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Viable System Model and the Project Management

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Abstract

The application of Viable System Model to project management structure has been hardly done in the literature. This research aims to fill the lack between the projects management and the analysis of VSM by using the guide to the project management body of knowledge (PMBOK), sixth edition, as a diagnostic analysis tool for assessing the viability. The research is based on a modified Viable System Model for the analysis of systems. The research establishes how PMBOK can cover the requirements for an application of Viable System Model in the project management field. The research is focused on to determine the significance and potential use of PMBOK as a tool, which methodology might link Viable System Model and the project management.

Keywords: Project management, Viable System Model, PMBOK, Viability

Chapter 1 Introduction

1.1 Overview

For providing leadership as well as management to project teams, the project managers have to work within project based on organizations, and these should keep within the context of their corresponding organization, project and environment.

This work is done to investigate the applicability of the guide to the project management body of knowledge (PMBOK) sixth edition to the Viable System Model (VSM) as a framework for structural study of Project Management Systems. The research is based on a modified VSM for the analysis of systems. The research questions that should be considered in this work are: (a) How can VSM be adapted for study of project management structure using PMBOK sixth edition?. (b) What do outcomes from the application of PMBOK to VSM framework help to project management structures?.

1.2 Motivation and Objectives

The application of VSM to project management structure has been hardly done in the literature. This research aims to fill the lack between the projects management and VSM, by using the PMBOK as a diagnostic analysis tool for assessing the viability, among others.

The objectives are:

- To investigate the relevance of VSM as a framework for structural study of project management systems using PMBOK sixth edition.
- To adjust VSM to ease the study of project management structures.
- What do outcomes from the analysis of the PMBOK application and VSM contribute the project management framework?

- Using VSM as a framework for analysis, it should be identified lacks in PMBOK for a whole application to the project management structures.

- How should PMBOK be adapted to be a proper framework using VSM for analysis of project management structures?

1.3 Outline

The research establishes how PMBOK can cover the requirements for an application of VSM in the project management field. Of particular relevance is the absence of research that assesses the confluence of PMOK and VSM, being the number of current contributions that can be found in the speciality literature reduced. The research is focused on to determine the significance and potential use of PMBOK as a tool, which methodology might link VSM and the project management.

This work is organized in different chapters as described below:

Chapter 1: Introduction. This chapter presents the overview, motivation and objectives that lead to this Master's Thesis.

Chapter 2: Literature Review. The chapter presents a literature review of past and recent studies and results in project management, project governance, viable system model and complexity.

Chapter 3: Research Design. It is provided an overview of PMBOK, Cybernetics and VSM.

Chapter 4: Theoretical Framework Study. The chapter shows the main outcomes, framework study findings and guidance on applying of viability and the projects management.

Chapter 5: Conclusions. The chapter contains the conclusions of the work.

Chapter 2 Literature Review

Sustainability requires a balanced, long-term relationship between the systems and their environment. It involves that the different interests of diverse stakeholders must be adapted for maximising the interest of each one through the co-existence of all of them. Thereby, it should be tackled sustainability from a perspective of complexity management considering the Organisational Cybernetics.

2.1 Project Management

According to Greer et al. (2009) when it is executed large development programs, as for example the aerospace. Taking into account the project management best practices, it is not surely achieved the program success. Standard project management tools employed on programs cover tools as earned-value analysis and critical path analysis, among others. However, these are insufficient for carrying out all the dependencies that exist. These tools provide a limited visibility into arising long-term and short-term dynamics. The work presented a research that improved the government's capability for managing complex and large programs. As a result, the research generated a dynamic model adaptable to multiple large space system development programs. However, the accuracy of the modelling process has highlighted the need for theoretical constructs that characterize management of large, complex programs. Sources were sought to support an emerging theory that could be translated into a dynamic model that appropriately symbolizes both best and current practices in program management.

Karayaz et al. (2011) determined that there was a need to expand the body of knowledge for project management. As a consequence, the background was developed and a perspective of project management systems was determined. A model was derived from systems sciences and management cybernetics. The initial explorations were promising and presented suitable results for a case study, which included multiple government agencies.

The concept of creating value begins with the processes required to boost innovation and test the viability of ideas, through the management of the developing of the related organizational change, (Too and Weaver, 2014). Project management processes and the training of new project managers should take into account the impact of organizational shift on the success and failure of project implementations, (Hornstein, 2015).

Svejvig and Andersen (2014) presented a structured review of the rethinking project management literature, a total of six categories come out as contextualization, social and political aspects, rethinking practice, complexity and uncertainty, actuality of projects and broader conceptualization; these cover a broad range of different contributions on project management.

2.2 Project Governance

Ahola et al. (2014) examined project governance literature and contrasted with general governance literature published outside the domain of project research. The study reported the existence of two different and relatively independent streams of research. One of them tackled project governance as a phenomenon external to a specific project, while the other was able to be dealt with as internal to a specific project. As a result, it can be affirmed that there exists sizeable potential for joining project governance literature and general governance literature further. Biesenthal and Wilden (2014) presented a framework that bridged governance theories to multiple organizational levels, which were relevant to project governance. The textual data mining software Leximancer was used to identify dominant concepts and themes underlying project governance research.

Young et al. (2012) concluded the projects may not be contributing to the implementation of corporative strategies of the organizations. Furthermore, other problem can be a systematic foul in the selection mode of projects and governance. Too and Weaver (2014) affirmed that systematic project failure was a breakdown of organizational governance. The differences between governance and management as well as the performances of each of them within the overall environment of project management and organizational governance were addressed. A framework on current theory development and practice was proposed for project governance and enterprise project management. Four key elements were established to improve the performance of projects and set up value for organizations. The aim contribution of the framework was to lead organizations in the development of project governance to optimize the management of projects. The results showed that VSM justified the necessary and sufficient precondition for the viability of any organization. In fact, the theory of the VSM provides both practitioners and social scientists, an effective conceptual tool to allow better organization, governance and management. Any application of the model is able to cause a huge possibility for the improvement of organizations. The study has borne out the VSM with its underlying theory. The result should promote practitioners to apply the model to their organizations and researchers to study and assess it further. The VSM allows "intelligent organizations," pointing the manner to their viability, adaptation and learning, (Schwaninger, 2018).

According to Musawir et al. (2017) the most projects do not have a robust process for realizing a strategic value. In fact, the literature accepts the importance of project governance for allowing benefits realization; however, this research area lacks empirical evidence. As a consequence, it was analysed the relationships between effective project governance, benefit management, and project success. The results indicated effective project governance enhanced project success both directly and through an improved benefit management process, which allowed the realization of strategic objectives through projects.

There exists a reduced research into how value is produced by temporary projects from the broader perspective of a permanent organisation. Riis et al. (2019) reported the advantages of assuming an organisational perspective to understand how governance of projects created value within a permanent organisation. The results showed the complex interplay of links which were imperative, if the permanent organisation obtained value from the projects, and displayed that these were context-dependent and vary between organisations. The links were extended beyond the project's execution was critical for maximising value.

2.3 Viable System Model

The project management structure was not established for viability, but rather the pre-determined success elements associated with initial project's goals. The project success is the completion of pre-defined accomplishment factors. Project management of viability is the management of projects to warrant that these are viable as a project and the organization. This absence on project viability in the initial construction and duration of the project provides the void, where the adapted VSM for project management structure is able to help within the body of knowledge of project managements systems, (Sisti, 2017).

According to Woodman and Krasa the projects are exposed to internal and external challenges, there is an inability to respond to this, which has triggered the many a project's demise. If it is considered VSM, the model is able to determine the organization's viability i.e., its ability to adapt to change. The authors propose that NASA project managers can use it to establish the projects' viability.

Truszkowski and Karlin (2000) discussed of one aspect of the Goddard Space Flight Center's to develop a community of agents that can back up both space-based and ground-based systems autonomy. An approach was presented to model an agent community based on the theory of viable systems. The work was focussed on a discussion of the fundamental concepts modelling and infrastructure that will respond as the basis of more detailed research work into the performance of agent communities. As a result, the concept of an agent community was modelled in the cybernetic context.

Research and development organizations are often met challenges such as an investment strategy for forecasting the cost and schedule performance of selected projects. The complex environments need managers to study swiftly and to determine the value of returns on innovation investments versus allocated resources. Innovation focused technology development demands funding and managing a portfolio of coupled projects through their project lifecycles. Balint et al. (2015) introduced the Project Assessment Framework Through Design (PAFTD), a tool developed within NASA for facing this problem. The PAFTD framework was aligned with VSM and it was applied to space technology portfolio. It was highlighted its benefits in reducing organizational barriers related to strategic estimations and decision making.

PAFTD helps decision making for NASA, allowing more strategic and consistent technology development investment study. The framework takes design principles of feasibility usability and viability for aligning them with methods employed by NASA's Independent Program Assessment Office for project performance assessment. There is the need to periodically check the justification and prioritization of technology development investments as modifications appear throughout project life cycles. The framework reports management quickly and comprehensively about outlook internal and external root motives of project performance. PAFTD features a medium to quantify and measures relevant aspects of different projects to allow consistent comparisons between projects in a loosely coupled investment portfolio. The model enables senior leadership to rapidly diagnose project performance strengths and weaknesses to enhance their corresponding investment decisions. This framework has been used to check system level technology development investments across the high technology readiness levels of the NASA Space Technology Mission Directorate. This one has shown to be robust sufficiently for assessment of investment endeavours at NASA centres. PAFTD can be adapted depending on the strategy and the parameters of the entity. It is able to customize to any type of organization that invests in technology development projects (Depenbrock et al. 2015).

Espinosa (2015) used VSM as a meta-language to ease long-term sustainability in communities, business and societies, by focusing on modes of learning about governance for sustainability. It was demonstrated the power of VSM as a mapping tool to depict the complexity of multiple ranges of agents and interactions with a unified language. In addition, it was also showed the usefulness of VSM as a language to learn about complexity management and the governance challenges in organisations. This enabled the project team to develop a shared mental map of their respective socio-ecological systems through the use VSM to facility participatory model building. This process of mapping set up a learning context which favoured the shape of collective understanding of the fundamental aspects for viability and sustainability of the socioecological system.

Wang et al. (2010) set up bi-level performance measurement framework to enhance the construction enterprises' productivity. The framework consists of two subsystems: project subsystem and company subsystem. The project subsystem was categorized around the knowledge areas of PMBOK. The configuration of the VSM was used to improve the model's implementation. The process was followed by a structured interview and a case study to distinguish the adoption of the framework. Outcomes displayed that the framework was able to be vital for enhancing productivity of construction companies.

2.4 Complexity

Traditional project management facilitates the planning and minimizes the role of learning even in complex projects. A form of complex problem solving is the governance challenge of knowledge management under uncertainty, (Ahern et al. 2014).

New perspectives and concepts for an advanced level of project management education could develop the abilities needed to lead the dynamic organizational environments and complex projects. Thomas and Mengel (2008) described the evolution of project management and project management education. It was reviewed the literature of project management training programs. The impact of taking complexity was discussed on the demands for professional development of project managers. It was laid out the requirements for preparing project managers to tackle complexity and present a comprehensive model of project manager development. The features of an appropriate framework of project management education was also discussed that hug uncertainty and unknown possibilities.

Understanding complexity is relevant for project managers due to the differences associated with decision making and accomplishment of the aims that appear to be related to complex projects. Complexity affects modelling, evaluation, and control of projects as well as the objectives of time, cost, quality and safety. Complexity can also impact the selection of a suitable project organization form and the project management arrangement. Two aspects can be highlighted, the lack of consensus for determining project complexity and the fact that the focus of complexity models is fundamentally on aims and methods, (San Cristóbal, 2017). According to Espinosa et al. (2008) there is broad acceptance of the requirement for a more holistic approach to sustainability. It was presented a theoretical framework based on complexity science which was focused on organisational and second order cybernetics.

