Univerza v Ljubljani
EKONOMSKA FAKULTETA
ZALOŽNIŠTVO

Aljaž Stare

Project management

Aljaž Stare

Project management

Course textbook

University of *Ljubljana* FACULTY OF **ECONOMICS**
Publishing

Faculty of Economics University of Ljubljana

Aljaž Stare
Project management, Course book

Publisher:	Faculty of Economics, Ljubljana
For publisher:	Dean, prof. dr. Metka Tekavčič
Editorial board:	prof. dr. Mojca Marc (predsednica), doc. dr. Mateja Bodlaj, lekt. dr. Nadja Dobnik, prof. dr. Marko Košak, prof. dr. Tanja Mihalič, prof. dr. Aleš Popovič, prof. dr. Tjaša Redek
Reviewer:	doc. dr. Darija Aleksić
Cover page designed by:	Robert Ilovar
Design and layout:	Nina Kotar
Textbook is availabe online:	http://www.ef.uni-lj.si/zaloznistvo/studijska_gradiva
	Ljubljana, 2019

Kataložni zapis o publikaciji (CIP) pripravili v Narodni in univerzitetni knjižnici v Ljubljani
COBISS.SI-ID=299423232
ISBN 978-961-240-351-5 (pdf)

CONTENTS

TABLE OF FIGURES

TABLE OF TABLES

PREFACE

From the prehistory projects bring positive changes to our lives, yet project management profession gained value especially after the information revolution at the end of the 1970s. Verzuh states that in the 1990s the project approach has developed from less useful industrial engineering discipline to the main driver of US business, and Frame believes that project management has become the hottest managerial approach in this period. The first one considers the project management to be the most effective toolbox of the 21st century, while last argue that flexibility is the guiding principle of the new world order, while project management is the key to flexibility. In the changing turbulent environment enterprises need to initiate even more changes than in the past in order to be competitive, to avoid market treats and to utilise the potentials. Direction of change is set by the strategy management while the project management toolkit enables the effective achievement of strategic goals.

The objectives of this book are to assure an awareness of the importance of project management in modern business environment, to understand the role of the project manager, to develop the capacity to assess business opportunities, to get familiarity with the project management toolkit, and to develop the capacity for teamwork and leading the team and individuals. This book guides students through fundamental project management concepts and behavioural skills needed to successfully initiate, plan, implement and close a project.

The book presents and explains project management methods, tools and techniques in order to learn how to manage project time, costs, quality, resources, risks and delivery. The gained knowledge will enable the development of skills for successful project scope definition and stakeholder analysis, appropriate selection of the project implementation strategy, assessing and planning the schedule, resources, costs, selection of appropriate project organization, and controlling the project.

Familiarity with the topics of the book will enable students to independently manage less complex projects or to lead project sub-teams under a mentorship of experienced project manager in an efficient manner, regardless of the type of project: product development, process reengineering, house construction, company takeover, or event organisation.

1 PROJECT – WHAT AND WHEN

In order to define the term more precisely, we quote some definitions from the world's leading project management experts. A project is:

- a unique task designed to attain a specific result that requires a variety of resources and is limited in time (Andersen et al., 2009)
- a goal-oriented process that involves the coordinated undertaking of interrelated activities (Frame, 2003)
- any series of activities and tasks that have a specific objective to be completed within certain specifications, have defined start and end dates, have funding limits (if applicable), consume human and nonhuman resources, and is multifunctional (Kerzner, 2009)
- a collection of linked activities carried out in an organised manner with a clearly defined start point and finish point to achieve some specific results that satisfy the needs of an organization as derived from the organization's current business plans (Young, 2007)
- sequence of unique, complex and connected activities that have one goal and purpose that must be completed by a specific time, within budget, and according to specification (Wysocki, 2009)

definition

A project is a unique, time- and cost-limited, complex targeted process of logically related tasks that must be accomplished in order to create products or services in accordance with quality standards and customer requirements.

1.1 CHARACTERISTICS AND TYPES OF PROJECTS

1.1.1 Typical project characteristics

Typical project characteristics include finality, uniqueness, goal orientation, complexity, integration of project tasks and conflictness. The following is a summarized definition of these characteristics by various authors (Burke, 2003; Frame, 2003; Meredith and Mantel, 2009; PMBOK, 2008). Most of those features are already included in the definition of the project:

Temporariness or finality – the project is not a process, which would be implemented permanently, but is limited in time and has a clearly defined and agreed time limit, including start and end date. The finality does not apply to products of the project.

Uniqueness – projects create unique products, services or results. The project is unique, because it is unlikely to be repeated in the same manner and with the same participants. Project execution cannot be a standard routine; however, each project contains routine tasks.

Goal orientation – a project is organised to achieve one or more objectives (product, service, etc..), so all project tasks are planned and implemented to achieve the set objectives.

Limited - the project is limited by constraints such as quality, deadline and budget (usually called triple constraint). Gilb (1997) further notes legal, ethical, community health and social aspects. Some authors note the constraint of enterprise personal. However, the real constraint is the budget of the project – if it is high enough, project manager can hire the best experts in the world.

Complexity – a project may have a very complex goals, which require a lot of interrelated tasks, and a wide mix of people with different skills, roles and responsibilities. The complexity of the project requires careful coordination and control of time, cost and performance. It is also important to harmonise the project schedule and execution with other projects in the enterprise.

Connected and interdependent project tasks – a project consists of a series of related tasks to be carried out in order to deliver the required deliverable(s). Tasks are mutually dependent, because some cannot be implemented before the previous one. Implementation of the project also depends on the implementation of the tasks of other projects in the enterprise, but often there is interference with the project due to day-by-day work in the enterprise.

Conflict - project managers work in a much more conflicted environment than other managers. The project is an organisation within the organisation, and project managers compete with line (function) managers for people and other resources, which is especially marked in a multi-project environment. Individuals have two superiors (project and functional), who have different objectives and priorities. Conflict can also be seen in the conflict of interest of the project stakeholders (client, enterprise, project team and the public).

Riskiness is related to uniqueness and conflict. Since each project is different from the previous one, there is a risk that the team will be surprised by many problems during the project, such as difficulties in implementation, change requirements by the client, weather, influential individuals, etc. All of this may hinder performance and prevent project completion within expectations.

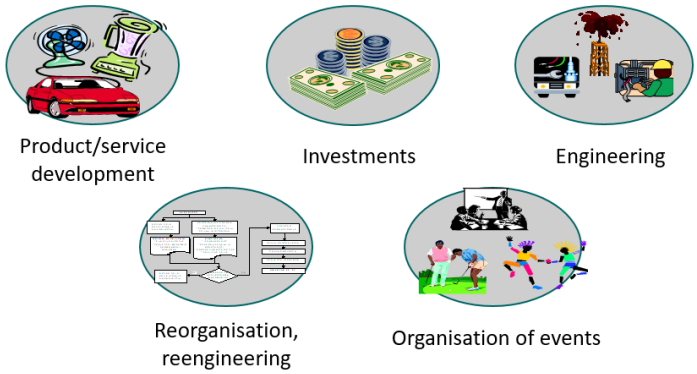
1.1.2 Typical types of projects

There are different criteria used to divide projects into different types regardless of the content, specificity of objectives, duration, intensity, repeatability of content. Projects can be divided into three main groups:

- investment projects
- research and development projects
- organisational projects

Investment projects are usually subdivided according to two typical groups of stakeholders - investors and contractors. The investor (and payer) will use project deliverable (building, production line, SW) for longer time and have long-term benefits, while the contractor will deliver a deliverable and receive the one-time payment. In this case, we are talking about **business** (usually engineering) projects (Fig 1).

Figure 1: Typical projects



Just like the term organisation has several meanings (enterprise, structure, organisation of work), there are different types of organisational projects: **(re)organisation** of enterprises (process reengineering, organisation structure change, introduction of new working methods, etc.) and the **organisation of events** (culture , sports, conferences, etc.).

The division of **external** and **internal** projects is also important. External projects have a known payer, and projects are executed under a previously signed contract. External projects are generally business projects (engineering, construction, SW development), and they are typically carried out by project-oriented companies (projects are their day-by-day work). Internal projects are implemented to strive for business results: competitive advantage, cost savings or increased revenues. Project deliverables provides long-term benefits. Typical internal projects are new product development, process reengineering, developing company website, investing in new production facilities, etc.

1.1.3 Objective, goal, delivery, and scope

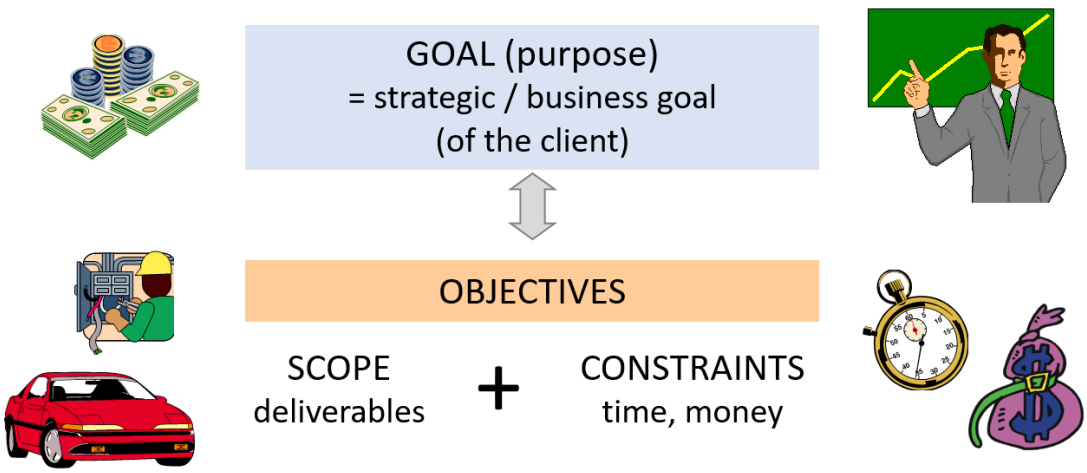
Oxford Advanced Learner's Dictionary defines goals and objectives as follows:

- **goal** – something that you hope to achieve, long term goals
- **objective** – something that you are trying to achieve

Projects are generally executed in order to bring some benefits. This is the goal (or the purpose, which is rarely used) of the project. To understand the goal, we ask: Why do we want to execute that project? A **goal** is therefore an implicit target which is not carried out directly in the project but is realised later as a consequence of the outcome of the project. Probability of goal achievement, due to indirectness, is lower than the probability of attaining the objectives for which the project team plans and carries out targeted tasks. The goal is also less precisely time-defined as an objective.

Andersen states that the goal of the project is to solve a business problem, since the project is always set up and executed in order to deliver products as a means to achieve business objectives. Thus, the project goal is a business objective (Fig 2).

Figure 2: Project goal and objectives



To define the final outcome of the project, authors use two terms: **objective** and **deliverable**. According to Oxford Advanced Learner's Dictionary, a deliverable is a product that a company promises to have ready for a customer. The deliverable could also be defined as a result of the project tasks (a product, a service, a new organization of work etc.). However, the terms objective and deliverable are not synonymous but are logically connected. Expected deliverables are part of the project objective, which is to create (develop, construct, establish) the deliverable(s) of appropriate quality, on time, and within budget.

Deliverables and goals - some examples

The new product (deliverable) will increase a market share (goal); SW will quicken a process and decrease costs; a conference will be organised to promote the profession; a new production hall will expand the production of products

Scope is *the range of things that a subject, an organization, an task, etc. deals with* (Oxford Dictionary). Wysocki (2009) states, that scope:

- defines the boundaries of the project and confirms the general understanding of the project among the participants
- is the basis for the definition of the objectives and the expected major products of the project, as agreed between the client and the contractor
- in the final phase (at delivery) is a utility to check whether the project is carried out in accordance with the requirements

Project scope - an example

The scope of setting up a new manufacturing plant may include building construction, production line establishment, modern warehouse equipping, employing people, design of logistics, and the plant opening. Part of those deliverables may be a part of the scope of another project (which will be implemented concurrently or later) or will not be carried out at all (e.g. employment).

1.2 PROJECT LIFE CYCLE AND PROJECT PHASES

There are two aspects of the life cycle. The first aspect shows a project through the function of expenditure for the implementation (money, input labour), while the other includes specific substantive phases. Regardless of the project type or included professions, every project has typical phases; however, the nature and the duration of these phases depends on the type of project.

Meredith and Mantel (2009) explain the progress of the project life cycle as follows. At the beginning of the project, the project manager is selected; the project team is composed; necessary resources are identified; and a list of tasks is drawn. At that time, the project is progressing slowly due to many uncertainties, discussions, coordination, and decisionmaking. When the project objective is clearly defined, an execution plan is prepared, and resources defined; the project rapidly progresses. Final project tasks are usually carried out slowly due to slower aggregation of partial results, complex final works, as well as quality control and correction of faults.

Project phases cannot be equated with the process of management, although some authors' designation of phases is similar to the management steps (planning, organizing, leading and controlling). Phases are more substantive, each involving a product such as feasibility study, project plan, product, etc., resulting in a coherent set of tasks.

Tabel 1: Typical project phases

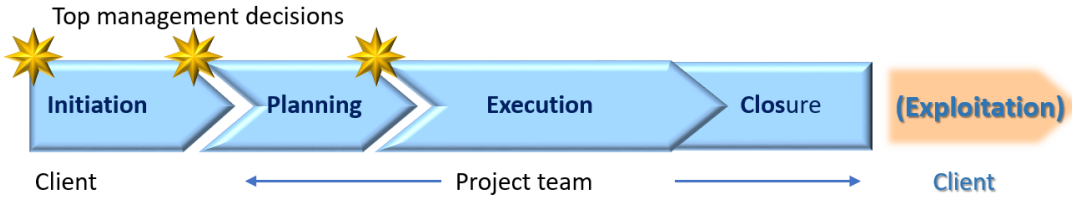
Burke, Charvat	Cleland, Frame, Dinsmore	Lewis	Meredith in Mantel	Thomsett	Morris & Pinto, Milosevic	Wysocki
Concept, analysis	Conceptualisation	Concept	Conception, selection	Feasibility	Conceptualisation	Scoping
Planning	Planning	Definition	Planning, scheduling	Analysis	Planning	Planning
		Planning				
Design	Execution	Execution	Monitoring, control	Design	Execution	Launching
Built, execute				Built, test		Monitoring, controlling
Closure	Termination	Closeout	Evaluation, termination	Ship	Termination	Closing

Sources: Burke (2003), Charvat (2003), Cleland (2007), Dinsmore (2010), Frame (2003), Lewis (2007), Meredith in Mantel (2009), Miloševic (2003), Thomsett (2002), Morris & Pinto (2007b), Wysocki (2009)

As shown in Table 1, authors note different phases which do not differ much. We consider the project phases proposed by Cleland, Frame and Dinsmore, and PMBOK (2008), yet the latter use different naming of the first and last phases: initiating and closing (Fig 3).

Initiation (conception) includes a definition of the idea (product, service), the problem that the project will solve, or opportunity, which we will availed - the reasons why the project is needed (project purpose), and an estimation of the expected benefits (success criteria). The feasibility of the project (feasibility study) is considered. Finally, project scope and deliverable specifications are defined along with the budget.

Figure 3: Project life cycle / phases



The **planning** phase follows. This is executed by the project manager and the core team, which consists of representatives of the professions involved in the project. They plan tasks, schedule, resources and costs, a contingency plan to deal with project risks, and the **organization** of the project (relations, roles, responsibilities and authorities) and information system.

Project **execution** includes implementation of the planned tasks by the schedule made in the previous phase. This is the most extensive phase of the project, since it involves many people and

most of the funds. For efficient execution, proper coordination of participants is critical along with leadership of team and control of performance.

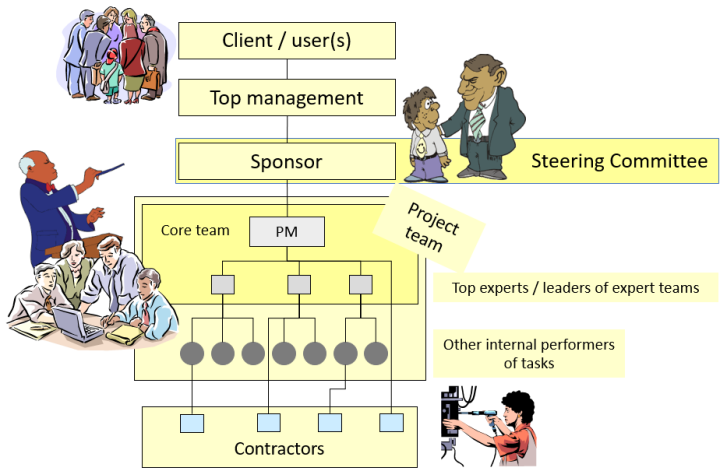
The last phase, project **closure**, contains the results delivery, documentation finalisation and final report writing. The project ends when the client accepts the deliverables; the project team is disbanded; and the project manager produces the final report of the project.

1.3 PROJECT STAKEHOLDERS

The project should meet the interests of different participants - project stakeholders (Fig 4): the client, users, project team, other involved persons from the enterprise where the project is implemented, suppliers, lenders, subcontractors, shareholders, etc. Stakeholders are individuals or organizations that are actively involved in the project or whose interests may positively or negatively affect the performance or completion of the project (PMBOK, 2008). Some authors divide stakeholders into active participants, key players that are part of the official project organisation and formally collaborate in project implementation, and project influencers, which may indirectly affect the achievement of project results with formal or hidden support or opposition.

The definition of typical stakeholders of the project follows, taken from various sources (Kerzner, 2009; PMBOK, 2008; Verzuh, 2008; Young, 2000). Note that one person can have multiple roles in a project (sales manager, for example, can be both, client and sponsor of the project).

Figure 4: Project stakeholders



The **project manager** is personally responsible for the effective implementation of the project (in time, budget, and quality), what ensures by appropriate planning, organising, leading and controlling of the team. Since this textbook deals with management of project, the role and tasks of the project manager will be explained in detail below.

Top management (board, CEO) ensures that project goals and objectives are aligned with business and strategic plans of the enterprise, determines the "fate" of the project (whether and when to start and execute it, eventual interruption), allocates resources (money, people, equipment, etc.), defines projects' priorities, supervises the project throughout the life cycle, and participates in the important decisions. The enterprise top manager may determine the supervising person on one's behalf; this may be a member of the management board, director of the project office (manager of project portfolio), or any of line managers.

Especially in larger enterprises, where many projects are implementing concurrently, each project has a **project sponsor,** selected by top management. This is usually a more experienced line/functional manager who ensures that the enterprise will have the greatest possible benefit from the project. Typical tasks include selection of project manager, validation of the project plan, participation in important decisions, supervising team and project progress, resolving disagreements between stakeholders, and validation of any changes. In addition, sponsor's influence and experience help the project manager to solve organisational problems in the project.

The role of sponsor can also take a collective body, usually called a **steering committee**. In the case of internal projects, members of the committee can be project sponsors, clients and line managers whose subordinates are members of the project team. For external projects, particularly in the construction area where the project will have significant impact on the wider social environment, such committees may consist of representatives of the client, investors, local communities, etc. Responsibilities of the committee are similar to those of the sponsor; however, validation of intermediate results at the project milestones and approval of changes that could significantly increase project costs or threaten the deadline are particularly important.

The **client/custome**r is the reason why the project exists. After completion of the project, the client will achieve business goals by using project deliverables. The client defines the purpose and objectives of the project, clarifies the requirements, confirms the results at milestones, and confirms the deliverables at the handover of the project. The client can be internal, from the enterprise where the project is implemented (department, process owner), or external.

The **project team** consists of those who carry out tasks with necessary expertise. According to the literature, there are three team levels:

- The **core team** consists of the closest collaborators of the project manager, usually key experts from professions included in the project. Members of the core team spent at least 60% (usually 100%) of their working time on the project for the entire duration. They are usually selected before the project planning phase through the proposal of the sponsor, project manager or steering committee. Due to their expertise and experience, they play a very important role in the project planning (planning the implementation tactics, duration of tasks, the amount of work required, risks, etc.).

