Cybernetics in Project Management: a conceptual framework to analyze and enhance the performance of alliances via the application of Viable System Model

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Abstract

Large infrastructure projects are becoming increasingly complex with ever-growing challenges ahead. To date, productivity growth in the infrastructure sector has been slow, when compared to manufacturing, but there are sector exemplars that have developed innovative approaches to delivery. Alliancing is one such approach that has showed promise in tackling some of the problems of poor infrastructure productivity. It is where all parties coalesce to form a project enterprise where they can share risks and rewards and remove transactional costs. This paper aims to investigate what is known about project alliancing, by reviewing it through the lens of a Viable System Model (VSM) and Cybernetics. As such it will explain and analyze the viability and capability of alliances in self-organizing and adaptability. This paper proposes a new approach and establishes a framework for project-based enterprises that will help them face challenges and adapt to environmental uncertainties.

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Introduction

Infrastructure projects, especially large complex ones often known as megaprojects, are considered to affect societies and economies. According to Hirshman (1995) such projects are "trait making" designed to change the structure of society, contrasting smaller conventional projects that are "trait taking" fitted in pre-existing structure. Mckinsey and co (2017) highlighted the importance of infrastructure and real estate projects to economies as it represents nearly 14 percent of the total GDP in 2015, with the expectation for a gradual increase to cope with the United Nations' sustainable development goals (Mckinsey and Co,2017). Nevertheless, such projects do not have promising performance data in terms of delivering projects within the cost baseline. According to Flyvbjerg (2014), nine out of ten of projects have cost overruns and a common benefit shortfall of up to 50 percent (above 50 percent not uncommon) without any sign of improvements through time and geography. Not to mention delays which in turn cause cost overruns and benefit shortfall (Flyvbjerg, 2014).

Project alliancing, among several approaches to enhance project performance and reduce costs, was introduced during the late 1990s (Walker, Hampson & Peters, 2002). Alliancing is a collaboration between several parties which integrate to overcome project challenges especially in large complex projects (Ibrahim et al, 2016). To many, project alliancing is considered the most attractive approach that tackles efficiency in terms of costs, time and quality and other objectives (Chen et al.,2012;Van den Berg and Kamminga, 2006). The concept of alliancing extends to more than an interorganizational cooperation between organizations in the supply chain; it is a new delivery model (Chen et al 2012), based on risk/reward sharing and enforced through contractual arrangements (Hauck et al., 2004; Walker et al., 2002). As such, no one party (the client or contractor) should dominate the alliance (Langfield-Smith, 2008; Mills, et al 2019). This require a committed behavior, good faith with transparency and trust to achieve the project objectives (Jeffries et al.,2006). Scholars have identified the success factors of project alliancing including project attitude, trust and equity between partners, education on alliancing philosophy, benchmarking and continuous performance monitoring, virtual team and integrated alliance office, coordination creativity, use of web-based management programme and electronic information exchange (Abrahams & Cullen, 1998; Hauck et al., 2004; Henneveld, 2006; Jefferies, Brewer, Rowlinson, Cheung, & Satchell, 2006; Love, Dina, & Davis, 2010; Ross, 2003; Rowlinson & Cheung, 2005;Chen et al., 2012). Alliancing as an approach has many advocates, but there is significant variation in its application. What is needed therefore, is a common way of investigating alliancing systems and a systematic approach to assessing their viability.

Cybernetics was described to be a new science during the 1940s (Wiener,1948). Cybernetics stems from the systems theory, and deal with how systems operate rather than the nature of systems (Robb,1986). Accordingly, cybernetics is transdisciplinary and tackle any system whether it was biological, electrical or organizational. Viable System Model (VSM) was developed by Stafford Beer and stemmed from cybernetics. The VSM serves as a representational model of organization and a diagnostic tool that can assess the viability of organizations (Beer,1981). The model attempts to replace organizational charts which according to Beer(1981) are "devices for apportioning blame when something goes wrong". The model has several functions depicted in its five subsystems; operational, coordination, control, intelligence and policy (Espejo and Gill, 1997).

The System 1(S1) consists of the operational units and its management, System 2 (S2) is the supervisory system which coordinates the activities of S1, System 3 (S3) represents the senior management of the operational systems that is the autonomic management and the lowest level of corporate management, it governs the stability of internal environment of the organization. System 4 (S4) is the developmental system which deals with the future and the external environment and advises in the decision making, System 5 (S5) is the highest level of senior management which takes the decisions and sets the policy and ethos of the organization.
Despite the wide use of systems theory in the field of project management, especially that project management emerged as systems integration (Morris,1994), little was discussed around the use of cybernetics in project management with cases such as the work of Piney(2008), Britton and Parker (1993), Saynisch (2010), Awuzie and McDermott (2013). The increasing complexity of projects require to look at them in a different lens; we propose the cybernetics lens. A cybernetic lens deals with complex systems integration and their adaptability to the external environments. In this paper, the viable system model is suggested as a framework to illustrate the connections among several systems, in the case of alliancing, the project entities (owner, integrator, consultant and suppliers) showing the communication channels among them while highlighting some of cybernetics concepts that deals with complexity.

