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FACULTY OF ECONOMICS AND ADMINISTRATION

The Basics of Project Management

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Dear readers,

the times that we live in make demands on us to make many changes and to work to very short deadlines using limited costs and resources. The trial and error method has turned out to be almost unusable in the competitive market environment where normally we are not given another opportunity to try again and do better.

Stiff competition forces companies into cost-cutting to keep the costs low and the same goes for deadlines. In the Czech Republic where big national grants are still unavailable funds tend to be used sparingly which causes delays in investing. Nevertheless time tends to be the decisive success factor in advanced western countries. A company that is first to enter a market monopolies the market with new products and when other companies follow later, they often find it very hard to promote their products even at a lower price.

It is therefore fair to say that the current lifestyle brings new demands for product manufacturing and distribution processes. These processes become apparent through a shortened product lifecycle where there is increasing demand for a higher quality product at reasonable price and prompt delivery to its potential consumers. Organization and preparation of production processes also have to contribute to meet this key objective. We are talking about a profound change in the management methods used up to now whereby goals are set and efficiently met. The concept we have in mind is project management which represents a way of managing one-off activities throughout each project.

Project management involves the creation of a new organizational structure which enables the management to coordinate project deadlines and available resources, reaching the required output quality using minimal time, finance and other resources. The project management tools offer flexibility in the areas of project planning, management and supervision, they provide an opportunity to quickly and effectively respond to inevitable changes in the conditions the project is being undertaken.

The basic requirements of project management include meeting the subdeadlines and final deadlines for project completion. The uncertainty that the management is often faced with makes it necessary to use methods and decision making tools relating to the conditions of risk and uncertainty. To attain the project goals effectively it is necessary to form a research team where the synergy or effect of working together is used to achieve the common goal.

The basic principles of project management are characterized by nine areas: integration management, scope management, time management, cost management, quality management, human resources management, communication management, risk management and purchase management. Processes which are dealt within the project management area are product oriented. This means that product creation or development is set out or decided upon according to the length or life of the project.

This module deals with the concept of project management and its given characteristics.

Authors

I. PROJECT MANAGEMENT - INTRODUCTION

History

The evidence to prove that project management is neither a new method nor a modern way of management can be found in its history throughout the course of the 20th century. In 1900 the so called **Gantt charts** started to be used which served as a visual aid in the process of planning and ship building management.

The main era of invention of new methods, tools and techniques is neverthelles linked to the development of military technology in 1940s during the second world war and with the development of cosmic projects in 1950s and 60s. During this time the following methods were developed: **CPM (Critical Path Method), PERT (Program Evaluation and Review Technique), PDM (Precedence Diagram Method)** which used graphics to illustrate the project. New opportunies were created to present projects using network diagrams. With the help of these methods it is possible to determine the total time for a complex project which contains thousands of subsequent activities and optimize its development timewise and costwise. These methods have been used up until the present day and they will be further explained in the next section of the module.

At the present time new methods of the constrained resources analysis and the project management using constrained resources are being created. New project management concepts are being formed, such as breaking down the project`s lifecycle into stages, establishing the position of the project manager and formation of organizational structures for project management.

In the mid 1960s an organization **INTERNET** was created, later renamed **IPMA (International Project Management Association)**, bringing together project managers in Europe and in the USA the **Project Management Institute (PMI)** was established.

In the 1970s project management was recognised as a specific field and the first professional groups were formed. In the 1980s the techniques devised earlier on were transformed into practical steps. The integration of time, costs and quality, formerly viewed as the Magical triangle used to explain the balanced influence of the basic factors on the project were made complete by other factors such as the scale, organizational structure of the project and the project environment.

In the 1990s project management started to become an indispensable feature in the process of introduction of a slimmer and more flexible company organizational structure. Smaller project teams were created which were able to face the competition and respond to the market demands more flexibly. These times are characterised by increased use of information technology in project management. For instance, the **TQM (Total Quality Management)** can be seen as a complex project system dealing with the importance of the customer, continuous improvement, team work and management throughout project lifecycle.

At this moment project management applies to the environment of shorter product lifecycle, resource coordination and activities both inside and outside the company.

When is it convenient to use the resources?

Project management method application is particularly suitable when in the course of solving a problem we first draw up a draft (according to the project procedure) and then we put it into practice.

A list of possible problems might include:

- new product development
- product innovation and reconstruction
- introduction of new technologies
- new product introduction into production and into the market
- proposal and realization of investment activities
- proposal and realization of construction activities

- proposal and realization of information systems
- creation of programme products
- introduction of quality management systems in accordance with ISO 9000
- preparation of marketing events
- processing of business plan
- machinery overhaul
- planning and carrying out company restructuring
- realization of business plans
- preparation and realization of orders for piece production
- etc.

If during the preparation or realization stage of such an activity a company finds it difficult to keep to the deadlines and the level of costs and has difficulty in using the available sources, or it fails to meet the expected goals, the reason might be the absence of project management.

When on the contrary it is not convenient to use project management!

For repeated activities, e.g. operational production planning, regular machine maintenance, daily checking activities, etc., it is more convenient to use other management methods (e.g. Deviation Management, Management by Extremes, Management Using Software Programs).

Project management is not suitable for simple riskfree operations either, where application of routine or common sense is sufficient.

Project management is equally not convenient to use in crises (technical catastrophes, natural disasters, immediate military operations, company and other crises). To deal with such situations there are other specialized procedures available to use (e.g. crisis management).

Long-term projects (two years and longer) are not very convenient for project management application. Project management methods are difficult to employ in conditions ruled by prevailing helplessness, chaos, emotions and ignorance.

1 THE BASIC TERMINOLOGY

Management by Project is used in planning and execution of complex, often one-off events which are necessary to complete within the agreed time and cost limits to achieve the set goals. Project management can briefly be characterized as a way of bringing about changes effectively and efficiently.

The focus of project management is a series of activities which are necessary to plan and undertake for a project to achieve the set goals.

Project management aims to ensure planning and execution of a successful project where all of the project goals have been attained while adhering to the time and costs constraints.

Change is brought about by the project performance. Usually we cannot bring about a change directly; we presume that carrying out the project will bring about the changes.

Project management is governed by the fact that as soon as scope, rarity, complexity, difficulty and riskiness of a project exceed a certain level, it becomes necessary to adopt adequate methods of management for the whole project.

Two other principles used in project management are:

- **teamwork principle**, where very complex issues may be tackled through cooperation of specialists;
- **principle of systematic work,** which relies on scientific methods.

Project management consistently follows a **systems approach** to problem solving, where things and phenomena are considered in conjuction with each other. Normally we proceed from global goals down to detailed activities (the **TOP DOWN** approach) and systematically and structurally (a big problem is broken up into smaller manageable parts which are easier to deal with – **Divide et impera!**). That is why a project should always be complex and cover all of the essential elements of change execution.

Contemporary project management is supported by specialized programmes belonging to the group of **CIP (Computer in Projects)** software which makes possible the usage of calculation potentiality, memory capacity and communication abilities of the modern computers to facilitate project management method application.

1.1. Project

A project is a unique sequence of coordinated activities and tasks conducted by an individual or organization. It is usually a **unique one-off process** – a short-term effort accompanied by knowledge and method application, the purpose of which is the transformation of tangible and intangible resources into objectives, services or objectives set in a different way.

A project is a means used to create a product, which can be a physical object, improved service or an entry into other external process – e.g. a document. The project result provides the users and investors with the **final value**, which in effect presents **the project goal**.

The scope of the project is defined by the following frames:

Time framework of the project – characterizes the project as a temporary sequence of activities alternatively defined:

- start and completion dates;
- start date and measure of achievement of the project´s goals;
- start date and communication of a change in conditions or needs to realize the project`s original goals.

Framework for drawing on resources – determined by the volume of financial, material and human resources. Financial resources are expressed through:

- financial limits – funds available to cover used up resources;
- budget set in accordance with the types of costs and how they are spent, and time schedule.

Organizational framework – determined in accordance with the structure of interest groups and the management of the project. The project can be understood as a temporary business group which sees the project as their business goal. In this sense the project is expressed through its organizational structure which ensures:

- management execution;
- work coordination
- shared responsibility for business goal achievement.

Specific social framework – defines the project as a temporary grouping of activities in a concrete cultural, legislative, international-political, economic and physical environment which all represent the project`s surroundings.

Project classification according to **results:**

1. buildings
2. facilites (fixtures and fittings)
3. infrastructure
4. events (e.g. sports events, exhibitions)
5. research and development tasks

1.2. Project Management

Project processes

Projects consist of processes. A process is a sequence of activities bringing about some result. It is also possible to say that a process equals a breaking down of the total activity necessary to create a product (project goals) into partial subsequent activities which make it possible to take advantage of the icreased specialization of the staff involved. Project processes are conducted by people and can be divided into two groups:

- **product oriented processes** – describe material and technological continuations in product creation;
- **project activities management processes** – describe the organizational methods of individual project parts and their direction towards project goals.

Project management is a group of activities consisting in planning, organizing, managing and controlling resources to the agreed time frame aiming to attain specific objectives.

Project management must be derived from and based on the product oriented processes – used as a model, business plan, but their focus lies in the creation and execution of organizational conditions and preconditions for the execution of the project`s goal, the product.

Project management necessitates the continuous solution of three imperatives of mutual dependence and relative importance:

- ensuring maximum quality of work done (individual activities and the end result);
- completing the project in the minimum scheduled time possible;
- using the minimum costs budgeted for individual activities and the total project.

Approaches used employed in project management

The basic tool for planning and execution of projects is a **network analysis technique** which is used to plan time, costs and resources. Recently a new approach has been preferred one of the **critical chain** based on the theory of constraints.

In the initial stage of a project a frequently used method is the **logical framework method** and the **management by objectives technique.** For design and more importantly presentation of the time schedule of different project activities Gantt charts are used. To identify potential obstacles in the process of achieving a successful project new procedures for risk analysis are applied originating in risk ingeneering. To find out about support of project success rate the **analysis of critical success factor** is employed and **Ishikawa diagrams`** technique is followed.

To assess the state of a project and to establish a prediction of its development the "**achieved value analysis**" or **SSD diagrams approach** are used. To decrease project costs different modifications of **value analysis** and **cost controlling** are followed.

To tackle teamwork successfully various **meeting types** are used (walkthroughs), **group problem solving methods** (brainstorming, Delphi, Occam´s Razor), to list a few. The list is not and cannot be exhaustive as a series of special methods are used by special teams to deal with specific issues.

As well as basic methods of project management a number of other **methods of systems and operational analysis** are used; methods to facilitate the decision-making process, process modelling, computer project simulation, etc.

1.3. Comparison of Traditional Approaches and Project Management

Project management in a new project organizational structure helps to solve problems when overcoming problems caused by **tradional managerial methods** in the classic hierarchical structure still prevailing both in our country and abroad.

We talk about the following problems:

- long communication chains;
- loss of time resulting from complex communication;
- distortion of information in in-house communication;
- ping-pong effect when dealing with the question of responsibility for different situations;
- slow response when searching for the most effective use of one`s resources;
- pursuing rigid repetitive unsuitable goals;
- slow response to changing conditions in the business environment;
- slow response to changes in the markets.

Teamwork and elaborate methods of project management make it posssible for companies to execute a very fast change or undertake complex activities which subsequently can give them a **competitive edge**.

Many progressive western companies have reorganized their organizational structures to suit project or matrix structures and while defining their companies` projects they have adopted a new managerial method – **Management by Project**.

Current turbulent times full of dramatic changes prove the classic regulation of company processes based on deviations created to be insufficient. A goal-oriented approach for achievement of change through Management by Project presents the desired alternative to solving this problem. Project Management is a tool used to carry out a modern managerial method – MBO **(Management by Objectives).**

If we sum up the positive aspects of project management and compare them with the negative aspects of traditional management approach, we see the following comparisons:

Chart 1: Comparison of a traditional management approach and project management.

Traditional management approach	Project management
procurement of resources	use of resources allocated based on the project`s needs
predictability	management under uncertainty
uniformity, repetitiveness	uniqueness
management of property	the control of the use of resources
the control of final results	progress checks (to achieve the project`s goals)
quality management based on the control of the results	quality management through plan and preventive measures
stable number of employees	changing number of employees
success rate measured by absolute performance of the chosen indicators	success rate measured by the extent to which set goals have been achieved.

1.4. Project Environment Constraints

Project management development is heavily influenced by a number of constraints of the project environment which include:

- **the project´s mission** – the complexity of a goal given by the requirement of the final product`s performance;
- **time** – temporality of the project expressed through the project`s deadline;
- **costs** – limits for all the resources needed by/for the project;
- **acceptable level of uncertainty** or **risk** caused by unpredictable changes in natural conditions during the project (development) and the consequent acceptable requirements for changes in the project by investors (clients) and acceptable requirements for the project execution by the project`s executor;

- **acceptable level of uncertainty or risk** created by unpredictable changes in the client`s requirements in the course of a project and the consequent acceptable requirements for changes in a project by the investor (client) and acceptable requirements for changes in its execution by the project`s executor;
- **quality of executed outputs** required by the investor (client) – expressed by the means of limits imposed on the quality of output achieved by the project`s executor.

