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HANDBOOK FOR TURNKEY DELIVERIES

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ABSTRACT

This thesis focused on studying best practises on project management and learning about different project delivery methods to develop a handbook for turnkey project deliveries.

Constructive research methods were employed to study the source material. Different project management handbooks were benchmarked to create a turnkey project management handbook that can be used as a basis for a project plan, or as an introduction to turnkey projects.

The result of these studies is a turnkey project management handbook. The handbook is divided into four chapters that each describe the essential tasks of project management in different phases of a project's lifecycle. The chapters consist of information on project management practises as well as tips on how a project can be managed, and a list of project meetings that are held during a project.

The study concluded that project management requires careful planning and execution. To reach optimal results projects need to be reviewed after completion to provide the project organisation with information on how to further develop their projects. Further development potential was found in certain project progression tracking and project organisation structures.

Keywords: project management, turnkey projects, project planning, project delivery systems

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1 INTRODUCTION

This thesis aims to review the best existing practices in project management and turnkey deliveries. Based on that research this thesis aims to create a handbook that consists of guidelines for the main points in successfully managing a delivery project and providing value for the end customer.

The thesis is based on both the literature related to the topic and my own experiences as a responsible project manager in geothermal projects. My experience has confirmed my view that successful turnkey projects require consistent methods and instructions. In this work, the methods and instructions are compiled into a project manual or handbook.

The handbook will be created by constructive research since it will be a guide to a certain kind of project management. The main parts of the turnkey delivery are presented separately in the handbook, and the requirements for a project manager leading the project are explained with examples on the subject.

The composition of this thesis is as follows. Chapter 2 will address the differences in project delivery systems (PDS) and expand further the meaning of the turnkey delivery model and value creation for the customer. Chapter 3 will consist of project management tools for turnkey deliveries by looking into the principles of contracting, scheduling, critical success factors and resource management. Chapter 4 will introduce the creative process and development methods used during the implementation of the handbook as well as the handbook itself. Finally, Chapter 5 summarizes the findings of the study and points out the development ideas for the handbook.

2 PROJECT DELIVERY SYSTEMS AND TURNKEY MODEL

This chapter introduced the different project delivery systems. After the introduction, the implementation of these delivery systems in Finnish building information file (RT-kortisto) will be described. In addition, the chapter focuses on turnkey project and customer value creation.

2.1 Introduction to project delivery systems

When looking into project delivery systems used in construction it becomes obvious immediately that there are a multitude of different delivery systems and variations of those methods. For this reason, it is easier to describe the purpose of a project delivery system. Project delivery systems describe the relations between the parties working on the project. They define the roles, responsibilities and activities needed to deliver the project. (PDI 1999 cited in Moore 2000.)

The way a project delivery system describes the different aspects of the project and distributes delivery responsibilities specifies the PDS under a few key characteristics. These characteristics are used in differentiating project delivery systems from one another and to divide project delivery systems into different categories. Those categories tell how many different entities hold responsibility in the project and how different roles are divided within the project. Project delivery systems can be divided in four most common methods. Design-Build (DB), Design-Bid-Build (DBB), Construction Management At-Risk (CMAR), and Integrated Project Delivery (IPD) (Kenig 2011, 14).

When the project owner gives responsibility of design and construction to a single source, the delivery system is termed Design-Build. In this delivery method, the Design-Builder is responsible for the schedule, cost, coordination, and quality of the project (Shoney-Darby 2010, 1). Turnkey projects are usually categorized under DB projects.

DBB is the most popular among these project delivery systems. In it the project owner is in contract with all different parties of the project, but they are usually not

bound to each other by contract. In CMAR deliveries the owner hires a construction manager that takes care of the design and tendering of the project. Usually in CMAR deliveries the project manager has a guaranteed maximum price towards the customer (Trimble 2024).

The most modern project delivery system in construction is Integrated Project Delivery (Ashcraft 2022, 369 – 384). IPD differs from more conventional project delivery methods as it aims to integrate all parties spanning the whole life cycle of the product to participate in the developing and delivering the project (Fischer et al. 2017, 29).

2.2 Project delivery systems in Finnish construction industry

Information about different delivery systems, their specifications and contracting can be obtained from Rakennustieto (RT), a Finnish construction information provider. It is worth noticing that all discussed project delivery systems can also be mixed and parts of them be used in different project deliveries. This is called a hybrid project delivery. The aim in hybrid project deliveries is to increase cooperation in construction. However, the hybrid project delivery methods are excluded from this thesis.

2.2.1 Design – Build

The guide to house building, RT 10-11223, tells us that when delivering a construction project as a design – build project, the developer must carefully define their scope in the project plan and invitation for quotes, to improve the quality of the resulting project. To reach this, it is important to focus on quality over price when choosing a tender (Rakennustietosäätiö 2016, 5)

The advantage of design–build projects is that the delivery and designs are developed by the contractor. This way when planning it is easier to take the delivery and its costs into consideration. The challenge of DB deliveries is to

define the scope and quality of the delivery in advance and to implement possible developer changes during delivery.

2.2.2 Design – Bid – Build

The same guide (RT 10-11223, Rakennustietosäätiö 2016) explains that in design – bid – build projects the developer contracts one contractor, based on designs produced by the developer. Then the contractor splits the project between subcontractors. These kinds of deliveries work well when the project content is easily defined, and possible uncertainties have a limited effect. When the contractor is in contractual relation with the subcontractors, the developers' effect on contractor choices is limited, and most instruction to subcontractors goes through the main contractor.

When the project is divided between two or more contractors who are in contractual relation to the developer, the project is called split contract. This increases the possibilities for the developer to instruct the contractors. In a split contract, the developer is responsible for most of the design and development which leaves plenty of responsibility to the developer.

2.2.3 Construction Manager at Risk

According to RT 10-11223 (Rakennustietosäätiö 2016), in a CMAR delivery the construction manager works closely with the developer, and the project is split into multiple smaller deliveries that are quoted separately as the designs are finished. This enables interlacing the planning, procurement, and construction. Also, this gives the developer all control over different designs and procurements.

2.2.4 Different forms of integrated project delivery

When responsibility for the planning, delivery and costs is common to all parties involved in the contract, the project can be called an Integrated Project Delivery. This term is further defined as project alliancing, project partnering, and public – private partnership. In these projects, all the risks and profits are split between parties according to the contract. (source for the information of this paragraph?)