That being said, this paper aims to bring together cybernetics and project management by applying Stafford Beer's viable system model to project alliances (more specifically to project enterprise). The VSM is proposed as a governing framework that can be applied to alliancing, where the five subsystems represent the project parties (client, integrator and suppliers). In doing this, each party will know its roles and set the connections between one another. Nevertheless, the application of VSM can also be used as a platform to enhance the integration and cooperation of project entities as it will set the communication channels among them. Therefore, enhancing project performance (cost, time and quality) and realizing value for money.

The following sections will discuss briefly project and the programme alliancing, enterprise-based approach, the origins of project management as systems integration showing how the field of cybernetics has been overlooked, cybernetics and the viable system model in management and project management. Subsequently, the paper will highlight the similarities between alliancing and the viable system model and state a set of propositions about the applicability of VSM to enterprise-based approach.

Programme and Project Alliancing

Project alliancing initially started during the Andrew field project with British Petroleum (BP) seeking a new delivery approach that was more effective than the traditional contracting method (Sakal, 2005). To realize such a radical change, BP needed to change its behavior and commit to teamwork, relationship building and trust (Sakal, 2005). Project alliancing required open-book accounting, sharing all risk between project members, and setting a target cost by the whole team which later will be compared to the final costs, then cost over/under runs will be shared by the participants (Sakal, 2005). In other words, project members will act as a whole organism which will share rewards and penalties.

Although alliancing has various definitions (Yeung et al., 2007), Gerybadze (1995) defined project alliances as a joint relationship between client and associated firms, but legally independent organizations. While for Nicholson (1996) it is when "organizations with capabilities and needs come together to do business and add value to the other partner, at the same time working to provide a product which enhances society and the capability of the ultimate client". Peters et al. (2001) defines strategic alliancing as the inter-organizational arrangement that happens between two companies and continue after the project with sharing ongoing business benefits. What is evident here is harnessing the relationships beyond a project to a more strategic organizational and inter-organizational level (Love and Gunasekaran,1999).

In an attempt to provide a general understanding of alliancing, Yeung et al. (2007) went further to point out the key elements of alliancing; formal contractual arrangements that binds all the parties together, real pain/gain share, trust, long term commitment, cooperation and communication, common goals and objectives, win-win philosophy, equity, agreed problem resolution methods, continuous improvements, alliancing workshops, early selection of contractors. The most successful alliances are fostering innovation at a programme or organizational level. Recently, the Infrastructure client group (ICG) and Institute of Civil Engineers (ICE) in the UK commissioned research to show how firms were commercially incentivized to deliver better value for customers and develop a sophisticated long-term relationship between project actors; owners, integrators, investors, suppliers and advisors. Clients are driving for changes in project delivery models that integrate their capabilities with those of project parties to form a long-term hybrid organizations (Mills, 2019) that overcome lowest price procurement and transactional risk transference (Latham, 1994; Cox and Townsend, 1998; ICE, 2017). In this view parties must operate the right culture and behavior with no blame (ICG, 2015). By doing this, notable examples have outperformed business plan targets, halve carbon emissions, improve time efficiency by 40% and establish an integrated supplier network (Mills, 2018). Others have shown 21% of project capital cost reduction (Bakshi, 1995; Halman & Braks, 1999) along with innovation and learning benefits at the organizational level (Chen et al., 2012; Barlow,2000; Hauck et al, 2004). Moreover, Walker et al (2001) and Alliancing Association of Australia (AAA) (2008) showed that projects performed outstandingly in terms of cost, time and other important areas (Chen et al., 2012). While for others it was the avoidance of disputes and other non-cost related outcomes that were most crucial (Wood and Duffield, 2009). Interestingly, these benefits were the result of cultural and procedural change in the construction sector that is also aligned with the culture and laws governing the viable system model as will be discussed in subsequent sections

The Origins of Project Management as a System

Modern project management was fundamentally underpinned by the system approach, this formed the bedrock of project management. Starting with mentioning challenges of the new world in their book "System Analysis and Project Management" which later becomes a classic in project management. Cleland and King (1983) characterized these challenges as interdependent, complex and changeable. They went further to describe the solution to such societal systems which has imposed the involvement of complex systems. A system can be defined as "An organized or complex whole; an assemblage or combination of things or parts forming a complex or unitary whole" (Cleland and King, 1983). Another definition of a system is given by Kerzner (2013) as "a group of elements, either human or non-human, that is organised and arranged in such a way that the elements can act as a whole toward achieving some common goals or objective*"*.

