management Office. The scope and the project team was largely similar than the Project 2 investigated at the phase 1. The Figure 14 shows that the success rate of the resource planning was high at the beginning of the project and realized work load conformed to the planned well. The high success rate might be caused by the professional

development of the team members due similar recently executed project and increased competence to use and update the portfolio management tool on time.

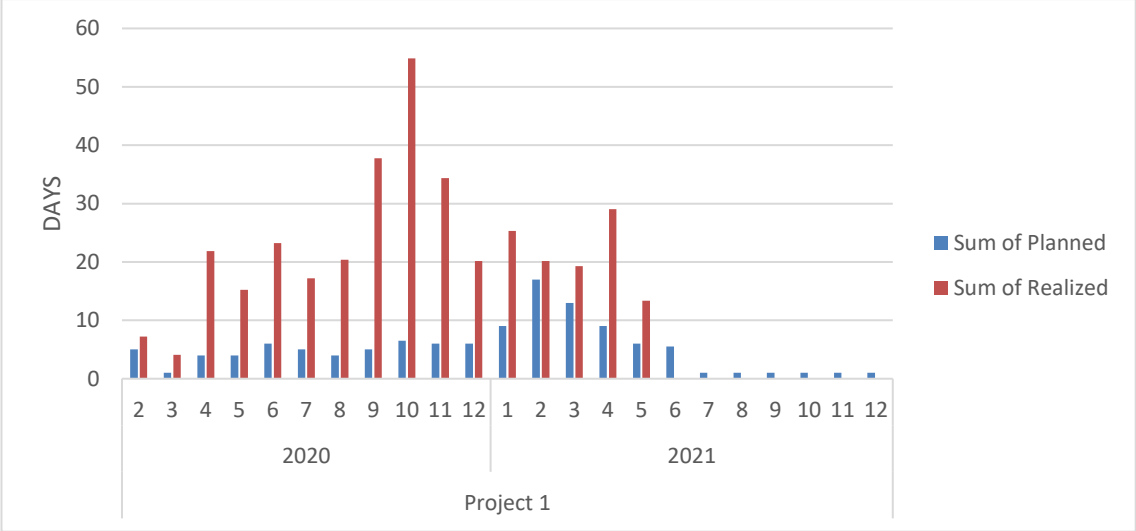

Figure 13. Execution phase follow up of the Project 1.

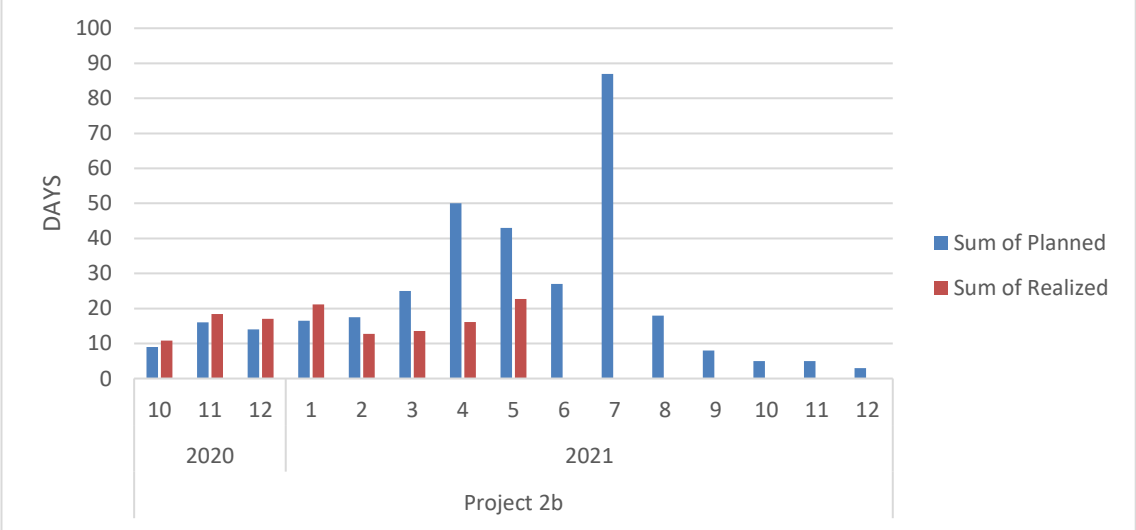

Figure 14. Execution phase follow up of the Project 2b.