SUMMARY:

1) A project is a unique, unrepeatable sequence of coordinated activities and tasks carried out by an individual or an organization which has:

- subject and a goal – product, scale and final value;
- time framework – the starting and finishing date;
- framework for the use of resources – volume of financial, material and human resources;
- organization framework – assigning authority and responsibility, roles and taks, the means of communication between the interest groups, people in charge of the project and implementation teams;
- specific social framework – environment, surroundings.

2) Project management is a sum of activities consisting in planning, organization and management and control of the use of resources within a set time limit aimed to achieve specific goals. Its importance lies in the necessity of a continuous assessment of the triple imperative of mutual dependency and relative importance.

- ensuring the maximum quality of work (individual activities and end result);

- achieving the minimal, or the maximum limited length of the project;

- keeping costs to a minimum for individual activities and the project as a whole.

3) Project management in a new project oriented organizational structure helps to overcome problems brought about by traditional approach management used in the classical hierarchical organizational structure such as insufficient flexibility in the use of internal and external resources and a slow response of the company to changes in the business environment and markets. The development of a particular project management is significantly influenced by the project environment`s constraints which include project goals, costs, execution time and acceptable level of uncertainty.

TEST QUESTIONS:

1. What is a project and what necessary qualities does it have to have?

2. What does project management consist in?

3. What are the differences between project management and tradional approach management?

4. What are the project management constraints and what do they consist in?

2 AN ORGANIZATIONAL STRUCTURE OF A PROJECT

A projects organizational structure is a network of defined relations among the project`s individual interest groups. In the organizational structure:

- there is **decision making authority** of the project;
- new **roles and responsibilities** are assigned, delegated and assumed by individual interest groups with regard to their responsibilities in the project execution;
- there is **communication** among individual project interest groups.

2.1. Interest Groups and Their Relationships

The project`s interest groups are formed by people and organizations which are actively engaged in the project execution, or whose interests may have an impact on the progress and result of the project. The interest groups include:

- the **project`s client** – most usually an investor – is a company who is a project submitter and who will benefit from the project. The client normally provides resources (usually funds and know-how) necessary for the project`s execution;
- the **project`s contractor** – project`s executor – a company who participates directly in the contract and consequently bears full responsibility for the actual project execution;
- **other key interest groups** – persons or organizations providing resources (financial, material or information) or political support for the project, or those whose interests are in conflict with the project`s goals.

To manage the project successfully it is important:

- to identify all interest groups;
- to describe their requirements and expectations;
- to understand the scope of their autority and responsibility;
- to assess the risks posed by the differences between their individual interests and the project´s objectives;
- to appropriately communicate the needs and status of a project in its course with the interest groups and to protect the project from negative influences.

2.2. Principles Applied in the Creation of a Project`s Organizational Structure

An organizational structure of a project is an environment which makes it possible for the contractor, the project`s main executor, to continuously manage a project; to direct the activities of all the entities engaged in the execution of the project so that all the results are achieved according to the planned parametres and sequences.

The main entities are:

- the chosen executive workers of the **main project executor**;
- the **executive workers of subcontractors**;
- other entities – the **project`s services** (agreed contractually, e.g. subcontractors providing materials, financial institutions).

We understand planned parametres of the project as goals of individual activities. These goals are achieved in all their aspects including the subject matter, time, costs and quality .

To form an organizational structure of the project it is necessary for the management of the main executor of the project to apply **the basic principles used in the creation of organizational structure**.

- to **delegate authority and responsibility** to participating entitities (executors of certain sections);
- to **assign tasks** to participating entities (executors of certain sections);

- to ensure personal **communication** among executors of certain sections;
- to **create conditions for the management principles to be applied**, to achieve project goals within the minimum time and using minimum funds and human resources.

Responsibility is an ability to achieve delegated goals – it is an quality of an individual to meet the expectations of the project`s executor and positively influence entities participating in the project`s execution towards the project`s goals. To achieve that the individual has to be equipped with the following:

1. **Authority** – a power delegated to him/her which makes it possible for the individual to make and enforce decisions.

2. **Moral aptitude** - an attitude of complete responsibility to comply with the adopted measures.

Task allocation is an ability to match project subtasks with individuals and groups (executors of certain sections), who have the greatest potential to fulfil them effectively.

Principles of professional communication are ways how to effectively solve cooperative relationships between individuals and groups (executors of certain sections) and how to determine tools used in the process.

Management principles are ways how to effectively deal with progress points using the principle of delegation (through project execution teams) within time, quality and cost constraints. The effective solution to changes brought about by unpredictable circumstances in the project execution phase form an important part of management principles.

2.3. Basic Entities Involved in Project Management

The basic entities engaged in project management who are equipped with the respective authority and responsibility and thus form a foundation of the contractor`s organizational structure are the following:

1. Project Manager (Project Manager of the project`s main executor)

The project manager is responsible for the achievement of project goals while keeping all the set parametres of the project.

Qualities of a project manager

He/she must have abilities, skills and moral responsibility which will enable him/her to:

- manage allocation and effective use of resources;
- manage timespan of activities;
- lead co-workers, motivate them to perform well;
- communicate with all the entitities involved in the project with the aim of harmonizing their interests;
- communicate with all the entities, whose interests are in conflict with project goals and search with them for a compromise solution satisfactory for both sides while still attaining the project goals.

2. Project team

The project team consists of responsible representatives of executors responsible for different parts of a project. They have an authority to manage the execution of a particular task – one unit of work with clearly defined instructions, outcome to a deadline and a well-defined work intensity estimate. The project team need to be made familiar with methods and effects used to evaluate the outcome of groups, (i.e. executors of certain sections) managed by them.

The qualities of a project team:

- the team has to be motivated to reach its goals;
- in the team there has to be created an atmosphere of mutual trust among its members and determination to obtain the expected result;
- team members have to have an opportunity to voice their opionions – to analyze and solve problems as a team;
- team members have to respect each other, respect their professional abilities, skills and competences.

SUMMARY:

1) To manage a project – an organizational structure needs to be put into place. The organizational structure is made up of people who work together on a project, where the decision-making autority is established, and where roles and responsibilities are assigned, delegated and assumed and where communication is effectively flowing.

2) Interest groups are formed throughout all the organizations involved in the project.

3) A contractor is the main interest group including the main executor of the project, who appoints the project manager. The project manager determines the scope of the main executor`s participation in carrying out the project and selects other people to be responsible

for remaining parts of the project. Cooperation and execution of the project is managed by project teams made up of appointed delegates of executors of certain sections.

4) To create an organizational structure for a project the main executor must lay out the basic principles applied in creating an organizational structure, namely delegating authority and assigning responsibility and tasks to participating entities, ensuring professional communication among them and thus creating the preconditions for application of management principles such as effective achievement of project goals within the minimum amount of time, and using the minimum financial and human resources.

5) The project management team consist of the project manager (the main executor`s manager) and the project team. The project manager is the person responsible for the completion of the project`s goals while adhering to the set project parametres. The project team consist of representatives of executors of certain sections who have been appointed to manage a particular task.

TEST QUESTIONS:

1. What is an organizational structure and what criteria must it meet?
2. Which interest groups take part in drafting and execution of the project?
3. With regard to interest groups what action does a project manager need to take to successfully manage the project?
4. What are the main principles applied in the creation of an organizational structure?
5. What are the basic tasks of a project manager?
6. What tasks have been assigned to members of a project team?

3 LIFECYCLE OF A PROJECT

The lifecycle of a project consists of a sequence of phases which can be labeled as:

1. Introduction - initiation
2. Planning
3. Managing and coordination
4. Monitoring and control
5. Closing

A number of methods is used to create and manage a project`s lifecycle:

At the initiating stage frequently used methods are:

- Logical Frame Method
- Management by Objectives

To decrease the project´s costs variations of the following are used:

- Value Analysis;
- Cost Controlling.

To ascertain the support of success rate of a project the method of Critical Success Factor analysis is applied:

- CSFA (Critical Success Factor Analysis);
- Ishikawa diagram´s technique.

To analyze risk ingeneering methods are applied:

- RIPRAN (Risk Project Analysis).

To plan and manage a project a number of methods are used. The main tool used in planning and managing projects is the **network analysis**, involving the following methods:

- CPM (Critical Path Method)
- PERT (Program Evaluation and Review Technique)
- MPM (Metra Potential Method)
- Gantt Charts

The network analysis methods are used to plan time, costs and resources. Recently a new approach based on the theory of constraints has been used:

- Critical Chain method devised by Prof. Goldratt.

Besides the basic methods of project management a number of other methods of systems and operational analysis are used: **methods to support decision-making process, process modeling, project computer simulation, etc.**

To monitor the project`s progress and **to predict its development** the following methods are used:

- Earned Value Analysis or;
- Structure-Status-Deviation Method.

To successfully tackle issues involving teamwork:

- different types of meetings (walkthroughs);
- group solutions (brainstorming, Dehphi, Occam´s Razor).

3.1. Initiation

The project is usually initiated by its investor. At this stage a decision is made about the following issues.

1. The strategic needs of the product – the project`s goals.

2. The ways the project will be accomplished– evaluation criteria are established to select the contractor – the project`s executor.

3. An initial plan is drawn up – a description of work that needs to be carried out and the sponsor`s scope of competence.

4. A feasibility study needs to be conducted.

5. A preliminary definition of the project`s mission needs to be created.

Methods used:

- Logical Frame Method ;
- Management by Objectives.

3.2. The Planning of the Project

The planning of the project involves creating a procedure for each of the activities which need to be carried out in order to achieve the goals. The planning is usually carried out by the project`s executor.

Plans must be created according to the criteria of the project which include the factors of *quality, time and costs*.

Under this second phase of the project`s lifecycle the following is carefully considered:

- **the final objective of a project** – is stated in the project`s foundation charter. The quantity requirement and the requirements for the quality of the environment in which the project is carried out are specified. The standard of quality required is usually shown by technical indicators which are relevant to the activities and their results and to the typical ways used to measure these activities. Requirements for the environment`s quality are usually specified by the investor (client). These are, for example, the quality of the product and the quality of the economic, organizational and social environment in which the project will be carried out by the contractor.

  - **a work breakdown structure** – from managerial to technical levels of detail it specifies what should be accomplished in the project and gives a platform to create a time schedule. At the most detailed level the activities are matched to the individual workers who assume responsibility for the performance of these tasks in regard to the time schedule and quality of the work. A detailed work breakdown structure is therefore an important performance indicator for triple imperative project management.

  - **the project`s schedule** – defines the deadlines which each project activity must meet. The project`s schedule usually takes the form of diagrams and charts which make it easy to show very complex connections between all the different activities. At present there is a number of software tools available offering support in creating and using these diagrams and charts.

- **plan of allocation of resources** – defines the allocation of the project`s roles and specifies the use of material resources (machinery, property, etc.). Allocation of resources must be planned in order to make optimum use of the resources in an organization and therefore maximizing efficiency of the projects undertaken.

- **budget** – is in essence a plan to use resources, represented by financial figures. In more complex projects several types of budgets are set containing a different degree of detail (e.g. a total budget, a budget for each activity, a detailed budget for a project`s specific time schedule, etc.)

Because of uncertainty caused by the fast changing environment in which the project is being carried out it is necessary, as well as planning according to the project`s key criteria of the triple imperative, to anticipate and assess the possible risks and to plan strategies to prevent them or respond to them.

The second chapter of this course takes a closer look at the selected principles, methods and procedures which can be used in creating the above documents.

3. 3. Management and Coordination of the Project

Management and coordination in a project`s execution and simultaneous monitoring and control are all carried out by the executor of the project.

In managing and coordinating the activities the following steps are taken:

- the materials used, the time taken, the cost and the efficiency of the activities carried out are monitored and their progress is compared with the estimated values in the network diagram;
- in the case where there are deviations from the estimated results, there are ways of removing these deviations;
- a decision is made about the best way of removing the deviations from the planned results using criteria stated in the Foundation Charter;
- adjustments are carried out by the project manager and his/her team (usually by contracting additional resources enabling successful completion of the project on time and to the standard required).

Methods:

To manage projects a number of methods are applied which are used at the planning stage of the project. The **network analysis** is used as a basic tool in the planning and management of the project, namely:

- CPM (Critical Path Method);
- PERT (Program Evaluation and Review Technique);
- MPM (Metra Potential Method);
- Gantt Charts.

Recently a new method based on the theory of constraints has been used:

- Critical Chain Method.

Besides basic methods of project management a number of other methods of system and operational analysis are employed: **methods to support decision-making process, process modeling, project computer simulation, etc.**

To assess the status of the project and **to make a prediction** of its development the following methods are followed:

- Earned Value Analysis Method;
- Structure-Status-Deviation Method.

To successfully tackle issues involving teamwork the following methods are used:

- different types of meetings (walkthroughs);
- group solutions to problems (brainstorming, Dehphi, Occam´s Razor).

