THE VIABLE SYSTEM MODEL AS A FRAMEWORK TO GUIDE ORGANISATIONAL ADAPTIVE RESPONSE IN TIMES OF INSTABILITY AND CHANGE.

ABSTRACT

Purpose: This paper analyses the convenience of the Viable System Model (VSM) as a framework to guide organisational adaptive response and resilience in times of instability and change.

Methodological approach: A thought experiment based on the case study of an eco-village where a project based on action research was conducted following the introduction of the VSM

Findings: The work provides evidence of the efficacy of the VSM and its recursive structure to facilitate resilience and organisational adaptation, and provides evidence of its advantages over conventional management tools to deal with uncertainty in complex environments.

Research limitations: Based on a case study, the scope of the study is limited and context specific. The comparison of tools is also limited to the ones related with allocation of resources aiming to provide resilience, viability and adaptive response to critical events.

Implications: The case study invites to revisit and discuss the fitness of conventionally used management tools to cope with complexity – from an organisational perspective.

Originality and value: This document invites to a reflection on the nature of dominant management tools used in contemporary management to cope with complexity - The document provides insights on the value of organizational cybernetics and its capability to guide organizations in times of instability and change while facilitating resilience and adaptation through the management of variety

Key words: Resilience, Organizational Cybernetics; Adaptive Management; Complexity theory; Adaptive Response.

Case Study

1. Introduction

Pascale (1999), based on the work of Alfred Marshall - The theory of industrial Organization - describes how the early micro-economists copied the mathematics of the XIX century, laying the foundations of modern management that conducted to the development of methodologies and tools that became of conventional use in management in the XX century, particularly after the WWII. Based on Newtonian laws, cause-effect and linear behaviour; these principles of management apply under the assumption of a dynamic equilibrium, predictability and stability. Lampbel et al (2014) summarize the emergence of such tools and paradigms of management and strategy in ten different schools; each with its own set of characteristic tools (e.g SWOT, Porter's five forces, portfolio management, Ansoff Matrix, etc), being most of them descriptive and/or prescriptive by nature (table 1).

Schools	Source	Base Discipline	Champions	Intended Messages	Realized Messages	School Category	Associated Homily	Some Shortfalls
Design	P.Selznick	None (Architecture as metaphor).	Case study teachers (especially at or from Harvard University), leadership aficionados, especially in the United States	Fit	Think (strategy making as case study)	Prescriptive	"Look before you leap"	Neither analytical, nor intuitive. Too static for the era of rapid change.
Planning	I.Ansoff	Some links to urban planning, system theory, & cybernetics	"Professional" managers, MBAs, staff experts (especially in finance), consultants, & government controllers - especially in France and the US	Formalize	Program (rather than formulate)	Prescriptive	"A stitch in time saves nine"	Neither supports real-time strategy making nor encourages creative accidents.
Positioning	Sun Tzu's The Art of War Michael Porter Purdue University	Economics (industrial organization) & military history	As in planning school, particularly analytical staff types, consulting boutiques", & writers, especially in the US	Analyze	Calculate (rather than create or commit)	Prescriptive	"Nothing but the facts, madam"	Strategy is reduced to generic positions selected through formalized analysis of industry situations.
Entrepreneurial	J.A.Schumpeter, A.H.Cole & others in economics	None (although early writings come from economics)	Popular business press, individualists, small business people everywhere but most decidedly in Latin America & among overseas Chinese	Envision	Centralize (then hope)	Descriptive (some prescriptive)	"Take us to your leader"	Vague vision; strategies are designed manly based on the leader's intuition.
Cognitive	H.A.Simon & J.March	Psychology (cognitive)	Those with psychological bent - pessimists in one wing, optimists in the other	Cope or create	Worry (being unable to cope in either case)	Descriptive	"I'll see it when I believe it"	Too subjective approach to strategy formulation - it is just in the head of the strategist.
Learning	C.E.Lindblom, M.Cyert, J.G.March, K.E.Weick, J.B.Quinn & C.K.Prahlad & G.Hamel	None (perhaps some peripheral links to learning theory in psychology & education). Chaos theory in mathematics.	People inclined to experimentation, ambiguity, adaptability - especially in Japan and Scandinavia	Learn	Play (rather than pursue)	Descriptive	"If at first you don't succeed, try, try again"	Strategy development process is rather chaotic, unpredictable and process- rather than result-oriented
Power	G.T.Alison (micro), J.Pfeffer & G.R.Salancik, & W.G.Astley (macro)	Political science	People who like power, politics, & conspiracy, especially in France	Promote	Hard (rather than share)	Descriptive	"Look out for number one"	Focuses mainly on the clash of self-interests of stakeholders during the process of strategy development
Culture	E.Rhenman & R.Normann in Sweden	Anthropology	People who like the social, the spiritual, the collective - especially in Scandinavia and Japan	Coalesce	Perpetuate (rather than change)	Descriptive	"An apple never falls far from the tree"	Not well suited for radical change projects.
Environment	M.T.Hannan & J.Freeman. Contingency theorists (eg D.S.Pugh et al)	Biology	Population ecologists, some organization theorists, splitters, & positivists in general - especially in the Anglo-Saxon countries	React	Capitulate (rather than confront)	Descriptive	"It all depended"	Severe limits to strategic choice.
Configuration	A.D.Chandler, McGill University group, R.E.Milles & C.C.Snow	History	Lumpers & integrators in general, as well as change agents. Configuration perhaps most popular in the Netherlands. Transformation most popular in the US	Integrate, transform	Lump (rather than split, adapt)	Descriptive & prescriptive	"The everything there is a season"	Polarized between two approaches favoring either radical or incremental change

Table 1. The ten schools of strategy. (Modified from Lampbel et all, 2014). Note the lack of contemporary approaches related with physics and complexity science.

