Chapter 4

Management and Leadership in Construction Project

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4.1. CONSTRUCTION PROJECT MANAGEMENT

Construction project management requires a wide range of skills. Not only one should be technically innovative but also have expertise of various leadership and communication skills. Construction project management has been defined in different ways, but, in general, regardless of the nature of the project there always should be a person or several persons who are fully aware in which state the project is.

Very straightforward example would be to design and build a small house for a dog. At first it sounds like a very easy task. However, it includes the same principles and stages as larger building projects in which one can make several mistakes.

This kind of task was given a few years back to our first term construction engineering students. Majority of the students did not have previous experience of designing buildings at all. One might think, what was the purpose of this task? There are hundreds of different kinds of dogs. From tiny ones up to large breeds such as St Bernard. In this case the customer is a dog with different kind of needs. Firstly, one should know what are the needs of your customer. Some original wild breeds would use your design doghouse roof top only for observing what is going on in the neighbourhood. The next step is to figure out environmental conditions. What is the climate zone, size of a plot, neighbourhood, average temperature, yearly rainfall, heating need, sustainable healthy materials, foundation, floor, frame and roof structures which would last the design lifetime of the building? Interestingly, there were as many different solutions to this task as there were students.

Before diving deeper into project management, it is necessary to define the term 'project'. According to Cambridge Dictionary it is: "A piece of planned work or activity that is finished over a period of time and intended to achieve a particular purpose." In construction industry a project is temporary and

has a defined beginning and end. Therefore a project has a defined scope and precisely estimated resources. Traditionally construction projects are unique (Fig. 4.1), and people from different organizations and locations are working together only once for the very project.

In general, there are three sectors of construction: buildings, infrastructure and industrial. Building construction is usually further divided into residential and non-residential. Infrastructure, also called heavy civil or heavy engineering, includes large public works, dams, bridges, highways, railways, water or wastewater and utility distribution. Industrial construction includes offshore construction (mainly of energy installations), mining and quarrying, refineries, chemical processing, power generation, mills and manufacturing plants.

In this chapter we are mainly focusing on residential and non-residential buildings, which allows us to study more about how to manage buildings that are meant to be lived in.

Fig. 4.1. Snow Castle Bar from plane ice, Levi Mountain resort in Finnish Lapland, 12/2020.

4.2. CONSTRUCTION PROJECT STAGES

Construction management or construction project management (CPM) is the overall planning, coordination and control of a project from the beginning to completion (Fig. 4.2). CPM is aimed at meeting a client's requirement to produce a functionally and financially viable project.