3.4. Closure of the Project

Closure of the project brings to an end the coordination between the project`s executor and the investor. This takes place when the project is handed over and financial and material obligations which have been contractually assumed by the project`s executor have been fulfilled.

SUMMARY:

1) The project has a defined beginning and end and within its lifecycle goes through a number of stages.

Project Initiation.

Planning – time, allocation of resources, costs, quality and risk assessment.

Management and coordination including monitoring and control.

The project`s closure and handing over of the product to the investor.

TEST QUESTIONS:

1. What is a lifecycle of a project and what stages does it have?

2. Which methods are used to create and manage a project`s lifecycle?

3. Which activities need to be carried out at the planning stage and what do they consist in?

4. What approaches are used to assess the quality of the project?

5. What types of risk might we encounter when carrying out the project and which factors need to be taken into consideration in risk analysis?

6. How do we proceed in risk analysis and which questions do we have to ask?

7. What does the management, coordination and monitoring of work during a project consist in?

SELF EVALUATION TEST I

Imagine you are faced with a task of assessing which entities will participate or be involved in the execution of the project "Town Bypass Motorway". Use the symbols to indicate in the chart below the role assumed by individual entities in the project:

Legend:

Submitter, Project`s Investor	I
Main Executor of the Project	ME
Project Manager	PM
Project Team Members	PTMs
Executor of the Various Sections of the Project	VSE
Project`s Services	PSs
Interested Organizations	IOs
Other Institutions and Organizations	Os

Complete:

Institutions and businesses	Interest groups supporting the project	Interest groups with conflicting interests	Interest groups not engaged in the project
The Government of the Czech Republic			
Regional authority of the respective locality			
Local authority of the respective town			
The Road and Motorway Directorate of the Czech Republic			
A big construction company			
A small company with specific technology			
Union for Nature Conservation			
Monument Preservation Institute			
Hunters´ Union of the Czech Republic			
Company – electricity distribution			
Company – cable telecommunications			
Bank			
Protection of Buildings and Constructions			

II. METHODS OF PROJECT PLANNING

The main information about the processes of project planning and key documents that were produced as a result were treated in the first part of this course.

The second section explains in detail principles, procedures and methods which can be used in project management. We are going to adhere to the established structure of the key planning documents.

The explanation of planning methods will be introduced by a presentation of principles and procedures from which we can prioritise activities. This will be followed by a section introducing planning and time estimate methods which are used to produce a project time schedule. We will briefly touch upon the procedures followed in the allocation of resources and then we will move on to the principles applied when setting a budget for the project.

A considerable part of the explanation will also be devoted to methods of risk analysis and risk assessment, and to the procedures created to deal with risk prevention and reserve planning.

Similarly to the other sections, you will be able to test your newly acquired knowledge through a self-evaluation test at the end of this part.

4 DRAWING UP A WORK BREAKDOWN STRUCTURE

To be able to meet the basic objectives of any project (to meet the quality, time and budget requirements), it is necessary to break down these goals into smaller activities, whose content, time and economical complexity are easier to predict. Thus we can better connect the subject matter of the project, its time frame and budget, in other words its consistency, with the financial goals of the project.

For this very reason we have a **Work Breakdown Structure (WBS)** which in essence is a hierarchical structure of tasks ensuring a successful accomplishment of the set project goal. Drawing up this document would typically be the responsibility of the project manager with the assistance of his/her project team.

The work breakdown structure is the project`s key document serving as a basis for other documents, e.g. the time schedule, the plan of allocation of resources and the plan for allocation of the budget. A detailed work breakdown structure is thus the fundamental methodical approach to project management which is used to facilitate planning and management of the three basic elements of the triple imperative in connection with each other (never separately).

In the following units we are going to have a closer look at the basic principles and procedures used in the preparation of a detailed work breakdown structure. Our attention will be turned to problems typically arising when it is created.

Again you can test you newly acquired knowledge by answering a few test questions listed in the final part of the section.

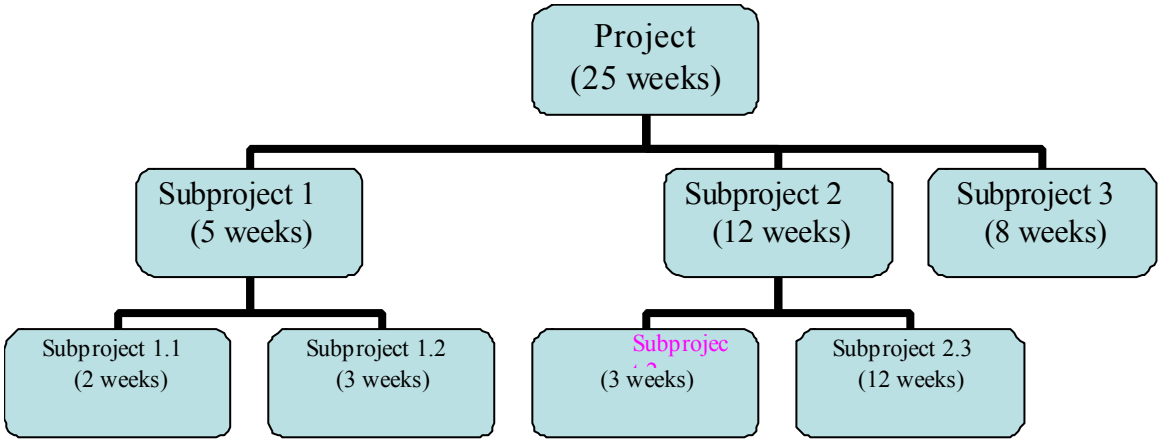
4.1. Principles Applied in the Creation of the Work Breakdown Structure

For the work breakdown structure to serve as a highly reliable basis from which further planning can be broken down, a few fundamental principles must be respected when drawing up this document.

We are talking especially about the following principles:

- **the hierarchy principle** – a detailed work breakdown structure resembles a prioritised structure of activities. Using a hierarchical structure reduces the risk of an important activity being missed and at the same time it makes it possible for all the activities to be logically linked. The amount of work done on a certain level of a detailed work breakdown structure always represents the sum of the amount of work done of the lower level of the same branch of the structure.

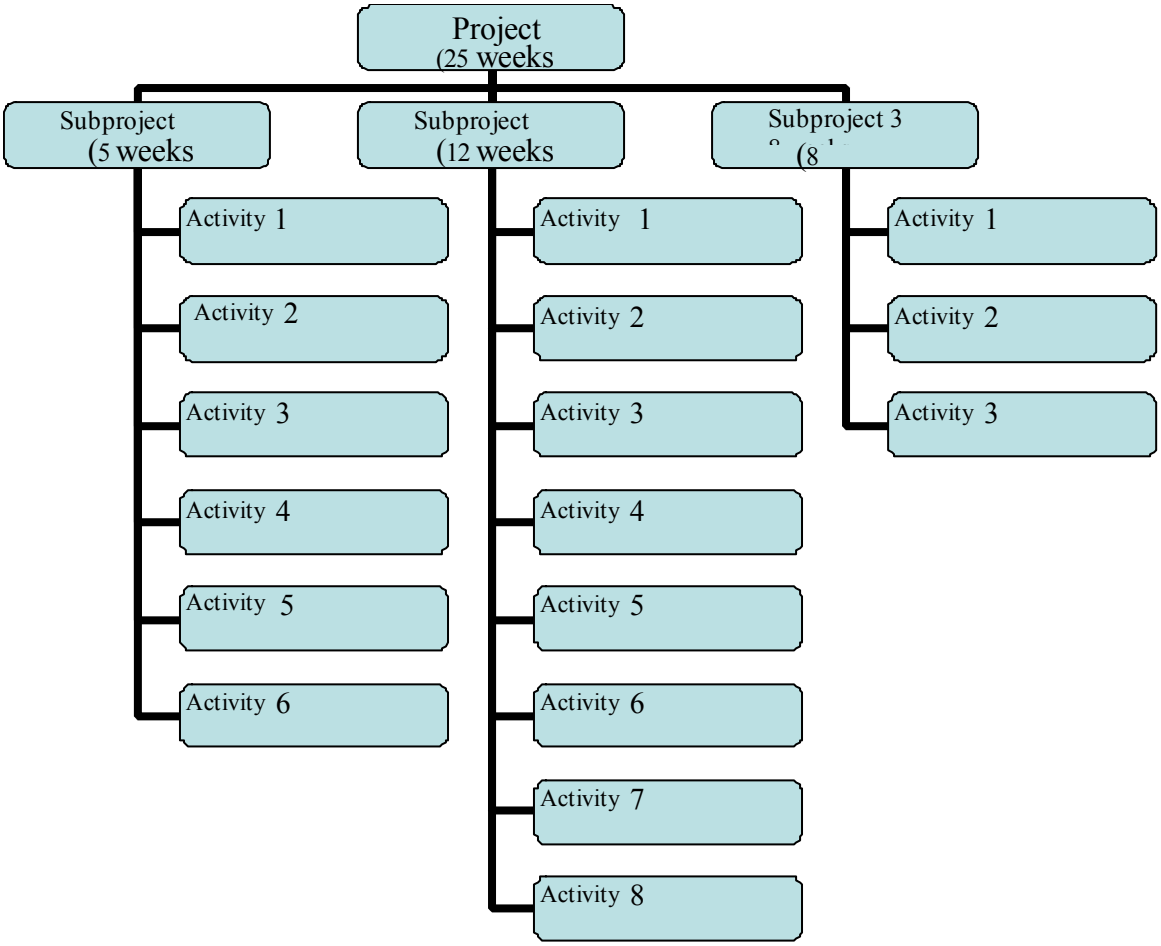
Picture 1: The example of a hierarchical work breakdown structure.



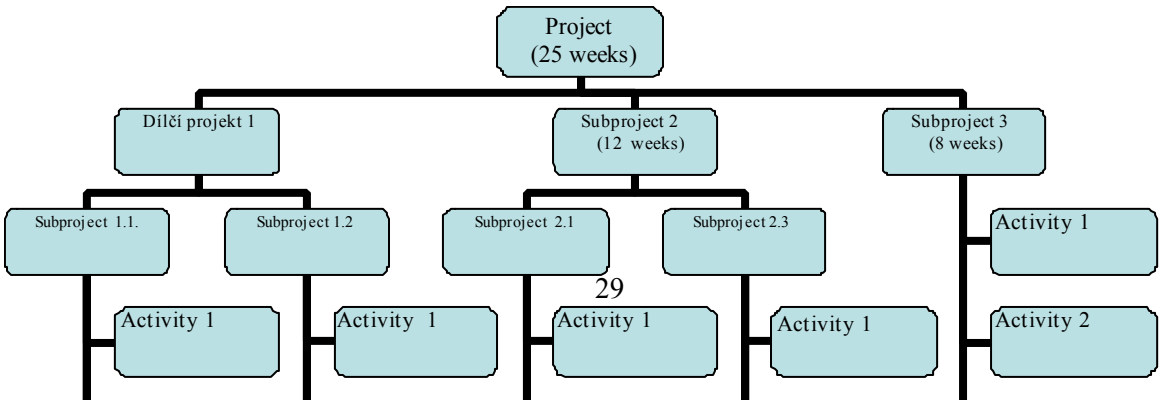
Source: Svozilová (2006)

- **the adequate scope of structure principle** – this principle is based on the fact that the more structured the approach to the project, the simpler and clearer and more manageable the activities. At the same time, the coordination and management of more activities will mean increased demands (time, financial, etc.), as more links are created requiring further coordination and management.

Pict. 2: Hierarchical structure of the same project activities reflecting different areas of the project.



Source: Svozilová (2006)



Source: Svozilová (2006)

For this reason it is nessary to take into account conflicting pressures when drawing up a detailed work breakdown structure and seek the right degree of detail with regard to the project`s complexity, the project team members experience, the time schedule and the financial complexity of the project.

- **the principle of interconnectivity** – the prioritised breakdown of work must fit in with the project`s time schedule and financial plan. In the case of projects with fixed costs hierarchical structures are created with precisely allocated costs or a strictly allocated time frame for individual activities.

4.2. The Procedures Followed in the Creation of a Work Breakdown Structure

It is best to create a detailed hierarchical work breakdown structure based on the contractually specified goals of the project. This ensures that the parts of the structure which represent the tasks at various levels correspond to the goals of the project at its various stages.

Although the preparation of a detailed work breakdown structure is one of the project manager`s responsibilities, cooperation of the whole project team is needed especially at the lower (technical) levels. The project manager does not necessarily have to be an expert in all

the project areas. This could even enable him/her to better motivate the team and himself/herself.

The final version of the work breakdown structure will reflect the steps taken during its preparation. **Generally the following steps are recommended:**

1. to put together data based on the already existing documents (definition of the objectives, the terms of the contract detailing how the project should be carried out, etc.);

2. to discuss the main areas and the various stages of the project within the project team;

3. according to the agreed areas and stages of the project work can be divided into smaller tasks and activities which will be relatively independent and will be recorded in the time schedule, in the same way that the costs are recorded in the project`s budget;

4. to control the project from the lowest level upwards and discover that the final outcome is achieved through the integration of various subtasks.

