VILNIUS GEDIMINAS TECHNICAL UNIVERSITY
FACULTY OF MECHANICS
DEPARTMENT OF INDUSTRIAL ENTERPRISE MANAGEMENT

Justinas Sinkevičius

INDUSTRIAL ENTERPRISES PROJECT MANAGEMENT
PRAMONĖS ĮMONIŲ PROJEKTŲ VADYBA

Final Master Work

Studies‘ program: Industrial Engineering and Innovation Management, State Code 621H77002
Study area of Production and Manufacturing Engineering

Vilnius, 2012

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OBJECTIVES FOR MASTER THESIS

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For student Justinas Sinkevičius
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Thesis title: Industrial Enterprises Project Management

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THE OBJECTIVES:

1. To make analysis of the industrial enterprises project management theory.
2. To do empirical research of the situation of project management in Lithuania industry.
3. To establish main problems in this area.
4. To suggest the model for project management system improvement.

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Thesis language

	Lithuanian
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Annotation

In the final master work is analysing the industrial project management, its system and practical issues. Therefore is made analysis of theoretical aspects of fundamental project management methods. Questionnaire of manufacturing sector was made. Collected data about projects and its implementation from 42 enterprises of Lithuania industrial enterprises. Analysis is made by statistical data and empirical research results to evaluate parameters and successfulness of project management in industrial enterprises. Regression relationships are defined between organizational parameters and project implementation success. According to analysis of scientific literature, statistics and results of empirical research formed an improvement model of project management system in industrial organization. After an examination of the theoretical and practical aspects, the conclusions and recommendations are formed.

Structure: introduction, theoretical aspects of projects management, industrial enterprises empirical research on project parameters, model for projects preparation improvement in Lithuanian industrial design sector, conclusions and suggestions, references.

Thesis consist of: 73 p. text without appendixes, 33 pictures, 13 tables, 43 bibliographical entries.

Appendixes included.

Keywords: project, project management, industrial enterprise, manufacturing, project parameters, project problems, project management system improvement

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Pramonės inžinerijos ir vadybos studijų programos baigiamasis magistro darbas

Pavadinimas **Pramonės įmonių projektų vadyba**

Autorius **Justinas Sinkevičius** Vadovas dr. **Augustinas Maceika**

Kalba

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[X] užsienio

Anotacija

Baigiamajame magistro darbe nagrinėjama pramonės įmonių projektų vadyba, jos metodai ir praktinės problemos. Šiam tikslui atliekamas bedrosios projektų vadybos metodologijos teorinių teiginių analizė. Vykdyta gamybinio sektoriaus įmonių anketinė apklausa. Surinkti duomenys iš 42 Lietuvos pramonės įmonių apie projektus ir jų įgyvendinimą. Atlikta empyrinių duomenų anlizė, kurios tikslas remiantis tyrimo ir statistiniais duomenimis įvertinti gamybos įmonių projektų parametrus, bei jų įgyvendinamumą. Nustatytos regresinės priklauomybės tarp parinktų kriterijų ir projetų įgyvendinimo sėkmingumo įmonėse. Remiantis mokslinės literatūros analize, statistiniais duomenimis ir empiriniais tyrimo rezultatais suformuotas projektų vadybos sistemos tobulinimo pramonės įmonėms modelis. Išnagrinėjus teorinius ir praktinius projektų vadybos aspektus, pateikiamos baigiamojo darbo išvados ir pasiūlymai.

Darbą sudaro šios dalys: įvadas, projektų rengimo teoriniai aspektai, pramonės įmonių empirinis tyrimas gamybos įmonių projektų vadybos sistemos tobulinimo modelio sudarymas, išvados ir siūlymai, literaturos sarašas.

Darbo apimtis – 73 p. teksto be priedu, 33 iliustr., 13 lent., 43 bibliografiniai šaltiniai.

Atskirai pridedami darbo priedai.

Prasminiai žodžiai: projektas, projekto vadyba, pramonės įmonės, gamyba, projektų parametrai, projektų problemos, projektų vadybos sistemos tobulinimas

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INTRODUCTION

Recent industry reports highlight the growing adoption of project management standards and practices across large numbers of organisations (Winter et al. 2006).

Lithuanian industrial companies often apply project management methods for uniquely their own activities in order to adapt to a changing environment. The economic benefit of project management was proven in numerous studies and practices. However, there are often inadequate or negligent methods of project management applications. Many projects are proceed without taking into account all risks and opportunities, or do not formulate appropriate goals. In this case, using the test-error method, that increases the activity amount of failures, and resource consumption.

Nowadays, many researches are made in technology, innovation and new product development process, the activities of organization, application and commercialization. The unique activity or task is not resolved effectively without project management. Cyclical nature of the global market growth leads to increased new technology, innovation and product demand as well as project management. A lot of attention and support is given for the development of these activities.

It is worthwhile to distinguish production activities and the organizational impact to the projects and their management by shaping strategies and selecting appropriate interface models of project life-cycle and methodology. However, enterprises deal with business as usual and unique activities, functions and importance of preference conflict. It shows the problems of changes in organizational structure from a traditional towards projects or matrix organizational form. Unfortunately a lot of manufacturing companies not able fully implement project management systems, it is easier to modify and customize to their needs. Because it is most of casual activities are executed as standard operational. Project Management Body of Knowledge (Project management institute 1996) classifies manufacturing-production as non-project based activities.

The business philosophy of continuous improvement as production improvement – Toyota and Lean production systems, quality - Total Quality, Six Sigma, supply - Supply chain management, information technology and resource management - ERP, MES, and etc. methods, tools, installation and use of everyday activities. The latter and other similar techniques are popular for execution into the industrial enterprise, but the costs and benefits difficult to quantify. However, these continuous improvement projects have a significant impact on the ordinary course of business organization and corporate structure of the organization, its units between the operation and management of the project itself.

Traditional approach in customer-order environment is used project management, especially use in construction industry, as well as in more complex unit or series production. In this

case, the product could have wide specification should meet the needs of customers with unique and a little repetitive activities. Process modified products or services are adapting individual customer needs.

The discipline of project management has served, and will continue to serve as the fundamental philosophy in industries to deal with product and manufacturing process changes as projects become the foremost mechanism for creating new products and processes. This change is occurring, however, because organizations have the willingness and strength to adopt project management as a body of system rather than as a set of tools or a special case of traditional management.

Research problem. Fast changes in requirements and lack of analysis in project management practices of Lithuania's industrial sector. There is a many research about construction and product development projects. Project management attract major attention from researchers. However, there is minor information about project management situation in industries of Lithuania. The implementation and execution of effective project management into manufacturing based enterprises. Furthermore, industrial enterprises do not use effective project management systems and methods. Improvement model is significant important to complete self-improvement project management system.

Research object. Projects management methodological and practical issues in Lithuania industry. The main goal to make the research of the industrial enterprises project management process and create the improvement model for project management system.

Research aim. Analysis of project management practice according statements of project methodology. To determinate the main problems in manufacturing industry, practice, and to find solutions of them. Research was made by fundamental methods of research: systemic analysis, logic analysis and questionnaire data general and correlation-regression analysis. To simplify research is done on manufacturing based enterprises.

1 SCIENTIFIC LITERATURE ANALYSIS OF PROJECT MANAGEMENT

1.1 Basic terminology analysis.

Many of the scientific literature examining changes in routine and operational management. However, there is no single definition of management. Scientists are working to identify key terms of aspects, but the definitions are applied to the industrial areas which used.

Management is the process of designing and maintaining an environment in which individuals, working together in groups, efficiently accomplish selected aims towards any project. It is the art of creating an environment in which people can perform as individuals and yet cooperate towards the attainment of group goals. (Chambers 2007)

Management is governing without political power, is leading without recourse to political or religious authority. Its legitimacy is functional: Management is justified by its function to increase efficiency, not by the political good or the consent of those influenced by the management. Its legitimacy is neither traditional nor consensual, it is functional. The idea of management implies that the people managed feel that they win by being managed (Koslowski 2010).

Managing is an art of getting things done through and with people in formally organized groups (Thomsett 2002).

Strategic management is an on-going process that evaluates and controls the business and the industries in which the company is involved; assesses its competitors and sets goals and strategies to meet all existing and potential competitors; and then reassesses each strategy annually or quarterly [i.e. regularly] to determine how it has been implemented and whether it has succeeded or needs replacement by a new strategy to meet changed circumstances, new technology, new competitors, a new economic environment, or a new social, financial, or political environment (Ketchen and Bergh 2004).

Management in all business and organizational activities is the act of getting people together to accomplish desired goals and objectives efficiently and effectively. Management comprises planning , organizing, staffing, leading or directing, and controlling an organization (a group of one or more people or entities) or effort for the purpose of accomplishing a goal. (Wikipedia 2011).

General management processes (Salvendy 2001):

- Planning—What are we aiming for and why? Develop the objectives, goals, and strategies to provide for the commitment of resources to support the project.

- Organizing—What is involved and why? Identify the human and nonhuman resources required, provide a suitable layout for these resources, and establish individual and collective roles of the members of the project team, who serve as a focal point for the use of resources to support the project.
- Motivation—What motivates people to do their best work? Establish a cultural system that brings out the best of people in their project work.
- Directing—Who decides what and when? Provide for the leadership competency necessary to ensure the making and execution of decisions involving the project.
- Control—Who judges the results and by what standards? Monitor, evaluate, and control the use of resources on the project consistent with project and organizational plans.

According definitions of management by different authors provide main aspects on it. Management process involves governing and leadership abilities for maintaining environment to achieve objectives within best usage of resource.

1.2 Term of project management analysis

Project management institute defines project as a temporary endeavour undertaken to create a unique product, service, or result (Project management institute 2008).

A project is an organized endeavour aimed at accomplishing a specific non-routine or low-volume task (Shtub et al. 1994).

Cleland and Ireland provide other definition to project is any undertaking that has definite, final objectives representing specified values to be used in the satisfaction of some need or desire or project is a combination of organizational resources pulled together to create something that did not previously exist and that will provide a performance capability in the design and execution of organizational strategies (Cleland and Ireland 2002).

Project management is the planning, organizing, directing, and controlling of company resources for a relatively short-term objective that has been established to complete specific goals and objectives. Furthermore, project management utilizes the systems approach to management by having functional personnel (the vertical hierarchy) assigned to a specific project (the horizontal hierarchy) (Kerzner 2001).

A project is a set of activities with a defined start point and a defined end state, which pursues a defined goal and uses a defined set of resources (Chambers at el. 2007).

And also project is a temporary organization to which resources are assigned to undertake a unique, novel and transient endeavour managing the inherent uncertainty and need for integration in order to deliver beneficial objectives of change (Turner 2003).

Projects are formally defined by Cleland and Gareis (1994), as the process that transforms and unsatisfactory state of affairs into better state within certain time and resources limit.

In any case project must be managed by people and this activity is called project management.

Project management is a series of activities embodied in a process of getting things done on a project by working with members of the project team and with other people in order to reach the project schedule, cost, and technical performance objectives (Cleland and Ireland 2002).

Project management is the application of knowledge, skills, tools, and techniques to project activities to meet the project requirements (Project management institute 2008).

Project management is "The application of knowledge, skills, tools, and techniques to project activities in order to meet or exceed stakeholder needs and expectations from a project" (Program Management Institute 1996).

A project management process is a collection of tools and techniques that are used on a predefined set of inputs to produce a predefined set of outputs. Processes are connected to each other as the input to some of the project management processes is created (is an output) by other processes. The collection of interrelated project-management processes forms a methodology that supports the management of projects throughout their life cycle, from the initiation of a new project to its (successful) end (Salvendy 2001).

The goal or aim of the project system (Leach 2005) is to deliver project results that satisfy all project stakeholders. This requires delivering the promised scope, on or before the promised delivery date, at or under the estimated cost. The black-box view of the project system clarifies the system goal, identifies the system inputs and outputs, and leads to the measures that aid controlling the system to achieve the goal.

1.3 Project management problems in literature

Project managers must meet customer needs on time, at or under budget, all of the time.

Black (Black 1996) surveyed professional engineers to determine the causes of project failures. His top12 causes of project failures are:

1. Lack of planning
2. The project manager
3. Project changes (scope creep, poor planning, etc.)
4. Poor scheduling
5. Skills of team members

6. Management support

7. Funding

8. Cost containment

9. Resources

10. Information management

11. Incentives (lack of rewards and penalties)

12. Lack of continuing risk analysis

Pinto and Slevin (1987), Pinto and Prescott (1988), Pinto and Slevin (1989), and Pinto and Mantel (1990) examined the presence of critical success factors in project implementations. The critical success factors are project mission definition, top management support, client consultation, personnel, technical tasks, client acceptance, monitoring and feed-back, communication, and troubleshooting.

Of the projects accessed as failures in the strategic stages, the relevant criterion for failure was that related to external effectiveness: perceived value of the project and client satisfaction. In the tactical stages, the relevant criteria for failure were those related to trouble shooting, lack of adequate personnel, ineffective scheduling, lack of client acceptance, and inadequate technical support (Pinto and Mantel, 1990).

Neimat (Neimat 2005) provides similar list of project failures: planning, unclear goals and objectives, objectives changing during the project (scope creep), unrealistic time or resource estimates, lack of executive support and user involvement, failure to communicate and act as a team, and inappropriate skills.

Flowers (1997) concluded that the unpredictability of the technology is a primary complexity factor that contributes to project failure. (Salvendy 2001)

A project failure is characterized by overrun cost and schedule objectives, and/or a failure to meet technical performance specifications. Other reasons to terminate a project include: a change in strategy so that the project is no longer a strategic fit, an external environmental change renders the project useless, or the project's importance has diminished within the organization (Lester and Geng 2003).

A leader can cause organizational or project failure by ignoring the needs of followers or employees, such as by doing any of the following (Charvat 2002):

- Not providing the information or tools needed to do the job
- Not taking an interest in people

- Not considering compensation adequately
- Not providing a positive environment
- Not sharing goals

Typical reasons why plans fail include (Charvat 2002):

- Corporate goals are not understood at the lower organizational levels.
- Plans encompass too much in too little time.
- Financial estimates were poor.
- Plans were based on insufficient data.
- No attempt was made to systematize the planning process.
- Planning was performed by a planning group.
- No one knows the ultimate objective.
- No one knows the staffing requirements.
- No one knows the major milestone dates, including written reports.
- Project estimates are best guesses, and are not based on standards or history.
- Not enough time was given for proper estimating.
- No one bothered to see if there would be personnel available with the necessary skills.
- People are not working toward the same specifications.
- People are consistently shuffled in and out of the project with little regard for schedule.

Other authors (Leach 2005) identified factors and influences that affect the success of projects.

1. Selection of the right problem;
2. Selection of the right solution;
3. Creation of a satisfactory plan;
4. Use of an effective project-control system;

4.1 Resource quantity;

4.2 Resource skill;

4.3 Resource behaviour;

4.4 The project-management process;

4.5 Project execution tools;

4.6 Project changes.

5. Effective project execution;

6. Use of an effective method to manage uncertainty.

The literature provides significant issues in project management that should be resolved. Most authors define primal data acquiring, planning issues, high rate of technology change.

1.4 Term of industrial enterprise analysis

Industry consists of enterprises and organizations that produce or supply goods and services. Industries can be classified as primary, secondary, or tertiary.

Primary industries cultivate and exploit natural resources, such as agriculture and mining. Secondary industries take the outputs of the primary industries and convert them into consumer and capital goods. Manufacturing is the principal activity in this category, but construction and power utilities are also included. Tertiary industries constitute the service sector of the economy. A list of specific industries in these categories is presented in table 1 (Groover 2010).

Manufacturing can be defined as the conversion of raw materials into useful articles by means of physical labour or the use of power driven machinery (Groover 2010).

Manufacturing is a commercial activity and exists for two purposes (Timmings 2004):

- To create wealth. There is no point in investing your money or other people's money in a manufacturing plant unless the return on the investment is substantially better than the interest that your money could earn in a savings account.
- To satisfy a demand. There is no point in manufacturing a product for which there is no market. Even if there is a market (a demand), there is no point in manufacturing a product to satisfy that demand unless that product can be sold at a profit.

The manufacturing environment may differ with respect to (Gideon 2001):

- size of plant;
- type of industry;
- type of production (mass production, job shop, etc.).

The activities may involve (Gideon 2001):

- developing and producing products;
- producing parts or products designed by the customer;
- reproducing items that have been manufactured in the past.

Table 1. Specific industries in the primary, secondary, and tertiary categories (Groover 2010)

Primary	**Secondary**		**Tertiary (Service)**	
Agriculture Forestry Fishing Livestock Quarries Mining Petroleum	Aerospace Apparel Automotive Basic metals Beverages Building materials Chemicals Computers Construction Consumer appliances Electronics Equipment	Fabricated metals Food processing Glass, ceramics Heavy machinery Paper Petroleum refining Pharmaceuticals Plastics (shaping) Power utilities Publishing Textiles Tire and rubber Wood and furniture	Banking Communications Education Entertainment Financial services Government Health and medical Hotel Information	Insurance Legal Real estate Repair and maintenance Restaurant Retail trade Tourism Transportation Wholesale trade

However, the fundamental principles of the manufacturing process are the same for all manufacturing concerns, and thus a general cycle can be formulated. Because each mode of manufacturing is subject to different specific problems, the emphasis on any particular phase of the cycle will vary accordingly.

In order to ensure good performance the manufacturing process must consider the requirements of many disciplines (Gideon 2001), such as:

- marketing and sales
- customer relations
- product definition and specifications
- product design
- process planning and routing
- production management: MRP, capacity planning, scheduling, dispatching, etc.
- shop floor control
- economics
- purchasing
- inventory management and control
- costing and bookkeeping
- storage, packing and shipping

- material handling
- human resource planning.

Manufacturing capability refers to the technical and physical limitations of a manufacturing firm and each of its plants. Several dimensions of this capability can be identified: (1) technological processing capability, (2) physical size and weight of product, and (3) production capacity.

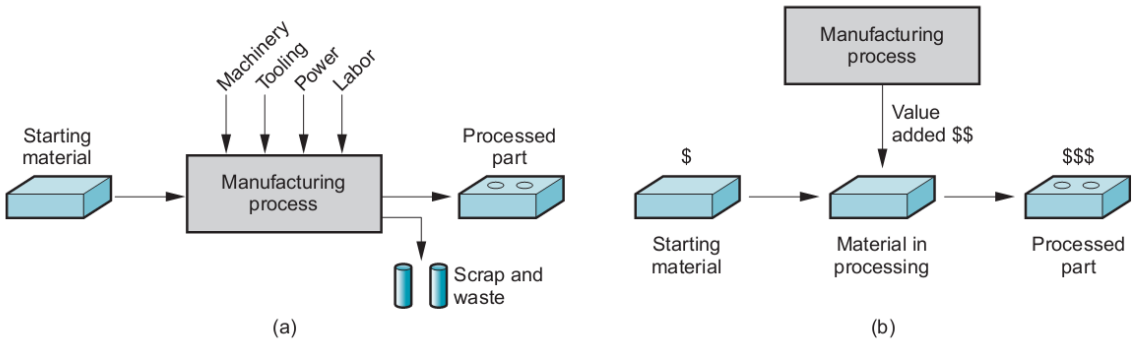

Fig. 1. Two ways to define manufacturing: a – as a technical process, b – as an economic process (Groover 2010)

Technologically (Fig. 1 a), manufacturing is the application of physical and chemical processes to alter the geometry, properties, and/or appearance of a given starting material to make parts or products; manufacturing also includes assembly of multiple parts to make products. The processes to accomplish manufacturing involve a combination of machinery, tools, power, and labour.