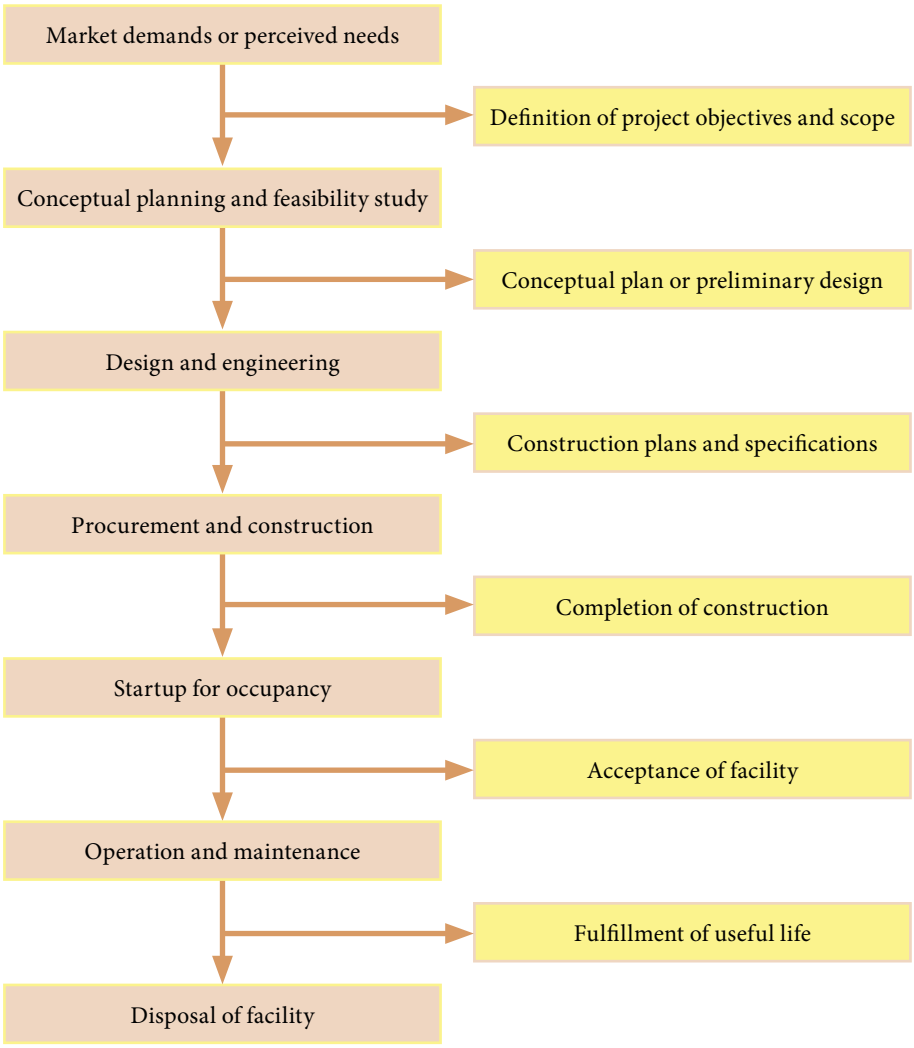

Fig. 4.2. Project life cycle of a constructed facility (Hendrickson, 2008).

Of course, the stages of development in Fig. 4.2 may not be strictly sequential. Some of the stages require iteration, and others may be carried out in parallel or with overlapping time frames, depending on the nature, size and urgency of the project. Furthermore, an owner may have in-house capacities to handle the work in every stage of the entire process, or it may seek professional advice and services for the work in all stages. Understandably, most owners choose to handle some of the work in-house and to contract outside professional services for other components of the work as needed. By examining the project life cycle from an owner's perspective, we can focus on the proper roles of various activities and participants in all stages regardless of the contractual arrangements for different types of work.

4.2.1. Feasibility Study and Design

Feasibility studies are preliminary studies undertaken in the very early stage of a project. They tend to be carried out when a project is large or complex, or where there is some doubt or controversy regarding the proposed development. If an environmental impact assessment (EIA) is required, this may involve assessments best undertaken as part of feasibility studies (Designing Buildings Wiki, n. d.). Property developer would firstly start finding the right spot for the project. Same housing project in a wrong place can be financially disastrous. In general, construction costs are almost the same regardless of the location in the country. Naturally, increased logistics and extra foundation costs will make a difference, but more importantly the price of land.

The purpose of feasibility studies is to:

- establish whether the project is viable;
- help identify feasible options;
- assist in the development of other project documentation such as the business case, project execution plan and strategic brief (Designing Buildings Wiki, n. d.).

For large or complex projects, there may be a few different feasibility studies carried out, sometimes requiring different skills and considering issues such as:

- planning permission;
- the likelihood that an environmental impact assessment will be required;

- other legal / statutory approvals;
- analysis of the budget relative to client requirements;
- assessment of the potential to re-use existing facilities or doing nothing rather than building new facilities;
- assessment of any site information provided by the client;
- site appraisals, including geotechnical studies, assessment of any contamination, availability of services, uses of adjoining land, easements and restrictive covenants, environmental impact, and so on;
- considering different solutions to accessing potential sites;
- analysis of accommodation that might be included or excluded;
- assessment of the possible juxtaposition of accommodation and preparing basic stacking diagrams;
- evaluation of operational and maintenance issues;
- appraisal of servicing strategies;
- program considerations;
- procurement options (Designing Buildings Wiki, n. d.).