An integrated project delivery is usually suited for complex and large projects that have plenty of risks and possibilities. An example about a successful integrated project delivery in a form of public–private partnership is a new highway tunnel in Tampere, where the City of Tampere, Finnish Transportation, and communications agency Traficom, A-insinöörit and Insinööritoimisto Saanio & Riekkola were allied for the project delivery. In the project 2.3 kilometres of highway 12 were transferred underground to release space for housing. The project succeeded in shortening total time of construction and reducing costs from the original budget. (Väylävirasto 2023)

In public – private partnerships (PPP) the contract can also be binding for decades this leads to PPP businesses potential for profits being constrained by contracts rather than market forces or regulations (Gerrard 2001). Deliveries of this type of an integrated project delivery aim to bring private funding to public projects and lighten the load of the public sector in governing.

2.3 Turnkey

As mentioned above, a turnkey project delivery is in essence a Design-Build project delivery. The name turnkey comes from the idea that the customer only contacts one source and receives the project delivered complete and ready for use. In this project delivery method, the customer is in contract only with the party that is responsible for everything concerning the delivery of the project in schedule and budget in accordance with customer specifications.

Turnkey projects can be categorized into four main categories depending on whom the customer has contracted for the DB delivery. These categories are (Lahdenperä 1999, 27):

- Designer led, in which the contract is made with the party that designs the project.
- Contractor led, in which the contractor is responsible of all required tasks.
- Joint venture, in which the contractor(s), and possibly the designer is bound by contract to each other and then the joint venture is contracted by the customer to deliver the project.

- Integrated Design-Build contractor, in which the contractor has the necessary design elements in house.

Turnkey projects have three distinct phases that usually overlap each other. The first phase starts when the idea or the need for the project is brought forward. This is the preplanning before the project starts. In the preplanning, the scope of the project can be considerably more extensive than when the project starts. After the preplanning, the next phase consists of the day-to-day or week-to-week activities of the project. In this phase the whole of the project is designed and built and the product is handed to the customer. Finally, after the active phase of the project comes post project activities, which can be anything from guarantee period maintenance to life cycle managing. (Hailey 2016, 48.)

2.4 Turnkey and customer value

In this chapter, the concept of customer value and the positive and negative side of turnkey deliveries within that frame are further elaborated. Value of something cannot only be described as the monetary worth of a product (Carter 2020, 18) or a service. Especially in design/build or turnkey projects one must consider the deeper meaning of value and broaden the scope of the definition. Turnkey projects have distinguishable long- and short-term gains and losses to the customer, thus customer value is time dependent.

These factors of the created value are defined in this thesis as benefits and sacrifices that jointly determine the value created for the customer. They can be divided into short- and long-term factors and are described in more detail in Tables 1 and 2.

Table 1. Short-term benefits and sacrifices (Ahola 2008, 90)

Benefits	Sacrifices
Product performance	Price
product reliability	Delayed deliveries
product consistency	Repair and maintenance
product quality	Inventory management
Product customization	Order-handling
on-time delivery	Incoming inspections
delivery flexibility	Manufacturing
Accuracy of delivery	Time/effort/energy
Efficient delivery	Conflicts
Problem solving	Information collection about suppliers
Product-related services	Negotiations
Training programs	Drawing up the contract
Service flexibility	Establishing delivery procedures
Product testing and validation	Logistics
Customer information	Installation
Outsourcing of activities	Ordering costs
Business critical communication	Monitoring supplier performance
Support for customer in early project definition phase to create optimal outcome	Coordinating and communicating with supplier
Incremental innovation enhancing efficiency	Internal coordination

Table 2. Long-term benefits and sacrifices (Ahola 2008, 90)

Benefits	Sacrifices
Image	Risk that the supplier will lose its competitiveness
Trust	Risk that the supplier will behave opportunistically
Solidarity	Customers' R&D function may suffer
Mutual goals	
Prototype development	
Innovations and new solutions supporting customers' business	
Radical innovations opening new business opportunities	
Design tasks	
Alternative solutions	
Warranties	
After-purchase services	

Later, this thesis aims to use these factors as guidelines in the development of the turnkey handbook.

3 MANAGING A TURNKEY PROJECT

In this chapter the core principles of managing a successful turnkey project are explained. Even though project deliveries are made in multiple markets and different fields of technology, numerous points discussed here are universal to project management in general.

3.1 Project initiation

At the beginning of a project, it is important to define who are the stakeholders of the project, what is being delivered, and why. These factors and preliminary budgets, project risks, milestones, and requirements for approval are usually described in a project charter. A project charter is drafted for and by the project manager and sponsor of the project to clarify the aforementioned factors driving and defining the project. (Wells & Kloppenborg 2018, 24.) The project charter is a necessary part of starting the project as it works as an initial agreement between the project team and the project sponsor so that further work and resources can be used in more detailed planning and launching of the project. When the decision is made to initiate and go forth with the more detailed planning of the project, the project manager and the project team create a project plan.

3.2 Project planning

Success of a project depends on achieving what the sponsor and key stakeholders perceive as defining success factors and answering to the set of constraints that affect the project. These factors are also known as critical success factors and project constraints. Project managers and project teams have a lot of power over the specifics of the project plan but cannot change the constraints regulating the delivery or the objectives set by sponsors and key stakeholders when first conceiving the project. (Worsley & Worsley 2018, 7.)

When planning to answer the constraints and critical success factors, there are different kinds of processes in creating a project plan. In this thesis, the focus is on the process defined in (the book) *Adaptive Project Planning* by Worsley and

Worsley (2018). They explain the method of planning a project delivery after the constraints have been determined as shown below in Figure 1.

