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TRIPLE RESTRICTION IN MANAGEMENT TECHNIQUES IN PLANNING PROCESSES IN THE PROJECT MANAGEMENT: A REVIEW

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ABSTRACT:
The management of the triple restriction or iron triangle, in project management is a fundamental part of the knowledge of a project manager, therefore, the article aims to review the techniques that a project manager must know to do an adequate work within the framework to guarantee the success of the project under its charge, emphasizes the role of the triple restriction, what the elements of cost, time and scope consist of, and finally the techniques for the proper management of each one of them, according to the characteristics of the project in its planning phase. The adequate management of the elements of the triple restriction, allow guaranteeing the success of the project according to the requirements of the interested parties, in the stipulated time and with the resources available for it, in a crucial stage of the same, the planning.

INTRODUCTION:

When the subject is about projects it is also about multiple elements that interact with each other, all aimed at achieving a goal. Similarly, the projects peaks based on time, as a temporary effort to create a unique product, service, or result (PMBOK, 2017), based on an intelligent solution to the approach of a problem (Urbina, 2001), such as the result of materializing an idea according to the need (Estrada, 2015), projects as a set of activities involved in the use of resources to obtain benefits (Gittinger, 1985), all definitions seek to fulfill a purpose and an objective.

What differentiates projects from an ordinary activity are planning (Nilsson and Söderholm, 2005),planning is an intrinsic process in projects, this is how work´s

team members are guided to achieve the objectives that the project has established, together with the achievement control of the project objectives, when the techniques and tools are applied, make the organization meet the project objectives in the required time, with the requested technical specifications, with the assigned resources (Muhammad, 2017).

The project management purpose is the fulfillment of the project in time, cost, and technical requirements. The main referents of project management emphasize this definition, The International Organization for Standardization (2013), in ISO 21500 defines project management as the application of methods, tools, techniques, and competencies, in a compendium of processes in the different stages of the life cycle of a project, in relation to costs, deadlines, and requirements, project management is also defined by PRINCE2 as a temporary organization to produce a single result, in a set time, using predetermined resources, for its part PMI, Project Management Institute (2013) refers to the application of knowledge, skills, tools, and techniques to project activities to meet the requirements of the same.

All definitions include compliance with the scope, cost, and time for project management, these elements make up the so-called triple restriction, that is why the objective of this document is to describe the techniques for managing the triple restriction of projects during the planning process.

METHODOLOGY:

This document was created to follows a descriptive model. For this reason, a collection of bibliographic information on project management was carried out, the bibliographic material corresponds to articles published in academic journals, master's theses, or doctorates in the area of project management, as well as excerpts from the most recognized project management guides worldwide, in this case, those prepared by PMI, ISO and PRINCE2 and project management books with ISBN numbers.

DEVELOPMENT AND DISCUSSION:

The Triple Constraint in Project Management:

The project management core has hearth three edges, it talks about the scope or quality, time, and costs. These are evaluated for the correct execution of a project as elementary proposals(Quintana, 2017), definitions, and conceptual conjectures the success of projects dates back to 1970, and those who have not yet reached a consensus (Joslin and Muller, 2015), there are authors who define the success of projects when the results are delivered on time, complying with a budget and with all the required characteristics and functionalities (The Standish Group International, 2013), meanwhile, Wysocki (2014) accredits the success of the projects to business areas such as increased profits, avoided costs, and improved services. Other authors are a little more conservative, in stating that the success of the project must be agreed upon at the beginning of the project by the interested parties, and agree at the discretion of the parties that it is considered as a success within it, according to what it represents and grants the project for stakeholders (Turner, 2009).

All the definitions of project success contain the three elements that start from the fundamental model called by multiple authors as the iron triangle, project triangle, the project manager's trilemma, the project management triangle, triple restriction, among others. A project must begin to be planned according to these three elements, time, cost, and scope or quality, this last element is a fundamental factor for the purpose achievement of the projects, regardless of the conceptual variations of the success definition of the project. These elements will always be present; therefore, the review will be focused on the management of techniques that allow controlling these elements of the triple restriction.