4.3. Problems that Typically Occur when Creating the Work Breakdown Structure

Mistakes made when working out the detailed work breakdown structure might very often distort the structure of the document to the point where it becomes quite difficult to use as a base document for other documents.

The following situations must be avoided:

- **the focus of the project is lost** - this problem arises in cases where individually defined sets of activities do not correspond to the project`s goals. The project managers thus find themselves in a situation where they concentrate on planning the sequence of activities regardless of whether the activities aim to achieve subgoals or not. This can result in a situation where small individual activities with unclear standards by which progress is measured can take priority over the main goal of the project. In critical situations this can mean that the project loses sight of its main goal.
- **wrongly defined level of detail** – results from failing to apply the adequate scope of structure principle. Previous experience of a project team can serve as a standard by which the progress of the project can be measured. The more a defined activity in the

hierarchical structure corresponds to the previous experience of the team, the easier it is to manage the time schedule and cost plan. The complexity and scope of the project as well as the experience and competence of the team members, and accounting standards of the company are all significant factors

SUMMARY:

1) The detailed work breakdown structure is a key document of the project which defines the basic project activities within the hierarchical structure which must be carried out if the individual subgoals are to be achieved.

2) In the preparation of the detailed work breakdown structure the following principles have to be adhered to:

- the hierarchical principle;
- the adequate scope of structure principle;
- the principle of interconnectivity.

3) It is crucial to keep the focus of the projects goals and clearly determine the level of detail in the structure. Thus a document can be produced which is used to plan and manage the three basic elements of triple imperative (quality, time, cost) conjunctively, not separately.

4) Preparation of the work breakdown structure would typically be the responsibility of the project manager. It is nevertheless advisable to involve other project team members in its preparation.

TEST QUESTIONS:

1. Which principles need to be followed when working out a work breakdown structure?

2. What purpose does the work breakdown structure serve?

5 PLANNING AND ESTIMATING OF THE TIME TAKEN TO COMPLETE THE PROJECT

A project`s time plan includes any deadlines and the time taken for project to be carried out.

Complex projects can sometimes suffer from information overload and project plans whether they take the form of texts or charts are sometimes difficult to follow. For this reason graphics have been created to show time plans.

This graphic illustration then serves as a basis for all of the methods used which are collectively titled the **network analysis**, which is used in the project analysis of costs and resources.

The selected tools and methods are introduced in the following sections. How they are used practically is then shown in a simplified summary illustration. Similarly to previous sections you will be able to test your newly acquired knowledge in the final part where there are questions.

5.1. Overview of Tools Used in the Depiction of Time Plans

The time plan is most frequently shown in the form of a diagram or chart. This acts as an important aid for the project manager not only at the planning stage but also in the day-to-day management of the project. These tools can be very flexible and their easy-to-follow structure facilitates decision-making in critical situations.

In the following two sections we are going to introduce the most commonly used types. The first group comprising the simpler tools will include the so called **line segment graphs, Gannt charts** or **milestones.**

One of the disadvantages of these tools is the fact that they don`t show the connections between the activities which makes them almost impossible to be used to manage (especially complex) projects. The theory of project execution doesn`t necessarily correspond to the actual project execution because the links between the individual activities and also the links between the required outcome of the whole project and the individual parts of it are not shown.

For this reason more complex tools have been developed which include all types of network graphs which do show the connections between individual activities. They make convenient tools which can be used in the network analysis, especially in “what if“ analysis and some methods of risk analysis.

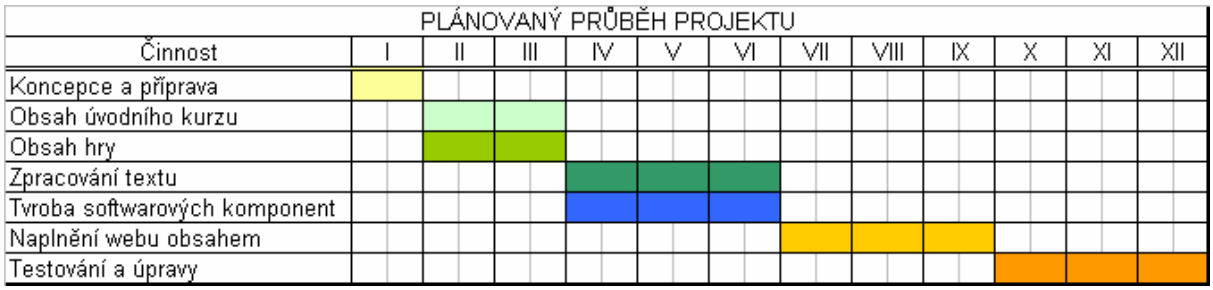
Today thanks to different software products it is possible to benefit from the advantages presented by both groups of tools. In the following two sections of the book we are going to take a closer look at the most frequently used types from both these groups.

5.2. Line Segment Graphs

Line segment graphs (Gannt charts) are a diagram technique which clearly displays a sequence of tasks showing their beginning and end. They are often used to show how far the work has been completed.

Tasks tend to be displayed in the top bottom sequence. Time is shown on the horizontal axis.

Picture 3: Example of a Gannt chart.



Legend:

THE PLANNED COURSE OF THE PROJECT

Activity

Conception and preparation

The introductory course programme

The game´s content

Text processing

Creation of software components

Uploading information onto the website

Testing and modification

These charts are popular because of their simplicity. They are easy to create even without specialised software equipment. They are frequently used as an easy-to-follow communication tool in negotiations and discussions.

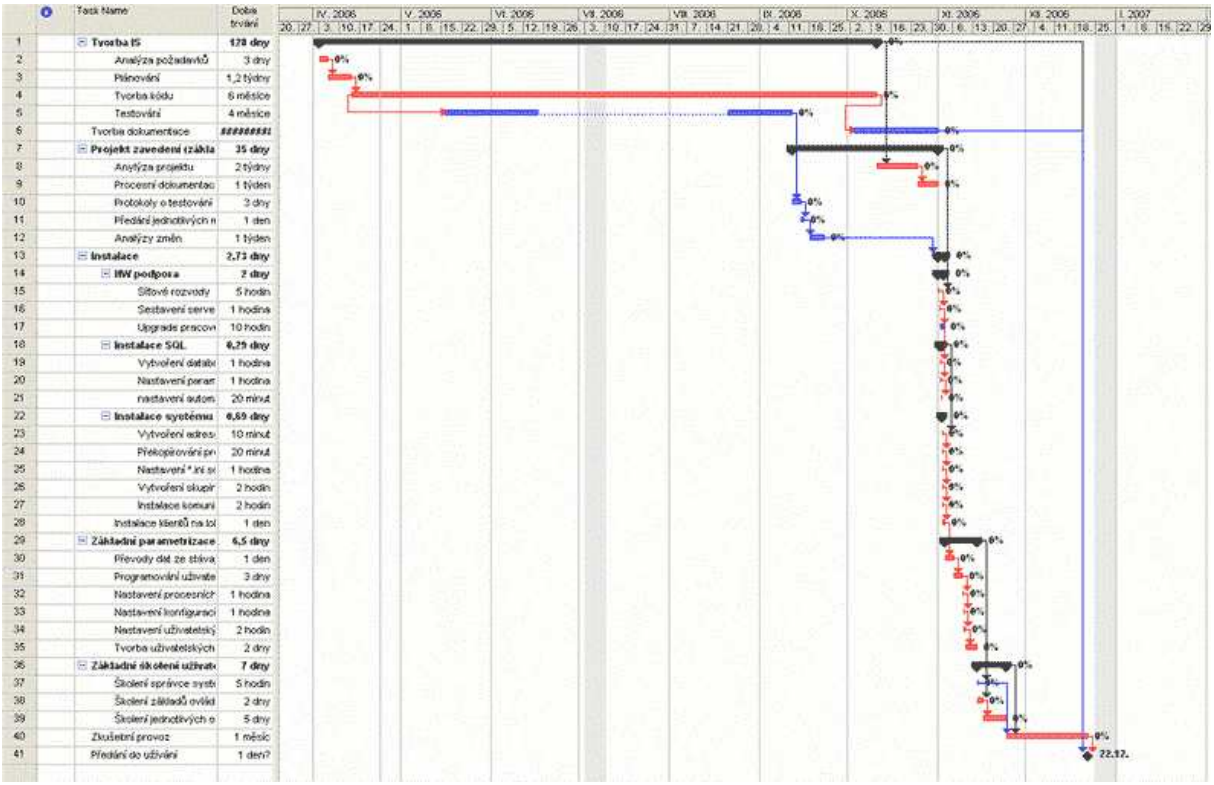
As stated above their disadvantages include the inability to display the connections between activities. In its pure form the Gannt charts do not display the connections between the former, the current and the future activities.

Besides this a frequently criticised aspect is the inability to show the completion rate as a percentage. It is necessary to determine which factor (time, costs or quality) would be affected by the percentage of the completion rate. Unless the completion rate is linearly measurable, its informative value and usefulness is very small.

Critics claim that this tool is more suitable for illustration of past events than for projection of future activities.

A number of these faults can, however, be put right by using modern software products designed to be used in project planning and which complement the classic Gannt charts. These modern software products make it possible to display the links between activities and make it easy to monitor the status of the project measured by several different standards.

Picture 4: An example of a Gannt chart in the MS Project programme.



5.3. Network Diagrams

A network diagram is a mathematical model of a project which clearly depicts the links between activities. It is an oriented diagram comprising edges and nodes.

Creating network diagrams is not difficult, but some simple rules must be followed.

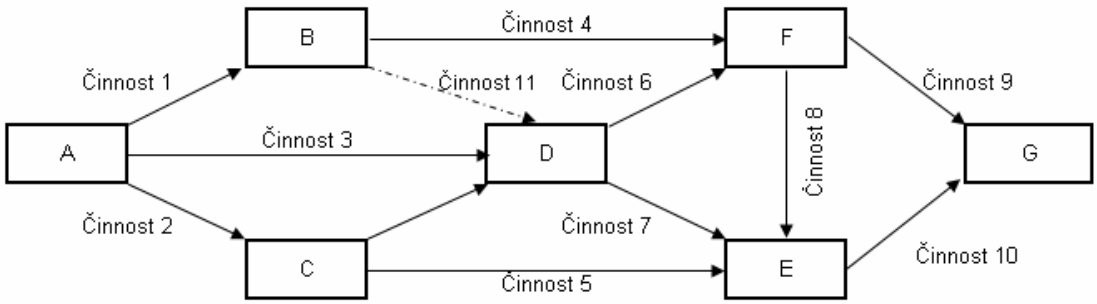
- A network diagram can only have one node at the beginning and one node at the end.
- Each node must must be preceded by an edge.
- Each node, with the exception of the final one, must be followed by at least one edge.
- Any two nodes in the diagram can be connected by using one edge only.
- Any two nodes in the diagram can be linked by only one edge.

Based on the definition of a network diagram we distinguish two types**:** **edge defined** or **node defined** network diagrams.

1. Edge defined network diagrams

These are models, where project activities are represented by the diagram`s edges. The diagram`s nodes represent events. Events are defined as the beginnings and endings of activities.

Picture 5: Example of an edge defined network diagram.

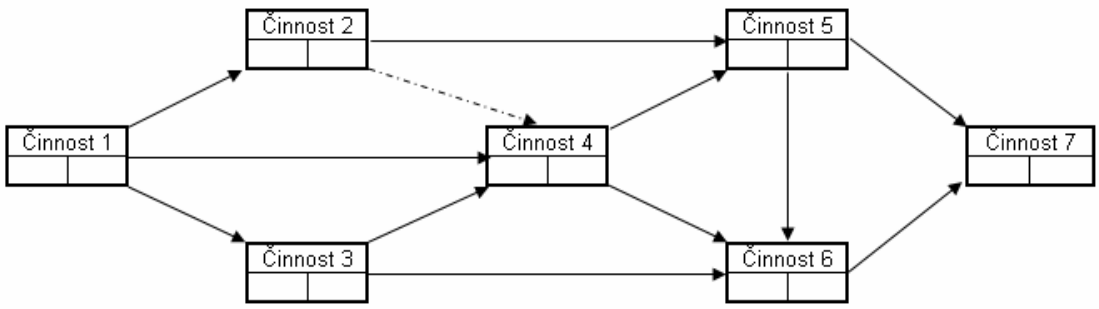


Source: Fiala (2004)

2. Node defined network diagrams

These are models where the diagram`s nodes represent activities within a project, whereas the edges show connections between these activities.

Picture 6: Example of a node defined network diagram.

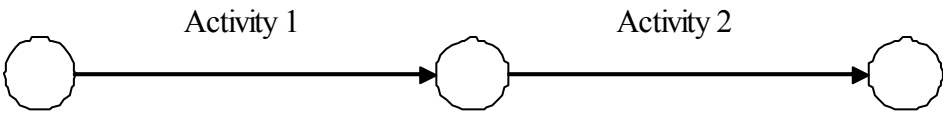


Source: Fiala (2004)

In the following explanation we will focus on the construction of edge defined network diagrams.

