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Factors in Turnaround Refinery (TAR) Project Management Process

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Abstract: Maintenance of process plants such as refinery plants requires implementation of good maintenance practices due to the presence of high complexity. With regard to the aspect of refinery plants maintenance, the most significant undertaking is the turnaround (TAR) carried out through a project task with a long duration of planning and a very short duration of realisation period, which makes it one of the most complex maintenance projects in general. Such maintenance is based on multidisciplinarity that must be implemented through a quality management system at all levels of maintenance management. This paper will define and test factors in turnaround refinery project management process, which also represent the quality factors inherent to the turnaround refinery project. Research findings point to the importance of evaluating leadership, team, policy and strategy in the turnaround refinery project management process.

Keywords: maintenance management; management process factors; project quality; turnaround refinery (TAR)

1 INTRODUCTION

Maintenance of production facilities with the minimum budget and with as many demands for the quality of the performed works carried out is a collection of complex activities of several different disciplines that often overlap. The maintenance of refinery plants is based on multidisciplinarity that must be implemented through a quality management system at all levels of maintenance management. With regard to the aspect of refinery plants maintenance, the most significant undertaking is the turnaround (TAR) carried out through a project task with a long duration of planning and a very short duration of realisation period, which makes it one of the most complex maintenance projects in general. Turnaround is the most significant planned periodic halt in which the most important planned maintenance activities are carried out in the form of a project task. The process industry, such as oil refining, which is designed with the requirements of continuous work and with the greatest mechanical availability, requires that halts must be minimal and as planned as possible. The specificity of the approach to managing complex oil refineries turnaround projects in relation to existing generic projects is a consequence of the very specific features of the TAR project. In scientific literature, approaches to quality management in TAR projects are extremely neglected. The most common approaches represented in the existing literature are not based on the specifics of TAR projects, but rather generic projects. Mostly, the quality of management is reduced to the generic standards, which in fact represent the minimum that the company has been committed to. It can be concluded that the management of TAR projects and the adaptation of such projects to meaningful integrated quality assurance in the individual phases of the project has not been sufficiently researched. The aforementioned contributes to the achievement of the low performance results of TAR projects in practice. Available literature deals with the subject in the field of project management, quality and maintenance, but very rarely all three scientific disciplines are united in the TAR project research.

The purpose of the research is to scientifically identify the factors in turnaround refinery project management process, which can result in greater performance of such projects in practice and a greater level of relevance in the scientific field of managing complex maintenance projects. The objectives of the research are to define the factors of the management process and to determine their contribution to the process of managing TAR projects, using the logistic regression method and considering the specifics of such projects.

2 THE MOST SIGNIFICANT MODELS OF QUALITY MANAGEMENT

Most of the quality management models are generic and are trying to encompass a wider area of business organisation quality. The most recognized models are EFQM, MBQA and IPMA, on which many other applicable models for different business systems are based. Therefore, their characteristics needed for quality management in TAR projects with emphasis on management processes will be presented further in this paper.

For example, EFQM model (European Foundation for Quality Management) is based on the principles of total quality management [1]. It includes oriented results, focus on the buyer, leadership and purpose consistency, management on the basis of processes and facts, development and including people, continuous learning, innovations and improvements, partnership and social responsibility. The EFQM model provides a framework based on nine criteria used for assessing excellence. Five criteria are enablers or factors (leadership, people, policy and strategy, partnership and resources, processes) and the remaining four are criteria referring to people results, customer results, society results and key performance results. The whole purpose of the self-evaluation process is the analysis of unsatisfactory results and discovering fields where improvements can be carried out. The EFQM model of business excellence is carried out in the process of self-assessment based on assumptions that there is causal connection between the enablers criteria and results criteria. The authors Ghobadian & Woo [2] confirm that the EFQM model strictly recognizes the quality of the final (end) results of integrated processes and provides an insight into organisational methods of quality management and the final result. The model does not only provide an insight into final performance, i.e. result, but also measurement of organisational functioning.

Malcom Baldrige National Awards (MBNQA) is a model which represents a national award for quality in the USA. The model was implemented with the aim of providing a framework for complete quality auditing [3]. The award is given annually to the best company in the field with a successfully implemented system for quality management. The award is implemented through three major criteria: for development of award, self-assessment of organisation and receiving feedback from the applicant of an award request. Furthermore, criteria are based on the following concepts, including: visionary leadership, excellence management initiated by buyer's needs, organisational and personal development, valorisation of employees and partners, focusing on the future, management based on innovations, management based on facts, social responsibility, focusing on creating a perspective system and value of results. Many authors have concluded that the influence of quality in project management also influences key project results. For example, Anderson & Jerman [4] analysed in their paper the influence of quality management on logistic performance. Measurement of quality was defined through factors of quality management. The measurement was based on MBNQA quality criteria, and nine constructs were created for analysing their logistic network which proved the influence of quality on key project results in the logistic industry.

