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TRANSITION FROM PREDICTIVE TO ADAPTIVE METHODOLOGIES IN THE PROJECT MANAGEMENT LIFECYCLE USING TRIZ

Daniel Tiuc
Politehnica University of Timisoara, Romania
dani_tiuc@yahoo.com

George Draghici
Politehnica University of Timisoara, Romania
george.draghici@upt.ro

Abstract:
Nowadays the concept of product development arrived in the phase in which activities are oriented to prediction through rigorous planning of the activities. Furthermore, related activities' parameters and indicators are predicted in order to precisely estimate their future state. All the debates during meetings and brainstorming sessions, during the product development process, are concerned with the future product result. In the project team, the engineering approach is applied based on the integrated system defined by people, equipment, tools and materials, but which are inter-related in a present moment. Actual corporations' processes are strongly based in planning and prediction of their outcomes. Therefore, a need to adapt the actual predictive methodologies, by creating a new approach of how to apply TRIZ and other methodologies has raised. In this sense, the new tendencies of using and applying the cloud concept in manufacturing or product development have imposed the transition from the predictive to the adaptive concept. The aim of this research is to use TRIZ methodology combined with other methodologies (e.g. Agile, PMP, etc.), in order to create a new approach based on adaptability (adaptive process). The passing from the predictive to the adaptive concept, assumes a closer collaboration between project team members, which have to collaborate also, with other actors as suppliers and customers.

Keywords: project management, adaptive model, TRIZ, methodology, project life cycle

1. INTRODUCTION

In the actual product development market, the results are directly or indirectly influenced by the project management strategy. In this sense, projects are guided from different points of view like planning, organization, execution or implementation. Considering the background in which projects are driven to reduce the delivery time, products become more and more complex and the teams more and more diversified and complex, a need to have the projects adaptive to specific situation during development is identified.

In current situations, the project management is based on the predictability and detailed planning of the project activities, which will be carried out in the future. The scope of this research is to show an adaptive approach of applying techniques and methodologies for unpredictable situations.

In specific situations like customer complaint or design change required by the customer or by project, the project techniques should help the project to be flexible, to react in re-planning of the activities in order to achieve the final objectives of the project.

The new approach assumes to use the TRIZ methodology in combination with other techniques and methodologies, in order to improve quality of the product and to reduce to development timing, especially when special situations occur.

2. SOME ASPECTS OF THE PROJECT MANAGEMENT

According to the literature, in the product development, different approaches of the project management are used. Many companies take over data and guides from the actual project management guidelines. The Project Management Institute (PMI), the Projects in Controlled Environment (PRINCE2) or TenStep are the well-known applied approaches.

A definition of project management was given by the Kerzner, which consider that it is “the art of creating the illusion that any outcome, it is the result of a series of predetermined, deliberate acts when, in fact, it was dumb luck” (Kerzner, 2013). Moreover, the PMBOK Guideline (A Guide to the Project Management Body of Knowledge) define project management as “the application of knowledge, skills, tools, and techniques to project activities to meet the project requirements” (Institute, 2013).

According to PRINCE2 “project management is the planning, delegating, monitoring and control of all aspect of the projects, and the motivation of those involved, to achieve the project objectives within the expected performance targets for time, cost, quality, scope, benefits, and risks” (OGC, 2009).

2.1. Functions of the project management

The project management functions are target definition, project organisation (role and rights assignment), project planning and scheduling, resource planning, budget planning, project documentation, risk management, controlling, reporting, change management, project evaluation, project closure. The project team through the project life cycle supports these functions.

A detailed description of what means project management is given by Harrison and Lock describing “project management has evolved to become a general management-oriented and integrative activity, usually operating below board and top management levels.