Chapter 3 Research Design

3.1 PMBOK Outlook

PMBOK is admitted as a guide and knowledge source for the project management profession throughout the world. It provides "guidelines for managing individual projects and defines project management concepts" (PMBOK, 2017). The definition of project from PMBOK is "A project is a temporary endeavor undertaken to create a unique product, service, or result" (PMBOK, 2017, p. 521). This one is considered a guide rather than a specific methodology. It should be highlighted that provides an essential tool for a professional discipline such as a common vocabulary, and this is required for applying and using project management concepts within the profession.

Regarding the PMBOK standard for project management the project objectives may generate one or more of the following deliverables:

- A unique product that is able to be either a component of another item, an enhancement or correction to an item, or a new end item in itself.
- A unique service or a capability to carry out a service.
- A unique result, such as document or output.
- A unique combination of one or more services, products or results.

PMBOK splits project management into five groups such as:

- ✓ Initiating process group
- ✓ Planning process group
- ✓ Executing process group
- ✓ Monitoring and controlling process group
- ✓ Closing process group

Figure 1 shows level of effort versus time for the different process groups.

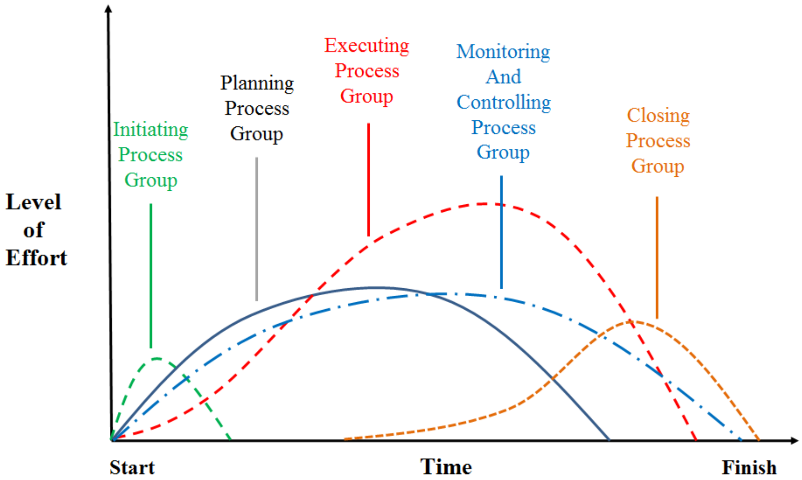

Figure 1. Example of process group interactions within a project or phase. This figure is done by the author and based on PMBOK (2017).

Table 1 displays the project management process group and knowledge.

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 Manage Project Knowledge	4.5 Monitor and Control Project Work 4.6 Perform Integrated Change Control	4.7 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 Schedule Management		6.1 Plan Schedule Management 6.2 Define Activities 6.3 Sequence Activities 6.4 Estimate Activity		6.6 Control Schedule	

		Durations 6.5 Develop 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 Manage Quality	8.3 Control Quality	
9. Project Resource Management		9.1 Plan Resource Management 9.2 Estimate Activity Resources	9.3 Acquire Resources 9.4 Develop Team 9.5 Manage Team	9.6 Control Resources	
10. Project Communications Management		10.1 Plan Communications Management	10.2 Manage Communications	10.3 Monitor Communications	
11. Project Risk Management		11.1 Plan Risk Management 11.2 Identify Risks 11.3 Perform Quality Risk Analysis 11.4 Perform Quantitative Risk Analysis 11.5 Plan Risk Response	11.6 Implement Risk Responses	11.7 Monitor Risks	
12. Project Procurement Management		12.1 Plan Procurement Management	12.2 Conduct Procurements	12.3 Control Procurements	
13. Project Stakeholder Management	13.1 Identify Stakeholder	13.2 Plan Stakeholder Engagement	13.3 Manage Stakeholder Engagement	13.4 Monitor Stakeholders Engagement	

Table 1. Project management process group and knowledge area mapping. The table is done by the author and based on PMBOK (2017).

Projects are developed to carry out business opportunities that are in agreement with an organization's strategic aims. Prior to start a project, a business case is performed to outline the project objectives; this provides the basis to work out the success and the progress throughout the project life cycle, as the results are compared with the objectives and the recognized success criteria. The projects are often initiated as an outcome of one or more of the following strategic items:

- ❖ Market demand
- ❖ Strategic opportunity/business need
- ❖ Social need
- ❖ Environmental consideration
- ❖ Customer request
- ❖ Technological advancement
- ❖ Legal or regulatory requirement
- ❖ Existing or forecasted problem

According to PMBOK, the technical project management competences can be defined as the skills to administer project management knowledge to derive the desired results for projects or program. PMBOK describes many of the necessary project management skills. Research has demonstrated that the project managers show skills including, but not limited to, the ability to:

- ❖ Critical technical project management elements for each project as critical success factors for the project, schedule, selected financial reports, and issue log.
- ❖ To adapt both traditional and agile tools, techniques and methods for each project.
- ❖ To plan thoroughly and prioritize diligently.
- ❖ To manage project items, including, but not limited to, cost, resources and risks.

The project manager is the person who heading the corresponding team for achieving the project objectives. The project managers should present at least the following qualities:

- Knowledge about project management, technical aspects, the business environment and other information required to manage the project successfully.
- Skills needed to address the project team, coordinate the work, collaborate with stakeholders, solve problems, and make decisions.
- Abilities to develop and manage scope, schedules, budgets, resources, risks, plans, presentations, and reports.

- Other attributes required to successfully manage the project, such as personality, attitude, ethics, and leadership.

According to PMBOK a stakeholder is "an individual, group, or organization that may affect, be affected by, or perceive itself to be affected by a decision, activity, or outcome of a project". As project lead, strategic vision and stakeholders connections are a relevant role for the project lead. Project stakeholders can be internal or external to the project and these ones can be actively implicated, passively involved or unaware of the project. Project stakeholders can present a positive or negative impact on the project or be positively or negatively influenced by the project. Examples of stakeholders are shown in Figure 2.

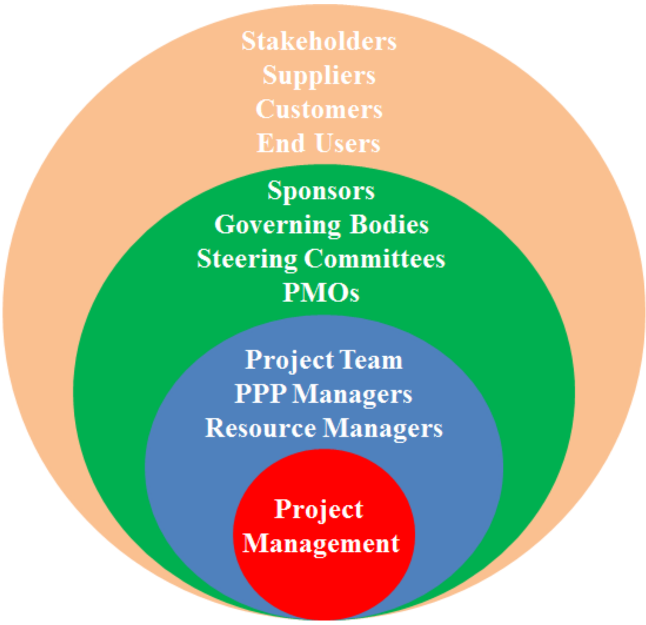

Figure 2. Example of project stakeholders. This figure is drawn by the author and based on PMBOK (2017).

The processes necessary to satisfy the information needs of the project as well as the stakeholders should be included in the project communications, taking into account an effective information exchange. Project communications management consists of two parts. The first one is to achieve a strategy to ensure that the communication is efficient for the stakeholders. The second one is done the activities necessary to implement the communication strategy. The Project Communications Management processes are monitor, manage and planning management of the communications.

Organizational structures can display different forms or types. A comparison is carried out between several types of organizational structures and their impact on projects, see Table 2.

Organizational Structure Type	Project Characteristics					
	Work Groups Arranged by:	Project Manager´s Authority	Project Manager´s Role	Resource Availability	Who Mangers the Project Budget?	Project Management Administrative Staff
Organic or simple	Flexible; people working side by side	Little or none	Part-time; may or may not be a designated job role like coordinator	Little or none	Owner or operator	Little or none
Functional (centralized)	Job being done	Little or none	Part-time; may or may not be a designated job role like coordinator	Little or none	Functional manager	Part-time
Multi-divisional (may replicate functions for each division with little centralization)	One of: product; production processes; portfolio; program; geographic region; customer type	Little or none	Part-time; may or may not be a designated job role like coordinator	Little or none	Functional manager	Part-time
Matrix-strong	By job function, with project manager as a function	Moderate to high	Full-time designated job role	Moderate to high	Project manager	Full-time
Matrix-weak	Job function	Low	Part time; done as part of another job and not a designated job role like coordinator	Low	Functional manager	Part-time
Matrix-balanced	Job function	Low to moderate	Part-time; embedded in the functions as a skill and may not be a designated	Low to moderate	Mixed	Part-time

			job role like coordinator			
Project-oriented (composite hybrid)	Project	High to almost total	Full-time designated job role	High to almost total	Project manager	Full-time
Virtual	Network structure with nodes at points of contact with other people	Low to moderate	Full-time or part-time	Low to moderate	Mixed	Could be full time or part-time
Hybrid	Mix other types	Mixed	Mixed	Mixed	Mixed	Mixed
PMO*	Mix other types	High to almost total	Full-time designated job role	High to almost total	Project manager	Full-time

PMO* refers to a portfolio, program or project management office or organization.

Table 2. Influence of organizational structure on projects. The table is done by the author and based on from PMBOK (2017).

Governance is the framework within which authority is performed in organizations. This framework covers but is not limited to:

- Rules
- Policies
- Procedures
- Norms
- Relationships
- Systems
- Processes

This framework influences how:

- ➢ Objectives of the organization are set and achieved
- ➢ Risk is monitored and assessed
- ➢ Performance is optimized

Project governance is the framework, functions and processes that address project management activities in order to set up a unique product, service, or outcome to meet organizational, strategic and operational aims. Governance at the project level incorporates:

- Guiding and overseeing the management of project work
- Ensuring adherence to policies, standards and guidelines
- Establishing governance roles, responsibilities and authorities
- Decision-making regarding risk escalations, changes and resources (e.g. team, financial, physical, facilities)
- Ensuring appropriate stakeholder engagement and monitoring performance

A project life cycle is the set of phases that a project passes through from its start to the end. The phases are able to be sequential, iterative, or overlapping. The life cycle provides the basic framework for managing the project, regardless of the specific work involved. The project life cycle is able to be impacted by the unique aspects of the organization, industry, development method, or technology employed. The projects can shift in size and complexity, a typical project is able to be mapped to the following project life cycle structure, see Figure 3.

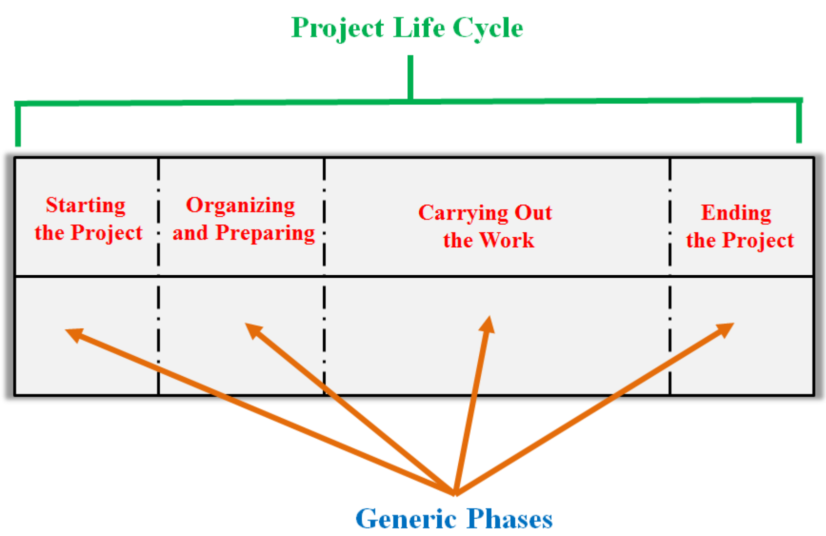

Figure 3. Generic description of a project life cycle. This figure is drawn by the author and based on PMBOK (2017).