There are both simple and complex systems models of organizations, abstract and real world (Cleland and King, 1983). Complex systems show multiple environments in which the organization operates various controls, influences and subsystems acting together (Philips, 1974; Cleland and King, 1983). Daft and Lewin (1990) described organizations as enormously complex systems. Therefore, such systems are hard to predict as they operate in a nonlinear way, that is changing inputs to outputs nonlinearly due to system's components interaction via a network of feedback loops (Anderson, 1999). Nevertheless, Walker (2007) mentioned that open systems, especially in construction projects, are also characterized with a negative entropy; a self-adaptation phenomenon in a complex situation.
Project Management emerged from the defense sector which placed significant emphasis in the 1950s on systems thinking and system integration (Hughes,1998), however the emphasis since this time has predominately been process planning and monitoring tools such as PERT and Critical Path Methods (Morris, 2011) which became synonymous with the discipline. In the 1960s, several operations management practices such as Life Cycle Costing, Quality Assurance, Value Engineering, Configuration Management, and the Work Breakdown Structure were added (Morris, 1994). Arguably, there is a need to reconnect with the principles that underpin systems thinking and to review project alliancing through the lens of a Viable System Model (VSM) and Cybernetics, as means to stimulate this reconnection. Cybernetics allows the study of complex systems, and so there is significant value in this in devour. It is therefore surprising that there has been no thorough studies of project management and cybernetics. What is clear is that the field of project management must reinvestigate its origins and explore other streams of management literature that have answers to some of the fundamental challenges faced by programme alliances today.

Reintroducing the Consideration of Cybernetics and Viable System Model to Project Management

Cybernetics originated from the Greek word "*Kibernetes"* which means the "art of steering" evoke the interaction of actions, goals, feedback, predictions and response in any system (Wiener, 1948). The term "governor" is also derived from the same root (Wiener, 1948). Cybernetics or control and communication as described by Wiener (1948) is a field of study that is transdisciplinary which touches on established disciplines as electrical engineering, mathematics, biology, neurophysiology, anthropology and psychology. It attempts to find the common components in the functioning automatic machines and the nervous system (Wiener, 1948). Although the term "Cybernetics" was introduced by Wiener (1948), it was firstly used by Maxwell (1864) in which he described feedback in mechanical governors. Followed then by Ampere (1884) description of the "social science concerned with the government"

Cybernetics stems from the general systems theory and concerned with how any system is operated (Robb, 1984). It can be applied in widely diverse fields such as radar control, animal genetics, automatic machine tool control, artificial intelligent machines and robots nevertheless it also studies social systems, how they work and are controlled (Wiener, 1948; Ashby, 1956). The themes which Cybernetics deal with are coordination, regulation and control, reflect a different angle of study that is essentially behavioristic and functional; Cybernetics does not deal with things but the way of behaving (Ashby, 1956). Cybernetics focus on the system functions rather on what the system is – whether it was biological, mechanical or social (Ashby, 1956). In order to relate cybernetics to the organizational structure and management, first some terms, language and concepts should be highlighted in order to explain the viable system model afterwards.

- A "***System***", whatever is its complexity can be illustrated by an opaque black box in which it operates as a transfer function from an input to produce an output (Robb, 1984).

- ***Feedback***, which was identified in the general systems theory, is considered to be a flow of information that feeds back to its origin (Krippendorff, 1986). A negative feedback decreases the input and stabilize the system; an example is that of the governor of a steam engine, however a positive feedback can be destabilizing an example given of the growth of a city and its opportunities will result more people living there (Krippendorff, 1986). The term here does not represent the response to a stimulus rather it is a circular causal process where a system's output involving other systems in the loop, is returned to its input (Krippendorff, 1986).

- ***Variety*** is the number of states a state can take up (Ashby, 1956) for example the light switch has two state (on and off) therefore two varieties, in other words it is a measure of complexity (Beer,1981). Ashby's law of requisite variety, coming from his invention of the Homeostat, states that a system could be controlled, if and only if the variety of controller has at least as much variety than the environment in which the system existed (Ashby, 1956). The law of requisite variety is central of cybernetics and information systems (Robb, 1984).

- ***The holistic*** concept stands for "the whole is greater than the sum of its parts (Nagel, 1961; Robb, 1984)

- ***Recursive system theorem*** suggests that in an organization structure if a viable system contains a viable system, then the organizational structure must be recursive.

The relevance of these terms is that they provide a means of describing and explaining the VSM as the model is underpinned by these principles. Nevertheless, such terms reflect a portion of cybernetics term and principles.
The inter and transdisciplinary nature of cybernetics science have benefited management science, and the founder of VSM (Stafford Beer) developed concepts and tools to deal with the complexity and ubiquitous issues in organizational life (Schwaninger, 2006). One of which is the viable system model that looks beyond a reductionist, simplified and formulaic prescription (Marion and Uhl-Bien, 2001). As reducing the holistic system to isolated observations misses the influence of interactive dynamics (Marion and Uhl-Bien, 2001), this view is supported by complexity theory which views the organizations as complex adaptive systems composed of subsystems or agents who interacts and affect one another. It is these adaptive systems that generate behavior for the system as a whole, rather than the controls of an organizational chart per se (Marin, 1999; Martin and Rosenhead, 2003; Regine and Lewin, 2000). Therefore a control system model, rather than organizational structure and process alone, is needed if someone wants to know how control is achieved in an organization. Like Neurocybernetics which is concerned with the nervous system, these models must focus on "…organizational invariances in large, complex, probabilistic systems within the methodology of model-building" (Beer, 1981).

There are five necessary subsystems found in any organism or organization, that are able to maintain its identity with other organisms within a shared environment (Beer, 1984). Within a whole system there is viability, but also recursion in viable subsystem operating displayed at 45-degree angle (Figure 1). Beer (1984) states that "In any recursive organizational structure, any viable system contains, and is contained in, a viable system". The five subsystems of the viable system model and the way they are organized and interconnected highly correlated with the project enterprise mentioned earlier.