Liedtka (1998) in her analysis of the development of strategic thinking identifies that emergent concepts from the dominant schools of strategy such as “strategic intent” and “the crafting of strategic architecture” are starting to insinuate the need to embrace approaches that are close to systems thinking through mechanisms such as the democratization of decision making process by understanding it as a dialogic process.

Beckford (1993) identify these dominant schools from an organizational perspective as either related with the “machine model” , the “Organic Model” or the “Systems model” of the organization; offering a critique to the suitability of dominant methodologies to deal with the contemporary challenges of management. Later, Jackson (2003) develops further this line of analysis guided by the different paradigms used in social sciences. He provides a review of the dominant schools - and methodologies - of management, concluding that most of them are aligned with the functionalist paradigm; and with the machine, organism, brain and flux metaphors of the organization. He also states that the related methodologies devised within the functionalist paradigm overemphasise the efficiency, in most cases ignoring the human component as well as turning inefficient or not fit for purpose in scenarios of increasing and dynamic complexity. This paradigm is also criticized for its inherent limitations related with their linear and deterministic nature. In its analysis, Jackson also provides a framework in which a distinction is made between hard and soft systems approaches to management; placing complexity as close related with the postmodern paradigm. A summary of the virtues and criticism of the main metaphors of the organization is presented in table 2.

Machine Model (Fayol; Taylor; Weber; Porter; Schumpeter; among others).	**Organism Model** (Mayo; Maslow; Hersberg; Ansoft; Mintzberg; Hannan and Freeman; Barnard; Selznick and Von Bertalanfy, among others).	**Systems (and complexity) Model** (Senge, Checkland, Beer, Jackson, Stacey, among others)
Main assumptions: - The organization can be treated as isolated from its environment - Improvements of performance of a part will improve overall performance - The organization can be	Main assumptions: - Recognition of the contribution and needs of individuals - Emphasises autonomy and decentralization of power and decision making powers	Main assumptions: - Recognising the environment of the organisation (and their interdependence) as being of importance - organizations are made out of networks and networking patterns (social interactions)

studied from the perspective of its management through systematic analysis of tasks - Successful in stable environments and straightforward tasks (eg. manufacturing),	- is based in flexible -informal and emergent- networks. - Is successful in changing and dynamic environments that demand fast decision making - Principles of the first generation of systems thinking (mainly from biology)	- Advocates for flexible (organizational) structures - Based on concepts coming from hard sciences - second generation of systems thinking (mostly form Physics and Biology).
Criticism: - Dehumanize people, by assuming them as unthinking human parts. - it has been considered to inhibit adaptation. - Limits the understanding of the environment and the interdependence of parts. - Fosters control through hierarchy and - almost - only deals with formal organizational structures.	Criticism: - human needs must be fulfilled through work (despite warnings from Herzberg et al) - it does not allow that the needs and goals of the organisation may sometimes necessarily override those of individuals within it. - it does not help with the specific tasks of designing and structuring organisations to deal with tasks which are becoming increasingly complex.	Criticism: - It appears to accept survival as being the primary aim of the organisation - Still needs more validation through empirical evidence in social sciences (Human systems). - there exists no adequate method of measuring "success".

Table 2. Summary of the models of the organization (based on Beckford, 1993 and Jackson 2003).

This summary makes evident the gap with - and the need for the adoption of - the recognition of emergent and well documented contemporary approaches to management and strategy, related with quantitative methods rooted in physics and natural sciences that in general, are close related to the second generation of systems thinking and the study of systems dynamics under uncertainty. In this sense, approaches such as complexity science and chaos theory that are close to the study of systems that operate far from equilibrium; show nonlinear behaviour; are unpredictable and adaptive by nature are increasing in the number of documented cases of applications in management as well as the number of tools and supportive theoretical frameworks (Clippinger, 1999; Bhamra et al, 2011).

The field of study that better matches these properties is Complex Adaptive Systems (CAS) as these are described as systems composed by agents which are self-similar and which interaction shows self-organizing and complex behaviour; emergence; co-evolution - through the interaction with their surrounding environment - and path dependence. In general, CAS can be described as systems with a high degree of adaptive capacity,

giving them resilience in the face of perturbation due to the following properties (Cilliers, 1998; Axelrod and Cohen, 2001):

- Made of a number of interacting agents which behavior cannot be described with linear equations.
- High interconnectivity: any element in the system can affect and be affected by several other elements or subsystems
- Nonlinear Interactions: small changes in inputs, interactions or stimuli can cause significant changes in outputs
- Interactions are primarily but not exclusively with immediate neighbours and the nature of the influence is modulated by feedback mechanisms
- Any interaction can feedback onto itself directly or after a number of intervening stages. Such feedback can vary in quality. This is known as *recurrency*
- The overall behavior of the system cannot be predicted by the behavior of individual elements
- Such systems may be open and it may be difficult or impossible to define system boundaries
- Complex systems operate under far from equilibrium conditions. There has to be a constant flow of energy to maintain the organization of the system
- Complex systems have a history. They evolve and their past is co-responsible for their present behaviour - hence, path dependence.
- Elements in the system may be ignorant of the behaviour of the system as a whole, responding only to the information or physical stimuli available to them locally

The adoption of such new approach is paramount as the current environment has proved to be unpredictable (economy, politics, security, etc) with the establishment of hyper-competition in almost all the industries where rising complexity and uncertainty is showing nonlinear behaviors making prediction virtually impossible; driving organizations to perform at the edge of chaos - a situation in which in order to respond to the unpredictability of the environment - the organizations have to develop partially structured architectures, where the key to success is to define an organizational structure capable to

provide flexibility and respond better to the changes in the environment, not losing control of the operations (Brown and Eisenhardt, 1998).