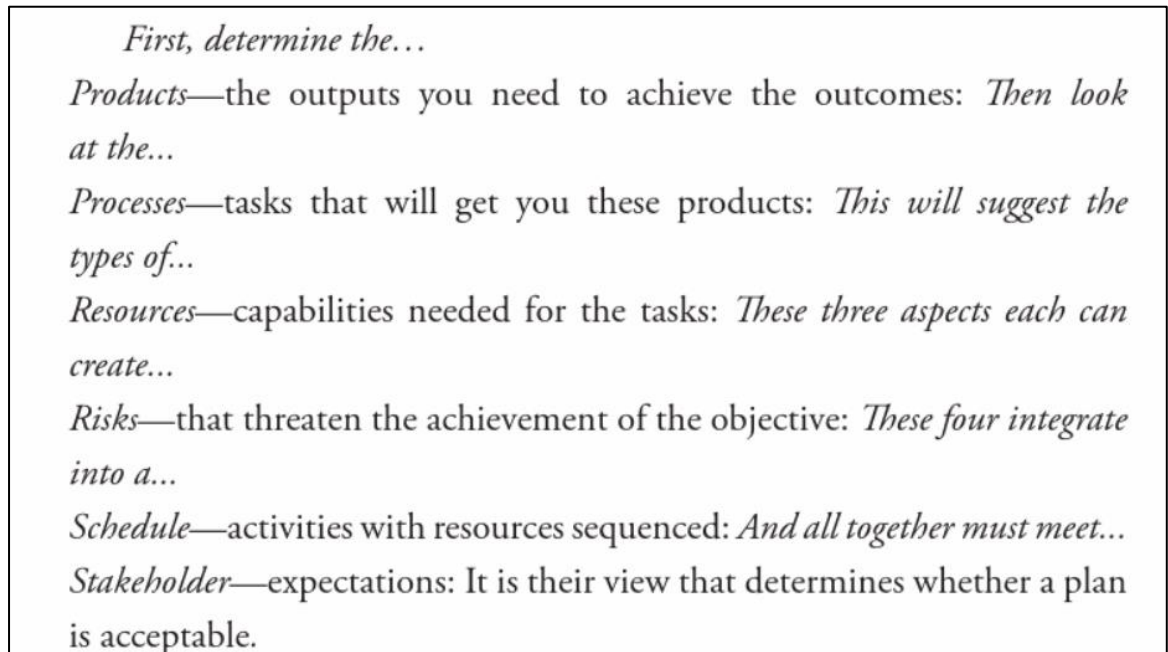


Figure 1. Steps in project plan creation (Worsley & Worsley 2018)

3.2.1 Products

Usually in construction industry products is understood as the buildings and built environment. When delivering a turnkey project, instead of seeing the result as the only product being delivered, the entire process of delivery needs to be seen as a product that must bring value to the customer. Therefore, it is important to recognize that the delivery starts with determining the outcome with the customer.

3.2.2 Processes

When the desired outcome is clear to all stakeholders, project managers will need to determine how this outcome can be achieved. Typically, every process has three phases, product definition, product manufacture, and product use (Atkin et al. 2003, 4). Defining needed tasks for all these phases should be a part in every comprehensive project plan. Below Figures 2 and 3 present examples on how a turnkey process might work for a contractor and a customer.