- The **broader team** is composed of the remaining performers of project tasks, working under the direct leadership of members of the core team – key experts. Members of the broader team are determined during the project planning or project execution. The members of the broader team do not have to participate throughout the entire project.

- The third level of project team are **contractors**.

Line/functional managers (Young, 2000, calls them resource managers) allocate their subordinates to the project. Their responsibility is to ensure qualified and available professionals for the project. They are indirectly responsible for the effective work and the quality of the results of their subordinates. If necessary, they participate as expert advisers.

If the enterprise that implements the project cannot provide total funds for the project, the project (co)founders can also be important stakeholders. Especially in projects with wider social significance, funders can be local communities or the government. Different coinvestors and sponsors can be invited to help with a loan, or an international (e.g. EU) or national grant may be obtained. Teams should be aware that co-founders want an influence in defining the objectives and in the project execution; in addition, they require periodic reports on the implementation.

According to Young (2000), the project also includes influential entities within or outside of the enterprise, called influencers. Internal influencers can be line managers, while external influencers may be individuals or socio-political interest groups. Influencers are not a part of the formal project organisation, but they can - by formal or hidden support or opposition - strongly impact project implementation and achievement of project results. Therefore, the project team needs to identify potential influencers, determine their interests and their influence, and find a way to satisfy their interests or avoid their potential negative impact (Burke, 2003).

1.4 DISCUSSION QUESTIONS

1. Define the project and explain its characteristics.
2. Show typical types of projects.
3. Define project goal and objective (explain the difference) and list some samples of them.
4. What is the project scope? Show an example!
5. List the project phases and the project constraints.
6. Draw an organizational chart of typical project stakeholders (RBS). For each define the role in the project.

2 PROJECT MANAGEMENT

2.1 PROJECT MANAGEMENT PROCESS

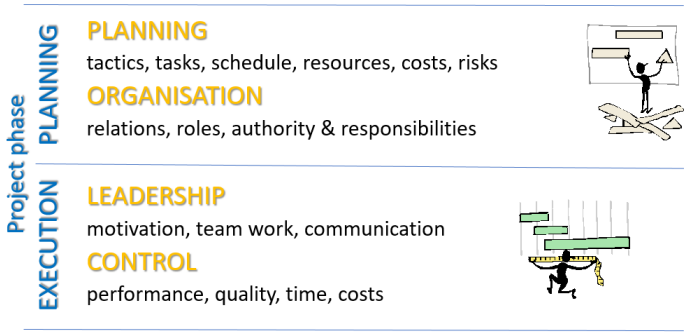
»To get the job done!« is a general widespread perception of project managers in practice, while adding that it should be done on time, within budget, and according to specifications (Frame, 2003). Project management includes identifying requirements; establishing clear and achievable objectives; balancing the competing demands for quality, scope, time and cost; and adapting the specifications, plans, and approach to the different concerns and expectations of various stakeholders (PMBOK, 2008).

The main problem is that many authors equate project management processes with project phases. Thomsett (2002) address the topic *Project management process*, but in the context he indicates justification, approval, review, planning, tracking, and reporting. Wysocki and McGary (2003) explain the topic as a part of the traditional project management cycle with project phases such as scoping the project (which is actually client's responsibility, no manager's!), developing a project plan, launching the plan, monitoring/controlling the progress, and closing (all stated are in fact the project phases). Turner and Simister (2000) address the topic *Project management: the process*, and within explain phases of the project. Meredith and Mantel's (2009) description is similar to the previous, while many other authors explain project phases only, rather than the process of project management.

The closest to the traditional definition of management is Kerzner, who defines a process as planning, organising, staffing, controlling and directing. The latter is defined as training, supervision, delegation, motivation, counselling and coordination. The individual steps of project management should include the following tasks and areas (Fig 5):

Planning: After definition of the project execution tactics, preparation of the work breakdown structure (WBS) follows. Determination of task sequences and linkages in combination with the estimated duration of the tasks (needed time for the execution of the individual tasks) also defines the task execution dates and the final deadline. Next, the performers of the tasks and the other resources required are determined (equipment, material, etc.). The resource plan is input for the project cost estimation. Usually, the last planning step addresses the potential risks and develops a contingency plan. Less often (depending on the type of the project and the frequency of repetition of similar projects in the organisation) few other affairs is planned: a project control, quality assurance, how to cope with influencers, contractors and suppliers; and the communication plan (transfer of information and documentation management).

Figure 5: Project management process



Organisation: The resource breakdown structure (RBS) is prepared in order to define the relations among project stakeholders, while an additional organisation chart determines the relation of the project team and the parent organisation, (matrix, project, etc.) which also determines the authority of the project manager. Roles, authorities and responsibilities of the key project stakeholders are defined in more detail in the responsibility assignment matrix. Some authors also consider team rules as part of organisation (the way of reporting, communication, regular progress meetings, etc.).

Team leadership: Although it does not significantly differ from leadership in general, team leadership has one important difference: team members are not the project manager's permanent subordinate staff (so e.g. project manager does not define their wages nor grant their leave), but rather are temporarily assigned for the execution of project tasks by line managers. Therefore, high interpersonal relations are of great importance; leadership is based on the strength of personality rather than position, etc. Relations and motivation of team members depend on leadership style, team work, and working atmosphere. Leader need to promote direct, open and informal communication between all team members and to resolve any conflicts.

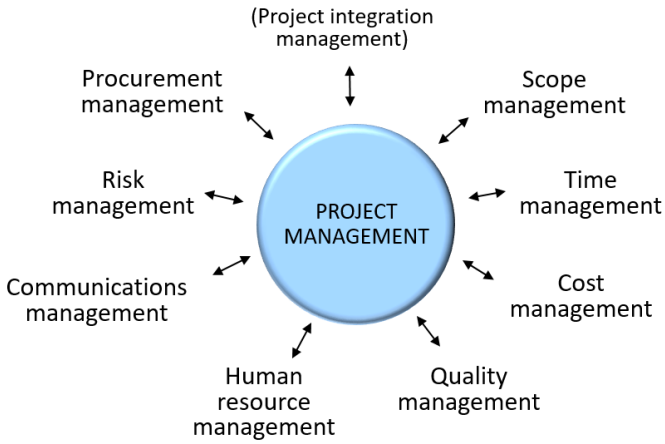
Control includes three steps: determination of the current level of performance, comparing the situation with the plan and identifying the deviations, and corrective measures implementation to (re)ensure the project execution within its constraints, despite of the current deviations (e.g. the project delay). The most common areas of control are the results of work, time, costs, quality and risks.

Regards the relation of project phases and project management process it is considered that the planning phase of the project includes planning and organizing, while the project execution phase includes leadership and performance control.

2.2 PROJECT MANAGEMENT KNOWLEDGE AREAS

Project management includes managing typical areas with their own rules, methods and tools. Areas do not operate independently but are closely related and intertwined, even interdependent. Without information on one area, teams cannot manage other are, or they cannot make a decision in one area without considering others. The following provides brief descriptions of key areas as defined by PMBOK (2008). Since we found some inconsistent statements in its description, we slightly adapt the content (Fig 6).

Figure 6: Project management knowledge areas



Source: PMBOK (2008)

PMBOK first highlights the importance of integrating all areas through the project life cycle. This is designated as *project integration management* and includes charter preparation, all project plans, directing of execution, project control, management of changes and project closing.

Scope management focuses on project content. The project manager has to ensure clear and properly defined client requirements, even with helping the customer with advices and additional questions. During project execution, this area includes scope control (related with control of changes) and results confirmation.

Time management includes the processes required to accomplish timely completion of the project. It includes the definition of tasks to achieve the objectives, interconnection of these tasks, estimation of time for implementation (i.e. preparation time schedule), identification of resources needed for task implementation; and schedule control in the project execution phase.

Cost management includes the processes involved in planning, estimating, budgeting, and controlling costs, so that the project can be completed within the approved budget. It includes estimating, budgeting and controlling costs.

Quality management processes include all tasks that determine quality policies, objectives, and responsibilities, so that the project will satisfy the needs for which it was undertaken. It includes quality planning, assurance and control.

Human resource management includes the processes that organise and manage the project team. It includes human resource planning as well as acquisition, development, and management of the project team.

Communications management employs the processes required to ensure timely and appropriate generation, collection, distribution, storage, retrieval, and disposition of project information. It includes communications planning, information distribution, performance reporting, and management of stakeholders.

Risk management includes risk management planning, risk identification, qualitative and quantitative risk analysis, response planning, monitoring and control. The objectives are to increase the probability and impact of positive events and decrease the probability and impact of events adverse to the project.

Procurement management assures the materials, semi-products, services, or results needed from outside the enterprise. It includes purchase and acquisition planning, contract planning, request for seller responses, selection of sellers, administration of contract, and contract closure.

2.3 PROJECT MANAGER

The project manager is the holder of the project management functions and is responsible for the project execution. According to Newel (2002), the project manager is responsible for almost everything, so it is easier to determine for what he or she is not responsible. This is the most vital role of the entire project. The project manager should have the full support of top management and thus the necessary authority.

An excellent project manager is a generalist with a broad spectrum of knowledge and experience needed to direct and control many areas, covered by various experts. The project manager is expected to link tasks from different areas into a coherent, efficiently functioning whole. The project manager must also create a good business and personal relationships among people who normally do not work together.

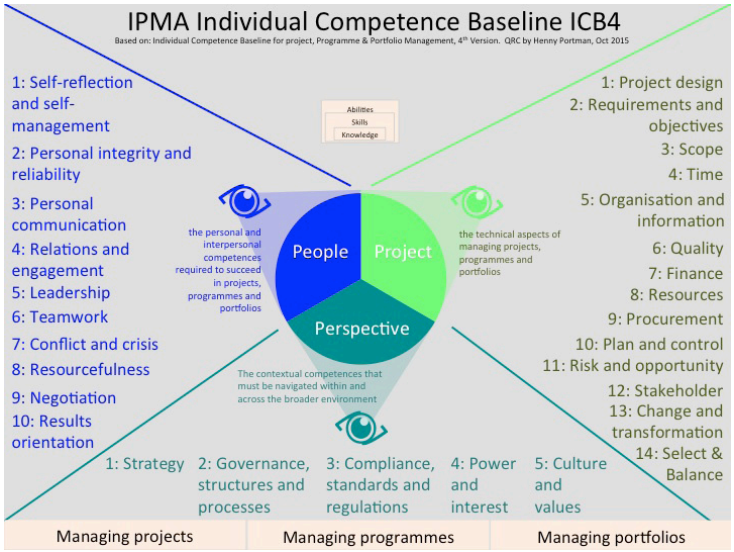
This section highlights the skills, experience, and personal qualities of the project manager and provides recommendations for choosing the right project manager.

2.3.1 Competencies

The International Project Management Association (IPMA) identifies 29 competencies of an excellent project manager in three groups: practice (14), people (10), and perspective (5). Competences are graphically illustrated with the *eye of competence®* (ICB, 2016, Fig 7).

Different sets of skills and competencies can be found in the literature (Charvat, 2002; Heerkens, 2002; Heldman, 2005; Kerzner, 2009; Lewis, 2007; Meredith and Mantel, 2009; Newell, 2002; Philips, 2004; Thomsett, 2002; Verzuh, 2008). Combining all of these competencies leads to *the IPMA eye of competence®*.

Figure 7: Project management competencies



Source: ICB International Competence Baseline (2016)

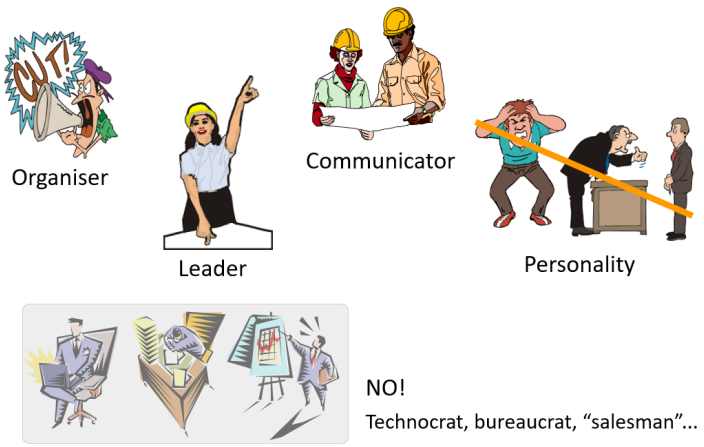
Some important additional skills not listed in the eye of competence are the ability to delegate, tolerance for failure, entrepreneurial spirit, writing skills (minutes, reports, contracts), administrative skills, and public speaking skills (presentations). Young (2007) also adds:

- choosing the right team members with the appropriate skills
- ability to identify and understand personalities of team members
- reconciliation of tasks objectives and personal goals of performers
- creating a real sense of responsibility in a team
- establishing the interconnection of team members and their commitment to the project
- understandable explanation of decisions and effective reporting on project progress
- coordination and management of contractors, suppliers and consultants
- understanding the real needs of end users

2.3.2 Recommended personal qualities

The most important personal characteristic of the project manager is a **sense of organisation**. For disorganised persons who rarely meet deadlines and keep the arrangements, it is even more difficult to organise the work of others. A sense of time is necessary along with the ability of **coordination** of team members and external contractors. It is important to manifest confidence when delegating and to trust team members and empower them, especially for decision making and implementation (Verma, 1996.) Organisational characteristics also include entrepreneurial spirit, strategic vision, systematics and flexibility, negotiation skills, and the ability to delegate (Fig 8).

Figure 8: Important project management personal qualities



Project manager must also be a good **leader** with enthusiasm, optimism, energy, persistence, courage, and personal maturity to affect the team to follow him. This is even more important for the project than for line managers, as project team members come from different departments and are not permanent direct subordinates of the project manager. Important leadership characteristics include managing interpersonal relations, creating a good working environment, ensuring team affiliation, motivating through non-monetary incentives, motivating and mentoring, and willingness to resolve interpersonal conflicts. A real leader shows satisfaction with successes and praises team but still critically evaluates the work. Despite the managerial position, he or she must remain a team player.

In addition, a project manager must be a good **communicator**. Communication affects the behaviour of the team. A manager should be able to talk to members, to be open and critical, and to listen and understand others. Informal cooperation is often more important than strict bureaucratic relations with letters, regulations and refereeing to jurisdictions. The project manager must be able to communicate at all levels within and outside of the enterprise and to adjust communication

to various situations and interlocutors. This requires flexibility in managing different ways to communicate, negotiate, persuade, advise and listen.

The last group are the **behavioural personal qualities**. As projects are related to risks and unanticipated events interwoven with various interests of the project stakeholders, the manager's emotional stability and stress management stress are also very important. In addition, a manager must be self-confident, believe in him(her)self and one's team, and be self-critical in order to continuously strive to improve performance. Determination is also important, but not all decisions are necessarily made by the manager; rather, the manager needs to ensure that the best decisions are taken as soon as possible.

Some personality types are poorly suited for project management. **Technocrats** seek the perfect solution, rather than to being satisfied with the first solution that would satisfy the customer's needs. Because technocrats enjoy technical work, he or she does not have enough time, desire, or ability to coordinate others for administrative work. For bureaucrats, procedures and reports are more important than keeping the project execution on schedule. They focus on excessive precision, and reports are not used for any productive purpose. Sellers talk much but do little, so the project often remains a plan and becomes a missed opportunity.

Excessive optimists or pessimists should also be avoided. The first usually prepare unfeasible plans and, despite the delay of the project, believe that everything will be fine in the end. The latter lacks the enthusiasm and energy to make a positive impact on the team members and may surrender at the first obstacle.

Personal characteristics of project managers have been summarised by: Andersen et al. (2009), Charvat (2002), Heerkens (2002), Heldman & Heldman (2007), Kerzner (2009), Kleim & Ludin (1998), Meredith & Mantel (2009), PMBOK (1996), Škarabot (1994), Turner (2009), and Young (2007).

2.4 DISCUSSION QUESTIONS

1. Explain project management process and show some typical manager's tasks/areas.
2. Show project management knowledge areas.
3. List five most crucial manager's competencies in your opinion and explain why you find them important!
4. What are the most important personal qualities of excellent project manager.

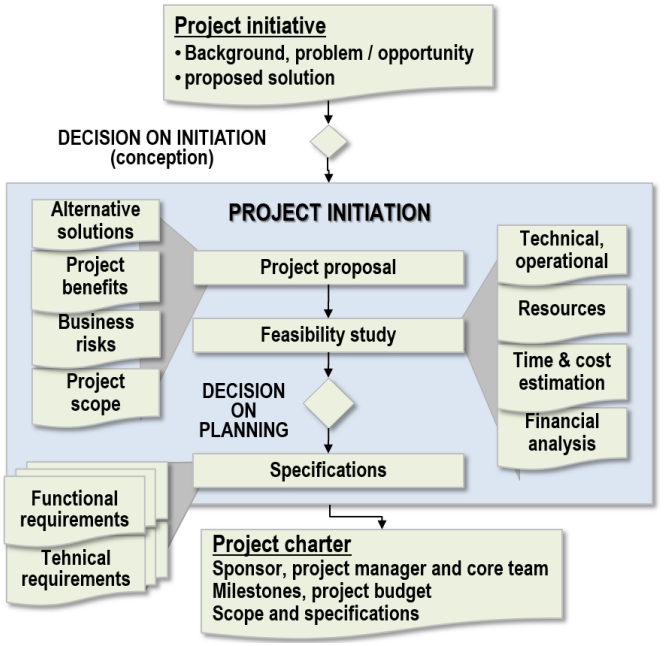
3 PROJECT INITIATION (CONCEPTION)

One of the crucial problems of many enterprises is unsystematic implementation of too many projects, which are often cancelled before completion, do not bring enough benefits after the competition, or do not return invested funds. Successful enterprises, on the other hand, seriously consider the expedience of the project proposal during the initiation phase. Initiation should not be equated with the preparation of tender for an external client. It is aimed at verifying the expedience and feasibility of internal projects, while preparation of tender means planning of an external project.

3.1 DEFINITION AND PROCESS

Project initiation is the first phase of the project in which the reasonableness and feasibility of the project is verified. This is done on the basis of expected business benefits, especially in comparison with the necessary resources and costs for implementation. The project initiators, leads by the project sponsor (usually not members of a subsequent project team), define the scope of the project and prepare deliverable specifications. Based on the expected success of the project, top management confirms project execution, selects the project manager and key experts (core project team), and defines the constraints of the project including deadline and budget. Next, the project enters the planning phase.

Figure 9: Project initiation



Initiation is only a part/phase of internal projects, the results of which bring long-term benefits for the initiator/enterprise (new facility or equipment, reorganisation, computerised process, a new working method, a new product, etc.). The input and the cause of an external project is a demand, and payment is one-time, so these projects do not include an initiation phase.

Initiation is the first project phase, but its **tasks are not part of the project manager's responsibilities**. Collaboration during the entire project is recommended, but initiation is in the domain of initiator(s), end users and/or project sponsor (usually a representative of end users).

Frame (2003) states that projects arise out of needs; the project management process begins when someone has a need to be fulfilled. Other authors explain the need as a business problem (e.g. insufficient production capacity) or opportunity (e.g. exploitation of niche markets). In most cases, the project proposer has already prepared a solution (new production line, a new product or service). As enterprises have limited resources to implement all ideas, and because all ideas are not always as brilliant as proposers think, the project proposal is examined in more detail in terms of the expected benefits and implementation capabilities.

The proposal is presented to top management or to a manager who is responsible for the evaluation of proposals of certain project types. Usually, compliance with the mission and strategic policies of the enterprise is first examined. Based on a subjective assessment, it is then determined whether execution of the project makes sense. The initiation phase of the project begins with confirmation of the idea/proposal and creation of the initiation team. Noted that the team that initiates the project in principle is not the same as a team that executes the project. The future project manager may not necessarily be a member of this team.