This dynamic of uncertainty is imposing to all companies (and managers) a challenge to their cognitive capacities, deeply affecting organizational learning processes and the capacity of firms to create conceptual models that allows them to cope with the current dynamic change of their (increasingly complex) environment. Consequently, the development of adaptation capabilities - together with changes in cognition and the conceptualization of the organization - to cope with an ever changing environment has become paramount to the survival of any organization.

1.2. CAS in Business

Bohorquez and Espinosa (2015) highlight that CAS has been studied originally in physics, and then applied in biology and artificial societies before their use in human social systems. its use have enriched traditional management theories in areas like strategy, change management, innovation, and leadership (e.g. McMillan, 2004, 2008; Mitleton-Kelly, 2003, 2005, 2011; Stacey, 1995, 1996; 2010, 2012, etc.). despite this increasing interest in the application of CAS in management; a need for well structured methodologies, methods and analytic tools to support organizational analysis and interventions in business still required, as the instrumentalization of this paradigm in management is not completely developed and different application frameworks have been designed (e.g. McMillan, 2004; Mittleton-Kelly, 2003) using CAS mostly as metaphors or analogies from an interpretivist perspective.

More developed applications start to embrace issues such as variety and recursivity together with features such self-organization, non-hierarchical models and recursive (organizational) structures. Recent examples of these more evolved and robustly documented frameworks inspired in complexity science are the framework for Transition Management (Kemp & Loorback, 2003; Loorback, 2007; loorback, 2010; Kemp, Loorback & Rotmans, J. 2007; Rotmans & Loorback, 2009; Loorback, van Bakel, Whiteman and Rotmans, 2010): which design and application has emphasis on issues of governance and sustainability, through iterative and co-adaptive processes - somehow similar to the PDCA Deming's cycle - as mechanisms to explore the landscape of possibilities (variety

of paths, multiple final results) at the edge of chaos. Similarly, the Agile organizations framework - a further development of the Agile methodology (Goldman et al, 1995; Stacey, 2012; Gobillot, 2008) - relies on simple rules to operate at the edge of chaos following an iterative planning cycle similar to the Deming's' PDCA and provides guidelines for the management of complexity by: a) keeping activities loosely structured but tied to strict deliverables, targets and deadlines; b) develop a culture of constant change and few strict - operational- rules; c) create channels for real time communications and feedback between groups; d) allow semi-coherent strategies to emerge; d) teamwork based on decentralization and empowerment. In this sense, these two methodologies/frameworks provide some general guidelines about how to explore the landscape of possibilities at the edge of chaos (a situation in which turbulence induce the system to a region of bounded instability where the self-adjusting parameters of the system have the opportunity to express their full potential, becoming the most effective form of control that facilitates the adaptation process), in coincidence with the developments of Brown and Eisenhardt (1997), Davis et al (2009) and Eisenhardt and Piezunka (2011) when referring to the need of flexible organizational structures to cope with complexity.

However effective a the time to harvest the positive characteristics of self-organization; these approaches to address complexity management lack on clear definitions of the organizational structures required to guide the adaptation process; they ignore the law of power (that describes the dynamic of systems at the edge of chaos) and despite their growing literature, they still need to develop a well structured and comprehensive theoretical background backed by empirical evidence.

Looking at the origins of complexity science, self-organization and chaos - and their conceptualization in social systems - many of its scientific foundations share a common origin with organizational cybernetics (introduced as Viable System Model - VSM); which instead of an adaptation of principles of complexity to management, it is - by design - a framework for effective complexity management of social systems that provides a guide to design and analyze viability in organizations.

With strong theoretical and well documented foundations supporting its underpinning principles, and over 60 years of documented applications as well as new developments

and applications in multiple fields proving to be an effective tool to deal with complexity and variety in a wide variety organizations e.g. sustainability (Espinosa et al, 2008); production (Dominici and Palumbo, 2013); IT (Rozenkranz and Holten, 2011); governance (Peppard, 2005); private and public administration (Christopher, 2007, 2011; Devine, 2005).

1.2.1. The VSM, adaptability and resilience

Created by Stafford Beer, the VSM was inspired on the structure of the human neural system as the most robust known system of communications and control, and has its foundations on the early developments of neurophysiology, systems thinking, cybernetics and complexity (Beer, 1962; 1964; 1970; 1979; 1981; 1984; 1985). The model introduces the field of organizational cybernetics being its fundamental theoretical claim that the VSM determines the necessary and sufficient conditions of organizational viability - defining viability as the capacity to exist over time; implying it change and adaptation. It also suggest recursivity (and iteration of organizational feedbacks) as the mechanism to cope with complexity and variety. The general rule is that just complexity can assimilate complexity; hence, to respond to the complexity/variety of the environment the VSM can provide guidance on how the complexity of the organization should be readjusted through the redesign of its organizational structure and flows of information. The VSM is constituted by 5 embedded systems organized in a recursive/fractal architecture as follows (see figure 1):

- System 1 (S1): The primary activities. These are the the basic operative units - e.g. divisions or business units of a company - that should be autonomous and adaptive. These should be viable systems in their own right by following the principle of recursion (fractal design). They are in direct interaction with their respective environment.
- System 2 (S2): The coordination function. This role/function dampens oscillations and enhances self-regulation (among the S1). Information systems, operative plans, schedules and programs, teams, internal service and support units,

standards of behavior, knowledge bases, and a great part of communication are expressions of this role/function.

- System 3 (S3): The operative management. It is responsible for resource allocation, resources accountability and the implementation of policy to foster cohesion among the S1. It is in charge of the "here and now" of the organization. It has a sub-component (System 3*) that acts as a monitoring channel, in which the information flowing through (sporadic) validation.
- System 4 (S4): The long-term orientation. It models the organization in its environment (ecological, social, economic–technological). Is in charge of the exploration of the "there and then" of the organization. The dialog between S3 and S4 acting as a homeostat is the core of the engine of adaptation of the organization, anticipate changes and define proactive response to changes in the environment.
- System 5 (S5): Is the highest authority that defines the identity, purpose, policies and in general, the ethos of the organization. An example of this is the Board of the organization. It overlooks the dialog between S3 and S4 to ensure strategic alignment and coherence in the decision making process.

