Decision Support

Constitutive rules for guiding the use of the viable system model: Reflections on practice

David Lowe [a,b,c], Angela Espinosa [c,d], Mike Yearworth [e,*]

[a] *Systems Centre, Faculty of Engineering, University of Bristol, Bristol, BS8 ITR, United Kingdom*
[b] *Dstl, Portsdown West, Fareham, PO17 6AD, United Kingdom*
[c] *Centre for Systems Studies, Hull University Business School, Hull, HU6 7RX, United Kingdom*
[d] *Centro de Innovación y Sostenibilidad, Facultad de Administración de Empresas, Universidad Externado de Colombia, Bogota, Colombia*
[e] *Centre for Simulation, Analytics & Modelling, University of Exeter Business School, Exeter, EX4 4ST, United Kingdom*

A R T I C L E I N F O

A B S T R A C T

The Viable System Model (VSM) provides a well-established framework to aid the design and diagnosis of organisations to survive and thrive in complex operating environments. However, the cognitive accessibility of the VSM presents a significant barrier to its application with non-expert stakeholders. In the face of such difficulties, VSM practitioners will often take steps to adapt the classic presentation of VSM to suit the needs of their particular operational context. We propose a set of constitutive rules, including an explicit epistemology, that can both account for the variety of VSM practice reported in the literature and also be used to guide practitioners in their application of the VSM and thus make rigorous use of VSM theory. The epistemology is expressed as a performative model, expressed as a Hierarchical Process Model (HPM), of the practitioner's use of the VSM in an engagement. We use this model to describe, reflect upon, and learn about VSM practice by the cross-case analysis of three recent VSM interventions. The combination of variability in problem structuring and specificity to the VSM afforded by the constitutive rules and the performative epistemology in combination has provided insight into the social ontology of VSM practice and the boundaries of what should be considered acceptable practice from a competence perspective. Our approach is intended to encourage wider and better application of VSM theory in preparing organisations to maintain performance in uncertain futures.

1. Introduction

The Viable System Model (VSM) was developed by Beer (1979, 1981, 1984, 1985) to explain how organisations can continuously adapt to changing environments by harnessing the principles of complexity and variety management. Whilst the VSM was first proposed long ago, it is attracting increasing numbers of researchers and practitioners, as the operating conditions faced by many organisations in the 21st century are more clearly characterised by increasing volatility, uncertainty, complexity and ambiguity (Bennett and Lemoine, 2014). These conditions threaten not only the performance of organisations but their very existence. The VSM draws upon Ashby's laws on requisite variety and self-organisation (Ashby, 1958) and McCulloch's model of neural networks (McCulloch, 1965) to support the diagnosis and design (and

redesign) of organisations to not only survive but to thrive in such changing environments.

The VSM specifies the necessary and sufficient conditions for any organisation to remain viable in any environment. The VSM asserts that this viability is dependant on keeping a balanced relation with the environment in which it operates, and from which it gets its resources; and that such balance results from the existence and interactions between five key typologies of organisational functions (Systems 1 to 5) with their external and internal stakeholders at different levels of organisation. The VSM offers basic criteria to manage complexity and 'Laws, Axioms and Principles of Organisation' to guide the organisational analysis. It is a recursive model which can be applied to organisational networks of any scale and complexity.

The VSM has been widely used in domains as diverse as strategy management, operations and supply management, information management, service science, governance, sustainability, knowledge management, performance management, learning, education

and innovation, and community development. The use of VSM in these domains has been both in a functionalist sense, where practitioners act in expert mode, and in an interpretivist sense where practitioners act in facilitator mode (Franco and Montibeller, 2010). In the functionalist mode, the practitioners compare the 'reality' of the problem situation to VSM theory and recommend actions accordingly. There are specific methods for using VSM in this mode such as Viable Systems Diagnosis (Flood and Jackson, 1991) and Systemic Management Control (Schwaninger, 1990). Whereas in the interpretivist mode, practitioners work with organisations to understand their (dis)function, identify actions to improve their effectiveness and viability and to follow through building on the consensus that has been established (Espejo, Bowling, and Hoverstadt, 1999; Espinosa, Harnden, and Walker, 2008). A number of examples of the use of the VSM in this way have been reported (Brocklesby, 2012; Espejo and Reyes, 2011; Espinosa and Duque, 2018; Espinosa and Walker, 2013, 2017; Harwood, 2012; Tavella and Papadopoulos, 2015). Together these suggest ways in which the VSM supplies the necessary systemic approach to be a Problem Structuring Method (PSM) by using "*systems ideas (including boundary, complexity, variety, learning, heterarchy, communication and control), which (i) are appropriate to context, (ii) theoretically adequate, and (iii) supported by appropriate systems modelling*" (Yearworth and White, 2014). More recently, Harwood (2019) has provided a short critique of the evaluation made by (Smith and Shaw, 2019) and concluded that the VSM can indeed be viewed as a PSM.