Every network diagram must depict correctly the links between and the sequences of the individual activities within a project. We express technological or organizational connections by making the final node of the preceding activity the first node of the following activites (see picture).

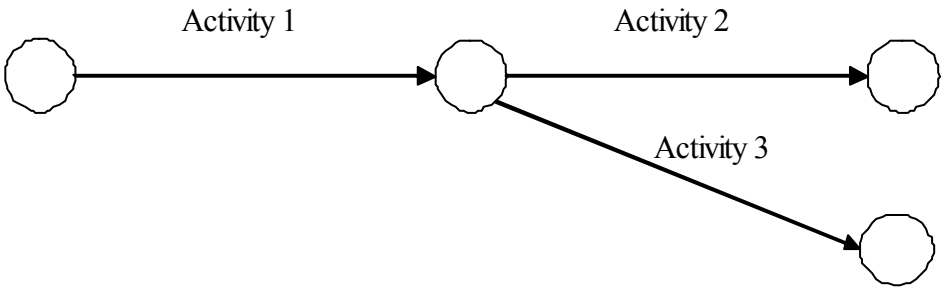
Picture 7: The construction of a network diagram.



Source: Fiala (2004)

In the case of an increased number of activites the picture may look like the following:

Picture 8: The construction of a network diagram.

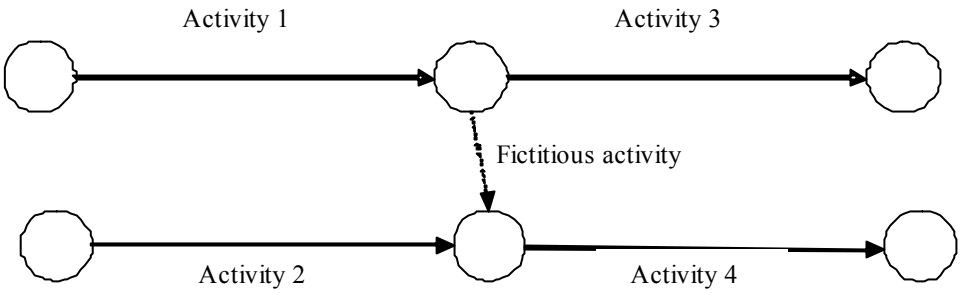


Source: Fiala (2004)

In some cases the so called **fictitious activities** have to be used. A fictitious activity does not take place in reality (the time taken is zero). They sometimes have to be used in edge defined diagrams to show the correct links. The use of fictitious activities will guarantee that the above rules for construction of network diagrams will be adhered to. The network diagram will thus become an oriented diagram, which has only one defined beginning and one defined ending. Fictitious activities will be used particularly in the following cases.

- to separate the dependent activities from the independent activities.

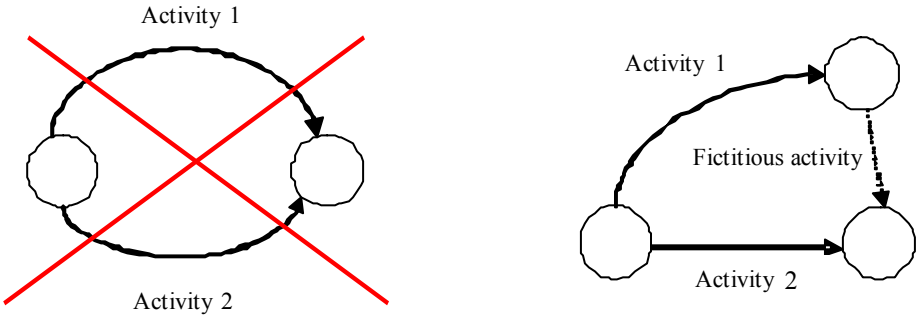
Picture 9: Use of fictitious activities – separation of the dependent activities from the independent ones.



Source: Fiala (2004)

- to separate parallel fictitious activities.

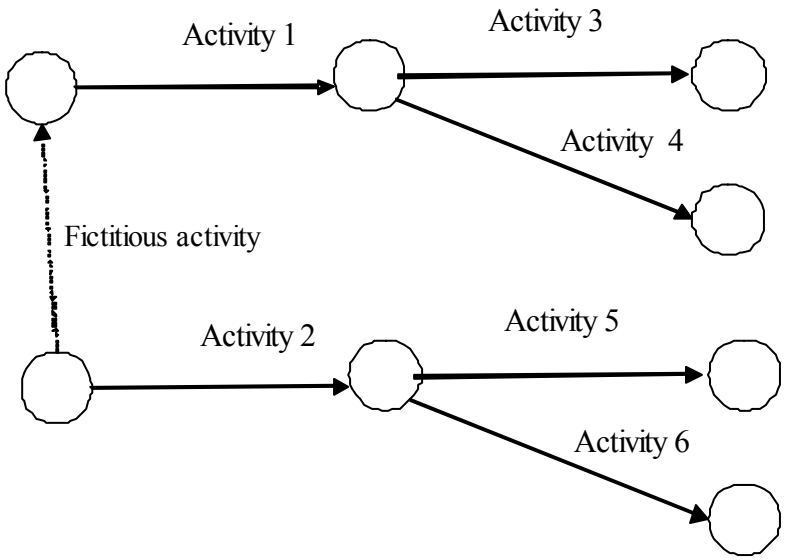
Picture 10: Use of fictitious activities – separation of parallel activities.



Source: Fiala (2004)

- to ensure the network diagram has one beginning point.

Picture 11: Use of fictitious activites – ensuring the graph has one beginning.

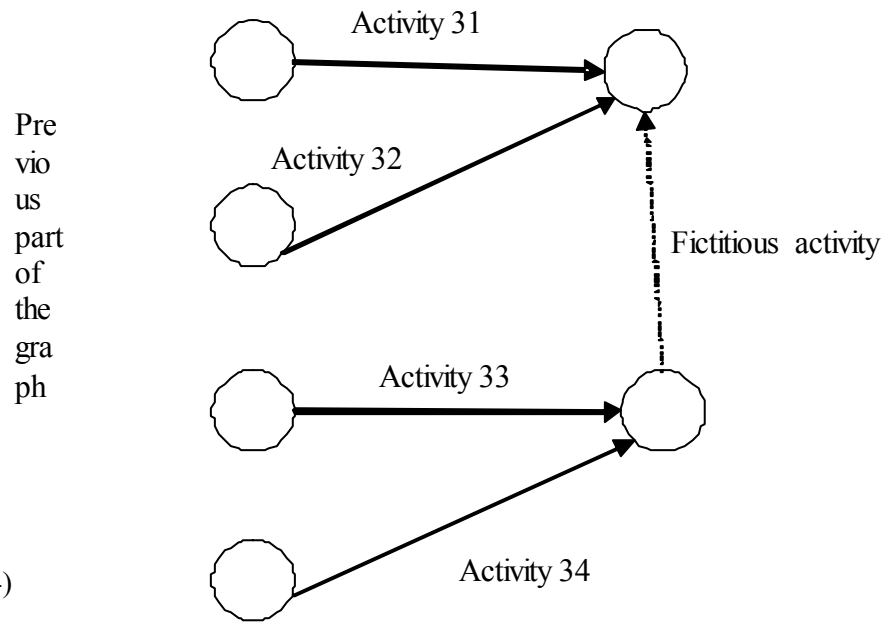


Graph continuation

Source: Fiala (2004)

- to ensure the graph has one ending.

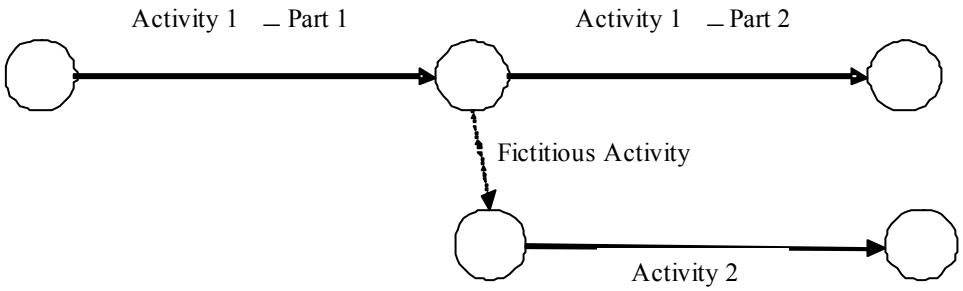
Picture 12: Use of fictitious activities - ensuring the graph has one ending.



Source: Fiala (2004)

- if the sequence of work is designed to be completed before the completion date of the preceding activites).

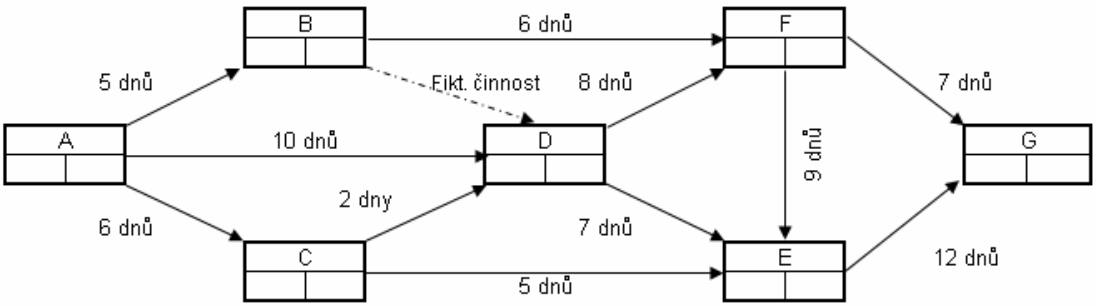
Picture 13: Use of fictitious activities (if the sequence of work is designed to be completed before the completion date of the preceding activites).



Source: Fiala (2004)

A graph that is constructed in this way can be properly evaluated, i.e. populated by the necessary figures. The data on the graph edges represent the time, costs or resources needed for individual activities.

Picture 14: Example of an evaluated network diagram.



Source: Fiala (2004)

5.4. Network Analysis Methods Overview

As well as network diagrams and Gannt charts a number of other methods of project planning and management are used.

One of the oldest and best known methods is the **Critical Path Method (CPM).** It is a deterministic method that uses a fixed time estimate for each activity. While CPM is easy to understand and use, it does not consider time variations that can have a great impact on the completion time of a complex project.

The PERT method (Program Evaluation and Review Technique) is slightly more advanced than the CPM. Although the PERT also works with a deterministic project structure, it takes into account the time variations and thus makes it possible to create a time analysis which takes into consideration the risk posed by variation in time taken to complete the tasks.

The availability of a number of project management software products has made it possible to use old methods, formerly rejected for their complexity.

These methods would include the **CPM/COST method** which is based on the Critical Path Method but is further expanded to include cost analysis. Thus a method has been created which enables the simultaneous optimization of cost and time in the deterministic activity structure and in the evaluation of deterministic time and cost.

The Precedence Diagram Method (PDM) uses complex graphs to explain a project with the support of optimization and maintenance when changes occur.

Besides the basic methods applied in project management a number of other methods of systems and operational analysis are used: **methods to support decision-making, process modelling, computer project simulation**, etc.

In other sections we will deal with two basic methods: Critical Path Method (CPM) and Program Evaluation and Review Technique (PERT).

5.5. Critical Path Method

This method is used to determine the so called **critical activities**, i.e. the activities whose delays will cause a delay in the completion of the entire project (or whose shortening will mean earlier completion of the entire project.)

ET = earliest possible time = time at which the activity can commence at the earliest (given the constraints, i.e. technology, resources);

$$ET = \max \{ET(x) + t(x)\}; \text{ where } x = \text{immediately preceding activity}$$

LT = latest possible time = time at which the activity can be completed at the latest without a delay in the completion of the whole project;

$$LT = \min \{LT(y) - t(y)\}; \text{ where } y = \text{immediately following activity}$$

FT = float time = the longest possible delay in the activity that will not cause a delay in the completion of the entire project.

$$FL = LT - ET - t; \text{ for each activity} \Rightarrow$$

If FT = 0 – we cannot postpone the activity or extend its deadline => this is a critical activity.

5.6. The PERT Method

Time estimates for individual activities tend to be very unreliable. As a result of frequent changes in the environment and the effects of many unforeseen influences the estimated time is very different from the real time.

The deterministic time estimate is therefore the expected value of a random variable according to the mathematical-statistical terminology. Therefore new methods have been developed where the time estimate for the activity **based on points** is replaced by the **probability based** time estimate. We are talking here about the **PERT method**.

Similarly to the Critical Path Method the PERT Method tries to solve the problems related to a project`s time analysis. The differences between the two methods include the following:

- CPM uses one time estimate for the activity while PERT considers three estimates – the optimistic time, the pessimistic time and the most likely time. The time estimate for the activity is then calculated using all three estimates;
- by using the element of probability, unlike CPM, it is possible to calculate risk;
- PERT is more likely to be used in projects where the duration of an activity is more difficult to estimate, whereas CPM is used in projects where the time estimate for an activity is easier to determine.