Figure 1 shows the iron triangle edges, in this case, the relationship of the triple restriction in projects, the lines that join them, represent the dependence of the cost, time, and scope or quality parameters, if one of these values is altered, at least one of the other parameters needs to be modified to restore the symmetry of the triangle, which represents the balance of the project (Wysocki, 2014)

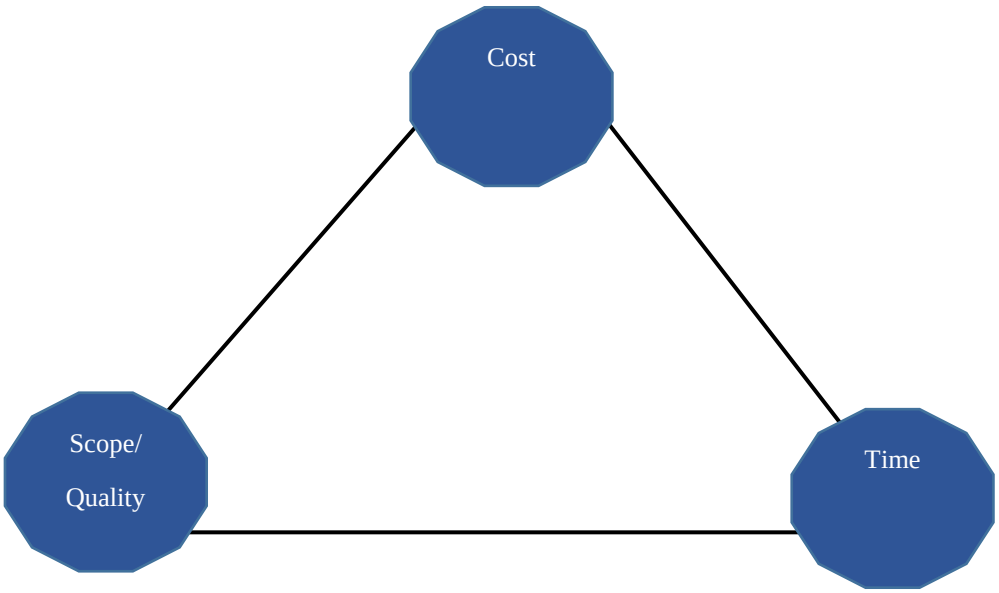

Figure 1. Triple Restriction in Project Management According to The Author

The game between scope and cost in one of the edges of the triple restriction triangle allows to elucidate two variations, if one of these is moved to the center of the triangle brings with it different ways of conceptualizing this variation.

Figure 2 shows the first variation that establishes the project quality is directly rooted in the three variables of the triple restriction and is affected by the balance of the three factors (Van Wayngaad, Pretorius, and Pretorius, 2012).

Figure 2. The First Variation of The Triple Restriction According to Atkinson (1999)

According to PRINCE2, a product is of higher quality if it has a greater number of functional functions, and directly relates the deliverables as qualities.

Figure 3 represents the displacement of the scope in one of the triangle edges of the triple restriction, which focus the success of the project to the scope, which means, all the work must be done to achieve the objectives of time, cost, and quality, a reduction in scope means less work will be done, making time and cost goals more achievable.

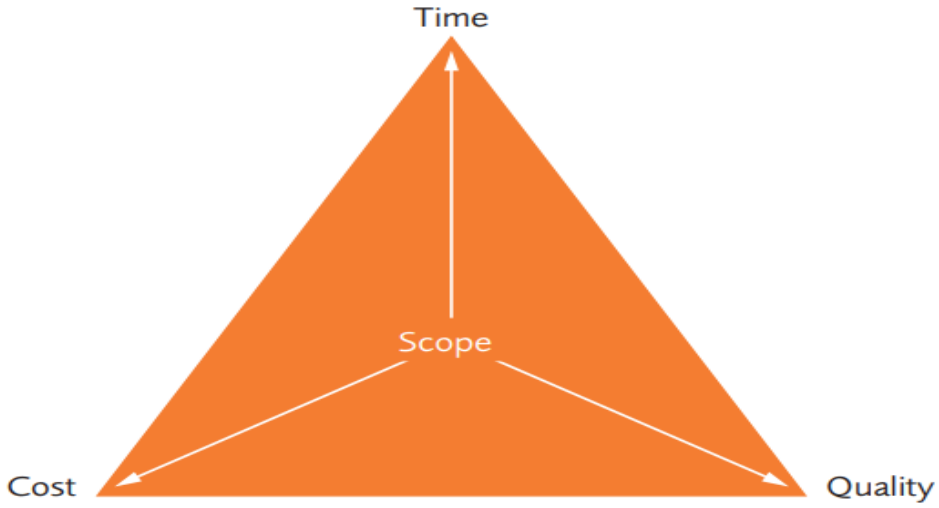

Figure 3. The Project Manager Trilemma According to Heldman (2005)