The last one mentioned in this paper as one of the most significant is IPMA model. The International Project Management Association (IPMA) developed its own model of excellence in project management. The model is used for best practice assessment for project management [5]. The model has elements and a database founded on the EFQM model of business excellence in many aspects. It is comprised of two groups of criteria, the first being project management (in EFQM-enablers), where as the second comprises the results (EFQM also comprises the results). The first group, project management, includes: objectives, leadership, people, resources and processes. The second group, results, includes: people results, customer results, results of other parties, key performance and project results. The IPMA model of excellence also emphasizes a feedback connection called innovations and learning. Information gained through the feedback connection after project completion is of great significance as an input parameter for similar projects. According to elements of the IPMA model, it is concluded that the left side of the model, project management, is responsible for the success of project results. Therefore, improvement of criteria, through the project management variable, influences the improvement of the project itself in the phase of execution. IPMA recognizes and presents awards solely to the project team that achieved the best results, making them the most successful representatives of the project management. Evaluation criteria indicate that it is not possible to evaluate excellence in project management relying solely on project results.

It is difficult and almost impossible to fully apply generic models of business excellence to all business organisations and especially to organisations based on project management. For complex projects such as turnaround refinery projects, it is not enough to apply generic project management and generic models of business excellence [6]. Accordingly, factors in turnaround refinery project management process will be defined and their contribution will be tested by applying the method of logistic regression.

3 FACTORS OF QUALITY MANAGEMENT PROCESS IN TURNAROUND REFINERY PROJECTS

Factors in the TAR management process need to be defined on the basis of existing quality management models, especially the EFQM model, and on the claims that adequately confirm the strength of the variables.

Many authors have noticed the lack of implementation of the EFQM model of business excellence in project management. For example, Westerveld [7] and Bryde [8] have concluded that the EFQM excellence model was inappropriate for project management and developed its own model. Also, Zulu & Brown [9] have created a model of business excellence that focuses on defining the construct for quality measurement in project management processes. All described business excellence models focus on business environment in project management but are not sufficiently empirically researched and tested. There is a degree of consensus among some researchers that the EFQM model, based on TQM philosophy, performs an effective performance estimation of model variables [10, 11].

The relationship between the factors of the TAR project, i.e. their relation is unknown, especially in the process of management. Studies that include quality management are complex, because there are no unified criteria for measuring quality. Because of the nature of the quality itself, it is not possible to measure it directly and it is necessary to use adequate factors and adapt them to the project environment in order to measure the impact of quality. In this paper, the factors of the TAR project quality management process will be defined on the basis of previous research and on the statements confirming the strength of the variables. As the most important factors of the TAR project quality management process were defined: leadership, team, policy and strategy, partnership, resources and processes, the explanations of which are given below.

3.1 Leadership and Team in Project Management

Leadership in the project is defined as the ability to establish vision and direction and the alignment of all project participants towards a common goal. Leadership empowers and encourages project participants to achieve key project results and enables project success in the context of frequent changes and uncertainties. Organisational leadership consists of skills and behaviours that enable an impact on an individual or group of people. The vision and goal of leadership is to guide and motivate the team to achieve the desired set of goals. Leadership with their innate and acquired skills and with the help of a team turns vision into reality. The task of leaders is primarily to convince and motivate followers, in order to ultimately achieve the planned tasks and goals that are beyond their expectations [12].

When it comes to leadership, it involves influencing the processes of interpreting events for its followers.

Management also affects the selection of goals for the group or organisation, raising motivation for followers to achieve certain goals while maintaining teamwork. Undoubtedly, leadership is a role, a way of thinking, and a set of behaviours that exist to build, maintain, and promote the culture which will embody the vision, and thereby represent the best interests of stakeholders. This approach focuses on a tactical and strategic dimension to ensure a successful outcome. The ideal role of the leader, including the team, is primarily to ensure quality, integrity, responsibility, fairness, balance and the satisfaction of interest groups. The project leader must have a clear mission during the project implementation phase and such a precondition is necessary for the project to be successful [13].

For repetitive projects, such as the TAR project, permanent business processes are being established. In such organisations, a matrix model of organisation is often used. Allocation of responsibility and competence is of primary importance. If the division of power and responsibility is not clearly defined, various conflicting interests often arise between the project leader and the teams [14, 15].

The variable of leadership in project management can be measured using multiple constructs. For example, according to Whetton & Cameron [16], constructs of successful leadership are defined by clear objectives, division of leadership, clear roles and responsibilities, members' independence, mutual encouragement as well as trust between leader and team. Factors contributing to the team's effectiveness are the increase in closeness between project team members, team goals and feedback, linkage between team members and decision-making process in the team. According to Odusami [17], constructs that describe leadership with the ultimate goal of improving performance are the ability and leadership style of a project manager. It is certainly critical, if not crucial, the appointment of a competent project manager. The project manager's competences have a significant impact on the achievement of the goals, i.e. the project's success [18].

The existing project management and management literature generally emphasize that the impact and support of top management is a necessary prerequisite for successful quality management. Quality management is recognized as an effective factor that improves project performance [19-21]. Cooke-Davies & Arzmanow [21] define constructs of organisational leadership as measurement of project management maturity to top management. Also, as a significant construct, they emphasize the strategy and ability of the project manager.

Kerzner [20] identifies the following statements that describe the variables of leadership: choosing the right person for a project manager, top management support, authority, delegation, management, direction, and project organisation. According to EFQM [1], excellent leaders develop and facilitate the realisation of mission and vision. They develop organisational values and systems required for sustainable success carried out through their actions and behaviour.