Initiation is the first phase of the project in which:

- the need is examined; alternatives are assessed; the goals and objectives of the project are established; and a sponsor is identified (Wideman, www.maxwideman.com)
- investigation of the ability of execution is made; and the expected benefits are evaluated; the products of the project are identified; and a draft execution plan is created (Charvat, 2002),
- ideas are discussed; the project is approved and begins; the purpose and the products of the project are defined (Heldman, 2005)
- the technological and economic feasibility are assessed along with the costs, and a draft project plan is prepared (Kliem and Ludin, 1998)
- the guidelines and restrictions of the project are defined (Martin and Tate, 2001)
- the business needs and the project product(s) are defined, and the project manager is selected (Philips, 2004).

3.2 PROJECT PROPOSAL

The project initiator/proposer first presents the project **background** (happening on market or in enterprise), and then highlights the **problems** that could be solved by the project or/and the opportunities that enterprise could have benefit from. In many cases, especially if the project results from strategic plans, problems and opportunities derive from the SWOT analysis.

After confirming the suitability of the proposed idea, a detailed project proposal needs to be prepared by the project initiator or/and other competent person(s). The first important information (the criterion for decision on project execution) is the expected benefits (impacts) of the project, called the business case. This may also include an assessment of potential business risks, alternative business solutions (PRINCE2, 2002, www. method123.com), definition of the project success criteria, and key stakeholders of the project (Lester, 2003).

The final, official comprehensive project proposal consists of the project idea/initiative and a *business case*. The proposal includes the following information:

- project background and business problem or opportunity
- solution or alternatives with projections of the effects
- business and organisational benefits (shown financially, if possible)
- market aspect (customers, competition, society) and business risks
- compliancy with enterprise strategy
- a way of measuring the project effects (income, savings)

The background of the project may include extensive market analysis, analysis of technology trends, etc. The calculation of benefits can contain many tables and simulations for different scenarios. The quality of decisions (and consequently the likelihood of achieving the benefits) depends on the quantity and detail of the information provided for decision-making.

3.3 FEASIBILITY STUDY

If the business case confirms the appropriateness of the project proposal in terms of expected project benefits, then a more extensive set of initiation tasks begins, usually involving several people. Namely, to determine whether the project is worth implementing, it is not enough just to know the benefits that it will bring; it must be determined whether the project is feasible and how much money and time will be needed for execution. The decision on project implementation is based on a comparison of estimated costs and expected benefits.

Moreover, management must often decide among several feasible and beneficial projects, because the enterprise does not have enough resources to carry out all projects. Therefore, the feasibility

study is applied to select most beneficial project, which is usually the one that will derive the greatest benefits as quickly as possible.

3.3.1 Content of the study

The team that takes over the conduct of the study preliminary assesses whether the initiator was too optimistic in the benefit assessment and if he or she neglected any factor. This is followed by a discussion on whether the proposed project will actually develop the most optimal solution of the business problem (or exploit the opportunity), or if there may be other alternatives and what benefits they bring. The benefits have to be evaluated financially, taking into account the operating costs, such as production of the product, line maintenance, etc.

The second part of the study contains an assessment of the project feasibility. Even then, it is necessary to consider more alternatives, for instance, whether the whole project should be implemented in the enterprise or (partly) by the external contractors; or should the solution be bought. The abilities of employees (knowledge, experience, availability) should be considered, so as the necessary needed equipment. Are employees less expensive than outsourcing (taking into account the duration of the tasks and quality of implementation)? How quickly can the project be executed? In terms of the expected benefits, it is reasonable to financially evaluate the execution time (i.e. will the benefits increase in the case of shorten project).

Before the costs are evaluated, it is necessary determine the project scope. Depending on the project, it is probably reasonable (if possible) to evaluate the benefits and costs for each deliverable separately (although it would be absurd, for example, to set up a new production hall without a production line). The enterprise sometimes decide to postpone part of the investment due to high costs (or include it in another project).

A draft estimation of the implementation costs follows in which enterprises mostly use an analogical (top-down) technique where the project costs are estimated based on the actual costs of comparable past projects (the method is described in more detail in the chapter on planning costs). When evaluating costs, the team can get help from consultants who have run similar projects in the past, professional colleagues from other (non-competitive) enterprises, or classmates and other acquaintances with experience in comparable projects. The project office, which systematically analyses completed projects and creates a knowledge database, can also be of a great help as well as the future manager of the project.

Summarised from: Brandon (2006), Heldman and Heldman (2007), Kerzner (2009), Lock (2007), Newell (2002), Thomsett (2002), Turner (2009)

3.3.2 Criteria for project approval and prioritisation

Based on the expected benefits and costs, a cost–benefit analysis is made. This is the calculation of the financial indicators of the project. Indicators help managers to decide whether to implement the project and to select the most beneficial project(s) when deciding among several proposals. The calculated indicators are also used to determine the priorities of projects.

The simplest assessment of the project execution reasonableness is the ratio between the benefits and costs, which should be more than 1 (**project profitability**). However, we are also interested in the time when the income (or savings) will return the invested funds (payback).

$$\textbf{Payback} = \frac{\text{invested assets (project costs)}}{\text{expected annual financial benefits (income,savings)}} \quad (1)$$

Payback, also called the amortisation period of the investment, tells us how soon after the project ends the benefits of the project (profits from the product trading, savings from the reengineered process) will return the invested funds (formula 1). Of course, the payback period is not computable for external projects where the costs are reimbursed immediately after the project delivery (through payment of the contractor).

Project profitability is a ratio of the project cost and:

- the price of the service/project, agreed with the client (external project, formula 2)
- sum of annual earnings/savings over the lifetime of the product, facility or ITsolutions (internal project, formula 3).

$$\textbf{Project profitability (A)} = \frac{\text{price of service}}{\text{invested assets (project costs)}} \quad (2)$$

$$\textbf{Project profitability (B)} = \frac{\text{present value of the total annual profits}}{\text{invested assets (project costs)}} \quad (3)$$

Profitability of the project is an even more important decision factor than the payback, as it demonstrates whether the benefits of the project will cover the invested funds. The enterprise decides to implement the project only when the profitability is greater than 1.

Following the case of a new product, Kerzner (according to Souder, 2009) explains the 25 criteria of project evaluation, divided in five categories which are linked to specific group of evaluators:

- Top management – capital requirements, competitive reaction, return on investment, pay-out time, Wall street impacts
- Engineering – required equipment, availability of personnel, know-how, design difficulty, equipment availability, piping layouts
- Research – patentability, likelihood of success, know-how, project costs, availability of personnel, availability of laboratory
- Marketing – length of product life, product advantage, suitability to sales force, size of market, number of competitors
- Production – processability, know-how, equipment availability

The project with the greater sum of the ratings criteria has higher priority. More importantly, this project has usually a powerful sponsor with high competencies, a more experienced manager, priority in the selection of team members and the use of equipment, and priority in resolving crises and problems.

3.4 DELIVERABLE(S) SPECIFICATIONS

The last step in the project initiation is the detailed definition of the final deliverable(s) - product, result, service, event or ingredients. The specifications (also called configurations) define the design, features, functionality, etc. Input for specifying the deliverables is the proposed solution, which is clarified based on user needs and requirements.

If the project will be implemented for internal purposes and exploitation (e.c. the development of SW for a warehouse), then the analysis of needs is derived directly from interviews with users. In the case of developing a new product, the specifications are defined by marketing analysis. When a company implements a project for an external client as a contractor, it is expected that the specifications are prepared by the client.

Several authors break down specifications on functional and technical. Frame (2003) states that functional requirements describe characteristics of the products in an unprofessional language, as they need to be understandable to users, while technical requirements are described in the technical language (parameters, technical terms, operating conditions, etc.).

Based on the scope and specifications, the project team knows exactly what is expected of the team and the project. This document is the basis for the execution planning (team starts to plan the project only after the mutual approval of specifications). At delivery, the client verifies the adequacy of the deliverables with the specifications.

3.5 PROJECT CHARTER

The project charter is the final document of the project initiation phase and announces the transition of the project from the initiation to the planning phase.

Several authors use different terms for the project charter, including *project brief* (PRINCE2, 2002; Young, 2007), *project overview statement*, POS (Wysocki, 2009), *business plan* (Brandon, 2006), and *project mandate* (Andersen et al., 2004).

The most common definition is: project charter is the official launching document that announces the existence of the project and provides a clear picture of it. This document provides the project manager with the necessary authority, gives the formal right to devote working time to the project, and begins providing internal staff for project execution (PRINCE2 even states that the sponsor and manager sign the contract to execute the project). In addition, the project charter is the input of the planning phase of the project and defines the expectations and limitations to guide the project team in the planning of the project.

Although the content and documents of the project initiation have already been defined, we add the charter content, resumed by various authors:

- basic information: project title and number, sponsor, manager, (client)
- project background – problem/opportunity
- business case and feasibility study
- scope, deliverable specifications (client demands)
- stakeholders analysis
- organizational, environmental and external assumptions and limitations,
- budget and rough schedule (milestones and deadline)
- authorities of the project manager, key personnel and special staff requirements • the role of departments and functional/line managers

The project charter should be prepared by the project sponsor, but it is sometimes prepared by the (future) project manager; the sponsor only signs it at the end. While the sponsor is ultimately responsible for its preparation, he or she may be assisted by the project proposer, the future project manager, and other experts who have the appropriate knowledge and necessary information for quality analysis of the project proposal.

3.6 DISCUSSION QUESTIONS

1. Define the process of project initiation.
2. What is the recommended content of the project proposal.
3. Show content of business case and feasibility study and explain the impact of them on the decision to implement the project.
4. What are typical criteria for project approval and prioritisation; which data the criteria are based on?
5. What is the difference of the functional and technical specifications of project deliverables. Give three examples for each.
6. Show the content of the project charter. Who selects project manager and core team members?

4 PROJECT PLANNING

With the project charter, the project enters the second phase: project planning. In this phase, the core team produces a detailed project execution plan and organises all participants. While project initiation focuses on finding the product that will bring the greatest benefit, project planning is aimed at finding the approach that will ensure obtaining the desired product as quickly and cheaply as possible.

4.1 PROJECT SCHEDULING

The project schedule precisely defines deadlines and duration of all tasks needed to achieve the objectives. It starts with defining of a list of tasks, followed by considering the possibility of concurrent execution of individual tasks (thereby shortening the duration of the project) on which the network plan is based. When the start of project execution and the duration of all tasks are defined, the schedule in finished. The graphically displayed schedule is called a Gantt chart, and it is a basis (and a tool) for monitoring/controlling the progress of the project during the execution phase.

4.1.1 Work breakdown structure (WBS) – the list of project tasks

Project structuring and the defining of the task list are the first steps in the detailed project planning, although a rough plan with milestones can be defined during the initiation phase.

Some authors also suggest that the team (sometimes together with the client) should first discuss the tactics of execution. Common tactical decisions are:

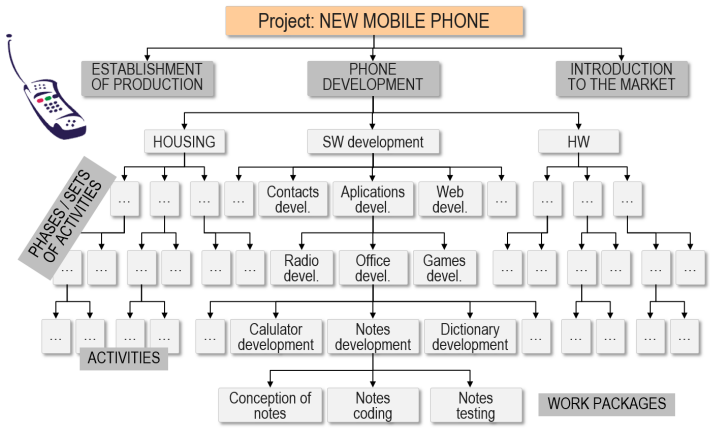
- main execution phases regard to the client's requirements and the way or/and the technology of the execution
- distribution of work between the team and the client
- whether (and where) hiring contractors would be beneficial
- what solutions or semi-products can (and should) be bought
- the use of specific solutions or components developed in previous projects • funding the project

Although tactics are not specifically defined or documented, the team should discuss tactical ideas in defining the WBS. Inputs for the WBS preparation include the scope, product(s) breakdown structure (PBS), product(s) specifications, and the potential client's requirements regarding the project milestones.

The typical **graphic format** of a WBS is similar to that of an organisational chart (Fig 10), however the work can also be structured (and tasks listed) only textual, in one column or with indents (as shown in the project scheduling tools). To increase transparency, the individual levels of tasks should be attributable to the relevant numbers (2 Product development, 2.1 Product design, 2.2 HW development, 2.2.1 Scheme conception, 2.2.2 Prototype design, etc.).

There are two origins for the project breakdown: the scope (or PBS, Fig 10) and technology of execution (typical execution phases, Tab 2). In the first case, if the products are well specified and broken down, then we add a gerund and obtain a task (and WBS) for each object of PBS. With more gerunds, the task is further broken down.

Figure 10: WBS, developed from PBS



In defining the tasks, tactical decisions should also be considered. If we choose to entrust a service (a set of tasks) to a contractor, then we do not plan its tasks, but only the solicitation tasks (preparation of demand, tender or direct communication, negotiation, signing a contract); then we add only one task – execution the service by contractor.

The starting point for the second breakdown technic are the typical successive phases of the project related to project milestones, such as product design, prototype development, product verification, validation of production. The difference lies in the fact that PBS is taken into account, but only as a basis for discussion during the planning of tasks.

Tabel 2: WBS based on technology / phases of execution

F1 Design	F2 Purchase of land	F3 Licensing	F4 Setting up the building	F5 The inner works	F6 Furnishing
A11: Preparation of the architectural design A12: Production of building plan A13: Making Plans installations A14: Manufacture interior plans…	A21: Search for suitable locations A22: Obtaining information about the area A23: Negotiations with the owners…	A31: Preparation of project construction A32: Preparation of documentation A33: Filing an application…	A41: Search for contractors A42: The mplementation of the tender A43: The signing of the contract A44: Construction …	A51: The installation of water A52: Electrical works A53: Installations sewage system A54: Establishment of a heating system	A61: Purchase of furniture A62: Furnishing of the living room A63: Furnishing the kitchen…

In practice, a combination is sometimes used, where a matrix has an execution phase horizontally and the structure of the products (PBS) vertically. In doing so, the tasks are defined through the intersections.

Qualitative WBS preparation is very important, because the WBS is a basic input for all other plans of the project – the network diagram and the schedule, the plan of resources and costs, and the risk management plan! It is also the starting point for the distribution of the responsibilities among client, project team, and contractors.

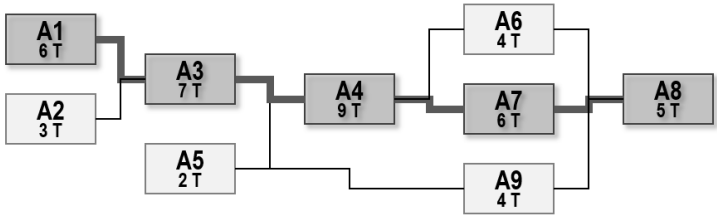
4.1.2 Network planning and the critical path – CPM

Tasks could be carried out sequentially, as listed in the WBS, however, it would be irrational, because many tasks can be performed concurrently; thus, the project can be executed much faster. A technique that ensures rational timely execution is **network planning**.

There are two graphical displays of a network plan. In the first, we use arrows and circles; in the second, lines and rectangles. In the first, called the **arrow** network diagram, also known as TOA (task-on-the-narrow), the arrows show the tasks, and circles are used to mark events (the beginning and end of tasks) and to link several tasks (when more tasks have to be completed, to start the next one or more ones).

The second diagram is called the precedence or **activity** network diagram (Fig 11). Lock, (2007) calls it *the precedence logic diagram*, Kerzner (2009) *precedence network*, while Wysocki (2009) talk about the PDM method - *Precedence diagram method*. Rectangles show tasks, while lines link tasks. Lines (links) always flow from the right side of the precedes rectangle (task) to the left side of the successor.

Figure 11: Activity network diagram



For each task we define the probable duration and calculate **the critical path** – which is the path through the network with the longest duration (the interrelated tasks, whose sum of durations is the longest). This is the expected duration of the project. This process is called the critical path method (CPM). The team needs to know which tasks are critical, as only their shortening shortens the whole project in the case that first schedule does not meet the expected deadline. In addition, team need to give greater emphasis to the risks of a critical path, since the delay of a critical tasks directly indicates the delay of the project in the execution phase.

4.1.3 Project schedule & Gantt chart

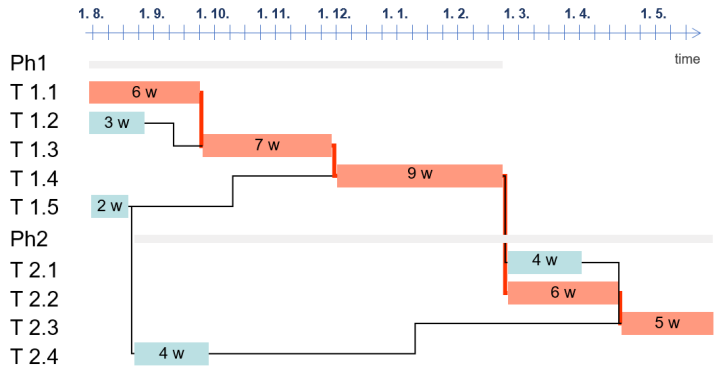
One of the most important tools, so to say a basic project manager tool for time planning and controlling, is the Gantt chart (Fig 12). It, unlike the network diagram, graphically displays the duration of tasks, while tasks are listed down, one below the other. It clearly displays the starting date and the deadline of each task, and by that also defines when the tasks' performers need to reserve their time for work on the project (Fig 13). The Gantt chart also shows project phases with milestones, and time reserves of non-critical tasks that can be used for levelling the workload of employees (more on this later).

Verzuh (2008) on Gantt chart says: »A picture is worth a thousand words!«, while Pinto (2010) highlights it's advantages: it is evident and understandable, very easy connects a network plan with the client's preferred milestones, it is useful for identifying resource needs and for control, and easy to update. It also enables quick and easy calculation and verification of several possible scenarios of the execution, and simulation of measures and consequences in the risk management process. With Gantt chart manager coordinates tasks of team members, tasks to be executed by the client, and those that will be entrusted to contractors.

Participants in the project planning process (project manager, core team, sometimes also contractors) **usually estimate** the **duration** of tasks based on their experience. In more developed enterprises, plans and reports of similar previous projects, and standard plans of typical projects (project models) are used for more realistic estimations. Moreover, colleagues from the project office can help the team with the statistical norms established through analysis of completed projects. Offers of contractors can also be of help, or experiences with similar projects in other

enterprises (classmates, friends, professional associations). Kerzner (2009) proposes that the durations should be estimated by line managers, who have the richest experience.

Figure 12: Gantt chart



Tasks that are not on the critical path (floating tasks) have some time reserves, what means that they do not have to be accomplished exactly in the proposed time; however, they have to be finished before the first critical task that follows. Of course, there can also be more successive non-critical tasks, so it is necessary to agree on how the joint reserve will be distributed to the tasks. Time reserves may be used for the allocation of overloaded performers in one project or in all projects (in combination with an operational work) in a multi-project environment.

While in the network diagram, the project could be shortened only by shortening the critical tasks, the Gantt chart also allows shortening with overlapping tasks. To speed up the execution(already in the planning phase, yet, many times in the execution phase to resolve delays), the task that should be launched immediately after the previous one may start few days sooner, so two related tasks will be execute concurrently for a short time. Of course, tasks (and thus the project) can also be shortened by allocating more people (although the duration cannot be just divided by the number of people), or the task can be outsourced.

4.2 RESOURCE PLANNING

After the tasks distribution and the duration estimation, the project schedule is not yet finalized for two reasons: the constraint of resources, especially the lack of human resources and the equipment occupancy, and protection against problems. The latter refers to measures in anticipation of potential problems, resulting in one of the tasks being brought forward, additional control tasks, or prolonged tasks. More on this will be explained in the context of risk management, but this chapter focuses on resource planning.