Note: Additional comprehensive descriptions of the VSM can also be found at: https://www.youtube.com/watch?v=SPSBJwGKRsw ; http://www.scio.org.uk/resource/vsmg_3/pdf/vsmg_2_2.pdfhttp://www.scio.org.uk/resource/vsmg_3/pdf/vsmg_2_2.pdf or http://www.fractal-consulting.com/wp-content/uploads/Modelling-Organisations-using-the-Viable-System-Model.pdf

From an empirical perspective, the VSM has proved to be able to guide the creation of viable effective organizational structures capable to respond to complex environments, simplifying management by providing a rich modeling language that facilitates autonomous response and adaptation (e.g. Ruiz-Martin et al, 2016; Schwaninger and Scheef, 2016; Bohorquez and Espinosa, 2014; Beer, 1989; among others). Evidence of this is the work of Dijkstra (2007) who test and proves the advantages of using the VSM for the engineering of resilience in complex operations. On this same trend, more specific evidence is provided by Chan (2011), who documented the use of the VSM and MCDA as

a decision making tool to enhance resilience in a SME proving that the VSM provides management with objective and systematic means to make organisational resilience decisions by evaluating various structural arrangements of an organisation for achieving adaptation in a changing business environment. As a general review of the capacity of the VSM to provide resilience in times of change to organizations, Schwaninger & Scheef (2016) interviewed managers in 50 companies and validated the usefulness of the VSM to deal with change and facilitate resilience; and Ruiz-Martin et al (2017) after analyzing the last 20 years of the study of resilience in management they introduce the VSM as a valid framework to design resilient organizations.

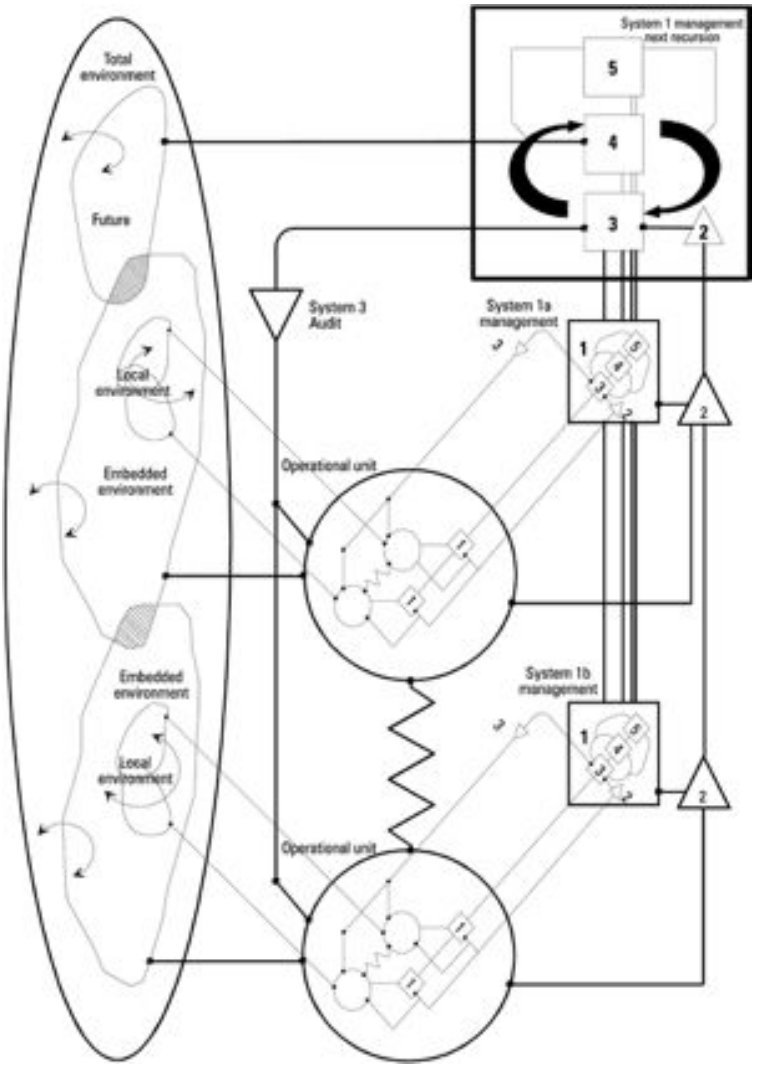


Figure 1: The Viable System Model. (Modified from Beer, 1986). The graphic describes the VSM of an ideal organization with two operative units (S1); each of them connected with their respective environment. Note the distribution and connections that provided viability prescribed for the systems 1-5. Also, the recursive nature of the model - self-similar structure inside each S1.

[Insert here figure 2]

2. Methodology

A thought experiment (Brown, 1986; Bunzl, 1996) was conducted to reflect on the effectiveness of some managerial tools and the use of the VSM, based on a well documented Irish eco-villa where an action research intervention was made from 2007 to 2010, with short follow up visits until 2016. During the visits interviews and direct observations were made through the conduction of periodic workshops in which the majority of the eco-villa members participated. During the initial workshops the VSM modeling language was introduced to the community following the methodology proposed by Espejo et al (1986). Subsequent VSM diagnostics were carried out in which the researcher acted a s facilitator of the diagnostic process. Questionnaires were applied to collect information about the networking activity of the members and to develop a more complete VSM diagnostic at different moments of the action research project (for more details see: Espinosa et al, 2010; Cardoso, 2011; Cardoso, 2015). Before, during and after the intervention different conventional management tools were used by the community (e.g. Value Chain, SWOT, BSC). The results of the intervention were finally consolidated as a case study (Espinosa et al, 2010; Espinosa and Walker, 2011; Cardoso 2011; Cardoso, 2015) and used in this paper to analyze resilience in critically changing and uncertain times in a social-oriented entrepreneurial project.