Various stakeholders, statutory authorities and other third parties may need to be consulted during the preparation of feasibility studies. The assessments carried out should be presented in a structured way so the client can decide whether to proceed to the next stage. Wherever possible, any information prepared or obtained should be in a format that can be readily shared and used and should be stored and named in a way consistent with the long-term project and operational needs (Designing Buildings Wiki, n. d.).

4.2.2. Bid and Tendering

A bid is given to the owner by construction managers that are willing to complete their construction project. A bid tells the owner how much money they should expect to pay the construction company for them to complete the project. Bids are either open or closed. An open bid is generally used for public projects. Contractors can submit their bid due to public advertising. Majority of contractors in private projects are chosen via closed bids. A selection of contractors is sent an invitation for bid without advertising the project openly. It is benefactory to have longer co-operation with contractors.

4.2.3. Selection of Contractor

Selecting a contractor is one of the most difficult aspects of project management. It is why most large companies have an entire department hired for project procurement. Contractors want the work, but how do we know they are not too busy and will start our project later than agreed? How do we know they are as capable as they say? (Roseke, 2019).

There are several ways of choosing a contractor when considering the bid by the following criteria:

- least cost;
- qualifications only;
- quality and cost based;
- quality based;
- sole source;
- fixed budget (Roseke, 2019).

The most basic and intuitive method is to choose a vendor based on cost alone. This is how most construction and trades are chosen. Using price as the sole selection criterion should be limited to situations where the work is relatively well defined and understood by the contractors. Otherwise, they are likely to inspect the contract documents extremely carefully and ensure that their price addresses the risk of project changes (Roseke, 2019). If the tender process is hasty, it may happen that one gets only one or two offers out of ten.

In the following case, old museum school roof cover needed to be changed. The school was built from logs roughly 120 years ago and the sheet metal covered roof was at the end of its life cycle. The project budget was 120 000 €. The cost of the first offer was 168 000 €, which was far from the estimated cost. The cost of the second offer was 98 000 €, which enabled to proceed with the contract. The whole building had to be covered due to weather conditions and the nature of the project, as shown in Fig. 4.3. Scaffoldings were erected next to the building, and steel trusses + tarpaulins covered the upper part. In this way the old building was safe from rain and sleet. Conditions for roofing were nearly perfect as well.

However, the contractor can be chosen based on their qualifications only, without any consideration of cost. Firstly, the contractors are asked to provide information on their methodology for performing the work, including scheduling and methods for ensuring project safety and quality. Secondly, the

contractors are asked to provide information on their project team, including professional resumes and a listing of relevant work experience. These can be assessed to provide a score for the project team. Information on past projects that the company or project team has performed can provide confidence in the quality of work the contractor will produce. This information can be provided in any format preferred by the contractor if the relevant information is produced. Items like location, cost, size, completion date, duration, and a brief project description can be requested to obtain the context.

Naturally, the price is established prior to performing the work, but it does not factor into the contractor selection. The contractor is selected based on the qualifications and then requested to provide a price after they are informed that they will be performing the work. This is generally limited to small projects, or small portions of larger projects that have a low likelihood of having a significant impact on the project budget. Because it is unknown whether the chosen contractor's price is reasonable relative to the others, it is used where qualifications are worth significantly more than the price.

In fixed budget the owner specifies the price, and the contractor adjusts the scope of work to that. They might remove items that are considered by the

Fig. 4.3. Old school roof renovation for weather protection at Padasjoki, 10/2020.

owner to be critical to the project. This method is rarely used, but when we wish to perform whatever work is possible within the budget, it is available as an option. Unlike the other methods, the contractor is writing out the scope of work rather than determining a price. Hence, the document should be reviewed and negotiated to ensure that all stakeholders are clear on what work is included.