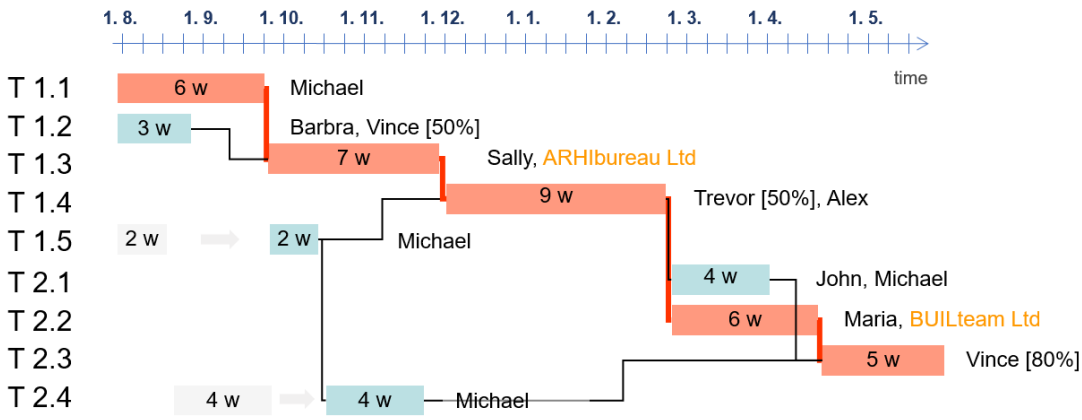
We need to plan different sources at the beginning of project for several reasons. People and equipment should be reserved early enough to assure their availability when needed. Some equipment and materials will be purchased from suppliers, so it must be considered when to place an order regarding to delivery times (see Procurement chapter for more details). Intended use of resources is also key information for cost estimation, while in combination with the schedule a plan of the needed founds is defined.

Tabel 3: Resource plan

Task	HR	Outsourcing	Material	Equipment	Energy	…
T1.1	Michael (240h)			Test. device		
T1.2	Barbra (120h), Vince (60h)		PVC, 5 kg			
T1.3	Sally (280h)	ARHIbureau Ltd	10 Prototipes			
T1.4	Trevor (180h), Alex (360h)				Fuel, 100 l	
T1.5	Michael (80h)			Assem. line		
…			10 Sony µP			

Although the literature generally places emphasis on planning people, we must stress that many other resources are needed. People without equipment, materials and energy cannot do anything, yet money is also an important source as we need it to pay/buy other sources. To accurately estimate project resources, the necessary resources and the quantities are defined for each task listed in the WBS (Tab 3). When resources are allocated in the Gantt chart, the time at which the resources are needed is also determined.

Figure 13: Human resources plan in Gantt chart



Talking about the people availability and workload, we need to mention resource levelling, which is done first for the current project and then for all projects in the enterprise. In scheduling, at the end of resource allocation, the overload individuals need to be found, i.e., those whose planned workload is more than eight hours per day on two or more concurrent tasks. Their workload can be solved by postponing the non-critical tasks (Fig 13: Michael's tasks 1.5 and 2.4), reassigning team members, or including new people. Some low overloads in a short period of time can be ignored, since micro-levelling could take too much effort compared to the benefits it would bring.

4.3 COST PLANNING

Schedule and resource plan are the most important inputs for a detailed estimation of the project costs. The team only needs to define the cost (price) of each planned resource. Detailed assessment of the costs and the cost plan are needed for:

- checking indicative cost estimates, which were constructed during the initiation phase, correcting the value of the project, and verifying financial indicators
- final agreement on the project budget
- controlling costs in the execution phase
- defining the plan for project financing

A detailed cost estimation is used for verifying the financial indicators of the project, which are calculated by the initiators based on a cost-benefit analysis, where costs have been roughly estimated on the basis of the comparable previous projects or the parts of them. In planning, the project team estimates the costs in detail, so the planned value cannot be equal to the initial rough estimation. The question is whether the detailed cost estimation is higher or lower than the initial one and what is a difference.

If we assume that the project team has prepared a realistic cost plan in which the initial estimation was lower, then only two alternatives remain: the project can be cancelled, or the project budget is increased. The latter is chosen when the revised financial indicators (profitability, payback) still satisfy the client (therefore the client make this decision). However, in many cases, top management decides not to execute the project after a detailed cost plan, since the cost of project initiating and planning is usually negligible compared with the cost of project execution.

4.3.1 Cost estimation techniques

Project cost estimation techniques were mentioned in the project initiation chapter, where the feasibility study was described. As previously explained, in the initiation phase, costs are estimated analogically (top-down), what means that the cost of the entire project is roughly assessed based on the actual costs of previous similar projects, or a rough cost assessment for the individual sets of tasks is made based on similar task groups in the past projects or operational tasks.

Analogy estimation is prorated from previous projects that are similar in scope and capacity (Kerzner, 2009). The input for such assessment is the project scope, final reports of previous similar projects, and needed resources. Analogue estimation is fast and cheap, and it can be done without all of the necessary data.

Parametric modelling assesses the cost of the project using a mathematical model, taking into account the statistical links among different project parameters. It is similar to analogy estimated and is typically used in the early stages when the project has not yet been fully defined. The data needed to produce parametric estimates are the project scope, the selected parameters of the project and historical data. Costs are estimated based on the norms for a unit. For example, one meter of the cable installation (m2 of asphalt, m3 of concrete) costs 1,72 €.

The most accurate technique is **engineering** (bottom-up) method, which assesses in detail all costs of individual tasks. During project execution, this assessment, in combination with the schedule, is also used for controlling costs.

4.3.2 Project cost estimates using the engineering method

For a detailed estimate of costs using the engineering bottom-up method, three basic input information are required: a list of all tasks (WBS), a plan of resources, and the cost of those resources. Typical project costs are:

- work,
- equipment,
- material,
- contractors,
- insurance,
- energy,
- travel costs,
- administrative costs.

The plan of resources can be easily remodelled into the cost plan, so that the quantity is multiplied by the price (i.e. the cost per unit). In addition, the indirect people costs , such as travel expenses and daily allowances, need to be added (Tab 4).

Tabel 4: Task based cost plan

Task	HR	Outsourcing	Material	Equipment	Energy	…
T1.1	4.800 €			12.400 €		
T1.2	5.100 €		500 €			
T1.3	6.440 €	45.000 €	1.200 €			
T1.4	13.320 €				200 €	
T1.5	160 €			8.700 €		
…			140 €			

* based on resource plan (Table 3)

The accuracy of cost estimates depends largely on the proper assessment of resource use (work hours, materials, etc.) and corresponding estimates of the costs of resources. For a better assessment, the team uses updated information on the prices of equipment and materials as well as internal tariffs of general expenses (travel costs, energy). To better assess the services of contractors, it is reasonable to obtain several offers; however, if the team has no time for that, then information from previous projects should be used. Publicly disclosed recommended price lists of professional associations can also be considered.

When the enterprise executes many similar projects, **reference models** can be developed based on the database of previous projects. Models include tasks, schedule, resource needs (a position/post or profession) and the costs of resources. With some adjustments regarding the specifics of the new project, the team can quickly prepare a realistic cost plan.

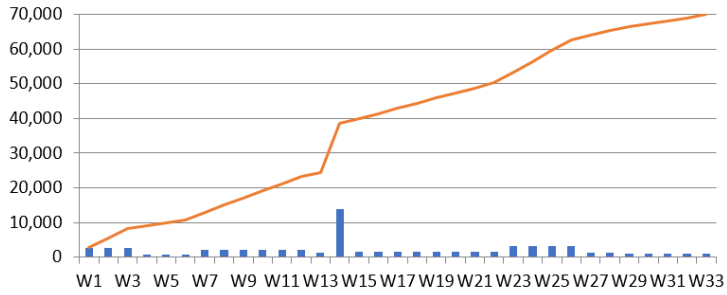
4.3.3 Cost plan

There is only a slight difference between the cost estimation and the cost plan. Namely, the cost estimation only includes the cost of resources for individual tasks. When tasks (with the costs) are scheduled on the timeline and the costs of concurrent tasks are summarised per time unit (usually one week), then we get a cost plan. It is used for the project funding planning and for cost control.

Costs over the project life cycle are usually displayed in a graph, where the abscissa indicates time and the cumulative costs on the ordinate. The curve of the cumulative costs usually has an S form (Fig 14).

Based on the cost schedule and risk reserves, a project funding plan and project budget are defined. Usually, funding is the responsibility of a project sponsor or manager of the project portfolio, although there are some exceptions when funds must be gained by the project team (e.g. acquisition of event sponsors, projects in societies, or projects co-financed by the government or the EU). In these projects, the team is responsible for acquiring part of the financial assets; therefore, it has to schedule tasks in order to obtain the necessary funding.

Figure 14: Cost plan



4.4 PROJECT RISK MANAGEMENT

Even the most perfect plan cannot prevent unwanted events during the execution of a project. This may cause at least some unforeseen additional work as well as significant delays and costs.

The risk that the project will not turn out as expected arises directly from the uniqueness of projects (Turner, 2009). On addition, the objectives of projects are complex in order to meet the diverse interests of stakeholders; this requires a lot of tasks, which involve a lot of people with different skills, responsibilities and authorities. From complexity derive many opportunities that the tasks would not run as planned!

Given that risks in project execution are inevitable, the project team needs to identify, minimize, or even eliminate them. Risk management aims to find effective measures to reduce or eliminate the impact of an event as well as a suitable ratio of additional costs that would be caused by the problem and the money willing to be spent on risk prevention (mitigation).

None of the plans introduced so far (schedule, resources, costs) are final until preventive risks measures are included. The saying: "Prevention is better than cure!" is especially true in the management of the project risks.

4.4.1 Project risks

In order to properly understand the management of project risks, it is necessary to define the basic terms and their relations:

- There is a **risk** that something will occur (an event, a set of circumstances, or situation) that will negatively impact on execution of the project.
- Such an event or a condition is a **risk factor**, while the occurrence of an event or situation is the **risk materialisation**.
- **The risk source** is the individual, enterprise or area (someone or something), whose operation can lead to the occurrence of the risk factor and thus materialisation of the risk.

Most authors sorts risks into **business** (investment in the wrong project), **technical** (the impossibility of achieving goals), and **operational** risks (inadequate client collaboration). Business risks (affecting the success of the project) are usually the responsibility of project client and/or sponsor, while technical and operational (affecting the effective project execution)risks are dealt by the project team. The last two types, commonly called the project risks, are derived from the project environment or directly from the project.

As the project manager is primarily responsible for the effective project execution, we discuss only project risks here. The most common sources of and risk factors (the latter in parentheses) can be found on Fig 15.

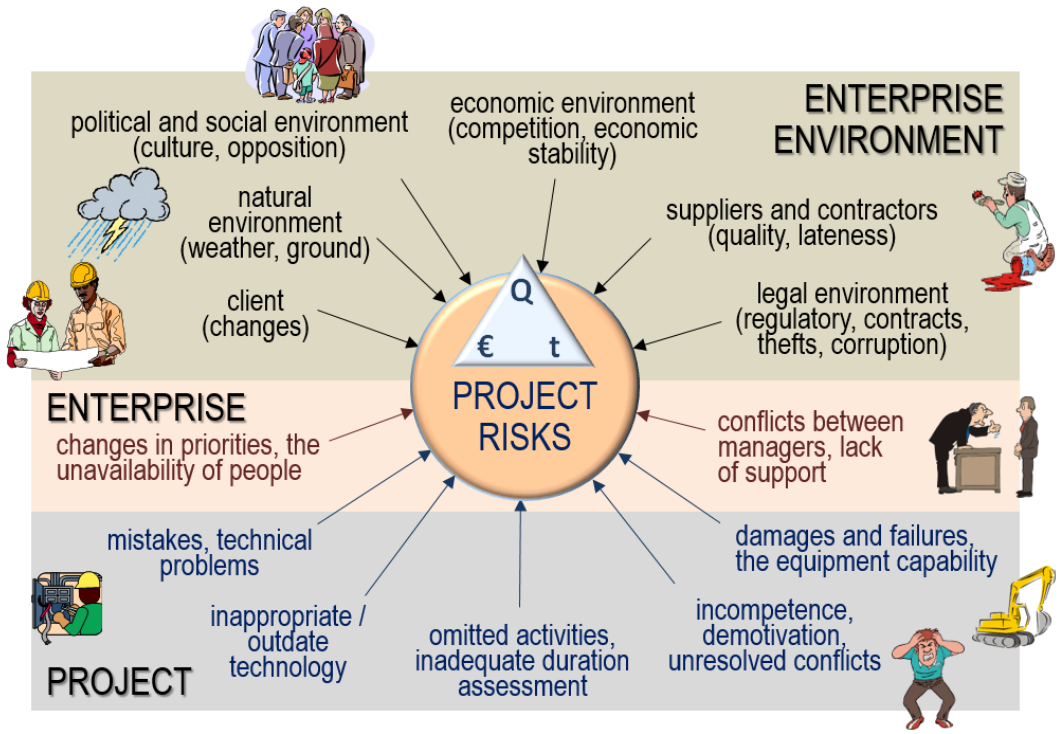
4.4.2 Risk management process/steps

Project risk management is the process by which the team tries to reduce or eliminate the likelihood of risk materialisation; and process, which reduces the negative impact of the risk events on the effective project execution. Risk management process is divided into **four steps**:

- risk identification (what can go wrong)
- evaluation of risks (how strong can affect the execution)
- planning measures to reduce the risks (can we prevent them or at least minimize their impact)
- risks control and response to materialised risks (early detection and intervention).

The first three steps are part of the project planning, while the last is carried out during the execution phase.

Figure 15: Typical project risks and risk sources



4.4.3 Risk management plan

Risk identification includes a discussion of the potential risks and preparation of a list of risks. The inputs are WBS (the list and specifications of project tasks), the scope and specifications of products, the plan of resources, information about the enterprise environment, the risks database (risks' data from previous projects), as well as the expected benefits of the project. Identifying risks involves searching for reasons for problems in the execution. For every task listed in WBS, the team should find the risk most likely to occur by asking the following questions:

- What would be the reason for delays or increased cost of individual tasks?
- What would be the reason that the results of the tasks (the project) won't satisfy the customer expectations and requirements?
- What obstacles could cause lower quality of performance or/and results?
- Are there any risks related to project resources (unavailability, poor knowledge, motivation)?

The team can help itself with the experience and expert knowledge of its own members and other experts from the enterprise; it may also rely on intuition or use a variety of brainstorming techniques. If the enterprise conducts a systematic analysis of the final project reports, then data on the risks of past projects are of great help.

Identified risks are entered into a table (Tab 5), where the task, within which the risk can materialise, for each risk is also defined.

Tabel 5: Evaluated identified risks

	Potential risk	Task	PR	CO	RF
01	Lack of information	1.1 Evaluation	3	2	4
02	Funds reduction by Board	1.2 Developing hardware	2	3	6
03	Sponsor will not fulfil obligation	2.4 Collect sponsorship money	1	2	2
04	Delay of contractor	3.1 Sensor development	2	3	6
05	Problems with components integration	4.3 Systems integration	1	3	3
06	…				

Risk evaluation: In next step, each identified risk has to be evaluated. The main reason is to focus on the most important risks (statistics showed that one-fifth of all risks can cause 80% of problems or damage to the project - the Pareto principle).

Risks evaluation (sizing) involves assessing the range of possible impacts and associated probabilities. For every identified risk, the team has to estimate the probability of the risk event

occurrence and the expected consequences. The risk size (factor) is the product of probability and impact.

Risk = likelihood * impact	*Kerzner*
Risk size = probability * impact	*Chapman & Ward*
Risk priority = probability * consequence / impact	*Burke*

There are different units for assessment:

- both factors from 1 to 3 (Burke, 2003)
- consequences of from 1 to 3, the probability of 1 to 9 (Young, 2000)

Many authors propose that the likelihood of risk materialisation should be expressed in percentages, while the consequences can be assessed by the months of delay (duration) in work hours/days (additional work) or by monetary units. If the impact is estimated financially, then ranking risks regardless of the type of consequences can help. The risk may impact

- time (e.g. delays because of troubleshooting),
- finance (payment of penalties in the case of mistakes), or
- quality (inadequate delivery has to be repaired).

The overall impact of time and poor quality can also be financially valued. Repairs and elimination of delays require rental of additional resources or payment of the overtime work, while project delay brings fewer benefits.

Risk mitigation strategies: Having identified, evaluated (quantified) and prioritised risks, the team is in a position to consider ways of reducing risk and to develop a risk response plan. The most appropriate measures are those which reduce the probability of risk materialisation or even eliminate the risks. In the literature, there are several basic approaches / types of response:

- passive acceptance and contingency actions (active acceptance)
- prevention/avoidance (risk elimination)
- reduction/mitigation (reducing the probability of materialisation)
- transfer/deflection. (reducing the impact in case of the risk materialisation)

Acceptance refers to risk toleration. Perhaps because nothing can be done at a reasonable cost to mitigate the risk, or the probability and impact of the risk occurring are at an acceptable level. Sometimes, contingency plans can be determined in advance; these are actions planned and organised to come into force as and when the risk occurs.

Prevention/avoidance is the elimination of the risk by removing the cause or by doing things differently where it is feasible to do so (changing the project plan). Measures are put in place that either stop the threat or problem from occurring or prevent it from having any impact on the project.

Reduction/mitigation means reducing the risk probability. This could be achieved by using proven technology, developing prototypes, simulating, early actions, adopting a less complex process, conducting more tests, or choosing a more stable supplier. Frequently control actions either reduce the likelihood of the risk developing or limit the impact on the project to acceptable levels.

Transfer/deflection is a special form of risk reduction where the management of the risk is passed to a third party via, for instance, an insurance policy or penalty clause, such that the impact of the risk is no longer an issue for the project. However, shifting the negative impact of threat to a third party does not eliminate the risk. There are three ways of deflecting risk: through insurance, by which it is passed on to a third party; through bonding, by which a security is held against the risk; or through the contract, by which it is passed between owner, contractor, and subcontractors.

The more tasks on the critical path, the riskier the project is, since the delay of critical tasks directly delays the project. Therefore, scheduling a time reserve at the end of the project reduces the likelihood of project delays in case of risk materialisation. Time reserves are also intended to cover all risks and difficulties that were not identified during the project planning. In addition, an extra budget is planned in case of additional costs.

Tabel 6: Risk mitigation plan

Risk ID	Risk description (potential risk)	Task	Risk factor	Risk owner	Risk mitigation	
					Strategy description	Trigger
02	Funds reduction by Board	1.2 Developing hardware	6	Claudia	Reduction of some functions	Board Decision
04	Delay of contractor	3.1 Sensor development	6	Michael	Additional workshop and joint design	Low quality of samples
07	Scope changes	4.6 System integration	6	Greg	User Survey, an additional workshop for specifying specifications	Ideas during meetings
12	System failure at start-up	5.3 Trial operation	9	Anna	Additional preliminary component tests	Failure
…						

For a comprehensive overview of the most important risks for the purpose of controlling risks, a list of risks with planned measures needs to be prepared (Tab 6). For each risk, the owner is defined, usually a member of the team who is nearest to the source of the risk, who will be responsible for continuous risk tracking during the execution phase, detecting the occurred risk event as soon as possible, and launching the planned corrective action. For this reason, the trigger also is defined – a sign of risk materialisation when corrective action will be launched.

4.5 PROCUREMENT PLAN

Procurement includes products of suppliers and services made by contractors. The resources that need to be purchased include material and semi-finished products as well as equipment. Service includes execution of work (set of tasks, a project phase), and execution on the site / at the event.

The procurement planning and the integration of purchasing tasks into the project schedule depends on the availability of the required resources. If the material can be bought in the store or taken from the enterprise's warehouse at any time, then the project team does not deal with procurement in the planning phase. However, when the delivery time is longer, especially when supplier has to adapt the semi-products or equipment to our needs, purchasing tasks have to be included into the project schedule. Procurement planning is also important in enterprises where usually order material/equipment for more projects at once to get a quantity discount.

