

## 6. Completing a project

Many of the fundamental concepts of industrial engineering and management are based on a presumption that production is repetitive. However, by definition, projects are unique and in this sense form their chapter in planning, managing and developing economic activities. A project can be seen to serve different purposes which leads to three different perspectives to define a project:

1. From a prescriptive view, a project is viewed as a unique entity of complex, interrelated tasks which are done to achieve a predefined goal. In principle, the project is carried out according to predefined plans, in a cost-effective and fast manner. As a result, changes in the goal or plans during the project are mainly perceived as unfavourable things - i.e. risks.
2. From an adaptive point of view, a project can be seen as a solution to a specific (unique) problem or need that needs to be actively managed, with an understanding of what should be achieved along the way. During the project, both the project goal and how it is implemented may change.
3. From a business perspective, a project is considered to serve an organisation's goals. In any kind of business, projects are set up in some form and usually serve primarily the organisation that set up it. However, the project itself can also be seen as an independent organisation. Therefore, the activity of a project can be managed on the same principles as a company. For example, a construction company can build a dedicated project organisation for a project, which aims to build, e.g. a block of flats, that has business responsibility and thus considerable autonomy in the decisions regarding the project goals and implementation.

We can define three objectives bases on the desired result of the project:

what should be done (scope, the end result of the project)

when should it be done (time target)

with what costs/resources and by whom (cost target, resources needed for the project).

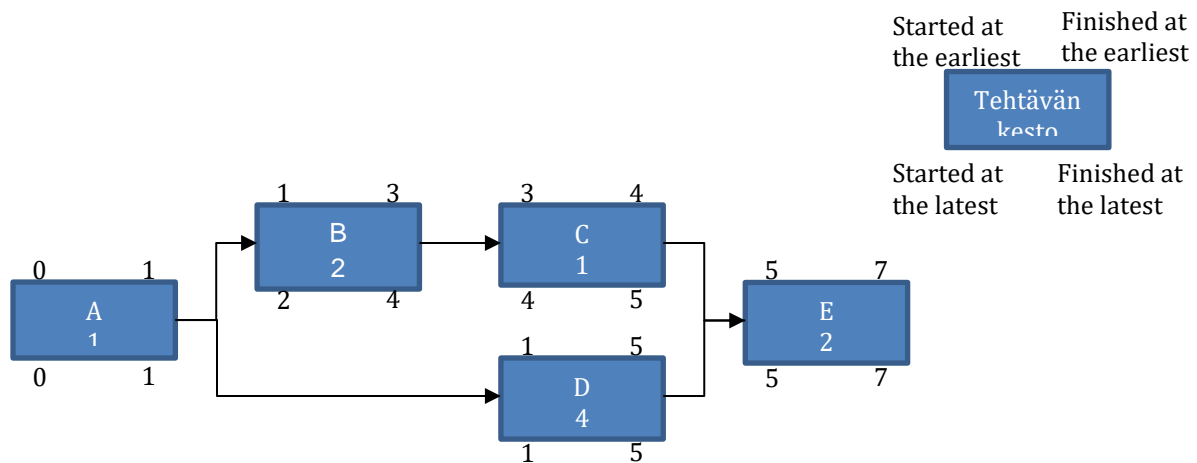
Scope refers to the result of the project and its features, i.e. what should be achieved. A scope can be described as the technical design of the end product and its specifications. The scope objective includes not only the physical characteristics of the deliverable but also its functional properties. The time target, in turn, can be described by a timeline, which may include, in addition to the completion date of the entire project, the completion targets of the projects sub-

entities. Milestones along the project's time axis can represent the time targets for the project sub-entities. The cost objective of the project limits the available resources of the project. The cost objective can be referred to as the budget.

The completion of a project has many different stages. Long before the actual project is set up, there are various tasks including research on alternative options, idea development and analysis of the idea. These tasks can have a significant impact on how a project is shaped, and the interesting question is when the project will actually start, given that the most important strategic decisions of the project may have been made before the project is formally launched. In turn, the completion of a project is followed by the end-use phase, during which the investor of the project usually receives benefits and returns from the projects.