3. Case study

The Eco-Villa is a project created in 2005 by 5 young families - later growing to 120 families; with no backgrounds in management - who decided to initiate a self-funded rural regeneration project based on the principles of sustainability, consensual and participative decision making, self-organization and non-hierarchical organizational structures. Once consolidated, the project received support from the EU to develop some of the facilities (e.g. Solar park, community central heating system). Since the beginning of the project conventional management practices and tools were adopted (SWOT, BSC, Value Chain, Project Management) while the complexity of the project increased moving from the initial founder members to 120 families; and from the conceptual design, to the acquisition of land, adequation of the terrain - and other preliminary engineering works in

the field - and applications for individual planning permission; all under an environment of stable economic growth (the Celtic Tiger). The academic intervention started in 2007 due to effects of the Irish economic crisis (the death of the Celtic Tiger) which induced great financial uncertainty, and a nationwide freeze in the building industry cutting off the provision of financial support for development initiatives. The management of the project was unable to cope with the new circumstances, finding themselves moving towards operational collapse and financial inviability. The principal causes for such collapse were - aside the economic downturn - the increasing complexity of the operations (with up to 25 operative groups at a given moment of time); mostly coming from building and engineering works in the field, and the increasing pressure and complexity for the management in terms of direction and decision making processes related with critical events and issues (e.g. formalities for the legal acquisition of land, economic downturn, harmonization of designs for planning permission, contract of engineering works, relocation of budgets due new economic context, supervision of engineering works, lack of qualified staff and knowledge, etc). Such complexity derived from the growing variety induced by the addition of new members: the variety of their backgrounds, motivations and approaches to the project that distorted the original definition of identity, vision and mission; and the changing nature of the project (evolving from a conceptual design project to the specificities of an engineering/construction site with multiple simultaneous stages of development with no funding). In this changing context standard management practices where proving not suitable to generate cohesion, provide direction and preserve the identity of the project. Some of the reasons for this were related with the dependence on timed and complete standardized datasets (e.g informing about the different activities of the general project, updated financial reports, recruitment of new membres, community issues, etc) that were not always available (due to changing tasks in the evolution of the project and construction of a new community - e.g. mobility, social activities, town X, land use, planning applications, building, business development, among many others); the lack of instructions from standard managerial tools to guide the creation of responsive organizational structures; the prescriptive and - organizationally - centralized nature of the decision making process, in contrast to the self-organizing ethos of the project; and the time gap coming from the linear and prescriptive nature of standard managerial tools to

react to quick changes in the environment, map processes and adjust to a very dynamic rotation of managerial roles in all levels of the organization (e.g. in 2007 land use had 4 coordinators, planning 3, project management 3 and an external consultant, 3 general managers and a political crisis inside the direction of the project in addition to a general emotional and political crisis within the community owning the project, involving the withdrawal of 30% of the membres at that time).

In consequence, the initial definition of tasks and allocation of resources using conventional management tools (Value Chain and Balanced ScoreCard) was not adequate to embrace the complexity of the project and its context; being perceived by the community as too technical, confusing and exclusive, for a community without background or previous experience in management. For instance, the Value chain was not customized to reflect the changing nature of the primary activities, and collapsed at the time of accurately represent the updated (?) information of the different ongoing primary activities (operative groups as defined by the community. At some point they were up to 25 different primary activities). In this context it also turned to be too complicated to effectively map and analyze the deployment of resources and capabilities when trying to introduce methods of Business Process Management within the practice of project management. Particularly when the development included a myriad of unconventional self-building initiatives, standard designs and building using external contractors and Hi-tech fast modular buildings; all of them in different stages of development. Not to mention the engineering works for the solar park, the comunal central heating system, the design and operation of communal services (water, waste and energy and internet) and the works in the group of land use for organic farming and forest management.

Under this conditions the VSM was introduced to the community. After a couple of workshops a VSM diagnostic was co-created with the community. In general, poor control and inefficient allocation of resources where detected- due perhaps to the impossibility to clearly define and differentiate primary and secondary/supportive activities - as poorly defined in their use of the Value Chain. Also, slow/no response to dynamic changes in the environment was observed and evidenced in very outdated strategic and operative plans. Consequently, outdated and diverging mental models

describing the fast changing dynamic and shape of the project at operational level were in place; being these unfit to understand the increasing complexity and new demands for direction, coordination and prioritization of activities. In addition, the lack of control (relevance, performance) of operative units provided for the existence of too many of them, not necessarily related to the priorities that the new changing environment imposed (e.g. mobility, social activities). More concerning was the effect of rotation of managers, as some left the project and others were moving to different positions to respond to crisis, in some cases not having the skills or technical knowledge required in these new assignments (e.g. Land use, Planning, Building). in general, the management (S3) was overwhelmed as many responsibilities collapsed upon this role/function, and the board (S5 - with more than 30 membres) was interfering in all the activities (micromanagement - big brother syndrome) in an attempt to keep the project under control. A complete description of the situation can be found in the VSM diagnostic in figure 2.