The calculation of the duration of an activity applying the PERT method is made using three time estimates which can be found over the interval (a,b), where:

a…… is an optimistic time activity estimate which is based on the assumption that nothing will occur that will extend the duration of an activity.

b……. is an pessimistic time activity estimate which assumes any possible negative circumstance which could extend the duration of the activity.

These estimates are futher expanded by the mean estimate.

m…… is an estimate of the most likely time it will take to complete the activity. If there are statistical data available, it is possible to use them. In such circumstances modus is used to estimate the **m** value.

Subsequently it is possible to calculate the **projected time estimates of an activity** together with the variance according to the following patterns.

Picture 15: Mathematical equations used in the PERT method.

$$T = \frac{a + 4m + b}{6} \qquad \sigma^2 = \left[\frac{b - a}{6}\right]^2$$

As in the case of the CPM method we use individual time estimates to calculate the expected duration of project T, which will be the sum of the expected critical activity time estimates.

The standard deviation of the expected duration of project T equals the root of the sum of the variances of the critical activity time periods. See the equation below.

Picture 16: Mathematical equation used in the PERT method.

$$\sigma(T) = \sqrt{\sum\nolimits_K \sigma^2}$$

Using the PERT method we can carry out the probability analysis of the project from which we can find answers to the following questions:

1. What is the probability of keeping the agreed completion date?

2. What planned completion date to determine to achieve the chosen probability?

To answer the first question tabled values of normal distribution function can be used. Probability that the project will be completed in time T which will not exceed the project time TP equals a value of normal distribution function in a point.

Picture 17: Mathematical equation used in the PERT method.

$$\left[\frac{TP - T}{\sigma(T)}\right]$$

The answer to the second question is an inverse task to the previous question and we will again use the tabled values of normal distribution function to reach a solution.

An answer to the question: *What is the probability of the uncritical activities becoming critical ones?* can be found in a probability analysis carried out for individual nodes in the network diagram.

5.7. Exercise – Project Planning

You are in a position of a manager responsible for the most efficient production of your company`s new product. The product was developed by your colleagues at R&D Department at the demand of your company`s best customer. The customer has ordered 1000 pieces of this new product and demands that the product is available no later than 38 days.

You have consulted your subordinate functional managers and divided the whole process into six activities as listed in the following table:

Činnost	Délka trvání (ve dnech)	Bezprostředně předcházející činnosti	Bezprostředně následující činnosti
1. Školení a trénink pracovníků	6	žádná	3, 4
2. Objednávka a nákup materiálu	9	žádná	3, 4
3. Výroba dílů	8	1, 2	6
4. Kontrola kvality	7	1, 2	5
5. Montáž výrobku	10	4	6
6. Vyskladnění a doprava	12	3, 5	žádná

Activity	Duration (days)	Immediately	Immediately

		preceding activities	following activities
1. Training	6	none	3.4
2. Purchasing materials	9	none	3.4
3. Production	8	1.2	6
4. Quality control	7	1.2	5
5. Assembling	10	4	6
6. Transporting	12	3.5	none

Task 1: Construct a Gannt chart for this project.

Imagine that only a few days afterwards the customer calls to tell you that the goods are needed not in 38 days as originally planned but in 36 days AND for the same price! As this customer is very important for your company, you promise to meet the 36-week deadline.

You immediately consult your financial managers in order to find the best possible solution. Your HR manager offers you to cut the training time by two days (from 6 to 4), if you pay him 40% extra reward.

Task 2: Would you accept your HR manager`s offer? Give reasons for your answer.

Since you have rejected the offer to cut the training time, you must find an alternative solution. You have asked your managers to suggest the possibilities of shortening the activities under their supervision and the cost of doing so. Their answers are included in the following table:

Activity	Initial item costs	Max. possible shortening (days)	Cost change (for 1 day shortening; in CZK per piece)
1. Training	10,-	3	2,--

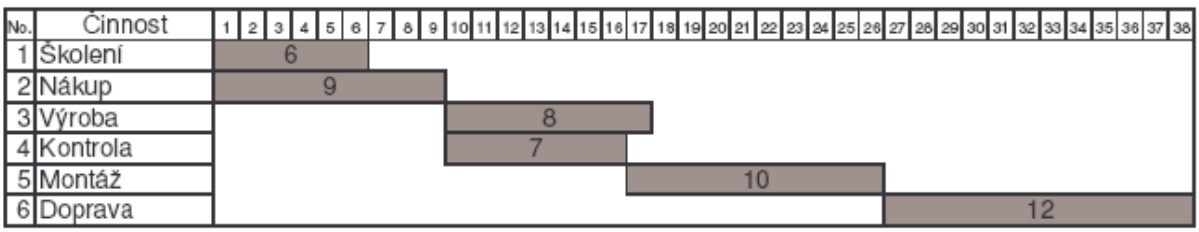
2. Purchasing materials	25,-	4	5,--
3. Production	9,-	4	1.80,--
4. Quality control	10,-	1	2,--
5. Assembling	9,50	1	1.90,--
6. Transporting	6,5	0	---
Total costs	**70,-**	**---**	**---**
Price	**100,-**	**---**	**---**
Profit	**30,-**	**---**	**---**

Činnost	Kalkulace nákladů (Kč / ks)	Max. možné zkrácení (ve dnech)	Náklady na 1 den zkrácení (v Kč/ks)
1. Školení a trénink pracovníků	10,--	3 dny	2,--
2. Objednávka a nákup materiálu	25,--	4 dny	5,--
3. Výroba dílů	9,--	4 dny	1,80
4. Kontrola kvality	10,--	1 den	2,--
5. Montáž výrobku	9,50	1 den	1,90
6. Vyskladnění a doprava	6,50	nelze zkrátit	---
Náklady na 1 ks výr. celkem	70,--	---	---
Prodejní cena	100,--	---	---
Zisk z jednoho ks výrobku	30,--	---	---

Task 3: Whom will you pay the extra money for being quicker and why? Give reasons for your answer.

SOLUTION:

Task 1:



Legend:

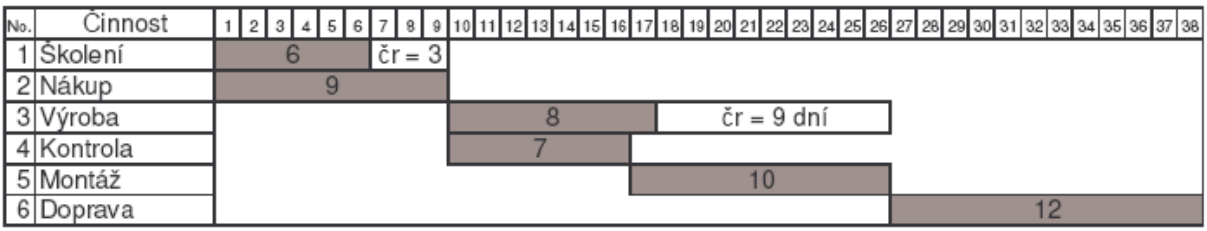
1. Training 2. Purchasing materials 3. Production 4. Quality control 5. Assembling 6. Transporting

Activity	Duration	ET	LT	**FT**
Training	6	Initial activity 0	LT(3) = 26-8=18 LT(4) = 16-7=9 9	**9-0-6** **3**
Purchasing	9	Initial activity 0	LT(3) = 26-8 = 18 LT(4) = 16 - 7 = 9 9	**9-0-9** **0**
Production	8	ET (1) = 0+6 = 6 ET (2) = 0+9 = 9 9	LT(6) = 38 – 12 = 26 26	**26-9-8** **9**
Quality control	7	ET(1) = 0+6= 6 ET(2) = 0+9 = 9 9	LT(5) = 26 – 10 = 16 16	**16-9-7** **0**
Assembling	10	ET(4) = 9+7 = 16 16	LT(6) = 38 – 12 = 26 26	**26-16-10** **0**
Transporting	12	ET(3) = 8+9 = 17 ET(5) =16+10 = 26 26	terminal activity 38	**38-26-12** **0**

Task 2:

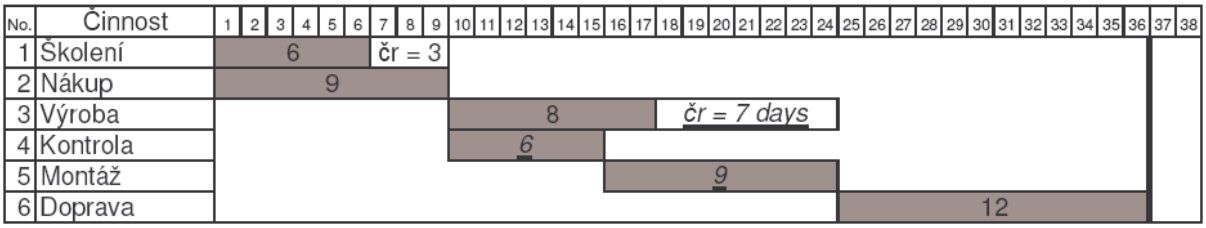
Critical Path:

Training → Quality control → Assembling → Transporting



We can`t accept the offer made by the HR Manager. Training isn`t a critical activity. (The float time is bigger than zero.) Time shortening won`t result in bringing forward other activities and the project duration will stay the same.

Task 3:



We will shorten the assembling stage as this will lead to the least extra costs (from the set of critical activities). The maximum time by which we can shorten the activity is 1 day. We therefore need to shorten the time allocated for the quality control (a critical activity whose shortening will mean the second least extra costs) .

We have thus shortened the duration time of the project to meet the 36-day deadline. At the same time we have managed to decrease the float time for the production stage from 9 to 7 days.

SUMMARY:

1. The time schedule of the project is one of the most important documents drawn up at the planning stage.

2. The time schedule is most commonly shown through graphics and easy-to-follow graphs and charts. The line segment graphs (Gannt charts) are very simple-to-use tools. The disadvantages include the inability to display the dependence of the depicted activities. These drawbacks can be overcome by using the modern software tools.

3. More sophisticated tools have been devised to remove the disadvantages. A network diagram is a mathematical model used in project management which clearly describes the dependencies between all the activities.

4. These tools play a fundamental role in using a number of methods used in planning and managing a project, e.g. the CPM, PERT methods and others. One of the most important goals is to identify the so called critical activities whose delays will result in the delay of the whole project.

TEST QUESTIONS:

1. What are the main advantages and disadvantages of using the line segment graphs?
2. What is a network diagram?
3. What are the main two types of network diagrams?
4. What is a fictitious activity and why is it used?
5. What do we aim to achieve by using the Critical Path method?
6. What is a critical activity and how do we recognize one?
7. What is the difference between the CPM and PERT methods?

6 RESOURCE ANALYSIS AND RESOURCE ALLOCATION

We can classify resources under three main titles:

- **human resources** – can be characterized as the total number of people, their knowledge, abilities and skills whicha are available for activities which need to be done to successfully complete the project;
- **tangible resources** – include technical equipment and any kind of material. Use and consumption of tangible resources creates the project`s mission;
- **financial resources** – are in fact a tangible resource. They can often be classified as an independent category.

One of the most important reasons for taking a closer look at this issue is the economic necessity of identifying any potential future discrepancies between the available resources and the need to use them. These discrepancies can in essence lead to two types of consequences.

- **long-term underuse** of resources – this situation is not economically sustainable as such resources generate costs (e.g. wages, depreciation charges, etc.) but are not being productive or generating any revenue;
- **overuse of resources** – which will result in poorer performance and time overruns which will in the long run negatively show up in the business results of both the project and the company.

The following paragraphs will therefore be devoted to the procedures of analyzing, allocating and optimizing the use of tangible and human resources. Financial resources will be dealt with separately and particular attention will be paid to procedures and methods used in drawing up a budget.

6.1. Procedures Applied in Resource Analysis

Resources are needed for the execution of a project`s subtasks. From the planning point of view it is important to realize that there is a limited number of resources for the given time and space in which to carry out a project. It is therefore necessary to analyze the quantity and quality of the resources available in order to allocate them to set activities. The use of these resources will then depend on the time plan.

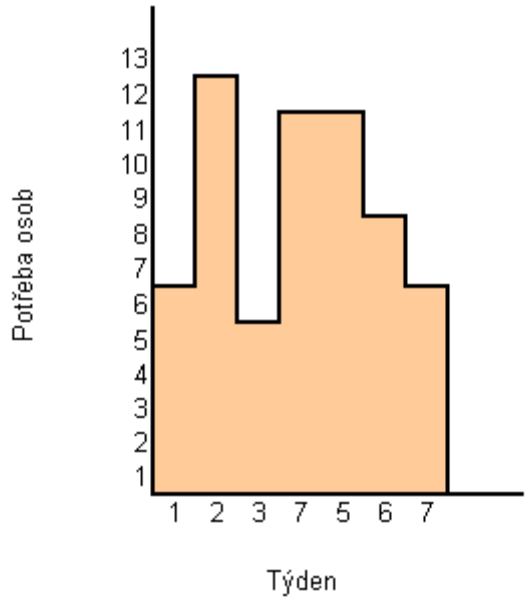
In the process of analyzing resources it is possible to use **summary procedures.** We are talking about the procedures which are based on how the resources are used under the fixed time plan for the project. This procedure uses the results produced by the CPM method.