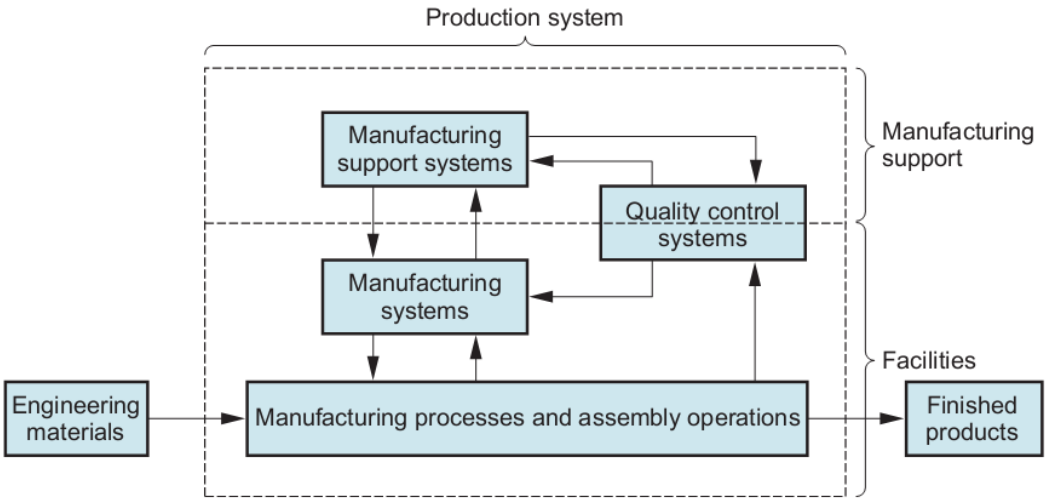

Fig. 2. Main production systems (Groover 2010)

Economically (Fig. 1 b), manufacturing is the transformation of materials into items of greater value by means of one or more processing and/or assembly operations (Groover 2010).

According diagram (Fig. 2) manufacturing system has input material engineering materials into production or assembly operations and delivered finished products. Production system includes facilities included production line, operation machines and assembly operations

1.5 Types of projects

The purpose of this practice is to specify the classification for every project in order to assist in describing the important characteristics of each project and to allow stakeholders to immediately associate the importance of each project to the business. (Hill 2010)

Other classification provided in table 2:

Table 2 Project classification (Parnell 2011)

Operational	**Innovation**	**Mandate**	**Customer**	**Strategic**
Work is conducted to fulfil operational needs or maintain internal operating capabilities.	Work is conducted to design or develop new products, services or technology for subsequent internal use or external sale.	Work is conducted to satisfy the requirements of an internal (business) or external (industry or government).	Work is conducted to provide product or service specified by internal/external customer.	Work is conducted to achieve a market position, or to achieve business expansion or other strategic objective.

A typical project classifications are:

Product projects. Projects that design, develop, and deliver a product as a result of the work effort. The customer for this project is typically an external stakeholder, who has contracted for a product to meet a specific need.

Service projects. Projects that plan, design, and deliver services to external customers. The customer has contracted for specific expertise that is not available in-house.

Continuous improvement projects. Projects are internal to the organization and result in process change. The customer is an internal manager, or group of managers, who wants to change the manner in which current operations occur (Charvat 2003).

The principles of project management can be applied to any type of project and to any industry. But main characteristisc varied on types and industries as provided in table 3.

Moylan wrote about two broad classifications of manufacturing projects: the engineer-to-order project, in which each new product requires a major project to introduce it, and the capital

project, which does not relate to new product development, but rather involves an improvement in manufacturing capability and capacity via a facility infrastructure implementation (Geng 2004).

Table 3 Classification of projects/characteristics (Charvat 2003)

	Type of Project/Industry				
	R&D	**Small Construction**	**Large Construction**	**Aerospace /Defense**	**Management Information Systems**
Need for interpersonal skills	Low	Low	High	High	High
Importance of organizational structure	Low	Low	Low	Low	High
Time management difficulties	Low	Low	High	High	High
Number of meetings	Excessive	Low	Excessise	Excessive	High
Project manager's supervisor	Middle management	Top management	Top management	Top management	Middle management
Project sponsor present	Yes	No	Yes	Yes	No
Conflict intensity	Low	Low	High	High	High
Cost control level	Low	Low	High	High	Low
Level of planning /scheduling	Milestones only	Milestones only	Detailed plan	Detailed plan	Milestones only

Project classification, when constructed with consideration for the business interests of the relevant organization, will be an aid in the following areas (Hill 2010):

- Selecting, prioritizing, and managing projects in portfolio management
- Aligning projects with business objectives
- Identifying business and technical risks that may be encountered

- Calculating levels of project work performed in different technical areas
- Providing general indications of duration, resource requirements, and complexity
- Identifying and assigning project managers with appropriate skill and experience
- Qualifying team members for participation in the project effort
- Selecting vendors and contractors for participation in the project effort.

The use of a project classification scheme will convey a significant amount of information about each project in just a few words. Project classification is normally conducted during project initiation but can be reviewed or updated at any time during the project. (Hill 2010)

1.6 Project management framework (project life cycle)

The project management consists of context and processes. Project management context defines the environment in which projects operate. The project management team must understand this broader context – managing the day-to-day activities of the project is necessary for success.

Project Management Framework:

- Introduction defines key terms and provides on over view of the rest of the document.
- Context, describes the environment in which projects operate. The project management team must understand this broader context managing the day-to-day activities of the project is necessary for success but not sufficient.
- Processes, describes a generalized view of how the various project management processes commonly interact.

Because projects are unique undertaking, they involve a degree of uncertainty. Organizations performing projects will divide each project into several project phases to provide better management control. The project phases are known as the project life cycles (table 4). There is similar to the life cycle of product or other system. During the past few years, there has been at least partial agreement about the life-cycle phases of a product. They include (Charvat 2003):

• Research and development
• Market introduction
• Growth
• Maturity
• Deterioration
• Death

Similarly a project's life cycle contains a series of major steps in the process of conceptualizing, designing, developing, and putting in operation the project's technical performance "deliverables" (Cleland and Ireland 2002). The need for a model of the project's life cycle arises to

facilitate the understanding of the project's complexity, duration, and its associated management functions. Project goes through a series of phases that separates the project tasks. Between each of these phases are decision points, which are used to determine when or if the next phase of the project should be carried out **(**Salvendy 2001).

Table 4. Project life cycle phases by authors and application area

Author	**Phases**	**Author**	**Phases**
PMBOK 1996	1. Initial 2. Intermediate 3. Final	Morris, 1981 (PMBOK)	1. Feasibility 2. Planning and design 3. Production 4. Turnover and start-up
PMBOK 2006	1. Starting the project 2. Organization and preparing 3. Carrying the project work 4. Closing the project	Kevin D. Creehan	1. Concept development and project definition 2. Project planning 3. Project execution or operation 4. Project delivery and termination
Cleland 2002	1. Conceptual 2. Planning 3. Execution 4. Termination	U.S Department of defence	1. Determination of mission needs 2. Concept exploration and definition 3. Determination and validation 4. Engineering and manufacturing development 5. Production and deployment 6. Operations and support

Generally the project life cycle will define, or help to define, the work that is required in each phase and the participants who should be involved.

Project life cycle's models vary by application field.

There is a routine protocol that should be followed to include identify the need, plan the project, collect relevant information, analyse the data, develop alternative ways to accomplish the project results, and present suitable recommendations (Cleland and Ireland 2002).

Table 5. Life-cycle phase by industries (Charvat 2003)

Engineering	**Manufacturing**	**Computer Programming**	**Construction**
Start-up Definition Main Termination	Formation Build-up Production Phase-out Final audit	Conceptual Planning Definition and design Implementation Conversion	Planning, data gathering and procedures Studies and basic engineering Detail engineering Construction Testing and commissioning

For non–project-driven industries, projects may be managed more informally than formally, especially if no immediate profit is involved (Charvat 2003).

1.7 Project management processes

A process (Fig. 3) is a set of interrelated actions and activities performed to achieve a pre-specified product, result, or service. Each process is characterized by its inputs, the tools and techniques that can be applied, and the resulting outputs. The project manager must consider organizational process assets and enterprise environmental factors. These must be taken into account for every process, even if they are not explicitly listed as inputs in the process specification. Organizational process assets provide guidelines and criteria for tailoring the organization's processes to the specific needs of the project. Enterprise environmental factors may constrain the project management options. (Project management institute 2008).

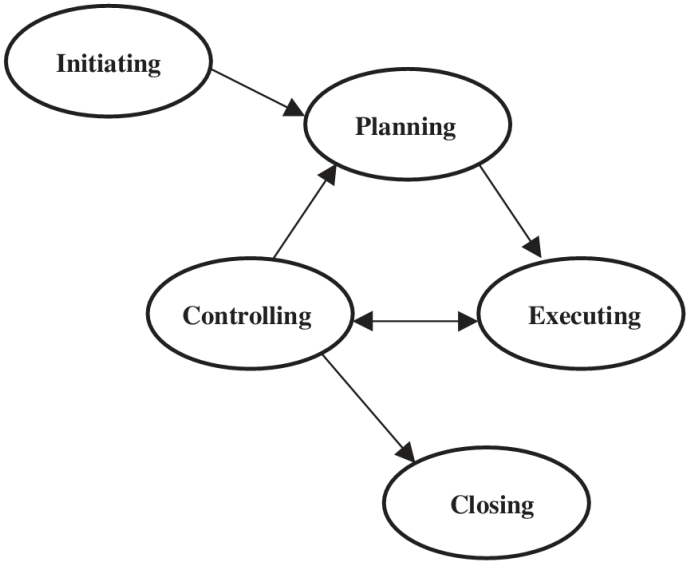

Fig. 3 Project management processes (Salvendy 2001)

Initiation is the process of formally recognizing that a new project exists or that an existing project should continue into next phase (Project management institute 1996). The initiating process incorporates development of the idea for the project and justification based on feasibility study. At this stage the boundaries of the project should be defined. Planning phase, a detailed project plan is laid out-—describing how and by whom, specific project tasks will be performed. Included in this plan are the project team members, preliminary studies and analyses, project targets, and a detailed schedule for the execution phase. Controlling phase consists of the daily management and operations of the project, monitoring the performance, updating the project plan, and examining potential areas of improvement.

The executing process requires the project management team to perform a myriad of actions to put the project management plan into action. In closing phase, the project deliverables are transferred as specified in the project plan, the project is terminated, the project team is disbanded, rewarded, and reassigned, and any post implementation review processes, including the recording of lessons-learned, are performed (Geng 2004).

1.8 The project management knowledge areas

The project management knowledge areas provide project management knowledge and practice in terms of its component processes. These processes have been organized into nine knowledge areas (Project management institute 2008):

Project Integration Management describes the processes required to ensure that the various elements of project are properly coordinated. It consists of project plan development, project plan execution, and overall change control.

Project Scope Management describes the processes required to ensure that the project includes all the work required, to complete the project successfully. It consists of initiation, scope planning, scope definition, scope verification, and scope change control.

Project Time Management describes the processes required to ensure timely completion of the project. It consists of activity definition, activity sequencing, activity duration estimating, schedule development, and schedule control.

Project Cost Management defines the processes required to ensure that the project is completed within the approved budget. It consists of resource planning, cost estimating, cost budgeting, and cost control.

Project Quality Management describes the processes required to ensure that the project will satisfy the needs for which it was undertaken. It consists of quality planning, quality assurance, and quality control.

Project Human Resource Management describes the processes required to make the most effective use of the people involved with the project. It consists of organizational planning, staff acquisition, and team development.

Project Communications Management describes the processes required to ensure timely and appropriate generation, collection, dissemination, storage, and ultimate disposition of project information. It consists of communications planning, information distribution, performance reporting, and administrative closure.

Project Risk Management describes the processes concerned with identifying, analysing, and responding to project risk. It consists of risk identification, risk quantification, risk response development, and risk response control.

Project Procurement Management describes the processes required to acquire goods and services from outside the performing organization. It consists of procurement planning, solicitation planning solicitation source selection, contract administration, and contract close-out.

Table 6. Sample Project Management Knowledge and Skill Areas (Cleland and Ireland 2002)

1.0 Primary knowledge and skill areas (samples)	**2.0 Supporting knowledge and skill areas (samples)**	
1.1 Scope management	2.1 Risk management	2.8 Customer relationship
1.2 Technical performance management	2.2 Communication management	2.9 Personnel conflicts
1.3 Schedule management	2.3 Contract administration	
1.4 Cost management	2.4 Negotiation	
1.5 Configuration management	2.5 Leadership	
1.6 Planning	2.6 Decision making	
1.7 Resource management	2.7 Marketing	

The similar list of project management knowledge areas are provided by Cleland and Ireland in table 6. Additionally, it provides skill sample as contract administration, negotiation leadership, customer relationship, personnel conflicts.

1.9 Organization structures in project management

To manage a project, a company or authority has to set up a project organization, which can supply the resources for the project and service it during its life cycle (Lester 2003).

Basic definitions of the types of structures in this study were similar to the types described in research by Larson and Gobeli (1989):

- Functional organization. The project is divided up and assigned to relevant functional areas with coordination being carried out by functional and upper levels of management.
- Functional matrix. A person is designated to oversee the project across different functional areas.
- Balanced matrix. A person is assigned to oversee the project and interacts on an equal basis with functional managers.
- Project matrix. A manager is assigned to oversee the project and is responsible for completion of the project.

- Project team. A manager is put in charge of a core group of personnel from several functional areas who are assigned to the project on a full-time basis.

For better image of the organizational structures are divided in to three types as shown in Fig. 4:

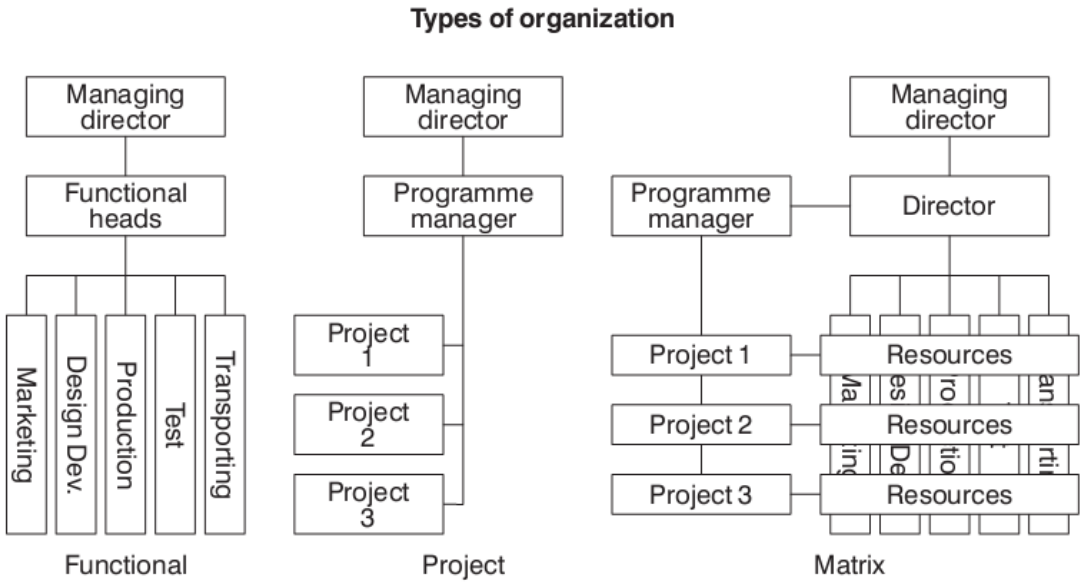

Fig. 4. Types of organization charts (Lester 2003)

Authors suggest matrix organization for an effective project management is the dominant mode for completing development projects.

The advantages of a matrix organization are:

1. Resources are employed efficiently, since staff can switch to different projects if held up on any one of them;
2. The expertize built up by the department is utilized and the latest state-of- the-art techniques are immediately incorporated;
3. Special facilities do not have to be provided and disrupting staff movements are avoided;
4. The career prospects of team members are left intact;
5. The organization can respond quickly to changes of scope;
6. The project manager does not have to concern himself with staff problems.

The disadvantages are:

1. There may be a conflict of priorities between different projects;
2. There may be split loyalties between the project manager and the departmental manager due to the dual reporting requirements;

3. Communications between team members can be affected if the locations of the departments are far apart;
4. Executive management may have to spend more time to ensure a fair balance of power between the project manager and the department manager.

All the above problems can, however, be resolved if there is a good working relationship between the project manager and the department heads. At times both sides may have to compromise in the interests of the organization as a whole.

Follow-on research by Larson and Gobeli (1989) leads them to conclude that different management structures can be applied at different phases of the project life cycle, and that there is no one best way to organize the project team except that the functional matrix and the functional organizational design for managing projects are less effective than a form that provides strong project leadership.

1.10 Stakeholder management

One of the major concerns coming forth in the management of projects is the recognition and "management" of project stakeholders. These stakeholders are project team members, higher-level managers, and outside organizational entities such as contractors, subcontractors, customers, regulators, financial institutions, and other claimants who have or believe they have vested rights in the project. Acceptance of the notion of project stakeholders means that the project has to be managed from an overall perspective of all of the stakeholders not just the customers and the organization. (Cleland and Ireland 2002)

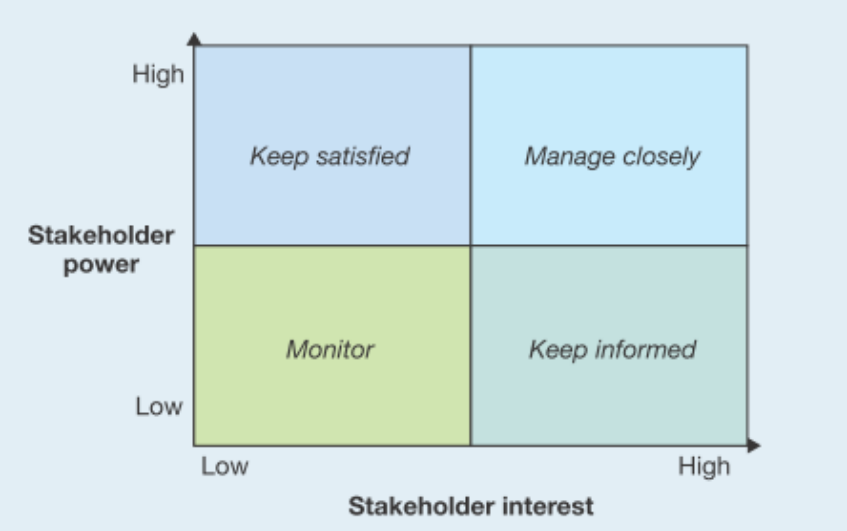

Fig. 5. The stakeholder power–interest grid (Chambers 2007)

The management of stakeholders on these projects involved five essential elements: (1) identification of stakeholders, (2) tiered approach to involvement, (3) active investigation to identify issues of concern or conflict, (4) resolution of concerns and conflicts to an acceptable solution, and (5) formal approval. (Cleland and Ireland 2002)

1.11 Project authority, responsibility, accountability

Accountability is the state of assuming liability for something of value, whether through a contract or because of one's position of responsibility. A professional is held accountable for excellence in the quality of the service rendered to the organization. Project managers have dual accountability: They are held answerable for their own performances and for the performance of people who comprise the project team. One of the basic characteristics of managers is that they are held accountable for the effectiveness and efficiency of the people who report to them (Cleland and Ireland 2002).