PMBOK tackles the aim and definition of what a project is within an organization. PMBOK deals also with the roles and expectations of the project lead as well as the strategic roles it performs within the organization. The project's governance within the organization was described as the alignment of stakeholders to the project's aims and the organizational strategy. The knowledge management area along with governance guidance to the project manager provide the confluence of the Project Management Process Groups defined by PMBOK. The decision making governance determined by PMBOK establishes the framework of the project management structure. Project based organizations are those “that create temporary systems for carrying out their work". The use of project based organizations may reduce the hierarchy and bureaucracy inside the organizations due to the success of the work is gauged by the final outcome rather than by position or politics. This overview of the PMBOK can be used as the project based standard framework of analysis for finding the intersection and implications of incorporation with the VSM. This outlook should be a fundamental element to obtain the theoretical frame of reference for leading the research design (PMBOK, 2017).

3.2 Cybernetics and Viable System Model

Cybernetics is the ‘science of control’; cybernetics is able to be management’s ‘profession of control’ (Beer, 1981). According to Pérez Ríos (2008) “cybernetics can be understood as the science dealing with control, in the sense of governing (managing) an organization”. Cybernetics distinguishes the existence of feedback and the concept of systems showing a ‘holistic’ behaviour. The holistic behaviour can be described as belonging to the system and not the individual parts (Beer, 1979; Patton, 2002). Beer proposed the neurocybernetic model to be used as model of a viable system for any type of organization. The laws of cybernetics are established around three fundamental laws (Clemson, 1984):

a) The Self-Organizing Systems Law
b) Feedback
c) The Law of Requisite Variety

On the other hand, “for a system (an organization, company, etc.) to be viable it must be capable of coping with the variety (complexity) of the environment in which it operates. From the cybernetics point of view, managing complexity is the essence of a manger´s activity. Controlling a situation means being able to deal with its complexity, which is its variety” (Pérez Ríos, 2012). The variety is employed to understand the mechanisms available for dealing with complexity. Ashby called "Law of Requisite Variety", which established that "only variety destroys (absorbs) variety" i.e., to reach a certain degree of variety, the system in question should be capable of expanding an equivalent amount of variety. The Conant-Ashby theorem says that "a good regulator of a system must be e a model of that system".

Viability may be understood as the capacity of a system (organization, company, etc.) to maintain a separate existence over time, and to do this despite ongoing changes in the environment. VSM is a model of the organizational structure of a viable system established by Stafford Beer (Beer, 1966). The main contribution of cybernetics is the identification of the basic principles of control applicable to large systems. VSM determines the necessary and sufficient conditions for an organization to be viable. Beer called these five sub-systems System 1, System 2, System 3 System 4 and System 5. Each one corresponds in a simplified way with the function of implementing, coordinating, integration, intelligence and policy. In addition, System 3* is added as complement to System 3. The systems are communicated with each other and work for balancing the system, ensuring that variety created within the system is absorbed. A VSM is shown in Figure 4, a project organization is able to be considered as a system, performing the functions specified by VSM to keep viability within a project or organization.

Pérez Ríos (2010) presented a systemic methodological framework to design systems considering the viability. The application of this process was organized in four stages. The first stage was to establish the identity and the aim of the organization. In this process, it should be assessed the purpose of the organization. In a second stage, it should be checked how the organization copes the total environment complexity. It was carried out setting up a vertical structure of sub-organizations where each one will be in charge of the different sub-environments in which the whole environment is split. The third stage should go through each one of the vertical levels and verify that all the necessary and sufficient elements for viability are represented in the organizations and sub-organizations, among others. The last stage would be to assess the degree of coupling of the organizations; sub-organizations etc, at the recursion levels, taking into account the coherence among their identities and purposes. It should be highlighted that any lack in these five systems or functions due to deficient design, absence or malfunction of the communication channels that link them causes pathologies in the organization. These ones involve that the organization does not work or even it could disappear, at least as an independent body.

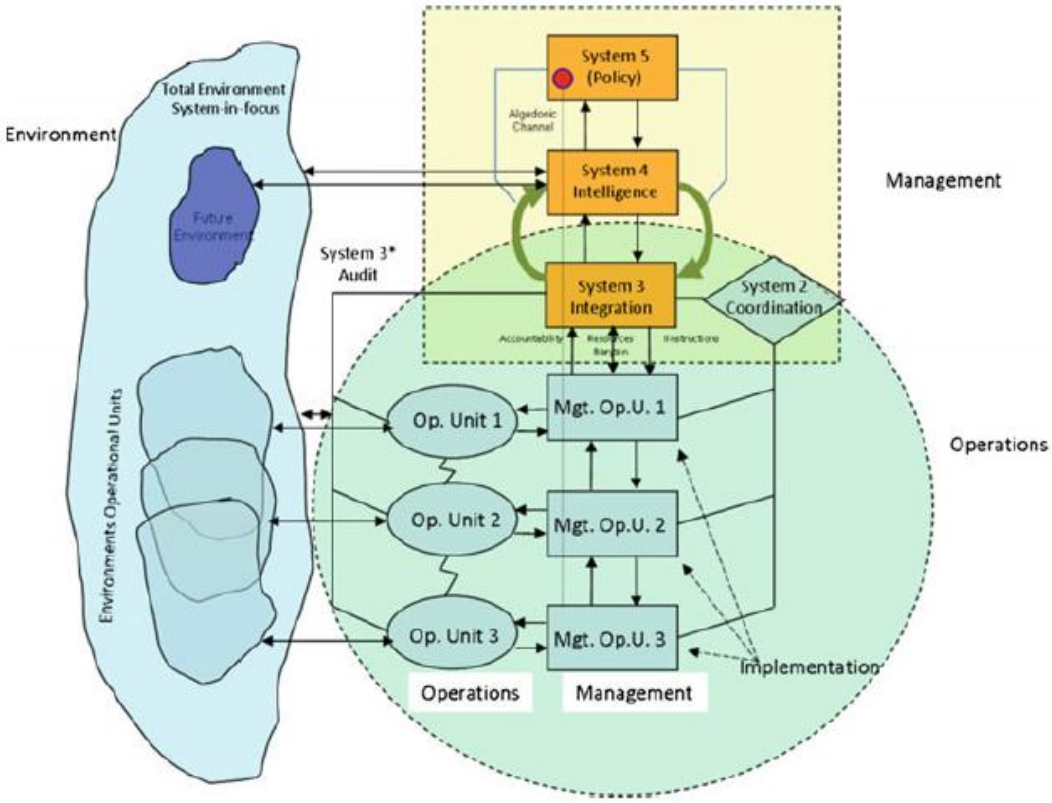

Figure 4. Viable System Model, adapted from Beer. Taken from Pérez Ríos (2012).

3.3 System Interactions and Channels in the VSM

Three divisions of management must be identified "large part of their activity, perhaps eighty percent of it, is purely anti-oscillatory" (Beer, 1979): a) interventions on the vertical line from the metasystem to System One which restrict horizontal variety for legal motives. b) Interventions on the vertical line from the metasystem to System One which restrict horizontal variety for the benefit of institutional cohesiveness, according to the purpose of the institution. c) System Two activities, which are anti-oscillatory (Sisti, 2017).

The first three managerial restrictions are the variety-interconnections in the vertical plane of the environmental, the operational as well as the managerial domains. The fourth managerial restriction is the channels of the metasystemic intervention, the anti-oscillation channels that interconnect System Two, and the operational monitoring channels of System Three. The last three are “there to contain the residual variety not absorbed by the first three, given the purposes of the enterprise as a corporate entity” (Beer, 1981). Beer established that the first three variety absorbers just occur and the second three must be recognized and afterwards designed. The environment of the viable system is the environment that must be taken into account as an operational factor of the metasystem (Beer, 1979). The use of VSM requires the understanding of the system boundaries selected and their relationship to the boundaries determined at the forthcoming upper level of recursion, (Espejo and Harnden, 1989).

According to Beer (1979), all viable systems include viable systems and are themselves included in viable systems. The most relevant point of this recursive definition is that, these must contain the five functional systems, that establish viability without consider which position they hold within the chain of systems, keeping in mind to be viable.

System 1 delivers the services or goods that the organization generates. For instance Figure 4 shows as System 1 is composed by three basic operational units (Op. Unit 1, 2 and 3) which are able to be divisions of a company, sub-organizations, etc. The principal role of System 2 is to ensure a suitable functioning of the organizational units, which makes up System 1. System 3 optimizes the functioning of the entire set of System 1, composed of the different operational units. The System 4 monitors the environment of the organization and the aim is to keep it prepared to change. System 5 handles the normative decisions and it is liable for defining the identity of the organization and the vision, among others.

Beer established six primary channels which work along the vertical plane and manage the channel variety associated with the viable system (Beer, 1979). The communication channels in VSM are the components that link both the organization with its environment(s) and the diverse functions specified in the model. The channels afford the equilibrium, or homeostasis of the internal environment of the system in view. The six primary channels and one additional channel can be distinguished as follows (Pérez Ríos, 2012):

Channel One (C1): channel that connects and absorbs the variety between the environments of each elementary operational unit.

Channel Two (C2): channel that connects the different elemental operations (operational units setting up System One).

Channel Three (C3): collective intervention channel (System Three-System One).

Channel Four (C4): resources bargaining channel (System Three – System One).

Channel Five (C5): anti-oscillatory channels (Co-ordination) (System Two).

Channel Six (C6): monitor channel (Auditor).

Algedonic Channel: transmits alert signal about any incident or contingency that could hazard the organization. Travels directly to the top through existing connections.

The basic VSM communication channels are shown in Figure 5. The communication channels cover those between the environment and the Systems called C1. The C2 channels are between the S1's. The C3 cooperation channels are between the management portion of the S1's up and incorporating the management portion of S3. The C4 channels determine the bargaining that goes on between the S1's and managed by the S3. The C5 channel monitors and controls oscillation between the S2's. The C6 channel that establishes the auditing function of the S1's using unfiltered data and managed as a S3* (Star) function. The Algedonic channel supplies the emergency channel directly to the top without filtering from the lower systems (Sisti, 2017).

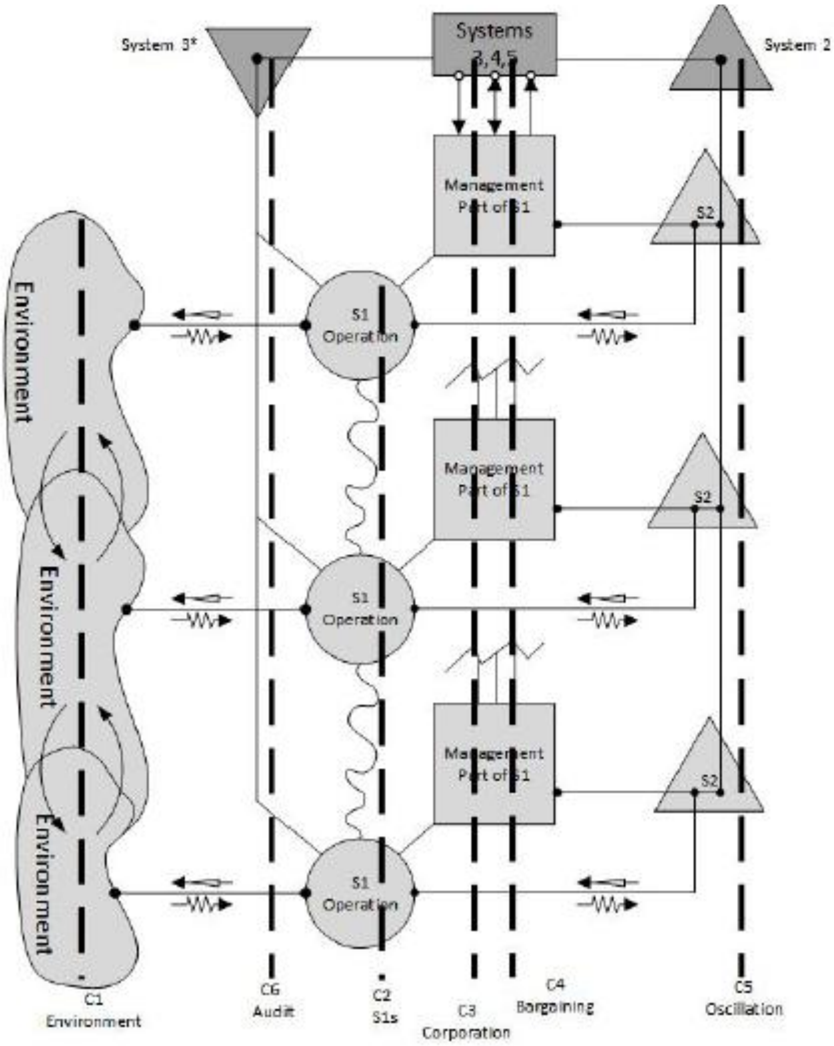

Figure 5. VSM six channels. Taken from Sisti (2017).