4.2.4. Pre-construction

The pre-construction phase includes all the activities in a construction project that occur prior to construction. From the moment a project begins to the time you are ready to start construction you are in the pre-construction phase. During the pre-construction phase a strategic plan must be created, a budget and timeline must be agreed upon, a design for the project is begun and finalized, permission is acquired, and procurement of both labour and resources occurs. If the project is complex or rear, it normally means difficulties all the way from the beginning to the end. Berlin-Brandenburg airport recently opened nine years later than originally planned. Construction work of Olkiluoto-3 Nuclear Power station started in 2005 and it has not been finished yet, just to mention a few extreme examples. On the other hand, if everything goes smoothly from the start, the results can also be praised by critics. Travel centre and fuel station at Niemenharju (Fig. 4.4) was selected as the most beautiful fuel station in 2017 by DesignCurial.

Fig. 4.4. The most beautiful fuel station of 2017. Glulam and CLT structure. 12/2020.

4.3. MANAGEMENT AND LEADERSHIP

There is a significant, yet unclear difference between management and leadership. When discussing these concepts, it is useful to clarify which one is under surveillance. The terms of management and leadership are often used interchangeably. Bennis and Townsend (1995) have written a famous yet controversial quote of the difference: "Leaders are people who do the right things, and managers are people who do things right". Comparison is straightforward and oversimplistic but gives an idea of the division. Leaders are interested in direction, goals, vision, objectives, intention, effectiveness and purpose, which Bennis calls the right things. Managers are interested in efficiency, i.e. 'how to', the short for 'running of doing things right'. Kotterman (2006) discusses the same distinction in slightly different terms. Both leaders and managers may be involved in establishing direction and motivating people and aligning resources. Managers plan and budget, while leaders set the direction. Managers' purpose is narrower while they try to stabilize work, maintain order and organize resources. Leaders aim to develop new goals and align organisations. Leaders motivate, while managers control and solve problems.

Whereas the scope of this book is practical, the scope is in management, i.e. what kind of construction processes there are in the field that help to manage the process from order to plan and further to delivery, from an idea of a building to a product ready to be handed over to the user to people to whose purposes the building is made. However, only through recognizing and developing own leadership style it becomes possible to manage the concrete processes efficiently and effectively. Well-functioning leadership, whether namely as position delegated to you or somebody else, is everybody's responsibility in work community. By respecting values such as good communication and trust and act in manners which promote harmony in the work community, we contribute to good leadership. Shift from old-fashioned leadership structures to new co-operative ways of working does not happen overnight. Bringing different parties into 'one room' does not create trust. Different trainings and rewarding policies may function as agents for change. Construction leadership is undergoing a cultural shift from the time of characteristic theories where commands are given hierarchically from top to bottom cannot be 'sold' to future generations.

Need for a better dialogue in construction leadership is referred to in many other articles, particularly concerning alliance construction model. Typical features of alliance are shared contract agreement, shared organization, shared risks, trust, commitment and co-operation. The first three are referred to as structural (hard) type features and the last three as co-operative (soft) type features. Soft features are prerequisites for successful processes but difficult to measure (Yli-Viilamo & Petäjäniemi, 2013).

Rottermann et al. (2015) have identified engineering leadership roles in their study in which they have conducted four focus group interviews with engineers to find out how engineers define leadership. They have named their first finding: "Leadership is not us". This means that leadership altogether was found elitist, imprecise, impractical and simply 'not us'. There seemed to be cognitive dissonance between engineers' professional identity and their views of leadership as antithetical in relation to these strongly held identities. Engineers, being applied scientists, found the strategic plans of charismatic visionaries impractical and imprecise. Engineers defined themselves as service professionals. This approach was seen conflicting with the hierarchical notion of traditional leadership. The individual implicit in 'great man' theories of leadership contrasts with the 'day-to-day' work. Engineers depend on objective and rational data to execute their core task, which is solving technical problems. This is the reason why they felt unprepared to deal with emotionally intense and highly subjective problems. Delegating tasks was an unpleasant task for engineers who identify themselves as 'doers'. Engineers also felt that the nature of their work has directed them to build iterative processes and leaders as change agents tend to mess this order by restructuring.

