



Innovative Applications of O.R.

## Complexity management in practice: A Viable System Model intervention in an Irish eco-community

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## ABSTRACT

While soft OR tools offer specific solutions to manage complexity in organisations, little is known concerning soft OR tools to deal with self-organisation in communities. This paper describes an action research project where the authors facilitated a process of self-organisation in a developing Irish eco-community whose members operate in a non-hierarchical, and cooperative fashion. We used the Viable System Model as a hermeneutical enabler of the community learning process concerning their self-organisation: by embedding VSM distinctions, they redesigned their primary tasks and developed meta-systemic management tools to deal with the complexity they were facing. Observations of the dynamics of the self-organising process over a period of 3 years show the community designed their roles and tasks more effectively, improved the connectivity of roles, and in general, their viability and sustainability. We reflect on the distinctiveness of the methods used, and their contributions to research in soft OR in community projects.

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### 1. Introduction

Individuals all over the planet are responding to the challenges of sustainability by designing and building their own communities. Access to the technical expertise required to build eco-houses, develop organic food production, use solar power, and so on is relatively easy to find – the main problem is often how they self-organise as a grass-root community in an appropriate fashion which is compatible with their core ethic values. In this (practiced research) paper we present an action research project aimed to improve the self-organisation skills of such an eco-community during its development stage. As their constitution specifically rejects command and control, traditional organisational design methodologies were inappropriate, and thus we supported them by using the VSM, in a constructivist way, as a meta-language to guide their self-organising process. Members of the community learned core VSM distinctions and criteria of self-regulation and this resulted in fundamental changes in their organisation. An academic research project aiming to observe self-organisation and division of labour in social systems simultaneously evolved in the background providing us with tools to observe the results of the self-organisation process. Here we summarise the learning

from using our approach with this community, and reflect on its usefulness to guide the intervention. This is relevant for OR research in showing an example of how the VSM can be used as an hermeneutical tool to guide a process of self-organisation in a community aiming to improve its viability and sustainability.

#### 1.1. The ecovillage

The Cloughjordan ecovillage is an Irish project established in 1999 with the aim of developing a highly cooperative, democratic, sustainable settlement where people can live and work in a completely eco-friendly way.<sup>1</sup> It is run by SPIL,<sup>2</sup> a not-for profit organisation that aims to experiment with the latest green technology for housing and services and to become an educational centre on sustainable living. Its members, European Union banks, and the Irish Government have supported it financially. When we started our work in 2007, they had been in the initial development stage for 7 years: this included researching the concept and technologies of a sustainable rural housing development, raising finance, locating and purchasing a suitable site in a region needing regeneration, recruiting members, and obtaining outline planning permissions for more than a hundred homes.

The design of the site included residential, community, agricultural, woodland and wildlife areas. The members agreed on a

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<sup>1</sup> The Cloughjordan ecovillage – see more at <http://www.thevillage.ie/>.

<sup>2</sup> Sustainable Projects Ireland.

master plan based on sustainable principles, and chose ecological technologies, including reed bed wastewater treatment, a district heating system powered by a combination of sunlight and wood, and permaculture based allotments. Green principles are used to guide the design of individual houses. As in other eco-villages, they were deeply engaged in the transformation of values like reconnecting people with the place where they live; de-linking economic growth from well-being; creating a more sustainable way of living; affirmation of indigenous values and practices; and developing a cooperative organisation based on 'an holistic and experiential educational ethic' (see Dawson, 2010). In particular, they had decided to innovate in the way they organised themselves, making a clear policy decision to avoid traditional top down approaches to management and to promote autonomy, encouraging participation and involvement from all members, thus producing a cooperative culture. All of this had been achieved by a small group of highly motivated founder members.

The project then moved onto a new phase. The plans had to be turned into reality. Details of roads, pathways, and services needed to be designed and built. Surveyors and civil engineers were hired, plans were agreed, and contractors moved in. A number of the community members had already moved to the town in order to over-see the process. By the end of 2006, the growing organisation had about twenty self-organising working groups, mostly composed of volunteers from the Village's membership, but including some (paid) staff members, responsible for finance, legal and administrative issues. Following common sense, and not any structured methodology, their cooperative approach worked well initially and the organisation of the ecovillage project evolved naturally; they used a self-assignment of tasks approach, allowing all members to contribute to the best of their ability and skills. Representatives from each working group met at a monthly 'Group Coordinators' meeting to monitor progress and make decisions. They also held a monthly 'Members Meeting' – often involving over 100 people – where major policy decisions were taken by consensus. Unusually, they had established a 'Process Group', to facilitate the ongoing development of their organisational structures and processes. The Board of Directors was legally responsible for the project, and elected democratically.

However, problems had started to appear. The existing organisational structure had proven to have some shortfalls, and some of the major issues requiring attention were not getting resolved. By summer 2007, the members were beginning to have serious concerns as several situations threatened the viability of the project and the organisation failed to respond effectively. As problems worsened, they felt they were losing control of their destiny. A rapid decline in the price of houses in Ireland combined with unseen problems in developing the site infrastructure ended up causing major financial problems. Many members who had houses to sell were forced to drop out, as the lower house prices lessened their purchasing power, whilst the site prices almost doubled. There were also severe delays throughout the construction of the site, and further increases in costs. Initially all the sites had been sold (subject to contract) but these new problems meant that several people had to drop out, and the remaining sites had become difficult to sell and thus the income from site sales dropped alarmingly. Many core decisions had been delayed and some members begun to lose faith in the project. These issues made them realise there were serious flaws in their organisational arrangements that needed urgent attention. The imperative was to find a path through the crisis and keep the project alive: the focus was to be on completing the roads and infrastructure and to sell more individual building plots. The members wanted to maintain a cooperative and democratic organisational approach as expressed in the eco-community's constitution, but it was clear that something had to be done to survive the crisis.

## 1.2. Invitation and initial visit

In this context, we were invited to help. They were aware of previous work using the VSM in large co-operatives and communities (which had also been looking for alternatives to traditional hierarchies), and felt this work was of relevance. They had already attempted to apply the VSM and were looking for expert support. During our first visit we made a presentation to a Member's Meeting of around 150 people, explaining the VSM in outline and the application in large co-operatives and communities, and how it had proved to work in such a context. The following day we ran a workshop with about 25 people to begin to explain the VSM in more detail. After internal debates, the community decided to continue with the process. The process group were our primary contact but our client was the community as a whole. Our main commitment was to coach them in the application of the VSM. We would provide the tools and training, and make suggestions: they would work with these suggestions and put them into practice in their unique situation.

## 1.3. The action research project

From the beginning, one of the authors requested permission to operate in an action research mode, using the learning process from the intervention as an experimental terrain for learning about self-organisation in communities developing sustainability programs. Borrowing Checkland's *FMA* description of an action research project (Checkland, 1981; Checkland and Holwell, 1998; West and Stansfield, 2001), our *Area of concern* was finding ways to improve viability and sustainability of the community project by encouraging self-organisation; in the following sections we make clear the *Framework of ideas*, the *Methodology* used, and describe the learning process. We hoped that by using the selected *F* and *M* we will provide practical help with the ecovillage situation; specifically, we hoped that by supporting the community to embed their learning on using VSM meta-questions, they'd be capable of self-organising more effectively and improve their viability; also that the experience of using this methodological approach and assessing its usefulness will bring new insights and lessons for the soft OR community. The community accepted developing the project as an action research project, where we would be highly involved and changes would be expected as a result of our involvement.

At the same time this project started, one of the authors was working within the context of a EPSRC funded research project 'Defying the Rules: how self regulation works in social systems',<sup>3</sup> specifically aiming to develop innovative ways of measuring and observing different aspects of self-organisation and division of labour; It included parallel experimental studies in biological (ants), artificial (robots) and human societies, and shared tools to observe self-organisation and division of labour at each level (Arcaute et al., 2009). With permission from the community and with the support of a PhD student (PP Cardoso), we used this community self-organising process as an experimental terrain to observe the self-organising process over a period of time. Cardoso joined us in 2009, after 18 months of VSM based work: he stayed for a three months on-site visit when he interviewed a number of staff and members, aiming to formally assess the process of self-organisation both in terms of structural and dynamic evolution. He used Longitudinal, Narrative and Social Network Analyses, with the data collected from members, which have enabled us to assess changes in the structure and dynamics of the organisation resulting from our intervention.