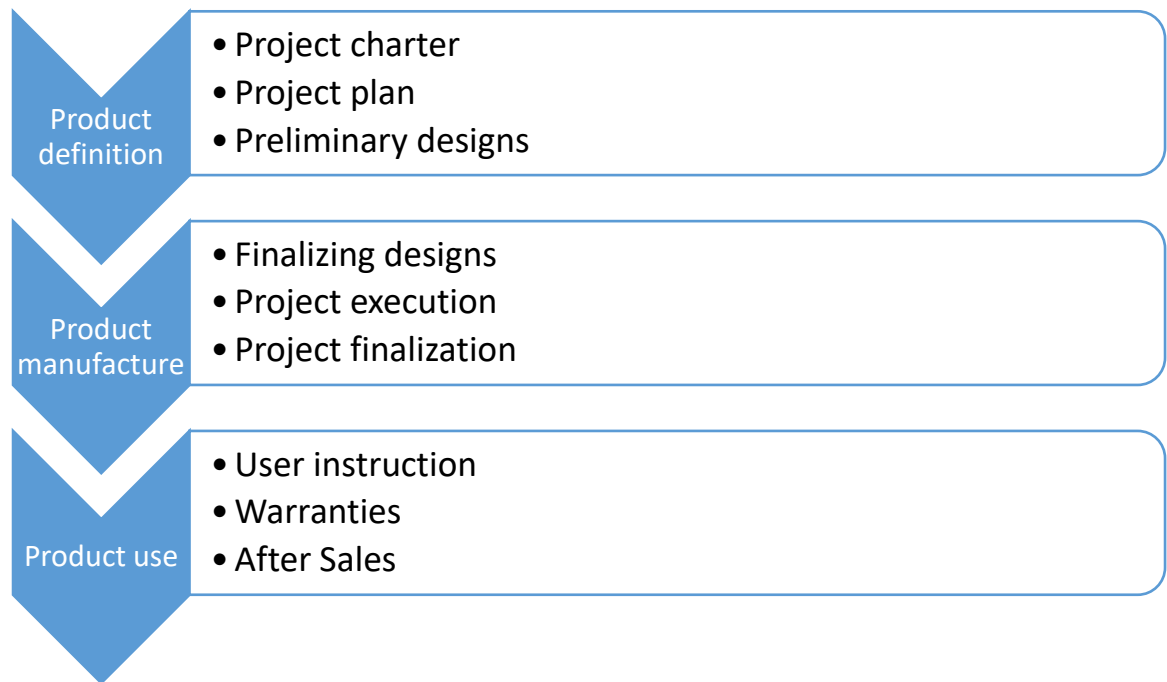


Figure 2. Turnkey contractor process flow chart

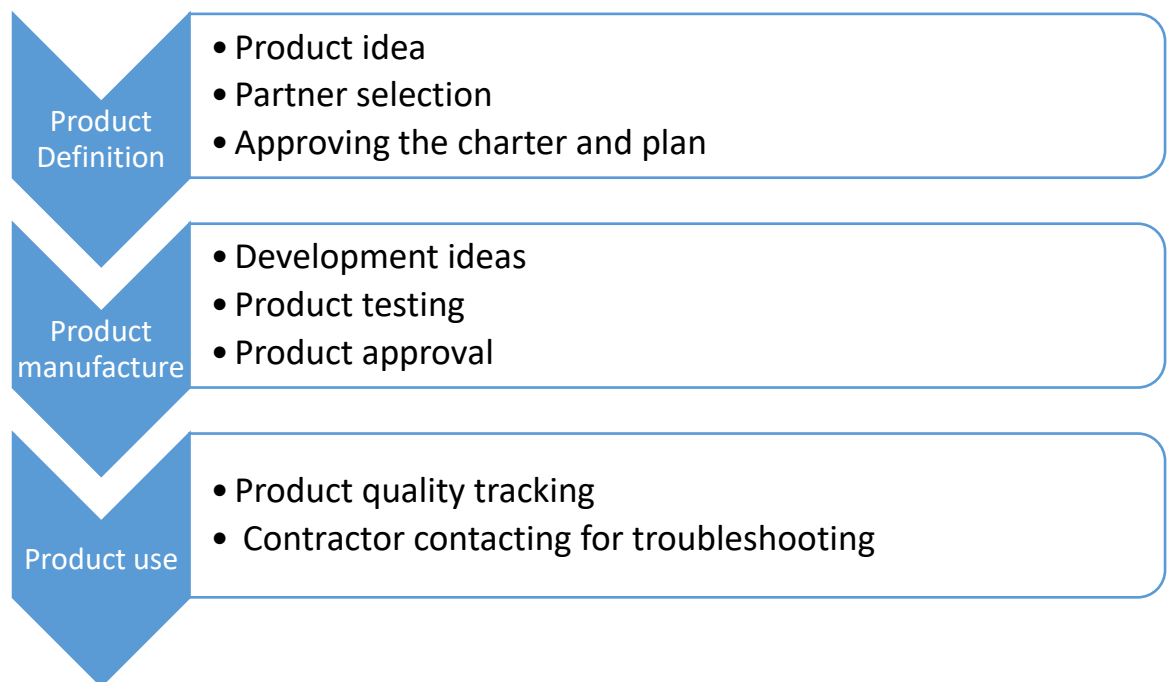


Figure 3. Turnkey customer process flow chart

3.2.3 Resources

When the product and process have been outlined, the next phase is to recognize what resources are needed to implement the process that will lead to

the completion of the product. When determining resources in a project plan, project management must recognize critical resources and plan the use of resources accordingly to ensure that those resources are available for the project. Resources can be people, machinery, tools, materials, capital, or facilities. Resource management requires a comprehensive resource plan because allocation of resources has a direct link with project duration. (Mäntyneva 2016, 54.)

3.2.4 Risks

Every project has paths that lead to success and failure. When planning a project, project management needs to recognize these paths and pinpoint what are the elements that lead to success or failure. These are known as project constraints. A good rule of thumb is that a change in one of these constraints will affect at least one of the other constraints. A project plan should include a risk management plan that describes how risks or constraints are recognized, what is the severity and probability of risks, how risks are monitored and managed, how known risks are documented, and which risks are stakeholders informed about and when. (Mäntyneva 2016, 132.) There are several ways to recognize project risks, but the most usual way is a combination of brainstorming, interviews, and expert judgment (Michael & Bissonette 2016, 54.) Figure 4 shows a way to categorize a risk by its probability and impact.

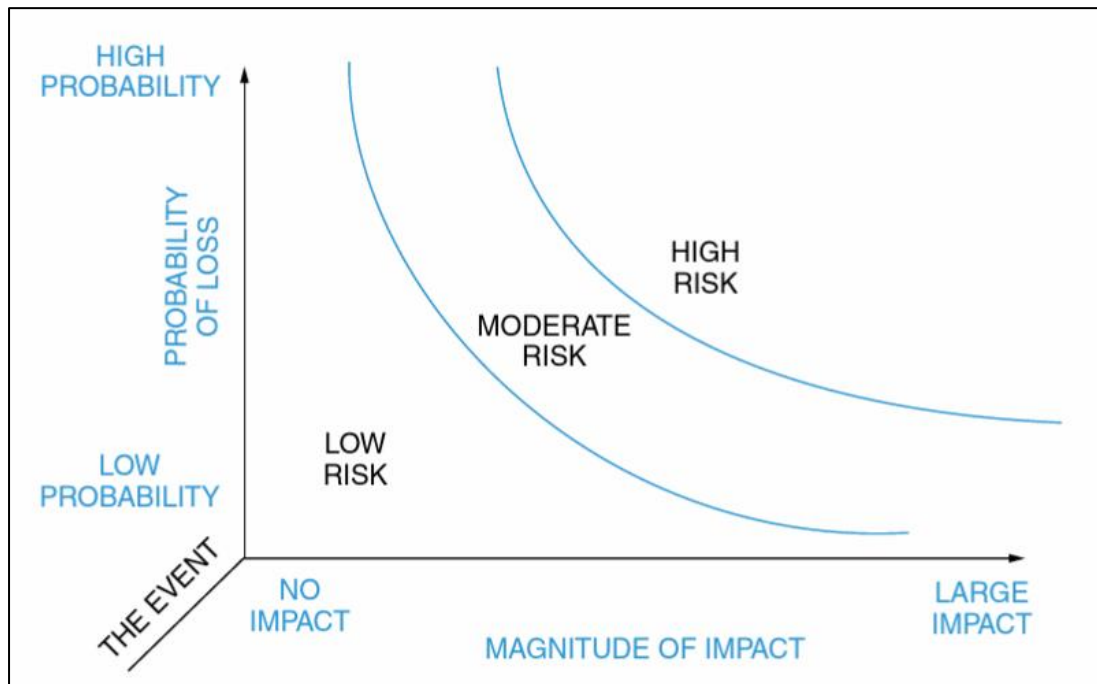


Figure 4. Risk matrix (Kerzner 2013, 874)

3.2.5 Schedule

A schedule does not just tell the start and end dates of the project. Before creating a working schedule, the project management must first distinguish the components that describe the different phases and tasks needed to complete the project. When these components are defined, they will provide the base for a project schedule. In a schedule, these components, and the connections between them are recognized, and time allocations are given for each task and then set on a timeline. Then the component with the latest end time gives the end date of the whole project. (Mubarak 2015, 5.) In a project plan, schedules do not usually describe minute details, but instead, especially in longer projects, the schedule can be further defined during the delivery.

3.2.6 Stakeholders

Understanding project stakeholders is a key part of project planning. A project plan should, by addressing the previous points, take into consideration the expectations and interests of stakeholders. Failure to meet those interests often leads to stakeholders challenging the project, and in a worst-case scenario, it could lead to project failure. (Marina & Pernille 2016, 17.)

3.3 Project execution

During the project execution phase, the project plan implementation is started. Not only does project execution mean the phase of the project life cycle where most of the physical work is being done, but also a point where project management critically reviews the earlier plans and adjusts them accordingly to the needs of the project.

Usually in the execution phase the amount of people working in or for the project will increase. A project manager's role is to gather and guide the team into the best possible project team. Working towards the goal of completing the project requires comprehension of all the components that need to be delivered. This can be achieved through product breakdown structures (PBS) and work breakdown structures (WBS).

The product breakdown structure helps to define what the project needs to be completed from start to finish. The work breakdown structure tells us all the most important tasks between the start and end. This is depicted in Figure 5 where the first three boxes can be seen as the Product Breakdown level and the boxes after them as the Work Breakdown level.