Responsibility, a corollary of authority, is a state, quality, or fact of being responsible. A responsible person is one who is legally and ethically answerable for the care or welfare of people and organizations. A person who is responsible is expected to act without specific guidance or being told to do so by a superior authority. To be responsible is to be able to make rational decisions on one's own, to be trusted to make such decisions, and to be held liable for one's decisions (Cleland and Ireland 2002).

Authority, responsibility, and accountability can rest with a single person or with a group of people. An example of pluralism in this sense is found in the use of a plural executive at the top-management level of organizations such as a management council or the board of directors. The

plural executive serves as an integrator of top-management decision making and implementation. The increasing complexity and size of many large organizations have created managerial responsibilities beyond the capabilities of one individual. The plural executive that has been created by organizations usually acts in an advisory capacity to the chief executive by providing stewardship for the strategic management of the company. The specific authority of such plural executives depends on the character establishing such a body. Authority, responsibility, and accountability within the matrix context are the cohesive forces that hold the organization together and make possible the attainment of the organization's cost, schedule, and technical performance objectives (Charvant 2003).

1.12 Project leadership and motivation

Hauschildt, Keim, and Medcof, in a study of 257 successful and 191 unsuccessful projects, found that project success is much more dependent on the human factor (project leadership, top-management support) than upon project management (Keim 2000).

Leadership is a part of management, but not all of it. A manager is required to plan and organize, for example, but all we ask of the leader is that he gets others to follow. Leadership is the ability to persuade others to seek defined objectives enthusiastically. It is the human factor, which binds a group together and motivates it toward goals. Management activities such as planning, organizing, and decision making are dormant cocoons until the leader triggers the power of motivation in people and guides them toward goals (Cleland and Ireland 2002).

People need to know they and their work are valued. Treating people fairly and showing concern for their loved ones are important. Often the greatest motivator a person has for working is his or her family (Bull 2010).

1.13 Project operations

It is reported that the front end planning process is often carried out poorly (Khurana and Rosenthal 1997), when in fact the strategic direction of the firm should be determined before individual projects are evaluated for a project portfolio**.**

Studies have identified planning as one of the critical success factors in a project (Pinto and Slevin, 1989; Meredith and Mantel, 1995; Johnson et al., 2001, etc.). Thus, high-quality planning increases the chances that the project will be properly executed and completed. Responsibility for planning lies with the project manager, who must ensure that it is carried out properly, and to the complete satisfaction of all relevant stakeholders.

The planning process serves as a simulation of the project in the planners minds before significant resources are expended. Thus false starts are avoided and problems are identified and resolved when solutions are the easiest (Zwikael and Globerson 2006).

Fig. 6. Project processes and operations according Cleland and Ireland (Cleland and Ireland 2002)

There are four basic reasons for project planning (Charvat 2003):

- To eliminate or reduce uncertainty
- To improve efficiency of the operation
- To obtain a better understanding of the objectives
- To provide a basis for monitoring and controlling work

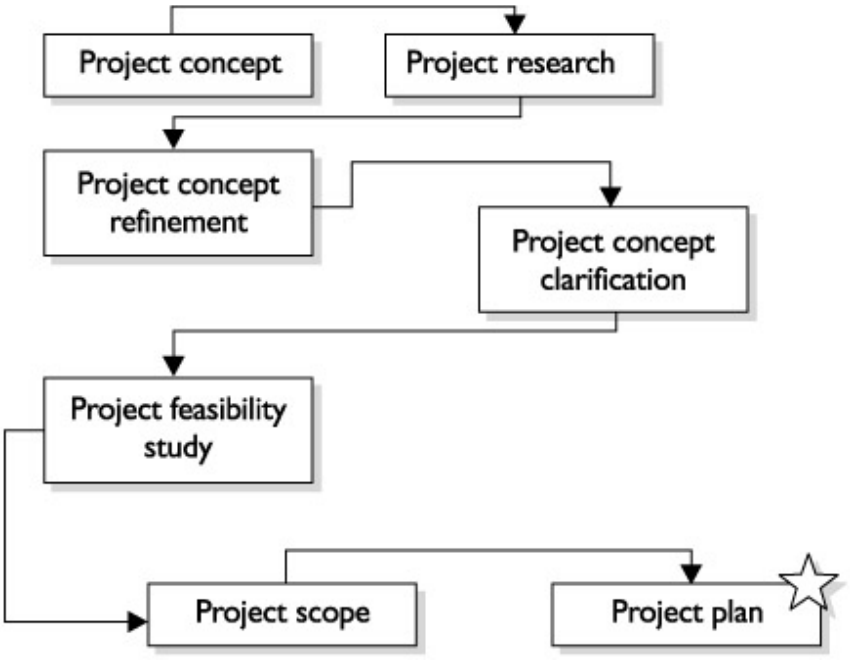

Fig. 7. Progressive elaboration is the refinement of project concept to project plan (Charvat 2003)

Planning starts with the development of a vision—the ability to see something that is invisible to others. Planning involves thinking through the possibilities and the probabilities of the future, and then developing a strategy for how the organizational resources will be positioned to take advantage of future competitive conditions.

Insufficient front-end planning, unrealistic project plans, failing to estimate the degree of complexity, and lack of consideration for the project's objectives will lead to reduced accomplishment of project objectives.

Project planning elements are defined by researchers (Cleland and Ireland 2002).

Project mission/purpose: The central reason for the project, such as creating a product, service, or organizational process change.

Project objectives: The desired future position of the project in terms of cost, schedule, and technical performance.

Project goals: Milestones leading to the completion of the project's "work packages."

Project strategy: A plan of action with accompanying policies providing general direction of how resources will be used to accomplish project goals and objectives.

Organizational structure: The project-driven, matrix organizational structure, functions, and processes.

Project team roles: Identification, negotiation, and resolution of individual and collective authority, responsibility, and accountability.

Style: Project manager and project team member manner, knowledge, skills, and attitudes.

Systems: Combination of management and organizational functions forming an integrated entity to support project activities.

Project resources: Quality and quantity of human and nonhuman resources to support the project.

Literature suggests simple and sophisticated project planning tools to help determine activities, provide time and resource assumptions and other data.

A Gantt chart is a horizontal bar chart developed as a production control tool in 1917 by Henry L. Gantt, an American engineer and social scientist. Frequently used in project management, a Gantt chart provides a graphical illustration of a schedule that helps to plan, coordinate, and track specific activities in a project. These charts might be as simple as a hand-drawn image on graph paper, or as complex as purpose-built computer software.

The advantages of the Gantt chart are

- time is explicit (and linear)
- all tasks visible in relationship to others
- deadlines are shown
- project status at intermediate times is shown
- can show progress by “filling in” task boxes

The unmodified Gantt chart has the following shortcomings:

- tasks might not be associated with people (solution: tag tasks with the initials of the people responsible)
- person-hours are not indicated, only calendar time (solution: note person-hours near the task “box”)
- dependencies are not explicit (solution: imply dependencies by ordering tasks, or use extra lines and arrows)
- no summary of the load on a person (solution: create an additional set of horizontal “task” lines for each person, showing what tasks they are working on when)
- other resources not shown (e.g., financial) (solution: note resources in description or near task “box”)
- critical paths are not explicit (solution: use highlighting or other graphical means to indicate the sequence of tasks along the critical path)
- does not record difference between original plan and actual (solution: enhance
- the task “box” to show two different durations—an upper (actual) and lower (estimated))

The work elements of the hierarchical levels of the work breakdown structure are called work packages. They are used to identify and control work flows in the organization, and they have the following characteristics (Cleland and Ireland 2002):

- A work package represents a discrete unit of work at the appropriate level of the organization where work is assigned.
- Each work package is clearly distinguished from all other work packages.
- The primary responsibility of completing the work package on schedule and within budget can always be assigned to an organizational unit, and never to more than one unit.
- A work package can be integrated with other work packages at the same level of the work breakdown structure to support the work packages at a higher level of the hierarchy.

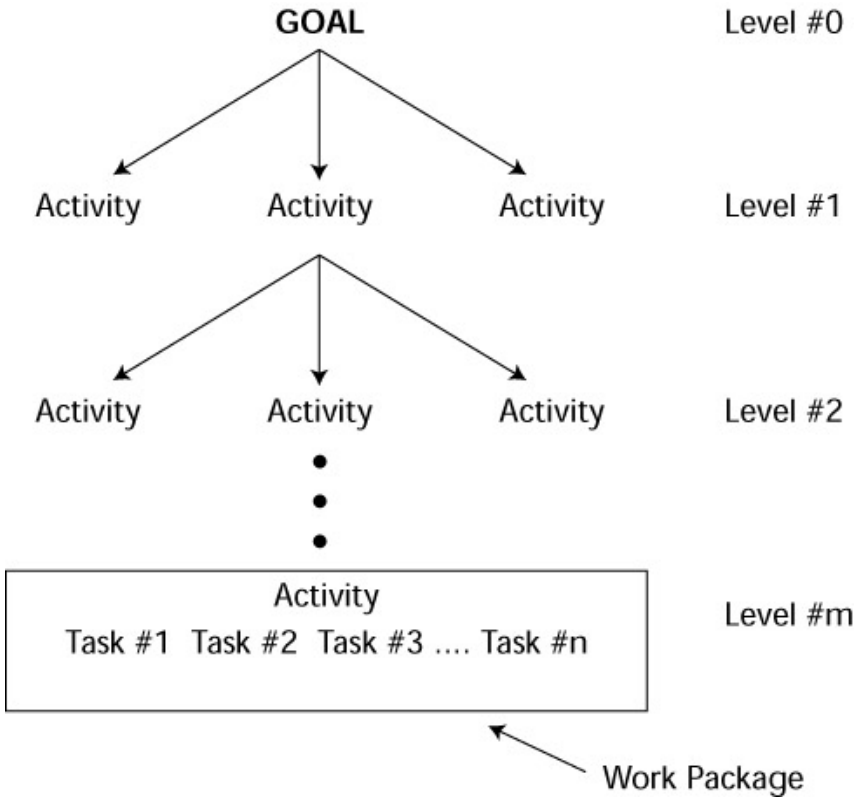

Fig. 8. Hierarchical visualization of the Work Breakdown Structure (Charvat 2003)

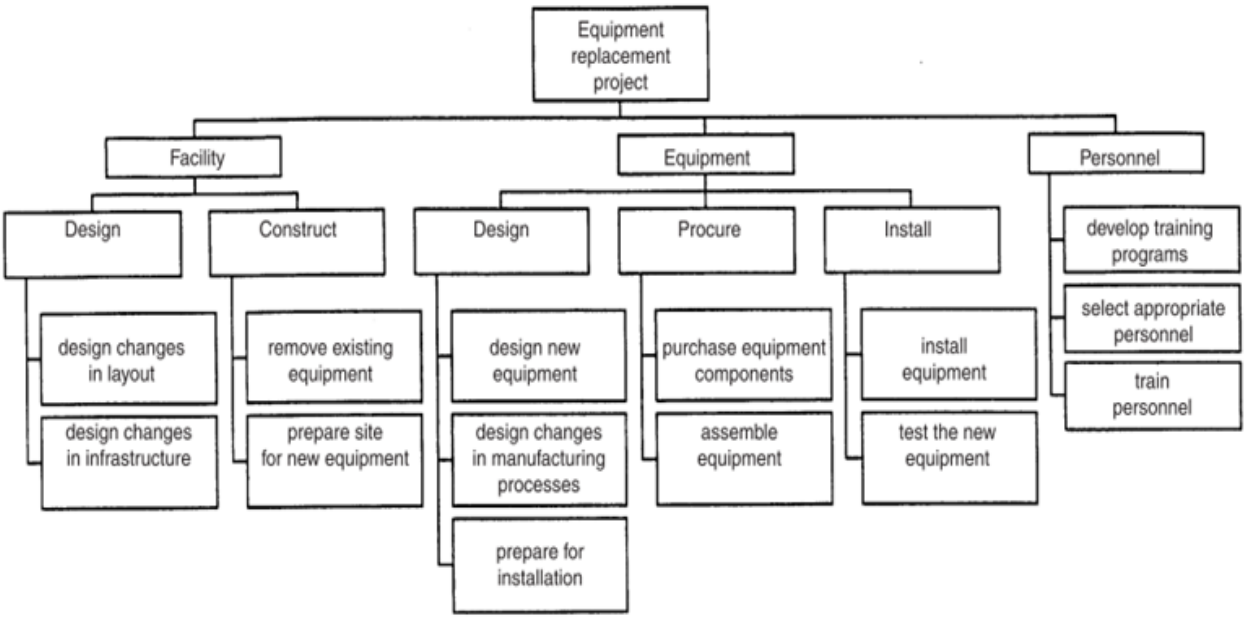

Fig. 9 WBS for an Project (Salvendy 2001)

A Work Package is a generic term describing a unit of work at the lowest developed level of the relevant part of the Work Breakdown Structure (WBS) (Fig.s 8 and 9). The distinction is

made between the lowest developed level and the lowest possible level, because at any given time not all work packages will be classified at the same level. In other words, a work package is not a distinct level in the WBS (Salvendy 2001).

1.14 Risk management

The risk management processes include identifying the risk or hazard, assessing or analysing all risks and/or hazards, making risk response decisions, implementing controls to mitigate the risk, and supervising or overseeing the implementation of the responses or corrective actions. Unlike crisis management, good project risk management often goes unnoticed, because well-run projects appear to be almost effortless, but, in reality, a lot of work has gone into running the project well. Hence, project managers should strive to make their jobs look easy; thus, reflecting the results of well-run projects (Cleland and Ireland 2002).

Such a matrix (table 10) could be used for each risk worthy of further assessment, and to assess, for example, all major risks to a project or programme.

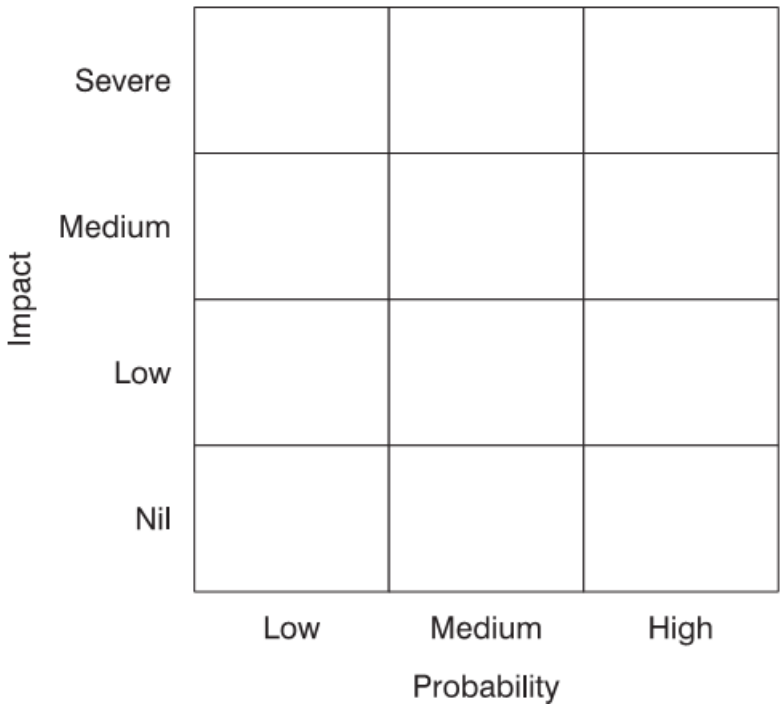

Fig. 10. Probability versus impact matrix (Lester 2003).

Risks may be managed through a risk management plan. Establishment of such a plan entails identifying the risks, determining the potential impacts, defining preventive actions, estimating the costs (both monetary and nonmonetary) required to reduce the risks to acceptable

levels, developing contingency plans, and obtaining management's commitment to the risk management plan.

Risk management is valuable in that it minimizes the unfavourable impact of unplanned incidents on a project. It enhances the probability of successful project implementation, creates a sense of urgency when unplanned incidents occur, and facilitates their timely and effective resolution. Risk management typically involves assessing a number of dimensions of each identified risk (Cleland and Ireland).

1.15 Project templates

Templates—also referred to as artifacts or boilerplate templates—are essential to the success of any project. Templates are seldom found bundled together nicely in a box, ready for use. Project or development managers do not want to spend the time to create new project templates for their projects. Instead, they benefit greatly from using a wide variety of tried and tested methodology templates, which gives them time to concentrate on the actual project. (Charvat 2003)

Table 7 Advantages and disadvantages of project templates (Charvat 2003)

Advantages	Disadvantages
Reusable— no need to start from scratch	Needs custom tailoring
Saves time	May contain difficult style and ineffective format
Pick and mix	
Ease of use— simply edit, copy, and paste	
Format already exists	

Methodology templates support the user in creating and maintaining project data/information in a formalized and structured manner. Templates also focus on guiding users to specifically define key deliverables, addressing issues such as quality, scope, resources, risk, and cost. These templates help project team members gain a better understanding of the project and its associated tasks (Charvat 2003).

1.16 Project benchmarking

A benchmarking project, which seeks to learn something about competitors and the "best in the industry" performers, will probably raise issues relating to the local culture. A reengineering project which results in downsizing, restructuring, and realignment of the way in which organizational processes are managed will impact the local culture, perhaps in adverse ways as people are reassigned, lose their jobs, or have to learn new duties in managing the organizational processes. (Cleland and Ireland 2002)

Gideon (2001) provide main types of benchmarking:

1. Internal benchmarking: a comparison of internal operations.
2. Competitive benchmarking: specific competitor – to – competitor comparison for the product of interest.
3. Functional benchmarking: comparisons of similar functions within the same broad industry or industry leaders.
4. Generic benchmarking: comparison of business functions or processes regardless of industry.

Also proposed benchmarking procedures includes the following steps:

1. Systematize benchmarking goals.
2. Identify relevant objects to be benchmarked.
3. Assess the applicability of the current benchmarking procedure.
4. Find typical illustrative examples for benchmarking.
5. Identify potential problems and further research opportunities.

Benchmarking is efficient and frequently used in the project management environment. The planning team visited a number of notable enterprises, and then shared findings with other teams (Zwikael and Globerson 2006). Improve their projects by working cooperatively and benchmarking; instead of compete with one another (Asadullah 1999). Stork (Stork 1997) suggests focusing on effectiveness rather than efficiency when benchmarking for project purchasing.

1.17 Creativity tools in project management

Today many authors analyse applicability of individual or group creativity for problem solving or a new ideas generation. Most popular methods involve two main types of thinking for Solution finding process by use divergence and convergence (aappendix 4).

Brainstorming capitalizes on the idea that a panel of creative thinkers can create a pool of ideas that will include the nucleus of a solution. Brainstorming sessions generally take one or more of three forms: structured, unstructured (free form), or silent. The main difference between the first two forms involves the level of control by the facilitator, who may combine any of the three to meet problem needs.

A typical brainstorming session has six steps and lasts for about an hour. Care is needed in selecting the right mix of participants. Groups generally consist of 5–10 participants known for their creativity and initiative and represent a broad range of experience with the problem. A structured session may take the following form.

Brainwriting is a form of silent brainstorming that attempts to eliminate the influence of dominant individuals and vocal majorities. The two most popular variations are written forms of the structured and unstructured brainstorming techniques (Saunders et al. 2009).