<sup>3</sup> Defying the rules: how self-regulation works in social systems. (2007–2010). Partner universities: Imperial College, Bristol University, Central Wales University, and Hull University.

## 2. Conceptual framework (F) and methodology (M)

Over the last few years the authors have been developing a conceptual framework to reflect on the viability and long term sustainability of communities, organisations and societies – originally inspired by S Beer's work but also including newer insights from second order cybernetics and complex systems. We suggest that failure to overcome many of the core sustainability challenges in the XXIst Century comes from inadequacies in our understanding of sustainable development, the paradigms used to support interventions, and the way we organise ourselves and measure sustainability. As a way to overcome such inadequacies, we revisited, the Viable System Model (VSM) (Beer, 1979; 1981; 1985), from the ontology of the observer, following Maturana and Varela (1980), aiming to use it to facilitate processes of self-organisation. We have explained in detail this conceptual framework, the analytical tools needed for supporting organisational self-transformations, and multiple examples of applications in the context of communities, organisations and societies aiming to improve their sustainability (Espinosa et al., 2008; Espinosa and Walker, 2011). During this project we focused on learning about issues of self-organisation using insights from modern complexity approaches (i.e. Complex Adaptive Systems), and from more traditional VSM theory (see more in VSM vs. CAS in Espinosa and Porter, 2011).

Here we present the VSM as a meta-language, a hermeneutical tool, to enable people to consider issues of organisational viability – and thus create the required organisational arrangements needed to improve their own chances of long-term viability (or sustainability). Following Harnden (1989, p. 383–404) we used the VSM as a construct, in a consensual domain that enables valuable heuristics for structural coupling among the organisational members in their quest for viability. In other words, we used it as an enabling tool for supporting the progressive building of shared representations – as a way to facilitate learning about self-organisation.

While recognising that the learners will have different and sometimes-conflictive viewpoints, we took a highly participatory approach, inviting all interested to the process of model design/implementation taking it as a cross-construction process between the model and the organisation in which it is implemented, as in David (2001), or as facilitated modelling, as in Franco and Montibeller (2010). Essentially, the VSM distinctions become a shared language for the organisation, and consequently can be reapplied continuously as new challenges appear.

The initial project's design included the use of a generic methodology to support self-organisation of the community (see Fig. 1), as well as the development of a series of workshops to coach the members on its use. The methodology involves six stages: (1) identify the system-in-focus, (2) map the relevant recursions, (3) look for weaknesses in the system's viability by reflecting on the meta-questions, (4) reflect on strategy vs. structure gaps, (5) agree and implement the required changes; and finally (6) monitor and review the situation. Appendix 1 details the analytical tools we used at each stage – it included VSM Diagnosis, complemented by other soft tools in the initial and final stages: i.e. soft OR tools like rich pictures and root definitions at the initial stage; to assess the dynamics of the self-organising process, we used Social Network Analysis (SNA).

Table 1 describes the meta-questions that we used at each level of recursion to facilitate their self-diagnosis and to identify the required changes: it includes issues of identity, operational autonomy; mechanisms for dealing with environmental and internal complexity, for conflict resolution, for self-governance and for knowledge management (see Espinosa and Walker, 2011, Chapters 2 and 3 for details).

There were several iterations of the VSM Diagnosis: as we were acting on a facilitated modelling approach, rather than providing in advance a formal project design, the community members who participated in the process co-designed the workshops – with us – once each one was agreed. Initially, we designed in detail the first workshop (explaining the project's background, its aims and methodology, and introducing it to the wider community). Then, we applied the various stages as and when they became appropriate, as required by the nature of the core problems defined by the participants in the workshops. For example, the 2nd workshop we covered stages 1 and 2 of the methodology and started up the VSM diagnosis. For the following workshops we co-designed the agenda with the process group, aiming to respond to their most relevant questions about required changes to their organisation; during the workshops we visited stages 3–5 as required. Each learning cycle required the implementation of the agreed changes and closing the loop by monitoring, reviewing and re-thinking the process continuously.

As the learning progressed, the focus of the analyses shifted. Initially we considered the organisation as a whole, and issues of autonomy and cohesion; later, the focus was on each of the primary tasks at each level of recursion, and then on meta-systemic management, strategy vs. structure alignment, and on governance. Recently we have started a new learning cycle that included clarifying identity and levels of recursion again – the relationships of SPIL to the ecovillage and the town in which they live – and how to deal with the many emerging new businesses (governance at the emerging level of complexity). The monitoring and assessment of the whole intervention happened informally at the beginning – as feedback they gave us during our visits and responding to our reports, – and then more systematically, through Cardoso's interviews and analyses – see Section 3.6.

## 3. The methodology in action

### 3.1. The learning process

During our regular visits we ran VSM workshops to ensure as many member of the community as possible were familiar with the fundamental principles behind the intervention. Each of the VSM workshops included representatives of the Process Group, the Board, administrative staff, each of the core working groups (Primary Activity Groups or PAGs) and general members, with the number of participants varying between a minimum of 15 and a maximum of 40. Workshops were co-designed in advance with the Process Group and were open to all members. Between July 2007 and November 2011 we made 11 visits, each including at least one VSM workshop – see Appendix 2. There were two objectives in the workshops: firstly to support the members' learning about the VSM (basic training) aimed at improving their knowledge and skills in deciding about improvements to their own organisation. Secondly to address directly urgent issues that had been identified in and between workshops and that required an immediate response. Initially we facilitated the workshops and later, an experienced facilitator from the Process Group would take the lead, in coordination with us. Each of the VSM diagrams agreed at each stage was built during the workshops, including suggestions from all the participants. A culture of openness, participation and inclusion predominated. We also attended several of their decision-making spaces including Coordination Meetings, Board Meetings, Process Group meetings and Members Meetings as observers and gave them feedback about communication and organisational issues.

At each stage we produced a report with our observations and a structured cybernetic analysis. The Process Group reviewed these

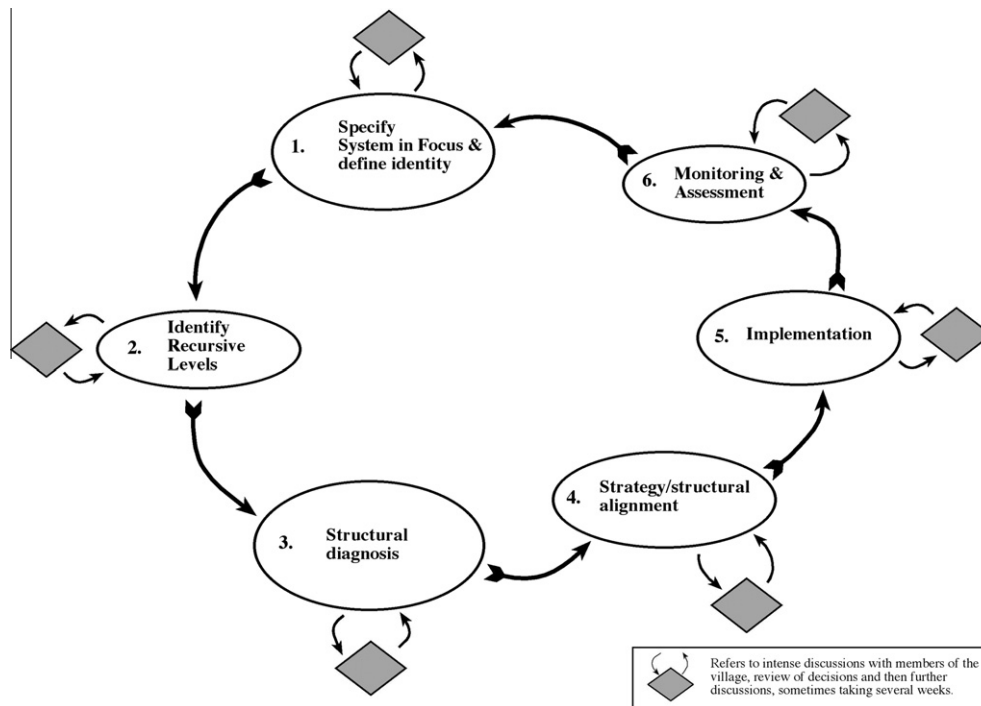


Fig. 1. Methodology to facilitate organisational self-transformation. (Adapted from Espinosa (1995), Espinosa & Walker (2011), Chapter 3.)