The VSM has been the subject of criticism and in particular the cognitive accessibility of the VSM has been recognised to be an issue for many who have tried to apply it in everyday OR practice (Jackson, 1988; Ulrich, 1981). It is therefore typical for those introducing the VSM to a new setting for use as a PSM to make adaptations to the VSM in how it is presented and used. This raises an important research question: how much adaptation is acceptable before the model being used to support interventions in terms of organisational and process design can no longer considered to be the VSM? It also raises other interesting research questions in the performative idiom (Ormerod, 2014; Pickering, 1993; White, Yearworth, and Burger, 2015) such as: how is the VSM actually being used in practice as a PSM and with what variability? Also, what is it that a VSM practitioner is doing when they are using the VSM as a PSM? In order to address these questions, we first elaborate a set of constitutive rules derived from previous work (Checkland and Scholes, 1990, pp. 284–290; Jackson, 2001; 2003, pp. 305–311; 2019, pp. 601–604; Yearworth and White, 2014) and then go on to develop an explicit epistemology to provide a basis for the comparative analysis of VSM practice. Both the constitutive rules and the epistemology are expressed as a *performative* model akin to a purposeful activity system model that can act as a handrail for practitioners when applying the VSM as a PSM – especially for novice practitioners applying the VSM the first few times, or established PSM practitioners with experience in other methods. In addition, the performative model can act as a reflective device to aid practitioners in their learning from practical applications of VSM theory. Our aim is to ensure that the connection to underpinning theory is not lost and to expand the application of this powerful approach – including to some of the most difficult problems faced by organisations today – by making it easier for others to understand.

This paper now proceeds to describe the VSM and review canonical VSM related methodology. It then outlines our development of a set of constitutive rules and the associated explicit epistemology (Section 3) to guide the application of the VSM as a PSM and so contribute to overcoming the difficulties experienced in practice. We then present three case studies of recent VSM interventions where the original theory and tools have been adapted to suit the needs of their particular operational contexts and are evaluated using our performative model (Section 4). The paper closes
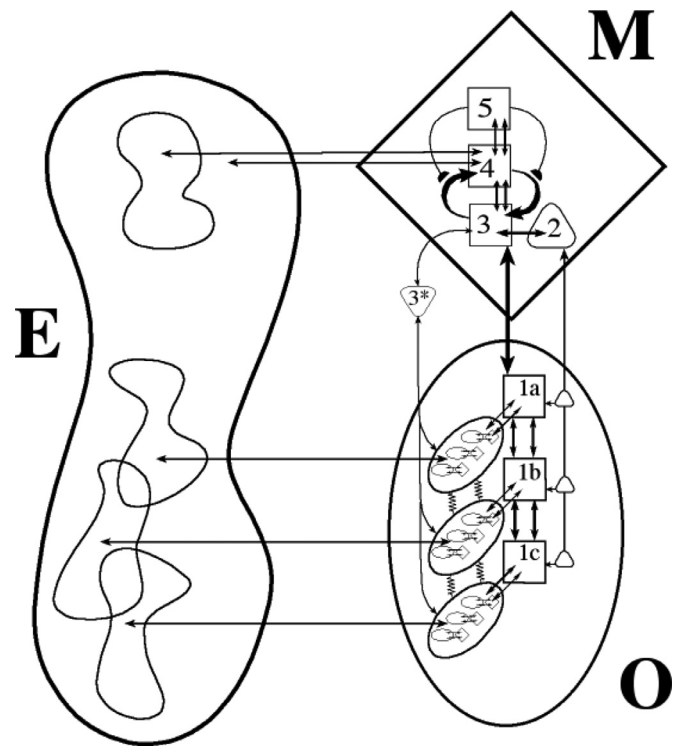

Fig. 1. The VSM adapted from Espinosa and Walker (2017, p. 64).

by discussing implications both for practice and for future research (Section 5) and drawing conclusions (Section 6).