Summing up the existing literature related to leadership and behaviour activities, it is concluded that they are an important factor that significantly influences the outcomes of the project. The relationship between specific leadership styles has not been fully clarified for all project types. It is certainly necessary to determine leadership styles for specifics of non-generic projects. There are many research papers published on the topic of the impact of leadership on project performance [13, 22, 23]. Authors J. R. Turner & Muller [23], based on existing literature, have ascertained the following characteristics of the project leader that influence the project's performance: 1. the competences of the leader, 2. the adequacy of the different leadership styles in the individual phases of the project life cycle, 3. the specificity of leadership styles in multicultural projects, 4. the importance of the project leader in creating an effective working environment for team members, 5. the preference of the project leader according to human-oriented tasks, 6. the influence of leadership style on the perception of success.

Existing literature related to the statements describing the leadership variable is very comprehensive. It is necessary to select statements that best describe leadership, especially for the specificity of the project being examined. Selected statements that describe the variable of leadership examine the most important elements of leadership in turnaround project management. Education and training of team leaders are crucial in team management. Teams are made up of experts from different professions, education and professional experiences. An important fact is that the age of the team is most often different, and for this reason, potential conflicts occur during the project. Team leader's education and skills are crucial to recognizing the most significant qualities of all team members. Human resources management, i.e. team participants, is just one of the most prominent skills of the turnaround project manager and these skills are most often acquired through training and experience. The roles and responsibilities must be clearly defined because of the large number of project participants. On the turnaround project, the main team is usually appointed for a particular plant or group of plants by profession. If the roles and responsibilities are not clearly defined, the team leader simply has no way to manage the team at all stages of the project, especially in the initial preparatory phase. A project manager is a person who unites all the advantages of his team's participants with his style that must be motivating.

Turnaround project is a multi-year project that has the characteristics of dynamics due to its specificities that require much patience and change in project preparation. The style of a project manager must be changeable depending on the circumstances surrounding it. Also, his performance must be a motivation driver directed towards the conflicts that must be recognized and eliminated to the fullest extent at an early stage. Due to the very specifics of the turnaround project, the project manager must be able to work with tools for network planning to the extent that can identify threats and risks that may occur. Update, i.e., tracking progress, usually linear tracking to the planned volume (Gantt chart), is done on a daily basis, while for example, other projects are performed weekly or multiple times a week. Most commonly, if delays in some executed jobs are found to exceed 10% compared to planned jobs in turnaround projects, this backlog cannot be achieved in the planned time, budget, and resources. The project management leadership must be enabled to understand

some of the day-to-day project tracking tools in order to eliminate the causes of delays at an early stage if possible.

Selected statements that describe the leadership variable in managing turnaround projects are shown in Tab. 1. Selected statements will measure the impact of leadership within turnaround project management on other factors, ultimately affecting the project's performance. The turnaround project starts by nominating project management leadership and also with leadership it ends. The research needs to define how much leadership influences other factors, and whether it affects positively or negatively. If the influence of leadership on other factors is strong it is necessary to direct the improvement to this variable.

Table 1 Statements describing variable Leadership

	STATEMENTS
LEADERSHIP PM	Team leaders of turnaround project have obtained a special training for turnaround project management.
	Roles and responsibilities in the turnaround project are clearly defined.
	The leadership style of project management is motivating.
	The leadership style of project management is focused on conflict management.
	Leadership is trained to work with network planning tools such as MS Project.

The team in the project can be defined as a joint co-operation of project participants towards a common goal. The team does not represent the individual work of individuals in the group. The two main skills associated with team success are accepting roles with certain advantages and providing feedback to other team members. Focusing on feedback on the behaviour not of one person, but a group is one of the ways to build positive relationships in order to maintain team spirit. Such a balance is constructive and corrective.

Previous studies are quite rich in statements that describe a variable team. Chan et al. [24] identified eight measures within organisational action, namely: the need for understanding, the need to share the functional and technical performance requirements of all participants, all project implementation participants must fully understand their roles and responsibilities in the project, all project participants are guided by the unique set of project goals, all project participants are fully cooperating, providing adequate channels of communication among all project participants, a high degree of trust and effective resolution of conflicts.

Kerzner [20] has identified the characteristics that describe effective project teams: task-effectiveness, innovative/reactive behaviours, team-based commitment, matching the professional goals of team members with project requirements, team members' interdependence, effective interface, ability to resolve conflicts, effective communication, high levels of mutual trust, results orientation, interest in participation, high levels of enthusiasm, high morale, and readiness to change.

Existing literature related to the statements that describe the variable team is very extensive. It is necessary to choose the statements that best describe the team and reflect the specificity of the project being examined. Selected statements that describe the variable team are shown in Tab. 2.

Table 2 Statements describing variable Team

	STATEMENTS
TEAMPM	The project team (TA office) is very motivated and satisfied.
	The project team (TA office) is focused on project work.
	The project team (TA office) has a high professional approach and work energy in the execution of activities.
	The project team (TA office) has a rich experience of participating in the projects.