Chapter 4 Theoretical Framework Study

Schwaninger (2006) presented a work which supported the theoretical claim of VSM that itemizes the necessary and sufficient preconditions of organizations for viability. A social system is viable if, and only if, its framework satisfies a number of requirements. According to the model, a viable organization must consist of at least five managerial subsystems and their interrelationships, as set forth by the theory:

System 1. Management of a basic subsystem.

System 2. Coordination of subsystems, attenuation of oscillations between them.

System 3. Operative management of a collective of subsystems.

System 3*. Auditing and monitoring channel.

System 4. Management for the long term, relationships with the overall environment.

System 5. Normative management, corporate ethos.

Through five cases in different contexts, VSM was applied, in all of them, the model showed to be as a conceptual tool for the diagnosis as well as for the design of the organizations. VSM proved to be a remarkably powerful tool. Due to it not only allowed an understanding of the studied cases, but it helped the work hugely.

4.1 VSM Different Perspectives

4.1.1 NASA's Wicked Problems

The comprehension of NASA's wicked problems for space technology development, and its organizational complexities are relevant to set up breaking points where improvements or changes are able to be inserted. The interactions between different NASA organizational entities from a project to the government level, show a nonlinear domain, wherein the interests and motivations are modified at each level.

Thereby, the making decisions on technology project portfolios needs a more extensive set of considerations than taking into account the technical applicability and fiscal viability. NASA Space Technology Mission Directorate (STMD) projects have developed a successful tool because of understanding of previous processes, where the findings were taken to maintain strategic thinking, planning and execution. These insights were obtained by using suitable models, such as the assessing the key project operation drivers through organizational cybernetics and wicked problems, among others. Figure 6 displays a mapped NASA STMD's organizational framework into VSM.

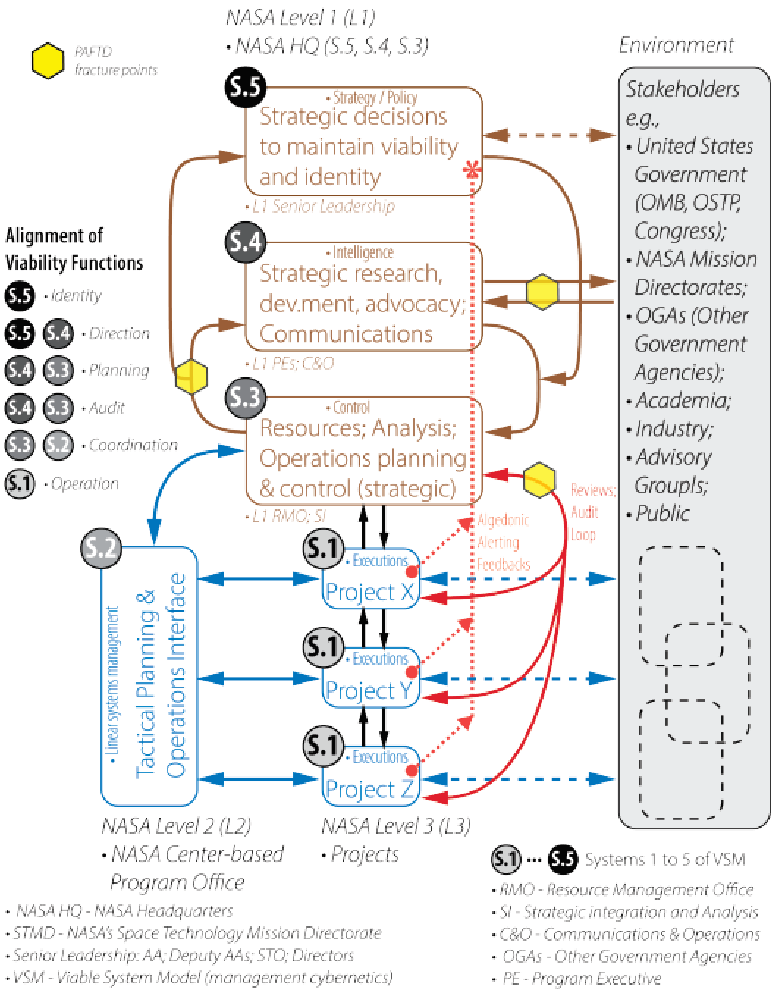

Figure. 6. Mapping of NASA's Space Technology Mission Directorate into VSM. Taken from Balint et al. (2015).

As Figure 6 shows that certain organizational functions are missing. The audit loops from System 1 the project level to System 3 and over levels are mainly lined up with project operation reporting at different key decision points. In this process, a project communicates the linear level activities to the strategic level, focusing on the technical feasibility and the resource viability. PAFTD has been implemented to lead this, by collecting additional strategic level information at the Systems 3 and 4, and whenever the synthesized and attenuated data to senior managers, allowing them to make more reported determinations, (Balint et al., 2015).

The concept of recursion applied to project management presents an important role in the structure of the corresponding organization, projects and subprojects. Due to this is not a simply hierarchical structure, each level of recursion has its individual identity and structure and it is capable of self-organizing to achieve the objectives of the total system. The viability of a project can only be maintained, if it is aligned with the total system, in which it is included (recursion), establishing a benefit for the total system. In any other manner, the identity of the project (through project governance) must be adjusted.

The organizations are autonomous i.e., viable systems and in line with VSM. These need five system functions to operate effectively, as it has been dealt with in previous sections. These organizational functions are recursive and this provides strength, integrity and robustness to the organization. Cybernetics related considerations achieve important roles in introducing new dialogs to any organization as NASA. The recursiveness is able to determine a distinction between first and second order cybernetics. First order cybernetics defines an observed system. Second order cybernetics establishes a cybernetic circular loop around the first order loop. The strategic level observing system is able to readjust the aims of the project systems.

4.1.2 VSM for Project Management

According to Britton and Parker (1993) exist two situations in which the project organization is able to be modelled as a viable system. The first one is when a viable system, as for example, an engineering company, can be categorized more specifically in project sets. The second one is when a project is being launched to develop a viable system that there was not previously. The project organization to carry out this duty, can be taken into account the developmental step of that viable system and, consequently, a viable system. A VSM of project management for a construction project is displayed in

Figure 7, the viable elements are commissioning, manufacturing, construction and engineering.

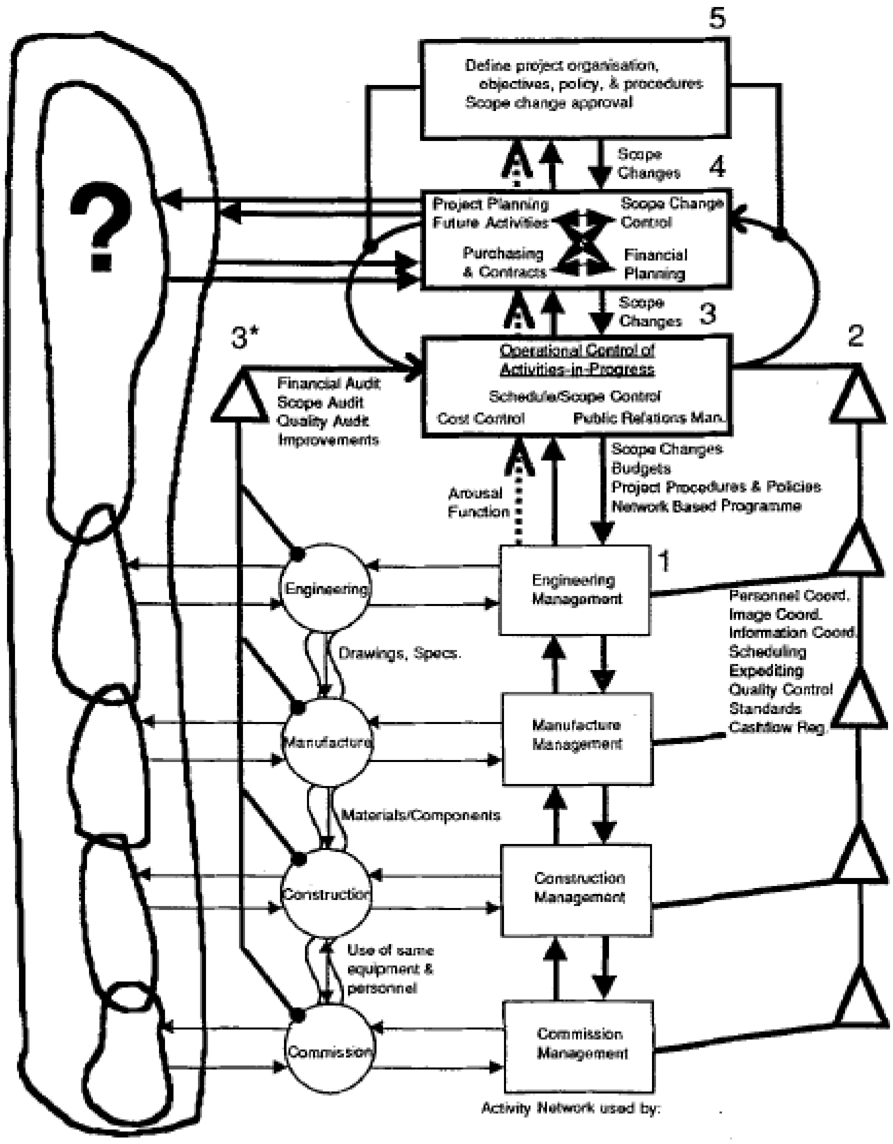

Figure. 7. A VSM of project management: overview. Taken from Britton and Parker (1993).

Britton and Parker (1993) discussed how three major processes in Systems 3 and 4 were done and how these interact. The processes are the scope-change control system, the control of activities in progress and finally project planning for future activities. The subsystems and the interrelationships are displayed in Figure 8.

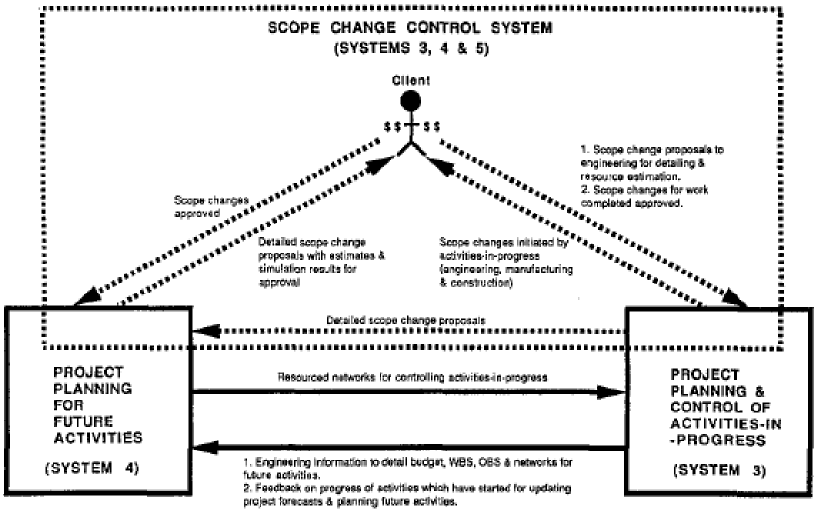

Figure. 8. Three major processes and their interaction. Taken from Britton and Parker (1993).