Table 1

VSM Meta-questions (Adapted from Espinosa & Walker, 2011, Chapter 3).

1. Co-evolution with the environment	<p>Is there enough capability to deal with core issues for viability at each level of organisation?                  What really matters to each System 1: what do you measure?                  Are the System 1s operating with real-time information?                  Are there closed loop Information flows aiming for effective governance?                  Are the System 1s responding quickly to changes in the environment?                  Are there effective environments for Decision Making?</p>
2. Autonomy and cohesion	<p>Are there proper ways to address issues of identity and closure?                  Developing meta-systemic management to support autonomous organisations to sustainably self-regulate?                  Have the operational units enough autonomy to perform effectively?                  Are there mechanisms to deal with conflicting interests?                  Are there mechanisms to provide synergy to System 1s?                  Are there management support systems to deal with critical issues for organisational viability?                  Are there ways to close the loop on critical issues for organisational viability?</p>
3. Recursive governance	<p>Linking local and global governance issues and decisions?                  Are there enabling conditions for sustainable governance at each level of embedded and embedding organisation?</p>

reports, circulated them among all members, requested clarification when necessary, and made proposals about changes to the way they organised themselves. They then coordinated the process to put the proposals into practice. Thus, the process of the community learning about the VSM and our learning about the community continued in parallel. There were undoubtedly a few members, who did not agree with the approach, and had disagreements about decisions made; the Process Group normally resolved those. Later on, we used these reports, as well as interviews to members, aiming to assess their perceptions about VSM process, and to analyse the co-evolution of working groups, communication mechanisms and roles through the processes – see more in Section 3.6.

### 3.2. 2007–2008. First learning loop

The first workshop in July 2007 lasted 2 days, was held in a small converted cinema, and attended by around 25 people. The members, coordination and Process Groups, board, and administrative staff were all represented. We began with an introduction

to the VSM and described the coaching/mentoring stance we would be adopting.

#### 3.2.1. Clarification of the problems

Participants were then asked to draw cartoons (based upon Checkland (1981)'s *rich pictures*) of the problems they were experiencing in their organisation that were affecting the performance of the eco-community. Some of these showed people with their head going in one direction and their body in the other. Others showed people rushing around in a confused state, going around and around a revolving door, running blind-fold, and talking incessantly (Fig. 2). The message was clear: despite the hard work and dedication of everyone, there were still serious organisational problems - the various functions were fragmented, teams did not communicate effectively, existing communication structures were inadequate and co-ordination almost entirely absent. Many important functions were dependent upon working-groups composed of members with full-time jobs and family commitments, who regularly struggled to get their tasks completed on time. In a few cases, groups had not met for months and no one seemed to know if they still existed.

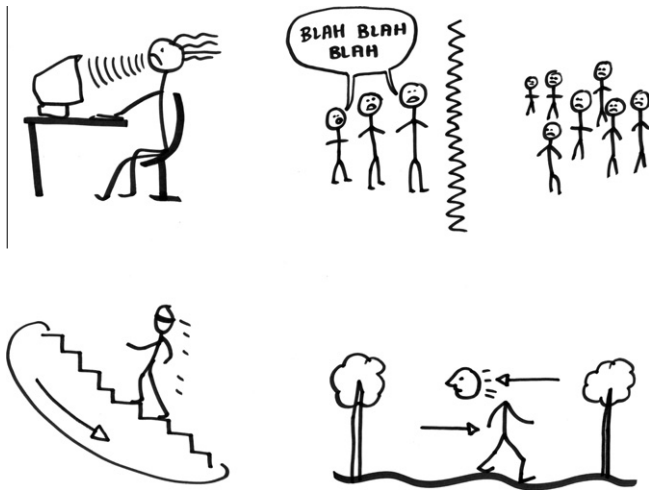


Fig. 2. Cartoon of the ecovillage problems (2007).

3.2.2. Defining the system in focus and agreeing on its identity

We then began a discussion to clarify the identity of the system that would be the focus of the study. At that stage most activities were focused on developing the site in readiness for the construction of houses. We understood that this temporary organisation would evolve into a different one once people moved in and began living in the village: then new VSM analyses would be required. But everyone was clear that the problems that needed resolution at that time were proper management at the development stage: the System in Focus was the developing ecovillage. The following statement about the organisational identity was agreed:

‘The ecovillage is a charitable company, founded on cooperative principles aiming to build a sustainable community by transforming a green-field site into a model of a sustainable community, using the best of environmental technology and providing sustainable goods and services, education and ‘dream houses’.

3.2.3. Identifying System 1s

The third stage required participants to focus on and identify the System 1s, sometimes referred to as primary activities, which between them make up the Operations of a Viable System. We explained a System 1 as a task, which is also a viable system that produces a product or service that is directly related to the organisational purpose, and has some sort of operational autonomy. In the context of the identity defined above we asked everyone to decide which activities were absolutely fundamental to the job of developing the ecovillage: what was it really all about, at that historical moment. We emphasised that jobs like accounting, legal functions and the Process Group were support activities, and that while they may have been of great importance, they were not central to the identity of the community.

At that time there were more than 20 working groups, many of them at a preliminary stage of development (e.g. education, dissemination of information) while others had clearer operational responsibilities, such as getting the roads built. People had subscribed to such groups, according to their own interests and a desire to contribute to the project’s development, rather than agreeing first which were the essential tasks needed for the success of the project, and then subscribing to them. Our first task was to help them to distinguish between primary activities from support activities. After much discussion, the members identified the following Primary Activity Groups (PAGs): (1) growing the green infrastructure; (2) building and maintaining the site; (3) site sales; (4) enabling members to build their houses; (5) building

community houses; (6) education, networking, disseminating; (7) creating a sustainable community.

The most relevant change resulting from this stage, was the migration from the initial structure of 20 working groups, to a structure focused on these seven primary activities – supported by technical and administrative roles; this significantly diminished the complexity of their interaction and focused scarce resources (mainly people) on the most relevant tasks. It was pointed out that if the PAGs, number exceeded  $7 \pm 2$  (following Miller, 1956) the complexity of their interactions would become very difficult to manage. Happily, the PAGs numbered seven on the first attempt.

3.2.4. Identification of the meta-system

Having identified the Systems 1, the discussion moved onto look at the meta-system defined by Beer as “a collection of subsystems that exists to look after the collection of operational elements so that they cohere into that totality which we called the Viable System” (Beer, 1979, p. 116). As the workshops continued, we explained and built up the full VSM diagram for the community, as it then existed: we introduced basic distinctions in VSM language like recursive organisation, Systems 2–5 (meta-systemic management functions) and the meta-questions involving criteria for dealing with complexity at each level. We asked the members to reflect on their organisation using these distinctions and to respond to these meta-questions. We helped them to draw a first VSM meta-systemic diagram, by asking the participants to identify those people or groups who carried out core meta-systemic functions. See Fig. 3.