- In structured brainwriting, ideas related to the given problem are written on a paper that is passed from member to member in much the same way as the My Turn object. New ideas may be added or built from others.
- Unstructured brainwriting does not follow a sequential path. Ideas are written on note cards and collected in a central location.

Affinity diagramming technique categorizes the ideas into groups that can then be rated or prioritized. This is also a silent process, with participants creating logical groups of ideas with natural affinity. Duplicates are first removed from the collection, and notes are stuck to a wall or large board so that all participants can see them. Without speaking, participants move notes into unnamed groups using logical associations until everyone is satisfied with the organization. This often results in notes being moved to different clusters many times until the groups reach equilibrium. The groups are then labeled with descriptive headers, and often form the basis of alternatives, with the header as the alternative name and the member ideas as attributes.

Delphi methods seek to minimize the biasing effects of dominant individuals, irrelevant or misleading information, and group pressure to conform. Delphi introduces three unique variations on the brainstorming concept (Parnell et al. 2011).

1. Anonymous response—where opinions are gathered through formal questionnaires.
2. Iteration and controlled feedback—processing information between rounds.
3. Statistical group response—with group opinion defined as an aggregate of individual opinions on the final round.

Groupware is increasingly popular for conducting brainstorming and other collaboration using networked computers. Applications such as GroupSystems mirror the brainstorming process and emphasize anonymity. Other groupware tools include e-mail, newsgroups and mailing lists, workflow systems, group calendars, server based shared documents, shared whiteboards, teleconferencing and video teleconferencing, chat systems, and multiplayer games (Parnell et al. 2011).

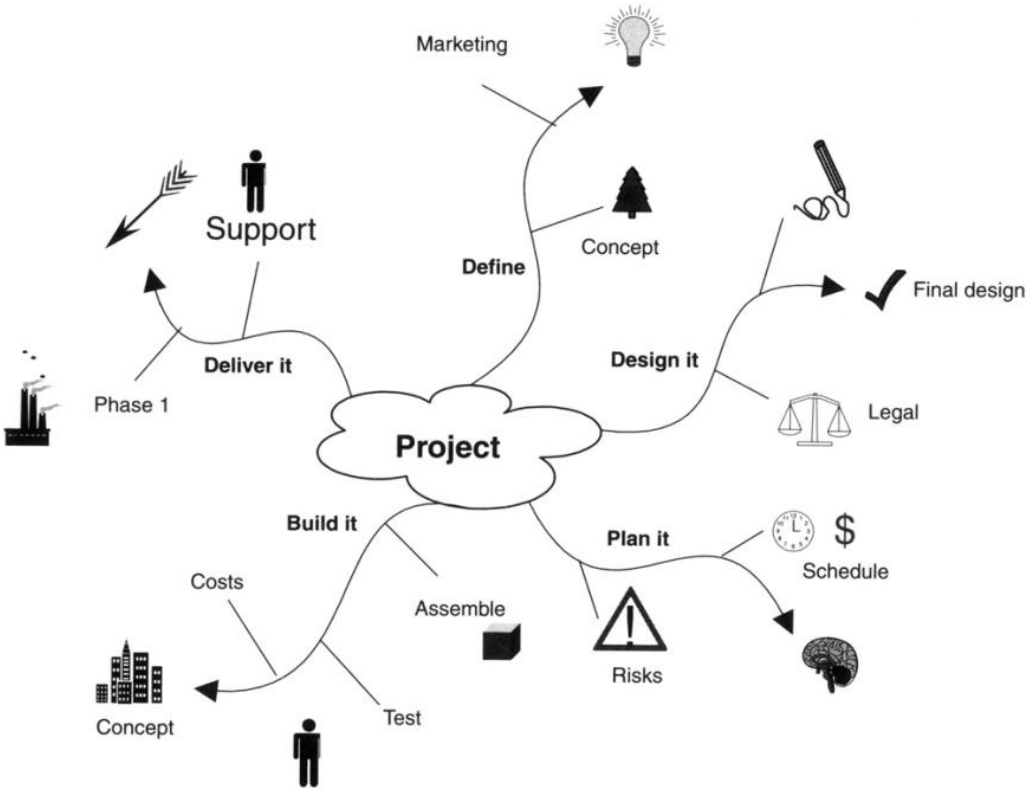

Fig. 11. Mind-mapping methodology (Charvat 2003)

For alternative generation approach is no clear line marking where idea generation ends and alternative screening begins. As seen earlier, this is built into many ideation techniques and the entire process normally cycles through several iterations. While the previous section focused on generating original ideas, practice shows that this represents only a fraction of the tactics used by organizations to uncover alternatives (Parnell et al. 2011).

1. The existing idea tactic draws on a store of fully developed, existing solutions and follows a solution-seeking-a-problem approach with subordinates on the lookout for ways to put their ideas and visions to use.
2. Benchmarking tactics draw alternatives from practices of others who are outside of the organization rather than inside, as with the original idea tactic. Nutt draws a distinction between benchmarking, which adapts a single practice used by another organization; and,
3. Integrated benchmarking uses a collection of ideas from several outsidesources.
4. Search tactics outsource the process through requests for proposals from vendors, consultants, and others who seem capable of helping.
5. Cyclical searches use an interactive approach, while simple searches use a one-time requests for proposals.

6. The design tactic calls for custom-made alternatives that stress innovation to achieve competitive advantage. These normally require more time and other resource commitment.

Mindmapping (Fig. 11) has been popularized by Joyce Wycoff and Tony Buzan. The technique is best described as a graphic dump of your brain. It is a nonsequential approach to recording your thoughts about things that must be done or considered in completing a certain task. (Charvat 2003)

Other useful thechniques as Lateral and Parallel Thinking and Six Thinking Hats, Morphology, Ends–Means Chains, Existing or New Options (Parnell et al. 2011) are popular in project and innovation related industries where new and unique sollutions is prefered.

2 RESEARCH OF THE PROJECT MANAGEMENT SITUATION

2.1 Current Industy situation analysis

The aim of empirical research (Fig. 12) is to provide more details about project management activities in Lithuania industry sector and prepare solutions to the existing problems and improvements to the existing management system.

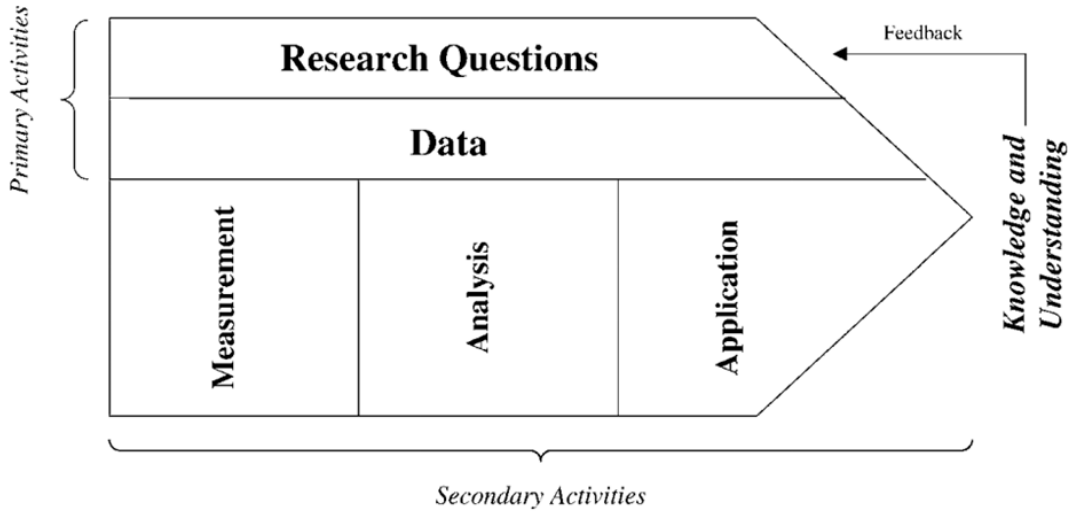

Fig. 12. A frame work for studying methodology issues in strategic management (Ketchen and Bergh 2005)

Goals of the empirical research:

- Selected industrial sector, according to the industry classification.
- To provide analysis of Lithuanian manufacturing industry situation in project management.
- To investigate the project management system in enterprises.
- To identify weakest points of project management system.

Methods used in the study:

1. Collection of statistical data (by using data sources from Lithuania Department of Statistics, of evaluating the main data about manufacturing industry).
2. Survey – a questionnaire for the enterprises.
3. Basic analysis of survey data.
4. Correlation and regression analysis.
5. Other complex statistical analysis.

Necessary information was found out by sending questionnaire which is prepared on general analysis of literature of project management.

The method used:

1. Determinate the scale of the research (Calculation of sample size).
2. E-mail interview.
3. Confidence interval calculation.

Provide an analysis of collected questionnaire results.

- Questionnaire results analysis (percentage, ratio evaluation, charts, diamond model etc.)
- Questionnaire results analysis using SPSS, computer program for statistical analysis.

2.2 Analysis of the population - manufacturing industry in Lithuania

Sampling techniques provide a range of methods that enable you to reduce the amount of data you need to collect by considering only data from a sub-group rather than all possible cases or elements. (2) Although, it is important to define and to analyse population of the research which is enterprises of manufacturing industry.

According statistical data (2012 01 26) provided in Lithuania Department of Statistics industry of Lithuania consists of total 128 972 companies. There are 12 233 enterprises that main economic activity is manufacturing. Also all economic activities are classified by Economy Classificatory (Appendix 1) in smaller industry fields.

Table 8. Industrial production, direction of realization, structure and indices

	Year	**2007**	**2008**	**2009**	**2010**
Industry except construction	**Index of industrial production as compared to 2005, %**	109	115	98,2	104,7
	Index of industrial production as compared to previous year, %	102,4	105,5	85,4	106,6
	Year	**2007**	**2008**	**2009**	**2010**
	Industrial production at constant prises, LTL thousand	44 567 458	47 023 653	40 170 280	42 817 311

Continuous table 8.

	Year	2007	2008	2009	2010
Production of total industry excluding refined petroleum products	**Index of industrial production as compared to 2005, %**	124,5	119	100,3	107,8
	Index of industrial production as compared to previous year, %	111,1	95,6	84,3	107,5
	Industrial production at constant prises, LTL thousand	37 290 928	35 632 618	30 041 101	32 289 996

Table 9. Manufacturing industry data except refined petroleum products

Year	2007	2008	2009	2010
Index of industrial production as compared to 2005, %	130,4	123,7	102,2	112,5
Index of industrial production as compared to previous year, %	113,2	94,9	82,7	110
Domestic turnover, %	46,9	45,6	44,3	40,3
Non-Domestic turnover, %	53,1	54,4	55,7	59,7
Industrial production at constant prises, LTL thousand	30 995 450	29 402 949	24 303 329	26 736 261

Research takes in account only a few industry fields according Economy Classificatory for specific analysis and better solution model implementation. The selection of industries was made by relevance to the research activities of Mechanical Faculty of Vilnius Gediminas technical university.

Research fields of Mechanical Faculty of Vilnius Gediminas technical university (http://www.me.vgtu.lt/en/research/research-fields/):

• Biosignal analysis and recognition;

• Research in rehabilitation and medical systems and their processes based on statistical and numerical methods;

• Modelling, design and technology selection for sandwich covers with different mechanical and chemical properties;

• Innovation management and development at industrial enterprises;

• Lean management system and innovation development;

• Development of creativity stimulation tools;

• Development of mechatronic systems, research and diagnostics of their tribological, metrological properties;

• Dynamic and metrological research and diagnostics of mechatronized systems;

• Investigation of advanced welding technologies, equipment and materials;

• Computational modelling of welding stress and strain;

• Creation of oxy-acetylene and arc sprayed coatings;

• Investigations of Process and Machine Dynamics;

• Investigation of the properties of the printing materials (paper, inks) ;

• Investigation of the micro and macrosystems using optical methods;

• Welding technologies;

• Modern materials;

• Dangerous welding design reliability, durability and ageing.

The comparison of enterprise economic activities with research fields mentioned above (table 3) provides selected manufacturing industries which consider as population (total number of selected companies) of empirical research in this project work.

Table 10. Selected industries for empirical research

Selected industries		
C22 Manufacture of rubber and plastic products	C25 Manufacture of fabricated metal products, except machinery and equipment	C28 Manufacture of machinery and equipment n.e.c.
C23 Manufacture of other non-metallic mineral products	C26 Manufacture of computer, electronic and optical products	C29 Manufacture of motor vehicles, trailers and semi-trailers
C24 Manufacture of basic metals	C27 Manufacture of electrical equipment	C30 Manufacture of other transport equipment

Relevance of research approve importance of selected industries (table 4) which consist of 2.34 % of total industry, employ 1.31 % of total workforce, but those industries generate 15.28 % of total production value. It shows that manufacturing sector is very important for Lithuania economy.

Chart (Fig. 13) reveals the changes of production value among industry of Lithuania. There is obvious that economy has experienced decline in 2008 – 2009, but significantly improve in 2010.

Table 11. Size of Lithuania industry and comparison to survey‘s population in 2010

	Number of enterprises	**%**	**Production value**	**%**	**Number of workers**	**%**
Total industry	128 972	100	42 817 311	100	1 094 866	100
Manufacturing, except refined petroleum industry	12 233	9,49	26 736 261	62,44	165 461	15,11
Selected manufacturing industry	3 023	2,34 (24,71) a	6 543 675	15,28 (24,47) a	14 374	1,31 (8,69) a

a - numbers are provided in bracket give percentage value of selected manufacturing industry to manufacturing industry.

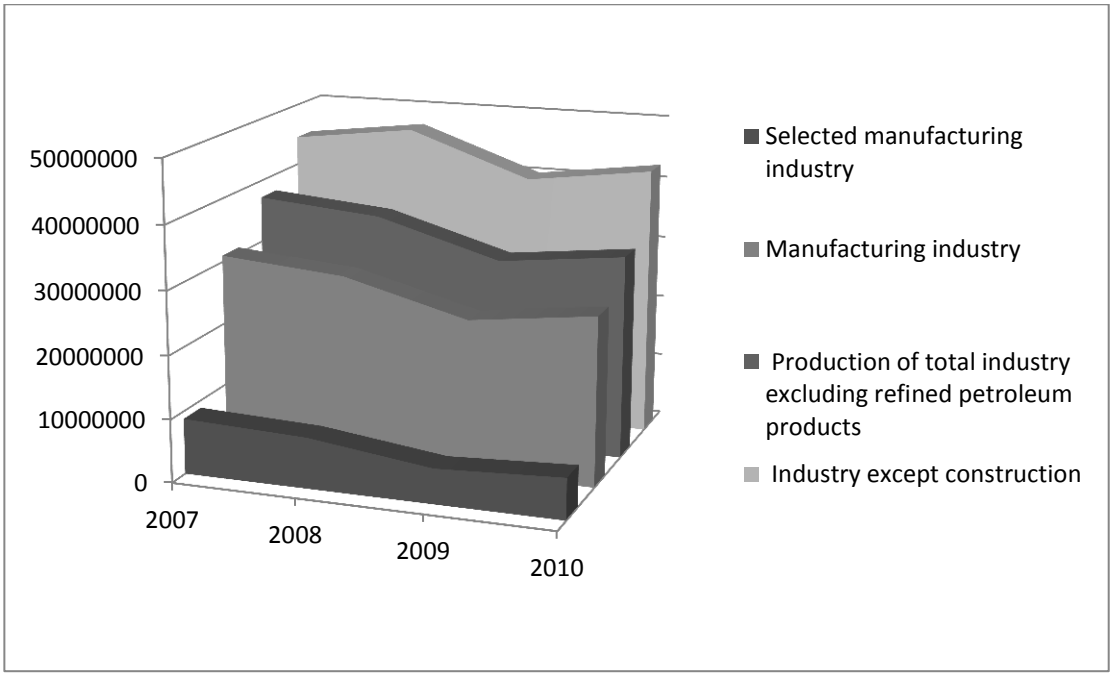

Fig. 13. Industrial production at constant prises, LTL thousand

However, looking at Fig. 14, it shows that domestic turnover of manufacturing industry has decreased during the period of 2007 – 2010. The phenomenon indicates an internal market

reduction, mainly related with contraction in construction and real estate industry. Although, external market for manufacturing industry improved in the period by achieving 59,7 % of non-domestic turnover. It concludes that manufacturing industry of Lithuania is changing from internal to global market orientation.

Also this process is impacted by other reasons as Lithuania is EU member, foreigner customers are looking for cheaper production etc.

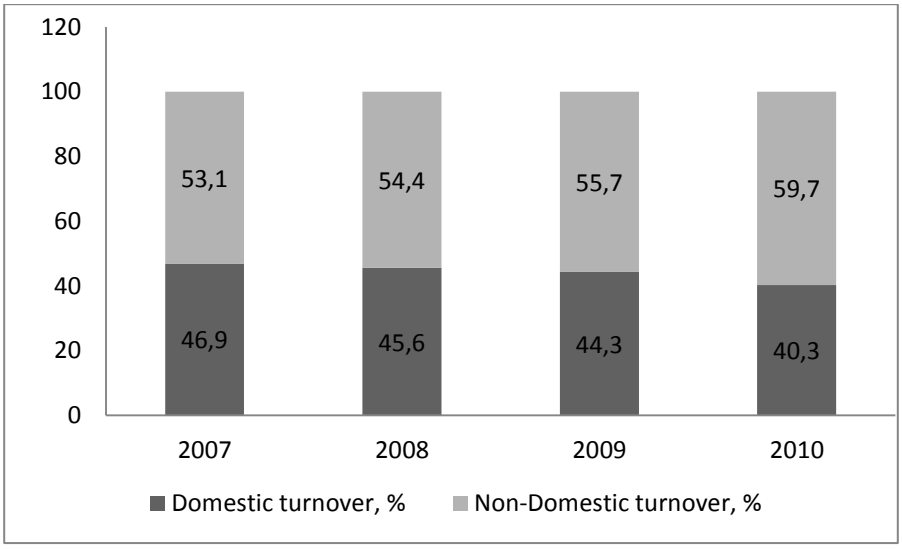

Fig. 14. Analysis of domestic and non-domestic turnover of manufacturing industry

Global market provides many related problems to the Lithuania business:

- Strong competition.
- Specific customer requirements.
- High quality and other standards.
- Rapid change of product and technology.
- Unstable demand.

To resolve obstacles mentioned above companies mainly have to concentrate on improvements in two directions:

- Improve relationship with customers and other partners.
- Install systems and technologies for productivity improvement.

Business confronts with change management activities that cope by projects.

2.3 Analysis of questionnaires results

Sample size and confidence interval calculation

Confident level is expressed as a percentage and represents how the true percentage of the population who pick an answer lies within the confidence interval. The confidence level means that survey is 95 % certain.

The full set of cases from which a sample is taken is called the population. *Population size* represents how many enterprises are in selected group research. Regarding Lithuania Department of Statistics it was 3023 industrial enterprises of selected sectors by Economic Classificatory C22 – C30 (table 3).

Confident interval is the plus or minus figure. It represents the amount of error that research data can tolerate.

The sample size of a statistical sample is the number of observations that constitute it. A greater amount of variance will be attributed to error in smaller sample sizes, reducing the chances of a significant finding.