Some authors confuse between scope and quality, the first defines the project results, which are generally physical elements, tangible results, while quality refers to the degree of specification in which the project results must be delivered (Heldman, 2005)

The use of one or another element in the triple restriction depends on the class of deliverables that the project proposes, in some cases defining the scope when the deliverables have a higher degree of tangibility is the best option, but when the deliverable is less tangible and criteria with a higher degree of subjectivity, applying quality would have better results. All triple constraint elements are the backbone of project planning processes.

Scope Management:

The project scope is the beginning of the planning of a project, this includes the process of including all the work required to successfully complete the project (PMBOK, 2017), deliverables are agreed upon, which are tangible and quantifiable products before from the start of the project, this agreement seals the technical conditions that it requires (Al-Turfi, 2017).

Scope management allows a better view of the project's deliverables, of each of its work packages, to be clear about the assumptions and restrictions, which must be documented from the beginning, all this results in a product, service, or result with specific functions and characteristics (PMBOK, 2017; ISO 2011) For the definition of scope management, the following criteria must be considered:

• Stakeholders or Stakeholders Management
• Requirements management
• Technical definition of the project requirements.
• Features and functionalities.
• Technical description of the deliverables.
• Criteria for acceptance of deliverables
• Control elements.

The correct definition of the scope requires great precision since the quality of the results, time and resources depend on it (Moreno et al., 2019).

Techniques For Scope Management:

The following sections show the different techniques that allow managing each of the criteria for managing the scope of the project.

Techniques For the Management of Stakeholders:

These allow the identification of the expectations and demands of the stakeholders, there are multiple techniques for the management of the interested parties, the following are those that in the author's discretion are of greater relevance due to their application.

•Dialogue with stakeholders. Prepared by the ORSE (French Observatory of Social and Cooperative Responsibility), this technique has two parts, the first one is carried out for identification with an expert panel to answer the questions, why? Who? And how? the second part lists the major interest groups; non-

governmental organizations, suppliers, local communities, employees, and consumers (Guerrero, 2013)

• Mitchel, Agle, and Wood model. It consists of a Venn diagram, which relates the variable power, legitimacy, and urgency, the combination of the different ones gives as a product seven stakeholders types; latent, discretionary, claiming, dominant, dangerous, dependent, and definitive, after which a matrix is proposed that assesses the magnitude of the variables, which is called consolidation (Guerrero, 2013)
• Gardner Power and Interests Model. This classifies the interested parties according to the "power they possess" and the "degree of interest", it does not propose identification strategies, the aforementioned model works to establish the relationship type and this connection must be had with the Stakeholders (Olander and Landin, 2005 cited in Wessinger, 2012)
• Savage model. This model to identify stakeholders, and manage strategies, the model consists of two axes: the potential of the actors to threaten the organization and their potential to cooperate with the organization, according to it4 types of Stakeholders are proposed: the mixed ones which the strategy will be to collaborate, the marginal ones which must be hired, the support ones which must be integrated into the organization, and the non-support ones from which the organization must defend itself (Savage et al., 1991 cited by Wessinger, 2012)
• Table of Stakeholders from Kloppenborg and the Project Management Institute. This model classifies stakeholders as internal or external to the organization, it takes into account whether or not they are affected by the implementation of the project. With this, it is possible to identify those stakeholders who receive the results and those who make contributions during the project (Kloppenborg, 2009; PMI 2004).

Scope Definition Techniques:

These allow the detailed description of the project and the product, the limits of the product, and the acceptance criteria.

• Expert judgment. This is required to analyze the information that needs to be developed in the project, it is made up of professionals specialized in the area. The professionals can be from the organization, consultants, Stakeholders including clients or sponsors, associations, group of industrialists among others (Khan, 2006)
• Product Analysis. This consists of making a technical sheet accepted by the organization, which translates the technical descriptions of the product, this method includes techniques such as product breakdown, systems analysis, value engineering, and value analysis (Khan, 2006)
• Analysis of Alternatives. It identifies the different approaches to carry out the work, it includes the ways to satisfy the needs and objectives defined in the project (PMBOK, 2017).