3.2.5. Initial VSM diagnosis (2007–2008)

The initial VSM diagram revealed a somewhat fragmented organisational structure. Although elements of all four meta-systemic functions could be identified, many happened sporadically, often no clear focus could be identified, and the activities of some systems were diverted into inappropriate areas. For example, Fig. 3 shows the members of the Board (System 5) operating in almost all areas rather than focussing on over-view and policy. They had (due to the lack of effectiveness in some working-groups) also felt obliged to perform System 1 tasks which were not completed on

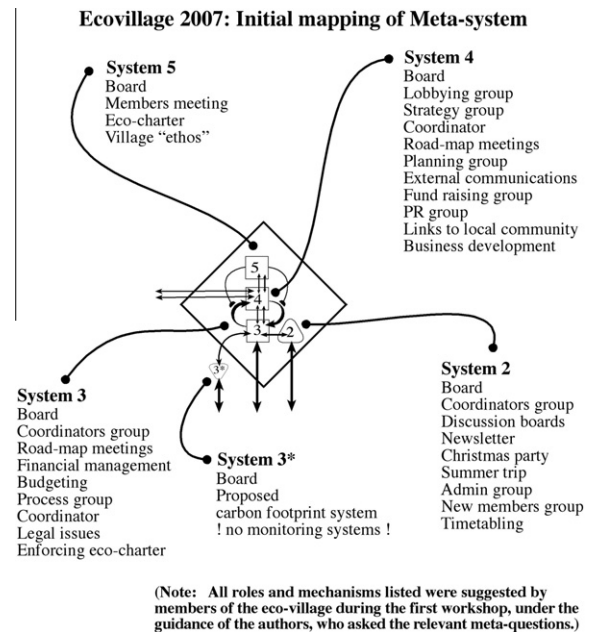


Fig. 3. Meta-systemic management (1st mapping).

## Eco Community : 2009

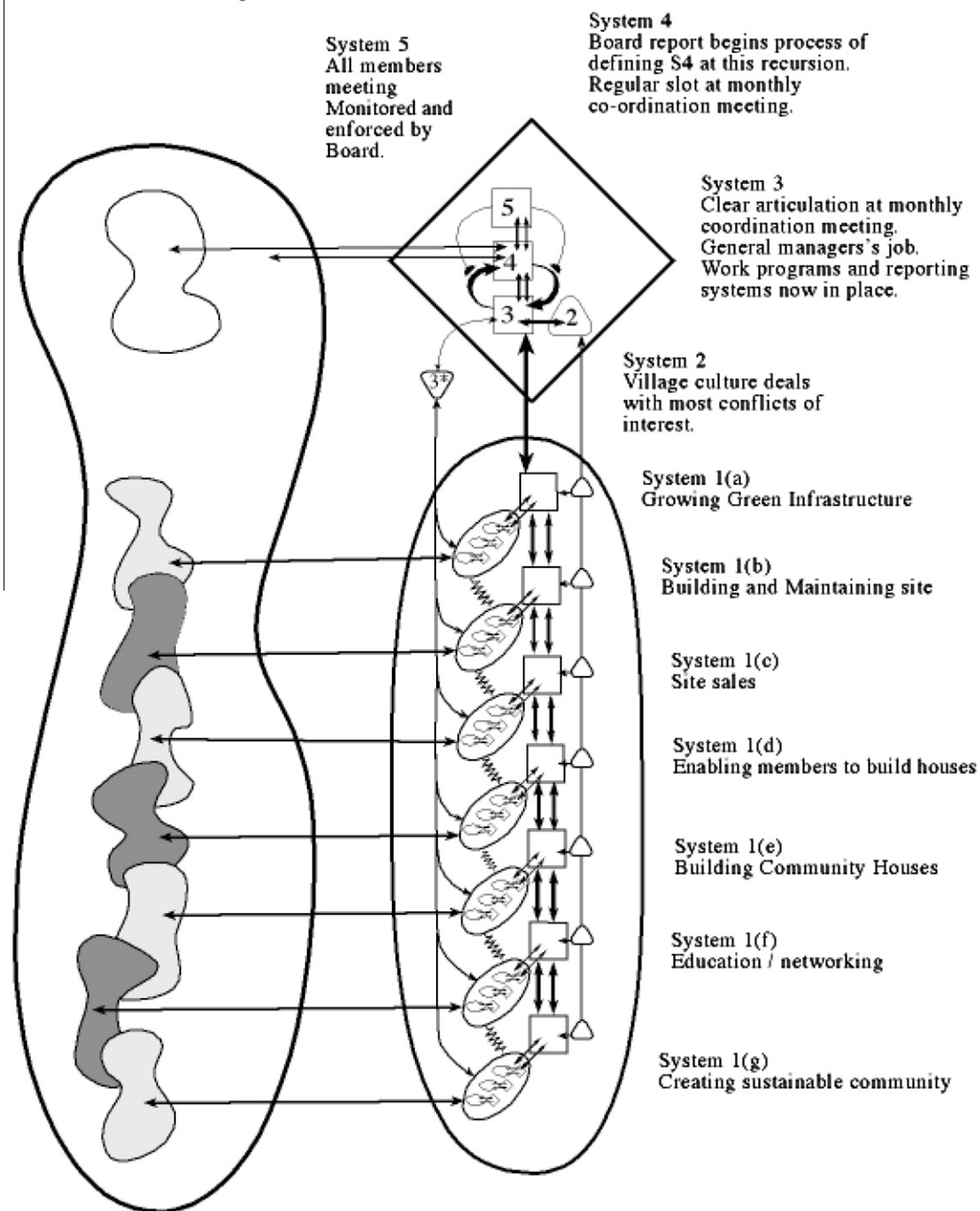


Fig. 4. VSM of the ecovillage (2009).

time, thus dramatically affecting their capacity to function as an effective System 5. System 4 was also unfocused and sporadic: there was no systematic environmental monitoring and so they did not respond effectively to external threats or opportunities.

During the workshops we explained how the VSM diagram highlights weaknesses in the structure, and asked for participants' views on what those were by reflecting on the meta-questions. Each sub-system needed to be clearly articulated and focused on its allocated task: at that stage several sub-systems, including some of the primary activities were un-recognised, under-resourced, or diverted from working properly. In the following days after

each workshop, we reflected upon our experiences, and wrote a report on how the VSM saw their current structure and suggested changes that needed to be made. The highlights of the first report included recommendations for consolidating the existing workgroups into the seven primary activities identified, allocating the remainder to support meta-systemic functions, and to re-focus the work of the meta-systemic roles (Board, Coordinators meetings, etc.). The reports were read thoroughly by the Process Group, circulated to all members and returned to us for correction. Between visits, they continued to study the VSM and to further develop the recommendations made in the reports.

**Table 2**  
Main structural changes 2007–2010.

Pre VSM	Post VSM
<p><i>System 1</i> Work groups, defined by members' interests. Inconsistent performance. Meetings and monitoring sporadic. Coordinated unreliably. Sporadic and unstructured reports Some work done by Board intervention</p>	<p>Primary Activity Groups (<math>\pm 7</math>) clearly focussed &amp; aligned with organisational identity. Meet and report regularly and concisely Coordination now focussed and reliable. More tasks now completed on time New PAGs recognised &amp; designed</p>
<p><i>System 2</i> Lack of shared information between working groups. Informal meetings at social events, timetables. Lack of reporting standards</p>	<p>New conflict resolution process; new reporting mechanisms from Systems 1; more effective facilitation and information management through Coordination meetings. Reporting and workload standards. Information management at each level</p>
<p><i>System 3</i> Fragmented. Carried out by the Board, the Administration Group, the Coordinators Group, the Legal Issues Group, the Road Map Group and the Process Group</p>	<p>Focused. Coordination Group now well organised to monitor Systems 1 progress and look for synergies. General Manager coordinating required managerial and technical support to Systems 1. Work programs now defined and monitored</p>
<p><i>System 4</i> Fragmented and unfocussed. Carried out by The Board, X Group, Planning Group, Process Group, Lobbying Group</p>	<p>Strategic roles developed at each level: Navigation Group created; strategy agreed and discussed; required structural changes recognised; PAGs, Coordination Meeting &amp; Board Meetings have regular System 4 slots</p>
<p><i>System 5</i> Policy defined by all-members meeting</p>	<p>As before Eco-charter agreed and used; Identity Group created; Board focussed – System 5 issues</p>

### 3.3. 2008–2009. Second diagnostic loop

During the early part of 2008 progress was rapid as the Process Group were working towards a series of proposals to be considered by the AGM to be held in May. We returned in January and March and extended the diagnosis by drawing several VSM diagrams including the lower recursions. Through the three workshops we had that year, we built up the full VSM diagram for the community as it then existed (Fig. 4): at the end of March the Process Group concluded its proposals for the AGM, and we were invited back in April to finalise preparations for the AGM. The ideas so far developed resulted in a series of changes in the structure of the Community, generally in line with our recommendations.