When investigated by the department PLM seems to underestimate the work load whereas TO tends to overestimate (Figure 15). Data for the Figure 15 was recorded from Jan 2021 to May 2021. For further understanding of the current status of the resource

estimation, hour recordings from May 2021 were compared to the realized work load in ten randomly selected projects (Figure 16). The work load data is gathered only from one department during one month. Figure 16 collated results show that in the department level, realized work load is almost 2-fold comparing to the outlined. More detailed examination in Figure 17 indicates that four projects are mainly responsible for the work overload and two of the projects compensate the results whereas four of the projects succeeded well for this particular month.

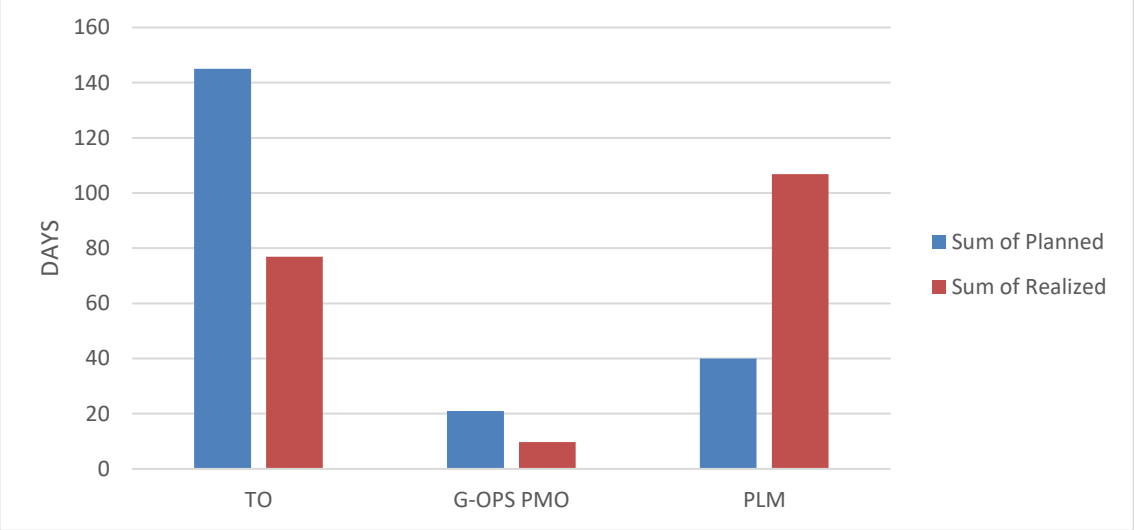

Figure 15. Planned and realized work load by departments from Jan 2021 to May 2021.