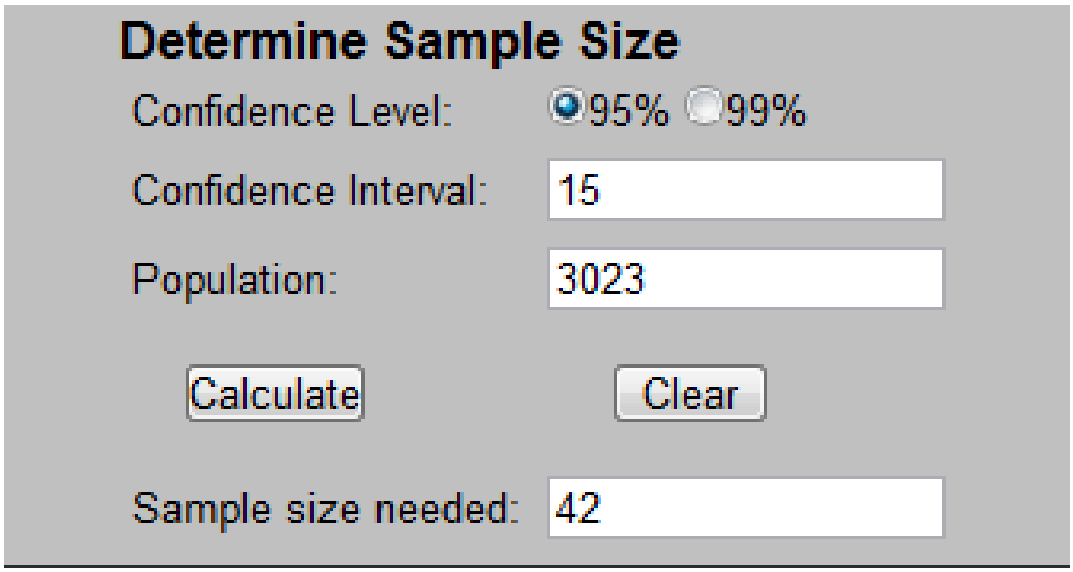

Fig. 15. Sample size calculation

Using Sample Size Calculator (Fig. 15) it was evaluated simple size was 42 respondents to willing get Confident Interval: c=15.

Analysis is made when data is collected during empirical research time. In order to show results were used charts tables data processing program SPSS (a computer program used for statistics analysis Statistical Package for Social Science).

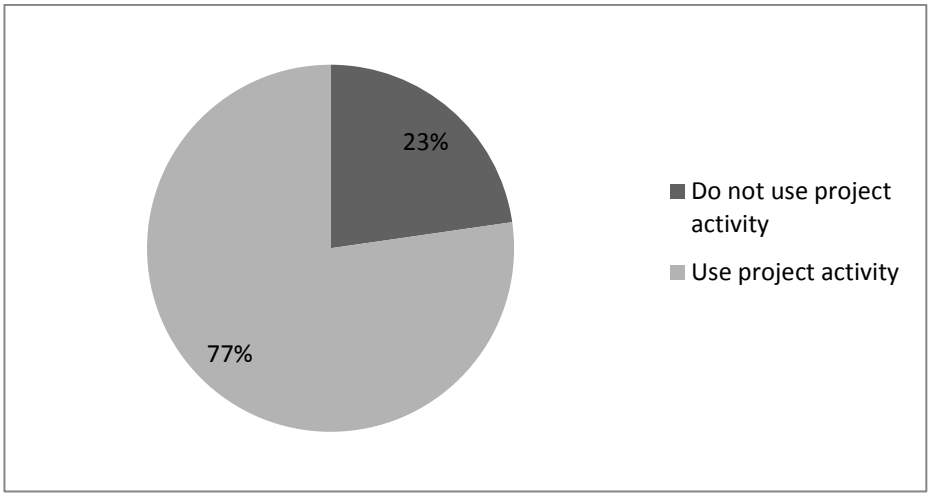

Fig. 16. Distribution of project activities among the poll enterprises

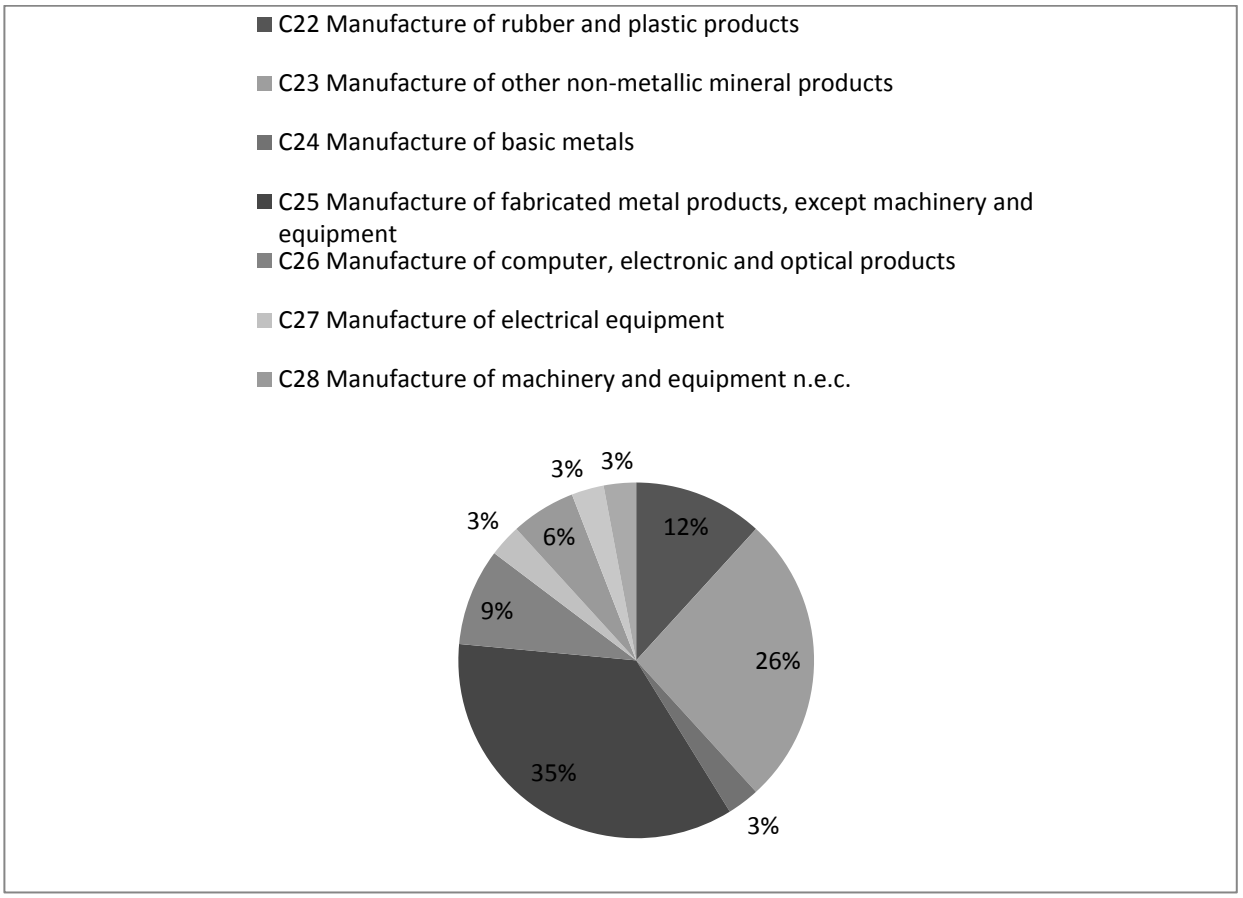

Fig. 17. Distribution of the poll companies (by economic activities) that answered questionnaire

Questionnaires were sending by email. Some of respondents were interviewed individually. There was send 323 e-mails by as to fulfil questionnaire, feedback was 44 respondents (enterprises) who answered survey questions, 34 respondents confirm that they use project as a tool for unique activities (Fig. 16).

Pie chart (Fig. 17) reveals percentage distribution of enterprise participated in survey. There is the biggest part 35 % take manufacture of fabricated metal products, except machinery and equipment, second place occupied manufacture of non-metallic mineral products 26 % and 12% manufacture of computer, electronic and optical products.

According questionnaire poll of Lithuania industry enterprises implement project on these relevant characteristics. Number of employees working in projects, project budget, time, success and other evaluation on project management practices in industrial enterprises are provided.

Projects mainly consist of 10 persons who are averagely working on it. Time mostly distributed in two groups less than year 57 % and more than year 43 %, but largest part of projects takes more than moth (81%).

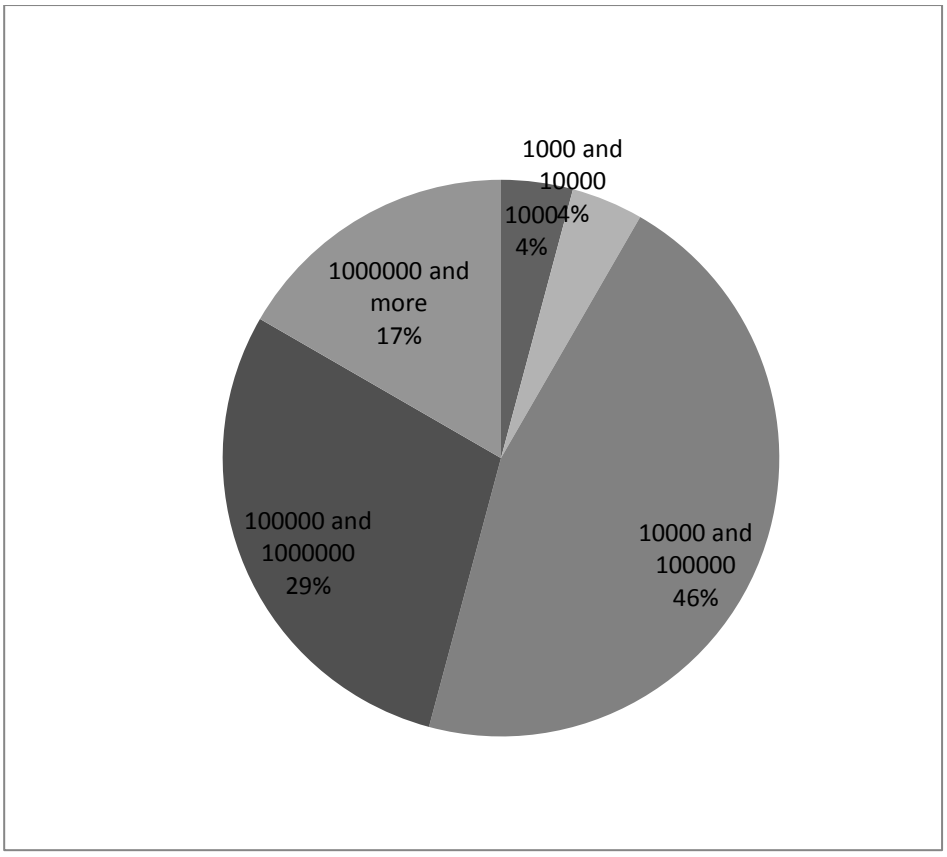

Fig. 18. Projects distribution according its time

Budgets for individual project are divided in two groups less than 100 000 LTL 54 % and more than 100 000 LTL 46 %.

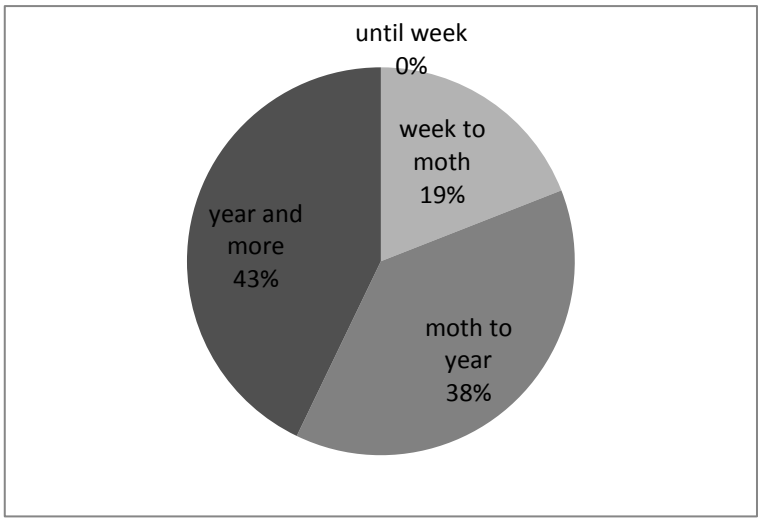

Fig. 19. Project budget size distribution

Diamond diagrams reveals comparison on average and standard deviation values of same group factors related to projects:

- The project purpose;
- Finance capital;
- Cooperation;
- Project completeness;
- Other factors affecting project management.

Questionnaire provides quantitative data that define many aspects on project characteristics according its evaluation average among industrial enterprises. Evaluation process was obtain by enterprises project managers whose assess enterprise or project parameters from 1-low value (importance) to 5 high value (importance).

First Fig. 20 shows most important projects are related with quality improvement (4.68), it conclude that companies are interesting for implementation of a new quality assurance and defect avoidance tools in their production and organisation systems. In this case to improve quality among the organization by organizing projects for adoption of ISO 9000 quality management standard, Lean methods and tools (5 why, poka-yoke, fish bone and others), six sigma statistical measurement tools then cost reduction and sales improvement. On the other side product development gathers lowest average value (4.12). Standard deviation collected highest value (1.25) on product development. It judges that various enterprises have different importance on product development projects. Here are more innovative companies that produce individual products according client specifications. However, others produce series and make changes rarely. All an averages values are above 4, it means that purposes have significant importance for Lithuania manufacturing industry.

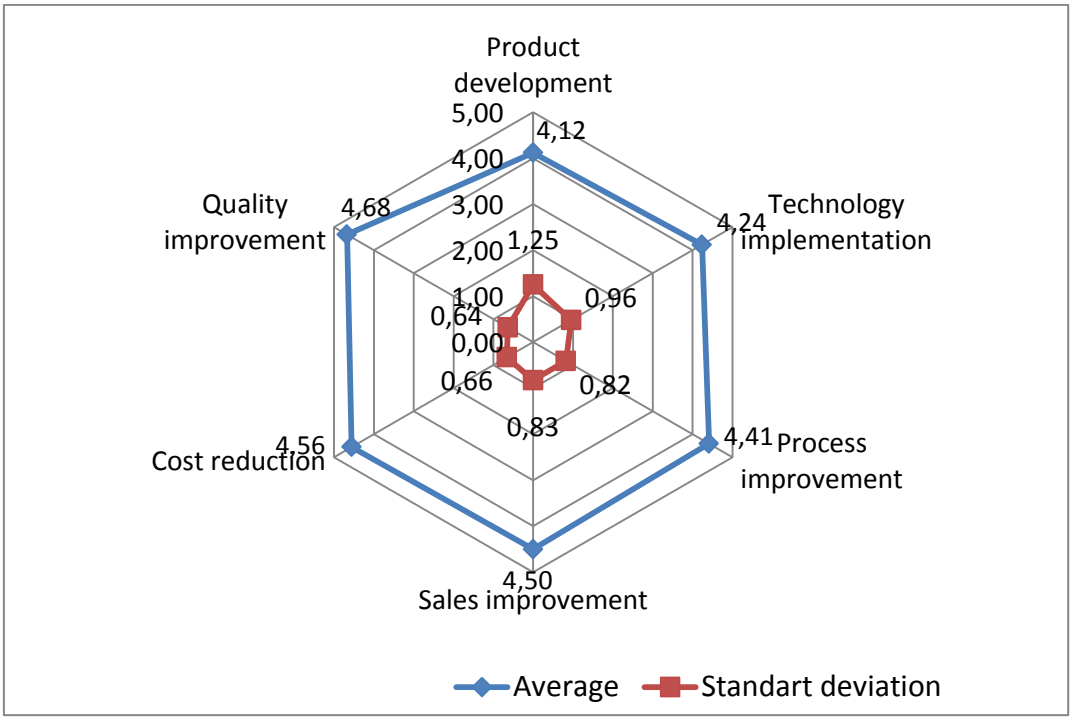

Fig. 20. Means of project purposes importance evaluation

- Product development when enterprise occupies main resources in projects to improve or create product for customer.
- Technology implementation when enterprise seeks to adopt new technologies for example ERP (enterprise resource planning) software or new production machine.
- Process improvement when enterprise prioritizes on effective philosophy as the Lean manufacturing.
- Sales improvement projects imply more marketing direction for the company's projects activities when it is vital to increase turnover by obtaining customers.
- Cost reduction when enterprise seeks to define accurately its production cost and provide means where it is possibility to reduce it.
- Quality improvement projects are to improve product or process quality and reduce material waste, additional product service time and so forth.
- Own capital it is internal resources, companies profit or turnover capital
- Investment capital money from outside or inside investors, for example introducing new shares into the market.
- Borrowed capital defined as capital obtained usually from bank loans or releasing obligations.

- Public support capital there is various funds for enterprise innovation and support for special improvement.

Financial purpose (Fig. 21) gives information on what source of capital is most important. According evaluation (4.71) own capital is main source for projects; some companies also take loans and use public support (3.13). Investment has lowest value (1.88).

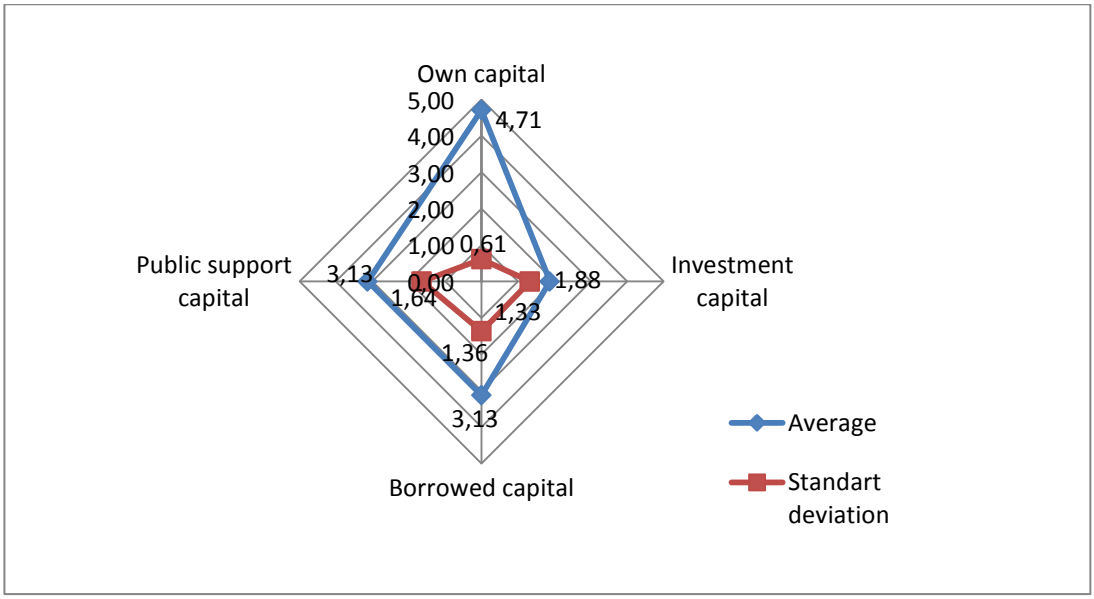

Fig. 21. Means and standard deviation of capital importance in projects evaluation

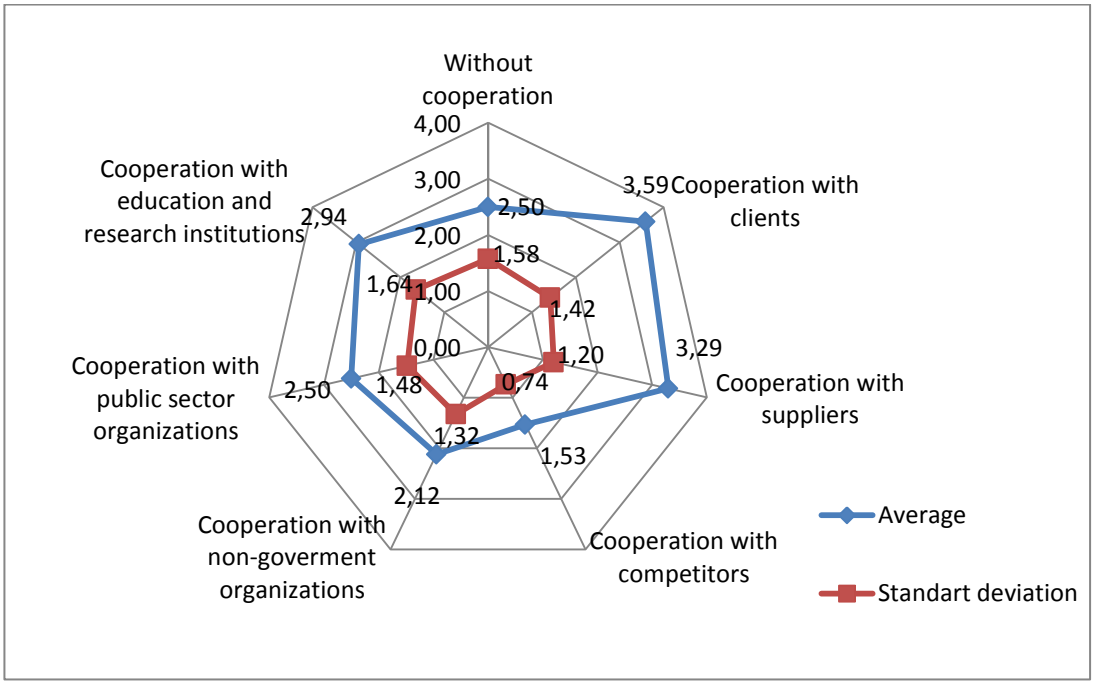

Fig. 22. Means and standard deviation of evaluation on cooperation frequency in projects

Cooperation is a form of partnership or co-working in the same project for the similar reasons and expectation. Industrial organization have to seek improve it. Cooperation with other

organization is very important in theory, but chart (Fig. 22) discovers average importance on partnership among organizations in Lithuania. Enterprises more cooperate with customers (3.59) and suppliers (3.29). Lowest results are shown partnership competitors and non-government organizations.