Leadership and team are very closely linked in each project organisation. It is almost impossible to plan projects where there would be no leadership and teams. It is this relationship that makes a significant contribution to the business organisation that is project-oriented. Teams are basically a temporary organisation with specific goals, resources, performances, and time constraints. There are researches that link the relationship between variable leadership and variable team, thus recognizing these two variables as one of the key relationships for project success.

For example, research conducted by Rahim, Antonioni & Psenicka [25] found that effective use of organisational strength and conflict management positively correlates with team results. Research has shown that leadership behaviour affects the team, and ultimately the results of the project. The study of transformational leadership identified the variables that connect the leadership behaviour and behaviour of members of their followers. Such variables include trust in leadership [26], intrinsic motivation [27] and team cohesion [28]. The research conducted by Bass [12] and Yukl [29] also confirms the positive relationship, i.e. the impact of leadership on team results. Theory of functional leadership emphasizes that success is solely a consequence of the team's circumstances influenced by leadership, and deny the influence of other circumstances that can contribute to success. Effective leaders possess the skills to define critical leadership activities, and their solutions are tailored to the specifics of the team [30]. The team leader's responsibility is to raise the team's collective efficiency [31]. If team members believe that their team is capable of achieving goals, then it is more likely that they will accept and achieve their goals [32].

Leadership and teams are strategically positioned to achieve significant organisational goals through teamwork. It is important to point out that leadership and teams in the organisation do not happen by accident, but for them there are pre-planned goals designed based on their skills that must be balanced. If the organisation places strong leadership and bad teams, this will result in very poor performance on project results. Also, if the organisation places strong teams but poor leadership, it will also result in very poor project results. Based on the above, the first hypothesis follows:

H1: Effective leadership will have a positive impact on the project team.

3.2 Partnership and Project Management Resources

Organisations that strive for business excellence plan and manage relationship with partners, suppliers, and resources in order to maintain the policy and strategy and the effective functioning of all processes. During this process, they maintain the balance of the current and future needs of the organisation, the community and the environment [1]. The relationship with suppliers and the

management of material and nonmaterial resources is the aspect most commonly mentioned in the literature under quality management [33].

Kerzner [20] considers that support to the user is of crucial importance for achieving the project's success. He also concludes that several aspects need to be identified: customer relationship, customer support and commitment, regular meeting with the client and conflict resolution with the client. A significant factor that can affect business relationships is the diverse experience of interest groups involved in joint affairs. Watson [34] emphasizes that contractors and clients often enter into partnership with precautionary measures and incomplete confidence. Namely, contractors are intensively trying to re-win a contract for repetitive business by trying to significantly reduce the cost to the user. Many participants on both sides of the user and contractor fail to come up with key aspects of partnership, which ultimately means they are disappointed with relationships.

Critical factors that have a significant impact on project success include, inter alia, partnership and resources, and in particular communication. Also, the problem that often occurs is communication between partners, contractors, subcontractors, etc. Often, when concluding binding agreements/contracts, subcontractors are not involved in agreements between the client and the contractor. Their omission adversely affects partner relationships during project work, ultimately affecting the project's performance. Effective leadership, which implies planning, communication, partner commitment, trust and joint vision of the project, has a significant impact on the project results, i.e. on project success [35].

Table 3 Statements and control questions that describe variable Partnership and Resources

	STATEMENTS
PARTNERSHIP AND RESOURCES PM	Steering committee of turnaround project fully supervises and monitors during the preparation and implementation of the project.
	There are known sources of communication risk between project participants on the turnaround project.
	Changes in all phases of the turnaround project are agreed with the end user of the project (production).
	Communication within the turnaround project is documented. (Any change that is significant, at all stages of the project).
	Communication with other interest groups of turnaround project is regular (eg. once a month and documented, archived in minutes).
	CONTROL QUESTIONS
	How many members participated in your team on the turnaround project (phase I, preparation, planning).
	Estimate the total number of persons who participated in the turnaround project (planning phase, execution phase, major contractors, subcontractors, maintenance, environmental service ...):

Pinto & Mantel [36] have identified communication as providing the network members with the necessary information of all key actors in project implementation. Müller [37] identified three aspects of communication he used in his research: the frequency of communication, the content of communication and the type of media through which communication was conducted. The frequency of communication is important due to the record of progress and knowledge of all necessary project information; it can be: daily, weekly, possibly monthly. Effective communication on the project is of crucial importance for the processes of creating and maintaining all project participant relationships. The success of the project is based on strong relationships that are effective, accurate and planned with all project stakeholders [38-40].

Existing literature related to the statements that describe the variable partnership and resources is very extensive and is not specified for particular types of project. It is necessary to choose the statements that best describe the variable partnership and resources and reflect the specificity of the project being examined. Selected statements and control questions that describe previously mentioned variable for TAR projects are presented in Tab. 3.

Based on previous research the second hypothesis follows:

H2: Efficient leadership will have a positive impact on partnership and resources.

3.3 Policy and Strategy, Partnership and Resources, and Project Management Processes

According to the literature and the business excellence models, the project manager is most responsible for formulating the goals and the strategy of the project [41]. In project management practice, policy and strategy are defined most often at the organisational level of the company. Project leaders and team nominees have minimal, almost no influence on the formation of a policy and strategy, but the existing organisational structure and resources are being exploited, applying different tools and techniques in order not to significantly affect established processes within the company [19]. Anderson & Merna [42] differentiate the project management strategy that is divided into management and strategy. Policy and strategy can be defined according to project performance criteria, project management methodology, human life safety and environmental protection, according to predefined criteria and other goals.