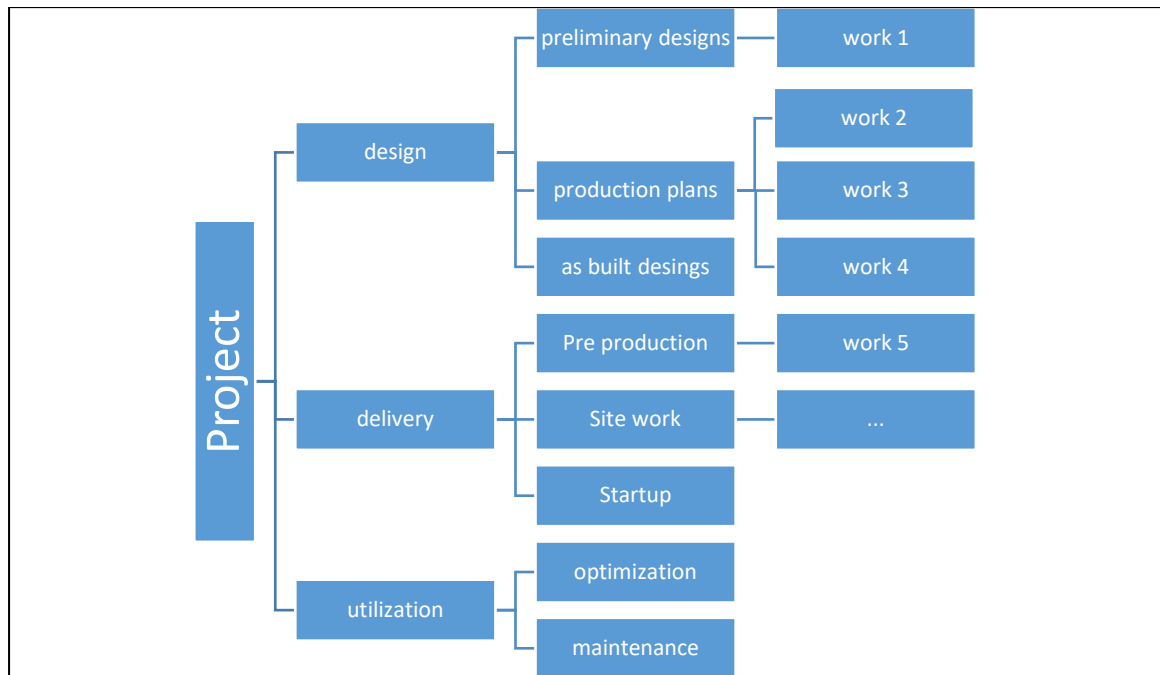


Figure 5. Product Breakdown Structure and Work Breakdown Structure

3.3.1 Success factors

Most commonly projects are deemed successful when they fulfil the criteria of satisfying stakeholder groups, meet functional requirements, meet quality expectations and requirements, all this within cost, and within deadline. In addition, a successful project delivers sustained and actual benefits and provides the team with professional satisfaction and learning (Camilleri 2011, 14). However, success can mean different things to different groups and people.

From the project management perspective, a study by Spalek (2005) determines critical success factors. It found that the following six factors pertaining to project managers and teams can be named as the most critical in a succeeding project.

- formal establishing of project manager,
- project manager competencies,
- high authority of the project manager,
- the project goal set in a clear and measurable way,
- formally establishing a project team,
- top management support for the project.

The three first factors concern the same theme; critical success factors were assumed as:

- A competent project manager is formally established and has a high level of authority.
- The project goal is clearly defined.
- The project has an experienced and competent project team.
- The project has top management support.

The afore mentioned critical success factors ensure that the project is managed well and gets the support necessary to succeed.

3.3.2 Documenting

Documentation carries a significant role in project management. It keeps the project moving at a pace, ensures that all stakeholders are well-informed, and helps project organisations to develop their projects. Often well-made documents can be used repeatedly in new projects giving project managers more time for management instead of redoing all the work from previous projects.

Typically, a project consists of a few major phases, such as project initiation, planning execution, control, and closure. In an ideal situation, all these phases can be studied later by the documentation produced. A few most notable documents in a turnkey project a project manager or a team produced in these phases are listed in Table 3 (Verma 2024).

Table 3. Produced documentation in different project phases (Verma 2024)

Initiation	Planning	Execution	Control	Closure
Project charter	Requirement specification	Traceability matrix	Change management document	Technical document
Feasibility report	Designs	issue tracker	Test document	Functional Document
	Work plan/estimate			User manual
				Transition/rollout plan
				handover document
				contract closure
				lessons learnt

3.4 Project closing

In a turnkey project, the closing phase is no less important than any other steps taken before or during the delivery. The main stakeholders of the project need to be in accordance to declare the project complete. No unfinished work should be accepted as a finalized product. The project can be closed even if there are deficiencies to be corrected but these need to be minor enough that the project organisation can be disbanded without effect on completing fixes to these deficiencies. A project should be formally accepted by the customer, and the acceptance should be recorded with included lists of deficiencies and work to be finished as part of the project (Artto et al. 2011, 37).

4 PRACTICAL PROJECT MANAGEMENT HANDBOOK

In this chapter both the development process and the outcome of the project management handbook for geoenergy system deliveries are described. The process description introduces both the method and material used during the process and the outcome highlights the content of the handbook.

4.1 Methods and material

The main development method used in the thesis is benchmarking. Harper (n.d.) lists four types of benchmarking: performance, practice, internal, and external benchmarking. In this case, external practice benchmarking is applied because the study focuses on how an activity is conducted in other external organizations.

This handbook is created by benchmarking two project handbooks, a handbook made by PM² Alliance, and handbook by project management knowhow.com. After the benchmarking, the resulting content of this handbook was supplemented with the teachings of Kuster (et al. 2015) in their book Project Management handbook.

4.2 Content of the benchmarked project handbooks

The handbook made by PM² Alliance (PM² EU, 2024) is focused on producing a very comprehensive guide to managing a project during its lifecycle that also works as a point of reference to project parties and stakeholders. In more general terms, it can be used as a basis of a project plan. In their handbook, they have created a table of contents that has six headers which are listed below with their main contents.

First, they give a **project overview** that has a summary of the project being delivered. In this chapter, they also review the project's critical success factors and additional project management's objectives. After this, project stakeholders and aims to identify project dependencies or interrelations are discussed. The last topic in the first chapter are the projects constraints.