Rottermann et al. (2015) found three different dimensions of engineering leadership in their study. Firstly, engineering leadership is about **technical mastery**. Engineers speak with admiration about solving technically challenging problems. Dimensions of mastery include subject-matter expertise, integrated application of scientific and mathematical theory, creative problem-solving peer-recognized expertise, ability to comprehend colleagues' questions and clarify confusion of others and support growth through formal and informal mentoring systems and confidence in own technical confidence. To conclude, technical mastery integrates elements of mentorship, coaching and communication with high level computational, pattern recognition and creative problem-solving skills.

Secondly, engineering leadership is about **collaborative optimization**. This approach highlights the need for teamwork in engineering profession. No

individual specialist can understand everything about a system, which is why teamwork is an essential part of engineering profession. Dimensions of this theme include optimizing team processes, facilitating independence, motivating and enabling others, balancing quality, building bridges across organizational units, leveraging team members strengths, skilfully assembling interprofessional teams, exhibiting organizational savvy, managing conflict through collegial communication, collective problem solving, shared responsibility, self-organizing systems and establishment of feedback of networks.

The third dimension is **organizational innovation**. This means entrepreneur-like thinking to bring technically and scientifically sound ideas to practice and further on to market. This dimension is property of all included in the work organization and not seen as property of top hierarchy. This includes dimensions such as operationalizing innovative ideas, system planning, establishing organizational culture by example, big picture thinking, problem posing, thinking outside the box, creating a vision, institutionalizing best practices, taking risks, learning from failure, founding start-ups, persuading others to follow, catalysing change, market savvy and identifying opportunities.

4.4. SAFETY MANAGEMENT

The construction industry is a challenging sector from the perspective of occupational safety. The work is dynamic and changeable, which makes it different from other sectors. Frequent moves between work sites and the presence of multiple contractors at the same site also make it more challenging to ensure occupational safety. The number of accidents in the construction industry is high because of the constantly changing circumstances, and there are also numerous health hazards, such as chemical exposure in the case of renovation projects. In addition to the risk of occupational accidents construction workers are exposed to, for example, noise, various kinds of dust and changes in temperature and weather conditions (Tyosuojelu.fi., n.d.).

Finnish Government's Decree on the Safety of Construction Work 26.3.2009/205 shares a lot of practical information which is useful to any builder regardless in which country the work is done. The concept of shared construction site means that it is the **developer's** duty to ensure that each of the stages of the build is planned so that the work can be carried out safely and without jeopardizing the health of the workers. The term 'shared workplace' means a workplace where employees of several employers and / or independent contractors are working simultaneously.

Most construction sites have one employer who acts as the project supervisor and therefore has more control and broader responsibilities than the other parties operating on the site, including keeping all other employers, their employees and independent contractors up to date on the hazards and risks associated with the site, the safety instructions and procedures to be followed in respect of firefighting, first aid and evacuation, and the identities of the persons responsible for the above, coordinating the work of the employers and independent contractors operating on the site, organizing access to and from as well as within the site, keeping the site sufficiently neat and tidy to ensure the workers' safety and health, overseeing the general planning of the site, ensuring the overall safety of the working conditions, and familiarizing new workers with the site.

4.4.1. Safety Measures

The developer must outline a safety document listing the hazards and risks involved in the construction project and provide information relevant to occupational safety and health. The developer must also ensure that the safety document is kept up to date as the project progresses. Furthermore, the developer must draw up written safety rules and procedures that consider the nature of the site and explain, among other things, how safety is to be monitored and photo IDs worn on site. Developers' obligations are set out in Sections 5 to 9 of the Government Decree on the Safety of Construction Work (205/2009).