As expected, the process of implementation has not been straightforward or immediate: it took several months of internal debate before many of the agreed changes were put into practice. For example, establishing a proper meta-systemic management role, in charge of the main Systems 2/3/3\* roles, took about a year. After a first failed attempt (to hire someone with traditional project management expertise) the Board appointed a new General Manager, who took many of these responsibilities. Due to his regular exposure to the VSM workshops, he has performed his role by providing cohesion to self-organising, autonomous Primary Activity Groups, and thus has consolidated the introduction of VSM principles into the community. We emphasised the role of the Resource Bargain: the Primary Activity Groups would be given resources and the autonomy they needed as long as they could demonstrate that they were doing the jobs they needed to do. In other words autonomy requires accountability.

### 3.4. 2009–2010. Third diagnostic loop

While members had a clear vision of their desired goals, early in 2009 they were still missing clear strategies and tactical plans to make it happen within the time and resource constraints they had. They recognised the lack of proper System 4 roles and processes and initiated changes to develop the System 4 role for the whole-community (they choose to call this the 'navigator' role), collecting information about the 'outside and then' and facilitating members involvement in the design of the community's strategic and action plans. In November 2009, they designed and ran a workshop to review a proposal for their strategic plan: it involved

40 community members. We participated in the workshop and provided reflections on the need to further adjust the structure to adapt to new changes and plans in the evolving organisation (stage 4 in Fig. 1).

A recurrent conversation throughout the VSM workshops in 2009 was about finding effective ways of dealing with their need to manage information and communications. They realised they needed to improve the information produced by the working groups about their activities and performance. For example, they designed and began to use new forms for recording results from each primary activity, and to take these summaries to the Coordinators' Group: they also introduced a performance management system that operates semi-manually through wall charts exhibited at the members' office, reflecting achieved vs. expected results from each primary activity. They improved the way of presenting information about the project for new members; and improved their communication tools through the web (members forums, news, etc). As a result they have less frequent communication problems among members and staff. By the end of this year System 4 was thus more developed and connected to both System 3 (Coordinators Group) and System 5 (Members Assembly and Board); and a full and detailed strategic plan had been produced incorporating members' views, and implementation had started.

Table 2 summarises the main changes achieved during these 3 years. In 2010 the agreed primary activities were still the 7 originally agreed; each with a coordinator, and the roles of each group were far clearer than the 22 groups that existed in 2007. The coordinators now present a summary of their work-plans including milestones and identified constraints/ opportunities for development at the Coordination Meeting. It has become very well organised with clearer representations from the seven primary activities (who form the inner circle) and meta-systemic management and support roles (who sit in an outer circle to provide information as required). Their focus on ensuring progress in each of the Primary Activity Groups, finding synergies (System 3) and responding to external factors (System 4), has resulted in improved self-governance. Core VSM distinctions have been adopted into the vocabulary of the people attending each management meeting.

There is now a permanent exchange of views through the web forum they created concerning progress in the site and houses development as well as in other community activities. Innovative communication mechanisms are now in use to keep everyone

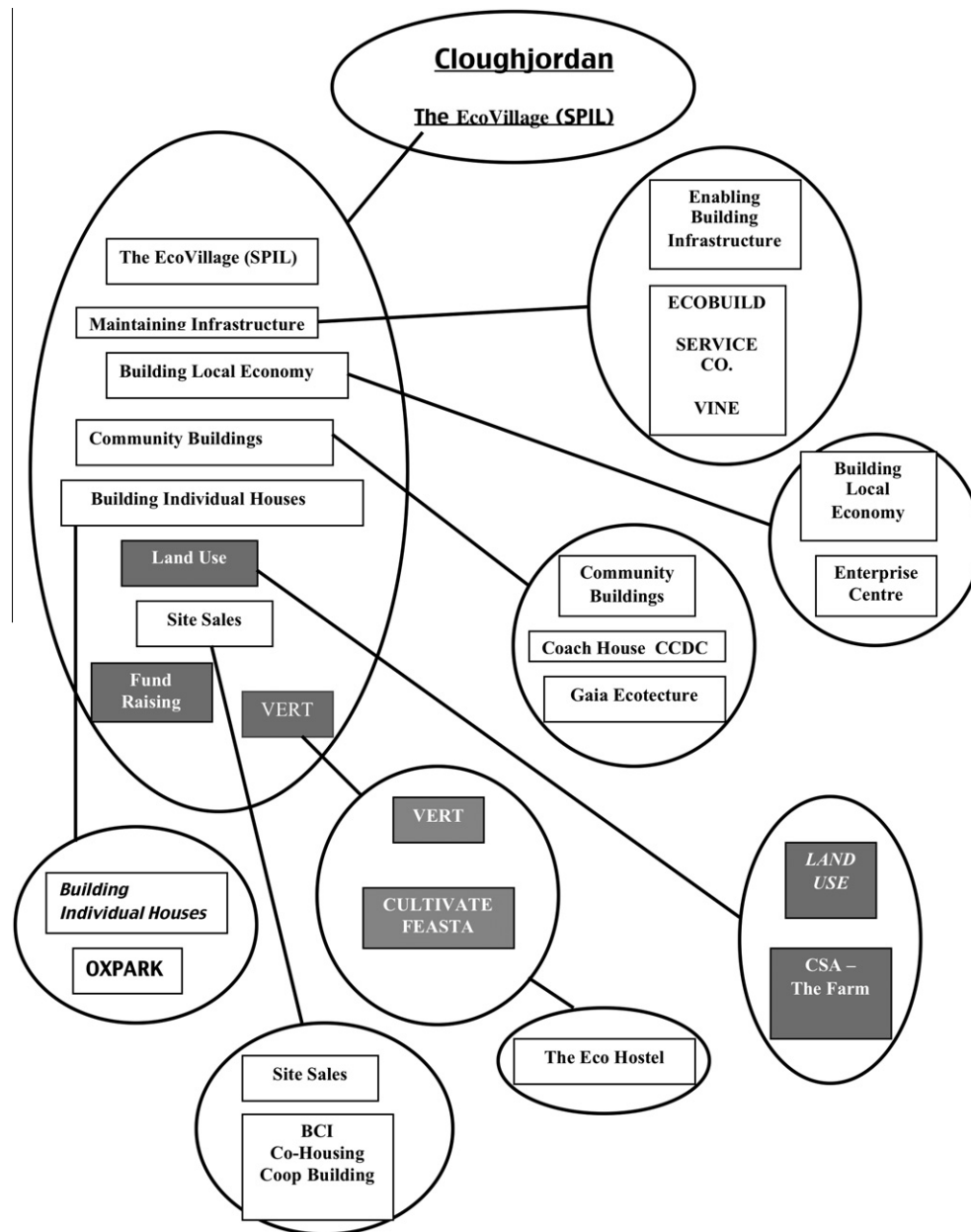


Fig. 5. Emerging levels of complexity (2011).

updated on progress and to collect suggestions or complaints. Issues of policy and identity were at the core of the last Board discussions we attended in 2009 and 2010. Generally, everyone seemed much clearer about his or her roles and decisions were getting taken in the right place. The culture of not getting things done on time, which seemed almost universal in 2007, now seems uncommon. In general, there was an atmosphere of greater trust and coherence. They had undoubtedly achieved significant improvements in skills for self-regulation, which are reflected in a better working environment, clearer roles and communication channels, and more effective interaction with their environment.

This has all been achieved despite serious difficulties, such as the extreme differences in the members' abilities to participate: some members were already residents in the town and engaged fully, others visited once a month and hardly participated at all. Some members still have little interest in understanding or participating in the VSM project; and there are still traces of a culture/mind-frame, which favours top-down command-and-control

structures. However, at the last workshop (November 2010) everyone in the Community seemed happy with the progress that had been made and the chair of the Board commented that, since the introduction of the new VSM-inspired structures, the community has been working far more effectively (see different testimonies of members collected as part of the PhD project during 2009 and 2010 in Appendix 3.).