The main challenge of a project is the complexity of it. Because of the interdependencies of tasks in a project matter, they must be executed in a specific order. Task interdependence here means that a certain precursor task must be completed before the successor task can be started. Each task can have several successor and predecessor tasks. Based on the dependencies, the project can be described using a task network. Moreover, given the estimated duration of each task, one can calculate when each task must be executed so that the project can be implemented as efficiently, systematically, and as quickly as possible.

Part of creating a task network is to identify the critical path of the project, which consists of all of the (critical) tasks that must be executed at the exact time assigned to them to achieve the shortest overall project duration. If any critical task on the critical path is delayed, then the whole project will be delayed. While critical tasks have no margin, those tasks in the task network that are not critical include a margin. Based on the margin one can assign a time window when a task can be executed without affecting the overall duration of the project. Tasks can be planned to be executed within the margin (e.g., by shifting the times of non-critical task within the allowed window and avoiding concurrency) so that the required production resources (e.g., people, machines) are sufficient for the task in hand, and/or resource usage is as stable as possible.



Before creating a task network, a work breakdown structure (WBS) is usually created. WBS is a hierarchical description of the tasks required to complete the project. In WBS, at the top of the hierarchy is the final result of the project. The lower levels of the hierarchy explain both the structure of the deliverable and the tasks required for producing it and its parts. The deliverable can be represented in the hierarchy by either its physical or functional structure. On the different hierarchical levels, the task required in producing these structures can be described with words such as design, build, install, test, and deploy. Of course, the project consists of people, not just jobs, tasks and subdivisions - we will now look at the project organisation.

A project organisation is made up of a project manager, a core team, and other project team members. Because of the uniqueness of the project, organisational challenges such as responsibilities and resourcing are highlighted. The project manager is responsible for the project management, and the core team has other tasks which they are responsible for. However, implementing a project often requires many specialised task-specific resources that can be borrowed for a task.

One of the most important tools for a project manager and the core team is a project plan that describes the project objectives and commonly agreed management practices. Also, the project plan describes the project's background, purpose, objectives, and risks.

There are risks involved in carrying out the project because a project is carried out for the first and the last time. Because of the risks, many times the project does not go as planned. A risk is an event that has a certain probability of occurrence 'p' ( $0\% < p < 100\%$ ) and affects the three objectives of the project; schedule, cost, or scale. According to this definition, the outcome of the risk can be unfavourable or favourable. This is important in

project management because then risk management is not only about reducing the likelihood or impact of adverse events, but it is equally important to identify favorable events and to make them more likely to happen. The concept of risk also involves uncertainty, which refers to a lack of knowledge. Typically, those involved in project planning and implementation can express the magnitude of the risk (including the degree of uncertainty, i.e. their level of ignorance), for example by estimating the minimum or maximum value of the duration of the task in days or the minimum and maximum cost. These minimum and maximum values can be considered as parameters of a probability distribution (e.g. uniform distribution), which can be used to calculate the standard deviation in days or euros, which can be used as a risk measure. In its simplest form, the risk management process consists of three risk phases: identity, evaluate, and plan and take action. Risk management is a continuous process throughout the project life cycle, so this process of risk management is repeated continuously as the project progresses through its life cycle.

Successful reporting during the project is deviation reporting. During the project, the final estimate of the scope, cost and timeline should be updated. By being able to compare the project goal with an up-to-date estimate of the costs schedule and scale of the project, the project management can take timely corrective action. Instead, if only the occurred outcome is reported, and we would only compare it to the desired outcome at this stage, we would figuratively manage the project looking in rear mirror, instead of the future (which is the final deliverable of the project). In this case, there would be a risk that the deviations affecting the deliverable of the project would be detected too late and would not be remedied by corrective management measures.