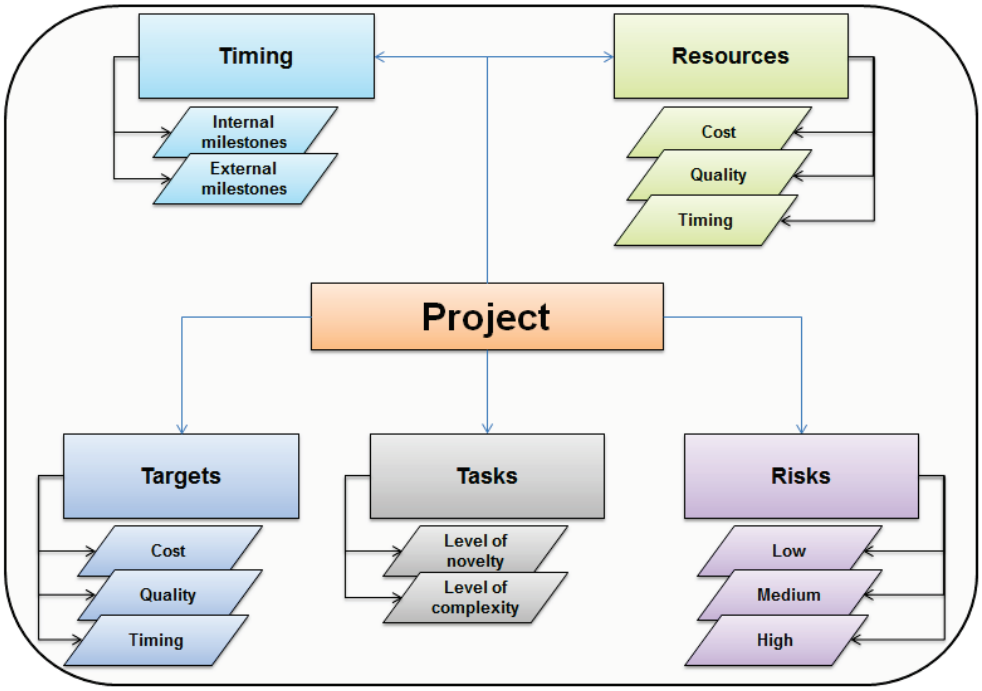
Effective project management integrates the various people and groups into one organization. It develops team working and commitment to project objectives. It is generally accepted that project management is essential for large, complex undertakings and that the effectiveness or otherwise of project management will have a profound effect on the cost of a project and the time taken to complete it” (Harrison & Lock, 2004).

The project team is managed by the project manager that involve also stakeholders in the decision making process.

The elements that characterize a project (Picture 1) are:

- Defined timing: project milestones (start, end, and customer dates);
- Limited resources: cost, quality, time;
- Measurable targets: based on quality, time, costs;
- Defined tasks: based on level of novelty and complexity;
- Risks: low, moderate or high based (technical, economical or timing).

Picture 1: Project elements



These project elements have a strong influence, any time, on the project development. These elements should be part of the functions for "planning, organizing, staffing, directing and controlling" (Chitkara, 1998). It is evident that the project needs to be much more adaptive in the specific situations, and the project team needs to be more collaborative in their daily job. In this context, is defined the team collaboration concept by considering the following aspects:

- Project start – in this step the ways of collaboration are agreed, like: meeting structure, reporting levels, escalation path, documentation;
- Schedule of work packages, milestones, responsibilities – the project team needs a clear definition of what each member has to do, what are the responsibilities, internal/external milestones, general activities;
- Tracking open points – define a specific tool for tracking the list of open points inside the team but also with external parties (customer, suppliers);
- Communication matrix – who communicate to whom (overview of internal and external team); also is defined who provides/needs information;
- Core team meetings, project status – status of project progress, time schedule reviews, work packages status;
- Virtual communication – define the communication ways between team members: net meetings, conference video calls, e-mail, PDM, chat, regular face-to-face meeting (at least for project reviews).

2.2. Adaptive model of the project management

The project management should ensure to the project team all the needed resources in order to achieve the project targets. In this sense a new approach of the project management is shown, the transition from the traditional to the new approach based on the ability of the project to adapt to the specific problems. An overview of this difference between traditional approach and adaptive approach is shown in Table 1. The new approach assumes that "projects are not just a collection of activities

that need to be completed on time. Instead, projects are business-related processes that must deliver business results" (Shenhar & Dvir, 2013).

A definition of the adaptive model PMLC (Project Management Life Cycle) is given by Wysocki: "an adaptive PMLC model consists of a number of phases that are repeated in cycles, with a feedback loop after each cycle is completed. Each cycle based on an incomplete and limited understanding of the solution. Each cycle learns from preceding cycles and plans the next cycle in an attempt to coverage on an acceptable solution" (Wysocki, 2013). Furthermore, models "are more appropriate for projects involving levels of uncertainty and complexity than the iterative models" (Wysocki, 2013).

In the next chapter are presented methods, tools and techniques used during the processes development related to a project.

Table 1: From traditional to adaptive project management

Approach	Traditional project management	Adaptive project management
Project goal	Getting the job done on time, on budget, and within requirements	Getting business results, meeting multiple criteria
Project plan	A collection of activities that are executed as planned to meet the triple constraint	An organization and a process to achieve the expected goals and business results.
Planning	Plan once at project initiation	Plan at outset and re-plan when needed
Managerial approach	Rigid, focused on initial plan	Flexible, changing, adaptive
Project work	Predictable, certain, linear, simple	Unpredictable, uncertain, nonlinear, complex
Environment effect	Minimal, detached after the project is launched	Affects the project throughout its execution
Project control	Identify deviations from plan, and put things back on track	Identify changes in the environment, and adjust the plans accordingly
Distinction	All projects are the same	Projects differ
Management style	One size fits all	Adaptive approach; one size does not fit all

Source: (Shenhar & Dvir, 2013)

