

Adaptation and Implementation of the PMBOK® for the Development of Software Applications

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Abstract

The development of software applications requires the definition of tools and techniques that allow covering and having control over the entire life cycle of the software until it is achieved. This paper proposes an analysis of the types of methodologies that currently exist and proposes the implementation of an easy-to-adapt model such as the guide of foundations for project management, focusing on the use of the four management processes and the ten areas of knowledge as found by the Project Management Institute (PMI). All this in order to obtain a model that defines a relational matrix between software phases and knowledge areas, facilitating the management of projects related to software development.

Keywords: PMBOK, software development, methodology, management processes, knowledge area.

INTRODUCTION

Directing a project regardless of the context, is one of the challenges that can face a project manager and in which good directing and management allow to reach the level of success and the achievement of objectives, especially if it focuses on the development of software projects. The project manager must identify, define, adapt and apply the knowledge, skills and tools necessary so that he can focus on making good use of the resources assigned. [1]

Therefore, for the development of software projects, there are different methodologies or models that can be adapted to implement and carry out the whole process [2], thus obtaining a single product that meets the previously established requirements.

Within the types of existing methodologies, it can be classified and grouped into two categories [3]: heavy or traditional methodologies that are characterized by being very laborious, in which each process is carried out in a meticulous manner, the requirements must be clear and complete from the beginning and all the development must be fully documented [4]; and the agile or light methodologies [5] that are the most practical methodologies, handle an informal communication style and

the projects are designed and built through the flow of information with clients that do not handle a large documentation. [6,7]

In addition to these two categories, it is possible to opt for the implementation of an easy and applicable adaptation model related to software development, which facilitates the management of the entire project through the use of methods, tools and techniques, such as the application of a PMBOK through its management processes and knowledge areas. [8]

Since carrying out a successful management of a project, incur to have abilities and to be receptive to an early alert indicating that the performed work can be in danger until the point in which not correcting it on time can unleash its complete failure [9], therefore, it is of vital importance to define a methodology from the beginning of the project that allows guiding the identification of a work team, defining responsibilities and structuring the dedicated work packages as well as the tasks of project management as well as technical tasks, besides, the elaboration of a schedule and budget adjusted to the need in a way that can ease a correct follow-up and control in order to reach successfully the project objectives.

MATERIALS AND METHODS

This paper proposes an adaptation of the PMBOK applied to the software development, for its implementation it starts from the analysis of the existing documentation and the software production, where the main components of the PMBOK are evaluated, and then a proposal of adaptation of this project management standard is made.

PMBOK:

The guide of the fundamentals for the direction of projects is a reference frame that defines a series of standards, guidelines or parameters that can be opened [8], meaning, it is not bound to be applied as such, so it can adapt according to the case, attempting to achieve results and proposed objectives.

Table 1: Relationship between the areas of knowledge and the groups of processes [10]

Knowledge Areas	Project Management Process Groups				
	Initiating Process Group	Planning Process Group	Executing Process Group	Monitoring and Controlling Process Group	Closing Process Group
4. Project Integration Management	4.1 Develop Project Charter	4.2 Develop Project Management Plan	4.3 Direct and Manage Project Work	4.4 Monitor and Control Project Work 4.5 Perform Integrated Change Control	4.6 Close Project or Phase
5. Project Scope Management		5.1 Plan Scope Management 5.2 Collect Requirements 5.3 Define Scope 5.4 Create WBS		5.5 Validate Scope 5.6 Control Scope	
6. Project Time Management		6.1 Plan Schedule Management 6.2 Define Activities 6.3 Sequence Activities 6.4 Estimate Activity Resources 6.5 Estimate Activity Durations 6.6 Develop Schedule		6.7 Control Schedule	
7. Project Cost Management		7.1 Plan Cost Management 7.2 Estimate Costs 7.3 Determine Budget		7.4 Control Costs	
8. Project Quality Management		8.1 Plan Quality Management	8.2 Perform Quality Assurance	8.3 Control Quality	
9. Project Human Resource Management		9.1 Plan Human Resource Management	9.2 Acquire Project Team 9.3 Develop Project Team 9.4 Manage Project Team		
10. Project Communications Management		10.1 Plan Communications Management	10.2 Manage Communications	10.3 Control Communications	
11. Project Risk Management		11.1 Plan Risk Management 11.2 Identify Risks 11.3 Perform Qualitative Risk Analysis 11.4 Perform Quantitative Risk Analysis 11.5 Plan Risk Responses		11.6 Control Risks	
12. Project Procurement Management		12.1 Plan Procurement Management	12.2 Conduct Procurements	12.3 Control Procurements	12.4 Close Procurements
13. Project Stakeholder Management	13.1 Identify Stakeholders	13.2 Plan Stakeholder Management	13.3 Manage Stakeholder Engagement	13.4 Control Stakeholder Engagement	

This guide is made up of five groups of project management processes that have well-defined dependencies [11], the application of these processes can become iterative and repetitive since all these can be carried out within the same

phase of the project's life cycle. These groups of processes are linked together by inputs and outputs, that is, the result of one process is transformed into the input of another process, see Fig. 1.