Techniques For Managing Edt / Wbs:

The scope management basic principle is to be able to have a broad and precise vision of all the deliverables of the project, which is why to achieve this task it is necessary to subdivide them and create smaller work packages that offer greater facilities for its management (PMBOK, 2017; Sapag, 2007).

• Decomposition. This planning technique subdivides the deliverables of the project into smaller components, which must be carried out by the work team (PMBOK, 2017). The decomposition brings with it a hierarchical order of each of the work packages, with their respective logical sequencing, the product of this procedure is the graphic representation of a genealogical tree with each of the work packages organized in a hierarchical way (Brotherton, 2008)

Techniques for Scope Validation. The validation process is summarized to the acceptance criteria of each of the deliverables stipulated in the EDT, this process is carried out periodically within the framework of the project as the need arises.

• Inspection. It is the simplest technique and by nature applied when receiving deliverables, it consists of measuring, examining, and validating that the deliverables meet the requirements (PMBOK, 2017).

Time Management:

Time is one of the most important restrictions within the triple restriction, the schedule is the basic control mechanism of the project's progress, in the same way, it allows to carry out the necessary analyzes and adjustments (Siles and Mondelo, 2018), the management of the project. The time contains the following elements:

• Time estimation.
• Sequencing of activities
• Schedule development.

Techniques For Estimating Time:

Estimating time is an iterative, non-linear process because each time progress is made in structuring the activities dependency and taking into account the environmental factors of the project and the company, the project total estimate tends to vary by their sensitivity until a suitable stage is reached and in accordance with the project requirements (Mendez and Ovalle, 2018; Siles and Mondelo, 2018), the estimation of costs can be carried out by the following methods.

• Analogous Estimation. It is carried out from the organization's historical data in projects with similar duration, budget, load, and complexity (Pérez, 2018).
• Parametric estimation. Quantitative determination, which is the product between the amount of work and the production rate of the worker (Hazar, 2014).

• Estimation by Three Values. It proposes the equivalence of the estimated value of the activity based on three estimates. Most likely time, optimistic time, and pessimistic time, these estimates are at the mercy of each of the scenarios and conditions mentioned (Pons, 2009)
• Reserve Analysis. It is the incorporation of additional time in the project´s general schedule, due to its natural risk, this can be defined as a percentage of the total duration of the project, the set number must be the product of risk management (Hazan, 2014).

Determination Of the Sequence of Activities.

The activities sequence is the logical relationship determination of the activities and the relationships between them (Siles and Mondelo, 2018; PMBOK, 2017; Hazan, 2014)

• Precedence Diagram. This is a graphical method that represents nodes with one or more logical relationships, this sequencing class includes 4 logical relationships: End to Start (FS), End to End (FF), Start to Start (SS) (PMBOK, 2017)
• Network Diagram. This is a diagramming technique, in addition to allowing observing the dependencies of the activities, it allows calculating the project time. (Siles and Mondelo, 2018). The network diagrams management in software such as Project allows to calculate variables that make the time control management in an adequate way, variables such as early start, limit start, slack, early finish, late finish, among others.
• Queue-Based Sequencing. This classifies the activities that can be executed with shared resources, according to their arrival in the queue, according to the sequencing rule in order of arrival or first in first out (Neagu et al., 2006).

Techniques For the Development of Schedules.

The development of the schedule is translated into graphic forms that facilitate the interpretation and subsequent control of the project's time management and the alerts that may be generated in the execution of the project.

• Critical Path Diagram. This assesses the longest and most complex path in terms of sensitivity in the control of project times, it is used to estimate the minimum duration of the project, it analyzes the moment in which they start and end to determine the slack of the tasks. (Méndez and Ovalle, 2018)
•Gantt diagram. This tool is one of the most important in time management, this representation helps stakeholders better understand the distribution of activities over time, it contains the activities on its vertical axis and their representation overtime on the horizontal. (Siles and Mondelo, 2018)
• Schedule compression. This technique helps to shorten the total duration of the project, reducing time to specific activities (Hazan, 2014), for this the analysis of negative gaps is used, using intensification or rapid execution (PMBOK, 2017).
Cost Management:

Cost management can vary according to the project stage, the purpose, the nature of the entity, the management process, and many other factors (Kim and Hyun, 2012; Villegas and Parra, 2011), therefore in a specific case, mention is made of those techniques that allow cost management in the planning phase of the project, excluding other groups of same processes. Cost management is one of the aspects with greater sensitivity in the triple restriction, and one of greater care if a balance is to be established in the project management.