2. Review of vsm methodology

Beer (1975) defined Organisational Cybernetics as the *"science of effective organization"* with the aim of challenging traditional management models, which he found to be inadequate for addressing the many complex and messy situations faced by managers. Beer (1979, 1981, 1984, 1985) developed the VSM as a conceptual model for the design of organisations as self-organised networks, operating without a central control (i.e. heterarchies not hierarchies). He described the necessary and sufficient conditions for an organisational system to be viable, i.e. capable of maintaining an independent existence in a dynamic operating environment. The VSM contains a set of typologies for organizational roles – which Beer named Systems 1 to 5 – whose balanced interaction is a pre-requisite for organisational viability. Beer recommended that organisations be (re)designed as neural networks where each operational unit (System 1 in his terms) creates value though the generation of products and/or services by operating with 'responsible autonomy'. These networks are repeated at multiple (recursive) layers of organization so that each node in these networks is in itself a viable system. VSM is thus a recursive model of organization.

The VSM offers a meta-language to map organizational complexity, and to analyse organizational viability. In doing so, the VSM distinguishes between three main elements; Operations (O) – where the products or services are produced; meta-systemic management (M) – responsible for providing the operations with all the required technical and administrative support for effective production; and environment (E) – for which the operations produce their products or services and within which the organisation as a whole lives. The model in its standard representation is shown in Fig. 1. In order to maintain viability, there is a need to manage complexity between operations and meta-system, between meta-system and environment and between operations and

environment. Each of these three elements changes over time and this necessitates continuous self-reference and self-adaptation. If the organization manages to keep its identity, reputation and patterns of interactions within its niche, despite the system having to cope with an unpredictable external environment, then it is said to be maintaining internal homoeostasis (Beer, 1985).

The focus of VSM analysis is the homoeostatic balance between operations and environment, meta-system and environment, operations and meta-system, and within the meta-system itself, following Ashby's laws of requisite variety (Ashby, 1958), Maturana's principle of autopoiesis (Maturana, 1975), and Beer's regulatory aphorisms, principles of organisation, theorem and law (Beer, 1979, pp. 565–567). Ashby defined 'complexity' as all the possible states that a system can exhibit at a particular moment; and 'variety' as the number of possible states, as recognised by an observer. Ashby's Law explains that "*only variety absorbs variety*" (Ashby, 1958). Beer (1979, pp. 32–48) explains the paramount consequences of this law for managing complexity, and for generating knowledge in organisations. The organisational purpose determines its variety: as each Operational System (System 1) enacts a purpose or identity, and there are always multiple ways for formulating organisational identity, the perceived purpose depends on the point of view of particular observers. The VSM offers criteria to balance varieties of operations, environment and meta-systemic management. It suggests that communication channels should be designed following variety laws; that it is desirable to balance horizontal variety (i.e. dealing with environment) and vertical variety (i.e. dealing with management and operations); and that in a recursive organisational structure, any viable system contain, and is contained in, a viable system. It also provides criteria to balance the variety of Systems 3, 4, and 5.

A complete VSM intervention would aim to support participants in finding more balanced and effective ways of self-organising, by focusing organisational tasks around the operational tasks; and by providing the required resources and skills for supporting their implementation. Beer provided the background theory and the generic methodological guidance on how to use the VSM in his core texts (Beer, 1979, 1981, 1985). There have been many subsequent contributions to apply the VSM via specific methods. VSM methodologies originally suggested for supporting organisational diagnosis included: 'Viable Systems Diagnosis' (Flood and Jackson, 1991), 'Viable Boundary Critique' (Yolles, 2001); 'Holistic Management Approach' (Christopher, 2007), 'Systemic Management Control' (Schwaninger, 1990, 2006), and 'Viable Knowledge Management' (Achterbergh and Vriens, 2002), Most of them focus on understanding functions versus structure, with emphasis on knowledge, performance and information management. Nevertheless, Beer's closest collaborators have worked on producing more constructionist interpretations of the original theory and methodology, focusing on learning while developing organisational tasks, rather than on effectively designed functions and roles; and therefore, emphasizing conversations rather than information exchange amongst stakeholders. This includes the 'Viplan methodology' (Espejo and Reyes, 2011), and the 'Self-Transformation Methodology' (Espinosa and Walker, 2017) – originally inspired by Viplan – both of which have been widely used in several contexts and countries to support organisational transformations. In both methodologies, the emphasis is in managing complexity to enable learning in related change processes. The variety of methodologies and related methods demonstrates a degree of interpretation in how to translate the VSM into a practical method for engagement with broad organisational problems, but makes it difficult for practitioners to understand what is most important, and what can be learnt from seemingly disparate practice.