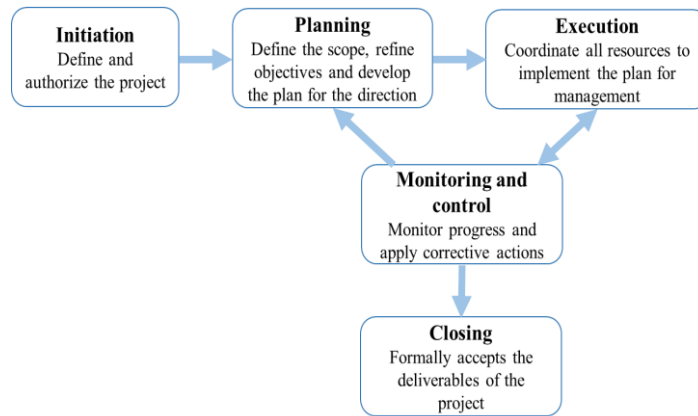


Figure 1: Process groups

In addition, the PMBOK defines 47 processes associated with the management of projects, which are grouped into ten areas of knowledge: integration, scope, time, costs, quality, human resources, communication, risks, acquisitions and stakeholders [8,10], which are mostly used throughout the project development or adjusted according to the needs and criteria of the project manager; for each of the defined areas, it will be necessary to have some inputs, tools, techniques and outputs to be fully covered. Similarly, Table 1 shows how the knowledge areas are integrated with the process groups of the project management.

Therefore, the relation of areas and processes presented in Table 1, provides a global and integrated view of the process, which facilitates the definition and adaptation of different models that allow advancing towards a viable structure according to the situation that is being handled. In the same way it is possible to identify a clear work scheme that allows, during the development of software projects, to question and correct the work that is underway, leading to make changes that result in the fulfillment of the defined objectives based on a correct

delimitation of scope, resources and time management, costs, risks and stakeholders.

RESULTS AND DISCUSSION

With the emergence of the PMBOK, as a guide for projects management, an adaptation of the same was made, oriented to the context of development of software applications, achieving as a result the obtaining of a work breakdown structure, see Fig. 2, in which can be seen the full scope of the project. The proposed adaptation defines in a hierarchical way six work packages: a first package that covers the tasks related to the management and direction of the project, four packages related to the technical tasks (software development cycle) and a last package dedicated to the disclosure of project results; with which an explicit definition was obtained of all the necessary tasks that the work team must perform to comply with the proposed objectives in the development of the software application.