• Analogous Estimation. This estimate uses historical data from previous projects of the organization, which are related to the project to be financed (PMBOK, 2017), this estimate is easy and fast as long as the organization has strong process assets within it, the challenge is in finding the correct analog for the estimation (Rodríguez and Rojas, 2015).
• Bottom-Up or Ascending Estimate. It consists of making a detailed estimate in which the human resource, materials, equipment necessary to complete each of the project items, this estimation is generic both in the projects field and for the estimation of an industry product manufacturing (Khodakarami and Abdi, 2014)
• Parametric estimation. This estimate offers a statistical relationship between the historical data and mathematical models that allow making a precision estimate, for example, square meters of construction, combined, for example, the linear regression method, it offers an estimate close to the reality of the organization (Marbán, Menasalvas, and Fernández, 2008)
• Expert judgment. An estimator based on experience and historical knowledge, this method tends to have a personal bias, depending on the cost direction. This kind of estimation is very useful especially when historical information is scarce. (Rodríguez and Rojas, 2015)
• Estimation By Three Values. This estimate is based on the range definition of values according to the uncertainty degree of the same, establishing a mathematical relationship (triangular or beta) between the most probable time, the optimistic and the pessimistic, this allows generating an estimated cost of the project (PMBOK, 2017).

CONCLUSIONS:

Proper management of the triple restriction allows guaranteeing the success of projects, regardless of nature or methodology selected to manage the project, these three elements are transversal in the development of this, they are part of the DNA of the project success. The technique for managing the triple restriction is broad, the selection depends on the nature of the organization, the group of processes in which the management tasks are located, process assets, human resources, historical information, and the level of precision when defining each of the management elements in the planning stage.

REFERENCES:

Al-Turfi, S. (2017). Best practice project management for the sustainable regeneration of Holy Karbala Province in Iraq (Doctoral dissertation, University of Bolton).

Atkinson, R. (1999). Project management: cost, time and quality, two best guesses and a phenomenon, it's time to accept other success criteria. International Journal of Project Management 17, 337-342.

Brotherton, S. A., Fried, R. T., & Norman, E. S. (2008). Applying the work breakdown structure to the project management lifecycle. In PMI Global Congres Proceedings (pp. 1-15).

Estrada, J. (2015). Análisis de los estándares internacionales más utilizados en la gestión de proyectos. J. Estrada, Análisis de los estándares internacionales más utilizados en la gestión de proyectos. Buenos Aires: UP.

Guerrero, G. A. (2013). Metodología para la gestión de proyectos bajo los lineamientos del Project Management Instituto en una empresa del sector eléctrico (Doctoral disertación, Universidad Nacional de Colombia).

Gittinger, J. P. (1985). Economic analysis of agricultural projects (No. UNN76, p. 1). The World Bank.

Hazar, H. H. (2014). Time Management tools and techniques for project management. Socio-economic research bulletin, (4), 57-62.

Heldman, K. (2005). Project Management Jump Start. John Wiley & Sons.

ISO. (2011). Iso-Dis:21500. Buenos Aires: Iram.

Joslin, R., & Müller, R. (2015). Relationships between a project management methodology and project success in different project governance contexts. International journal of project management, 33(6), 1377-1392.

Kim, H.-J., Seo, Y.-C., & Hyun, C.-T. (2012). A hybrid conceptual cost estimating model for large building projects. Automation in Construction, 25, 72–81. http://doi.org/10.1016/j.autcon.2012.04.006

Khan, A. (2006). Project scope management. Cost engineering, 48(6), 12-16.

Khodakarami, V., & Abdi, A. (2014). Project cost risk analysis: A Bayesian networks approach for modeling dependencies between cost items. International Journal of Project Management, 32(7), 1233–1245

Kloppenborg, T. J. (2009). Contemporary Project Management. Mason: South-Western Cengage Learning.