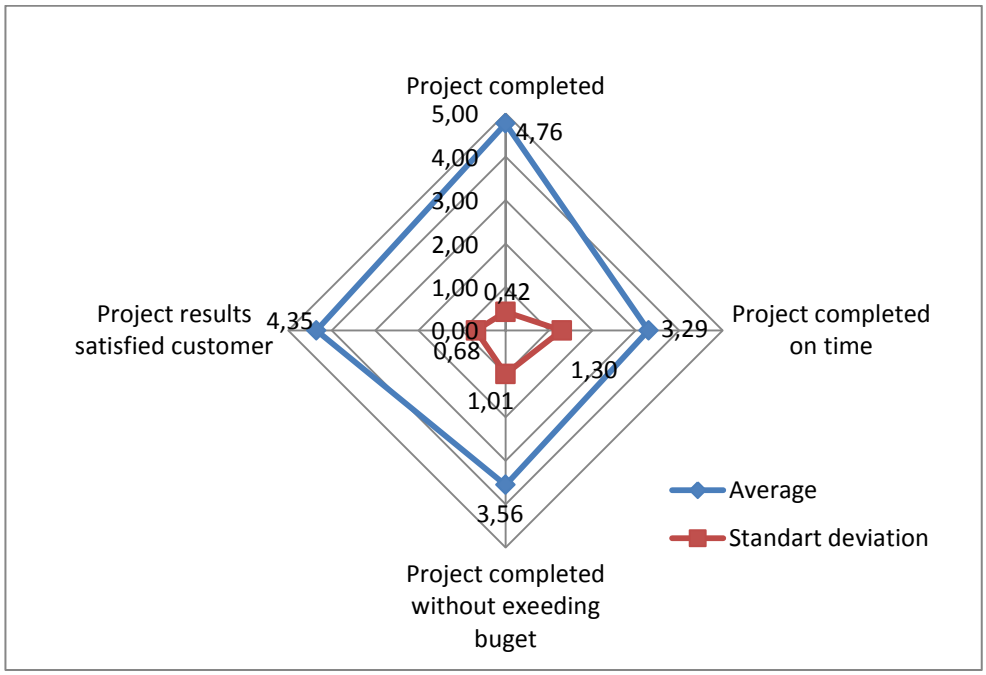

Fig. 23. Means and standard deviation of evaluation on project completeness

Successful project finishing is vital for business.

- Project completeness:
- By scope
- By time limit
- By budget limit
- By customer expectations

Manufacturing companies usually experience problems (Fig. 23) with project delays (3.29) and exceeding budgets (3.56) as all other companies across the world. Standard deviation shows higher fluctuation of these two problems.

Factors are affecting project management within the company (Fig. 24). The management attitude to projects and technical-managerial education collected the highest average value (4.35). Second place was occupied by an employee ability to innovate (4.06) and company profitability (4.03). The workplace criteria (3.44) have the lowest impact on project management.

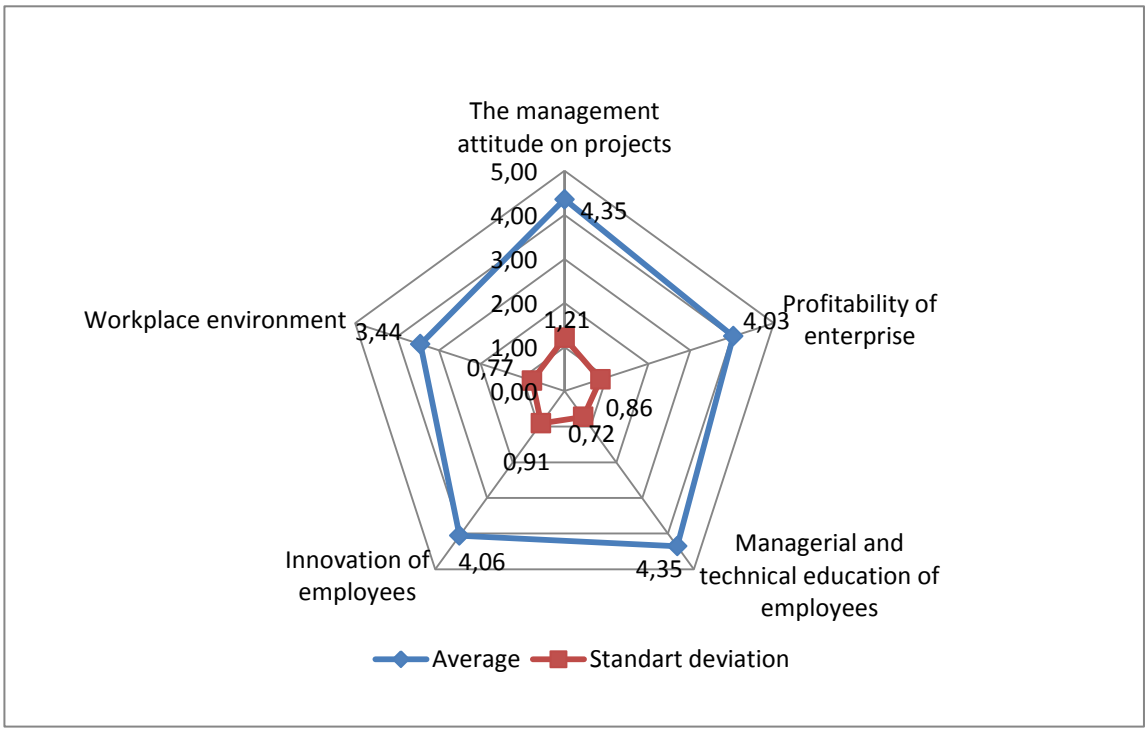

Fig. 24. Means and standard deviation of evaluation on influencing factors of project management

Table 12.The main problems occurred in project activities

Position	Problem	Frequency, %
1	Incorrect planning and decision making	23,53
2	Problems with suppliers and clients	20,59
3	Lack of recourse allocation	11,76
4	Weak motivation system	11,76
5	Shortage of skilful workforce	11,76
6	Lack of primary information	5,88
7	Unexpected events/ External factors	5,88

Other part of the questionnaire is collected data on project related problems that usually arise in implementation time and after. Respondents provided main problems (table 4) related to project activities that were grouped in 7 types. Most of respondents mention lack of good planning and decision making. The literature also reveals this problem very often and provides a many solutions for better project planning and management.

Problems with suppliers and customers identify that business cooperate more with them (Fig. 9). Moreover, it shows lack of supply chain integration in Lithuania industry.

2.4 Theory of correlation-regresion analysis

Regression analysis is a statistical tool for the investigation of relationships. Regression analysis involves identifying the relationship between a dependent variable and one or more independent variables. A model of the relationship is hypothesized, and estimates of the parameter values are used to develop an estimated regression equation. Various tests are then employed to determine if the model is satisfactory. If the model is deemed satisfactory, the estimated regression equation can be used to predict the value of the dependent variable given values for the independent variables.

In simple linear regression, the model used to describe the relationship between a single dependent variable y and a single independent variable x is $y = a_0 + a_1x + k$. $a_0$and a_1 are referred to as the model parameters, and is a probabilistic error term that accounts for the variability in y that cannot be explained by the linear relationship with x. If the error term were not present, the model would be deterministic; in that case, knowledge of the value of x would be sufficient to determine the value of y.

Correlation and regression analysis are related in the sense that both deal with relationships among variables. The correlation coefficient is a measure of linear association between two variables. Values of the correlation coefficient are always between -1 and +1. A correlation coefficient of +1 indicates that two variables are perfectly related in a positive linear sense, a correlation coefficient of -1 indicates that two variables are perfectly related in a negative linear sense, and a correlation coefficient of 0 indicates that there is no linear relationship between the two variables.

The coefficient of determination, denoted by r^2, is given by

$$r^2 = \left(\frac{1}{N}\right) \cdot \sum \left(\frac{(x_i - \bar{x}) \cdot (y_i - \bar{y})}{\sigma_x \cdot \sigma_y}\right)^2 \qquad (1)$$

where N is the number of observations used to fit the model, Σ is the summation symbol, xi is the x value for observation i, ẋ is the mean x value, y_i is the y value for observation i, ẏ is the mean y value, σ_x is the standard deviation of x, and σ_y is the standard deviation of y.

The coefficient of determination (R^2) measures the proportion of changes of the dependent variable y that are explained by the independent variable x. It is the square of the correlation coefficient r and for that reason; it is always positive and ranges between zero and one. When the coefficient of determination is zero, the variations of y are not explained by the variations of x. When r^2 equals one, the changes in y are explained fully by the changes in x. Any other value of R^2

must be interpreted according to how close it is to zero or one. According theory of regression the coefficient of determination $R^2 > 0.25$ then regression model is accepted (Saunders et al. 2009).

It is interpreted as the proportion of observed y variation that can be explained by the simple linear regression model (attributed to an approximate linear relationship between y and x).

The t-test and F-test are used to work out the probability of the relationship represented by your regression analysis having occurred by chance. In simple linear regression (with one independent and one dependent variable), the t-test and F-test will give you the same answer. However, in multiple regressions, the t-test is used to find out the probability of the relationship between each of the individual independent variables and the dependent variable occurring by chance. In contrast, the F-test is used to find out the overall probability of the relationship between the dependent variable and all the independent variables occurring by chance. The t distribution table and the F distribution table are used to determine whether a t-test or an F-test is significant by comparing the results with the t distribution and F distribution respectively, given the degrees of freedom and the predefined significance level (Saunders et al. 2009).

2.5 Practical correlation regression analysis of industrial enterprises

Practical regression analysis findings show that industrial enterprises profitability rate which was defined as evaluation in 5 point system from very low to very high. Project success rate that reveals enterprise ability to provide activity results by evaluation of project success factors: project implemented, project finished on time, project implemented without exceeding budget and project results satisfy client requirements. Regression equation and chart (Fig. 25) shows high relationship between profitability and project success rates. It concludes that successful projects implementation has vital impact to company's profitability. In general many industrial enterprises act order-in environment in this aspect company organize individual customer order as a project. In other cases, like internal improvement, production technology improvement or organizational changes, enterprises have to adapt to changing environment conditions and implement new technologies, reduce cost, improve quality and etc. Each aspect promotes importance of project success impact to the enterprise profitability. The parameters of regression model is accepted $R^2 = 0.3118$ and coficient a = 0.7521. Model confirms that projects is very improtant for enterprises existance and by this regression it is possible evaluate project‘s suceess and it impact for the enterprises profitability.

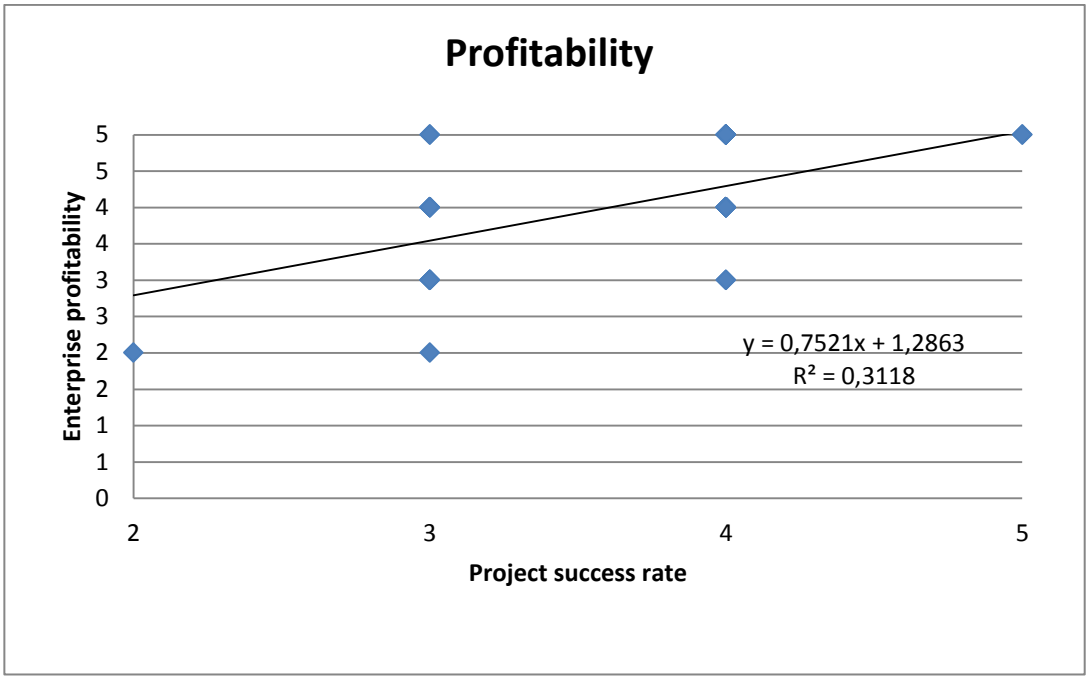

Fig. 25. Relationship between project success rate and enterprise profitability

Second factor for regression analysis is top management approach to project activities and process. The criteria defined how good senior managers support and promote projects. Fig. 26 reveals equation y = 0.5021x + 2.1613, coefficient a = 0.501 that project success has correlation with top management. It is vital a strong help from top managers, who able provide additional resources, more experience and motivation into project process. According regression coefficient R^2=0.3366 model is accepted.

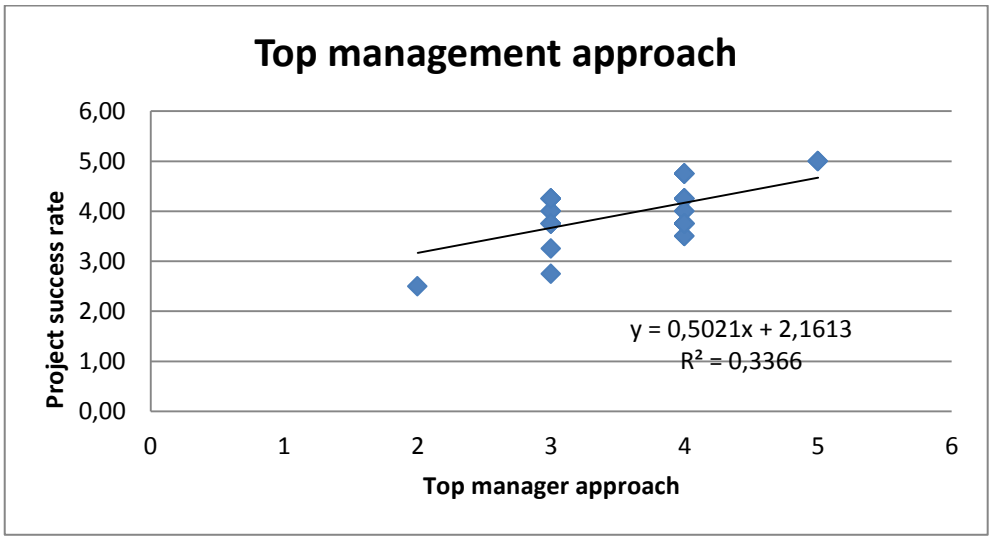

Fig. 26. Relationship between project success and top management approach to projects

Thirdly, research is defined an education level among industrial enterprises and its success on project. Regression confident is allowed to accept this relationship equation define a heavy

relationship between success rate and education level within organization. The education factor is very important for implementing and managing projects, however personal abilities as leadership and communication involved Regression model gives recommendations to improve the internal education in organization.

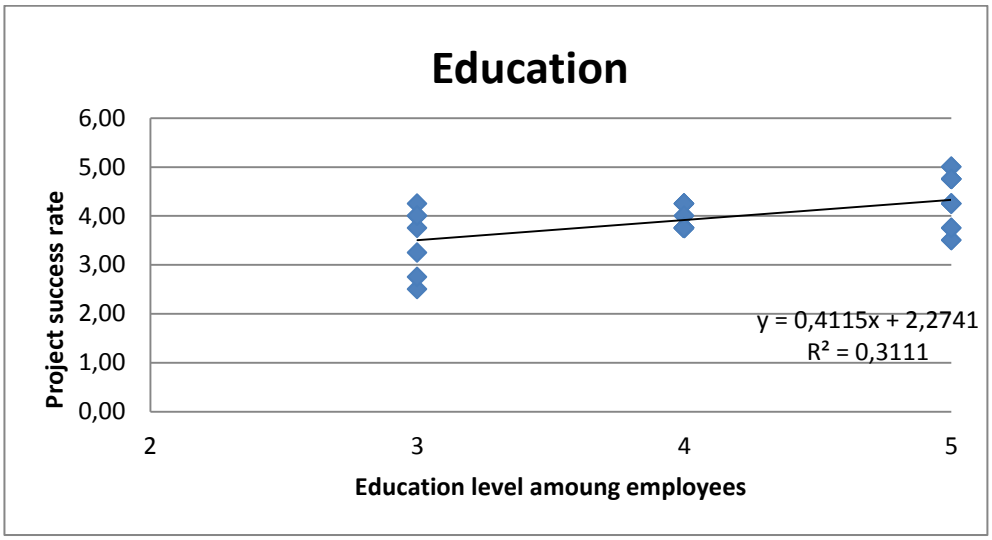

Fig. 27. Relationship between project success rate and top manager approach

Innovativeness understood as organizational and personnel ability to transform knowledge into a new and beneficial product or improvement. This factor correlates (Fig. 28) with project success rate and regression coefficient reveals strong acceptances of this model (R^2 = 0,5859) and strong correlation equation (0.4115x+2.2741).