The five subsystems features of the VSM are summarized below:

- System 1– S1: consists of variety operational units which execute organization's duties (Flood and Zambuni, 1990) and produce (citizens, firms, cities and industries). These units operate in autonomy within the limits of keeping systemic coherence and with direct interaction with the environment (Medina, 2006; Hildbrand and Bodhanya, 2015). The element of control in this system is based on the detection of pattern of achievement that can be reported through System Two to the organization (Beer, 1981) In project alliancing the system 1 consists of the suppliers that provide services for the project.

- System 2 – S2: acts as coordination system and a guarantor of harmonic functioning of the system 1 (organizational units) (Ríos, 2012). It coordinates the operations of the operational units and prevents uncontrolled oscillations from happening (Beer,1981). The main goal of S2 is to cut down the variety of its operational interaction which are inherently oscillatory (Beer, 1979). For example, System two control the disputes of resources that happen between the operational units. System two also deals with the transmission of filtered information to System Three (Ríos, 2012). System 2 is consistent with the work of advisors (consultants) who oversees and coordinate the work however it also can be part of the function of the integrator to coordinate the work and monitor it.

- System 3 – S3: is described by beer (1981) to be the highest level of autonomic management and the lowest level of corporate management. it governs the stability of the internal environment of the organization. In other words, S3 is intended to keep a homeostatic internal balance and optimize performance under certain criteria and within an agreed framework (Beer, 1981). Some of S3 characteristics include; surveillance of the total activity of operational elements of the enterprise, awareness of what's going on inside the firm, linkage with all managerial units, awareness of system two (Beer, 1979).Mainly system 3 fits in the integrator roles that involves the management of suppliers (S1s).

- System 3* – S3*: acts as a support system for system three getting the information from system 1, that is any information that doesn't follow the normal channel of communication (Ríos, 2012). In other words, S3* acts as an auditor ensuring that the information transmitted to system 3 is complete (Ríos, 2012). Some of S3* activities include; Quality audits, surveys, operational research, and compliance with accounting procedures. Here, integrator, client and the advisor are involved in quality audit and checks depicted in system 3*.

- System 4 – S4: described by Beer (1981) to be the “development directorate of the firm”. It provides all the necessary information to System 5, the highest level of decision making (Beer, 1981). S4 basically acts as a switch between S3 and S5, where a stream of instruction descending from S5 to S3 (Beer, 1981). Also, another stream of filtered information about the autonomic conditions are transferred from S3 to S5. Additionally, S4 is also connected to the outside world (the total environment of the enterprise) and the future by gathering information about the total environment and send it as an input to S5 (Beer, 1981). In other words, S4 is concerned with “outside and then” level (Beer, 1979). Some of the activities of S4 include; market research, scenario analysis, simulation modelling, operational room to make strategic and operational decisions, and innovation (Ríos, 2012). S4 usually reduces the variety of S3 by absorbing alternatives (Beer, 1979). Some of these elements that allow for changes in variety include; R&D, corporate planning and economic forecasting (Beer, 1979). The functions of system 4 require from the integrator, advisor and the client to work together in this system. It is where all the planning work happens; where all parties should be involved. Here it should be noted that suppliers are engaged in the planning work as shown in figure 1 by a communication channel linking the management of the supplier (on a second level of recursion) to the system 4.

- System 5 – S5: The highest decision point of the organization which forms the policy of the other organizational units (Beer, 1981). S5 handles the variety stemming from S3 and S4, it acts as a balance between the other two system (Beer, 1981). According to Beer (1981) System 5 monitor the regulatory machinery ensuring that it doesn’t have an uncontrolled oscillation. System 5 can be representatives of management, shareholders, and investors (Ríos, 2012). In short system 5 represents the identity of the enterprise. Here, It should be noted that the notion of closure is embraceable by any given level of recursion (Beer, 1979). In any viable system, S5 acts as an administrator of Ashby’s law (Beer, 1979). Some of the activities and responsibilities of S5 include; determining the vision, the mission and strategic goals of the organization, monitoring organization stability and internal equilibrium, ensuring that the organization maintains its identity and managing stakeholders (Ríos, 2012).Here, S5 corresponds to the owner/client/investor who set the ethos and culture of project enterprise.