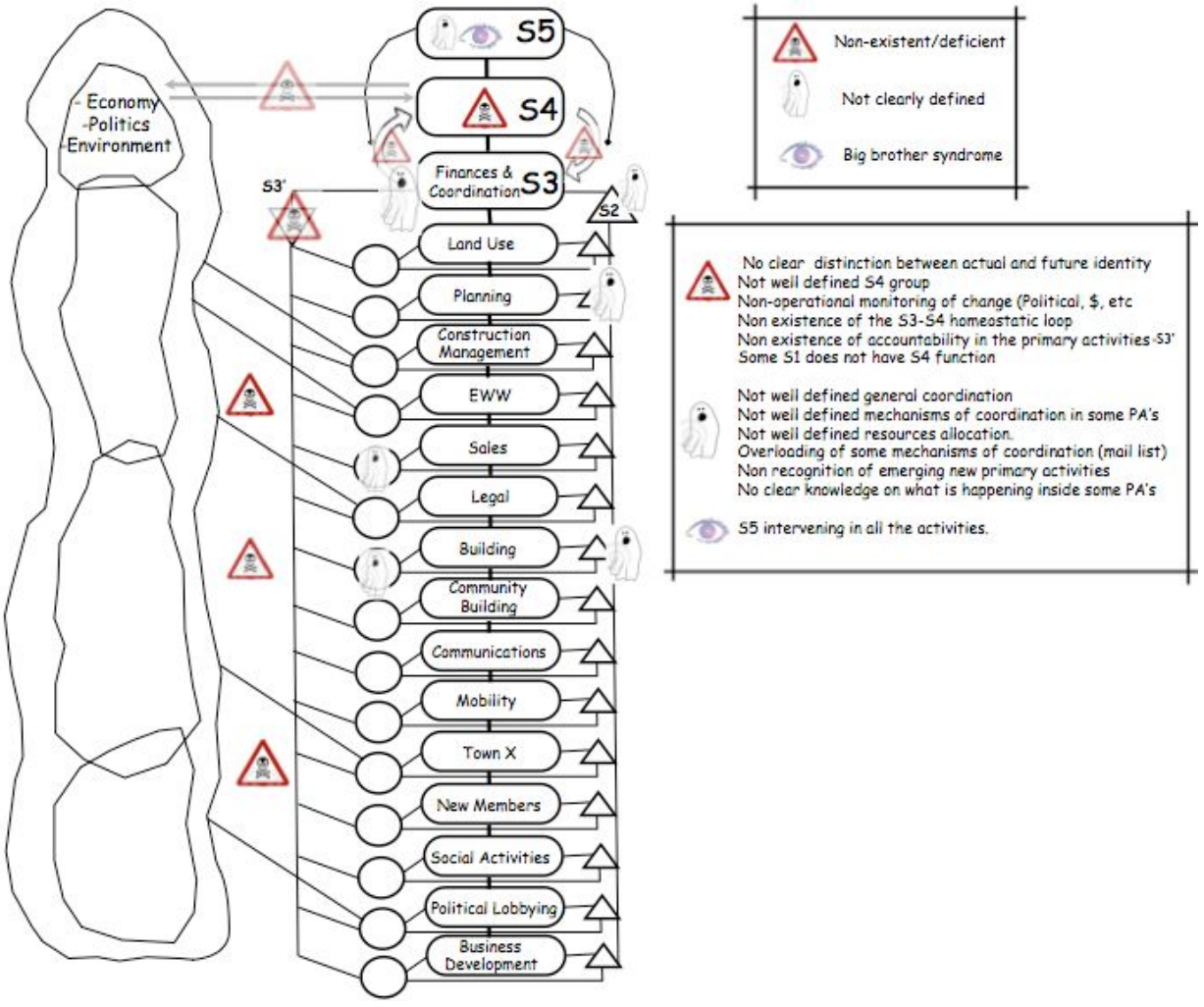


Figure 2. VSM diagnostic 2007. (from Cardoso, 2011). Notice the numerous operative groups without monitoring and contact with their immediate environment; micromanagement from the S5 (Board) and the lack of planning role/function (No formal planning group S4 and no dialog between S3-S4).

[Insert here figure 2]

In this context, the mapping made with the support of the VSM as a modeling language in the workshops with the participation of almost all the community was more aligned with the non-hierarchical ethos of the community and their self-organizing orientation to tasks - similar to the guidelines for Agile organizations (small groups, frequent meetings, gatekeepers, etc). After the full implementation of the VSM as the managerial language to model the organization, several improvements were evident (figure 3). Among them, the creation of a shared mental model of the organization; the number of operative units (primary activities, S1) was reduced to a manageable number (7), giving priority to those that were paramount for the completion of the development phase of the project. A clear definition of secondary - supportive activities was made (equivalent to the secondary activities/functions in the value chain), implementing mechanisms for planning (S4) and monitoring (S3*) with their respective metrics via participative co-design with the operative units and work teams, and the creation of well defined and clearly identified - organizational - task force groups to quickly respond to emerging critical issues - again, similar to the teams structure suggested in agile organizations.

The introduced changes improved the sense of general awareness of the whole organization and inside the primary activities (S1), generating more effective feedbacks to inputs from their immediate environment. The allocation of resources and capabilities was improved via the mapping of tasks and the available resources and capabilities at the different levels of complexity of the project. More importantly, the mapping made with the VSM allowed the identification of organizational structural equivalences (Burt, 1987) - individuals with similar connections and knowledge in the organization, crucial to provide organizational resilience. This element of the VSM modeling provided the foundations for a more effective identification and allocation of managers and membres for temporary task forces dealing with emergent critical issues.