Table 4 Statements describing variable Policy and Strategy

	STATEMENTS
POLICY AND STRATEGY PM	Quality management system was established (ISO 9001).
	Internal quality management system in the turnaround project was established. (The system is standardized and included in the fundamental manual on quality management).
	Business plan for education of employees is implemented.
	Quality management plan for turnaround project is established as a separate document (a document that is incorporated into the processes of the turnaround project).
	Established turnaround project quality plan identifies activities and resources required to achieve the objectives of quality (if the quality management plan of the turnaround project is established).
	System of end user (production) satisfaction measurement is applied.
	Defining of the turnaround project plan is harmonized to the requirements and objectives of the end user (production), investment projects and other stakeholders.
	Turnaround project results are measurable at all phases (financial indicator, an indicator of quality, equipment status indicator, indicator of the efficiency of the works, the works due to the prescribed safety measures…).
	Measurement system for the prescribed safety measures, the use of protective devices and their observance in the execution of works has been established and implemented (phase II).

The existing literature, related to the statements that describe the policy and strategy variable, is very extensive

and is not specified for particular project types such as TAR projects. Most of the literature deals with organisational policies and strategies. It is necessary to choose the statements that best describe variable policy and strategy and the specificity of the project being examined. Selected statements that describe variable policy and strategy are shown in the Tab. 4.

An organisation that strives towards business excellence manages and improves processes to fully satisfy and generate greater value for customers and stakeholders [1]. Key processes are those that have a significant impact on the critical results for a particular organisation [43]. Identification of the statements that best describe the variable processes are risk management, project management methodology, project management and control, process documentation and project management procedures, change management, project management tools and techniques, reporting on progress, project planning and implementation, process and procedure implementation, monitoring and feedback etc.

Dvir et al. [44] identified claims that describe leadership but are also significant for processes. One of the project management processes is the implementation of project management processes and procedures, and as a research variable is described through the following indicators: number of variables including systematic engineering, engineering design, risk management, resource planning and scheduling, financial management, contract management, procurement management, quality and reliability management, technical control management, end user management, configuration management, change management, team management, management by making decisions and meetings, reporting, communication and transferring them to production.

Table 5 Statements describing the variable Processes

	STATEMENTS
PROCESSES PM	Preventive actions are performed in all phases of the turnaround project (eg. implemented preventive actions are documented).
	Corrective actions are performed in all phases of the turnaround project (eg. implemented corrective actions are documented).
	Continuous improvements are conducted in all phases of the turnaround project and are standardized. (eg. activities that improve the processes of the Turnaround project are standardized...)..
	Risk management in turnaround project is established (methods of measurement and risk analysis in all phases of the turnaround project).
	Documentation of turnaround project is in all phases adequately collected, distributed and archived.
	Risk management related to the process of the turnaround project is established (planning, I. phase).
	Processes which proves that the Turnaround project is harmonized with the predefined quality standards are established.
	In the turnaround project statistical sampling is applied.
	In the turnaround project process of monitoring and recording the results of the implementation of quality activities (to assess the effectiveness) is established.
	Cost of project quality (e.g. cost of establishment) is calculated.
	The benefits of Turnaround project quality are defined.
	The most common tools used for quality control in all phases of the Turnaround project are: control charts, histograms, Paretto charts, line charts, scatter diagrams, diagram of cause and effect...
	The procedure of turnaround project management is conducted (a document that was established and introduced into the basic manual of quality management)..
	Reports on performed work on the turnaround project were submitted within the deadline, by the main contractor and other contractors (at the latest 30 days after the end of the II. phase - execution).
	Process for managing, identification and analysis of risks in turnaround project is established.
	Risks of turnaround project are measured, rated and archived (risk register).
	The effects of weather condition risks are taken in account during the turnaround project.
	The effects of environmental protection risks are taken in account in all phases on the turnaround project.
	Impact of the health protection and safety risks are considered in all phases on the turnaround project.
	Impact of the risk of changes in the project workscope in the "freezing" phase on the turnaround project are being observed.
	Impact of the risks of complex technical solutions (project solutions replacement of equipment, etc.) to the turnaround project are being observed.
	The effect of procurement of spare parts and materials (procurement) risk on turnaround project are being observed.
	The effect of the unplanned work risk on the turnaround project are being observed.
	The effects of contractors and subcontractors risk on the turnaround project are being observed.
	Impact of the risk of support from higher management on the turnarond project are being observed.
	The effects of the risk of additional end user requests (production) after the "freezing" of the workscope plan on the turnaround project are being observed.
	The effects of the risks of objectives such as cost and time under execution phase on the turnarond project (eg, unrealistic deadlines and price for particular works on particular equipment) are being observed.
	Impact of the risks of organisational skills of the project manager to the turnaround project are being observed.
	The effect of risk of planning time and expenditure of resources for planned work on the turnaround project are being observed.
	The effects of quality management risk on the turnaround project are being observed.
	The effects of the risks of nominated works selection based on the risk matrix to the turnaround project are taken into account.
	Impact of the risks of the turnarond project budget change after defining the workscope and other activities (immediately prior to the plan freezing or after freezing the plan) to the turnaround project are taken into account.
	Health protection and safety plan has been established in all turnaround project phases.
	The objectives of health protection and safety are prescribed for the turnaround project and quantified wherever possible.
	Management of health and safety risks are measurable turnaround project results.
	Internal audits of the health protection and safety management system are conducted in all phases of turnaround project in pre-scheduled intervals.
	Environment management plan has been established in all turnaround project phases.
	Measurement system for the prescribed measures of environmental protection management and their observance in the execution of works has been established and implemented (phase II).
	The objectives of environmental protection management are prescribed for the turnaround project and quantified wherever possible.
	Risk management for environmental protection are measurable turnaround project results..
	Internal audits of the environmental protection management system are conducted in all phases of the turnaround project in pre-scheduled intervals.