Knowledge (PMBOK guide). Newtown Square, Pa: Project Management Institute

Marbán, O., Menasalvas, E., & Fernández-Baizán, C. (2008). A cost model to estimate the effort of data mining projects (DMCoMo). Information Systems, 33(1), 133–150.

Méndez, G. L., & Ovalle, J. (2018). Diseño de proceso metodológico de gestión de proyectos de TI: basado en los lineamientos del PMI, para la oficina de tecnologías de la información y las comunicaciones del Ministerio de Vivienda, Ciudad y Territorio. [Tesis de maestría, Universidad externado de Colombia]. Repositorio institucional

Moreno Monsalve, N. A., Sánchez Ayala, L. M., &Velosa García, J. D. (2019). Introducción a la gerencia de proyectos: conceptos y aplicación.

Muhammad, H. (2017). Project management review: how the effectiveness of project management lead to project success [Thesis, Universiti Malaysia Pahang]

Neagu, C., Catanã, M., Roşu, M., &Melnic, L. (2006). A new view on sequencing the activities of production projects. In Proceedings of the 15 th International Conference on Manufacturing Systems–ICMaS (pp. 555-558).

Nilsson, A., &Söderholm, A. (2005). From blueprints to maps in project management. In EURAM Conference, Munich, Germany, May 4-7, 2005.

Olander, S., & Landin, A. (2005) citado en Wessinger, K. (2012) Evaluation of stakeholder influence in the implementation of construction projects. International Journal of Project Management, 23(4), 321-328

Pérez, M (2018). Model for Time Management based on PMBOK® Guide project Information Technology and Communications case study: Oil industry in Colombia. Revista Espacios, 39 (24), 1-14

Pons, J. F. (2009). Análisis Teórico del PMBOK y su puesta en práctica en proyectos de edificación Recuperado de http://docplayer.es/1402054-Analisis-teorico-del-pmbok.html

PMBOK, G. (2017). Guía de los Fundamentos para la Dirección de Proyectos. Project Management Institute, Inc. EE. UU.

PMI Standards Committee, & Project Management Institute. (2004). A guide to the project management body of knowledge. Project Management Institute.

Quintana Diosa, W. J (2017). Criterios para la selección de una metodología de gerencia de proyectos que permita el desarrollo de proyectos eficientes en el área de infraestructura de IT: caso de estudio en una empresa privada de transporte internacional de paquetería ubicada en Bogotá. [tesis de maestría no públicada, Universidad Nacional de Colombia] Facultad de Ciencias Económicas.

Rodríguez, H. G., & Rojas, P. A. (2015). Técnicas de Estimación de Costos para Proyectos: Revisión Bibliográfica de 2005 a 2015. [Tesis, Universidad Distrital Francisco Jose de Caldas]. Repositorio institutional.

Savage, G. T., Whitehead, T. W., Carlton, J., & Blair, J. D. (1991) citado en Wessinger, K. (2012) Strategies for assessing and managing organizational stakeholders. The Academy of Management Perspectives, 5(2), 61-75.

Sapag, N. (2007). Proyectos de inversión, formulación y evaluación. México: Pearson- Prentice Hall.

Siles, R., &Mondelo, E. (2018). Herramientas y técnicas para la gestión de proyectos de desarrollo PM4R. Guía de aprendizaje.

The Standish Group International. (2013). CHAOS MANIFESTO 2013: Think Big, Act Small.

Turner, J. R. (2009). The Handbook of Project-Based Management. Leading strategic change in organizations (3rd ed.). McGraw-Hill.

Urbina, B. (2001). Gestión de proyectos. En G. B. Urbina, Gestión de Proyectos. España

Van Wyngaard, C. J., Pretorius, J. H. C., &Pretorius, L. (2012). Theory of the triple constraint—A conceptual review. In 2012 IEEE International Conference on Industrial Engineering and Engineering Management (pp. 1991-1997). IEEE

Villegas, M. Á. O., & de Parra, H. C. R. (2011). Gestión de Costos en los Proyectos: un abordaje teórico desde las mejores prácticas del Project Management Institute. Visióngerencial, (1), 85-94.

Wysocki, R. K. (2014). Effective Project Management: Traditional, Agile, Extreme (7ed.). Indianapolis: John Wiley & Sons, Inc.