The input for procurement planning is the plan for needed resources by tasks (a type and the quantities). It must first be determined whether each resource will be produced in the enterprise or purchased ("*make or buy*" decision).

When is decided to purchase the resource, the team needs to determine the delivery time, and a new task (purchasing equipment/material) must be included in the schedule. The task has to be finished just before the task, where the equipment/material will be used, starts.

Duration of the purchasing task is the sum of delivery time and the duration of the tasks before placing an order (dispatching the demand, bargaining, development of adaptations, and/or testing of the samples). It is advisable to add a few days of reserve (risk of delay in delivery). Of course, the risk is lower when purchasing repeated material from a permanent supplier.

Service is usually used when the enterprise does not have enough experts for executing a set of tasks or/and when the enterprise assesses that the specified product/result will be made faster, cheaper, and with high quality by the contractor.

The typical acquisition process includes preparation of the specifications of the expected deliverable, searching for suitable contractors and sending the demand (or publishing it on the web site, in newspapers, or other media), negotiations with contractors (in terms of price and time), signing the contract and execution of the deal. The letter is the only task that the team initially includes in the schedule; all prior tasks need to be added into the schedule during procurement planning. It is important to define who will execute the process of obtaining the contractor. Based on the duration of all newly planned tasks, the start date of the preparation tasks is determined.

4.6 INFORMATION AND DOCUMENTATION MANAGEMENT PLAN

For some project teams and the parent enterprises this topic, also called the management of communications is irrelevant, because the enterprise has introduced a special computerised project information system for managing the information and documentation. This applies to enterprises where many similar projects are executed (e.g. construction and engineering, development of IT solutions, product development, etc.).

However, if the enterprise undertakes just a few projects annually, especially when a larger project will be executed by several partners and/or subcontractors, the information system is a rather important topic. Documentation and information is transferred among many individuals and groups within the project team as well as among the team, the contractors, the client, and the sponsor, line and top managers of the enterprise need to be informed. Sometimes, it is also necessary to regularly inform the public. According to PMBOK (2008), an important input for the definition of the communication system is the RBS.

Poor information and documentation management can cause major problems in the project. Wysocki (2009) states that 70% of IT projects are dropped due to lack of information; therefore, during the project planning, the team needs to determine the stakeholders of the project, what they want to know about the project, and how to ensure the needed information. Burke adds that the medium by which communication will take place should be chosen and when the information (documents, minutes, reports, etc.) will be transferred. The communication plan should determine who will receive the information, how often, by which medium, and whether/when the receiver has to send feedback (Verzuh, 2008). For a proper understanding, an explanation of technical terms should be prepared.

4.7 DISCUSSION QUESTIONS

1. Define the process of project planning. What kind of plans team prepares in the planning phase?

2. Explain project critical path! How it is calculated and what information it gives us?

3. How do we shorten the duration of the project, if the planned delivery exceeds the project deadline?

4. Draw a sample of WBS with 12 tasks. Tasks link into a network diagram and show the critical path.

5. List five types/sources of project costs. What are the inputs for planning budget?

6. Explain methods of cost estimation.

7. Define project risk and list some samples of risks and risk sources.

8. Show risk management process, list techniques for risk evaluation and make a case.
9. List risk prevention / avoidance measures. Who is risk owner and what is one's role?
10. What do you need to define for the service procurement in the planning phase?

5 PROJECT ORGANISATION

The term *organisation* has several meanings: 1) the process of ensuring efficient implementation (organisation of work), 2) a social unit, which operates in order to achieve common goals of participants, and 3) relations among members of the enterprise, providing the existence and development, and the rational achievement of the enterprise objectives. The first (processional) aspect we discussed in project planning, the second aspect is not important for the management of projects, while the third one will be discussed in this chapter.

5.1 DEFINITION OF ORGANISATION

Enterprises usually have an established permanent organisation that clearly defines the hierarchy of jobs, duties, responsibilities and authorities related to these jobs, and formal relations among them. In addition, the organisation defines departments associated with the hierarchy and lines of delegation, work coordination and reporting on performance. Organisation relations are shown by organisational charts, while authorities and responsibilities are defined in the matrix and job descriptions.

Project teams and other project stakeholders are not a part of that permanent organisation. Namely, each project involves different areas of expertise and different number of experts with varying workload in the project. For this reason, we cannot establish a permanent department with the same jobs/experts and entrust them with different projects; rather, we need to set up a temporary organisation for each project and somehow connect it with the permanent organisation. There is one exception: project-organised companies, where departments are actually permanent project teams who take over the projects, execute them, and then begin new projects. This kind of organisation is primarily established in companies whose core business is the implementation of projects for external clients (engineering, construction, IT-companies, consultants, etc.).

There are several ways of organising projects, which will be presented in the first part of this chapter. Selection of project organisation depends on various factors, particularly the size and activity of the enterprise and the type of the project.

Linking project and permanent organisation is very important for the project manager, because it also defines his or her authority and responsibilities. However, the project manager usually cannot influence the organisation selection, because it may already be defined by the enterprise's organisational regulations or determined by the internal project order (project charter).

The project is not properly organised until a few additional organisational issues are also defined. It is important to define the relations among all stakeholders and clearly define their roles, responsibilities and authorities. Terms include the Organizational Breakdown Structure (OBS) and Resource Breakdown Structure (RBS), which shows the relations among project stakeholders (in connection with WBS), and the responsibility and competence matrix (RAC) or responsibility assignment matrix (RAM), which define the roles, authorities and responsibilities of the stakeholders. The last organisational issue includes the team rules definition and the agreement on stakeholders' collaboration.

5.2 TYPICAL PROJECT ORGANISATION STRUCTURES

There are three typical ways of placing the project within the parent organisation:

- the project is implemented within the line/functional organisation
- a temporary department for the project team is established (pure project organization)
- employees are located in the parent department and partly involved in the project (project matrix organization)

5.2.1 Projects in line/function organisation

For projects in a permanent line/functional organisation, no extra organisation formation is established. Moreover, tasks performers do not have any official status of being a member of the project team. In many cases, even the project manager is not determined, yet the project execution is part of the current duties of one of the line managers, usually the one whose employees executes the majority of project tasks.

Two types of projects are executed in such an organisation. In the first, most of the tasks are executed by one department, while its manager is responsible for the project. If the project requires the participation of employees from other departments, the managers of these departments agree on implementation and schedule the project tasks at one of their regular coordination meetings.

In the second case, several departments are involved in the project and successively execute individual sets of tasks without mutual collaboration and without any responsible person (manager, coordinator) to encourage cooperation and accelerate execution. Because of this, projects can get stuck, and some departments criticise the results of predecessors due to sequential execution and lack of cooperation. In many cases, the project has to return to the previous phase (department).

Although this type of organisation is rare, it has some positive features:

- high flexibility of human resources in the department
- experts can perform the same work for several projects
- experts (colleagues in the department) collaborate in solving problems, sharing knowledge and experience as a source of creative synergic technical solutions
- if individual experts decide to leave the project or even the enterprise, the department has sufficient knowledge to continue the project work without any distinctive problems
- there is no need to add additional temporary department in the permanent organizational structure

- regular work in the department is not interrupted due to work on the project
- work on the project brings reanimation in an otherwise routine work

Weaknesses of such organisation:

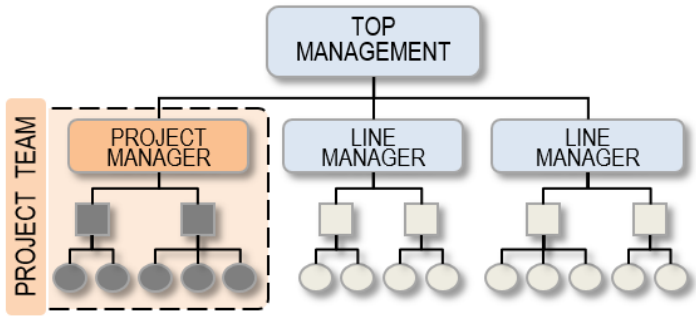
- functional department performs its operational work, which has higher priority than project tasks, making tasks not strictly focused on the client
- no one is fully responsible for the execution of the project; only the responsible for the task sets are defined, resulting in the unrelated task execution, errors, repairs, and ineffective execution
- performers may ignore project duties, because they are not placed in in the department where the project is implemented
- motivation to execute project tasks is weak, because the project is not their primary work
- the organisation does not provide a comprehensive overview of the project
- communication between the participating departments is poor, as is the sharing of knowledge and experience

This type of organisation of projects is less often used, yet it is typical for enterprises with poor project organizational culture and conditionally useful only in smaller enterprises where not many projects are executed.

5.2.2 (Pure) project organisation

In project organisation, also called "pure" (Kerzner, 2009, Lock, 2007, Meredith and Mantel, 2009), an enterprise establishes a temporary independent project department where the project staff is temporarily reallocated from parent departments (Fig 16). When not enough personnel with the necessary skills and knowledge are currently available in the enterprise, they can be temporarily hired or employed for the duration of the project.

Figure 16: (Pure) project organisation



All employees of the department are members of the project team and work full-time only on tasks within the project. The head of the department is a manager of the project who takes full responsibility for the project and also has full authority (the same level as the line managers of other departments). The other line managers have no impact on the project. The roles and responsibilities in this organisation are very clearly defined, as are the relations among the team members. Typically, the structure is the same as the lower levels of RBS (Fig 4, Fig 19) with manager of the project, core team (leaders of the expert teams) and other performers at the third level.

Advantages of pure project organization include:

- one person is fully responsible for the execution of the project and bears responsibility only for the project
- organizational structure is very simple and supports a comprehensive approach to the project
- responsibilities and authorities are well-defined and encourage participation of team members
- the project manager has full authority over the project team; the command lines are clearly defined; there is no conflict because of roles and responsibilities; team members report only to the project manager
- performers work in a strong team atmosphere, which increases motivation and engagement in a project
- when the project team separates from the parent departments, the communication links among the project participants shorten; the project manager communicates with the parent enterprise only through top managers, and there is no need for cooperation with line managers

› because all of the information related to the project is collected and evaluated in one place, the information flow is faster; thus, fewer errors occur

› centralised management enables fast decision-making, so the team can more quickly respond to the additional demands of the client

Major weaknesses of the pure project organization include:

› poor utilisation or unbalanced workload of people - experts from certain professions

› are differently loaded, some have to work full-time while the others only half

› higher cost for the enterprise due to lower utilisation of people (team members are paid for a full load but work less)

› greater possibility of work duplication (two projects develop the same solution, both with lower quality)

› team members are strongly attached to each other, so the we-they syndrome can occur (i.e., a rivalry between the project team and the parent organization)

› motivation can decline towards the end of the project due to threatening dissolution of the team, because they do not know whether they will be allocated back to the parent department after the project ends, assigned to a new project, or even fired; this is especially true for those who have been employed only for the purpose and duration of the project (they even wish to extend of the project)

› less professionalism and lower product quality, since the experts who have previously discussed solutions with their colleagues within the parent department are now too far to consult with them; moreover, the team can made some professional decisions that would be better elsewhere

› members of the project are not aware of the problems of the parent enterprise and often do not follow its policies

5.2.3 Matrix project organisation

Matrix project organisation combines the advantages (and eliminates the weaknesses) of functional and pure project structures. The basic feature of the matrix is that the project **team members remain working in their parent departments**. As a result, they can participate in one or more projects and also perform operational tasks when needed. The line manager ensures that individuals are fully employed. If an employee spends only 30% of his or her time on one project, then the line manager assigns additional tasks from the other projects or some operational work.

The project manager temporarily works with people from different departments. The **line manager** is responsible for finding skilled and available experts for the project and indirectly (via subordinate team members) contributes to the efficient execution and quality of the project. If an individual does not meet the project tasks satisfactorily, then both managers resolve the problem together.

Participation and workload of employees in the projects can vary. They can fully participate for a short period or part-time for a long period. That is why the close cooperation between the line and project manager is so important.

The matrix organisation may sometimes be less appealing for employees, because they are directed by two superiors. This creates a problem of **dual leadership**: individuals are responsible to both the line manager (for operational tasks) and the project manager (when they work on the project). This requires accurate delineation of tasks, in particular, the agreement between the project and line management on when the individual will be available for project tasks.

There are several possible locations and positions of the project manager in a matrix organization. One can be directly subordinate to the top management, which gives strong authority (and greater management support), or employed in the project office (where the superior can be a portfolio manager and a project sponsor). However, the project manager can also be an employee of one of the involved departments.

Advantages of the project matrix organisation include:

- optimum workload of team members; duplication of work is eliminated; the best experts can work on several projects
- greater adaptability to changes in the environment, technology or changing client requirements
- good information flows (both horizontal and vertical)
- as team members work in the parent department, they keep in touch with the profession, despite the work on the project; there is also the possibility of increasing the professional knowledge of the other team members
- the project is linked to the organisation of the enterprise, which encourages making important decisions in collaboration with other management
- staff can be freely assigned to projects; in addition, they can take the shorter tasks in different projects when necessary
- encourages participation on the projects; creative work on the project brings reanimation in the routine operational duties

- less fear of what will happen once the project is completed
- the enterprise can concurrently execute several projects

Weaknesses of project matrix organisation include:

- the problem of dual leadership, i.e. individuals are subordinate to the project manager for project tasks but professionally and disciplinary to the line manager; in the case of conflict between managers, team members suffer from vague priorities of their tasks and overload
- the problem is even worse, when an individual participates in several projects
- unclear division of authorities and responsibilities between the project and line managers, especially in the case of a poorly developed project organisational culture
- lack of cooperation between project who is responsible for the tasks, dates and content of work, and line managers (responsible for assigning skilled and available experts on projects)
- in the multi-project environment, the organisation is very complex and more difficult to manage; reallocation of people among projects in the case of changes; resolving delays is very challenging
- inconsistency of team members due to rapid changes of tasks, environment, managers and co-workers, due to the taking over the tasks in other teams or in parent department (it can generate obstructions to the project execution)
- problem of division of pure project tasks and operational tasks; the latter are usually linked with orders and production as well as shorter deadlines, which increase the line manager's pressure on employees if one is not assigned full-time to the project; sometimes even the performer himself prefers the operational tasks

The impact of the majority of mentioned weaknesses can be mitigated only by a welldeveloped project organisational culture in the enterprise.

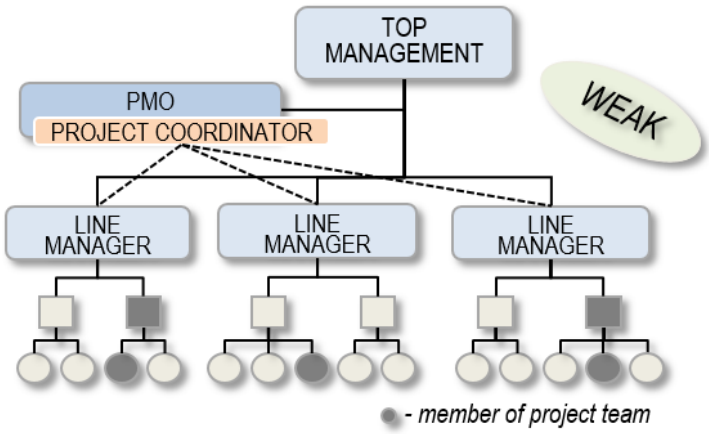
5.2.4 Weak and strong matrix organisation

Functional and project structures are extreme organisational structures; in between, there are three types of matrix organisations. The most important characteristic that changes in these organisational structures is the authority and responsibility of the project manager, which raise from the minimum in the weak organization to the maximum in the project organisation. The latter is the only one in which the team members work together in the same department.

A weak matrix structure (Fig 17) is very similar to a functional one, with a significant difference: a responsible person is selected who accelerates the performance and strives for effective project execution. Usually, this is the project **coordinator**, who has less authority than a typical project

manager and hence less responsibilities. He or she coordinates departments, monitors execution, and reports to superiors but is not responsible for the execution of tasks. Performers of tasks are not directly assigned to the coordinator, although one may collaborate with individuals. However, by the tactical decisions of the line managers (due to operational work), those performers may be replaced at any time.

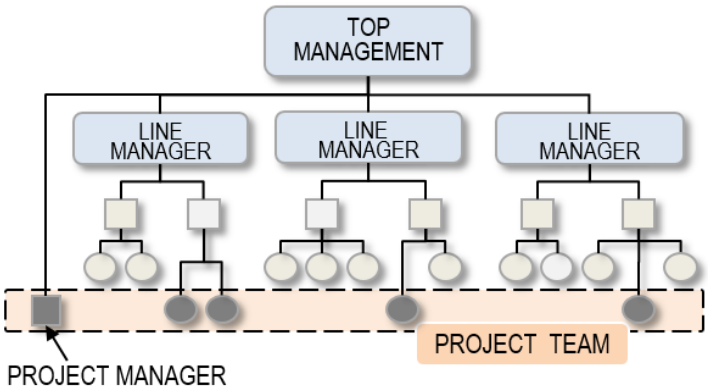
Figure 17: Weak matrix organisation



The coordinator plans the project with line managers or their subordinates, while line managers lead performers and take over responsibility for the implementation of tasks in the execution phase. During this phase, the coordinator does not really care who implements particular tasks. Line managers can even change performers or assign more of them to a task. In controlling the project, the coordinator organises control (progress) meetings, gathers information about the progress and ensures rapid response to delays or problems. In control meetings, the coordinator provides a decision on which department is responsible to resolve the problem or delay, but the means of resolution is a responsibility of the line manager.

Responsibilities of the coordinator are limited to the integration and coordination of departments; in addition, he or she is responsible for project documentation and for reporting to superiors on the progress of the project. Because the coordinator is less burdened with the implementation of the project, he or she can coordinate several projects at once (depending on the size, type, enterprise, etc.). This organisation is recommended for less complex sales and engineering projects.

Figure 18: Strong matrix organisation



A strong matrix structure (Fig 18) is very similar to the pure project organisation (compering the level of the authority and responsibilities), but team members remain in their departments, spending the majority of their time on one project. Since they collaborate more with the project manager than the line manager, the first one has greater influence on them. The project manager has overall responsibility for the project, while line managers assign them staff (full- or part-time) and advise on the implementation of tasks. In this organisational structure, the project manager works full-time on one project.

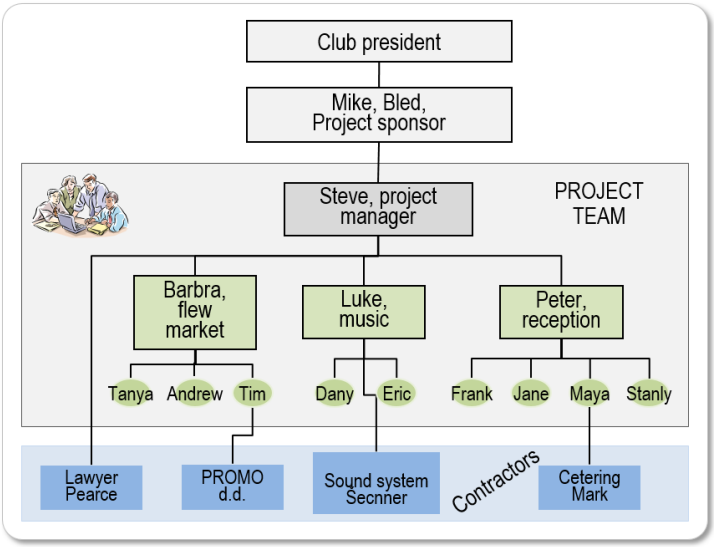
5.3 PROJECT STAKEHOLDERS ORGANISATION/RELATIONS – OBS/RBS

Sometimes, the enterprise which executes the project is not large enough and/or is not organised by departments (i.e. small companies, associations, an informal group). In addition, only a few employees may work on the project, since most of the work is outsourced. In this case, the project organisation shown in the previous chapter cannot be defined. However, an organisation chart helps to clarify the relations among team members and other project stakeholders.