Existing literature related to statements describing the variable process in project management is very extensive and is not specified for each project type. Most of the literature deals with organisational processes while less on project management processes. It is necessary to choose the most suitable descriptions of the variable process, especially given the specificity of the project being examined. The number of statements for this variable is

more extensive to cover all significant processes in managing TAR projects. Selected statements describing the variable processes are shown in Tab. 5.

Eskildsen and Dahlgaard [33] in the empirical analysis of EFQM models have found a significant positive relationship between partnership management and key elements of process management. It can be concluded that there is a positive relationship between partnership and resources and management process. The third hypothesis follows:

H3: Effective project team, partnership and resources and clear policy and strategy will have a positive impact on project processes.

4 TESTING THE FACTORS OF QUALITY MANAGEMENT PROCESS IN TURNAROUND REFINERY PROJECT

4.1 Sample

Empirical research was conducted by surveying in five oil refineries in Croatia, Italy, Slovakia and Hungary. The questionnaire is intended for project managers within the turnaround refinery project management offices and interest groups of the TAR project, most concerned with research issues. The survey was sent to 250 respondents. The response rate was 118 respondents, which is 47,2%. Questions were measured by Likert scale from 1 to 5 (1 = strongly disagree, 2 = disagree, 3 = neither agree/nor disagree, 4 = agree, 5 = strongly agree). The criterion for participating in the survey was the selection of respondents who participated in a minimum of one TAR project. This criterion was set so that TAR project could be seen as realistically as possible. The survey was also conducted on the basis of interviews of project managers and members of the TAR project stakeholders and by the author observations as the head of the main project team.

4.2 The Results of Hypothesis Testing

The method of logistic regression was used to test the set hypothesis. Since the dependent variable in this research is categorical, it is appropriate to apply logistic regression. Also, the particularity of logistic regression is that a smaller sample is generally needed to obtain an equal test strength compared to linear regression. Sometimes a dependent continuous variable turns into a categorical, because it is not possible to form a sufficiently large sample in the research.

H1: Effective leadership will have a positive impact on the project team. Based on the statements describing the variables leadership and project team, the results of the descriptive statistics for the variables leadership in relation to the project team variable are shown (Tab. 6).

Table 6 Descriptive statistics - variable Leadership versus variable Team

	LADERSHIP PM		
TEAM PM	*N*	Mean	SD
1	2	1,00	0,00
2	41	1,24	0,62
3	45	1,93	0,69
4	26	3,31	1,05
5	4	3,75	0,50

From Tab. 6 it can be seen that the variable team is most often rated at 3, while the average level of variable leadership in this category is rated at 1,93. The level of variable leadership increases with increasing levels of variable team. The obtained descriptive data suggests that the variable leadership has a positive effect on the variable team.

Furthermore, hypothesis H1 will be tested. The analysis of maximum likelihood, the results of which are in Tab. 7, shows that the coefficient of variable project management leadership has a p-value of < 0,05, which means that the variable has a statistically significant effect on variable project team. After determining the statistically significant impact of the project management leadership on the project team, the following Tab. 8 shows the nature of that impact. Each odds ratio estimate may be interpreted as the variable's impact on the likelihood that it will be in a higher category as compared to a lower category. In this case, the probability that observation will be in a higher category will mean a higher assessment of the project team. Odds ratio estimate is not a test, but serves for the purpose of easier interpretation. The odds ratio estimate for the variable leadership is 6,617. It can be concluded that with each increase of variable leadership by one mark, the odds ratio that the team is in a higher category increases 6,617 times. This implies that for each higher level of variable leadership the level of variable project team will also be better, i.e. greater.

Table 7 Analysis of maximum likelihood, H1

PARAMETER	DF	ESTIM.	STAND. ERROR	WALD Chi-Square	$p >$ ChiSq
INTERCEPT 5	1	−9,5328	1,2044	62,6516	< ,0001
INTERCEPT 4	1	−5,5361	0,6963	63,2068	< ,0001
INTERCEPT 3	1	−2,653	0,4597	33,313	< ,0001
INTERCEPT 2	1	1,4343	0,8009	3,2074	0,0733
LEADERSHIP PM	1	1,8896	0,2551	54,8656	< ,0001

Table 8 Odds ratio estimates, H1

EFFECT	POINT ESTIM.	95% WALD CONF. LIMITS	
LEADERSHIP PM	6,617	4,013	10,909

By proving the hypothesis of the positive influence of the variable leadership on a team variable (H1), it can be concluded that project management leadership is important to adequately educate and develop because it significantly affects the project team's efficiency. It can be assumed that the leadership and team impact will also enhance project management success and the success of the project itself.