### 3.5. Recent developments (2010–2011)

In 2010 we returned twice; this time, the situation had evolved in intriguing directions: there were new changes in their perceived identity and a lot of controversies occurring. The community is now less fragile financially; the site infrastructure is fully in place; there are now more than 30 houses inhabited, more than 70 members residing in it (or nearby while building their houses) and a number of new businesses emerging. Significant activity impacting on the local community is also happening, including



the development of a community farm, 'CSA the farm' (grown organically); a sustainability educational centre providing courses on sustainable agriculture, housing and living (VERT, Cultivate); an Enterprise Centre; a co-housing coop; a service company (Oxpark); an eco-hostel; and a local internet provider (VINE).

In the last workshops (October and November 2010) we discussed again the ecovillage identity, SPIL<sup>4</sup> identity and their relationship to Cloughjordan. We needed to revisit once more stages 1 and 2 of the methodology – Fig. 1 – to agree on current identity and levels of organisation – see Fig. 5 below for their resulting model of levels of organisation.

Their main concern was how to adapt to deal with the emerging new Systems 1 (VERT, etc.), as these are the sorts of 'permanent' primary activities that the ecovillage expects to develop in the long term: they are aware that enough attention/resources should be given to them to facilitate their emergence and consolidation. They may would either become new primary activities within the ecovillage, or would operate as separate companies, which will become equal partners to the ecovillage. They realised the need to define 'meta-norms' to clarify relationships between the new businesses and the ecovillage: (i.e. an 'Eco-business Charter').

The way they recognise the changing identity and increased complexity of their evolving organisation, and their preparedness to recognise its emerging tasks and provide them with the right resources to foster its development, shows more evidence that they have improved their capacity to adapt and co-evolve. They are still facing the need to deal with conflictive views on new identities and structures but they are better equipped to recognise their complexity management' challenges and to deal with them more effectively.

### 3.6. Assessing the impact of the intervention

As detailed above, informal feedback from the members show that they were generally pleased with the authors' continuing involvement and report that the new organisational structures are both effective and compatible with their culture. In practical terms, the community has survived a series of severe threats, and is growing and thriving. Members recognise that improvements in performance, tasks identification and connectivity are related to sharing a clear model of the organisation – resulting from the VSM project – see Appendix 3; see also the section about the VSM at their organisation from their website ([http://thevillage.i.e./joomla15/index.php?option=com\\_content&view=article&id=73](http://thevillage.i.e./joomla15/index.php?option=com_content&view=article&id=73)).

More systematically, Cardoso (2011) used a questionnaire with 25 members (80% of the members settled in the eco-village development) and developed 12 in depth interviews, to collect information about their perceptions on the VSM process and about their connectivity in three different moments of the evolution of the organisational structure (previous the intervention (2007), in the middle of it (2008) and in the last period (2009–2010)). These interviews were done to people involved in the early foundation of the organisation and/or those who played key roles in the VSM project. The data collected was tabulated to do Longitudinal, Narrative and Social Network Analyses (Scott, 2000; Webster and Mertova, 2007). Details on the measurements taken and the results obtained are in Cardoso (2011, 168–195). He observed, for example, that during the intervention, the matching of members' expertise – vs. – the tasks' skills requirements changed from 9% to 21%; members became closer to each other (reciprocity improved from 38% to 59.30% during the intervention); and there were faster flows of communication to taking place between roles at the end than at the beginning of the intervention. They also show that the

VSM intervention helped the community to develop a more cohesive community, with higher connectivity and reciprocity, and with a more efficient communication network.

Using this information we have presented elsewhere a structured assessment of the VSM intervention where we concluded that the choices made by the community members about working groups and meta-systemic management affected positively the connectivity and communications within them (see Espinosa et al., 2011, pp. 16, 17). This coincides with most testimonies from members about their perceptions on the organisational changes over the last three years, which they judged as beneficial and useful to improve the community's organisation. Also the nodes with major impact on the social dynamics mostly coincide with the strategic primary and support activities' coordinators identified in the VSM process. Not only the internal organisation improved but also new conditions appeared that facilitated the emergence of innovative associated businesses. In 2011 there were around 25 new local green business initiatives: (e.g., community buildings, organic farm, the sustainability education entity, an eco-hostel and an eco-build company). Through the learning process, they have developed awareness of the need to continuously review their emerging organisation and associated networks, and to design, when required, the necessary meta-systemic management mechanisms.

## 4. Discussion

### 4.1. The VSM as a hermeneutical device for learning on complexity management

A main benefit of this action research project has been to learn in practice what it means to use the VSM as a hermeneutical tool to support community members' learning about their own organisation, as this opens a route away from classical VSM critiques (e.g. Ulrich, 1981; Jackson, 1998; 2001). Seen with a functionalistic lens, the VSM loses all its power and becomes a traditional hierarchical or functionalistic model: we first need to shift our paradigm to a deep understanding of cognition (as in Maturana and Varela (1980) and the cybernetics of the observer (as in Von Foerster, 1981) in order to understand the power of the model and get practical benefits from its application. This case study – and its background research – constitutes a unique example of how this approach works in theory and in practice.

As in Hector et al. (2009), our approach is built deliberately on clearly stated theoretical foundations, originally from Beer. The VSM is a comprehensive theory of organisational viability that explains in depth issues of (structural) complexity. We have explained elsewhere how this applies to issues of sustainability – Espinosa and Walker (2011, Chapters 2, 3)). Here we illustrate how we used VSM distinctions and meta-questions to provide a learning context for supporting the self-organising process, allowing people to share mental maps and knowledge and make individual decisions aligned with organisational viability criteria.

Through the VSM workshops people came to understand the systemic aspects of their organisation, and learned distinctions which enabled them to deal effectively with complex tasks: They became more knowledgeable and able to -produce models of their organisation and to have better criteria for making decisions about the necessary transformations. The analysts' role was to facilitate their learning. The use of the meta-questions, during the learning process proved to be satisfactory in representing and addressing the breadth of the problems the community were experiencing, at different stages. We deliberately did not give them an expert's 'VSM ideal solution for their organisation' and expect them to

<sup>4</sup> SPIL: Sustainable Projects Ireland Ltd.

implement it: we gave them the tools to empower them to constantly rethink their organisation. They used them to invent new roles (e.g. the meta-systemic manager), to redesign their meetings (e.g. Systems 3 and 4 slots in the Coordination and Board meetings), to establish new support functions (e.g. the Navigation Group, the 'Identity group'), and to design System 5 mechanisms (e.g. The eco-charter and the business eco-chart). In many cases this involved the creation of new vocabulary such as "navigation" and "PAG (primary activity group)" which embed VSM concepts into their culture. In future applications, we may need more testing about effectiveness of the meta-questions from a participants' perspective.

The conceptual and methodological framework introduced here are a bonus to more generic problems solving methodologies to support community development, as the ones described in [Midgley and Ochoa-Arias \(2004\)](#), in that others help people to decide on solutions to specific problems, but do not offer specific theory and criteria for managing the structural complexity where these problems originated. It does have limitations as well: as with other facilitated modelling approaches, this one relies on VSM experts (and their knowledge on the VSM) to facilitate the learning process; even if the participants had an opportunity to learn from the meta-questions and contribute to design structural improvements, contributions from members vary importantly. In our example, the difficulty of learning VSM distinctions was overcome, to some extent, within those attending VSM workshops but not generally in all the community. We coincide with [Franco and Montibeller \(2010\)](#) suggesting that further research about better understanding, generalisation of best practices and systematic assessment of outcomes of this type of facilitated interventions are required and desirable.

#### 4.2. On using a multi-methodological approach

Since it was initially suggested by the first advocates of multi-methodologies combining soft OR (e.g. [Flood and Jackson, 1991](#); [Mingers and Gill, 1997](#); [Mingers and Brocklesby, 1997](#); [Zhu, 1998](#); [Ormerod, 2001](#)) there has been a growing number of examples of soft OR multi-methodological research (e.g. [De Tombe, 2002](#); [Gondal, 2004](#); [White, 1994](#); [White, 2003](#); [White, 2009](#); [White and Lee, 2009](#); [Hermans and Thissen, 2009](#); [Namen et al., 2009](#)); this is also true when using soft OR to study community developments ([Paucar-Caceres and Espinosa, 2011](#)). As [Howick and Ackerman \(2011\)](#) recommend, it is important to publish more in-depth descriptions of interventions using mixed methods in order to develop our understanding. The intervention described here reconfirms the value of combining VSM analyses with other soft OR analyses, at different stages of the intervention, aiming to better satisfy the client's needs for learning.