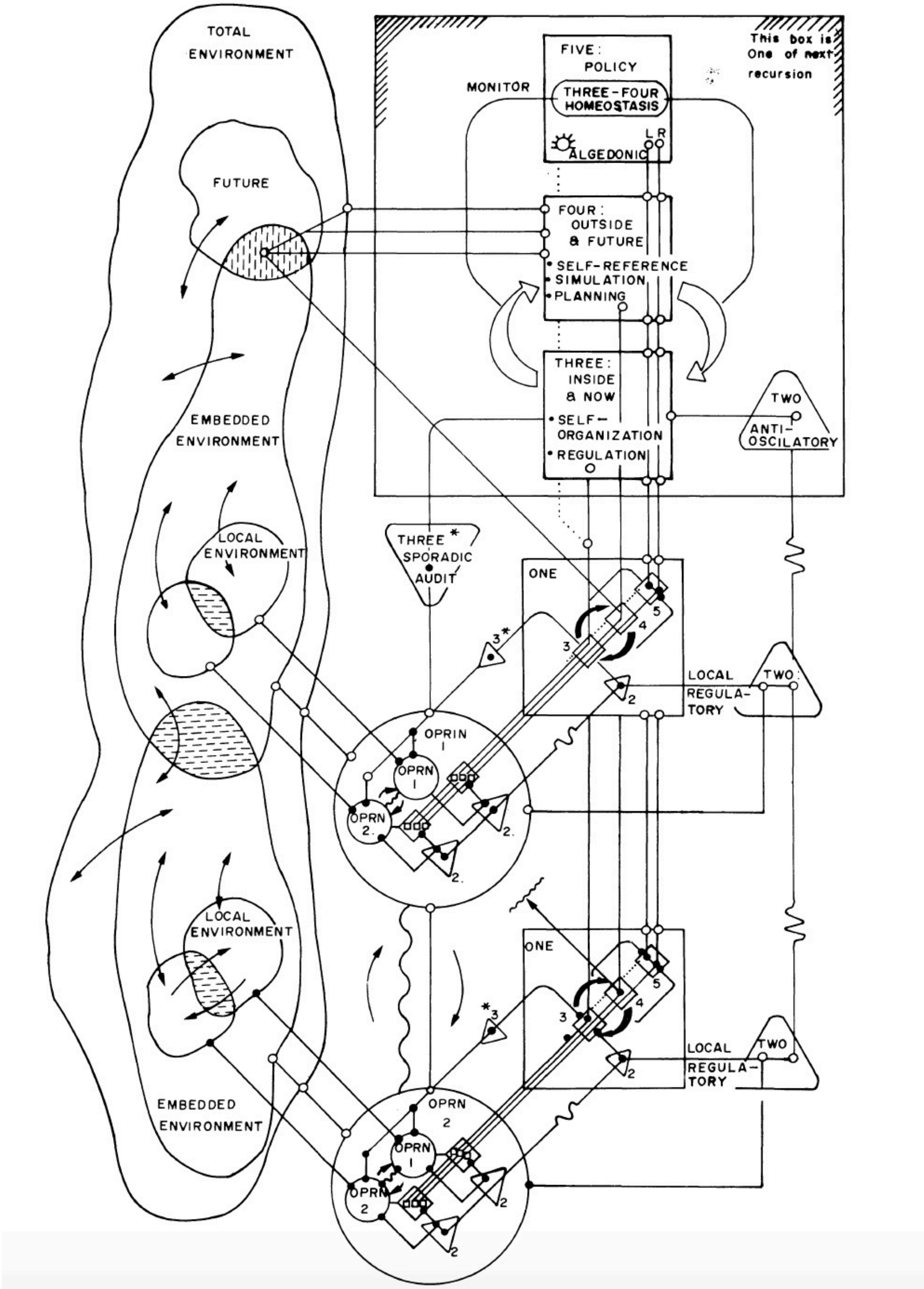

Figure 1 Viable System Model showing recursive embedment (Beer,1984)

The theorem of recursive systems is that each subsystem is embedded in a system like for example Russian dolls concept. Here it is worth to relate the concept of recursion to tier 1,2 and 3 suppliers.For example in system 1 (tier 1 contractor) in the figure 1 shown above there is a subsystem (tier 2 contractor) consisting of 5 sub subsystems and so forth.

Six primary channels operate along the vertical axis of the system and handle the channels variety of the viable system (Beer, 1979). The first three channels correspond to the variety-interconnections placed in the vertical plane of the environment, the operations and the management domains (Beer, 1979). Those channels are depicted in the following figure and named respectively C1, C2 and C3. In applying the model to project enterprise, Channel 1 corresponds to the interaction of external environments, channel 2 is the communication channel that link all the suppliers, channel 3 is the communication channel that relates all the management of suppliers with S3,S4 and S5. The other three communication channels that Beer describes are the “Metasystemic Intervention”, “Anti-oscillation channels” and the “Operational Monitoring channels” (Beer, 1979). Another important channel is the Algedonic channel which functions as an alert traveling straight to the top signal concerning any issue that could jeopardize the organization (Ríos, 2012). Channel 4 corresponds to the intervention of system 3 to coordinate the resources of the suppliers for example asking the supplier to increase his resources. Channel 5 analyzes the data from the operations and coordinate the work reducing the oscillations from the operations. An example for this is scheduling of the work. Channel 6 is related to the audit and check-ups of the work.