The detection of scope changes is done through “Scope-Change Control System". This is due to activities in progress which insure that scope changes are accepted by the client and include the client changes in the control and planning system. This controls the interrelationships displayed by the solid arrows in Figure 9, and it is a process which involves Systems 3, 4, and 5. Scope changes are displayed with saw tooth lines in Figure 9. These mostly disrupt project planning and control, although not required. Scope changes can be initiated by the client or by the project manager in conjunction with the client, or finally activities in progress may arise. The scope-change control system is principally a System 4 activity. However, System 5 is also implicated, which authorizes scope changes. System 3 monitors and controls scope changes deriving from work that has been realized and authorizes some changes under dominion from System 5. Furthermore, System 3 interacts with System 4 in evaluating and planning the effects of changes. Scope changes are implemented through the command axis; nevertheless there will be arrangement links between Systems 4 at different levels of recursion as they inspect the networks to consider the changes.

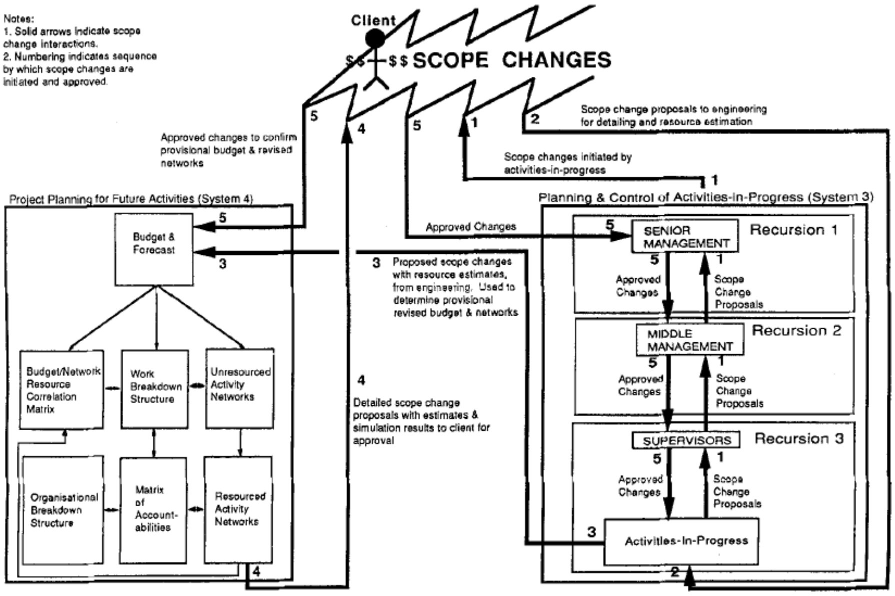

Figure. 9. Scope-change control system (Systems 3, 4 and 5). Taken from Britton and Parker (1993).

The main contribution is to link the VSM and management of the projects as well as the corporate management by using the recursive nature of the VSM, attempting to connect two recursion levels such as the individual project and the organization that runs it. Although the work was based on a single operational activity, this could have be done to a strategic level, using the recursion of the model to align the strategy and the objectives of the organization along with the projects. The proposed model is incomplete, in fact, it deals with some features of Systems 3 and 4, barely processing the rest of the systems as well as the interconnections between them and the environment.

4.1.3 Viable System Perspective

According to Rai and Subramanian (2007) program complexity can be displayed across two dimensions: complexity across the time and the space. The program phases can be spread complexity across time. A typical program cycle consists of the phases: initiation, definition, mobilization, execution and closure. The program complexity is extended in time and in phases. Programs propagate the complexity across space and the projects in the program portfolio.

Complexity management at System 1

Some of the mechanisms for handling the complexity at the implementation level are provided: the programs are split into projects and the projects are split into subprojects, etc. The selection of a suitable project manager as well as the program type are essential to insure successful completion of the project and the program. Division of work, the determination of the team structure as well as roles and skill selection absorbs the variety of the project. Senior management maintains the project manager accountable for the projects instead of the resources provided to them for project execution.

Complexity at System 2

It is managed through tools, artefacts, actions and techniques such as project plan and project management tools, among others. In addition to this, training and learning as well as knowledge and skill management. Establishment of program management standards. Program management methodology, finally, explicit and implicit exchanges between teams of different type of pieces of information.

Complexity management at System 3

Complexity is managed at System 3 with the aid of status report, audits, resource negotiation tools, exception handling system, accountability reports, and functional autonomy of projects to prevent needless intervention.

Complexity at System 4

The complexity is handled as follows; by using information technology and tools. To carry out research and development to take advantage of the opportunities and avoid the threats to the program. To establish intelligence and operations centres for the program. To employ program modelling and simulation based on the data dispatched by System 3 and returning feedback to System 3 to take adequate action.

Complexity management at System 5

Complexity is handled with the help of executing policies to manage program execution, using executive warrant to sort out outstanding conflicts, setting the priorities. It can be highlighted that mechanisms to manage the complexity have identified at each system and it has proposed design guidelines, see Figure 10.

The contribution of this work is relevant, due to the Cybernetics presents tools that can help to solve the problems of complexity to which must face many of the projects. In this way, the consideration of certain models as VSM can be important for the development of project management.

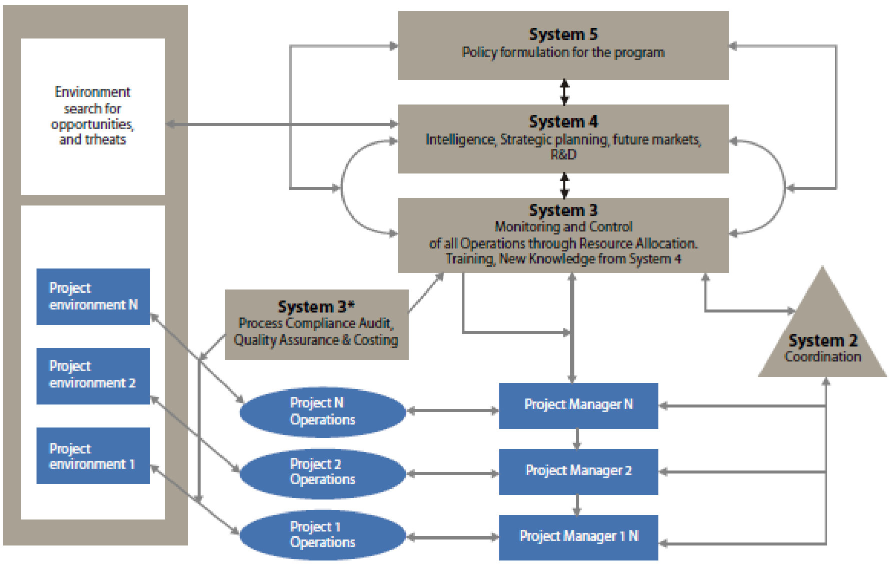

Figure. 10. Conceptual view of Viable System's architecture. Taken from Rai and Subramanian (2007).

4.2 Viable System and Metrics

The use of metrics can help to improve the understanding of the technical progression of projects and avoid the manifest unexpected failure of projects. Walworth (2015) used the ideas of VSM and the essence of Checkland's Soft Systems Methodology (SSM) (Checkland, 2000) to establish a comparison and contrast the existing factors and communication channels of the technical metrics program to a viable model. The research approach should respond to queries such as; is it feasible to achieve an adequate metrics program at an organisational level?. Can this be obtained through the VSM?, if it is feasible to identify the theoretical factors and the communication channels needed.

Walworth (2015) indicated that some studies have proved that metrics themselves are not able to satisfy the role of a Viable System. However, it has been shown to suitable for investigation as a System 2, which is responsible of the coordination activities of a VSM, attenuation of any system oscillations as well as providing feedback to recursive systems. The research approach employed a SSM as framework to set up a theoretical model based around the VSM. The model identifies the needed underlying phenomena for a proper System 2. The theoretical underpinnings of the VSM as outlined by Beer were studied in reference to the System 2 and metrics. The last ones can be perceived as real-world issue situation. This was combined with study from a viable knowledge perspective to derive a series of phenomena.

SSM is a learning system. It frames a process of inquiry which addresses to the action, however this is not an end point unless you select to make it one. Taking that action shifts the problem situation. Therefore, inquiry can carry on; there are new things to discover. This learning process is able to be thought of as a sequence of stages. Figure 11 displays the procedure by means of organized inquires related to problem situation, the learning should lead to taking deliberate action to derive about improvement in the situation. To sum up, SSM is a learning, not an optimizing system and the learning has to be participative, (Checkland, 1989, 2000).

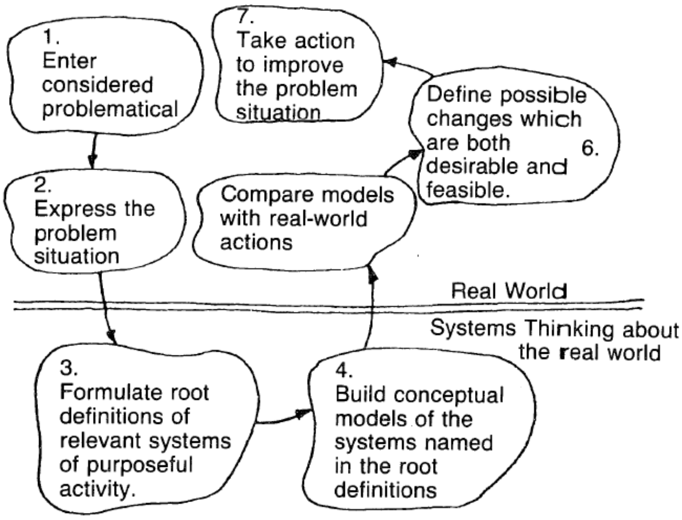

Figure 11: The learning cycle of Soft Systems Methodology. Taken from Checkland (1989).

According to Walworth (2015), if VSM and SSM are considered the following stages can be established.

a) Management Loop: System 5 decides the aims and afterwards passes policy and the organisational structure to System 3. This system allows on going management, partially through System 2 activities. This is impacted by the organisational structure and the Information Systems, see Figure 12.

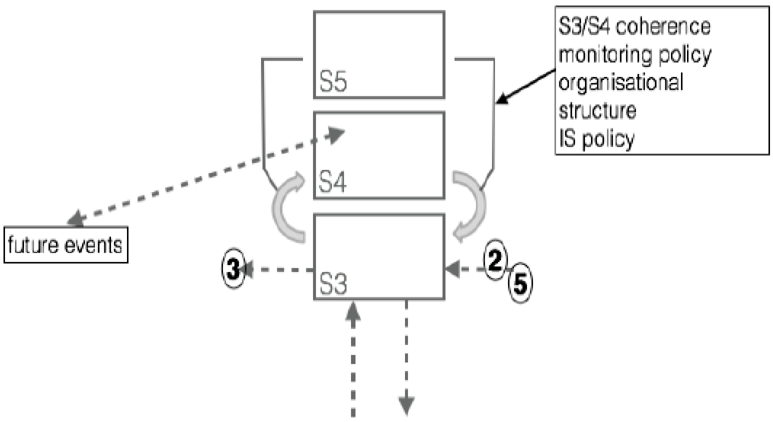

Figure 12: Management loop. Taken from Walworth (2015).

b) Management balance: it is later on needed to determine on the level of decisions the metrics can be used, and the decisions that demand System 3 attention. This is based on a recap of the aims to be satisfied and expected performance for System 1, see Figure 13.