Usually, there are three levels of the project team: the core team (project manager with the leading experts), the broader team (other employees who participate in execution of project tasks), and the contractors. The project manager and experts coordinate the work of others who report on the implementation of tasks. Which participants work together on tasks, who delegates tasks, who supervises work, and who reports to whom is normally showed in a specific organisation chart called the **RBS** (*Resource Breakdown Structure*, Fig 19).

Authors also mention the **OBS** (*Organizational Breakdown Structure*). It displays the structure of the departments involved in the project, while the RBS displays the breakdown of the team by expert teams of the same discipline or department (e.g. programmers) or by a set of tasks related to the scope of the project (e.g. software).

Figure 19: Resource Breakdown Structure



Newel (2002) states that in OBS, tasks from the WBS are related to departments who will perform tasks. Other authors point out that the OBS shows enterprise departments that are responsible for executing the task sets or take over a complete part of the project scope. Newel also points out that the difference between the OBS and the RBS is that the latter shows all individuals who are listed as task performers in the schedule, while the former displays only the departments.

The RBS clearly shows the expert teams (core team members with their subordinates), and defines which internal team member coordinates and controls particular contractors.

5.4 MATRIX OF AUTHORITY AND RESPONSIBILITIES (RAM/RAC)

The RAM (*Responsibility Assignment Matrix*), also RAC (*Responsibility And Competence or Responsibility Assignment Chart*), or the Linear Responsibility Chart (Tab 7), clearly defines the roles of the project stakeholders and thus avoids later misunderstandings and disagreements (e.g. *I am not responsible for that!* or *You should also obtain my opinion!*). It is also important to define who confirms the results/deliverables of the tasks and thus their completion (a performer, one's superior, manager of the project, client, or someone else?).

Managers used to include all tasks and all project performers in the matrix. Since modern tools enable planning of responsibilities for individual tasks directly in the Gantt chart, it is unnecessary to define that again in the matrix. The matrix includes only the sets of tasks (depending on the project scope, execution tactics and the WBS), while the roles are defined for the core team members, project manager, sponsor, client (user), contractors, and, if necessary, for the top manager and involved line managers.

Tabel 7: Responsibility Assignment Matrix

	Erica, PM	Steve	Vanda	Nico	Irene	John	Tanya	Frank	Club president	Mediana Ltd
Concerts	C	R							C	I
Culture events	I	A			R				C	I
Workshops	C		R		CO					
Sport events	C			R					I	I
Legal issues	R								C	
Promotion	C		A				CO		MC	R
Infrastructure	C	CO				R				I
Journal	C						R		I	
Sponsors	CO			A				R	C	

R-responsible C-confirms results CO-collaborates A-available to advise M-must be consulted
I-must be informed

What are the roles, authorities and responsibilities that are entered in the matrix? The most common role was once "executes,", but has been (due to the performers allocation in the Gantt chart) replaced with "**responsible**«. The responsible person in principle does not necessarily execute the task but is responsible for the task executed by co-workers and/or contractors who work under their coordination (of course, one can also take part of work). A very important role is **confirms** (the results), and others: **collaborates** (when minor involvement of other discipline is needed), has to be **consulted** (necessarily incorporation of some line manager or expert), is **informed, decides, controls**, etc. An individual may have several roles in one set of tasks (e.g. participates and confirms).

Typically, the matrix includes the first letters of the roles (R – responsible, Co – collaborates, etc.), or they can be replaced by numbers or symbols. In any case, it is necessary to add the legend at the bottom of the terms. **It is important that each row has only one R and at least one C (confirms)**.

5.5 TEAM RULES

One of more important issues to be defined in the team rules is the way of reporting, particularly how team members report to the project manager, so one can be constantly up to date with the project progress (control!). The frequency of reporting is defined along with the information to be contained in the report and when the report should be written or given orally (see the chapter on project control planning).

Team members most often report orally at regular progress meetings, so the rules determine the terms (an hour and a day in a week) and location of those meetings. The project manager books the meeting room at the project start for the entire duration of the project. Permanent participants of

these meetings are identified (usually members of the core team attend). Progress meetings are not extra convene during the project execution.

In the case of virtual dislocated teams, the way of communication has to be defined, especially if more companies participate and if participants do not know each other personally. The team defines whether communication will circulate by e-mail, phone, video conferencing, or IP telephony. For this purpose, the rules also include the contact details of the project stakeholders.

Wysocki (2009) in explaining the *operating team rules* suggests that at the beginning of the project, procedures and rules should be established for team meetings, problem solving, decision making, conflict resolution, consensus building, and brainstorming. The rules for dealing with changes can also be added.

We have already mentioned reporting of the project manager to the project sponsor. According to their agreement, rules for when the manager and sponsor will meet regularly are defined (i.e. on the last Wednesday of the month at 11.00 in the sponsor's office, while two days earlier, the sponsor must get a written report by the project manager). Interim meetings may be held if necessary.

The rules can also define any regular collaboration with line managers (e.g. the RD manager will attend monthly progress meetings). For internal projects, collaboration with end users can be defined, while team interaction with external clients is usually defined in the contract. The same usually applies to cooperation with contractors and consultants; however, the summaries of the agreed rules may also be included in the project team rules.

5.6 DISCUSSION QUESTIONS

1. Draw a pure project organizational structure; specify its characteristics, advantages and disadvantages.

2. Draw a matrix project organizational structure; specify its characteristics, advantages and disadvantages.

3. Explain the difference between matrix and pure project organization!

4. Explain the difference between weak and strong matrix organization!

5. What do you define with the RAM? What are the typical roles?

6. What is defined by the team rules?

6 PROJECT TEAM LEADERSHIP

Satisfied people make better use of their skills and abilities. Satisfaction impacts their contentedness with the work they do, their environment (equipment, co-workers) and their superiors. Leader's behaviour has a direct impact on the last aspect of satisfaction and indirectly on the other two as well. The leader delegates (right) tasks to subordinates, provides them equipment and maintain good relations among co-workers.

6.1 TEAM LEADERSHIP FACTORS

In defining the management, we defined leadership as influencing, motivating and directing staff so they adequately execute the tasks they have been assigned. It includes inspiring hard work, maintaining the work climate, ensuring proper communications and solving disagreements. Leadership affects how many hours people actually work on the project and how much they accomplish in that time.

Leadership is **especially important** in projects in a matrix organisation where employees do not work full-time on one project. The project manager has to fight for the attention of team members with other managers (at least with line manager, but also with several project managers). A leader should persuade people to spend as much time as planned on the project and, in particular, that they accomplish what has been entrusted to them.

In a **matrix organisation**, team members are typically assigned to the project for a limited period of time determined by their line managers. They are stronger and longer connected with their subordinates and know them better (their personality, abilities, etc.). In addition, they determine their salary and bonuses, approve leave, etc. Therefore, operational tasks that line managers delegate to team members have usually (informally) higher priority. For effective execution of project tasks, the project manager (compared to the line one) should struggle to find the right inspiring **attitude** with less formal pressure. A firm hand usually fails, because it can cause hidden rebellion of team members.

6.2 TEAMWORK

Teamwork is the basic form of work for the effective execution of project tasks, which differs from the work of the group. In group work a task is divided into several parts, and each worker independently performs a part, while in teamwork, each team member participates in the execution of joint tasks. As the project team has a joint objective, work should be conducted with a lot of collaboration and in a strong team spirit.

This is clear when people work together on one task. However, a certain level of teamwork also exists when different tasks are assigned among many individual performers. Despite working relatively independently, they must continuously harmonise their work with each other. Project delivery is not simply a sum of the results of the individuals; rather, all partial results affect each other.

Teamwork brings quite a few advantages compared with group or individual work. The first one is a **synergy effect**, which means that the effect of the work of the team is greater than the sum of individual effects. This is possible due to joint creativeness and mutual assistance, learning from each other, as well as sharing experiences and knowledge. In common discussions, the team can develop more efficient ways of project execution and qualitative solutions and deliverables. Combining knowledge and experience creates better ideas. Teamwork also **fosters innovation**, creativity and the self-esteem of individuals who learn from each other in the common search for ideas and solutions.

On the other hand, inadequate cooperation that does not attain synergy demotivates team members, resulting in ineffective execution of project tasks and possible project delay. Therefore, the project manager as team leader must constantly emphasise the importance of teamwork, encourage cooperation, and resolve disputes to ensure an adequate level of teamwork.

In particular, it is important to realise that teamwork does not happen by itself but must be created, which is one of the most important duties of the project manager (who is also the team leader). In the literature, many **teamwork obstacles** are indicated: vague responsibilities and authorities, unbalanced work-load, misunderstandings and poor communication, lack of trust among team members, disagreements, incoherence personal goals with the goals of the project, etc. A very important task of the project manager is to detect obstacles and eliminate them.

The literature offers many advices on how to **create a team from a group**. Most of the work must be done by the project manager, who should ensure appropriate communication (by example) and encourage conversations about collaboration among team members and the difficulties in doing so. Some authors suggest a joint definition of the team rules at the beginning of the project. Teamwork training has become very popular recently, especially **team building** outside the enterprise (e.g., in amusement parks, schools of wilderness survival, sailing, etc.). The key is more relaxed overall socialising - team members become more familiar with each other, which provides more collaborative project work.

6.2.1 Team development

The team may not work with the highest possible level of efficiency, even though members are motivated to execute the project. To work effectively, the team should first informally distribute roles, choose the method of collaboration, develop a set of shared norms and values, and establish mutual communication.

Before the team actually starts working, it must pass three levels: forming, storming and norming. **Forming** is the initial phase in which the team members begin to work together, each with their own expectations and responsibilities. According to experts, members of the team are highly motivated at the start, since the beginning of the new project is always a challenge. Moreover, awareness that superiors have recognised their skills and have assigned them to work on the project also motivates them.

However, their effectiveness is not yet at its peak, because they do not trust each other. They begin to learn how to work together, but collaboration is still more formal. At the beginning, the team leader is more focused on the content, objectives and tasks than on teamwork. The leader tries to establish an organisation (relations), clarify the roles of team members, and achieve loyalty to the team and project.

The second phase follows, called **storming**. In the joint work, differences arise. This depends on their nature and acquired habits as a result of work on earlier projects in other teams or departments. In addition, differences in personal goals also come to light. Different approaches to collaboration, execution of tasks, and problem solving lead to misunderstandings or even major disagreements, with negative effects on motivation and team performance. Ambitious individuals start to fight for supremacy and impose their ways of working on others.

Consequently, the team leader must now pay more attention to interpersonal relationships and collaboration. The leader should emphasize the importance of adopting a different way of thinking, active listening, resolving disagreements, flexibility and creativity. At this stage, it is especially important that all decisions are well explained.

The third level of teamwork is **norming**, in which members conform to each other and take their positions on the team. They begin a constructive dialogue on contentious issues in the debate and resolve various issues. Disagreements are rarer, and relations begin to improve. Some people still do not fully conform, but their resistance fades and slowly disappears. This is the stage of negotiations and compromises; the result of conformity is the development of common norms and values and identification with the team. This creates the foundation for joint action which enhances motivation and performance of the team. The manager's promotion of teamwork may be less intense as team members start to participate more by themselves.

The real effective teamwork follows, as people work with a high degree of mutual trust. Some authors even suggest that a team at this stage operates quite independently, without interference of the project manager. One's work becomes less stressful; there are fewer disagreements; and individuals can trust their team mates, who become more independent in decision-making. However, the manager constantly has to check and maintain a high level of implementation, especially since the members of the team after some time become less critical of his or her work, so motivation and team performance decrease.

6.2.2 Power of leader and leadership styles

Leadership is one of more demanding areas of project management. A good leader is able to influence team members through behaviour patterns, enthusiasm, optimism, energy, persistence, courage and personal maturity.

Project managers usually have a lower level of official authority than line managers, and their authority informally reduces the project organizational culture. Therefore, in leading the team, they have to rely mostly on their leadership abilities. For all managers, formal authority alone does not ensure that subordinates will follow them. People constantly observe and evaluate their

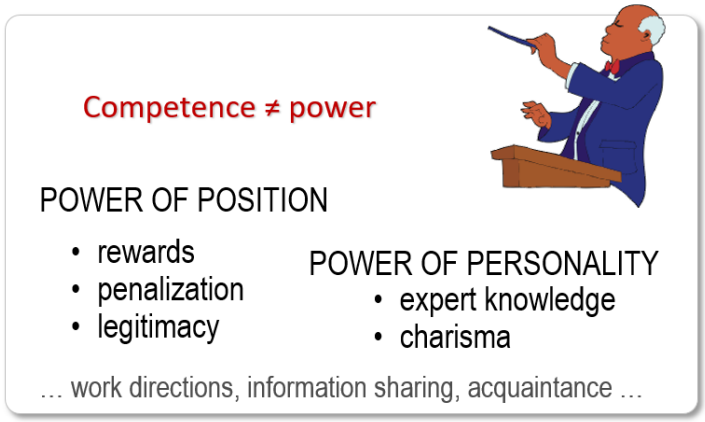
superiors, and their behaviour will depend on their valuation of the manager. Poor opinion can reduce their motivation to work. For example, if several individuals have a negative opinion of their superior, then they feel stronger and together can choose another informal leader.

The real power of leader is not only in the official authority, so the project manager builds team leadership based on the strength of his or her personality, and not on the strength of the position relating to his or her official authority. In doing so, different styles of leadership can be adapted to different circumstances.

6.2.3 Sources of leader's power

First, we need to clarify the difference between authority and the power. Authorities give the manager the right to command and make decisions, while real power is the ability to influence others in order to get the desired response. By using various forms of power, which are explained below, the manager tries to gain the team members' respect so that they will follow directions (Fig 20).

Figure 20: Real power of leader



Legitimate power derives from the fact that the leader was officially selected as the manager. Legitimate power is connected with the authority that gives managers the right to make decisions, delegate tasks, coordinate and direct team members, and reward and penalize them. Authority, which defines the legitimate power of the project manager, is determined by the organizational regulations in the enterprise.

Line managers regularly use **reward** and **a punishment** (i.e. coercive power), but project managers in many enterprises have no authority to use –this. They have no ability to determine the salaries of team members based on their performance. However, if the enterprise policy allows for this possibility, then project managers must use this power in the proper way, as inappropriate use of these instruments can cause more harm than good. The leader may unfairly reward one's

favourite team member, which will demotivate others. Moreover, punishment without any explanation can offend and cause low motivation as well as poorer results.

Another important source of power is the expertise of the manager. In contrast to line managers, who mainly operate in one area of expertise, the project manager is usually involved in several disciplines. The project manager is not expected to master all included areas (leading experts in core team helps him/her), but it is recommended that he or she know just enough in order to discuss with the performers about their work (and so that they do not cheat). However, team members may doubt the project manager's management skills. If they doubt about the professionalism of their superior, they may less confidently follow his or her directions!

Charisma, also called **reference power**, is derived from the personal qualities of leaders. As a result, subordinates can identify with the leader. This is achieved by one's natural ability to work with people and inspire exemplary behaviour.

6.3 DIFFERENT LEADERSHIP STYLES

First researches on the best leaders behaviour were published in the 60th of the last century (Verma, 1996). McGregor states that leaders behave based on their perception of subordinates. Their characteristics are distributed to the negative (theory X) and positive (theory Y). According to theory X, people are expected to be lazy and unambitious and would like to avoid work and responsibilities. Managers who have a negative perception of their subordinates lead them with a firm hand, autocratically make decisions only by themselves, and put those decisions into force at any cost.

According to **theory Y**, people are motivated, creative, ambitious and responsible; therefore, they should be democratically directed and led. Since the truth is somewhere in between (a bit closer to Y than X), other theories were developed along with intermediate stages between autocratic and democratic leadership (adapted from the Vroom and Jago model):

- patriarchal (*It will be as I said*)
- informational (*I made that decision for the following reasons*)
- consulting (*Your opinion is interesting, but I have already decided*)
- cooperative (*I will consider some of your opinions*)
- participatory (*My opinion is worth more than yours*)

These types of leadership styles mainly relate to the decision-making on who will execute the tasks and how to solve organisational or technical issues. In most cases, team leadership should be participatory; however, decision-making also depends on the current situation (more on this later).

In the 1960s, **behavioural models of leadership** were developed. Researchers exposed two types of successful leaders: task- and relationship-oriented. The latter is aimed at creating an appropriate working and friendly atmosphere on the team, while the former precisely organises the work of subordinates. Task-oriented leaders define tasks, set labour standards, plan with co-workers, and

encourage work according to standard procedures. Relationshiporiented leaders, on the other hand, praise colleagues for a job well done, do not require more than someone is able to do, and are friendly and accessible. Blake and Mouton developed the *managerial grid model*, which combines both types in a grid, defining five leadership styles. A leader who is positively concerned with both people (relations) and tasks (production) is said to display a *team style*, which emphasizes the role of teamwork.

Because the same leader behaviour is not necessarily appropriate in all circumstances, **situational leadership models** have been developed. Younger, less experienced team members, for example, do not want to make decisions by themselves, while more experienced members claim that before every decision should ask them for their opinion. Younger workers need a mentor, while seniors need a coordinator. Leading highly skilled creative employees should be different from the leading manual workers on site.

However, in finalising the project (or each phase), the leader should become more authoritative, because he or she is more focused on the tasks and strives to ensure that the team members have completed the tasks for which they were responsible. While team creativity is important in planning and searching for the right means of execution, effective completion of work is most important in finalising the project.

6.4 MOTIVATING TEAM MEMBERS

The efficiency of people depends on their commitment to carry out assigned tasks. Commitment, to a large extent, depends on motivation. Motivated people take advantage of their knowledge and experience; therefore, a highly motivated team with satisfied members is more productive; the quality of execution is better; and the project cost is lower. Consequences of poor motivation are disagreements, stress, low morale and low productivity, which may even lead to failure of the project.

Motivation is not based only on money, although we will also mention the monetary rewards. As already mentioned in explaining the sources of leader's power, project managers often have no ability to reward the team during the project, and rewards at the end of the project do not always compensate for inconveniences during project execution (including the arrogant leader). On the other hand, good relations within a team can bring more benefits than expected rewards (Fig 21).

One of the key motivational factors is a high level of **harmony** between the task/**project objectives** and the **personal goals** of team members. People distinguish themselves by their interests. When the project tasks and objectives are in line with team members' personal values as well as their professional and social goals, money is only a secondary reason to go to work every day. For projects, of course, we cannot always get the right person for a specific task, so project manager should try to negotiate for the right people. The manager should also discuss with team members which project tasks they would prefer to execute and how high their motivation is to participate in the project. Based on such discussions, the project manager then assigns tasks.

As indicated in the previous section, participatory leadership refers to the participation of subordinates in decision-making. Team members feel important if they can participate in decision-making, which is also a motivating factor. More importantly, participating in the project planning contributes to assessing the complexity and duration of planned tasks (goalsetting theory). If one defines the duration of their own task, there is usually higher possibility to finish it on time. When the task duration is defined by someone else an employee would even claim that the it is impossible to execute the task in such short time.

Figure 21: Motivation factors

A high level of **teamwork** provides welfare, orientation to work and a creative atmosphere. Due to good cooperation, team members mutually transfer knowledge and experience and produce better ideas. A real, motivational work atmosphere is created through proper communication, working conditions (equipment, place), and project **organizational culture**, especially by top and line management attitude. Sometimes, members of the team are highly dissatisfied due to poor support from top/line managers despite the efforts and leadership of the project manager. **Competition** can be a good motivator, regardless of whether the project team competes with a competitive company or another project team within the company. In the latter case, it is important that the competition is not destructive.

In order to understand people and their motivation, it is important to recognise some of the factors addressed by modern motivational theories (Verma, 1996). According to the Vroom's **expectancy theory**, people think about how much effort they should put into a task before doing it. The more that can be expected from a successful execution, the more motivated they are and the more they will work. **Equity theory** deals with the expectation of an individual to receive a fair reward for a

finished task, comparable to the rewards of other employees for similar work. At the same time, one considers the fairness of allocating tasks and the equity of the workload. **Reinforcement theory** addresses the impact of the expected rewards and punishments on the efficiency at work.