Before the building work begins in a construction project, the **principal contractor** must draw up plans in writing concerning occupational safety and the use of the building site. These plans must then be used to organize the various stages of the building work to make them as safe as possible. It must also be ensured that the work causes no hazards for those working on the building site or anyone else affected by the building work. For instance, any lifting and moving to be done on the building site, whether mechanical or manual, must be planned to avoid accidents and personal injury. The machinery and equipment to be used in the work must be carefully selected.

The **project supervisor's** duties cover the entire subcontracting chain, and the project supervisor is therefore responsible not just for the safety of its own staff but also that of all subcontractors' employees.

Conversely, the other employers and independent contractors on the site must inform the principal employer and other employers of any hazards or risks that their operations may cause on the site. They must also ensure from their part that the work they do will not endanger the safety or health of anyone else working on the same site. In addition to this, each employer must look out for his own employees in accordance with the Occupational Safety and Health Act.

It is the **employer's responsibility** to eliminate or reduce the harmful strain caused by physical work and to ensure that employees' health does not deteriorate at the workplace. Once an assessment of factors that cause strain has been completed, existing risks and hazards are addressed in order of importance. While measures focus primarily on prevention, measures to reduce the seriousness of any effects are also taken. It is important to ensure

that all employees receive appropriate information, instruction and training regarding health and safety at the workplace and that they know how to avoid specific hazards and risks.

Examples of measures:

- planning of work, design of workstations and selection of tools to reduce physical strain and improve the efficiency of work;
- development of working methods and tools to support ergonomic work;
- planning of work in such a way that employees do not work in poor positions for long periods or repeatedly by, for example, setting up breaks or cycling employees between different tasks;
- instructing employees on safe and healthy working methods and monitoring adherence to the instructions;
- acquisition of required assistive devices to lighten the strain caused by the work and the instruction of employees in their use; discussions with employees and their representatives regarding possible problems and solutions;
- improving the organization of work and psychosocial environment at workplace and promoting musculoskeletal health;
- any preventative measures also need to consider any technical changes to devices, the digitization of the work process and changes in the organization of work (26.3.2009/205).

4.5. QUALITY MANAGEMENT

Quality control in construction typically involves insuring compliance with minimum standards of material and workmanship in order to insure the performance of the facility according to the design.

All contractors at site should control their own work quality, but commonly most of them do not have a robust quality management process in place. In many cases, their written program is somewhat general. Traditionally, the project supervisor is responsible for the quality of the work. The supervisor depends on the different craft workers to follow normal and customary industry practice when it comes to the quality of the work. Such a process depends a lot on the ability, knowledge, judgment and diligence of workers, and the supervisor's persistent and careful control.

In this kind of management system there are many factors that come into play, which must be managed well to ensure that the subsequent quality of the work will meet expectations. The team must be qualified, so keeping qualified workers on the payroll is essential. Also, managing the worker workloads as well as the hiring practices is important. General contractor has to ensure that the supervisor has enough time to oversee the work quality and manage it effectively. Having management oversight of the quality process will ensure that standards are met. To some extent, this is how many of the construction companies try to ensure the achievement of contract quality requirements.

A more structured approach is to draft a quality management program and create a quality management process: instruct supervision on the process, implement a control system and hold people specifically accountable for their tasks. Every work performance and results should be reviewed. Continuously improve the process where possible. Following is a framework for a sample quality management process that may become the basis for managing quality of the project delivery process at a construction company (Furst, 2015).

Failure to meet project quality requirements can have several negative implications on the project delivery process. Quality failure creates extra work for the parties involved but has the greatest impact on the contractor. It negatively influences the designer and the owner as well. It can damage business relationships and possibly lead to time-consuming and costly legal action for contractors.

In research study conducted in 2015 in Finland by Sami Kirjalainen, the findings revealed that in the production of residential buildings in the target company defects happen periodically in irregular situations, and they cause significant cost effects (Kirjalainen, 2015). The causes of these defects are the habit and the way the job is done. It seems that the causes of defects are originating from the common culture of construction. To eliminate the causes, the company should concentrate on improving the knowledge of the management team and the constructability of designs already at the initial design stage. The research shows that in the worst case the defects during construction phase can decrease the contractor's margin even by 10 percent.