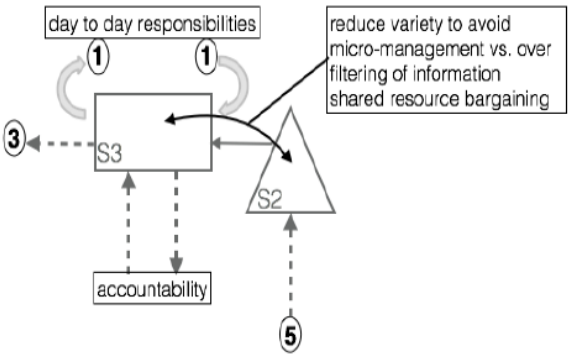

Figure 13: Management balance. Taken from Walworth (2015).

c) Audit Loop: a tool to enable the review of System 2 activities for assessing the management balance. This must consider the ongoing operations of each of the System 1 and the decisions execute as a result of the measurements assumed by System 2 (see Figure 14).

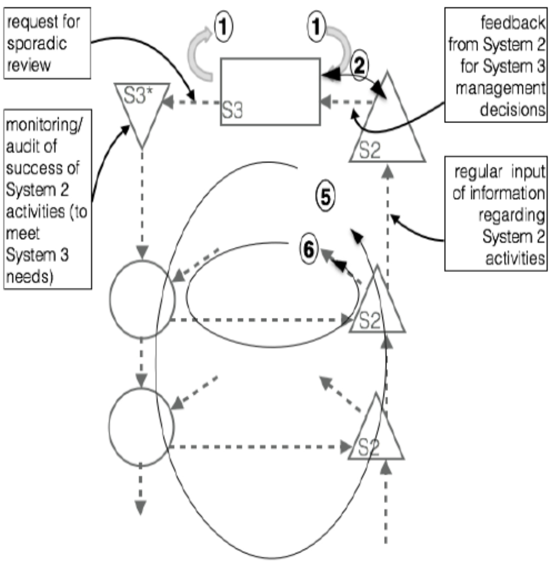

Figure 14: Audit loop. Taken from Walworth (2015).

d) Interdependency: System 2 activities require to be flexible sufficiently to allow System 1 to work in differing modes. The Outer Loop Decision making must enable suitable changes to occur in the individual Inner Decision Loops. This needs learning from individual System 1 (see Figure 15).

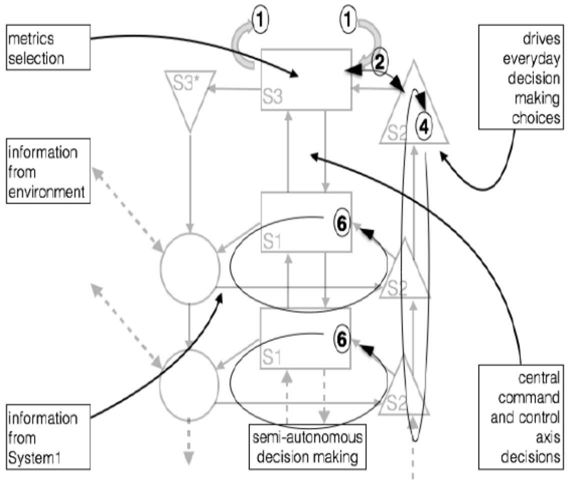

Figure 15: Interdependency. Taken from Walworth (2015).

e) Outer Decision: the Outer Decision Loop assimilates the decisions and outputs taken by the Inner Decision Loops and reports these into System 3. This helps with the Audit Loop and Management Balance. Adjusts performance depending on output from inter-dependency loop, see Figure 16.

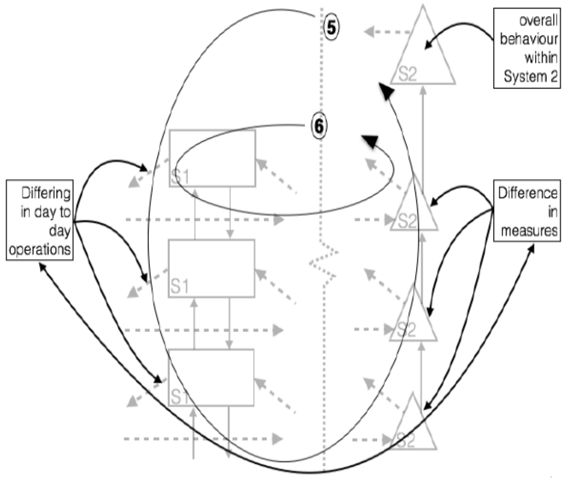

Figure 16: Outer decision, taken from Walworth (2015).

f) Inner Decision: it creates the majority of the anti-oscillatory activity for the System 1. It takes the aims and purpose from System 1 and System 2 measurement demands to set measures that enable System 1 to keep semi-autonomous, (see Figure 17).

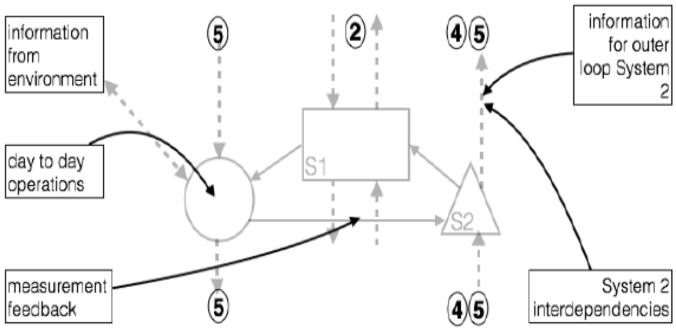

Figure 17: Inner decision, taken from Walworth (2015).

Sisti (2017) affirmed that the influence in the strategic project planning on resources as well as the project selection may take advantage of metrics that employ viability as a variable. The development of a robust group of metrics for a project management structure might help to better arrange performance of a project by using a more robust set of operation considerations. This would allow to the managers involve in project study from a more holistic viewpoint and likely create a much broader aperture of understanding a project management structure as well as implications for systemic enhancements. As a result, the viability metric is required for the project priority determination. One should consider that metrics based on VSM could be deployed for systems based on projects performance, in order to help to classify projects within an organization's program or portfolio.

4.3 Framework Study Findings

The use of VSM as a study tool into the PMBOK's project management structure should provide mechanisms for establishing enhances. This will enable to face the challenges that the field of the project management present nowadays.

This section is an extension of the work done by Sisti (2017), where the author analysed PMBOK (2013). In here, it is shown the outcomes from performing a matrix study using VSM analysis for PMBOK (2017) i.e., the common chapters or sections of them that match with PMBOK (2013) are not displayed. Tabular data display the features of systems and channels. Each section has been ranked 0-3 for content applicability to the VSM, according to criterion established by Sisti (2017). Each System and Channel Identifier was sum up for some sections, where a determination of whether the project management structure identified in PMBOK was associated with the applicable components of VSM. For the framework study, it is used the systems and channels dealt with in VSM in previous sections.

"1": there is not an identifiable recognition in the PMBOK, for the identified VSM system or communication channel.

"2": there is an implicit recognition in the PMBOK, for the identified VSM system or communication channel, but not sufficient to stand on its own.

"3": there is a remarkable explicit or implied recognition in the PMBOK, for the identified VSM system or communication channel.

There are some differences between the sixth and the fifth edition of PMBOK. For example, the three first chapters are different, as a consequence, these are analysed in the three following tables. Another three tables are added, due to chapters 4, 9 and 11 introduce new sections, which are marked in yellow in the respective tables.

Project Management Structure	Section	S1	S2	S3	S3*	S4	S5	C1	C2	C3	C4	C5	C6	Alg
Chapter 1	Intro.													
	1.1	1	1				3		1				1	
	1.2	1	2	2		3	2		2	1	1		1	1

Table 3: Chapter 1 VSM to PMBOK project management structure study matrix.

Project Management Structure	Section	S1	S2	S3	S3*	S4	S5	C1	C2	C3	C4	C5	C6	Alg
Chapter 2	**2.1**	1				1		3		1	2	2		1
	2.2	3				3		3	3	2	2	1		1
	2.3		2			1	2		3	2	3	3	2	2
	2.4	1		2		3	3		3	3	2	3	3	2

Table 4: Chapter 2 VSM to PMBOK project management structure study matrix.

Project Management Structure	Section	S1	S2	S3	S3*	S4	S5	C1	C2	C3	C4	C5	C6	Alg
Chapter 3	**3.1**	1					2		1		2	2	3	
	3.2	1					1		1		1		2	1
	3.3	2	1	1		3	3		3	3	3	2	2	2
	3.4	1		2		3	3	3	2	3	3	3	2	2
	3.5			2		3	3	3	3	2	3	3	2	1

Table 5: Chapter 3 VSM to PMBOK project management structure study matrix.

Project Management Structure	Section	S1	S2	S3	S3*	S4	S5	C1	C2	C3	C4	C5	C6	Alg
Chapter 4	4.1	2	2	3	2	2	3	2	2	3	3	2	2	
	4.2	3	3	3	3	3	3	2	3	3	3	3	3	
	4.3	3	2	3	3	3	3	3	3	3	3	3	3	
	4.4	1	2	2	2	3	3	3	2	1	3	3	1	
	4.5	2	2	2	2	2	2	1	2	3	3	3	2	2
	4.6	2	2	2	2	2	2	2	1	3	3	3	2	
	4.7	2	1	2	2	2	2	2	2	2	2	2	2	

Table 6: Chapter 4 VSM to PMBOK project management structure study matrix.

Project Management Structure	Section	S1	S2	S3	S3*	S4	S5	C1	C2	C3	C4	C5	C6	Alg
Chapter 9	9.1	3	2	3	2	3	2	1	2	3	3	1	1	
	9.2	3	2	2	2	1	2	1	3	3	3	1	1	
	9.3	3	2	3	2	3	2	1	2	3	3	1	1	
	9.4	3	2	3	3	3	3	2	3	3	3	2	2	
	9.5	3	2	3	2	2	3	2	3	3	3	3	3	
	9.6	3	2	3	2	1	2	2	3	3	3	2	2	

Table 7: Chapter 9 VSM to PMBOK project management structure study matrix.

Project Management Structure	Section	S1	S2	S3	S3*	S4	S5	C1	C2	C3	C4	C5	C6	Alg
Chapter 11	**11.1**	2	1	2	1	2	1	1	2	2	2	1	2	
	11.2	2	2	2	2	3	2	1	2	2	2	1	2	
	11.3	2	1	2	2	3	2	1	2	2	2	1	2	
	11.4	2	1	2	2	3	2	1	2	2	2	1	2	
	11.5	2	1	3	2	3	2	1	1	2	2	1	2	
	11.6	3	1	3	2	2	2	1	2	3	2	2	2	
	11.7	3	1	3	3	3	2	1	2	3	3	1	3	

Table 8: Chapter 11 VSM to PMBOK project management structure study matrix.

The inclusion of new chapters and sections has not supposed a significant increase in the progress the cybernetics perspective and the project management in the PMBOK. It can be highlighted the following implications; the algedonic channel, S2 (anti-oscillatory), C1 (environmental) channel and C5 (anti oscillation) channel were not significantly shown in PMBOK's project management structure. These channels and their incidences represent a relevant opportunity of development for further evolution of the PMBOK as well as the project management field. Although project management takes into account the communications, it is able to improve considerably through the understanding given by the management cybernetics communications outlook and the channels. There is considerable challenge for project management field progress using the cybernetics perspective as VSM has shown.

4.4 Guidance on Applying of Viability and the Projects Management

The viability of a system is a function of the balance between the stability versus the adaptability (Beer, 1979). A system accomplishes viability by keeping the aspects of its operations that are connected to its identity. Maintenance of these aspects needs that the management system to maintain the state of some variables of the operational, systems stable and/or accelerate shift in the state of some operational systems' variables. Recursively, the states that an operational system is to keep or obtain constitute its identity from the viewpoint of the management system. The management system within each operational system is to ensure the accomplishment or maintenance of those states, for the operational system to stay viable (Golnam et al., 2011).