Using the fixed time plan for a project it is possible to draw up an overview of the extent to which individual resources are used in the project. One can assume that for every activity to be completed a certain amount of resources is required for each monitored period of time. By putting together requirements for each resource at any moment in time (e.g. in the case where different activities require the same resources at the same time) it is possible to find which resources are required at any given time during the project`s execution.

Using the above procedure we will obtain an overview of the rate of consumption for individual resources throughout the whole course of the project duration. This can be shown in many ways, most commonly by the **histogram of the time reserve** or the **mass curve**.

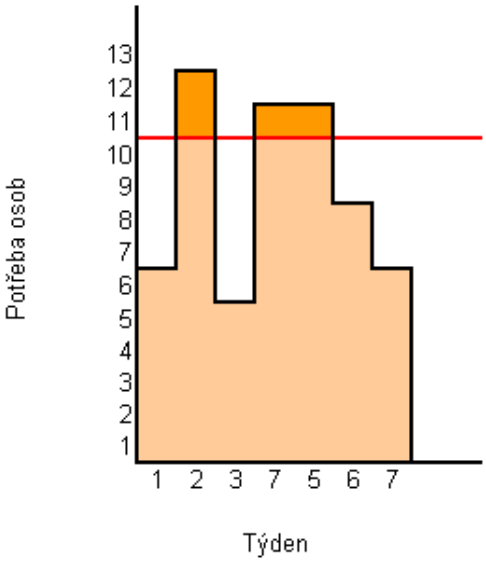
Picture 18: Example of use of a mass curve.

Legend: potřeba osob = requirement for a sufficient number of staff



By adding information on the capacity constraint we will obtain information about the moments of the proposed time plan where there is overuse or underuse of each and every type of resource.

Picture 19: Example of use of mass curve with capacity constraint.



These discrepancies then need to be resolved using optimization methods and tools. Some of them are described in the following section.

6.2. Optimization Methods Applied in the Use of Resources

The analysis of resources can reveal a serious discrepancy between the need for resources and the quality and quantity of resources available. Time plans for projects are often prepared regardless of whether the required resources are available, in other words, plans are made assuming unlimited resources, whether it is one`s own resources or resources obtained from external suppliers.

Analysis of resources can therefore decide the suitability of some resources. All these potential discrepancies need to be resolved in order to avoid the negative consequences of long-term overuse or underuse.

To guarantee the most efficient allocation and use of available resources one can use two fundamental approaches:

- **the method of the well-balanced use of resources–** the goal of this method is to get rid of the projected parts of the graph representing situations when the resource is being overused;
- **the method of resource allocation** = tries to find the shortest critical path through the project without exceeding the capacity constraints of individual resources.

The Method of the Well-balanced Use of Resources

The goal of this method is to get rid of the projected parts of the graph representing situations when the resource is being overused.

Ideally such modifications should take place without changing the project time plan. This is unattainable in reality. Using this method will result in the need to modify the project plan. Changes to resource allocation will usually lead to two scenarios:

1. **impact on the duration of the project** – will typically occur in situations where we do not want or cannot use additional resources (e.g. from external subcontractors, etc.) The use of a firmly fixed volume of resources then needs to be broken down over a longer period of time. If the activity happens to be included in the critical path, these changes will cause the duration of the whole project to change.

2. **impact on the project's costs** – will typically occur in situations where we can spend more money on additional resources. Using these additional resources will, however, cause an increase in cost for the activity in question and consequently for the whole project.

In reality we often see the two scenarios in parallel especially in situations where the same resource is used for two different activities which take place simultaneously.

The Resource Distribution Method

The aim of this method is to find the shortest critical path provided that capacity constraints of individual resources are not exceeded. The use of any resource must not exceed its capacity for the time for which it is used.

The exact answer to this challenge is difficult and different heuristic approaches are used.

- serial heuristic method;
- parallel heuristic method;
- parallel heuristic method with dynamic priorities.

These approaches are based on sophisticated mathematical calculations, which are not covered in this document.

Modern software products designed to facilitate project planning and management offer a whole number of automated procedures which use one of the above outlined methods.

SUMMARY:

1) In order to carry out the individual activities of a project resources are used - human, material, financial, which are limited in the given time and place. Therefore efficient use must be made of these resources to effectively conduct the project.

2) The objective of the resource analysis is to ensure the quantity and quality of the available resources. By adding information on the capacity constraints we discover the discrepancy between the need of the resources and the quantity and quality available. By using optimizing methods it is possible to minimize the discrepancies. The most commonly used methods include:

- The Method of the Well-balanced Use of Resources
- Resource Distribution Method

TEST QUESTIONS:

1. Which basic types of resources used in project execution can we define?

2. What is the goal of the analysis of resources?

3. What methods of optimization of the use of resources do you know?

4. What most common consequences does the method of the well-balanced use of resources have?

5. What is the goal of the resource distribution method?

7 BUDGET PLANNING

The budget for a project forms an integral part of a project plan. It comprises both global and detailed overview of the projected financial value of using individual project resources.

Only an elaborate and sufficiently precise overview can serve as a quality tool for the management of the resources. Before we can draw up the project's budget we need to understand the individual types of costs and their influence on the final balance sheet of the project. For this reason one of the following sections will deal with their definitions.

Based on the information derived from the project's budget and other documents arising from the process of project planning, it is crucial to judge the economic benefits of the proposed project as a whole. There are a number of methods used in the process of financial analysis. A brief description of these will be the subject of one of the following sections.

7.1. Types of Costs

To be able to manage the costs effectively, we need to understand the ways they are created and classified. From the efficiency point of view and cost management of both individual activities and the project as a whole it is necessary to differentiate between :

- **direct costs** – which can be directly matched to individual activities of a project, i.e. they are closely linked with a task carried out. This category would include all the costs related to performance based on the work breakdown structure. Direct costs typically include:
  - wages, salaries;
  - material;
  - depreciation costs of machinery and equipment, the cost of its maintenance and safety;
  - travel costs;
  - purchase of services and subdeliveries, etc.

- **indirect costs** – often referred to as overheads. Resources related to these costs ensure the progress of a project as a whole. These would typically include the costs related to the project management.
    - personal costs of the project's managers;
    - costs to cover the everyday use of buildings and equipment;
    - taxes, charges and other payments, etc.

- **other costs** – which do not fall into the above categories. Namely:
    - reserves to cover identified risks;
    - managerial bonuses, etc.

The budget can vary according to the investor**'**s requirements or legal norms and regulations in different countries.

To be able to use the budget as a financial management tool it is important to see the the link between the level of costs and the volume of performance. On this hypothetical level we can observe two types of costs:

- **fixed costs** – their amount is constant even if there is a change in the output. An example of fixed costs would be rent for the building;
- **variable costs** - they change according to a change in output, i.e. to be able to produce a higher volume of output you need more resources which in turn means higher costs. An example of variable costs would be costs to buy material;

Knowing the level of costs which are dependent on the volume of output makes planning and management easier. It means that an alternative attitude to problem solving can be used and this information also serves as a basis for a number of methods used in financial planning and management.

7.2. Setting a Budget

Drafting a budget is a sophisticated activity which forms part of a very specific know-how of each business. To produce such a draft it is necessary to first quantify as accurately as possible the future costs for each activity and the project as a whole.

A number of cost items can be accurately determined by calculating consumption for each resource. These calculations cannot be made on a general level, they are project specific.

It is also important to note that a project's budget is a type of plan which describes an uncertain future which will be affected, by besides the known factors, a number of identified and unidentified risks.

Besides the calculations based on using mathematical and statistical tools a number of data estimates, both amateur and professional, are published.

To be able to estimate the project's cost items one can use the following methods:

- **the method of analogy** – the estimate is carried out based on the previously conducted projects. This method is not costly, but its results can, however, be quite inaccurate.
- **the parametric estimate** – to carry out an estimate using statistical statements of the current project with historical data of previously conducted projects. This estimate can produce more accurate results (in comparison with the simple method of analogy).
- **the estimate based on the costs of individual resources** – the assessor must know the price of individual types of costs. The final estimate then equals the number of units multiplied by their price.
- **the bottom to top estimate** – aggregated cost estimates for the whole project are set in accordance with cost estimates for lower (more detailed) level of planning.

A number of specialized software programmes can be used to create more accurate cost estimates while minimizing the cost of processing a large volume of data information.

7.3. Financial Analysis of a Project

In the project's financial planning besides monitoring the cost of the project there is also the **complex financial analysis of the project**.

Cash-flow analysis forms an important part of the financial planning. This analysis is necessary because during the execution of the project, discrepancies occur between expenses (i.e. expenses we pay to contractors, subcontractors and employees) and incomes (i.e. the money which we obtain from the project's investor). This typically occurs with projects where an investor's payments are made in advance and not continually as and when the costs arise.

As well as drawing up the project's budget which contains an overview of the main cost items, it is necessary to analyze the cash-flow situation of the project and ensure in advance (by taking out a bridging loan, for example) that any financial commitments will be kept.

Especially in the case of large and long-term projects it is essential to continuously evaluate the financial side of the project during its execution (e.g. in the case of big investment projects) . Here the most commonly applied specialist methods include:

- **the method of calculating the return on the investment** – using this simple calculation will determine the time for a return to be made on the invested funds. A central weakness of this method is the inability to consider the value of money changing in time.
- **the method of calculating the net present value (NPV)** – is based on discounting the cash-flows throughout the whole course of the project duration. From all the alternative projects the one whose present net value is the highest will be chosen.
- **the breaking point analysis** – is such a point on the time axis when incomes and expenses are balanced (i.e. where the profit is zero)

SUMMARY:

1. A budget forms an integral part of any project. In the management phase the budget becomes one of the most important tools to ensure the economic effectiveness of the whole project.

2. For us to be able to plan the costs in the appropriate structure, it is essential to correctly determine the budget structure. Considering the prognosis of the future development of the costs for different alternative scenarios, it is necessary to correctly identify and differentiate between fixed and variable costs.

3. To be able to draw up the budget itself a number of methods can be used that are based on estimates of individual cost items. The overall financial analysis of the project plays an important role, especially from the cash-flow point of view. In the case of long-term projects it is also essential for the economic return of the project.

TEST QUESTIONS:

1. What is the main difference between fixed and variable costs?

2. What procedures can be employed in drafting a budget?

3. Why is it necessary to carry out the project's cash-flow analysis?

4. What is the difference between the method of calculating the return on the investment and the net present value (NPV)?

8 RISK PLANNING

As we have already stated in the first part of this course (see section 3.2.), we understand risk as being the **loss of value brought about by the project executor,** or the investor (client, user). This loss is expressed through money or other measurables. Risk is an indefinite phenomenon, which will impact the completion of the project.

There is an element of risk in each project. We therefore need to identify any risks and reduce them as much as possible. Risks must be managed properly during the project's execution.

The process of risk management can be defined as a sequence of activities through which events or negative influences, which could endanger the successful execution of the project, are prevented. The goal of risk management is to minimalize the probability of risk, but if it cannot be avoided then it is necessary to find measures of reducing the negative impact on the project as much as possible. This can be done even in the planning process.

By applying the risk analysis method we can identify the risks. The risk analysis methods will therefore be treated in one of the following sections.
We will also describe the most suitable tools which can be used in the project's planning stage to minimalize the negative effect of potential risks on individual activities and the project as a whole.

8.1. Risk Analysis Methods

Methods employed to analyze risks can be divided into two main groups:

1. qualitative methods;

2. quantitative methods.

The goal of the **qualitative analysis** is to identify risks and determine their effect on the project and the probability of them occuring. This method typically produces a list of risks structured according to their potential impact on the project's goals. If we use the qualitative method of risk analysis, we are able to evaluate probable impacts of the risk by means of qualitative verbal terminology (e.g. very high, high, low, etc.)

Quantitative methods focus on the analysis of numerical probability of each risk and its effects on the completion rate of the project's goals. If we use such methods it is always necessary to determine probability or probability distribution of each risk event. These are most commonly determined on the basis of the expert opinion.

In the process of risk analysis each risk must be described using the following characteristics:

- **risk event** – that is an account of the situation or the initiator of the process which can impact the project (harm the project);
- **probability of occurrence** – described either verbally (in the case of the qualitative analysis) or numerically (in the case of quantitative analysis);
- **the danger value** – the extent of the damage which can be done.

The most frequently used approach to risk analysis is the **combination of qualitative and quantitative methods.** First of all, qualitative analysis is used which determines the type of risk. Then the resources relating to the risk are identified and some other characteristics, e.g. the extent of the probability of it occuring, its seriousness, whether or to what extent the risk can be controlled or avoided. The techniques most commonly applied in the qualitative risk analysis include:

- the Delphi Method;
- Brainstorming;
- SWOT analysis;
- graphical tools (charts, network diagrams, etc.).

By using certain method of quantitative analysis the most serious risks can be analyzed more accurately. Terminology is translated into numerical expressions and scrutinized by the selected methods of quantitative analysis, among which are the following:

- decision matrixes and decision trees;
- sensitivity analysis;
- simulation.