The second chapter is about **project approach**. This includes presenting the project lifecycle, and determining what the project management plans are necessary for the project. When those are determined other standards that the project needs to follow are reviewed. Next, specific project management rules to be applied in the project are established. Lastly in this chapter, instructions on how conflicts are resolved are given or escalated to necessary steps, detailed in a risk management plan.

The next chapter, details **project processes**. This starts with guidance to risk management followed by issue management. After this, the handbook has instructions on how requirements, project change, quality, configuration, communication, deliverables acceptance, transition, business implementation, and resources are managed.

Their fourth chapter focuses on **project progress measurement**. This chapter details how project progress is measured, how the project should be reported on, and what kind of checklists are needed to control and monitor the project. In the last chapter Project roles and responsibilities are discussed. This is done by creating a consolidated responsibilities assignment matrix and describing the roles and responsibilities.

The second handbook made by project management knowhow.com (project-management-knowhow.com 2022) describes the way they use the term as “a handbook describing a specific project.” The handbook is meant to be created at the earliest stages of the project and updated throughout the project. Their handbook chapters are sectioned to follow the phases of a project with an overview page with basic project information.

The first chapter in this handbook called Definition Phase explains the project vision, main stakeholders, project goal, project charter, requirements and specifications, minutes of project definition meetings, and ends as the completion of the first project milestone.

Their next chapter is called Planning phase and in this chapter project scope is clarified with a product breakdown structure, a Work Breakdown structure, and an effort estimation and first risk analysis. Next a project schedule is established by planning out project milestones, creating a network diagram, a Gantt chart and assigning resources. After this a project budget is created by creating an accumulated cost plan and a payment or sales plan.

Next in their planning phase chapter, a risk management plan is created following with a contract management plan. This chapter also reviews controlling tools needed for the project. Their project communication plan is the next step in this handbook followed by detailing the acceptance procedures. The chapter ends with the second milestone of the project which is contract negotiation.

The third chapter in this handbook is called Implementation Phase. In this chapter, the authors examine what documentation should be accumulated during project implementation. In their handbook they detail project meetings, event logs, changes and claims and preliminary acceptance as the different sorts of documentation created. Preliminary acceptance is also their third milestone and an end to implementation phase.

The fourth chapter of this handbook has basically the same information as the previous chapter, but it ends with the final acceptance and recording of all procedures. They instruct to calculate the final costs and profits in this chapter and investigate lessons learned during the project. This final chapter ends with the fourth milestone, end of closure phase.

4.3 Content of the project handbook for turnkey deliveries

The handbook produced in this thesis has adopted structures from both benchmarked handbooks. It has been divided into four chapters, Definition Phase, Planning Phase, Delivery phase, and Closure Phase. This handbook works as a guide for project managers working with turnkey projects. It can be used as a base for a project plan or as an introduction to turnkey projects. To

facilitate the use of this handbook, tips have been added to relevant sections and each chapter ends with a list of meetings with agendas necessary to its topic.

4.3.1 Definition Phase

When defining your project, it is important to answer the following questions:

- why is this project being undertaken?
- how does the project answer to the first question?
- what is the content that the project delivers?
- who is this project for?
- what do the project owners want from the project?
- what risks do they project owners bring to the project and how are they managed?
- what is required from the project results?

Answering these questions should give anyone coming in the project a clear understanding of the scope and impact of the project. It is good to note that in a turnkey project this phase is usually done in a close collaboration with the customer and often many of the answers get specified during the project. Project constraints can still be named early on. It also should be possible to define, what are the projects critical success factors as early as possible in the definition of the project, so it can be planned to fulfill those criteria.

Tip: Make a document that has your project definition and answers to the earlier questions. Use this as the preface for your project plan.

Since a turnkey project requires a lot of work to be done without the knowledge that the project is going to be finalized. It is important to have a preliminary sales agreement with the customer. This should cover any preliminary designs and all work that can be delivered to the customer by the end of the definition phase.

Tip: In Finnish construction sector, RT 80368 can be used as a preliminary sales agreement.

Definition phase meetings:

- Project concept meeting is held with customers to define the core principles of the project and answer why is the project being undertaken and how the project will resolve the problems it is done for. In this meeting, the project manager and customer seek to define the rough outlines of the deliverables of the project and their requirements.
- Preliminary Sales Agreement
This can be a part of the first meeting, but it often needs to be prepared based on the agreed upon details of the project concept meeting.
- Preliminary design acceptance and Project start acceptance or rejection.
At the end of the definition phase the project manager and customer will go through the preliminary designs and other evaluations on project feasibility. Based on these the customer and project management decide upon project start, or rejection. At this point, the project will continue to be worked on under the Preliminary Sales Agreement, until final quotation is given in the planning phase, at which point the customer still can decline the project.

4.3.2 Planning Phase

When your turnkey project has been defined with the customer, it enters the planning phase in which usually the requirements of the project are specified further, to a shape in which they can be answered in the project. This should be started with clearly determining the project scope, with methods like the Product Breakdown Structure (PBS) and Work Breakdown Structure (WBS). At this stage the first risk assessments should also be made. Creating a WBS, will give you the necessary details for creating a schedule and a budget for your project. Going through these steps will help you to come up with necessary milestones for your project. Listing your milestones from start to finish will create a good basis for an instalment table. Your milestones can be for example:

- project start
- project contract conclusion
- kick-off
- preliminary acceptance
- project acceptance
- follow-up

Creating a schedule for your project is also an important part of the delivery process and even though a rough timeline has been developed during the definition phase you should go to more detail when planning for the delivery.

Tip: In your schedule you should have the same points as your payment plan. This will make it easier to see how your project is advancing and which instalments are ready to be billed.

Methods like Critical Path (CPM) and Program Evaluation and Review Technique (PERT) are some of the most used scheduling techniques in project management. They are used to calculate the time span of the project based on its scope. In small and simple projects, the schedule can be as simple as a task list. Often in delivery projects, a Gantt chart is used to visualize a schedule. In complex projects this can become difficult when there are a lot of work packets to include.

Tip: Workshop with stakeholders and subcontractors where everyone gets to participate in scheduling the work. This helps in getting more accurate timeframes for work packets and leads to less assumptions.

At this stage you should also detail your projects resource needs. Usually, its easiest to list your needed internal and external resources and write down when each resource is needed and for how long. If possible, the most required resources should be booked and reserved for the project in the planning phase. Your Resource Management Plan should include these details on the most critical resources for the project.