H2: Efficient leadership will have a positive impact on partnership and resources. The results of the descriptive statistics for the variable leadership in relation to the partnership and resources variable are shown in Tab. 9.

Table 9 Descriptive statistics - variable Project Management Leadership versus variable Partnership and Resources

	LEADERSHIP PM		
PARTNERSHIP AND RESOURCES	*N*	Mean	SD
1	4	1,25	0,50
2	32	1,28	0,63
3	52	2,02	1,02
4	23	2,61	0,84
5	7	4,29	0,49

Variable partnership and resources were most often rated at 3, while the average level of leadership variable in

this category was estimated at 2,02 (Tab. 9). The level of leadership variable increases with the rise in the level of partnership and resource variable. Such descriptive data suggests that a variable leadership could have a positive impact on the variable partnerships and resources.

Furthermore, hypothesis H2 will be tested. The analysis of maximum likelihood, the results of which are in Tab. 10 also confirmed that at least one independent variable in the model has an impact and describes the dependent variable. Also, from Tab. 10 it can be seen that the project management leadership variable coefficient has a *p*-value of < 0,05, which means that the variable has a statistically significant effect on the variable partnership and resources. After determining the statistically significant impact of the leadership on the partnership and resources, the following Tab. 11 shows the nature of that impact. The odds ratio estimate for the variable leadership is 4,381. It can be concluded that with each increase of variable leadership by one mark, the odds ratio that the partnership and resources are in a higher category increases 4,381 times. This implies that for each higher level of variable leadership the level of variable partnership and resources will also be better.

Table 10 Analysis of maximum likelihood, H2

PARAMETER	DF	ESTIM.	STAND. ERROR	WALD Chi-Square	*p* > ChiSq
INTERCEPT 5	1	−6,7843	0,8186	68,6855	< ,0001
INTERCEPT 4	1	−4,424	0,5812	57,9462	< ,0001
INTERCEPT 3	1	−1,696	0,4013	17,8652	< ,0001
INTERCEPT 2	1	1,151	0,5918	3,7821	0,0518
LEADERSHIP PM	1	1,4773	0,2135	47,8951	< ,0001

Table 11 Odds ratio estimates, H2

EFFECT	POINT ESTIM.	95% WALD CONF. LIMITS	
LEADERSHIP PM	4,381	2,883	6,657

By proving the hypothesis of the positive effect of the variable of leadership on the partnership and resource variable (H2), it can be concluded that project management leadership is a very important factor in the efficient application of partnership and resources, and then generally in the quality assurance process in TAR projects and therefore it is essential to educate them and develop. Also, in this case, it can be assumed that the impact of leadership and partnership and resources will increase the success of project management and the success of the project itself.

H3: Effective project team, partnership and resources and clear policy and strategy will have a positive impact on project processes. The results of the descriptive statistics for the variables project team, partnership and resources, and clear policy and strategy in relation to the project processes variable are shown in Tab. 12.

Table 12 Descriptive statistics - variable Team, Partnership and Resources, and Policy and Strategy versus variable Processes

	TEAM PM			PARTNERSHIP AND RES. PM		POLICY AND STRATEGY	
PROC. PM	*N*	Mean	SD	Mean	SD	Mean	SD
1	1	2,00	0,00	2,00	0,00	1,00	0,00
2	5	1,60	0,55	2,40	0,55	2,00	0,71
3	57	2,70	0,71	2,75	0,87	2,67	0,61
4	33	3,24	0,90	3,24	0,94	2,97	0,95
5	22	3,27	0,88	3,32	0,89	3,14	0,71

Descriptive data from Tab. 12 indicate that the variable processes are most often rated at 3 and 4, while very few respondents have chosen grades 1 and 2. Also, it can be concluded from the presented descriptive data that the average rating of variables team, and partnership and resources, as well as policy and strategy variable, increases as the variable processes grow. Such a conclusion based on descriptive data suggests a positive effect of variables team, partnerships and resources as well as policy and strategy on the variable processes.

Furthermore, hypothesis H3 will be tested. The analysis of maximum likelihood, the results of which are in Tab. 13 also confirmed that at least one independent variable in the model has an impact and describes the dependent variable. It can be seen from Tab. 13 that the project team and policy and strategy variables coefficient have a *p*-value of < 0,05, which means that these variables have a statistically significant effect on the variable processes. Partnership and resources variable has a *p*-value of > 0,05, which means that this variable is not statistically significant. After determining the statistically significant impact of the project team and policy and strategy on the processes, the following Tab. 14 shows the nature of that impact.