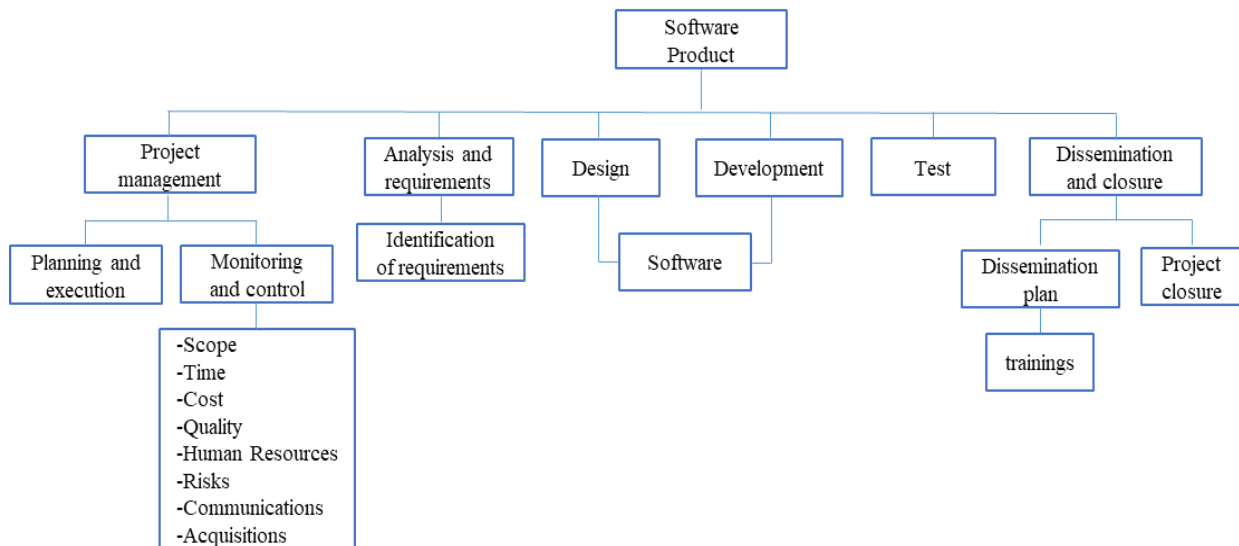


Figure 2: Work Breakdown Structure

Table 2: Matrix of software phases vs. knowledge areas

Analysis	Design	Development	Tests	Implantation	Maintenance
*Analysis of the need *Determination of requirements *Formalize the agreement with users	*Structure data representation *Interface *Procedural detail	*Generate the product or service *Integrate outsourced or externally acquired elements	*Validate that the product or service obtained meets the defined requirements	*Start up the product or service	*Ensure that the use of the project is the intended *Make corrections if necessary
Integration: *Act of Constitution of the project *Project Stakeholder: *Identify the interested parties Scope: Define scope Time: *Define activities *Develop schedule Cost: *Estimate costs Quality: *Plan quality Human Resource: *Team development Communication: *Plan communications Risk: *Identify risks	Integration: * Direct the project Acquisition: * Make acquisitions Time: * Manage deliveries	Integration: * Monitor and control work Scope: * Verify the scope * Control the scope Time: * Control the schedule * Perform integrated change control Costs: * Control costs Acquisitions: * Execute acquisitions	Risk: * Control risks Communication: * Distribute information	Scope: * Verify scope Communication: * Report performance Stakeholder: *Manage stakeholder participation	Integration: * Close project Acquisitions: * Close acquisitions
Project Management					

Likewise, the definition of a matrix in which were compiled the processes for the management of projects associated with their respective areas of knowledge and that in turn overlap and interact with each of the software phases, having thus a tool of easy adaptability, that allows to structure and to follow up to any project related to the development of software applications; This definition and association of processes is clearly shown in Table 2.

CONCLUSIONS

The project managers are responsible for defining how to perform the project management, in the same way choose which tools, methodologies and techniques to use; for this reason in this paper, it was performed an analysis of the conceptual framework and good practices that defines the PMBOK to adapt and implement it to software development, obtaining as a result the definition of a plan that includes aspects related to the description of a work breakdown structure and a combination of software phases regarding the knowledge

areas and groups of established processes. Therefore, the adaptation and implementation of the PMBOK is a valid option through which a software technology project can be managed.

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REFERENCES

[1] Crawford, L.: Senior management perceptions of project management competence. In: International Journal of Project Management, 23 (1), pp 7-16 (2005)
 [2] Shah, U.: An Excursion to Software Development Life Cycle Models: An Old to Ever-growing Models. In:

ACM SIGSOFT Software Engineering Notes, 41(1), pp. 1-6 (2016)

- [3] Leau, Y., Loo, W., Tham, W., Tan, S.: Software Development Life Cycle AGILE vs Traditional Approaches. In: Int. Conference on Information and Network Technology. IPCSIT Singapore, 37, pp. 162-167 (2012)
- [4] Khan, A., Qurashi, R., Khan, U.: A comprehensive study of commonly practiced heavy and light weight software methodologies. In: IJCSI International Journal of Computer Science Issues, 8(4), pp. 441-450 (2011)
- [5] Brhel, M., Meth, H., Maedche, A., Werder, K.: Exploring principles of user-centered agile software development: A literature review. In: Information and Software Technology. 61, pp. 163-181 (2015)
- [6] Moram, A.: Agile Software Development. In: Agile Risk Management. SpringerBriefs in Computer Science, pp. 1-16 (2014)
- [7] Singh, G., Mishra, A., Singh, H., Upadhyay, P.: Empirical Study of Agile Software Development Methodologies: A Comparative Analysis. In: ACM SIGSOFT Software Engineering Notes, 40(1), pp. 1-6 (2015)
- [8] Sánchez, L., Solarte, L.: The body of knowledge of the Project Management Institute-PMBOK® Guide, and the specificities of project management - a critical review. In: Innovar Journal of Administrative and Social Sciences, 20(37), pp. 89-100 (2010)
- [9] Kappelman, L., Mckeeman, R. and Zhang, L.: Early warning signs of IT project failure: the dominant dozen. Information Systems Management, 23(4), Pp. 31–36 (2006)
- [10] Project Management Institute.: A Guide to the Project Management Body of Knowledge (PMBOK® Guide) – Fifth Edition. Newtown Square, Pennsylvania, USA (2013)
- [11] Madani, F.: Embedding knowledge management to project management standard (PMBOK). In: Technology Management in the IT-Driven Services (PICMET). pp. 1345-1352 (2013)