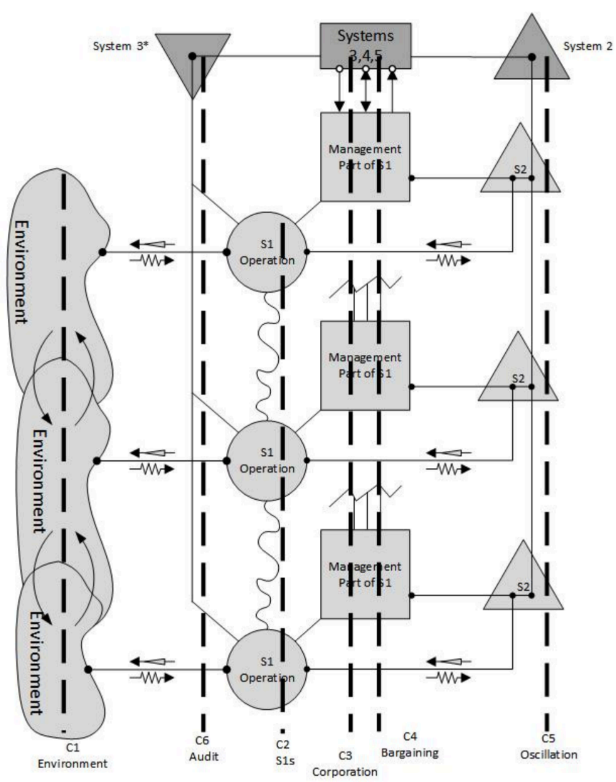

Figure 2 VSM channels (Ríos, 2012)

The communication channels connect the diverse functions specified and the organization with its environment (Ríos, 2012).

Schwaninger (2006) highlighted the diagnostic power of the viable system model and its applicability to organizations. He presented five cases each representing different industry, size, mission and products where the VSM has been applied as a conceptual tool for diagnosis (Schwaninger, 2006). He added that the application of this model allowed a better understanding of the case studies and facilitated the analysis of problems.

Although cybernetics has been applied extensively to management, it has had little or no attention in project management. Checkland (1999) provides cybernetics as an example of the meta-subject of the status of system thinking. Cleland and King (1968; 1975; 1983) describe the combination of system analysis and project management, but not cybernetics (Morris, 2012). Britton and parker (1993) proposed a model based on viable systems model to diagnose and design project management systems and that there are two specific circumstances to consider project based organizations as viable: first when the organization can be divided into projects, second when establishing a viable system through the execution of a project, for example the construction of a manufacturing plant (Britton and Parker, 1993). They presented the VSM model into the context of PM for a construction project as shown in Figure 3. However, this application is not complete in that not all aspects of system three, four and five were covered, which is surprising given that the model and language has been around for 40 years (Britton and Parker, 1993).