3. METHODS, TOOLS AND TECHNIQUES USED IN THE PROJECT PROCESSES' DEVELOPMENT

In order to have an efficient project management process and to implement the approach of adaptive model, related methodologies are defined (especially in the automotive industry). The present research aim is to show that combining TRIZ with these methods, tools and techniques, makes projects more adaptive to the specific situations, during the project management life cycle.
During the project development process, methods, tools and techniques "are used to manage technical and business activities of the program" (Bhise, 2014). Some of the well-known techniques in this sense are:

1. Advanced Product Quality Planning (APQP) "is a structured method of defining and establishing the steps necessary to assure that a product satisfies the customer; the goal then is to facilitate communication with everyone involved to make sure that all required steps are completed in time" (Stamatis, 2016). APQP "assures timing, capacity, and quality characteristics being within the necessary requirements" (Stamatis, 2016). APQP "is based on a vehicle development lifecycle and defines what activities (to ensure quality) must be complete by end of each development phase" (Redmill & Anderson, 2001, p. 115).
2. Design of Experiments (DoE) "is a series of tests in which purposeful changes are made to the input variables of a system or process and the effect on response variables are measured" (Telford, 2007, p. 224). The DoE methodology is based on experimental study systematic and efficient, afterwards to result the best solution used for solving the problem.
3. Fault Tree Analysis (FTA) is a deductive method, which can be quantitative, qualitative, or combination. It is "a logic diagram that displays the interrelationships between a potential

critical event (accident) in a system and the causes for this event" (Rausand & Hoyland, 2004) which is used mostly in safety and reliability evaluation.

4. Failure Mode and Effect Analysis (FMEA) "is an inductive method, which allow a systematic study of the effects and causes of the failures which could affect components of the system" (Draghici, 2013). FMEA is divided in FMEA Concept, FMEA Design, FMEA Process, FMEA System, etc.
5. Control Plan consists of all the characteristics of the products and process in order to assure the control of the production process and shows how are monitored the characteristics and what the reaction plan is.
6. Key Characteristics (KCs) "are aspect of the product that require close attention" (ReVelle, 2001). The impact of Key is revealed "in development and manufacturing process because of multiple influences, like scrap, complaints, warranty claims, safety of the human life, environmental impact, rework, homologation restrictions, tact time, etc., all these influences are in fact influences in quality, cost, time, safety and environment" (Tiuc et al., 2015, pp. 1269-1274).
7. Reliability Management is defined by the ability of the product/system do not failed for a defined period from the beginning of the project in the normal condition of product/system functioning. The calculation of the reliability is performed with statistical methods.
8. 5-Why is a technique based on repetitive question - asking, used in any stage of the project. The scope is to explore cause-effect relationship and to get more information about the real root cause of the problem.
9. 8D-Report is used in solving technical and non-technical complaints, using a systematic approach based on eight Disciplines. The 8D Report "is a standard defined by the VDA for documenting the problem-solving process, it is divided into separate sections which also represent a sequence of steps to be followed, as soon as a problem becomes apparent, in order to find prompt and comprehensive solution to the problem" (Automobilindustrie, 2009).
10. Voice of Customer (VoC) is based on customer requirements identification, analysis and "translation" of them in technical requirements.
11. Quality Function Deployment (QFD) is linked somehow with VoC and helps to "translate" the VoC into technical requirements and prevent over-fulfilment of the requirements, focusing on what really matter in the project.
12. Theory of Inventive Problem Solving (TRIZ) is used in many areas, and the purpose of this paper is to show how TRIZ can make the project more adaptive, applying TRIZ in the above methodologies, see below description.

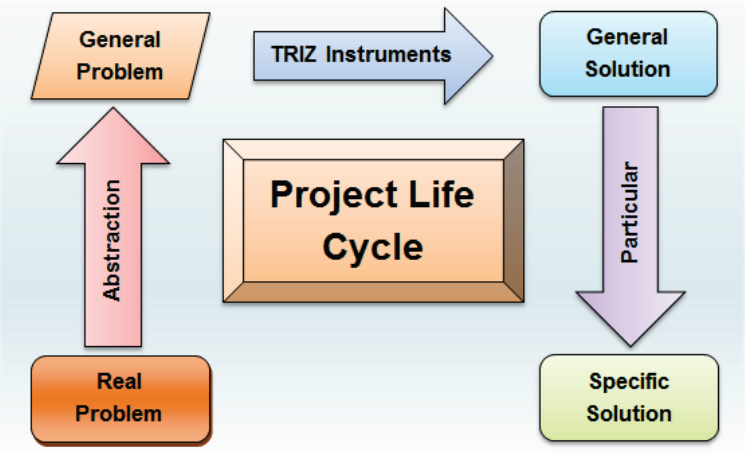
The above brief described techniques are used during the project life cycle in order to control the quality and as preventive methodologies. In this context, the scope of the present research is to see how TRIZ can be integrated in these techniques in order make them more adaptive.