8.2. Tools Used to Plan and Manage Risks

Based on the results of the risk analysis a plan is devised which will describe how to proceed in choosing the right strategy, methods and procedures, which will be employed to prevent the risks or reduce their impact on the project's goals.

One of the most important tools used to avoid risks or reduce their (negative) impact is the **creation of reserves** which can be used as early on as at the planning stage.

Reserves can be seen as a counterbalance of risk. Reserves the most frequently used relate to costs and time. There is a number of ways used of creating reserves in the project:

1. **the method of automatic increase** – for each activity in the project we will automatically plan values which exceed the original estimate by a certain percentage. (e.g. we will increase all the costs by 10% and all the execution times by 15%);

2. **by including the unplanned reserve activities** – these unplanned activities will be included in the project plan although they may not happen in reality and they are matched to a particular time schedule and to particular costs. These reserve activities can then be used in the management process in case there is time or cost overrun.

The reserves created are then used in the management process in a way that the impact of risk on the main parametres of the project (quality, time, costs) is minimalized.

The very existence of the reserves does not necessarily mean that this is a less effective solution**.** The task of the project manager is therefore **optimalization –** it is necessary to ensure the project against risk, on the other hand the cost of carrying out these measures (i.e. the volume of such reserves) should be as low as possible.

One of the ways of achieving this goal is through an **effort to reduce uncertainty** (and thus risk). One of the simplest (and most widely used) ways of reducing uncertainty can simply be to break down the project into more smaller stages and to include plans of individual subprojects activities whose goal is to reduce the risk of the subsequent subprojects. To be able to do this one can use models, prototypes, simulations which use the results of previous stages of the project, etc. Speciliazed software tools can be used to carry out these procedures.

SUMMARY:

1. Because projects are planned and executed in an uncertain environment full of changes and twists, risk management has become an integral part of each project plan.
2. The risk can be defined as any uncertain phenomenon which will influence the completion of the project goals. The process of risk planning can then be denoted as a sequence of activities whose goal is to identify risks, determine their influence on the project and the probability of their occurrence and plan strategies which will be used during the project execution to avert these risks.
3. One of the most important tools used to avert risks or reduce their impact is the creation of adequate reserves. Reserves thus become part of each „responsible“ project plan. The very existence of the reserves, however, clashes with the concept of economic effectiveness. The task of the project manager therefore is to optimize their volume and with the help of other adequate procedures to reduce uncertainty to the point where minimal reserves are needed.

TEST QUESTIONS:

1. Which characteristics define risk?
2. Which methods of risk analysis do you know?
3. Which methods used to create reserves are you familiar with?
4. What is the negative consequence of the existence of reserves?
5. How is it possible to reduce the negative impact of the creation of reserves?

SELF EVALUATION TEST II

Legend:

Activity	Immediately following activities	Standard duration (in weeks)	Maximum shortening of duration (in weeks)	Costs (CZK)	Costs per one week of shortening (CZK)
A	none	3	2	3 000,--	1 000,--
B	none	4	2	4 000,--	500,--
C	none	5	3	5 000,--	300,--
D	A	8	6	5 000,--	1 500,--
E	A, B	3	2	3 000,--	750,--
F	C	5	3	4 000,--	1 000,--

QUESTIONS:

1. What is the standard project duration (i.e. when all standard time schedules for activities are kept)?
2. What will be the costs in the case of the standard project duration?
3. Which activities can we find on the critical path?
4. Let's assume that the project order will be executed. Your client requires to shorten the standard project duration by 2 weeks. Time of which activity (activities) will you shorten and why. Give reasons for your answer.
5. What will be the critical path of the newly created project? (Considering the changes you proposed in question 4.)
6. What will be the costs of the modified project?
7. Let's assume that a contractual agreement has been made to pay a fine of 500 CZK for every additional week by which the project will be handed over earlier than required by the client. What is the economically most suitable project duration if the client's requirement is 9 weeks?

Correct Answers for the Test Questions

1. THE BASIC TERMINOLOGY

1. A project is a unique sequence of coordinated activities and tasks conducted by an individual or organization. It is usually a unique one-off process which has:

- goal and mission;
- time framework of the project;
- framework for drawing on resources;
- organizational framework
- specific social framework.

2. Project management is a sum of activities consisting in planning, organization and management and control of the use of resources within a set time limit aimed to achieve specific goals.

3. Project management in a new project organizational structure helps to solve problems when overcoming problems caused by tradional managerial methods in the classic hierarchical structure, especially:

- inflexibility in the way internal and external resources are used;
- slow response to changing conditions in the business environment.

4. Project management development is heavily influenced by a number of constraints of the project environment which include the project's mission, costs, time and acceptable level of uncertainty.

2. AN ORGANIZATIONAL STRUCTURE OF A PROJECT

A project's organizational structure is a network of defined relations among the project's individual interest groups. In the organizational structure:

- there is decision making authority of the project;
- new roles and responsibilities are assigned, delegated and assumed by individual interest groups with regard to their responsibilities in the project execution;
- there is communication among individual project interest groups.

2. The project's interest groups are formed by people and organizations which are actively engaged in the project execution, or whose interests may have an impact on the progress and result of the project. The interest groups include:

- the project's client;
- the project's contractor;
- other key interest groups.

3. To manage the project successfully it is important:
   - to identify all interest groups;
   - to describe their requirements and expectations;
   - to understand the scope of their autority and responsibility;
   - to assess the risks posed by the differences between their individual interests and the project's objectives;
   - to appropriately communicate the needs and status of a project in its course with the interest groups and to protect the project from negative influences.

4. The basic principles used in the creation of organizational structure are:
   - delegation of authority and responsibility to participating entitities;
   - ensuring personal communication among executors of a project;
   - creating conditions for the management principles to be applied (the right conditions to achieve project goals within the minimum time and using minimum funds and human resources).

5. The project manager is a person responsible for the achievement of project goals while keeping all the set parametres of the project. He/she must have abilities, skills and moral responsibility which will enable him/her to:
   - manage allocation and effective use of resources;
   - manage timespan of activities;
   - lead co-workers, motivate them to perform well;
   - communicate with all the entitities involved in the project with the aim of harmonizing their interests;

6. Project team consists of responsible representatives of executors responsible for different parts of a project.
   - The team has to be motivated to reach its goals.
   - In the team that has to be created an atmosphere of mutual trust among its members and determination to obtain the expected result.

- Team members have to have an opportunity to voice their opionions – to analyze and solve problems as a team.
- Team members have to respect each other, respect their professional abilities, skills and competences.

3. LIFECYCLE OF A PROJECT

1. The lifecycle of a project consists of a sequence of phases which can be labeled as:

- Introduction – initiation.
- Planning.
- Managing and coordination.
- Monitoring and control.
- Closing.

2. A number of methods is used to create and manage a project's lifecycle. The most widely used ones are the network analysis methods. Other frequently used methods used include methods of systems and operational analysis.

3. At the planning stage the following is carefully considered:

- the final objective of a project;
- work breakdown structure;
- the project's schedule;
- budget;
- plan of allocation of resources.

4. When setting the requirements for the project's quality, results and environment. The following requirements are imposed:

- requirements for the quality of the work done and the project's outcome which consist in the effective use of resources while complying with the given norms;
- requirements for the project environment's quality which consist in the effective use of the environment while respecting the client's requirements for the product's use.

5. The risks might be:

- permanent – occuring throughout the project's duration;
- random – occuring once or repeatedly during a certain period of time;
- extraordinary – usually not known when the risk analysis is made, they occur at the execution stage.

6. During the risk analysis stage the following most important questions are asked:
   - What unpleasant situations (breakdowns) can arise in the project execution?
   - How often can breakdowns happen? (What is the probability of them occurring?)
   - If a breakdown does happen, what consequences might it have?

SELF EVALUATION TEST I

Legend:

Submitter, project's investor	I
Main executor of the project	ME

Project manager	PM
Project team members	PTMs
Executor of the various sections of the project	VSE
Project’s services	PSs
Interested Organizations	IOs
Other Institutions and Organizations	Os

Correct Answers:

Institutions and businesses	Interest groups supporting the project	Interest groups with conflicting interests	Interest groups not engaged in the project
The Government of the Czech Republic	Os		
Regional authority of the respective locality	Os		
Local authority of the respective town		Os	
The Road and Motorway Directorate of the Czech Republic	I		
A big construction company	ME, PM, PTMs		
A small company with specific technology	VSE		
Union for Nature Conservation		IOs	
Monument Preservation Institute		Os	
Hunters' Union of the Czech Republic		IOs	
Company – electricity distribution		Os	
Company – cable telecommunications		Os	
Bank	PSs		
Protection of Buildings and Constructions	PSs		

4.

DRAWING UP A WORK BREAKDOWN STRUCTURE

1. In creating a work breakdown structure the following principles must be used:
    - the hierarchy principle;
    - the adequate scope of structure principle;

- the interconnectivity principle.

2. A detailed work breakdown structure (WBS) is a key document used in project management where the mission of the project interconnects with time and economic dimensions of the project plan.

5. PLANNING AND ESTIMATING OF THE TIME TAKEN TO COMPLETE THE PROJECT

1. Advantages and disadvantages of the Gannt charts:
   - advantages: easy to create and easy to understand;
   - disadvantages: they don't show the connections between the activities.

2. A network diagram is a mathematical model of a project which clearly depicts the links between activities. It is an oriented diagram.

3. There are two types of the network diagrams:
   - node defined network diagrams;
   - edge defined network diagrams.

4. A fictitious activity is an activity which does not take place in reality and the time taken is zero. It is sometimes used in creation of network diagrams to ensure the network diagrams have one starting and one finishing point.

5. The goal of the CPM is a creation of a time analysis of the project. It tries to find the shortest critical path, i.e. a set of activities that are crucial to the project.

6. A critical activity is an activity on the so called critical path. Its time reserve is zero and its late start or delay in its completion can cause the delay of the whole project.

7. The CPM is a deterministic method which takes into consideration the results of the probability analysis.

6. RESOURCE ANALYSIS AND RESOURCE ALLOCATION

1. We can define three types of resources:
   - human;
   - tangible;

- financial.

2. The analysis of resources is carried out provide data regarding the volume and quality of available resources.

3. There are two types:

- the method of the well-balanced use of resources;
- the method of resource allocation.

4. Using these two methods will

- change the project time schedule;
- change the project budget.

5. The method of resource allocation is used to find the shortest critical path through the project without exceeding the capacity constraints of individual resources.

7. BUDGET PLANNING

1. The fixed costs stay the same even when the volume of production changes. The variable costs change according to quantity made. (They grow.)

2. The most commonly used methods followed in budget planning:

- the method of analogy;
- the parametric estimate;
- the estimate based on the costs of individual resources;
- the bottom to top estimate.

3. The existence of the time discrepancy between the expenses and incomes during the project execution.(e.g. when advance payments are used) means it is necessary to carry out the financial flows analysis.

4. The second mentioned NPV method (method of calculating the net present value) takes into consideration the time value of money.

8. RISK PLANNING

1. Risk can be defined using the following characteristics:
    - risk event;
    - probability of occurrence;
    - the extent of damage.

2. Methods used to analyze risk:

- qualititative:
    - the Delphi Method;
    - Brainstorming;
    - SWOT analysis;
    - graphical tools (charts, network diagrams, etc.).

- quantitative:
    - decision matrixes and decision trees;
    - sensitivity analysis;
    - simulation.

3. Methods used in the creation of reserves:
    - the method of automatic increase;
    - the method of including unplanned activities.

4. The existence of reserves in a project plan means the plan does not consider the most effective approach.

5. The negative impact of the existence of reserves can be softened by:
    - reducing the volume of reserves as much as possible;
    - reducing uncertainty of a project (by breaking down the project into more smaller sections)

SELF EVALUATION TEST II

1. The standard duration of a project is 11 weeks.

2. The costs of the project of standard duration are 24 000,--.

3. On the critical path there are activities A,D.

4. Activity A will be shortened. It is a critical activity, which means its shortening will result in a shorter time taken to complete the whole project. At the same time activity A has the lowest cost needed to shorten a project, so its shortening will be the most effective.

5. The critical path of the newly planned project will not change.

6. The costs of the modified project will be 24 000,-- + 2* 1 000,-- spent to shorten the project. That is 26 000,-- altogether.

7. The project with the delivery time of 11 weeks and the total costs of 25 000,-- seems to be the most effective option.

LITERATURE USED

[1] FIALA, P. *Projektové řízení – modely, metody, analýzy*. Praha : Professional Publishing, 2004. ISBN 80-86419-24-X.

[2] CHVALOVSKÝ, V. *Řízení projektů aneb překážkový běh na dlouhou trať*. Praha : ASPI, 2005. ISBN 80-7357-085-8.

[3] ROSENAU, M. D. *Řízení projektů.* Praha : Computer Press, 2000. ISBN 80-7226-218-1.

[4] SVOZILOVÁ, A. *Projektový management*. Praha : Grada, 2006. ISBN 80-247-1501-5.

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