Table 13 Analysis of maximum likelihood, H3

PARAMETER	DF	ESTIM.	STAND. ERROR	WALD Chi-Square	*p* > ChiSq
INTERCEPT 5	1	−6,1209	1,0199	36,016	< ,0001
INTERCEPT 4	1	−4,5432	0,9435	23,1872	< ,0001
INTERCEPT 3	1	−1,0439	0,8944	1,3623	0,2431
INTERCEPT 2	1	0,907	1,2852	0,498	0,4804
TIM PM	1	0,6311	0,2557	6,0927	0,0136
POLICY AND STRATEGY PM	1	0,5721	0,2509	5,1984	0,0226
PARTNERSHIP AND RES. PM	1	0,2988	0,2284	1,7117	0,1908

Table 14 Odds ratio estimates, H3

EFFECT	POINT ESTIM.	95% WALD CONF. LIMITS	
TIM PM	1,88	1,139	3,103
POLICY AND STRATEGY PM	1,348	0,862	2,109
PARTNERSHIP AND RESOURCES PM	1,772	1,084	2,898

The odds ratio estimate for the variable project team is 1,88. It can be concluded that with each increase of variable project team by one mark, the odds ratio that the processes is in a higher category increases 1,88 times. This implies that for each higher level of variable project team the level of variable processes will also be better, i.e. greater. The odds ratio estimate for the variable policy and strategy is 1,348. It can be concluded that with each increase of variable policy and strategy by one mark, the odds ratio that the processes are in a higher category increases 1,348 times. This implies that for each higher level of variable policy and strategy the level of variable processes will also be better. The odds ratio estimate for the variable partnership and resources is 1,772, which means that with each increase of variable partnership and resources by one mark, the odds ratio that the processes are in a higher category increases 1,772 times. However, this variable, while achieving a positive effect, is not statistically significant.

It can be concluded that the hypothesis H3 is partially confirmed. The project team and policy and strategy variables have a positive and statistically significant effect on the process variable and are therefore important for improving the project process, i.e. acting on the efficiency of the project management process. Partnership and resource variable also has a positive effect, but the effect is not statistically significant, i.e. such a positive impact is not confirmed on the observed sample. It can be concluded that the partnership and resources factor does not make a significant variable, examined on the observed sample.

5 DISCUSSION AND CONCLUSION

Based on the conducted analysis of the refinery turnaround project management process, it can be emphasized the importance of clearly defined relationships and their mutual influence. Each factor is ultimately linked to the success of the project itself. It is important to distinguish project success from project management success [45]. Differentiating project management success and project success is the basis for identifying elements that make the project ultimately successful. If the project does not end with the achievement of the planned goals, i.e. it has not achieved the project's success, a management performance analysis is required. Most often, if project management is unsuccessful, then it is highly probable that the project will not achieve the set goals and will be declared unsuccessful.

Hypothesis H1 is confirmed, i.e. the relationship between the variables tested is positive and significant. This implies that if there is a high performance leadership in the TAR project, there will be a better project team also. If the project manager who has no special training for the management of complex projects and does not know the specifics of the project has been chosen to participate on the TAR project, it may have a negative impact on the project team, thereby directly attributing to the ineffective results of the project team. The medium size of the TAR project often includes a thousand participants. If the roles are not clearly defined, especially by the project manager responsible for project management, then such a situation may have a negative impact on the project team's effectiveness and thus on the success of the project.

Research results confirmed the **hypothesis H2**. Also, leadership has a significant and positive impact on partnership and resources. During the planning of the TAR project, the project manager has a significant role in presenting the issues of all project phases to the supervisory board, which is usually held once a month, if necessary more frequently. When managing partnerships and resources it is essential that communication must be established and documented in all phases of the project. The project manager influences the quality of communication being developed in all phases of the project, especially at the stage of preparation, when all participants have to be actively involved. Each change must be documented and distributed so that all participants are in the process of planning and preparing the TAR project. If the project manager does not recognize the problem of communication at an early stage of project planning and preparation, later these problems are multiplied with other project elements, and various conflicts occur.

Hypothesis H3 is partially confirmed. The TAR project's business processes are very wide and include business management policy and TAR project management processes. The processes set by the organisation of the company are most often rigid processes that can only slightly be affected because the changes in these processes are very trivial and include broader aspects of business. The TAR project management processes that are most commonly mentioned in the internal document of the turnaround management department, called turnaround management procedure, are more flexible and can be quickly changed and adapted to the business environment. If the project team's effectiveness level is higher and the policy and strategy is clearly defined then it significantly contributes to the efficiency of the project management process. Partnership and resource variable have not been statistically significant, which may be due to the insufficient number of respondents involved in the research.

Maintenance of refinery plants is complex due to the presence of multidisciplinary professions and the inability to prevent the current failures. In practice, the most commonly encountered is the situation where the most important maintenance works need to be adapted to the production plan. The most significant planned maintenance undertaking in the oil refinery is turnaround. Turnaround is characterized by a long planning period and short execution time, and is carried out through a project task with a large number of participants, who are often encountered for the first time with the specifics of the refinery turnaround. During maintenance, and in particular the turnaround project, high environmental protection requirements, participants' safety and other requirements and procedures prescribed by the company organisation must be adhered to, which ultimately increases the complexity of the whole project. Findings based on confirmed hypotheses and their statistical determination can contribute to the evaluation of the influence of certain variables, that is, factors that can ultimately have a positive effect on the key results of the TAR project.

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