One of more important personal motivators is career path, especially an expected **promotion** in the case of successful completion of the project. The project manager can praise the contribution of team members at project meetings that line managers and enterprise executives attend, which increases the reputation of individual team members. Public praises also increases their satisfaction, and they expect better paid duties in the future. The positive consequences of promotion, including the achievement of higher professional status and the opportunity to influence decisions, are also recognised among colleagues.

6.4.1 Rewarding project work

Money is not the main motivator in project work; however, it motivates when it comes as:

- a bonus (the promised reward for the efficient project execution)
- a temporary reduction in salary (when people fail to meet the objectives)
- an accompanying factor for the expected promotion (higher salary)

It is important to realise that team members have to **expect the reward** in order for it to motivate them. According to the motivational theory of expectations, opportunistic people often consider how much effort to put forth in a task. The more that they expect from successful task execution, the more motivated they are and the more effort will they put into work. Therefore, the enterprise should apply the rules which will provide transparent rewarding of project teams. *For instance, if the project is completed within the constraints (deadline, budget), team members get a bonus, or if the final cost is lower than planned, the project team gets 40% of the savings.*

Of course, we should also discuss the amount of rewards (i.e. how high it should be to motivate individuals). In an enterprise with a good working environment, a low reward motivates team members as it shows recognition of their contribution to the enterprise; this is *financially supported praise*. On the other hand, even a high reward does not motivate people to work in a high conflict team, with competitive and jealous co-workers, arrogant boss, etc. In addition, it is important that the rewards are relatively comparable across the whole enterprise; otherwise, people will be demotivated if some teams or individuals unjustifiably receive higher rewards.

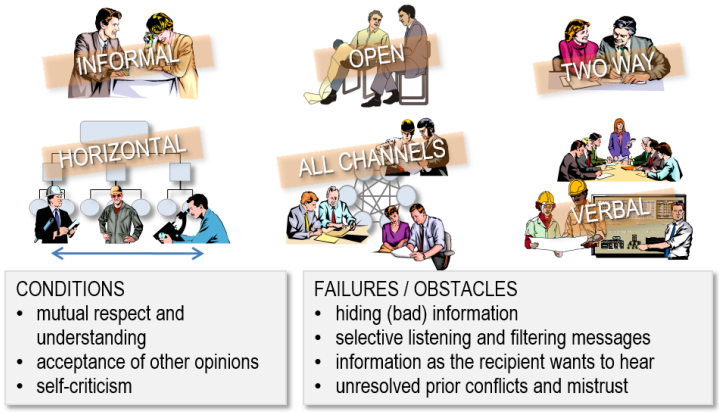
It is also necessary to mention **non-monetary** or indirect monetary rewards. Promotion or more pretentious and responsible work on the next project means recognition and could also bring a higher salary. Additional education/training may also motivate, as this contributes to personal development, and as a proof, that the enterprise count on one in the future. And the destination of a training (a trip!) can also motivate. The award may also be holidays using enterprise facilities …

6.5 COMMUNICATION ON THE PROJECT TEAM

A good working atmosphere is an important condition for successful team work. It is created by interpersonal relations, which often depend on communications among team members. The project manager directs the project, leads the meetings, encourages ideas, and connects team members with other participants. The team analyses the issues, makes decisions, and coordinates the work of individuals toward a common objective. In addition, communication enables problem-solving on a team, collaborating with other teams, and the transfer of ideas and good practice.

Communication on a team is based on mutual respect for colleagues, understanding others, and an open relationship. Communication among team members is not hierarchical (which includes only commanding and reporting), but **horizontal**, as the positions of team members are equivalent (rather than commands, the explanations, suggestions, interpretations, agreement should be used). Communication is **bidirectional**, which means that team members discuss (and not that only one, usually the leader, speaks, while others have just to listen). Communications also runs across **all channels**, which means that team members talk to each other, and not that one member ask (or told) the leader to talk to other team member about the problem at work (Fig 22).

Figure 22: Team communication



Furthermore, communication on a team is **informal**, as it is not predetermined when one can talk about something (not requiring a written report nor the prescribed forms). In addition, team members can informally discuss problems at a coffee break, without any official meeting. Communication is largely **oral** (personal or by telephone, at the meetings), although the use of written communication (e-mail) has increased, especially within virtual teams.

The basics for appropriate communication on the team are acceptance of other opinions and honesty. The team leader should also encourage a critical evaluation of the work (and frank discussion about possible improvements) and should be self-critical in order to enhance creativity and productivity. In order to improve self-behaviour, a good leader encourages subordinates to critically evaluate the leader's work. If one shows indifference to the problems of subordinates,

has no time to listen when acting from the power of position, and commands to team members rather than discusses with them, this undermines the motivation of the team.

For high team efficiency, it is necessary to raise the level of communication within a team. Teams should give priority to creating good relations and a good work climate. With this partnership, trust and understanding, they promote mutual help and support.

The team leader must ensure that inappropriate communication does not threaten the functioning of the team. The most common mistakes and barriers to communication within the team are hiding (mostly bad) information, communicating with only one or some of the team members, autocratic leading of meetings, inactive or selective listening, message filtering and distrust among members which may result from unresolved previous disagreements.

Adequate communication is also very important in **project control**, because reporters could withhold or distort information in order to cover up problems, faults and delays. The worst is when the reporter communicates information that the recipient wants to hear, not as it should be heard. The result is late response from the project manager and project delay.

6.6 DISCUSSION QUESTIONS

1. Define team leadership! What areas does it cover?
2. Explain the team development process. How would accelerate it?
3. List leaders' power sources (position/personality).
4. How do you recognise the participatory leadership (show typical characteristics)?
5. How would you non-financially motivate team members?
6. Explain the communications in project team!

7 PROJECT CONTROL

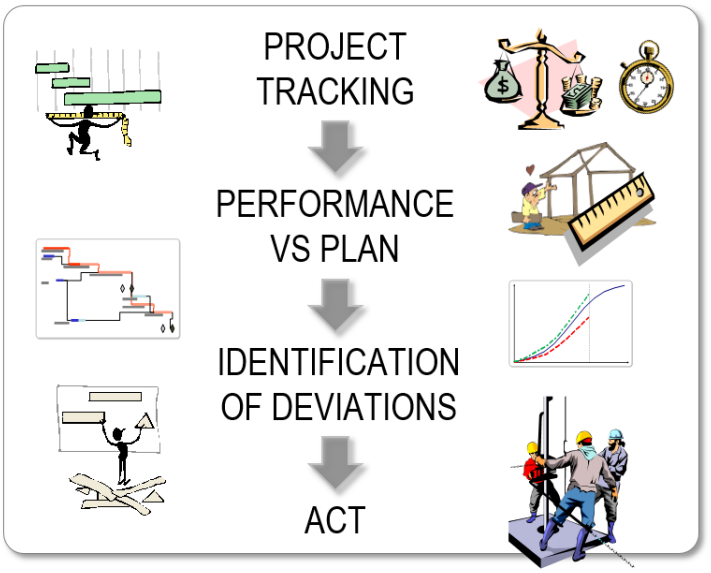
Despite detailed planning, project execution does not always go as planned. Reasons for deviations may be changes, technical problems, faults, poor planning, problems with suppliers, or inefficiency of the project team. To ensure effective project execution, the project manager (by proper leadership) ensures efficient task execution and controls the progress of the project, i.e. regularly checks whether the project is implementing according to plan and reacts in case of deviations.

7.1 EFFECTIVE AND INTEGRATED CONTROL

Control is similar to navigating a boat (Burke, 2003): when we find out that the boat has diverged from the planned direction, we refit it and re-direct it towards the goal. The project direction is defined by the baseline plan, while control (monitoring and responding in case of deviations) ensures returning the project in the appropriate direction. The later deviations are discovered, the larger they are and the more difficult the re-direction.

Project control includes monitoring execution, comparing the current state with the plan, identifying deviations, and planning and implementing corrective actions and measures to ensure project execution within budget and by deadline (Fig 23). Regular control detects and solves problems when they are still small, which provides faster response and reduces inefficient project execution - delays, higher costs and lower quality.

Figure 23: Project control process



The basic input for project control is the project plan, particularly the scope and specification of products, project schedule, cost plan, risk management plan and plan of procurement. Without qualitative **requirements** and an appropriate **plan**, **we cannot control** the project. For control purposes, the manager compares the state of execution with the plan. Thus, if the project has no plan (or is poorly prepared), comparison and identification of possible deviations (and the size of those) is not possible; consequently, team cannot know whether the current state indicates that the project will carried out within the constraints (deadline, budget) or not.

Control has to be regular. The sooner deviations are detected, the smaller they are and the easier to solve. According to our research, regular weekly control (compared to a monthly) reduces project delay by 10%. Team members should be involved in the control. They need to provide correct information about the tasks' state and should not disguise problems and faults. The project manager must tolerate bad information and focus primarily on problemsolving, not punishment (as a leader should latter discuss with the responsible for the problem).

Most authors indicate three key areas of control: time, cost and quality. Some add control of objectives and results or scope of the project. Thomsett (2002) also mentions control of human performance, i.e. efficiency or effort (hours spent) regardless of duration.

7.2 PROJECT TRACKING/MONITORING

Information on the progress and status of the project can be obtained from various sources. Cleland (1999) and Kliem and Ludin (1998) classify these sources as formal and informal.

Formal sources are various reports, checklists, meetings, letters, notes, and records of audits. **Informal** sources include informal conversations, observations of performers, and tracking rumours among team members and within the enterprise.

Most authors suggest **regular** (30-60 minutes long) **progress** (status) **meetings** so that the core project team can inform each other about their task progress. The project manager verifies the state of tasks and identifies possible deviations at the meeting. By encouraging open discussion, the project manager can collect information that team members otherwise would not note in their reports. Andersen (2004) also suggests that the manager should ask as many **yes or no questions** as possible.

The meetings are another effective tool for detecting problems and changes, and they give an opportunity for immediate response of detected deviations. Managers can also use them for continuous informal pressure on team members (encouragement, drawing attention on deadlines…). The frequency of meetings depends on the type and the complexity of the project– some authors suggest daily, others weekly or monthly meetings, while Heerkens (2002) proposes a meeting at every 4% of the project duration.

In this context, we have to realise that short reporting from performers is a starting point of control. If changes and problems occur, then further discussion is required to specify the problem in detail, investigate the causes, find solutions, and determine the measures.

Minutes of the progress meeting should include following information:

- tasks that have been (or were planned to be) executed after the last meeting
- tasks that are going to be (or were planned to be) finished soon
- tasks in progress and their current state (results)
- tasks that are planned to start in the future (and the adequacy of input data)
- actual project cost (and estimated value at completion)
- problems, obstacles, and risks
- proposed measures and changes to eliminate deviations (time, cost, quality), the responsible person, and the deadline for each one

What about the other ways of getting information? The project manager may require **written reports** from team members and contractors or set up a project information system where team members regularly (daily, weekly, monthly), enter the needed information (results, problems, time deviations, spent work hours, cost). This can be an alternative or a supplement to the progress meetings. Also, different **checklists** can be used for obtaining the control data, especially when a task involves a lot of short work packages (that last less than hour), and the number of already executed packages is easier to evaluate the progress of the task.

In the literature we have also found the terms *management by walking around and walking the project*. This includes a visit of the team members on the site and informal talks on the status, issues, assumptions, risks. Through visits, the project manager checks the level of team members' motivation, verifies the accuracy or validity of the information received by the reports and meetings, and detects potential problems (Heerkens, 2002).

Some projects also require special tools and control procedures, which must be bought or developed at the beginning of the project. It is necessary to determine the data to be collected (quantities, work hours, measurements, test results, etc.), and who and where such information will be collected (team members, project office, other departments; on site, by the information system, etc.). A special information system only for the purpose of control can also be developed.

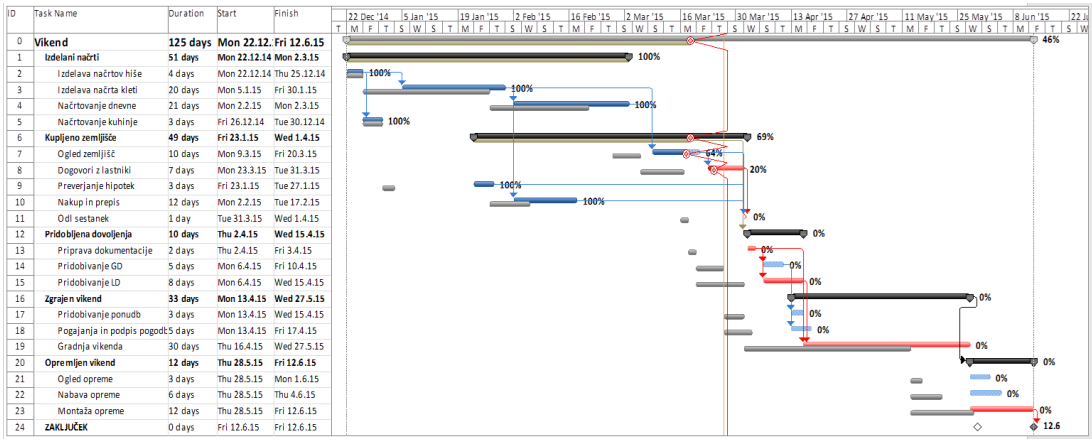
7.3 SCHEDULE CONTROL

The most common tool used for schedule control is a Gantt chart, which includes the actual start and end dates of tasks; then, these figures are compared with the baseline plan of the project. The difference between planned and actual dates at any given time shows the time deviation.

The most well-known techniques for time management (as an upgrade of the Gantt chart) are the jogging (progress) line and Baseline-Current-Future (BCF) analysis (Milosevic, 2003). **The jogging line** shows the time deviation of the execution of each task (Fig 24, red vertical line)

based on the current percentage of task execution. The line indicates the deviation where progress (percentage of execution) of the task does not meet the current date.

Figure 24: Project progress (time) control



For BCF analysis, the planned dates and duration of tasks (baseline) and the actual start and the level of progress (current) need to be shown in parallel. When the estimated time for the completing the current task is entered, the current delays may be seen along with the expected delay at the end (or at milestones) of the project in the event of inaction (future). The greater the difference, the sooner crisis action is needed.

It is often difficult to determine the percentage of execution. For example, while this can easily be measured in construction projects through meters of laid cables, the number of floors, square meters of laid insulation, etc., it is difficult to determine a percentage of developed software. Some authors suggest entering 25% when the execution starts, 50% when the task is nearly half done, and 75% when it is close to the end. Others suggest using only 0% (task has not yet started), 50% (it is performed) and 100% (the task is completed). Since this is particularly critical in the case of long-term tasks, it is advisable to divide such tasks into several shorter ones already during the planning phase.

Typical causes for poor performance and project delays are:

- poor estimation of planned work and task duration or overly optimistic estimates
- ineffective or incapable task performer
- insufficient resources when needed
- technical and quality problems
- additional requirements or changes in the client's specifications

- late delivery of materials and equipment
- poor integration of tasks or inter-functional complications
- technological breakthroughs
- conflicts in the project team (technical solutions, personal conflicts)
- changes in the entrepreneurship environment (market, legislation)
- delays caused by predecessors

Delays can be solved in three ways. First, we can try to solve the current task by performing the **crisis action** with the highest priority. In order to execute the task till the baseline deadline all available means should be used, which may cause a significant increase in costs, especially if suppliers or contractors are needed to participate. If the project is critically important for the enterprise, then the entire enterprise should participate.

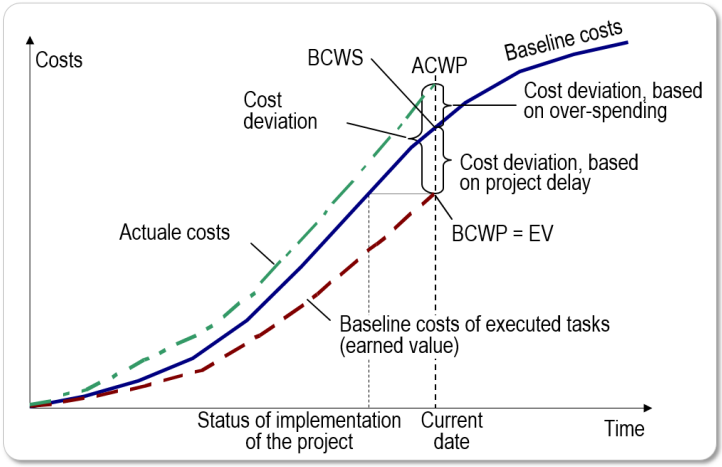
The second technique is called **fast-tracking**. Interconnections of the longest)critical tasks are verified, and the successors are rescheduled to start sooner; thus, the tasks that were originally scheduled to run in sequence will now partially run in parallel (as much as possible, yet up to a third of the predecessor's duration). The third technique, **schedule crashing**, means deploying extra people for future critical tasks, which shorten their duration and reduce delay; however, it may increase the cost of the project.

7.4 COST CONTROL – EVA/EVM

For the control of the project cost, **Earned Value Analysis** (EVA) is normally used. The basic input is the plan of costs (S-curve of cumulative costs over time), which should be regularly updated in accordance with any changes in objectives, requirements, and other project plans. To determine the current variance, two additional data are important: the actual costs at that moment and the progress state of the project. Based on the latter, we determine how much costs were planned for the current state of implementation. The difference between the current actual costs and the costs planned for the executed tasks is the real cost variance (Fig 25). Instead of costs, planned and actual working hours may be used for EVA (Lewis, 2007).

The EVA diagram typically displays information about the use of funds for the entire project. The current cost deviation and its causes are also useful for an indicative quotation of costs at the completion of the project. A clearer picture of cost variances shows diagrams for every type of costs – work hours, material, contract payments, etc. For efficient correction, it is crucial to know the precise causes of deviations. In some organizations, project managers are held accountable only for the hours actually worked on the project and for the work actually accomplished (Lewis, 2007).

Figure 25: Project cost control (EVA)



The most common reasons for cost increases are:

- inadequate assessment of costs in the planning phase
- difficulties, delays and additional tasks
- material price increases
- irregularities in the hours recorded
- invoicing by contractors for work that has yet not been performed
- belated or ineffective control
- pre-performance of the contracts, which was planned for a later date

Cost deviations are usually directly associated with changes in scope, time, and quality. Therefore, it is necessary to evaluate any change in terms of costs before it is approved.

Collecting data on spent funds can be performed manually (by project manager, administrator, project office) or automatically by a computerized information system, which can automatically display reports in different forms (tables, diagrams).

7.5 QUALITY CONTROL

No unified or widely used method has been developed in the field of quality control as it applies to schedule control (Gantt chart) or cost control (EVA). Namely, different project types have different quality requirements, standards, or unwritten rules. For some projects, quality is defined

by legislation; for others, by the quality of competitors' products. Quite differently the quality is controlled in software development, product development, engineering, and event organisation. As a result, it is necessary to adapt quality control processes and methods to the type of the project and to the specific fields of expertise included in the project.

Quality assurance is based on the philosophy of total quality management (TQM), which emphasises prevention rather than detection of faults. It is much better to create an environment that prevents faults and poor quality than trying to solve them (high quality of results cannot be expected from poor performance). Quality control by detecting and correcting faults can also lead to the desired quality at the end of the project; however, the repairs cause additional work and increased costs, which may also delay the project. Quality assurance is strongly influenced by the enterprise's perception of quality and the quality management approach as well as by project management – by choosing the right people, defining proper tactics of execution, highlighting the importance of quality, etc.

Quality control starts with the quality determining current deliverables such as inspection, testing, performance measurement, and data analysis. Many organizations have developed standard test procedures for each type of project. The findings are then compared with the requirements and quality standards, and corrective actions are implemented if necessary (e.g. eliminating the causes of unsatisfactory work). Quality control terms must be frequent enough to detect deviations and take corrective actions in a timely manner. The correction of technical drawings made by a designer in a few hours is less expensive than changing an already half-built building, which usually requires more resources and causes a higher cost increase.

