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PROJECT MANAGEMENT METHODOLOGIES IN THE ORGANIZATIONS OF YESTERDAY, TODAY AND TOMORROW

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Abstract: *The history has shown us over time that each way of managing an activity can lead to a different result, which has given rise to multiple approaches to the project management discipline through diverse models and methodologies, each one coming with a number of advantages and disadvantages. The software engineering branch is a climate where projects have a lot of room for flexibility, change and adaptability. However, this scientific paper aims to highlight the characteristics of these techniques, provided by experts in the field through the scientific literature, along with an original point of view regarding their future improvement. Project management is a complex, diverse and encompassing discipline, so each new model or methodology has come to supplement the shortcomings of the previous one. Starting from these, there are a number of factors that must be taken into account when determining how a project should be managed, such as: industry, size, resources, etc., and this paper presents the areas of applicability for each methodology in part, as well as data in which several approaches intertwine resulting in hybrid project management approaches. In the end, some conclusions and predictions about the methodologies in the field of software development industry are presented.*

Keywords: methodology, model, software engineering, project

1. Introduction

Since ancient times, people started to use project management tools and techniques by instinct, because they were facing challenges on a daily basis and looking for solutions to be more efficient and effective was the only way to progress. The organizations were like a giant sponge, meant to absorb all the knowledge discovered in order to improve themselves and therefore produce more, sell more and grow more. It was the evolution of society itself that contributed to the foundation of project management as we know it today, thanks to complex projects that needed both planning and controlling activities. In order to document all this research and development tremendous amount of work, different methodologies and scientific ways of working were invented in the form of literature to support with the sustainable development of organizations [1]. As the world was evolving on multiple areas like technology, social and emotional intelligence behaviour, this paper aims to present how the project management world

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was influenced by the evolution of telecommunication industry, technology and construction areas and therefore the actual documentation that we have represents a mix of lessons learned from the history. Depending on the result that an organization wants to achieve, the application of a project management tools can make the difference between number of resources used, time consumed, financial cost or even risks undertaken. Although at the beginning of history people were not prepared with the right knowledge to differentiate how to approach a project, nowadays it is more convenient to invest in the educational training of people involved in a project, rather than using a fit-to-all approach. The information itself was always the key element that led the society further and although boots-on-the-ground project experience will always be the best teacher, a certification in a project management methodology will be an advantage, as well, for both the organization and individuals, as a good foundation of knowledge in the field will broaden the horizons for novelty, innovation and improvement [2]. For a sustainable development of an organization, the professional training of the employees plays a very important role, as owning a diploma or a certification in a certain field is the assurance that the decisions and risks undertaken are seriously analysed through multiple points of view. Nowadays companies include several hours of training in the schedule of employees on a weekly or monthly basis and training materials and assuming the cost for the certification exam, as well, it is part of the benefits package. The software development industry took advantage of the models and methodologies from this field only lately, since the first computer was invented, and even now they built an entire culture to research, develop, test and produce based on the actual scientific literature. Therefore, a career in this branch will come also with the responsibility of each employee to seek for more knowledge, to learn new things every day and to deeper specialize on the specific areas of interest [3]. This approach later comes with better incomes, less working hours for the same activities, quick learning capacity for other tasks and adaptability improved in case of challenges. This paperwork has the mission to put on the table a deep analysis of the advantages and disadvantages of each model and methodology used in the project management field, emphasizing where they could be better applied and what are their components. For this research a mix of qualitative methods were used, as content analysis, narrative analysis and grounded theory.

2. Project management methodologies used up until today in software engineering

The history of project management presents a collection of best practices, improved from one methodology to another. It is all about the retrospective capacity of the individuals to reflect on what could have been done better in order to minimize risks, resources used and time consumed. The retrospective approaches were being done in each industry where a complex project was developed, because in the early ages efficiency and effectiveness were not as important as they are today [4]. The continuous seek of optimization made possible the elaboration of multiple methodologies and models, that are still in use nowadays. Seeing the success of projects and the quality of the results delivered, many software producers included these methods in their products, making them affordable for all types of organizations, both public and private. People were trained regularly to use these methods instead of none, which facilitated implementing microcultures inside organizations, that the work needs to be documented, analysed and improved for the future [5]. This approach has put a beneficial light over the certified people,

that had the chance to get a diploma of their knowledge since 1969, when the Project Management Institute (PMI) was founded in order to promote the project management industry as a discipline. It took over 16 years for the first individual to get the Project Management Professional (PMP) accreditation at PMI, which improved the prestige that this discipline takes effort and persistence.