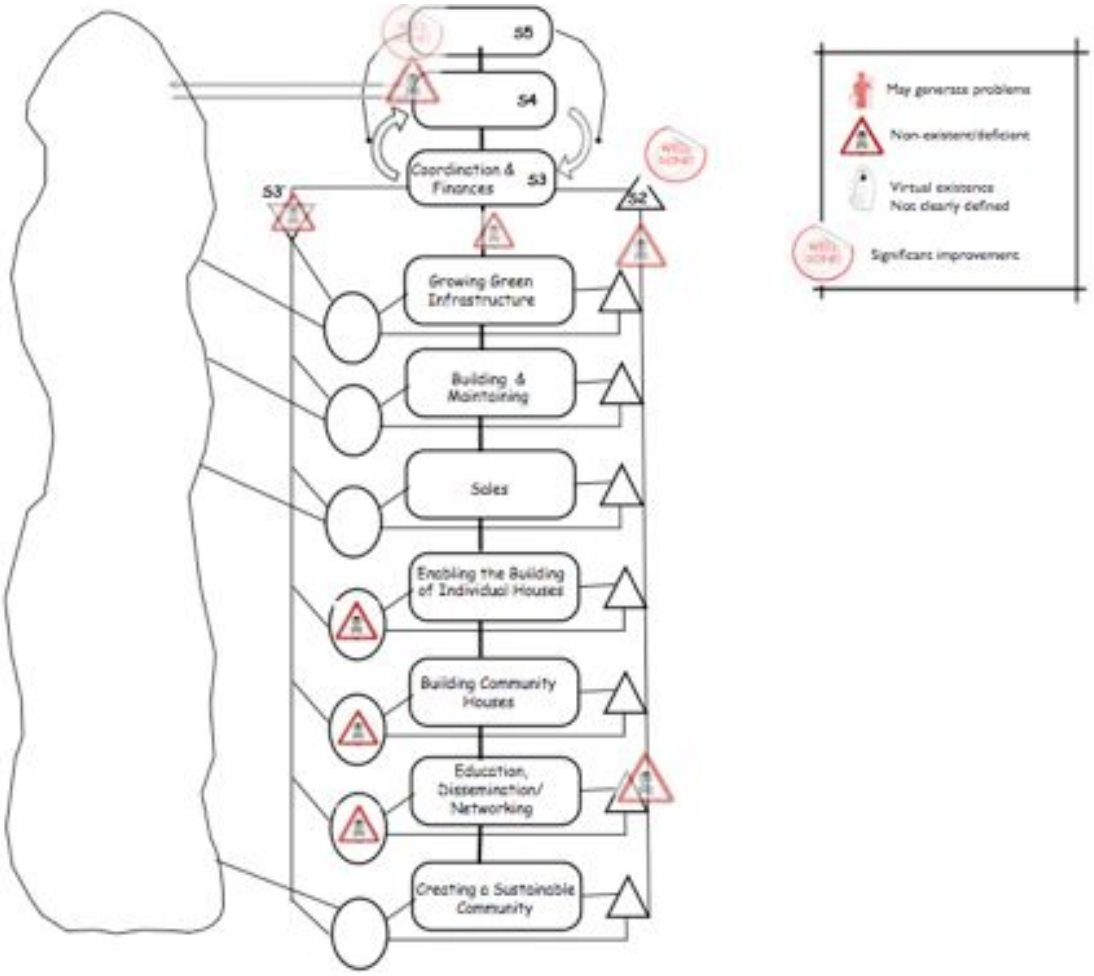


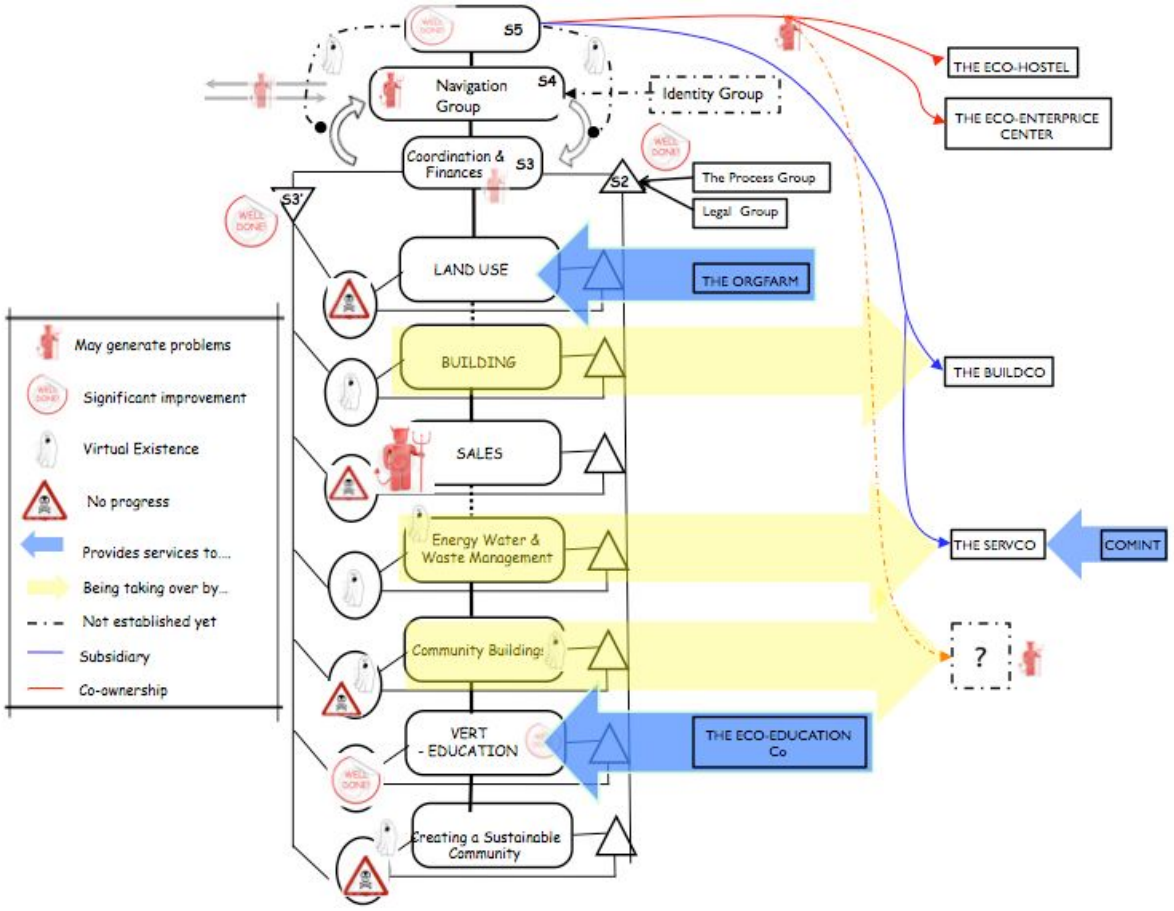
Figure 3. VSM diagnostic - second academic intervention. (from Cardoso, 2011). Notice the reduction of operative groups - primary activities (S1) with improvements in the general coordination of critical activities (S2). The reduction of the board to 8 members, and the creation of planning role/function as well as the design of monitoring mechanisms.