Combining soft OR tools like SSM and VSM to agree on organisational identity and identify core problematic issues (rich pictures and root definitions) (as in [Espejo, 1989](#); [Espinosa, 1995](#)) has proven to be a very good way of starting the project, as it focused on peoples' perception and understanding and allowed inclusion of a multiplicity of worldviews. From the outset the models and diagnoses were built from the viewpoint of the participants rather than the analysts. This reconfirms [Winter \(2006\)](#) suggestion that it is particularly relevant to use soft OR tools at the front end of complex projects: in particular it confirms the role that these analytical tools play at the initial stage in complex project management. Following [Mingers \(2006, Chapter 10\)](#), our methodology enhances the appreciation stage at the individual and social domains – see [Appendix 4](#). It does it by including ways to appreciate personal views and to generate accommodation and consensus about organisational identity and critical organisational issues (i.e. soft analyses at the beginning; facilitative modelling approach to use the VSM).

The combined use of both qualitative (VSM) and quantitative (SNA) analyses has shown that some of the often intuitive learning resulting from a VSM oriented change processes, can be more rigorously quantified and complemented with structured analytical techniques. It complements VSM diagnosis by identifying and characterising informal networks and power relationships (by using SNA at different stages of the intervention). This contributes at the social domain as provides tools for assessment of power structures. Learning more in terms of providing an even more robust evaluation of the intervention is an opened path for further research.

#### 4.3. About the engagement with the client's group

The intervention is an illustrative (and new) example of a facilitated problem structuring methodology (VSM) (see [Franco and Montibeller, 2010](#)); rather than the VSM being used in an expert mode, we co-designed and developed the intervention with the client from design to evaluation. This approach took away part of the uncertainty of engaging with the client group when using Problem Structuring Methods (PSMs), (see [Mingers and Rosenhead, 2004](#)) that includes: negotiating entry; workshops arrangements and process; what happened beyond the workshops; and how to assess the success of an intervention. In this project, we had no issues of negotiating entry as the members had already decided to adopt a VSM approach and were looking for experts with experience of co-operatives to support the intervention – in a coaching and facilitation mode. The arrangement of workshops and process was always based on people's interest in the VSM project, rather than any sort of pressure to participate. Undoubtedly the nature of the participants had a major impact on this intervention – see [Section 4.5](#). During the workshops, we facilitated the discussion and used the VSM models, produced by the participants, as [Franco and Montibeller \(2010\)](#) would say, as a facilitative learning device, a 'play tool' that allowed them to rehearse ideas and action possibilities about the organisational structure. The Process Group played a key role in the project, as champions of the VSM. 'What happened beyond the workshops was relevant: as VSM-literate members embedded the VSM distinctions in their daily life, others did not and even felt alienated; a major challenge was to diffuse the learning.

A critical issue for effective implementation was the democratic involvement of stakeholders, at all stages of development, from the design phase through to the implementation. It helped to create a collaborative environment focused on individuals and their purposes and not just focus on processes and efficiency. Undoubtedly, the members of this ecovillage are people with a clear environmentally responsible ethos, a desire to contribute to a radical new social experiment and to do it within a cooperative and democratic context. This is a unique combination of attitudes and values, that had a large influence on the success of the story told here; even if this is not unusual in eco-communities this still leaves questions opened about transferability of the approach to other less cohesive and democratic communities.

#### 4.4. Assessing the impact of an intervention

An issue in using PSM approaches in general is that there is not any formal and systematic way of assessing their impact: how we can verify that an intervention using a PSM approach is genuine and effective? This soft OR intervention is not an exception. [Mingers and Rosenhead \(2004\)](#) have provided an account on the use and effectiveness of PSM approaches. They consider that the benefits associated with PSMs are typically intangible, (for example, better understanding) which exacerbates the problem of how to evaluate the contribution; also that what a particular PSM

approach offers is a model of the situation that will enable participants to clarify their predicaments. We have evidence that the community found an effective way to structure their learning, that they found the VSM intervention useful; and that they have managed to overcome the original threats to the viability of the organisation; also that the use of VSM distinctions enabled the construction of a very rich narrative about the ongoing and desirable organisational transformations (Cardoso, 2011, p. 255–290). The VSM distinctions became well known to the community and many new applications are happening, with little or no reference to the analysts.

As Ackermann (2012) says, this, as other soft OR approaches, still provide insights rather than testable results, which exacerbates the problem of how to evaluate their contribution, and raises concerns over the methods' effectiveness; there is no consensus in the OR community on how to assess soft OR interventions Vidal (2004); also, given the idiosyncrasies of this application, many of the models are non easily transferable; as with other soft OR interventions, this raises concerns about validity and robustness of these methods (Mingers, 2011). Even though it shares limitations of other soft OR approaches, the improvements in the ecovillage organisation and performance revealed a positive effect from the (initially coached) self-organisation process, which goes far beyond problem solving or strategic formulation. If there are tools to enhance people's learning about good organisation and decide collectively on effective actions then we should use them.

We provided some statistical evidence of improvements in their connectivity and networking patterns, clearly associated with emerging roles decided during the intervention. The parallel mapping of the self organising dynamics (i.e. SNA) and the structural changes decided by the organisational members (e.g. VSM) is a new assessment tool to support studies of self organisation in communities. It is a contribution to overcome, at least partially, the 'lack of empirical evidence of effectiveness' of most soft OR methods – as in Ackermann (2012).

#### 4.5. On self-organisation and community OR

Many intervention approaches and methodologies to community OR have clear roots in soft OR (Taket and White, 1997; Midgley and Reynolds, 2004; Bell and Morse, 2007). In this intervention we have certainly learned that, essential for self-organisation to emerge, are the existence of mechanisms to share crucial information on the main organisational tasks. Distributing and sharing core information and knowledge widely between members and understanding priorities on tasks' distribution seem to be a common issue in social contexts. Using the VSM as a hermeneutical enabler allowed the community to share a common mapping of their co-evolving organisation and this resulted in more effective organisation and improved viability. In this community, a clearer mapping of the required tasks and roles shared by all allowed them to self-organise with less conflict; new mechanisms for interacting were agreed and put into practice. This resulted in improved communications and synergies without imposing top down hierarchical control. While there are a number of OR contributions to model complex interactions between agents, there are less developed theory and applications of neural like organisations operating in community contexts or soft OR approaches supporting their design. This approach and the example of application open a way to support communities to enhance their viability and sustainability by more effectively self-organising in a recursive, neural network-like way (VSM).

Undoubtedly, the ecovillage's very strong ideal to become a sustainable community, and their highly cohesive identity creates a unique context where an experiment on self-building their organisation and learning to cope with complexity was feasible

and positive. Clearly, this is not always the case: attempting this approach for instance, in a rigid and hierarchical organisation, may have less possibilities of success! An open research questions resulting from this work is about how a community like this, oriented by ideals and consciously assuming an approach to self-organisation, may be more sustainable than one that takes different organisational decisions (e.g. top-down hierarchical control). There are multiple examples of these kind of social experiments during the 19th and 20th Centuries like New Harmony in Tennessee and Brook Farm in Massachusetts in the XIX Century (Fogarty, 1990). More recently we find the Kibbutz in Israel, Findhorn in Scotland and many others around the world. Almost all of those communities hoped to create an alternative way of living, with more equality, higher ideals and a reconnection to nature, but some failed or dissipated after some time: it may be that the way they organised themselves had influenced their success or failure. It would be interesting to compare the ecovillage described here to these other communities focusing on the alternative social/organisational structures each had, but this is beyond the scope of this paper. We consider that this example has shown interesting links between sustainability, community development and self-organisation, and that it exemplifies innovative ways in which soft OR may contribute to this field.