Scheduling and resource management are a key part of following your project progress. Most often project progress is measured in a financial and work progress sense. This means that a project can be evaluated in so many ways that it is not possible to implement all methods in one project. That means that it is helpful to choose a method or two that best present your actual project progress.

For example, in a construction project it is easy to measure how much it is going to cost to build a house, or at least roughly estimate the costs. Then as building moves forward and some of the costs have been covered you can evaluate how much of your budget has been used. Which should give an idea of the amount of work that has been completed.

A more complex way to estimate the amount of work that has been completed is for example to use Earned Value Analysis. This method relies heavily on a comprehensive project plan and a complete WBS. It works by giving all work an estimated cost and an estimate of physical work done, this is called Planned Value. This then is measured against costs accumulated during the project or a part of it and is called Actual Cost. And lastly, the earned value is measured by estimating the amount of actual physical work done. Earned value management systems (EVMS) This gives a comprehensive idea of the actual state of the project given that all the prerequisite steps have been made with care.

Often in the planning phase, the budget of a turnkey project should be quite simple to create. The preliminary plans have been made, and most of the work should be easily definable. This should give you quite accurate details on the costs of project delivery. This we call accumulated project cost plan when making this table you should use your work breakdown structure and assign a cost to each work packet. As a part of your budget, you need to create an instalment table or a Project Payment Plan. You can use work packets as the base of your instalment table. At this point you also have assigned a time frame for each work packet and have a schedule when they will be started and finished, so you should date each instalment in your table. This will help when forecasting your project sales.

Tip: When creating your budget and project payment plan. It is useful to make each instalment of the payment plan to describe the cost and complexity of the task it describes.

Managing risks is an integral part of project management and you should plan accordingly. Easiest way to create your risk management plan is to workshop and

interview all major parties involved in the project. This way most project risks can be identified. After identification of the risks, you need to evaluate if they pose a large or small risk to the project. This is done by assigning a probability of loss, and impact on the project to each risk. If a project has a high potential for loss and a big impact on the project, it is a high risk. If the risk has low potential and low impact on the project, it is a low risk.

In your risk management plan, you should list the most probable risks and their impacts and what is being done to mitigate them. Also, you'll need to include instructions on how to recognize, assess, respond, and control risks. You can include your Project Communication Plan in your Risk Management Plan. This details how project events are communicated, to whom and when.

Tip: Create a plan on risk and constraint communication methods towards stakeholders. Often its best to share most information, but not all information is necessary to everyone.

At this point in the process, the contract for the turnkey delivery as well as most contracts with subcontractors and other developers are made. As a project manager you should plan on how change and deviations are recorded and approved. What is the procedure for notifications in case of deviations, and how claims are settled. Some of these things might be impossible for the project manager to decide upon, but planning and creating a procedure for these eventualities is still important.

Usually, it is beneficial to have the project manager be a part in drafting the contracts of the projects they're working on. Project plans should include details on contracts, filing, and necessary attachments for contracts. When drafting the contract being it the main contract about the delivery or a subcontractor contract, it is important to try and have all the things that have been agreed upon as clear as possible. The contract should describe the delivery or a part of it in such detail that everything the contractor is needed to deliver is included. For a turnkey delivery organization contract limits are also important, and they should be clearly

marked out in the implementation designs and in a written document as a contract attachment.

Tip: In a contract you should never use phrases that are easily misunderstood. Try to describe every detail as clearly as possible and if possible, go through the details and how they are interpreted with the other parties involved and create a memorandum of this as an attachment.

Planning your project also means that the results need to be measured. For this we develop Acceptance Procedures. This means that every part of the project that needs acceptance and its approver are detailed. You should also create the methods of approval beforehand.

A Quality Management Plan is a useful tool to assure that the project is accepted. In a Quality Management Plan you should define quality characteristics, detail how quality assurance is done, create checklists for quality control checks, detail when deliverables are ready to be accepted, and instruct at what point the deliverables can achieve final acceptance.

Tip: Create checklist for necessary documentation that need to be created during the Planning Phase. This should include all the management plans created for your project and necessary documentation for quality, risk and, acceptance procedures during the Delivery Phase. An example of this is shown in Table 4.

Table 4. Planning Phase documentation checklist.

Document	Yes/no	Person in charge	If No, short explanation
<i>Project Plan</i>	<i>yes</i>	<i>Project manager</i>	
<i>Risk management plan</i>	<i>no</i>	<i>Project manager</i>	<i>Risk assessment workshops ongoing</i>
<i>Quality management plan</i>	<i>yes</i>	<i>Quality officer</i>	
<i>Schedule</i>	<i>yes</i>		
<i>PBS</i>			
<i>Budget</i>			
<i>Payment Plan</i>			
<i>etc.</i>			

Typically, a planning phase consists of the following meetings:

- Implementation design control, often the turnkey deliverer will have control over design decisions so design control must be handled by the project manager.
- Quotation and project contract drafting. After implementation designs have been completed, a WBS has been created and the first risk assessment made the final quotation on the turnkey project can be given. Based on this the customer can decide if they will go forward with the project and a project contract can be drafted.
- Contract negotiations. Based on the drafted contract its normal to go through the schedule, implementation designs, payment plans, quality management, and risk management plans as well as any other required documentation before moving forward with signing the contract.
- Risk Assessment, this might not need to be a meeting but workshopping and brainstorming risks for a risk management plan must be documented and filed.

4.3.3 Delivery Phase

A turnkey project usually starts with a lot of planning and meetings. Therefore, it is important at the start of the actual labor to hold a start-up or kick-off meeting. In this meeting, all the parties involved should attend, and go through the project

schedule, budget, risks, quality management, and other important points. This will work as a reminder for the project team and stakeholders and can also work as a milestone for the project. At the latest at this point, it should be agreed upon how often project status meetings are held. In Project Status Meetings the project progress should be evaluated and possible changes and other project events and their impacts on the project noted.

Project risks should be monitored during the whole duration of the project. An easy way of making sure that this happens is making risk analysis a part of the project status meeting agenda. This means following up on risks already recognized and monitoring the mitigation of those risks. Recognizing new risks as they become apparent and making sure they are mitigated as needed. Following project progress requires documentation and reporting. These documents and reports should be described and specified in your project plan. Documentation should include all pertinent emails as well. Most documentation and reports are based on management plans made in the planning phase.

Tip: Create a document management plan, in which you detail where documents are filed and how documents should be named. This management plan needs to be accepted by all project team members. It will save a lot of time when final project documentation is being gathered.