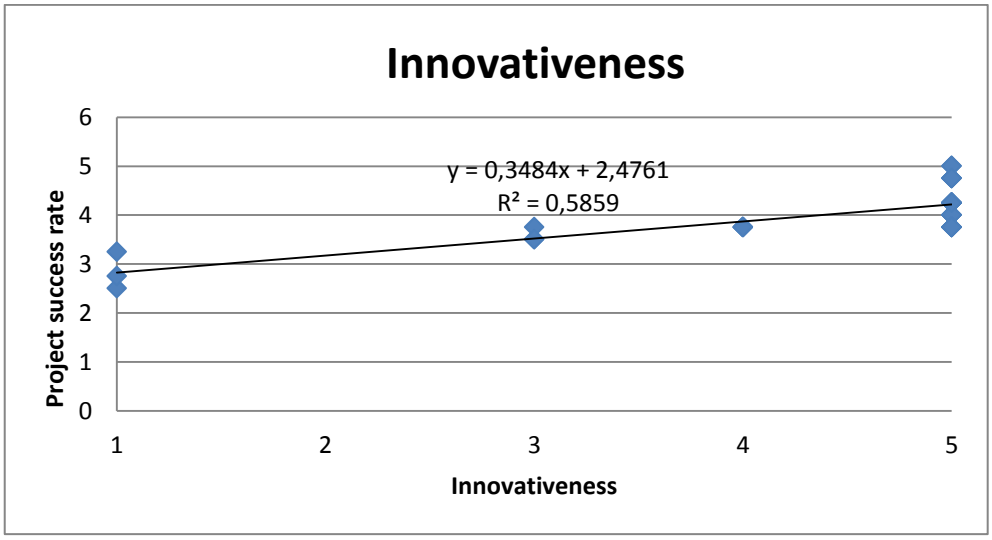

Fig. 28. Relationship between project success rate and education level

Work environment involve many aspects from organizational policy to general workplace and equipment quality. The research (Fig. 29) provides lower result (y = 0.3114x+2.5389) in

relationship between work environment and project success, but quite significantly important in practical field. In any case project management in industrial enterprises involve work environment as vital factor for success.

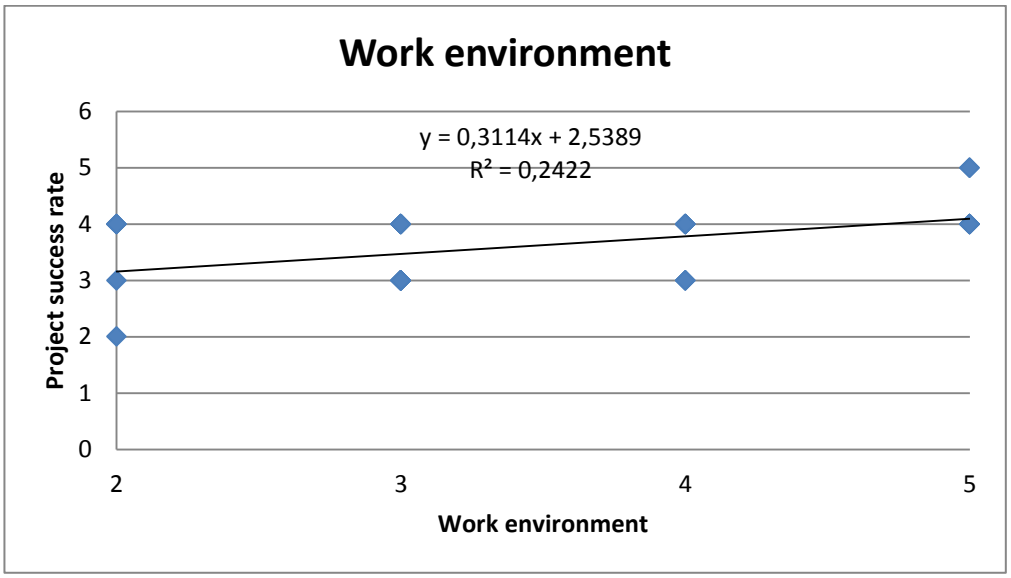

Fig. 29. Relationship between project success rate and work environment

Regression – correlation analysis shows that project implementation process management has many relations with different parameters of organization. Of course deeper research might provide other impact providers, however, for the moment project management in industrial enterprises have to accomplish the first stage of project management implementation within organization or methodology changes.

Regression models usability in project management improvement process provides good characteristics that need to optimise for organizational perspective. The optimization process is executed by sensitivity analysis or operational cost-benefit analysis. It defines level of parameters to ensure optimal effectiveness of project management system and provide benefits for industrial organization.

3 MODEL FOR PROJECT MANAGEMENT SITUATION

3.1 Definition of main problem

Project management data analysis according questionnaire (appendix 1) provides list of issues in project management activity (table 4) and project management problems in literature are significant similar. Solutions for these problems provided in table 8.

Table 13. Problems analysis and sollutions preposition

Problem	**Problem definition**	**Sollutions**
Poor planning	It is difficult to generate project path alternatives and make right decision which way to proceed it.	Use of traditional planning tools: Gannt chart, WBS, PERT, CPM. Involve in planning more creativity techniques: brainstorming, mind-mapping, TRIZ. Use monitoring and cotrol tools. Use templates Benchmarking method Risk matrix – risk evaluation and respons action plan (appendix 3)
Problems with customers	"Acquare goods as soon as possible, pay money as late as possible'' – avoid to make payment for project reusults. Difficulties with communication.	Customer analysis tools Parnership development Stronger legislation means in use ERP, MES systems with conection to client Direct involvement of customer in project (project sponsor)
Problems with suppliers	Delays and quality shortage in performance of services and products. Lack of responsibility	Supplier 's choosing methods Supply chain management The Lean approach on suppliers development. Just-in-time approach Evaluation tool of suppliers performance

Problem	Problem definition	Sollutions
Weak motivation	Staff do not provide attitude to project activities versus operational activities Lack of iniciatyve of personnel	Define and create good work environment. Introduce motivation system by emplyees satisfaction
Lack of skilful workforce	Poor Human Recource policy. Minor relationship with universities and other educational institutions.	Learning organization approach Looking for temporary specialists (web.page) Using Delphi method to involve partners in solution searching process Improving Human Resource policy on personnel multi-skilling development (appendix 2)
Quality issues in project deliverables	Lack of quality assurance in product and process within internal organization and external partnership	Standard ISO 9000 Total quality management Lean and Six Sigma methodology

Table illustrates main problems of project practices and identify possible solution means to it. The planning is a process to forecast future and provide vision of project work patch to achieve Managers consider with problems on generating alternatives project patch or activity sequence or other solutions. For this resolve literature provides basic project planning tools as Gantt chart and WBS also it is creative tools application in project planning processes it provide step by step visual documentation of project activities, work packages identify scope of project and Moreover, involvement of monitoring and quality assuring process is vital. Usage and creating new templates might improve planning and understanding among the organization. Benchmarking process allows to look for best solution in other organization and to adopt best practices in your enterprise.

Communication and financial issues with customer and suppliers are second place problem. There project management system should adopt customer and supplier analysis tools, partnership development, legislation means, ERP, MES systems with connection to supplier and client. The Lean, Just in time, supply chain approaches are good practice for improving procedures in many areas of industrial organization.

Motivation system should allow employees to satisfy primary requirement according Maslow‘s hierarchy. Also invest in work conditions and work ergonomics. Monitor staff satisfaction.

Skilful workforce is issue for many organizations, there should be more business cooperation with education institution, better practical skill development. Industrial organizations should use new approaches as learning organization, using Delphi method to involve partners in solution searching process and other means. Also improving human resource policy on personnel multi-skill development by implementing qualification matrix (appendix 2) and aassociated policy for improvement.

Quality problems offten occure in project implementation processes but it takes high impact for final result – customer satisfaction. Industrial organization should adopt standarts and methodologies for quality assurance, most popular methods improve quality in management processes by implementing ISO 9000 Quality management, Total quality approach and/or Lean-Six Sigma methodologies.

3.2 Model – solution of project management system improvement in industrial organization

The foundation for achieving excellence in project management can best be described as the project management maturity model (Kerzner 2001), which is comprised of five levels:

Level 1—Common Language: In this level, the organization recognizes the importance of project management and the need for a good understanding of the basic knowledge on project management, along with the accompanying language/terminology.

Level 2—Common Processes: In this level, the organization recognizes that common processes need to be defined and developed such that successes on one project can be repeated on other projects. Also included in this level is the recognition that project management principles can be applied to and support other methodologies employed by the company.

Level 3—Singular Methodology: In this level, the organization recognizes the synergistic effect of combining all corporate methodologies into a singular methodology, the centre of which is project management. The synergistic effects also make process control easier with a single methodology than with multiple methodologies.

Level 4—Benchmarking: This level contains the recognition that process improvement is necessary to maintain a competitive advantage. Benchmarking must be performed on a continuous basis. The company must decide whom to benchmark and what to benchmark.

Level 5—Continuous Improvement: In this level, the organization evaluates the information obtained through benchmarking and must then decide whether or not this information will enhance the singular methodology.

In any case project management system requires similar methodologies continuous improvement approach that allow industrial organization adopt new tool and techniques and become prepare for future projects' management. However, practical project management system does not have any concrete self-improvement system or model that introduces cycle improvement process for project implementation.

Fig.s 30 and 31 provide project process methodology usually applicable in industrial organization in any case project starts with input from customer who define primal assumption and requirement in terminology it define initiation process. It stage consider with defined proposals and approved proposals and evaluation priority among other project or alternatives.

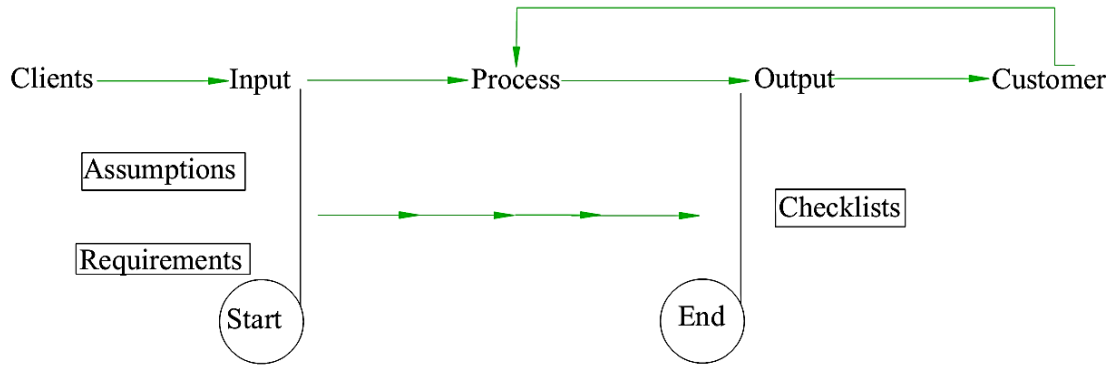

Fig. 30 Project process model as input output modeling (Charvat 2003)

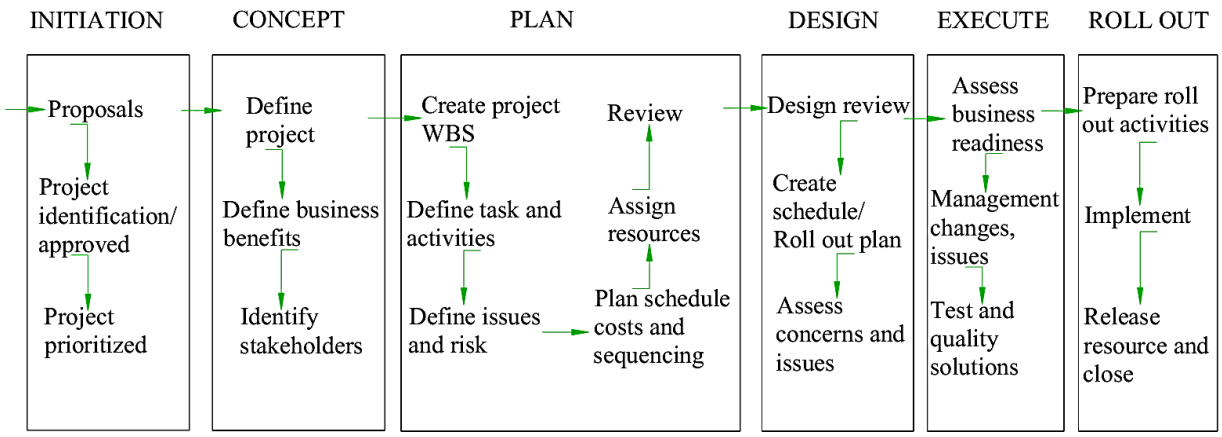

Fig. 31 Project process according project phases (Charvat 2003)

Concept stage provide introduction in project environment by clear definition of the project, identifying stakeholders and benefits. Planning process involve many project management tools and techniques especially creative thinking.

Define activities, risk, consumptions and other aspects in the project. Design process first point for plan execution it try to test plan and evaluate it consideration with project. After full execution, closing stage imply project process by providing product for customer and evaluation all process, in many case related service

The core of project management continuous improvement (Fig. 32) defined as cycle process that include improvement exchange and impact relationship between organization and environment for project management system. The current project process illustrates internal organization project management practice.

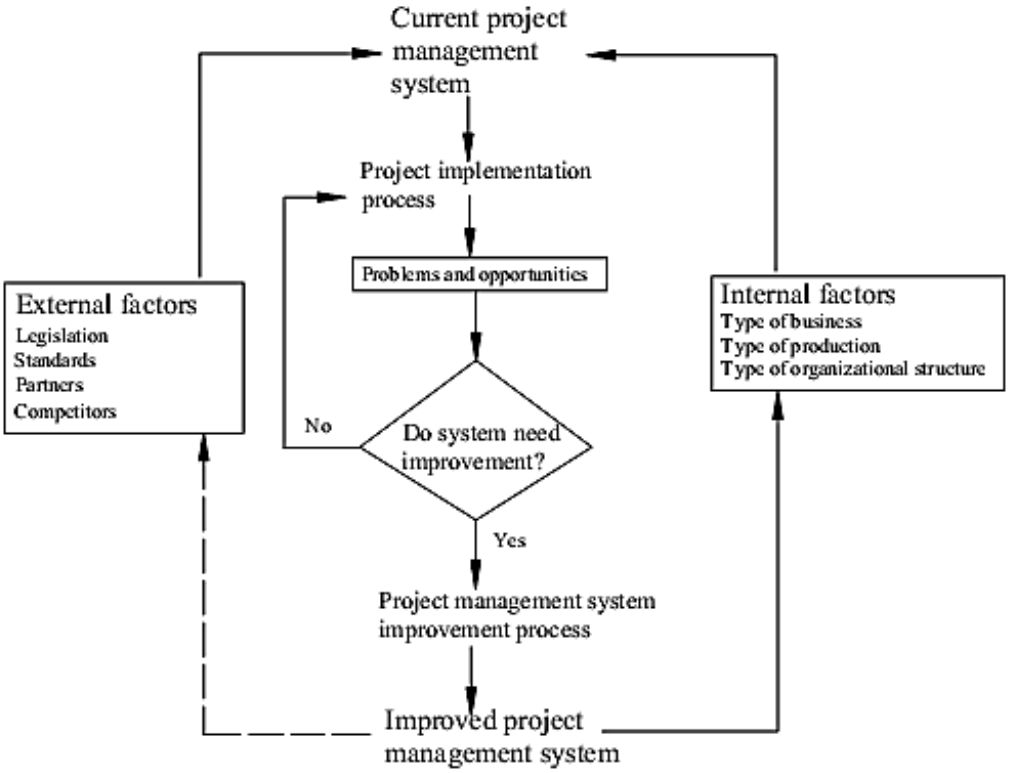

Fig. 32 Core of the project management continuous improvement model

Project management is influenced by the internal factors of the enterprise that are business area, type of production system and organizational structure. Other entities are influencing international standards, state laws, competitors and partners are distinguished as external factors.

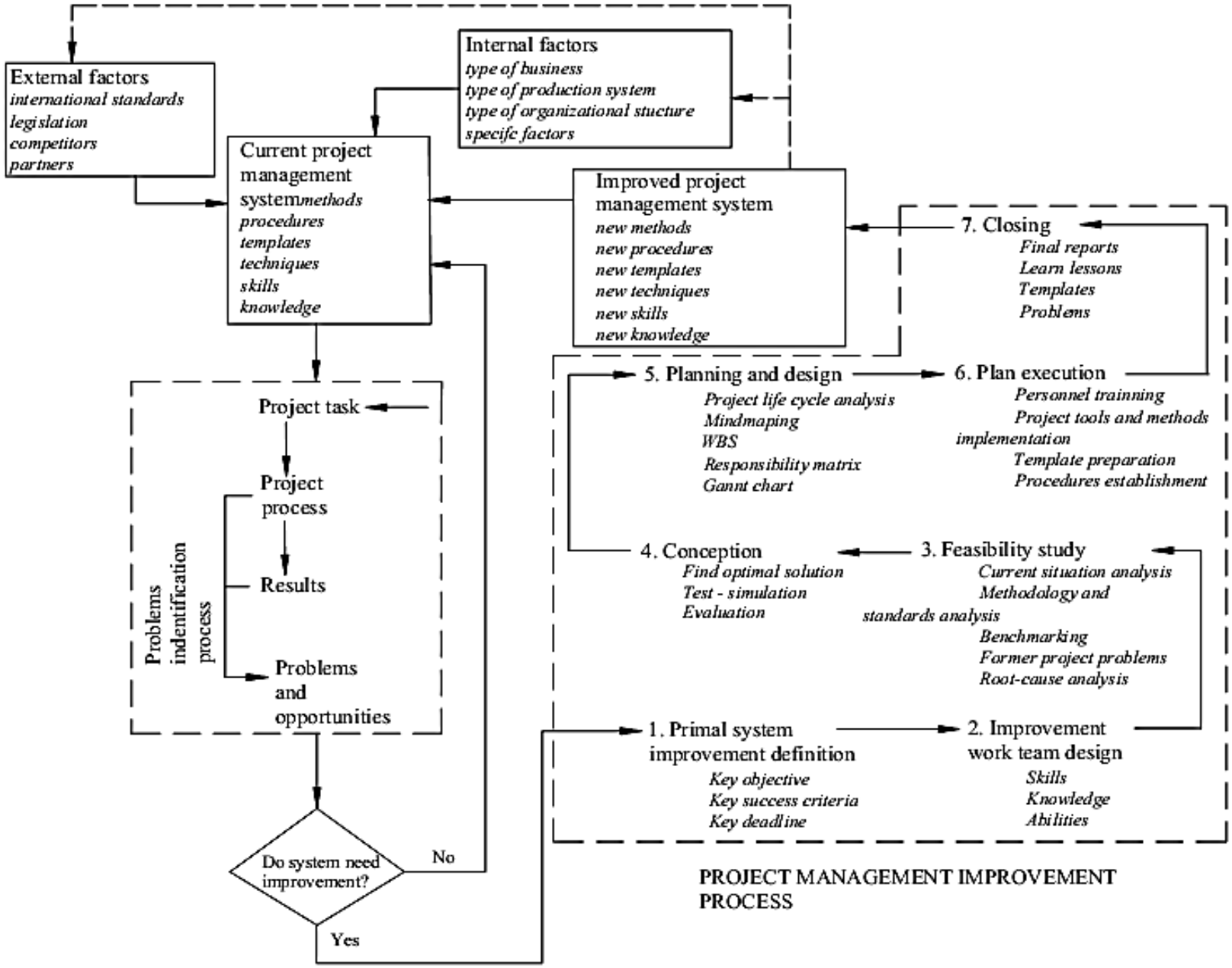

Fig. 33 Sophisticated model of the project management system with integrated continuous improvement subsystem

Model by the assumption that the normal implementation of the project using an existing (current) project management system. The project or project program produced a unique result and identified arising problems and improvement opportunities after project process. Identification process arise problematic to observe problem opportunities and define them for further evaluation

The top level management of enterprise provides decision-making function and initiating process organization development. At this stage, when improvement process is accepted, then the initial project definition should be created, which states primal project problem, success criteria and final time deadline. If not accepted then no changes with current project management system in organization is made, until new problem or opportunities will occur. For applicability this model should proceed after defined time period or number of project implemented. Project system should be evaluated analysed by past project results.