[Insert here figure 3]

This changes facilitated the transition to more independent and efficient operative units (S1) in which self-organization/management took place, reducing the pressure on the general management (S3). Later in the project, some of those S1 would start their process to become spin-offs: autonomous viable systems models by their own right - coinciding with the culmination of most of the development stage activities of the project. In general, the project evolved with its changing environment through the provision of a coherent organizational architecture that allowed decentralization and empowerment while preserving the ethos, identity and cohesiveness of the organization.

Within this new context the emergence of new organizational structures (spin-offs) was feasible, aiming to provide viability (operative and financial) to the general project. The

final balance when compared with other developmental projects in the country in the same period speaks for itself: It was the only project with continuity and viability during the peak of the economic crisis in the country. Currently, it is one of the few projects with expectatives for growth and proved generation of spin-offs after 10 years of economic uncertainty in the country. It stills providing a confident organizational platform that facilitates its adaptation to a challenging environment, and continue evolving in nature (e.g. Adapting from a developing project of young families to a community project of mature families with shifting priorities; becoming a regional platform for entrepreneurship, education on sustainability and innovation, and becoming a conglomerate of community owned business).



[Insert here figure 4]

Figure 4. VSM post intervention. (From Cardoso, 2011). To simplify this diagram the environment (amoeba-shaped figure at the left in the previous VSM diagrams) was omitted. The number of operative units was reduced to 7. From them 3 are starting a spin-off process to become autonomous viable business units on their own right. (yellow arrows), 2 other operative groups are developing partnerships/joint ventures

with external organizations (blue arrows) and the project was developing the organizational and managerial structures to invest in two new related projects (Hostel and enterprise centre).

4. Discussion and Conclusions

This study provides evidence of the relevance of contemporary approaches such as CAS, as a framework to provide tools and methods to cope with the current challenges in management - particularly the need for adaptation when disruptions occur (e.g. via the adoption of principles of self-organization, hierarchical complexity, recursivity, viability, co-evolution, emergence, and feedback loops, among others).

Despite the emergence of new toolsets and frameworks that embodied (some of) the key characteristics of CAS - e.g. agile organizations, transition management - the VSM seems to be the framework and methodology that provides the most comprehensive, well documented and empirically tested framework capable to guide the adaptive response - from an organizational perspective - in times of instability and change; that is more robust than any other (old and new) management tool focusing on organizational structures, and elements of communication (command and control). It also seems to provide a useful framework for the integration of other - more conventional tools of management and strategy - to aiming to cope with complexity (e.g. Value chain, project management and Business process management, SWOT; as evidenced in the case study.

A key element in the implementation of the VSM was the generation of cognitive changes - and awareness - in the community through the practice of iterative modeling. This feature facilitated the emergence of unified native narratives (as local adaptations of the VSM) to express their shared mental model and understanding of the project and its context; guiding the effective allocation of limited key resources; facilitating the management by clearly defining roles and functions; facilitating the occurrence of autonomous and coordinated operative units and ultimately, the emergence of new organizational structures as an efficient adaptive response to the challenges imposed by the changing environment - all this in a community with no previous training in management.

The organization moved form a rigid, classic business structure - based on principles of positivism, functionalism and control; to a flexible, fluid and environment-responsive

(co-adaptive) structure, close to the principles of systems thinking and complexity. Suggesting that the environment dictates what should be the most appropriate organizational architecture; in contradiction to the positivist view of the organization. In this sense, the VSM provided clear guidance on how to develop the minimum conditions for viability in times of uncertainty and change via the induction of a framework for coherent structural organizational change. This feature coincides with the suggestions of Brown and Eisenhardt (1997), Davis et al (2009) and Eisenhardt and Piezunka (2011) when referring to the need of flexible organizational structures to cope with complexity.

The achieved viability of the project is related to the introduction of the VSM - contingent evidence is the fact that other development projects at the same time in the country using standard management tools and professional managers collapsed. However, is arguable that the same effect could not be achieved through the use of any other tools or frameworks inspired in CAS (e.g. Agile Organizations, Dynamic Systems, Self-organization). This issue is difficult to address and prove as any organization at the edge of chaos operates under the power law: small numbers of large extinction events occur periodically while large numbers of small extinctions occur. It means that statistically there is no guarantee of survival at the edge of chaos; only the possibility of new forms emerging that might survive. In this context, the introduction of structures that are proved to provide viability e.g. VSM Structure, organizational structural equivalences; can be assumed as to facilitate the emergence of such new structures and consequently, their probability to survive. These features are not considered in the mainstream schools of strategy, nor in the conventional tools and frameworks for management and are in need of further research particularly in organizational studies under environments of dynamic change and instability. Hence, the need to increase the exploration of novel and more contemporary approaches to management considering the adoption of features from CAS, and/or complexity science and systems thinking in general.

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