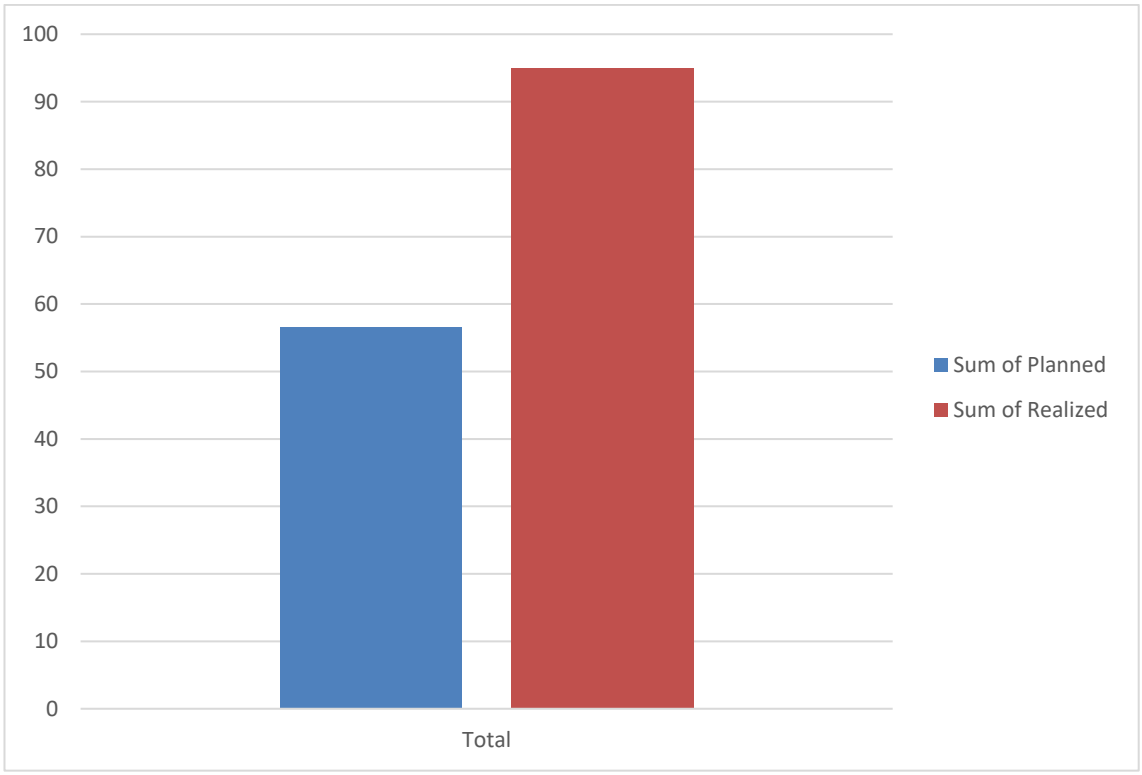

Figure 16. Planned and realized work load of during one month (ten projects included).

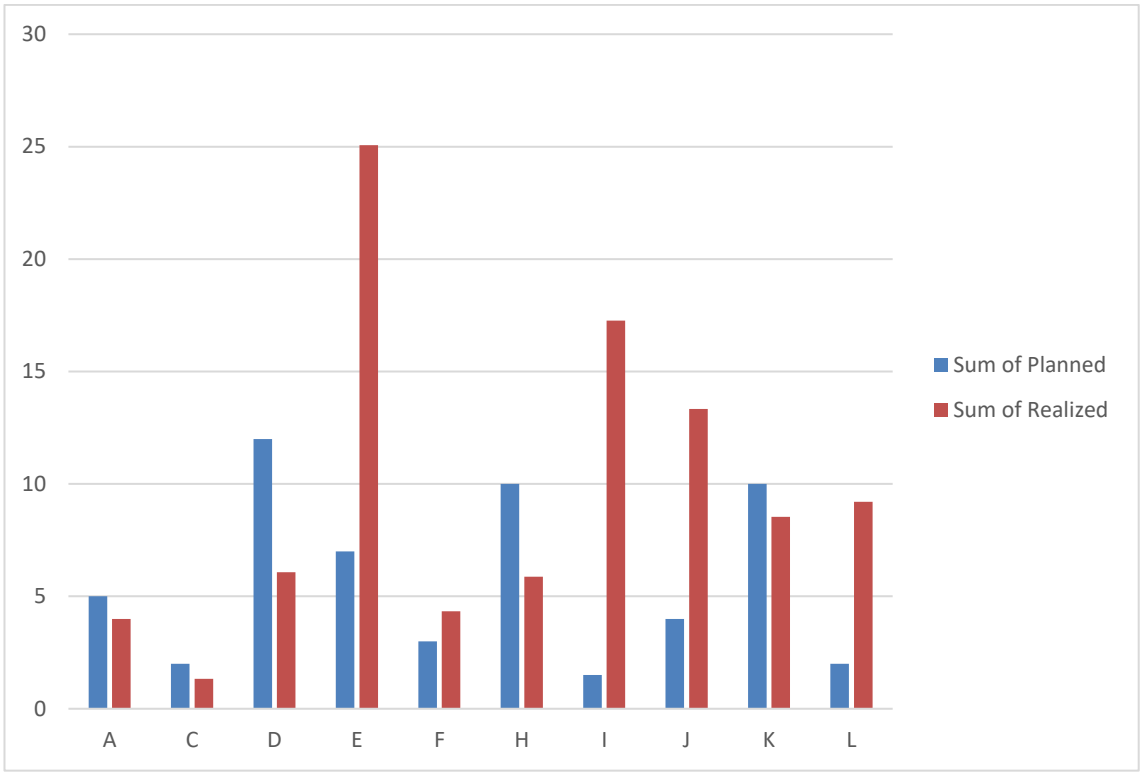

Figure 17. Work load realization of ten selected projects (A - L) during one month.

4.3 Process development

The aim of this section is to provide ideas to improve resource management processes. It is clear that accurate human resourcing is beneficial to all levels in company management. Operating experts and managers have a realistic view to the up-coming and on-going tasks eating up the resources and operating time. Based on the estimates lower scale prioritization is possible and future workloads can be reckon with. Realistic resourcing helps to prevent and minimize occupational stress and errors caused by too tight schedules and overload. General management is able to direct the operating group towards the company's strategy by allocating the scarce resources according the way that supports it. Ability to point out hot spots as well as overstaffed periods, projects or departments in order to start recruit process or resource re-allocation. With proper estimations resource related delays in the projects are minimized.