Jackson originally identified VSM as a functionalist approach in his System of System Methodologies (Jackson, 1993, pp. 86–111;

Jackson and Keys, 1984) but later conceded that "the functionalist paradigm certainly does not exhaust the possibilities opened up by the VSM" (Jackson, 2001). Jackson provides a useful, and forceful, critique of the use of systems methods with functionalist roots in plural contexts. The System of System Methodologies (SoSM) underpins the basis for this critique, structured as it is on the original work of Burrell and Morgan (1979) and firmly grounded in the assertion of paradigm incommensurability. Jackson classified the VSM as only applicable to unitary contexts in the SoSM, which he equates to the functionalist paradigm of the Burrell and Morgan Framework. Whereas, SSM and PSMs generally Jackson classifies as applicable to plural contexts in the SoSM with an underpinning interpretivist paradigm, and hence the original assertion of incommensurability of the VSM and PSMs. Even today, the use of the VSM as a PSM gives rise to some controversy, harking back to this old argument and underlining the influence of such frameworks. This is despite exhortations that we should all have 'moved on' by now (White and Taket, 1996). For example, the analysis of PSMs by Smith and Shaw (2019) would appear to exclude the VSM from qualification as a PSM. However, this conclusion is clearly challenged by Harwood (2019) through a different interpretation of the Smith and Shaw questions that focusses on subjectivism and facilitation in VSM practice, in effect arguing that VSM practitioners have been successful in its application to plural contexts and thus establishing its compatibility with an interpretivist stance. Contemporaneously, in his most recent work, Jackson (2019, p. 332) recognises that the methodologies developed by Espejo and Reyes (2011) and Espinosa and Walker (2017) seek to engage individual perceptions in a learning process using VSM as a guide. He also considers that Beer's 'Team Syntegrity' (1994) was his last methodological development to deal with the complexity of VSM's 3/4/5 Homeostat in that it "steers clear of functionalism" (Jackson, 2019, p. 464) and that it comes to terms with the pluralism and coercion that can arise in social systems' (ibid, pp. 467). The VSM has been critiqued for restricting focus to how the necessary functions are carried out underplaying cultural, political and coercive aspects (Jackson, 2003). This is largely restricted to the application of the VSM when used in a functionalist sense, where a VSM practitioner brings specialist expertise to bear in comparing 'as is' or 'to be' organisational models against the VSM 'blueprint'. However, this is contrary to the most recent trend in VSM research where there are growing number of innovative developments of the original VSM inspired by Soft OR, which move the use of VSM away from functionalism towards a more interpretivist perspective (Espejo and Reyes, 2011; Espinosa and Walker, 2017). Evidence of this can be found across a broad swathe of published work (Ackermann, 2012; Edson and Klein, 2016; Espinosa and Walker, 2013; Espinosa, Reficco, Martínez, and Guzmán, 2015; Hart and Paucar-Caceres, 2017; Harwood, 2018, 2019; Jackson, 2006; Lowe, Martingale, and Yearworth, 2016; Mingers, 2000; Preece, Shaw, and Hayashi, 2015; Smith and Shaw, 2019; Tavella and Papadopoulos, 2017). There have also been many new VSM applications that exhibit some degree of being a multimethodology approach (Mingers and Brocklesby, 1997; Pollack, 2009) such as combining the VSM with Complex Adaptive Systems (Espinosa and Porter, 2011; Espinosa et al., 2008), combining with Systems Dynamics (Schwaninger and Pérez Ríos, 2008), and with Lean Systems (Schwaninger and Pérez Ríos, 2008).

The potential for learning across the wide range and ever-increasing applications of the VSM is very significant. For example, from organisational transformation (Espejo and Reyes, 2011; Espinosa and Walker, 2013); strategic management (Espinosa et al., 2015), performance management (Bititci, Carrie, and McDevitt, 1997); information management (Preece, Shaw, and Hayashi, 2013); government and governance (Espinosa and Duque, 2018),

sustainability (Espinosa and Walker, 2017), learning, education and innovation (Leydesdorff and Nerghes, 2017), servitization and outcome based contracts (Batista, Davis-Poynter, Ng, and Maull, 2017) and community operational research (Espinosa and Walker, 2013; Tavella and Papadopoulos, 2015). The diversity of applications and the diffusion of learning shows that *methodological* learning is taking place, not just simple application of method. This is a key feature of a PSM, recognising that the unique context of messy problem contexts and the need for methodology to improve with application and adapt to circumstance. From this diversity of applications and the fact that learning is diffusing through the community of VSM practitioners suggests that there must be a *mechanism* that both aids this diffusion and also the flexibility to adapt to different messy problem contexts and allow this 'learning across' to take place. This sets up the fundamentals for our appeal to constitutive rules as the mechanism. We return to these points in the cross case learning and the discussion.