Golnam et al. (2011) decomposed a viable system into a set of operational systems that interact with a management system. Operational systems are the systems that carry out the operations within a viable system. The functions of the operational systems are the motive that the system occurs in the first place. An operational system includes smaller operational systems and is held in a hierarchy of larger operational systems. The operational systems in this model correspond to System 1 in VSM as Figure 18 shown. The management system achieves a set of systemic functions necessary for the system to keep viable. The main functions of the management system are homeostasic, heterostatic and identity functions. The first one directs the current and internal operations. It seeks manners to optimize the overall efficiency and enhance the performance of the operational systems by over viewing their interactions. In order to obtain regulation, it communicates the desired bounds of some variables of the operational systems and controls compliance. Stability is a feature of the homeostatic function of the management system. This function is in the conceptualization maps onto System 2, 3 and 3* in VSM. The second one tackles of the outside and the future. It ensures the adaptation of the system as an entire to a changing environment. This function needs an understanding of the entire environment in which the system is embedded. It is beyond the capability of the operational systems, as these ones affect themselves with their local environment. Furthermore, interacting with the environment, this function requires to interact with the homeostatic function. It is due to the adaptation cannot be obtained without an understanding of the system as it currently exists. As a consequence, the evolution and the adaptation are the emergent properties of the heterostatic function of the management system (Christopher, 2007). In Beer's VSM, System 4 does the heterostatic function. The last one function maintains the identity and ethos of the system by balancing the homeostatic and the hetereostatic functions. The identity can be understood as invariance in some aspects of the system, in spite of all the shifts that the system is crossed. Therefore, a system is able to keep its identity only when a suitable balance between stability and change is carried out. The identity function is done by System 5 in VSM.

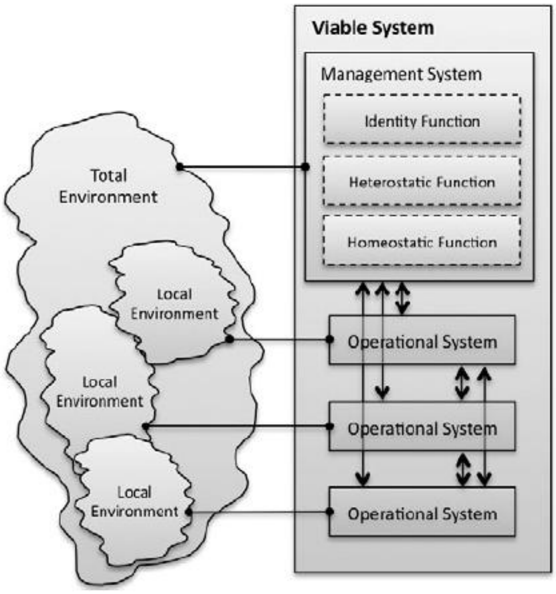

Figure 18: The conceptual model of a Viable System. Taken from Golnam (2011).

Schwaninger and Scheef (2016) in order to test the VSM empirically carried out a quantitative analysis on the grounds of an extensive survey. The data sustain the hypotheses and therewith confirm the theory of the VSM. This involves that the VSM is a valid orientation tool for the diagnosis and design of organizations to consolidate their development potential, viability and resilience (Ruiz-Martin, 2017).

Taking into account the above paragraphs, one should consider if it would be feasible through a short questionnaire determine, if the PMBOK sixth edition present the tools for ensuring the viability of project using the VSM as framework. According to VSM, viable systems must present five functional subsystems: policy making, intelligence, adjustment, coordination/monitoring and implementation. In addition, every single subsystem must itself be viable. For ensuring that a system shows recursion, it is relevant that a system can adjust swiftly to changes in the environment. As a result to determine if the projects have subsystems that work properly, Woodman and Krasa have established the following questions for the NASA project managers.

Each question is response with the corresponding number of chapter and sections from PMBOK sixth edition.

Policy Making

1. *Which elements of the project are responsible for setting its policies and requirements?*

Chapter 1

1.2.4.5 - Executing Process Group. Those processes performed to complete the work defined in the project management plan to satisfy the project requirements.

1.2.4.6 - Project Quality Management. Includes the processes for incorporating the organization's quality policy regarding planning, managing, and controlling project and product quality requirements, in order to meet stakeholders' expectations.

Chapter 2:

2.4.2 - Organizational governance frameworks.

2.4.2.1 - Governance framework: rules, policies, procedures, norms, etc.

2. *Do these elements have the authority required to make and implement decisions?*

Chapter 2

2.4.2 - Governance frameworks.

2.4.2.1 - Governance is the framework within which authority is exercised in organizations.

Chapter 4

4.1 - Develop Project Charter. The process of developing a document that formally authorizes the existence of a project and provides the project manager with the authority to apply organizational resources to project activities.

Intelligence

1. *How does the project connect with and monitor the outside environment?*

Chapter 3

3.5.4 - Integration and complexity: complexity within projects is a result of the organization's system behaviour, human behaviour, and the uncertainty at work in the organization or its environment.

Chapter 5

5.3.3.1 - Project scope statement

2. *What information is the project monitoring in the outside environment?*

Chapter 3

3.4.4.2 - Qualities and skills of a leader.

3. *How is important information from the environment being collected and then disseminated to the rest of the project?*

Chapter 10

10.1.3.1 - Communications management plan. Establishes how, when, and by whom information about the project will be administered and disseminated.

4. *How does the project market itself, and to whom should it be marketing?*

Chapter 3

3.4 – Project manager competences. Strategic and business management skills.

Adjustment

1. *How is compliance to project policies and requirements ensured?*

Chapter 5

5.2.3.1- Requirements documentation. This is used to demonstrate compliance with the project scope.

Chapter 8

8.3.3.1 - Quality control measurements. The quality control measurements document the results of Control Quality activities and demonstrate compliance with the quality requirements.

2. *How is project performance captured and reported?*

Chapter 4

4.4.2.3 Information management.

4.4.3 Manage project knowledge: outputs.

Chapter 8

8.3.3.3 - Work performance information. This includes information on project requirements fulfilment, causes for rejections, rework required, recommendations for corrective actions, lists of verified deliverables, status of the quality metrics, and the need for process adjustments.

3. *Which project element(s) can negotiate adjustments to project policies and requirements?*

Chapter 4

4.6 - Perform integrated change control.

Coordination/Monitoring

1. *How is coordination between project elements handled?*

Chapter 4

4.2.1.3 - Enterprise environmental factors. Organizational governance framework (a structured way to provide control, direction, and coordination through people, policies, and processes to meet organizational strategic and operational goals).

2. *Is there an established channel to report progress and problems?*

Chapter 6

6.5.1.4. Enterprise environmental factors.

3. *Can the project's elements handle the amount of internal communication they are getting?*

Chapter 4

4.7 - Key concepts for project communications management. Communication activities include internal and external, formal and informal, written and oral.

Implementation

1. *What are the project's technical elements?*

Chapter 4

4.2.2 - Develop project management plan: tools and techniques.

2. *Is each element its own viable system?*

Chapter 1

1.2.1 These factors influence an organization's ongoing operations and business strategies. Leaders respond to these factors in order to keep the organization viable.

3. *How do the project's technical elements connect to and monitor the outside environment?*

Chapter 10.

10.1.3.1 Communications management plan.

10.2.1 Manage communications: inputs.

10.2.3. Manage communications: outputs.

Regarding, the previous considerations and taken into account the work proposed by Balint et al. 2015. It is possible establish a parallelism between the decreasing hierarchical order of VSM and PMBOK sixth edition.

System 5: Strategy / policy / identity

Chapter 2

2.4.2 - Organizational governance frameworks

System 4: Intelligence

Chapter 3

3.5.4 - Integration and complexity: complexity within projects is a result of the organization's system behaviour, human behaviour, and the uncertainty at work in the organization or its environment.

Chapter 5

5.3.3.1 - Project scope statement

System 3: Control

Chapter 4

4.6 - Perform integrated change control.

Chapter 8

8.3.3.1 - Quality control measurements. The quality control measurements document the results of Control Quality activities and demonstrate compliance with the quality requirements.

System 2: Management / coordination

Chapter 4

4.2.1.3 - Enterprise environmental factors.

System 1: Executions / operations

Chapter 4

4.2.2 - Develop project management plan: tools and techniques.

Chapter 10

10.1.3.1 - Communications management plan.
10.2.1 - Manage communications: inputs.
10.2.3 - Manage communications: outputs.

Figure 19, 20 show as the different systems that can be associated with PMBOK.

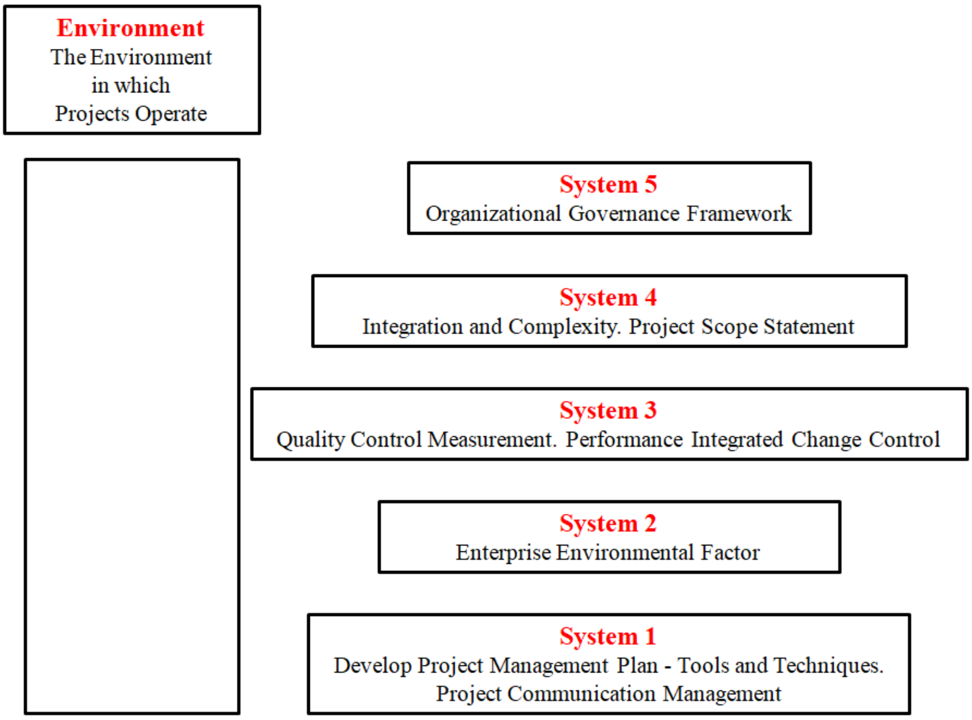

Figure 19: VSM and PMBOK, well-functioning system.

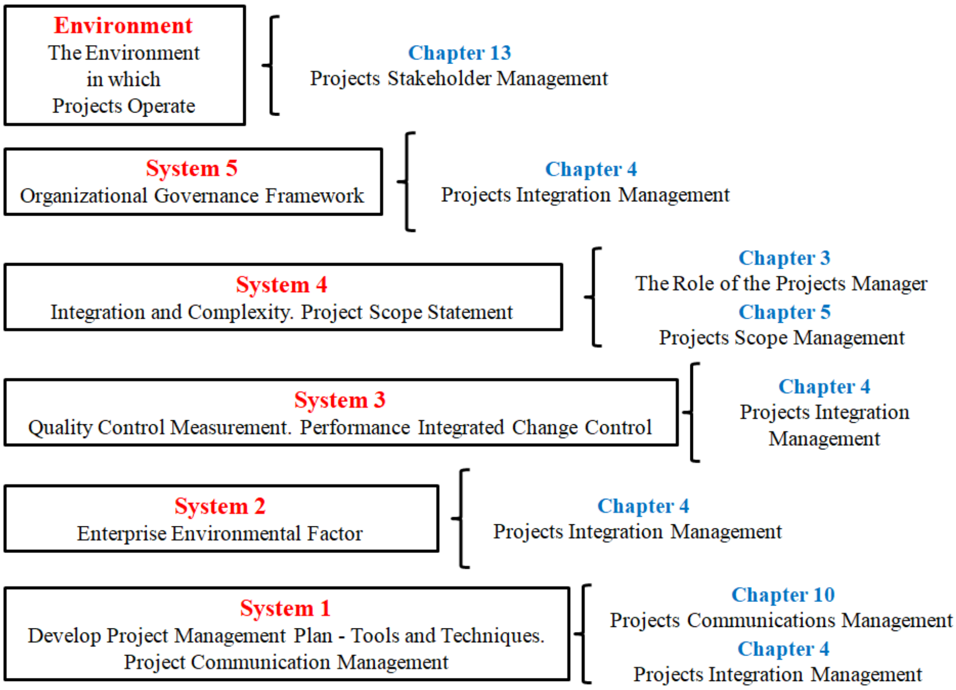

Figure 20: Viable systems and PMBOK chapters.