2.1. The beginning of Project Management

The world of project management debuted with the Gantt chart invention, in the beginning of 1920 years. This was a huge milestone for each major project developed in that area, as it was composed out of a chart with calendar planning split on activities, that facilitated a better visualisation of status and duration of a project or task. Usually, a Gantt chart includes the Work Breakdown Structure (WBS), as well. This one was a later invention from 1957, that was focusing on dividing a project into multiple manageable tasks and subtasks. The key element of the Work Breakdown Structure is the 100% rule, that states that in this structure the scope of project must fit 100% and all deliverables must be included. The most important advantages of the Gantt chart are: easy scheduling of tasks, facile creation of WBS (tasks, sub-tasks), easily integrated into software tools, clear visualization of the project status, resource management based on period of time, improved time management and transparent visualization of the belonging of the tasks. As disadvantages of the Gantt chart could be the extra time needed for updating the chart, the request for training in creating and maintaining it, difficulty in viewing the backlog, the measure unit system is not adapted to the country where the chart applies, high chances of human errors in assigning dependent tasks and extra payable hours in projects managed via Gantt charts.

2.2. Project Management recognized as discipline

Between 1958–1979 the project management industry was highly influenced by the development of the information technology sector. Starting with the Polaris Program [6], the need of a mathematical calculation to determine the deadline of a project was highly in demand and therefore the Program Evaluation and Review Technique (PERT) was founded. It consists of a diagram with the activities needed in a project, together with their duration and milestones required, as shown in the Figure 1.

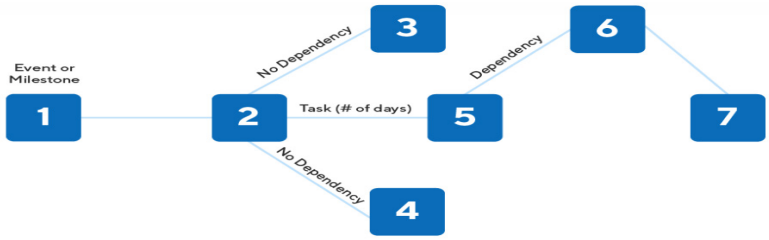


Figure 1: An example of PERT Network with 7 milestones[7]
Source: PERT Chart [Internet]. Accessed on 30th April 2023. Available from: https://www.productplan.com/glossary/pert-chart/

Then, three scenarios will be taken into consideration for the estimation of the deadline: an optimistic one, a pessimistic one and a most likely one. The PERT method is still in use for the projects with a high degree of uncertainty. The advantages of PERT method are: easy visualization on tasks' dependency, ideal method for holistically view of projects, „What if" analysis possible for each project, accurate in planning projects with high degree of uncertainty. The disadvantages of the PERT

method are: low degree of adaptability in change management, inefficient for shared resources in different projects, clearance of project scope and plan is needed at the beginning of the scheduling phase, extra payable hours needed for managing schedules via PERT diagram. In order to better emphasize the benefits of PERT technique, the Critical Path Method (CPM) was invented. This is showing via mathematical formulas the shortest way to achieve the expected results. The Critical Path Method is still at hand nowadays for projects where the deliverables, resources and deadlines are known from the beginning and no change is expected in the project plan. The most important advantages and disadvantages of the Critical Path Method (CPM) can be seen in the table below:

Table 1 Advantages and Disadvantages of CPM

Advantages	Disadvantages
Visualization of tasks that can run in parallel	Resource planning is not possible
Transparency in showing the critical activities of the project	The duration of activities can be hardly estimated
Easy to understand graphic design of the network	The shortest way to the same results is not always clear
It shows the activities that depend on each other	Not suitable for complex projects
Expectation management is accurately explained	Accurate calculations must be done to reflect the critical path.
Effective for simple projects	Extra payable hours for managing schedules via CPM

2.3. Project Management in the Human – Machine Colaboration

After 1980 the multiplication of hardware and software tools like the personal computer (PC), the printer and different project management information technology tools facilitated the enrichment of organizations with multiple smart solutions, that were able to track the efficiency and effectiveness, growing up their productivity, as well. [8] With regards to the software development industry, when the Waterfall Model was first developed it brought significant benefits in the analysis and coding phase of projects, as it is presented in the Figure 2:

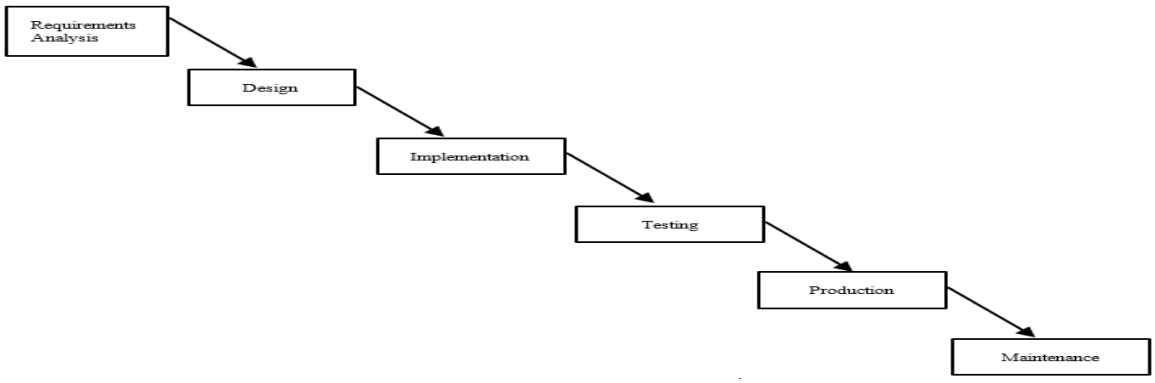


Figure 2: The Waterfall Model

Its mission was to document each stage very well before the actual implementation phase of the project and it aims to having a clear view over the solution in general [9]. It contains multiple steps disposed as in a waterfall, totally dependent on each other,

and focusing on firstly understanding what needs to be done and then applying it [10]. The main advantages and disadvantages of the Waterfall Model can be seen in the table below:

Table 2 Advantages and Disadvantages of the Waterfall Model

Advantages	Disadvantages
Progress measuring is easy	High risks involved
Simple structure	No space for innovation
Clear knowledge transfer	No customer involvement

Because the evolution of the society is in a dynamic pace, full of challenges, as the Waterfall Model was resilient to changes, the project management society was forced to develop an improvement of it, known as Agile Methodology, as shown in the Figure 3:

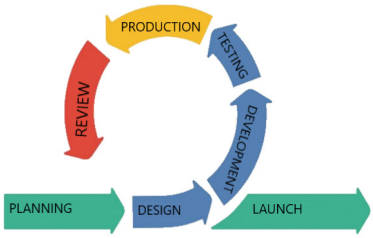


Figure 3: The Agile Methodology

It came to provide better adaptability when discussing about changes in a customer's order or just overall, so the algorithm was to produce and deliver in stages, also known as iterations, which facilitated a faster response rate and a better team collaboration [11]. This approach is contained in multiple methods like SCRUM, Kanban, etc. and it provides a flexible way to share knowledge within the team, to deliver continuously results and to increase the resilience in case of threats, instead of the Waterfall Model that was being built as a monolith and in case of errors the whole product was affected [12]. The main advantages and disadvantages of the Agile Methodology can be seen in the table below:

Table 3 Advantages and Disadvantages of the Agile Methodology

Advantages	Disadvantages
High adaptability to changes	Difficult quantification of the overall work
Risk reduction	No clear visualization of the result
High team cooperation between stakeholders	Fragmented delivery of product
Quick Return of Investment (ROI)	Limited documentation
Predictable overall costs	Uneven resource allocation

3. Conclusions

In the project management discipline, the analysed models are widely used, due to the high R.O.I. compared to the quality of products delivered. On a larger scale, the same models applied in management discipline might not present the same benefits, because they are mainly focused

on specific areas and not on the entire programs and portfolios, which represent the organisation's strategy. No methodology will be able to face all challenges of a project, for this reason the right percentage of experience and literature knowledge will lead the way to a sustainable development for each organization. The modern project management society faces dynamic changes in every moment like: how remote working is showing us how flexibility needs to be a key element in each project, how automation tools could not foresee human resources problems like lack of motivation, burn-out or lack of competences and knowledge, how digitalization is bringing the data collection topic to the next level, being able to gather information automatically about project in real time. The communication with human resources will be much more important in the future, although they will collaborate with robots, machines and informatic system tools, but they will also have to control them, to make some space for creativity, without altering in any way the personal values of each other. Hybrid approaches in project management industry focuses on learning everything from retrospectives, mitigating and foreseeing risks, taking each challenge as an opportunity and applying the knowledge from scientific literature as starting point for development, not necessarily as a standard. The latest approach called Agile has taught the world about adaptability, change and results in uneven situations and for an improvement of that, new approaches will have to come with flexibility, as well.

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