We now proceed in the next section to build on this broad foundation of VSM methodological development and wide application and address critique by presenting our development of a set of constitutive rules together with an explicit epistemology to support practitioners in their use of the VSM as a PSM.

3. Methodology

3.1. The use of constitutive rules, a review

The origins of constitutive rules for PSMs can be traced to the work of Checkland (1981, pp. 252–254) who defined them for Soft Systems Methodology (SSM), building on earlier work to develop constitutive rules for SSM as a pedagogic device to support teaching the methodology at the Open University (Naughton, 1977). Checkland and Scholes enlarged on the original concept of defining constitutive rules for SSM *practice* and introduced the idea that claims of 'valid' SSM use could be evaluated against these constitutive rules, at least in the case of Mode 1 use (Checkland and Scholes, 1990, pp. 280–284). The distinction that Checkland and Scholes make between Mode 1 and Mode 2 use of SSM has a direct bearing on the performative view of SSM, and hence PSMs generally and on the interpretation of using the VSM as a PSM, and on the notion of there being such a construct as a constitutive definition:

> "…the authors came to see a real difference, not merely a semantic conceit, between 'using SSM to do a study' and 'doing work using SSM'. The essence of this difference emerged as the difference between, on the one hand, mentally starting from the SSM, using it to structure what is to be done, and, on the other, mentally starting what is to be done and mapping it on to SSM, or making sense of it through SSM."

This distinction led them not to a dichotomy but the recognition that SSM practice occurred on a spectrum between the poles of Mode 1 and Mode 2 use and therefore the notion that the performance of an 'SSM' engagement with a client could in principle sit anywhere between the two. From this they proceeded logically to a presentation and discussion of the constitutive definition for SSM (ibid, pp. 284–290). It was clear that in contrast to rigidly defined method, constitutive rules would capture a description of the methodology that could account for practice anywhere on the continuum between Mode 1 and Mode 2 use i.e. the constitutive rules would be *generative* of the range of practice observed.

In addressing this question of validity, a more profound existential view of SSM emerged, neatly summarised by: "It is the Constitutive Rules which are of greater interest since they answer the stark question: What is SSM? If there are no such rules then in what sense can SSM be said to exist?" (ibid, p.285). Checkland and Scholes

augmented the original constitutive rules for SSM with an explicit epistemology (*ibid*, pp.288–289). In their formulation, we can think of the constitutive rules as comprising an action part, which describe the SSM *process*, and the epistemology part specific to SSM and which describes the objects or entities involved and in which the SSM process makes sense. Whilst Checkland and Scholes did put forward the case where the constitutive rules for SSM could be combined with other epistemologies, presumably leading to 'new' methodologies of the soft systems/problem structuring type, no evidence has been found in the literature for any such examples.

We conclude that developments along these lines pertaining to the use of an epistemology grounded in the VSM may well have been avoided due to burgeoning issues of paradigm incommensurability as discussed in the review,[1] causing the debate in the problem structuring community to turn to practical concerns with multimethodology (Howick and Ackermann, 2011; Mingers, 2001; Mingers and Brocklesby, 1997; Mingers and Gill, 1997; Pollack, 2009) aligned to a position of methodological pluralism (Jackson, 2019, pp. 519–522). It is perhaps unfortunate that the usefulness of constitutive rules was overlooked. We only return to the debate here because we are specifically resurfacing Checkland and Scholes' idea of combining constitutive rules with a defined epistemology, but with the benefit of further work on constitutive definitions we discuss below and sound empirical grounding of our argument in current VSM practice.

The utility of defining constitutive rules for a methodology was given a further boost by Jackson (2001; 2003, pp. 305–311), who developed constitutive rules for systems approaches grounded in each of the four sociological paradigms[2] defined by the quadrants of the Burrell and Morgan (1979) framework, which together formed the constitutive rules for the use of generic system methodologies as part of Critical Systems Practice (CSP). These, together with the original constitutive rules for SSM, led to Yearworth and White (2014) adopting a similar approach for developing a Generic Constitutive Definition (GCD) for PSMs. The original intention behind the development of the GCD was primarily to identify further sources of data about non-codified use of problem structuring methods. The authors envisaged a *fuzzy* interpretation of the elements of the definition when evaluating cases (ibid, p.942 Table 6). However, the performative construction of the GCD does mean that it is also useful in the *design* of problem structuring interventions and thus where a similar fuzziness applies. The situation is therefore not much different from that originally outlined by Checkland above; the GCD offers greater or lesser support to the practitioner in constructing a problem structuring intervention depending on how closely the elements of the definition are followed.