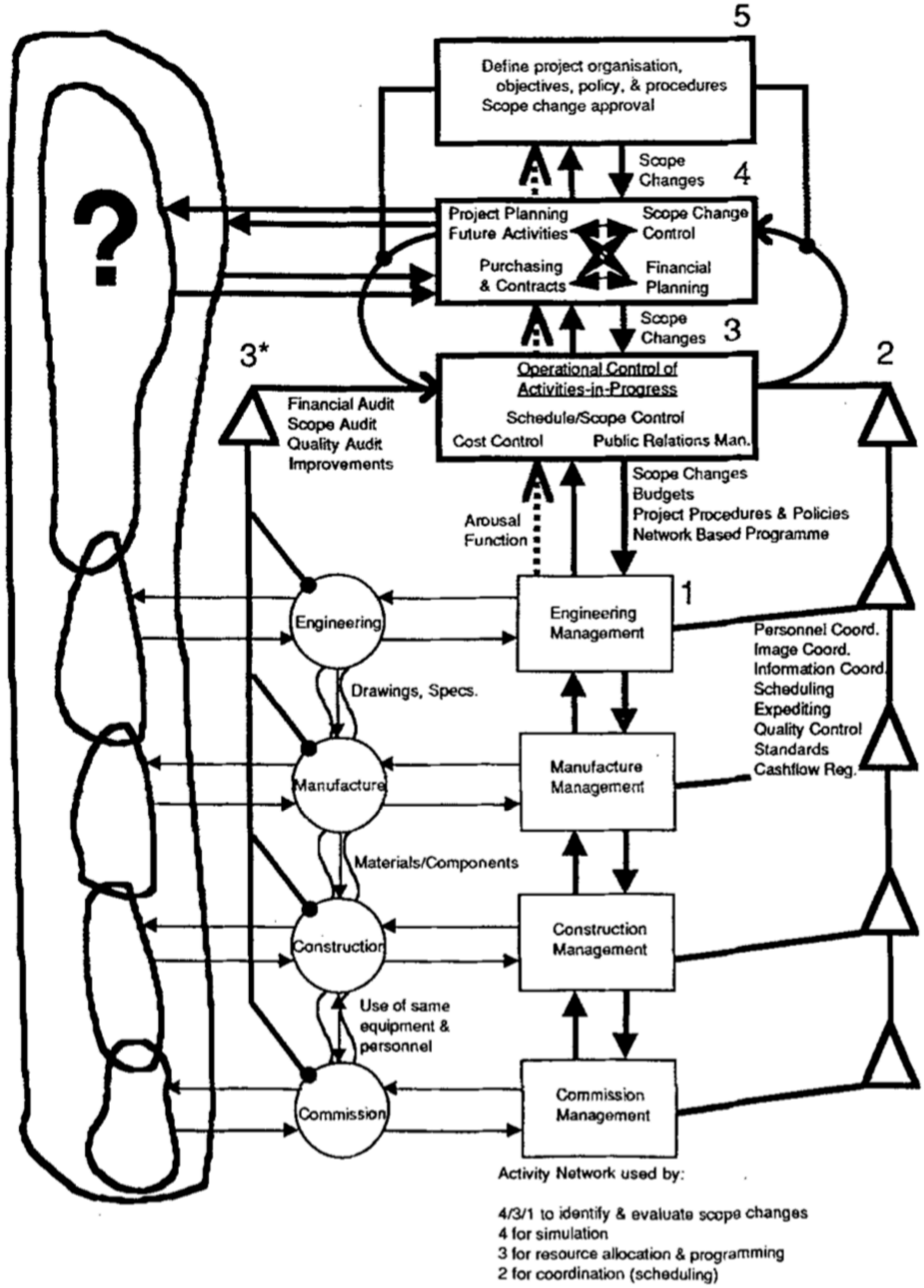

Figure 3 A Viable System Model of Project Management by Britton and Parker (1993)

Interpretative Discussion of How VSM Could be Applied to in an Enterprise Alliance Approach

This investigation of the applicability of cybernetics to project management is based on the interpretation of previous data collected in June 2015 (Mills, 2018). This data is relevant to understanding how alliances can be constructed that are dynamic and adaptive and how the composition of subsystems or agents are structured and incentivized to behave for the good of the system as a whole.Three infrastructure owner programme directors nominated two projects with very different outcomes. They represented positive examples of those found in the Infrastructure Client Group more widely. A case study design was applied (Yin, 2003). One owner had initiated the alliance within the last 15 years, and the other two had implemented their alliances in the last 5 years. All three had opted to change direction, but each had adopted a different strategy to structure the alliance. This study required a mix of qualitative and quantitative methods, including desk research, online questionnaires and in-depth interviews with key project participants. Triangulation was a critical strategy in the research design. The outcomes of this work have informed the development of a new enterprise model of alliancing that exists at a programme, rather than project level (ICE, 2017). A content analysis was used allowing to establish the context of the inquiry and drawing some inferences (Krippendorff,2018). Interestingly, the way these alliances operated was through the collaboration between several project entities. This kind of integration reflects what cybernetics and viable system model depict, that is a holistic behavior of systems. Such behavior is perceived to belong to the system but not to the individual parts (Beer, 1979; Pattron, 2002). The findings on how the viable system model can be applied to alliancing are derived from the interpretative study of alliance A is depicted in the following table:

Viable System Model	Functions and roles	Alliance A
S1	Operations and its management. The system that does the work	Suppliers and Sub-contractors
S2	Coordination	Mainly the consultant and partially the integrator personnel
S3	senior management of the operations and the lowest level of corporate management. it regulates and controls in case of oscillations	The integrator/ the main contractor
S3*	Audit (quality checks, performance audits etc...)	The integrator and the consultant and may be also the owner.
S4	Intelligence and future planning	senior member of integrator, consultants and owner.
S5	Highest level of the enterprise. It decides the policy and ethos of the organization.	This is the owner/investor role whom emphasize the alliancing culture and

		motivates the whole subsystems.

Table 1 VSM subsystems modelled into Alliance A

The enterprise alliance approach and the viable system model both promote the collaboration of entities and cross functional integration. An alliance in the form of an enterprise is where all entities (Owner, integrator, suppliers, consultants) work together as a whole organism, sharing risks and rewards, adding value to the project and achieving their objectives. A good analogy given to such integration is the human body and its nervous system presented by Beer (1981). In fact, the viable system model is based on human analogy describing how the brain controls the whole body. Moreover, it is worth restating that Beer (1981) contradicted the way organizations were structured and described them to be ineffective and just presenting "a procedural method for blaming somebody". This goes along with the "no blame" culture found in alliancing core principles.

From this initial interpretative study of the interviews, it is adequate to formulate the following propositions:

P1: The project enterprise and the viable system model are closely correlated in the way that are organized.

Project enterprise which operates on the value for money culture requires a governance framework that aligns and emphasizes this culture throughout the key stakeholders. A framework that transforms the current inefficient delivery model to a high performing enterprise delivering high performance infrastructure (ICE, 2017). Such framework would be required to set clear value definition, clear customer outcomes and clear targets and goals (ICE, 2017). This goes hand in hand with System 5, 4 and 3 in achieving those requirements. As already stated, S5 is the policy maker which set the ethos and culture of the enterprise. In this case will set the clear value definition. S4 serves as the intelligent part of the enterprise which deals with the customer requirements, the future and also set the goals and targets. S3 emphasizes the goals and targets to be achieved and translate it in the language of the suppliers (S1). Consequently, this will lead to the second proposition:

P2: The viable system model (VSM) can serve as a governance framework for project enterprise.