The next stage is formation of the development team, depending on the design specifics of the problem are chosen with appropriate expertise and skills of professionals. The team performs feasibility study of the extent which depends on the complexity of the problem and importance. Further process is achieved by decision making and the concept of optimal solution testing and evaluation of the enterprise at the top level management.

Adoption of the decision created an implementation plan, depending on the chosen design of the project management packages and tools, as WBS, Gantt chart, Responsibility Matrix, resource allocation chart and etc. Also the planning phase provides a design of project which verified introduction pages of project problem, where is done a feasibility of the project requires use of control (process and outcome measurement) and the flexibility mechanisms of the plan, as well as leadership, motivation. Top level managers approve improvement plan and allow to proceed execution stage. The closing stages of the development process, they are validated against the benefits and other strategic criteria. After evaluation of positive use of new or improved project management system, this improvement affects the parameters of internal organization can influence and the external factors and create a continuous improvement process.

CONCLUTIONS

In masters work was researched situation in Lithuania industry, significance and relevance of the problem. The continuous improvement in project management system in the industry enterprises is instant and necessary in order to ensure unique activity implementation process in modern manner.

1. *Analysis of project management scientific literature*

Analysis of preparation scientific literature defined formally common terms: management, project, project management. Management identifies the objective achievement by impact to environment. The term project management is specifically and precisely defined as project management processes with the implementation of management means although the authors following different variations of the terms depending on what industry and project type. Definition of the project implies unique activity which demands creativity, resources and time for implementation. Analysis of industrial enterprise defines types of industrial enterprises and wider investigation in manufacturing industry process and aspects. Manufacturing enterprises could to execute projects for technology implementation, product development, cost reduction, process improvement, and market occupation. Furthermore, work includes a review of project management methods as life cycle analysis where are a variety of project phases according industry and type of project.

Also work includes recommendations for using project management methods: project benchmarking, project templates, risk (Fig. 10), stakeholder (Fig. 5) assessment tables. Matrix organizational structure is most suitable for industrial enterprise that is seeking cope with projects. Creative tools involvement in planning process vital and might improve project outcomes.

2. *Statistical analysis of industrial design sector in Lithuania*

Statistical analysis of Lithuania industry provide important sectors of production which related with metal and other material processing, machine, equipment and transport production. There is found an importance of selected industrial sectors (table 4) which consist of 2.34 % of total industrial enterprises, employ 1.31 % of total workforce, however, those industries generate 15.28 % of total production value. It shows that manufacturing sector is very important for Lithuania economy.

3. *Empirical analysis of industrial manufacturing sector in Lithuania*

Questionnaire data analysis concludes average project in industrial enterprises by different aspects as project time where critical period for project is one year 57 % of projects takes less than

year and budget is divided in two parts less than 100 000 LTL 54 % and more than 100 000 LTL 46 %. Quality improvement project was defined as main priority projects among enterprise, but product development is not popular. Industrial enterprise do not willing to use more risky capital for own project. It reduce enterprise opportunities implement more expensive and more beneficial projects. Cooperation in project involves mainly clients and suppliers which is main important for industrial enterprises. There is missing involvement and participation with research and education institution. Furthermore competitors do not provide intent for cooperation in projects.

4. *Correlation-regression analysis of project management:*

Empirical research provides significant result on regression models where are defined relations between project success rate and profitability, which shows importance of effective project management for enterprise success. Regression parameter is $R^2 = 0.3118$ and equation coefficient $a = 0.7521$. The improvement model illustrated in fig. 32 and fig. 33 provide opportunity consistently implement a necessary means for project management system. Other acceptable regression models reveal importance of a top management approach on projects. Regression parameter $R^2 = 0.3366$ and equation coefficient $a = 0.5021$. There is suggested stakeholder management planning and tooling also functional policy of organization should be improved by motivation system. It includes that project management system implies means for involvement, personnel education, regression parameter $R^2 = 0.4115$ and equation coefficient $a = 0.3111$. Manufacturing organization should firstly define what skill is needed and implement work qualification improvement matrix (appendix 2). It should provide steady upturn in personnel education. Creativity (ability to innovate) regression parameter $R^2 = 0.3484$ and equation coefficient $a = 0.5859$. To apply creative tools are best for specific organization model and activities. Also qualification matrix should help boost skills of employees on creative thinking. And work environment has significance to successful project implementation regression parameter $R^2 = 0.3484$ and equation coefficient $a = 0.5859$. There is needed improvement of team work, physical and emotional work environment; it should increase project implementation process.

5. *Model for project management system improvement for Lithuania industrial enterprises:*

Project management improvement model allows proceed organizational change improvement provided by internal and external impactors. It implies capacity for continuous improvement approach and suggest a main processess and means for effective analysis, adoption and implementation of a new project management methodologies. According regression model of enterprise profitability and project implementation. However, project success depends on reliable project management, which has different methods and tools. Model does not insist install all

methods for project management system. Instead it requires deeply analysis and improvement of existing methods by creating procedures and templates. Also there is strong recommendation to imply benchmarking for obtain best practices in other organization and to use creative techniques in project implementation processes.

The cost of project management improvement model execution and maintainance depends on organization characteristics and projects parameters.

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APPENDIX

Appendix 1 Research questionnaire

Questionnaire

1.Type of business

2. Number of employees

3. Do your enterprise proceed any projects? What is the reasons if do not proceed?

4. Average period of project?

- ☐ Until week
- ☐ From week to moth
- ☐ From moth to year
- ☐ Year and more

5. Average budget of project?

- ☐ Until 1000 LTL
- ☐ From 1000 to 10 000 LTL
- ☐ From 10 000 to 100 000 LTL
- ☐ From 100 000 to 1000 000 LTL
- ☐ 1000 000 LTL and more

6. Please evaluate the purposes of projects according importance to your enterprise? (1 – irrelevant to 5 – very important)

	1	2	3	4	5
Product development	○	○	○	○	○
New technology implementation	○	○	○	○	○
Production processes improvement	○	○	○	○	○
Sells promotion	○	○	○	○	○
Cost reduction	○	○	○	○	○
Quality improvement	○	○	○	○	○

7. Other projects purpose important to your enterprise, but not included in question 6?

8. Please evaluate financial means (sources) for projects in your enterprise?

	1	2	3	4	5
Own capital	○	○	○	○	○
Private investors capital	○	○	○	○	○
Borrowed capital	○	○	○	○	○
Support capital (e.g. ES funds)	●	○	○	○	○

9. Please evaluate how often and with what kind of organizations your enterprise cooperate in projects (1 - very rarely 5 - very often)

	1	2	3	4	5
Without any cooperation with other organizations	○	○	○	○	○
With clients	○	○	○	○	○
With vendors	○	○	○	○	○
With competitors	○	○	○	○	○
With non-government organizations	○	○	○	○	○
With public sector organizations	○	○	○	○	○
With science and research institutions	○	○	○	○	○

10. Please evaluate importance of the cooperation with other organization to project's results (1 - very low, 5 – very high)

	1	2	3	4	5
Evaluation	○	○	○	○	○

11. Please evaluate how often project success to implement by criteria? (1 - very rarely, 5 – very often)

	1	2	3	4	5
Project implemented	○	○	○	○	○
Project implemented on time	○	○	○	○	○
Project implemented with budget	○	○	○	○	○
Project results satisfy client expectations	○	○	○	○	○

12. How many employees participate in project organizing and implementation processes?

13. Please evaluate main factors to the project management effectiveness. (1 – very low 5 – very high)

	1	2	3	4	5
Top managers approach to projects	○	○	○	○	○
Profitability of enterprise	○	○	○	○	○
Education of employees	○	○	○	○	○
Innovativeness of employees	○	○	○	○	○
Work environment	○	○	○	○	○

14. Other important factors that are not included in question 13?

15. Please evaluate top level managers' approach to enterprise projects? (1 – no interest in problems related to project implementation, 5 – seek to resolve any related problem)

	1	2	3	4	5
Evaluation	○	○	○	○	○

16. Please evaluate enterprise profitability (1 – very low 5 – very high).

	1	2	3	4	5
Evaluation	○	○	○	○	○

17. Please evaluate education level of employees, who work in projects (1 – very low, 5 – very high)

	1	2	3	4	5
Evaluation	○	○	○	○	○

18. Please evaluate innovativeness of employees. (1 – very low, 5 – very high)

	1	2	3	4	5
Evaluation	○	○	○	○	○

19. Please evaluate work environment in your enterprise (1 – very unsatisfactory 5 – very satisfactory)

	1	2	3	4	5
Evaluation	○	○	○	○	○

20. Please evaluate effectiveness of project management in your enterprise (1 – very low, 5 – very high).

	1	2	3	4	5
Evaluation	○	○	○	○	○

21. Please define main difficulties that are raising in project management processes?

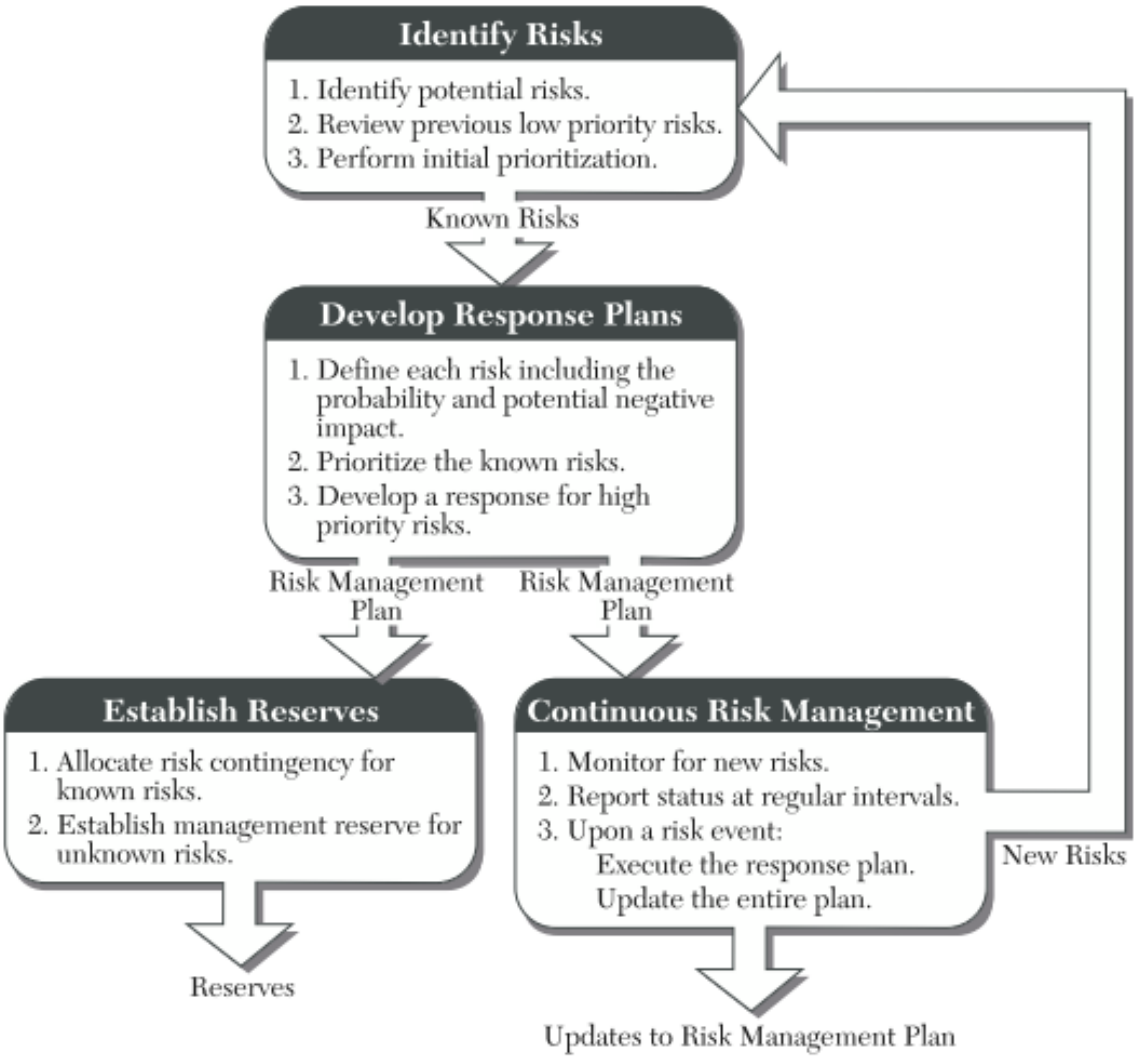
Appendix 2. Work qualification improvement matrix

Skills and activity, job unit / Personnel of department	Work unit 1	Work unit 2	…	Work unit n	Abilities				Notes
					⊕	⊕	⊕	⊕	
Worker 1	⊕	⊕		⊕					
Worker 2	⊕	⊕		⊕					
….									
Worker n	⊕	⊕		⊕					
Date:_____									
Sum ⊕									
Sum ⊕									
Goal ⊕									
Goal ⊕									

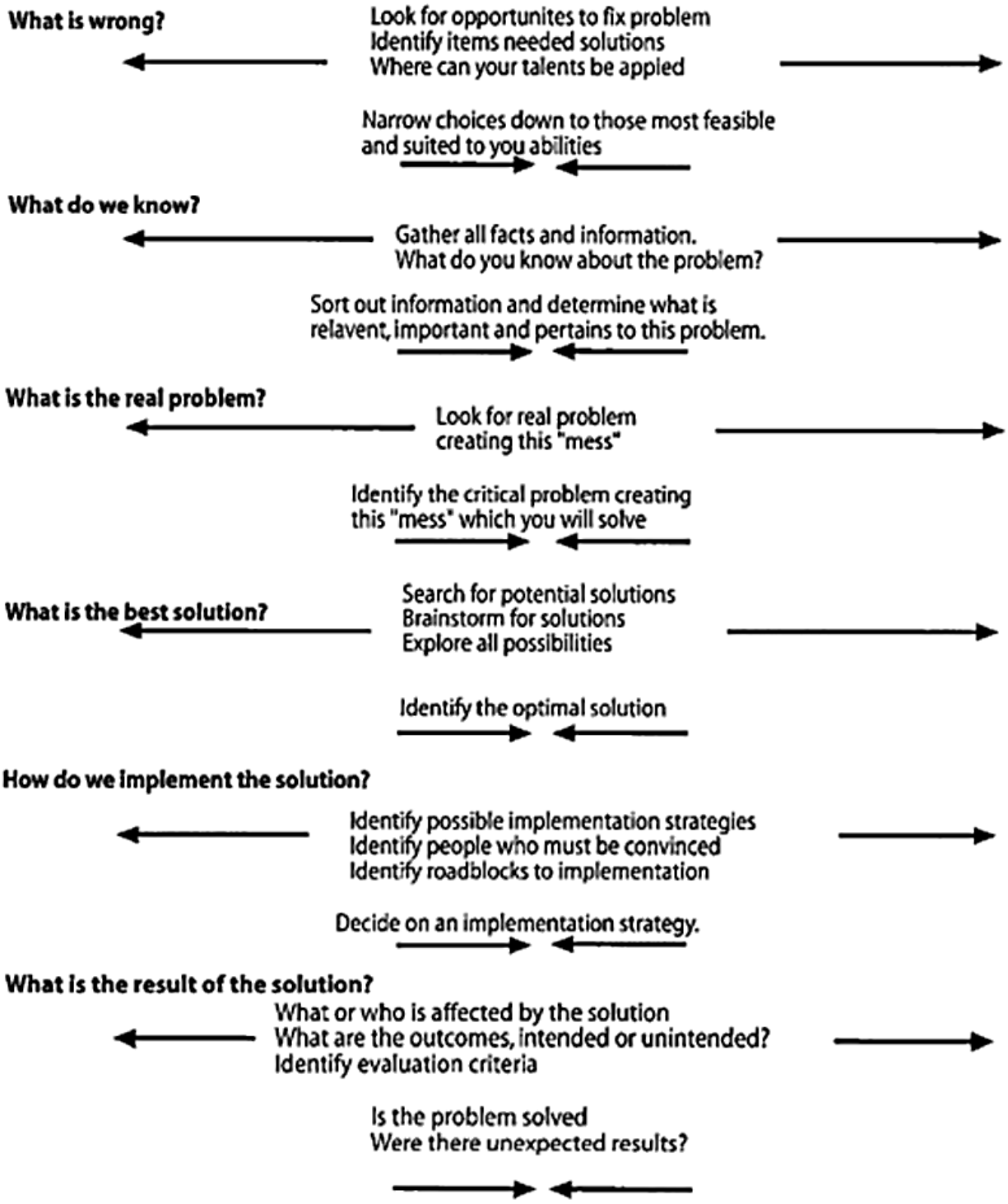
⊕	Not qualified
⊕	On learning
⊕	Able to work with qualified supervision
⊕	Qualified
⊕	Qualified and able to teach others

Work qualification matrix use full in manufacturing operational staff improvement, but also it may work in project management area as a tool to develop human resources in enterprise have to be improvement program with defined goals according to enterprise strategy.

Appendix 3 Project risk management model



Appendix 4 Solution finding process by use divergence and convergence processes



Appendix 5 Failure mode analysis table

Function	Potential Failure Mode	Potential Effects(s) of Failure	S	Potential Cause(s) of Failure	O	Current Process Controls	D	RPN	CRIT	Recommended Action(s)	Responsibility and Target Completion Date	Action Results					
												Action Taken	S	O	D	RPN	CRIT
Dispense amount of cash requested by customer	Does not dispense cash	Customer very dissatisfied	8	Out of cash	5	Internal low-cash alert	5	200	40								
		Incorrect entry to demand deposit system		Machine jams	3	Internal jam alert	10	240	24								
		Discrepancy in cash balancing		Power failure during transaction	2	None	10	160	16								
	Dispenses too much cash	Bank loses money	6	Bills stuck together	2	Loading procedure (riffle ends of stack)	7	84	12								
		Discrepancy in cash balancing		Denominations in wrong trays	3	Two-person visual verification	4	72	18								
	Takes too long to dispense cash	Customer somewhat annoyed	3	Heavy computer network traffic	7	None	10	210	21								
				Power interruption during transaction	2	None	10	60	6								