4. TRIZ

Genrich Altshuller developed TRIZ after his analysis of around 2 million of the patents. The method is used on a large scale in the world, starting in Automotive Industry, aeronautics, etc. The applicability of TRIZ can be used in many areas like research and development, quality management, business management, conceptualization, production, etc.

The problem solving with TRIZ methodology is performed applying the concept presented in Picture 2, it starts with the definition of the real issue, after that the issue is generalized, than the general solution and after that, the specific solution is obtained.

Picture 2: Problem-solving concept using TRIZ

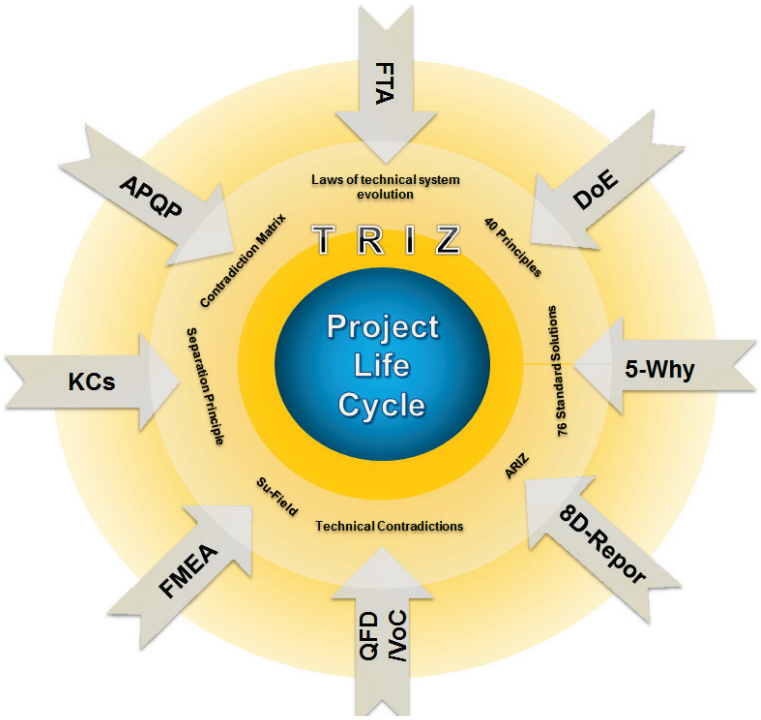


The problem solving is performed by following the next steps:

1. It starts with the base level – from the specific, real or concrete situation (problem);
2. The concrete problem will be abstracted – pass to the next step (segment product, company, activity domain, etc.);
3. The general solution will be chosen;
4. The general solution will be particularized in order to find a specific solution for the specific issue.

The occurrence of the problem in the project is caused in general, because at least two elements are in contradiction. If contradictions would not exist, it will be an ideal situation, which is impossible in real life of the project. TRIZ is based on elimination of the contradictions. In this sense, “The key to a new invention is the resolution of what appears to be an inherent contradiction or limitation in a process or system. What we normally do is to compromise. TRIZ inventive principles and the historical study of great inventions teach us that direct confrontation and resolution of contradictions are the keys to breakthrough inventions and ideas” (Innovation-TRIZ, 2016). All the techniques interact in between them and each of them receive/deliver an input/output each to other. TRIZ interconnect these techniques presented in Picture 3 and helps for the collaboration and integration of them efficiently in the project life cycle.

Picture 3: Integration of TRIZ within quality techniques in the project life cycle



TRIZ is a method, which mostly is oriented on problem solving. While QFD is used for example to determine and analyse the customer requirements, a combination integration of "QFD and TRIZ enables the effective and systematic creation of technical innovation for new products" (Yamashina, 2010). QFD is used in an efficient mode applying the 40 inventive principles from TRIZ. Integrating TRIZ in FMEA helps to find the solutions when causes are unknown, TRIZ being "a comprehensive systematic innovation and creativity methodology and its main goal is to solve unconventional problems and to forecast technologies and future products" (Regazzoni & Russo, 2011, pp. 40-51). In case of customer claims 8D Report can be validated with TRIZ before to have implemented the permanent corrective actions (Tiuc & Draghici, 2015).

5. CONCLUSIONS

TRIZ used in combination with other techniques during project life cycle and leads them to be adaptive for the specific situations – by modelling the actual techniques with TRIZ. The key in development is creativity, but not only, and this is the point where TRIZ makes sense to be applied. TRIZ makes problems and contradictions to be understandable and open new approaches of how to solve the issues. Using a general concept on problem solving with TRIZ, there are all the domains (processes) from the project management approached.

The projects are much more adaptive for the specific situations if the best specific technique to solve the contradictions, which cause the problem, is chosen.

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