Alliancing generally and project enterprise particularly advocate for integration of project entities. As stated in ICE (2017) an integration strategy is essential in achieving the required performance of the project enterprise. It involves the selection of project partners, the definition of their roles and responsibilities and the interfaces in which they operate. The VSM provides an integration for all partners including the integrator and owner/investor. As mentioned earlier, there are six communication channels that help lay the map for integration and information processing. These channels were already shown in figure 2 As an example of such integration of the work, according to the model there is a communication channel between the operational units of the suppliers denoted as S1. Another two channels between S3 (the integrator) and the management of these suppliers with regards to the resource allocation and corporate rules. Further, another communication channel that align all system 2. This channel serves as a coordinator, information processor and a monitor between multiple operations/divisions (S1). Beer (1981) has given an example regarding such coordination and monitor. For example, suppose there are two divisions A and B, both divisions are considered to be system 1. Also suppose that the task of B is dependent on the work of A. Assuming that the capability of A has fallen, eventually it will affect its performance. Now what does this mean to division B? According to Beer (1981) in an orthodox system, whether and when B will be informed is a "moot point". The management of A may be too optimistic, too proud or too forgetful to alert B. Complicating the example more, assume there are other divisions C,D and E. also these divisions are dependents of the work of A and B. C, D and E will be in a position of blaming and criticizing B which in turn will do the same to A, this will shift the collaborative and trustworthy relationships to a blame and defensive culture, which in turn will embark oscillations. The function of system 2 is twofold here; first it will inform other systems 2 with purely statistical information (neither emotional nor fuzzy) to evaluate the situation and reorganize their plans. Second, the system 2 belonging to the division A will send the information to the regulatory center which in turn will inform system 3 to solve the situation. Therefore, we can formulate a third proposition:

P3: By having a set of communication channels between its systems, the viable system model can be used as an effective platform for integration.

Moreover, in aiming to increase the performance, the productivity and to ensure the alignment of the programme and the project, the project enterprise creates performance baseline to measure the delivered outcomes against the customer needs. This can be provided through system 3* which will serve as an audit function (Ríos, 2012). Nevertheless, the whole VSM can serve as a diagnostic tool for organizations (Beer,1994). This claim was underpinned by many scholars who used the model to improve and redesign organizations ranging from small-medium enterprises to government divisions (Beer, 1981; Schwaninger, 2006; Burgess and Wake, 2012; Mugurusi and de Boer, 2014). Modeling the project enterprise according to the viable system model can serve mapping all project entities; their operations, management and environments. By doing this, the problem can be detected in terms of variety mainly denoted V_M V_O and V_E, this can be taking care of in terms of amplification or attenuation of variety. In the previous example, what happened was a high variety of the operations. In order to control the situation, either the variety V_O should be attenuated or V_M should be amplified. the attenuation can be done for example by informing the other divisions of what happened directly. The amplification can be achieved by applying some management procedures for example increasing the number of staff or value analysis such as the FAST technique. Therefore, reaching to the fourth proposition:

P4: The viable system model has shown a diagnostic power when applied to organizations. Similarly, project alliancing (the project enterprise) has also shown promising results. Therefore, an application of VSM to project enterprise will improve project performance.

The inherent complex, risky and uncertain nature of large projects force organizations to adopt a new innovative response to such challenges, a response that involve adaptability and control. Certainly, one cannot quantify and predict all the risks and uncertainty involved in the project however, what can be done is a paradigm shift to cybernetics using the amplification of the management and attenuation of operation and environmental varieties respectively to match them similar to the example stated above. Another real life example explaining the law of requisite variety and the attainment of a stable state; mass production has been used as a reduction of the environment variety by limiting the product and standardization such as Ford's model T, however the rapid technological advancement and the rise of the internet made it impossible and unprofitable to reduce this variety by mass producing making automakers adopt new approaches such as lean thinking (variety of operations increased) to match the customer's needs (the variety of environment). Taking Beer (1981) example of variety from a project management perspective.Large complex projects arguably have large variety taking the number of stakeholders state. for example, let's assume there is 50 stakeholders (which is a conservative number) each of the 50 has two states that is making yes/no decisions leaving us with 2^{50} patterns, the management tend to reduce this variety by reducing the number of stakeholders for example by doing stakeholder analysis and identifying the important ones that need to be dealt with. This was a small example of what large complex projects face and how many varieties its environment proliferates. It is worth looking back to this aspect when dealing with complexity. Therefore, leading us to the fifth proposition:

P5: In large complex projects, where risks and uncertainty are considered to be the main attributes, there is need for adaptability, control and coordination. An application of Cybernetics and VSM can provide such properties and can help adjust organizations to face these risks and the uncertainty associated with the project.

Furthermore, it should be noted that the concepts which VSM are based on needed to be translated into project language (Piney, 2008). However, the previous attempts to apply the model into projects might not be fruitful, mainly because the model was not applied in project organization context where all stakeholders or project entities are presented and working as an enterprise. Having a new form of project alliancing – the project enterprise – the viable system model therefore can be applied adequately in a project context where project sponsor, integrator, advisors, and suppliers will be depicted in the model forming a viable system.

The application of the VSM to project enterprise can help the main stakeholders of the enterprise to interact as a synergetic whole. This will help in designing flexible adaptable organizations balancing external and internal environments. Nevertheless, such application will also help the control of complex projects, the integration and coordination of project teams.

Conclusion

This paper aims to reintroduce the concept of cybernetics and viable system model to project management. Project Alliancing generally and the project enterprise particularly has shown promising results to improve project performance. On another hand, the viable system model has also proved to be valuable for organizations in different industries. This paper brings the science of cybernetics into a project context by proposing the application of viable system model to the project enterprise. Having stated a set of propositions, this new approach may have promising results given the affirmatives of alliancing and VSM.

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