Project portfolio management tool has an excellent potential to visualize the current status of resources. However, the reliability depends largely on the accuracy of supplied data which is, in the best case estimations, based greatly on the previous projects. In addition, whole workload, including non-project of line work, should be somehow visible and the invisible work unambiguously defined.

The main message concluded from the top management interviews defining the thesis subject and operating level interviews was a lack of transparency and control of the resource allocation. The company has successfully carried out other lean process improvement projects, which implementation methods can be useful also in resource allocation improvement. Main points for the improvement of the resourcing process are

1. Agreed and clear responsibilities for workload estimations and regular updates.
2. Required resources are evaluated with project manager at planning phase.
3. Follow up of realized and planned resources within the project team and/or with the supervisor.
4. Access to history data for all operating levels.

The company's working instruction directs the project resourcing responsibilities. Working instruction states that

- Resourcing and follow-up are done in portfolio management tool by project manager or responsible expert
- Resources are updated prior to project phase decisions
- Supervisor, project manager and operating expert define required amount of resources to complete necessary actions
- Resource status is controlled monthly in project team meetings
- Operating expert is responsible for the required updates

Current working instructions seem to be in the line with interview findings. Implementation throughout the portfolio needs more training and discipline for the execution. It could be beneficial to look back the realized work load also with the operating level and provide the access to the historical data to extent the knowledge. Since the operating experts are responsible of the work load estimation of the up-coming projects, the accuracy status of the previous estimates should be available for all team members.

The study data pointed out the relationship between the better estimation accuracy and double book-keeping of realized working hours. It could be beneficial to provide easy access tool(s) for hour recordings (e. g. Excel template and/or other tools) to enhance accuracy of realized work load recordings. Since future resource estimations in future projects are greatly based on the previous projects, better accuracy in current work load recording means more reliable resource planning in future projects. However, double entries are considered to cause unnecessary burden and therefore it should be used only if it found out to be beneficial and easy to use by the operating expert him-/herself. At the end the best case would be to use same system for planning and recordings. In addition, ratio between the used and planned resources should be frequently followed at project and organization levels. It seems that some of the projects are already succeeding well in resource management and it could be beneficial to share the best practices throughout the organization.

In the literature review section analogous, parametric, three-point time estimation, Delphi WBS and COCOMO techniques for activity duration estimation are shortly introduced. All of them have advantages and disadvantages. Analogous technique was used among the project managers interviewed in this study and it seems to be the most commonly used also in wider range in the case company. Choosing suitable technique for each project belongs to project manager's expertise and depends greatly on the project. However, it could be considered whether providing some guidelines or suggestions to ease up the activity duration estimation process. It is clear that the estimating project's activity durations itself is time-consuming and requires resources which should be noted at pre-planning and/or planning phases.

5 CONCLUSION

The resource allocation is one of the main tasks of the project portfolio management. Resource allocation across the portfolio is also seen as main benefits of the PPM due visibility of on-going projects and ability to allocate resources according to prioritization which supports strategic goals. Project costs and scheduling are depended on the accurate resourcing. Therefore, resource allocation executes company strategy whether it is intended or not-intended. As all activities in flourishing company, project management methodologies, including resource allocation, should undergo continuous improvement (Kerzner 2019).

This study revealed the gap between planned activity estimations and realized work load within a one month. Even though the sample size was small when compared to amount of all on-going project in the Global Operations organization, it gives an idea of the scale of the gap. The root causes may include incorrect activity duration estimations, shifts in the active periods and lack of timely updates of the plan. In addition, portfolio management tool was quite recently introduced and therefore, not familiar to all project managers dealing with the resource estimations.

The company's working instructions related to project management were well established and in the line with study findings. However, the implementation of the instructions need more effort. Tools and methods to improve transparency of up-coming and earlier resourcing should considered.

Interesting study topic for the future would be realization of planned resources and activity durations on the larger scale as well as shifts in the active periods within the projects. In addition, continuous follow-up for the resource usage could be implemented to the project and portfolio management process.

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Questionary for semi-structured interviews

1. Who estimates activity durations for up-coming projects?
2. Who should do the estimates?
3. If you participate the estimation, do you find it easy?
4. Does it seems to be correct?
5. How do you or your organization follow up the realized activity durations?
5. Open question: General development ideas for resource management and activity duration estimations