4.6. PRINCIPLES OF MAKING CONSTRUCTION SCHEDULE

Construction projects are particularly difficult, and they are known for encountering delays as mentioned before. Construction site is a combination of lot of moving parts, teams, contracts, designers, equipment and materials. In addition, the weather is not always favourable for builders.

Tools that are rooted in construction project management software, such as Gantt charts and resource management, are key features to control the many phases of construction. Still, they just support the process. The construction schedule is the pillar of any successful project management for construction.

It is true that different levels of construction schedules are time consuming. You need to take all the steps, avoid shortcuts and work towards creating the most accurate schedule you can. The more time you put into the construction schedule, the less issues you will have when you execute the plan, which is key to good construction project management (Weber, 2020).

Three most important steps in a functioning construction schedule are as follows.

1. Get necessary information and tools

Begin by listing all the subcontractors involved in the project. Once you have completed the list, reach out to them to make sure their timing is the same as yours. Once you have that information, ask how long different phases of the project are estimated to take. This is key for accurate time estimation on your part.

You will also need to make sure that the plans are complying with the local codes. Get the list of requirements and what inspections will be needed throughout the process. This is normally part of the starting meeting with local authorities. Code restrictions vary depending on the type of construction and materials you will be using. The main designer should do the research to make sure your project is compliant.

Use the project management tool that suits your needs. There are templates and charts that can help you get started if you do not want to build your plan and schedule from scratch. There is several different project management software to make your schedule look professional. However, it is more important for you to know how long different tasks will take using different methods or teams.

2. Prioritize Tasks

After having the context and tools, you need to break your project down into the tasks that will lead it from schedule to wanted results. You need a truthful schedule listing every task that must be performed to have a successful construction.

One can use a work breakdown structure (WBS) to get a handle on the size and scope of the project. You can think of this tool to visualize your deliverables by starting with whatever you are going to construct and then breaking it down level by level until you are at the most basic parts.

At this point it is useful to gather the necessary input from your teams and subcontractors that you are going to employ. The more thorough your task list is, the more accurate your schedule will be. Missing tasks are what can ruin your project, so keep your mind on scope. Remember that some tasks are dependent on others, so you must link those. It is quite challenging to build the roof before external walls.

After you have written down your task list, you will need to put those tasks in the right order. Also use the information from your team and not count only on theoretical figures. You can also use Gantt chart software to spread these tasks over a project timeline.

In the beginning your tasks might be small, which helps you to break larger tasks down into controllable smaller pieces. It also helps to break up the whole project into larger phases or milestones. A milestone in the construction project is a point that marks the end of some large phase, for example completion of foundation works.

3. Duration

Depending on how long-term the project is, you will need to calculate into your schedule public holidays and consider sick and vacation days for employees. If there are other seasonally related or personal issues that might come up, be sure to use them as a ruler when measuring your schedule's duration. The tasks are given starting days and completion days. These determinations must be realistic. Construction site is affected by climate, but weather forecasts are not precise, especially long-term. Therefore, find out historical data about the weather to get an estimation of how the climate might impact the work. The closer to arctic circle we work, the more wintertime construction varies from that in Mediterranean climate.

This means that you have more thinking to do on working with subcontractors and suppliers. The project details are outlined in your contract, but usually those dates are subject to change. This means that your schedule needs to have allocation for instabilities.

Theoretical time schedule to complete any given task is important and should lead your planning. Still, make the schedule realistic! Be honest with yourself and give everything enough time in your schedule to be completed properly. Bear in mind also a non-task related scheduling, such as procurement, delivery and other issues that are crucial to the project. You need to have a clear picture of what you are receiving, when the material or service is arriving and how you will handle the delivery. Inspections, necessary tests and in the end handover to the happy client.

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