Few projects go through their life cycle without experiencing some sort of change. For this reason, in the planning phase, we have created steps to help us manage change, constraints, and risks. To manage these things, we must know how to recognize them and which of them can be solved by the project manager and project team, and which need to be resolved by the customer or other stakeholders. Usually in a turnkey project the project deliverer handles most changes internally because the customer has given the deliverer most of the power over designs.

Subcontractor claims and changes should be processed as soon as they emerge. These claims and changes need to be documented and all changes with possible effects on the project need to be approved in a written form before they are made.

Tip: It is important to recognize the magnitude of a change or claim. Therefore, they need to be documented clearly and as many possible effects it might have on the project are recognized as early as possible.

When project delivery nears its completion, it is important to document that the deliverable product meets all requirements set by the customer and project definition. In the planning phase the acceptance process and requirements have been detailed and in the delivery phase they are documented. This documentation needs to be worked on for the duration of the project and final testing with the customer and configuration of all project systems needs to be done before acceptance for delivery is proposed.

During a delivery phase following meetings should be held:

- In a kick-off meeting, the customer, project team and all necessary stakeholders are invited to start the physical delivery of the project and together go through the project step-by-step.
- Project status meetings are to be held as needed by the project, but at least one should be held before project acceptance is sought.
- In risk management meetings, project risks are monitored for the duration of the project and can be discussed in project status meetings but should there be a lot of high risks or if a lot of new risks are recognized during delivery risk management meetings can be held as necessary.
- Quality management, testing and configuration meetings are held for the whole duration of the project and if the project delivery has distinct phases or parts each should have its own meetings.
- Preliminary acceptance can be sought from the customer after all the final testing and configuration are done, and this should be documented.

4.3.4 Closure Phase

The line where a project moves to its Closure Phase can be hard to determine but it can be defined as the point when most of the project delivery is completed, and the customer has with conditions accepted the outcome of the project. In the

closure phase all the documentation of the project is completed, and final acceptance is sought.

Closing a project means that the outcome or deliverables of the project are handed over to the customer. At this stage the project team introduces the customer organisation in the use and maintenance of the deliverables. This hand over needs to be documented and repeated as many times as needed until the users are proficient enough so that the project organisation is no longer needed.

Tip: Create a plan for hand over events and have it accepted by the customer and users. Have the users sign for the different parts after having received introduction to them to keep track of introduced personnel.

When all the project costs and sales have accumulated the final costs and revenue of the project can be calculated. This should be done as soon as possible, but not until all costs, sales and extra work has been completed and billed. Usually at the end of a project, final financial reports are made with the customer and subcontractors. Before these are done, the final revenue cannot be calculated.

After calculating the revenue of a project, it is possible to measure this against all the preliminary calculations. This ties into learning about every project undertaken and helps the organization to develop more accurate quotations in the future. Every project can lead to learning and development of project processes. It is important to take the time to analyse and record project successes and failures to help future projects and project managers. Holding a lessons-learned meeting with the customer is also a good point to gather customer feedback.

Often at the end of a turnkey project, the responsibility of upkeep and maintenance is transferred to the customer. However, some or all maintenance responsibilities may remain with the deliverer. These responsibilities should be

documented, and all necessary follow-ups planned before dissolving the project organization.

Tip: Name a person responsible for troubleshooting and assistance for the customer. This should be a person with enough knowledge to help with most issues arising in the use of the deliverables. It is also a good way to increase after sales when the customer has a reliable personal connection within the project organization.

Closing the project also requires the final acceptance of the customer. Therefore, no unfinished parts of the project can be accepted by the project management from own work or subcontractors. Some work can be left to be finished after the project has closed, but this needs to be minor enough that the project is not needed for its completion. After all the work is completed and accepted by all project stakeholders, it can receive final acceptance.

Tip: List all the work that is left after the project closes and assign responsibility to individuals on their completion. Often the minor details that are left after the project closes are the hardest to get fixed.

A Closing Phase contains the following meetings:

- In hand over meetings, the project team teaches users and maintenance personnel to use the project deliverables. In simpler projects one may suffice, but handing over more complicated projects usually require more meetings.
- Final Acceptance is sought when the customer accepts the outcome of the project and is the last point at which claims are made.
- Final Financial report is discussed in a meeting after all the costs and sales have been billed and all claims settled the final financial report can be made.
- In a lesson learned meeting, project successes and failures are listed, documented, and filed. This can be done separately for customers and the project team.
- In a follow-up meeting or meetings, the customer and necessary stakeholders meet after some time the project has finished to make sure the project has met its requirements.

5 FINDINGS AND FURTHER DEVELOPMENT

Working on this thesis has highlighted that not only is it important to prepare your projects with care but also the processes and supporting factors inside a project organisation play a big part in successful project deliveries. Project managers and project organisations play a significant role in many different fields and though the principles of project management and project deliveries have been studied for a long time there remains room for improvement.

Project deliveries are developing constantly and customer and social preferences on projects are changing. This drives the need for more agile project organisations that can offer a variety of different project delivery methods and keep a good track record of their deliveries. Projects are inherently by definition all different and project delivery organisations, project management companies, and customers need now and, in the future, keep developing new methods to find best possible solutions for different project deliveries. Many long-standing delivery methods work in modern projects, but the needs of projects and understanding of project business have grown, which leads to the need for development of new and more integrated project delivery systems.

On a personal level, creating a project management handbook has helped me in pointing out my own shortfalls in project management and to develop the skills needed to be more successful as a manager. It has given deeper insight into differing methods of tackling project tasks and helped in creating new outlooks on project decision-making. Developing this handbook and the research necessary for its creation has left me with a better understanding of project management and project delivery systems.

Based on my experience mainly from Finnish construction sector projects it would seem beneficial to further develop instructions for project organisations in their organisational structures and processes to better facilitate different project deliveries.

After working on this thesis, I find that an area in which more research needs to be made is assessment of work in progress calculations and forecasting. Especially in construction projects, work in progress is often described by estimating the completed work in percentages, but this method has room for improvement.

Further study would also be beneficial in how construction project management organisations could structure their organisations outside of division between different areas of expertise. In my experience, many project management organisations and project delivery organisations are structured in a way that could be developed to better help project team members to work on their projects.

There might be possibilities in organising project delivery and management organisations in a way that makes the projects more accountable on company success instead of dividing responsibility by creating teams and departments that have little influence over project success.

This could lead to project teams being more invested in making their projects succeed instead of focusing on department or sector profitability.

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