## 5. Conclusions

After more than three years of in depth interaction with the ecovillage, there is little doubt that the intervention has produced several positive outcomes: the main structural problems, which were threatening the survival of the community in 2007, have now been identified and solutions found. There has been improved communications, task appropriation, and organisational effectiveness for achieving their core purpose of developing as a sustainable community. With this case study, we illustrated a new approach to using the VSM as a hermeneutical enabler of a community's learning process about viability and self-organisation that overcomes previous criticisms of the VSM as a unitary, functionalistic approach (Jackson, 1988; Jackson, 2003; Ulrich, 1981). By using the VSM in this way participants take control on their own decision-making, and decide on improvements to their organisation in a more informed way.

In this case study, for example, the learning process through the VSM intervention allowed the community members to produce clearer mappings of the complexity of their tasks and patterns of interactions that would not have been possible with more generic problem solving methods, or just using common sense; for example a conceptual model following SSM allow members to structure generic activities to resolve problems, but it does not provide theory or tools to do organisational diagnosis or design as the VSM does. So the type of solutions found through SSM are more intuitive – driven by the members' current understanding rather than generating richer narratives on issues of organisational viability and self organisation, as this methodology allows.

In comparison to other soft OR methodologies, the VSM offers a consistent viability theory and analytical tools that allows us to learn new ways of managing organisational complexity. Most of the other soft OR methodologies would allow the analyst to deal with the participants' complexities by supporting more specific organisational needs: i.e. problem solving, strategic planning, project management and so on. Our approach to VSM focuses on enabling and supporting people to analyse the context in which recurrent social interactions occur in their organisation. For instance, the analytical tools used helped the community members to distinguish between levels of organised complexity – by identifying nested viable systems, each one responsible for primary

activities at different levels of recursive organisation; this allows participants to concentrate the analysis at each level, on core issues of organisational viability. When – as in the case study – the learning community decides to act and re-organise around core tasks for the community viability, and required meta-systemic support, the self-induced transformation may result in improved self-regulation, performance and therefore viability.

Echoing Mingers and White (2010, p. 1157), the challenges of climate change and the global economic crisis need innovative solutions including the development of more resilient communities; demonstrative examples supported by soft OR approaches are an essential element. This case study highlights some of the core organisational challenges of bringing to birth a self-organised and more resilient community, and one clear way in which soft OR can contribute. The community felt they were more effective – over that period- in identifying and implementing structural changes and reckon the learning context created by the VSM project enhanced the self-organisation process. This is encouraging and make us hope that our approach would be beneficial to multiple communities in the world exploring new avenues to self organise, and improve their sustainability. We do not know how this learning will or not evolve over time, without further facilitation. We ignore how the approach will work in a different type of community.

It was not the intention of this paper to present a fully proven soft OR methodology, but to suggest a new way of using a traditional soft OR approach and to exemplify how it has been used, through a case study. We are aware that all evidence presented here may not be enough to prove the effectiveness of our methodology: but it gives us enough positive feedback to continue testing it in other communities and contexts. As with other action research projects, the transferability of the findings is limited, as so far, we have focused in one particular organisation. As Ackermann (2012) concludes, when taking into account the positive impacts and the negative issues on rigour and evaluation, the verdict for soft OR methods still appears to be a positive one. We still consider that the limitations of our approach does not limit the value of the experience and the worthiness of making it available to other OR researchers and practitioners, as a new way of experiencing the VSM, that may be very useful in the context of other communities aiming for improved resilience.

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### Appendices 1–5. Supplementary material

Supplementary data associated with this article can be found, in the online version, at <http://dx.doi.org/10.1016/j.ejor.2012.09.015>.

### References

- Ackermann, F., 2012. Problem structuring methods 'in the Dock': arguing the case for Soft OR. *European Journal of Operational Research* 219, 652–658.
- Beer, S., 1979. *Heart of the Enterprise*. John Wiley & Sons, Chichester.
- Cardoso, P.P., 2011. *Facilitating Self-Organization in Non-Hierarchical Communities: A Methodology for Regeneration Programs*. Doctoral Thesis, Hull University Business School, UK.
- Checkland, P., Holwell, S., 1998. Action research: its nature and validity. *Systemic Practice and Action Research* 11, 9–21.
- David, A., 2001. Models implementation, invited review. *European Journal of Operational Research* 134, 459–480.
- Dawson, J., 2010. Ecovillages and the transformation of values. In: Starke, L., Mastny, L. (Eds.), 2010 *State of the World: Transforming Cultures from Consumerism to Sustainability*. Earthscan, London, pp. 185–190.
- Espinosa, A., Harnden, R., Walker, J., 2008. A complexity approach to sustainability: Stafford Beer revisited. *European Journal of Operational Research* 187, 636–651.
- Espinosa, A., Walker, J., 2011. *A Complexity Approach to Sustainability: Theory and Application*. Imperial College Press, (Invited Book). Book Series on Complexity, London.
- Espinosa, A., Porter, T., 2011. Sustainability and complexity: insights from viable and complex adaptive systems. Invited paper, special issue. *The Learning Organisation* 8, 54–72.
- Espinosa, A., Cardoso, P.P., Arcaute, E., Christensen, K., 2011. How self-organisation works in social systems: a case study in an irish eco-village invited paper. Special issue. *Kybernetes: An International Journal of Systems and Cybernetics (Highly Commended Paper. Emerald Literati (2012))*, 40(3/4), 536–558.
- Franco, A., Montibeller, G., 2010. Facilitated modelling in operational research. *European Journal of Operational Research* 205, 489–500.
- Jackson, M.C., 2003. *Systems Thinking: Creative Holism for Managers*. John Wiley & Sons, Chichester.
- Harnden, R., 1989. Outside and then: an interpretative approach to the VSM. In: Espejo, R., Harnden, R. (Eds.), *The Viable System Model: Interpretations and Applications of Stafford Beer's VSM*. Wiley & Sons, Chichester.
- Midgley, G., Ochoa-Arias, A.E. (Eds.), 2004. *Community Operational Research – OR and Systems Thinking for Community Development*. Kluwer Academic, New York.
- Midgley, G., Reynolds, M., 2004. Systems/operational research and sustainable development: towards a new agenda. *Sustainable Development* 12, 56–64.
- Mingers, J., 2011. Soft OR comes of age – but not everywhere! *Omega: International Journal of Management Science* 39, 729–741.
- Mingers, J., Gill, A. (Eds.), 1997. *Multimethodology: Theory and Practice of Combining Management Science Methodologies*. Wiley, Chichester.
- Mingers, J., Rosenhead, J., 2004. Problem structuring methods in action. *European Journal of Operational Research* 152, 530–554.
- Mingers, J., White, L., 2010. A review of the recent contribution of systems thinking to operational research and management science. *European Journal of Operational Research* 207, 1147–1161.
- Ormerod, R., 2001. Mixing Methods in Practice. In: Rosenhead, J., Mingers, J. (Eds.), *Rational Analysis for a Problematic World Revisited*. Wiley, Chichester, pp. 311–336.
- Paucar-Caceres, A., Espinosa, A., 2011. Management science methodologies in environmental management and sustainability: discourses and applications. *Journal of the Operational Research Society* 62, 1601–1620.
- Taket, A., White, L., 1997. Wanted dead OR alive – ways of using problem-structuring methods in community OR. *International Transactions in Operational Research* 4, 99–108.
- Ulrich, W., 1981. A critique of pure cybernetic reason: the Chilean experience with cybernetics. *Journal of Applied Systems Analysis* 8, 33–59.
- Von Foerster, H., 1981. *Observing systems*. Intersystems, Salinas, CA.
- Winter, M., 2006. Problem structuring in project management: an application of soft systems methodology (SSM). *Journal of the Operational Research Society* 57, 802–812.
- White, L., 2003. The role of systems research and operational research in community involvement. *Systems Research and Behavioural Science* 20, 133–145.
- White, L., 2009. Understanding problem structuring methods interventions. *European Journal of Operational Research* 199, 823–833.
- Zhu, Z., 1998. Conscious mind, forgetting mind: two approaches in multimethodology. *Systems Practice and Action Research* 11, 669–690.