Typical causes for quality deviations are technical problems, unsuitable and overloaded resources, bad material or equipment quality, changing demands, new technology, poor task linkages, and unsuitable quality culture.

7.6 RISK CONTROL

Risk control implements the risk management plan. Continuous risk monitoring is the responsibility of risk owners. Their duty is to detect the occurred risk event as soon as possible and to launch the planned corrective action promptly. The sooner the risk is detected, the lower are the consequences. Risk should be controlled weekly; the highest risks, even more frequently. The project manager checks the status of the risks at the progress meetings and, if necessary, updates the list. Risk owners regularly report to the project manager on the following:

- the effectiveness of the implemented risk reduction strategies
- the emergence of any new risk factors
- the elimination of existing risk factors
- any change of status of existing risk factors, for example, a medium risk factor becomes high risk

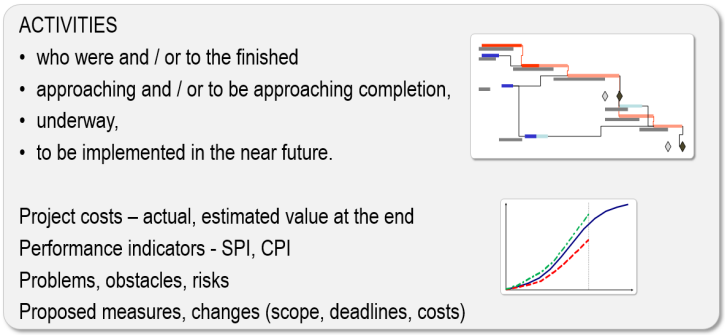
At each review, during the progress meetings, the risk list is sorted by current importance. However, it is important that the team constantly adopt a risk perspective and keep a collective »risk antenna« tuned for any early warning signs of new risks or changes in the level of existing risks.

7.7 REPORTING TO SUPERIORS ON THE PROGRESS OF THE PROJECT

In accordance with the agreement or practice in an enterprise, periodic reports on the project progress should be prepared monthly, quarterly or at milestones. The frequency of reporting depends on the individual stakeholders and on the duration and type of project. Stakeholders want to be informed whether the project is executed by the plan, what has been done so far, if there are any problems, the likelihood of completion in accordance with the objectives and constraints, etc.

The content of the regular project report is similar to the content of the minutes of the progress meeting, but it refers to a longer period and is less detailed. The report does not include the minor deviations and problems that have been successfully eliminated. Usually, only the structure of spending is defined in detail.

Figure 26: Regular project report



Some authors suggest that the project manager meets the **sponsor** at least **monthly**, while other influential stakeholders (general manager, client, steering committee, co-investors) meet at the milestones of the project. A few days before the meeting, the project manager usually prepares a written report and then presents key information on the progress, deviations, corrective measures and expected problems (risks) at the meeting. The meetings are also used to discuss and confirm the major changes; discussion should focus on searching for solutions to major problems.

The content of reports may vary according to individual stakeholders. Most authors recommend that the reports for sponsors, seniors and other line managers should be short and concise. Many enterprises have a standard A4 form, as superiors rarely have time to read extensive reports and to look for the most important information. When the project is funded by co-financiers and banks, more extensive reports are usually required, as special experts are employed for supervising the projects (and the reports' revision).

General information included in the report can be found on Fig 26. It is recommended to graphically represent the performance (Gantt chart) and the costs (EVA). Many authors state that the report should provide a variety of **indicators**, such as:

- Schedule performance index (**SPI**), the rate between baseline costs for the work performed and the baseline costs for the scheduled work at the time of reporting (formula 4)
- Cost performance index (**CPI**), the rate between baseline and actual costs for the work performed (formula 5)

$$SPI = BCWP/BCWS \quad (4)$$

$$CPI = BCWP/ACWP \quad (5)$$

ACWP *- Actual Cost of Work Performed*
BCWP *- Budgeted Cost of Work Performed*
BCWS *- Budgeted Cost of Work Scheduled*

When the SPI is more than 1, more work has been done than scheduled (when is less than 1, performance is behind schedule). The same is true for the CPI: a value over 1 indicates that the actual costs are lower than planned, while the value below 1 points out the spending is more than planned.

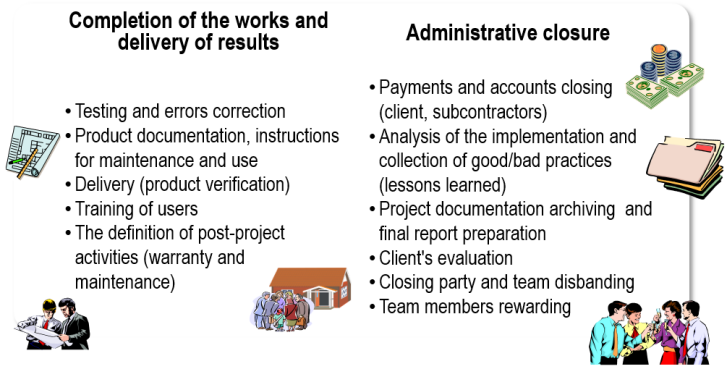
7.8 DISCUSSION QUESTIONS

1. Define the project control process and indicate some causes for project delay.
2. Show ways of collecting information about the project progress.
3. What questions does project manager ask at control/progress meetings in order to control time?
4. Specify ways of delay reducing. With one sentence explain the »fast tracking« and schedule crashing«!
5. Describe the control of costs and give reasons for the deviation.
6. What inputs you need to determine the cost deviation?
7. Explain risk control process.
8. What is included in the regular report and to whom it is intended?
9. What are the SPI and CPI indexes and what data do you need for their calculation?

8 PROJECT CLOSURE

Although completion of the project, more than any other phase, requires extremely diverse technical, organizational and leadership skills, research shows that this is the most ignored and least systematically derived phase in practice. The project does not end by itself, with the completion of last task of the execution phase. The project closure tasks should be carefully planned, coordinated and controlled. Project closure is typically divided into two parts: completion of work and administrative closure (Fig 27).

Figure 27: Project closure



8.1 COMPLETION OF WORK

One of the more important closure tasks is **documenting**. The most common are project execution documentation (assessment of performance and experiences gained) and technical documentation of deliverables (of the object, production line, IT solutions, etc.) and manuals (for the use, maintenance). In the construction industry, it is very important for documentation to be consistent with the actual situation on site, as many small changes can be done during construction which can later be dangerous for the users (e.g. electrical installations). We must not forget that the documentation could someday be required in the courtroom.

Review and verification of deliverables is a joint task of the client and the project manager (team) through the *acceptance test procedure* (ATP), which is previously defined by both, client and team. The client (or an independent competent service) checks whether the deliverables comply with the specifications, standards and legislation. After verification, the client starts to use products, while the project team administratively finalises the project.

Some closure tasks are formally linked with the tasks after the project closure, since the project team sometimes needs to prepare a rough plan of **after-project tasks**. Normally, these tasks are not executed by the team members, who usually start work on a new project; after-project tasks are the responsibility of other departments. However, the project team should (together with the responsible for after-project tasks) prepare the schedule and procedures, such as periodic check of the conditions, and the maintenance (of facilities, equipment). In SW development projects,

agreement of the subsequent upgrades can be signed at completion. In product development, the project team can adapt products to meet the specific client's needs. A special issue is also the plan and determination of the responsibilities for solving the problems within the warranty period.

8.2 ADMINISTRATIVE CLOSURE

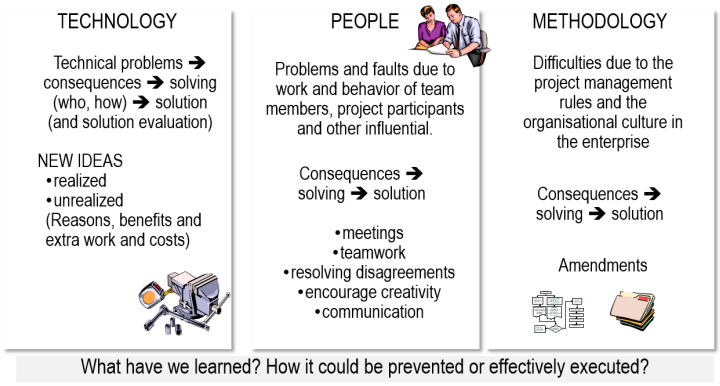
8.2.1 Evaluation of the project execution and organisational learning

Team members learn a lot in executing the project, but experiences can be forgotten if they are not recorded. Because of the abundance of problems, tasks and information, project members cannot remember all of the problems they dealt with during the project and may have forgotten how they solved them. In addition, not all of them addressed all of the problems, and the problems caused different levels of stress to the individuals.

Therefore, (at least core) team members should assess implementation of the project prior to preparation of the final report and discuss the lessons learned: what approaches, ideas or solutions were particularly successful; what their biggest mistakes were; and what they would do differently next time. A set of the most important lessons learned are incorporated into the final report. It is advisable to present experiences to other project managers in the enterprise. The systematic collection, documentation and transfer of experience (**organisational learning**) can bring a lot of long-term business benefits.

In assessing the efficiency of the project execution, the team compares planned and actual performance (time, cost, product quality, compliance with specifications), and the sources/ reasons for inadequate performance are also identified. Team expose other faults in their work (team work, project methodology in enterprise, technology, client collaboration, environment) and make suggestions for improvement in future projects.

Figure 28: Evaluation of the project execution



Other project stakeholders may also participate, especially the sponsor and the client. The latter assesses team work, cooperation and team terms with the client, whether the deliverables are as they were demanded (and specified), and whether the project brings the expected benefits.

The experiences (good and bad practice) can be recorded to a **knowledge base**, which should be systematically arranged, allowing future project managers to quickly find the right information. These plans can be used for the subsequent similar projects. All past causes of deviations can be potential risks for new projects.

The project manager also need to assess his or her performance. Where was the manager successful, and what needs to be improved prior to the next project? Based on the identified weaknesses, it is reasonable to consider further training.

8.2.2 The final report of the project

Irrespective of whether the project was successfully completed, or terminated for any reason, a final report needs to be prepared. It should contain a presentation of the results, deviations from the planned results, the reasons for deviations, analysis of mistakes and delays, and a financial report. It is also recommended to include lessons learned and analysis of risks and changes.

The report is prepared by the project manager with the help of core team members and then usually presented to the key project stakeholders, especially the sponsor and senior managers. The manager presents a separate report to the client (usually without information on the cost). Another presentation could be held for other project managers in the enterprise.

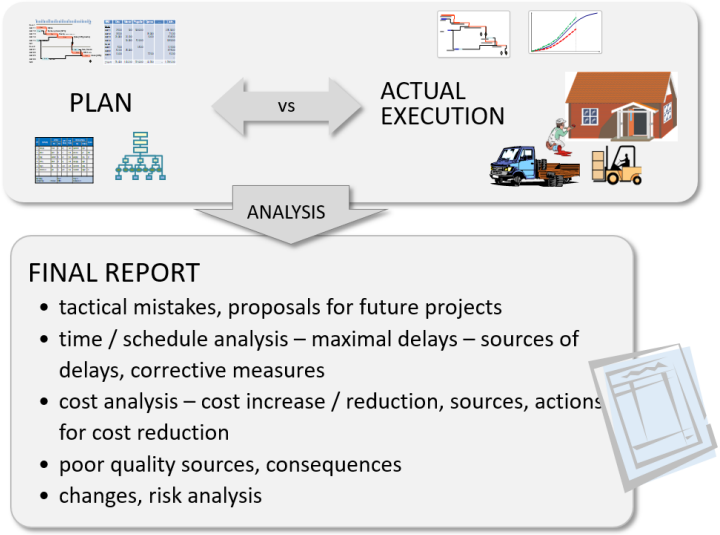
The **purpose** for preparing the **report** is threefold: first, the team gains a clear idea about the quality of its work (part of which was previously presented assessment of execution),; second, the lessons learned, summarised in the report, can be used for subsequent projects; third, on the basis of repeated problems in the implementation of projects, top management can make strategic decisions and plan/execute corrective actions so that the exposed problems will not arise again in the future. Sometimes, it is also necessary to change the enterprise's methodology of project execution.

The final report should start with a brief overall assessment of performance. The following areas are evaluated in detail (Fig 29):

- tactical mistakes and good practice: techniques used, special, unusual approaches that helped team to achieve the project objectives
- analysis of performance: delays/completion prior the deadline, causes of deviations, and assessment of measures to reduce deviation and/or shorten the project
- cost analysis: surplus/decrease, causes of the surplus, and successful/ unsuccessful measures of surplus reduction and/or cost decrease
- analysis of performance and product quality: causes of any quality deviation, consequences of poor quality

- risk management: identified risks that occurred and those that did not, (in)effectiveness of the measures, risks' impact on costs and deadlines
- changes and other unforeseen events that occurred and affected implementation (deadlines and costs) of the project
- other recommendations of the project team: findings and suggestions given during project execution
- client's report: assessment of execution and overall satisfaction

Figure 29: Project final report



The client (especially an internal one) participates in the preparation of the report and gives an unbiased opinion. We also recommend that the client sign the report.

8.3 DISCUSSION QUESTIONS

1. Project closure is divided into two parts … which? List three tasks for each of them!
2. Show an example of the verification of project deliverables (project type, deliverables, what do you verify).
3. What should team evaluate after the project execution and why?
4. When the project team complete the work and it is disbanded?
5. Show the content of the project final report. What would be the purpose of the report?

9 ACRONYMS

ACWP	Actual Cost of Work Performed
BAC	Budget at completion
BCWP	Budgeted Cost of Work Performed (=EV)
BCWS	Budgeted Cost of Work Scheduled
CBS	Cost breakdown structure
CEO	Chief executive officer
CPI	Cost performance index
CPM	Critical path method
CPO	Chief project officer
CSOW	Contract statement of work
EAC	Estimate coat at completion
ETC	Estimate cost to complete
EV	Earned value (=BCWP)
EVA, EVM	Earned value analisys, earned value management
HW	Hardware
IPMA	International project management association
IT	Information technology
OBS	Organizational breakdown structure
PBS	Product breakdown structure
PDM	Precedence diagram method
PM	Project manager
PMBOK	A guide to the Project Management Body of Knowledge
PMI	Project management institute
PMIS	Project management information system
PMLC	Project management life cycle
PMO	Project management office
RAC, RAM	Responsibility and competence
RBS	Resource breakdown structure
ROI	Return on investment
RR	(Research and development, RD)
SBEO	Senior buyer executive officer
SPI	Schedule performance index
SPMO	Strategic project management office
SVEO	Senior vendor executive officer
SW	Software
SWOT	Strengths, weaknesses, opportunities, threats

TOA	Task-on-the-narrow (network diagram)
TQM	Total quality management
WBS	Work breakdown structure

REFERENCES

Andersen, E.S., Grude, K.V., Haug, T. (2004). *Goal directed project management: effective techniques and strategies*. (3th ed.) London: Konan Page.

Andersen, E.S., Grude, K.V., Haug, T. (2009). *Goal directed project management: effective techniques and strategies*. (4th ed.) London: Konan Page.

Brandon, D. (2006). *Project management for modern information systems*. Hershey: IRM Press.

Burke, R. (2003). *Project management: planning and control techniques*. Chichester: John Wiley & Sons.

Chapman, C., Ward, S. (2007). *Managing Project Risk and Uncertainty: A Constructively Simple Approach to Decision Making*. John Wiley & Sons.

Charvat, J. (2002). *Project management nation: tools, techniques and goals for the new and practicing IT project manager*. New York: John Wiley & Sons.

Charvat, J. (2003). *Project Management Methodologies - Selecting, Implementing, and Supporting Methodologies and Processes for Projects*. Hoboken: John Wiley & Sons.

Cleland, D.I. (1999). *Project management: strategic design and implementation*. (3th ed.) New York: McGraw-Hill.

Dinsmore, P.C., Cabanis-Brewin, J. (2010). *The AMA Handbook of Project Management*. New York: Amacom.

Frame, J.D. (2003). *Managing projects in organizations: how to make the best use of time, techniques, and people*. (3th ed.) San Francisco: Jossey-Bass.

Gilb, T. (1997). *The Evolutionary PM Handbook*. Najdeno 2009 na http://www.ida.liu.se/~TDDB02/pkval01vt/EvoBook.pdf.

Heerkens, G.R. (2002). *Project Management*. New York: McGraw-Hill.

Heldman, K. (2005). *PMP: Project management professional, study guide*. (3rd ed.) Hoboken: Wiley Publishing.

Heldman, K., Heldman, W. (2007). *Microsoft office Excel 2007 for project managers*. Indianapolis: Wiley Publishing.

ICB International Competence Baseline (2016). (4th ed.). Nijkerk: International Project Management Association.

Kerzner, H. (2009). *Project management: a systems approach to planning, scheduling, and controlling*. (10h ed.) New York: John Wiley & Sons.

Kliem, R.L., Ludin, I.S. (1998). *Project Management Practitioner's Handbook*. New York: Amacom.

Lester, A. (2003). *Project planning and control*. (4th ed.) Oxford: Elsevier Butterworth - Heinemann.

Lewis, J.P. (2007). *Fundamentals of project management*. (3rd ed.) New York: Amacom.

Lock, D. (2007). *Project management*. (9th ed.) Aldershot: Gower.

Martin, P., Tate, K. (2001). *Getting started in project management*. New York: John Wiley & Sons.

Meredith, J.R., Mantel, S.J. (2009). *Project management: a managerial approach*. (7th ed.). New York: John Wiley & Sons.

Milošević, D.Z. (2003). P*roject management toolbox: tools and techniques for the practicing project manager*. Hoboken: John Wiley & Sons.

Morris, P., Pinto, J.K. (2007b). *The Wiley Guide to Project Organization and Project Management Competencies*. Hoboken: John Wiley & Sons.

Newell, M.W. (2002). *Preparing for the project management professional (PMP) certification exam*. (2nd ed.) New York: Amacom.

Philips, J. (2004). *PMP Project Management Professional Study Guide*. Emeryville: McGraw-Hill.

PMBOK - A guide to the project management body of knowledge. (1996). (1st ed.). Newtown Square: Project management institute.

PMBOK - A guide to the project management body of knowledge. (2008). (4th ed.). Newtown Square: Project management institute.

PRINCE2. (2002). (3th ed.). London: The Stationery Office.

Pinto, J.K. (2010). Project management: achieving competitive advantage. (2nd ed.) Upper Saddle River: Prentice Hall.

Škarabot, A., (1994): Moč in uspeh vodje projekta. Projektni management kot orodje za obvladovanje sprememb (zbornik posvetovanja). Ljubljana: Združenje za projektni management Slovenije. 113-122.

Thomsett, R. (2002). *Radical project management*. Upper Saddle River (NJ): Prentice Hall PTR.

Turner, J.R., Simister, S.J. (2000). *Gower handbook of project management*. (3rd ed.) Hampshire: Gower.

Turner, J.R., (2009). *The handbook of project-based management*. (3rd ed.) Maidenhead: McGraw-Hill.

Verma, V.K. (1996). *The human aspects of project management*. Newtown Square: Project Management Institute.

Verzuh, E. (2008). *The fast forward MBA in project management*. (3rd ed.) Hoboken: John Wiley & Sons.

Wideman, M. (2004). Wideman comparative glossary of project management terms v3.1. Najdeno 2008 http://www.maxwideman.com/pmglossary/index.htm.

Wysocki, R.K., McGary, R. (2003). *Effective project management: traditional, adaptive, extreme.* (3th ed.) Indianapolis: Wiley Publishing.

Wysocki, R.K. (2009). *Effective project management:traditional, agile, extreme*. (5th ed.) Indianapolis: Wiley Publishing.

Young, T.L. (2000). *Successful project management*. London: Kogan Page.

Young, T.L. (2007). *The handbook of project management.* (2nd ed.) London: Kogan Page.