4.5 Agile Project Management Framework

Agile process models determine patterns for modern software development. Due to the principal purpose is to finish projects as successfully as possible. It appears necessary to review how reliably can be achieved by means of these models. Research has been carried out to determine the coherences between agile process models and cybernetics. Bogner et al. (2014) studied how to cope the complexity, which should allow viable complex systems or processes. Cybernetics is important for agile process models. Once the fundamental cybernetic factors are applied, the processes are maintain under control and organized in modes that insure long-term viability. The results of the agile method Scrum were presented and this showed that although some cybernetic factors like communication, feedback and circularity were covered, however essential cybernetic principles were missing in Scrum. These shortcomings can be compensated in order to obtain basic reliability, especially in critical situations.

An extensive empirical research over five years was done by Bititci et al. (1999), this related to modern business process thinking and VSM. The work established the foundations for a viable business structure which maximises opportunities for managing agility. In addition, it is shown how VSM and modern business process thinking are combined to set up a powerful structure for planning and managing organisation in a dynamic and uncertain environment. As a result, the viable systems structure presented provided a powerful framework for the strategic analysis, planning and management of the agility of a business. Therefore, managing a business using the viable business structure would result in improved agility, responsiveness and business outcomes. However, the authors set out that the research was not advanced enough to derive objective data on the actual agility and performance of organizations using the viable business structure, among others. Molhanec (2010) introduced a modern agile framework covering the whole life cycle of project. The goal was to define, the phases and stages of project management process in the frame of the whole product life cycle. The result of the work was a detailed referential description of and user guides for the product design project management process based on the agile project management.

Tackling a progressively volatile organizational environment is an acute challenge for managers of any development project, especially software (Truex et al. 1999). Traditional software development methodologies are able to be characterized as linear, sequential processes, and the related management approaches can be efficient in developing software with stable and known, among others. However, it is more likely that the real-world development efforts are conducted in more volatile environments. As a consequence of this, the requirements of the systems must shift along with them (Baskerville et al. 2003). In fact, apparently minor changes are able to derive unanticipated effects, as a result systems become more complex and their components more interdependent. Thereby, project management approaches based on the linear development methodologies are not matched with dynamic systems (Augustine, 2005).

The fundamental features of complex adaptive systems are presented in the principles of agile methodologies parallel the ideas delineated in Checkland’s Soft Systems Methodology and Ackoff ‘s Interactive Planning (Cavaleri and Obloj (1993), Cockburn and Highsmith (2001), Highsmith (2002), Highsmith (2003)). These possess the potential to endow organizations and systems with emergent properties. Agile methodologies are appropriate for projects that present an elevated variability in tasks as well as the capabilities of people and the technology employed. Organizational ways and cultures derive from innovation may adopt the agile methods straightforwardly instead of those set up around bureaucracy and formalization (Nerur et al. 2005).

It is usual to tackle of agile methods in the scenario of the lightweight activities employed to manage the acquisition or development of software. The set of underlying values for an agile project include, (Alleman, 2002):

- Communication
- Simplicity
- Feedback
- Courage
- Humility

According to Hoda and Murogesan (2016), PMBOK and software extension use the terms initiating, planning, executing, monitoring and controlling, and closing for management activities. The mode of interacting of agile practices with cybernetic management incorporates a new aspect to understanding agile management. As Figure 21 shows, the specialist literature tackles the comparison of traditional project management with agile techniques. Otherwise, the connection between traditional project management and the control functions of the VSM has been dealt with by Britton and Parker (1993), Saynisch (2010), Morales-Arroyo et al. (2012) and Muradand and Cavana (2012). Although agile techniques and methods can be considered as a subset of conventional project management, however; a deep examination with respect to the cybernetic value has not been done. It seems justified and essential to look deeper into that relationship, (Müller, 2015).

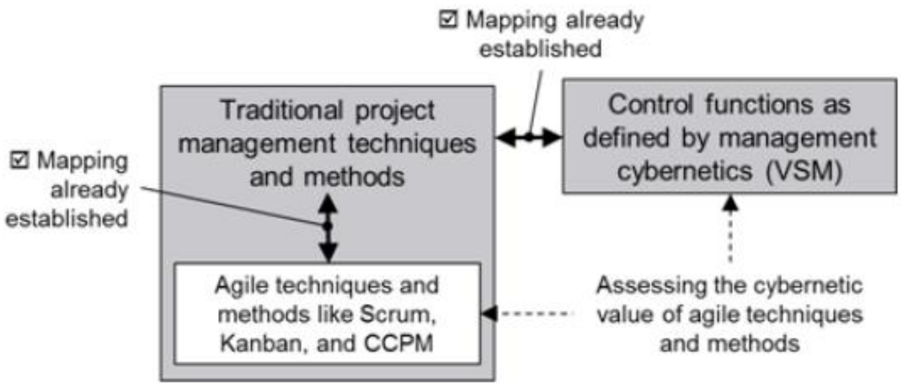

Figure. 21. Methodological approach. Taken from Müller (2015).

Agile methodology presents its fundamental assumptions in the high-quality that is able to develop by small groups using the principles of continuous design enhancement and assessing based on swift feedback and change. The control is done through people centric. The management style is based on leadership and collaboration. The knowledge management is tacit and the role assignment is self-organizing teams, which promotes role interchangeability. Furthermore, the communication is informal, being the customer's role vital. The project cycle is guided by product features, the development model is the evolutionary-delivery model and finally the desired organizational form or structure is participative and flexible promoting cooperative social action, i.e., organic.

In order to consider the migrating to agile methodologies should be tackled the management and organizational such as organizational culture and form, management style, reward systems, etc. The process should change to a feature-driven as well as people-centric approach. Managing large, scalable projects and short, iterative, test-driven development that accentuates adaptability. People should work effectively in a team with high level of competence and the customer relationships should be carried out through knowledge, proximity, etc.

One of the most relevant issues of the existing sales organization can be the slow response time to customer needs. Thus, the work rate time of an offering can be very long and this can lead to a continuous deteriorating of customer satisfaction metrics. Under a cybernetic viewpoint, the issue can be set out as shown in Figure 22, where the customers are treated by the sales system of the S4 management layer in an uncoordinated mode and each customer account unit was not attended adequately. Once the contract is signed, the work is done by the operational units which are controlled and ruled by the S3 management function. However, the deficiencies of the operations for the customer are multiple and this can reach, for example, a low quality perception. These conditions can be realized directly to the management of the sales organization, which address to a depreciation of the prestige of the sales people in the eyes of the customer. Furthermore, this limits the possibilities of raising the sales volume. The problem can be sorted out by creating a new vision for the organization and working structure. Based on this jointly created alignment of the sales organization’s future vision and mission, it is believed that the effective handling of the customers’ variety can occur and will guide to much better outcomes in the close future.

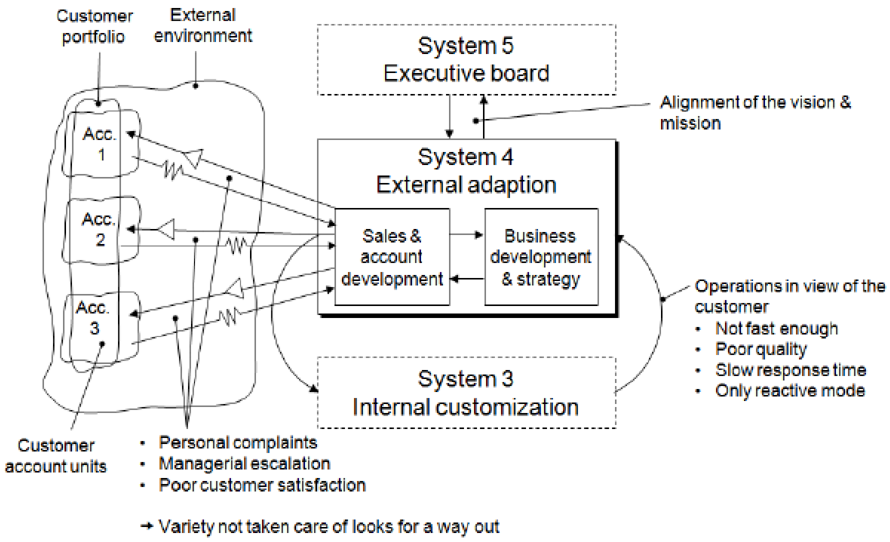

Figure. 22. Deficiencies of the initial situation. Taken from Müller (2015).

The gap between the agility of the market along with the customers and the mode of managing projects raises continuously. This complex system could be led by using a cybernetic model, which would enable to obtain more insights and to assume the mode of project management, through the embeddedness of the potential users and the management based on mission and vision. According to Stumpe (2014), the using a cybernetic approach for project management evidence, that the traditional business management is not sufficient. In order to keep the markets different adaptations are required on the project management.

5. Conclusions

The potential of viable systems lies in that it can be used for the design and diagnosis of organizations, whether temporary or permanent, as the organizations in which they are executed. VSM deals fundamentally with the study of communication channels as well as information flows that are generated. A project is a viable system with its identity, motivations, objectives and strategies at a first level of recursion where corporate governance is located.

In this work, a literature has been done. It consists of four parts such as Project Management, Project Governance, Viable System Model and Complexity. A PMBOK sixth edition outlook has been provided because it is the main tool used to carry out the study purpose. Cybernetics and VSM have been also dealt with to establish the research framework. The systems interactions as well as the channels in the VSM were tackled, as well. VSM describes the organisation as homeostatic i.e., able of maintaining independent lifetime in response to changes in their environment, and each VSM is featured by the principle of recursion i.e., that each viable system both holds and is containing within other viable systems which share a system structure. VSM is able to link project management with corporate management by using its recursive feature. Organizational cybernetic can aid to deal with the complexity which the projects have to face, nowadays. Thereby, VSM can be a fundamental tool to develop the project management field.

A theoretical framework study has been carried out where VSM different perspectives were presented. In fact, NASA’s wicked problems were studied because the organizational cybernetics was used to meet this type of problem. VSM for project management was considered as an approach needed for a better understanding the context where this work is developed. This one was completed tackled viable system perspective, which allowed to know the role of the complexity management. The management of complexity is done through vertical splitting and the mechanisms of attenuation and amplification that underlie the model, which can be suitable mechanisms to tackle the growing complexity of projects and their environment. On the other hand, viable system and metrics were analysed to shed light on this complex field.

A VSM and project management were studied and a framework study was done, which allowed to establish a connection between PMBOK sixth edition and VSM. As a conclusion, the algedonic channel, S2 (anti-oscillatory), C1 (environmental) channel and C5 (anti oscillation) channel were not significantly shown in PMBOK's project management structure. The viability of a project can only be maintained, if it is aligned with the total system in which it is included (recursion). Guidance on applying of viability and the projects management is also provided, being this a tool that has enabled to study the viability of a project by using the PMBOK. Agile project management framework is taken into account to fill the lack that the previous frameworks have been able to show in some way, in the link between VSM and the project management.

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