Although the idea of constitutive rules has not been applied yet to the use of the VSM we have established in our review that there is sufficient methodological justification and evidence of the use of the VSM as a PSM to suggest that we can concentrate on developing a performative (process) description of VSM-as-a-PSM in practice i.e. how the VSM is used as method or what we define here as the *VSM process*. Our review also theorised that the process of learning across a diverse range of applications of the VSM *must* be mediated by a mechanism such as constitutive rules. Finally, there is support from Jackson (2019, p. 604) who states that "…*the VSM, originally designed as a functionalist device, can be seamlessly fitted into the interpretive or emancipatory generic methodologies*". Our approach is essentially implementing this suggestion, a multimethodology that reconciles the purely phenomenological position

---

[1] See, for example, Lane (1994) who wrestles with this problem in the case of Soft OR and System Dynamics.

[2] Although in the latest work this had been reduced to functionalist, interpretive, and emancipatory.

on systems of Checkland (1981, pp. 278–281 in particular) and the interpretivist underpinnings of PSMs, with the functionalist position (that Jackson considered was adopted by Beer) in proposing that some generic patterns of interaction between organisation, environment and management (O, E, M) through different types of roles (the 5 systems) represented by the VSM are common to all viable systems. Nevertheless, their identification and mapping rely on the observers' Weltanschauung.

3.2. Approach

Checkland and Scholes developed their rules for SSM based on both extensive empirical work and derived from an original pedagogical purpose. On the other hand, Yearworth and White developed their constitutive rules from an extensive qualitative analysis of published PSM research. In yet another approach, Jackson developed constitutive rules from the perspective of Critical Systems Practice (CSP). All three sources suggest that there is no single unifying approach to describing constitutive rules and that they have all 'emerged' from observations and experience of practice. In all cases they capture a description of actions that are collectively recognised as belonging to a particular type of intervention (Searle, 2006).

Our approach is a synthesis of Checkland and Scholes, who separated the constitutive rules of SSM from its epistemology, and Jackson, who posits that the functionalist "*device*" of the VSM can be "*seamlessly fitted into*" an interpretive generic methodology. We have, therefore, chosen to represent the empirical evidence of the use of the VSM as a PSM as a combination of i) a set of constitutive rules that capture an interpretive methodology describing the problem structuring aspects of using the VSM in engagements, together with ii) a set of constitutive rules that describe how the VSM has been used to diagnose problems and thus capturing a more functionalist epistemology. Furthermore, based on experience of using systems representations expressed as Hierarchical Process Models (HPM) (Lowe et al., 2016) we have chosen to use a process perspective to represent the latter. Analysing the structure of constitutive rules from a process perspective suggests a performative, behavioural interpretation of the act of intervention in a problematic situation (Ormerod, 2014; Pickering, 1993, 1995). The question of the validity of the intervention, in the sense of whether it was, or was not, a VSM intervention, can be answered performatively by examining[3] what it was the practitioner was *doing* when they claimed to be conducting an intervention using the VSM.

3.3. Constitutive rules for an interpretive vsm methodology

Our putative set of constitutive rules to guide VSM practice have been synthesised from the extant constitutive definitions for SSM (Checkland and Scholes, 1990), CSP (Jackson, 2003, 2019) and the GCD (Yearworth and White, 2014) and their interpretation in the light of the VSM as a PSM approach discussed in the review. Our synthesis, or theming, is inclusive rather than being selective and is presented below together with further supporting references and then summarised in Table 1 to show cross referencing to their sources. In formulating these rules, we are in effect filling-in the gaps in our understanding between literature and practice i.e. codifying the constitutive rules that generate variability in practice.

    I *Aiming to bring about improvements*: The aim of using the VSM as a PSM to guide interventions is to bring about im-

provement in a problematical situation. It is important to recognise that whilst definitive answers or solutions may be sought, this is impractical in almost every case and so improvement is sought instead (Rittel and Webber, 1973).

  II *Using models as learning devices:* VSM-guided interventions use models as a means to structure debate and so enable stakeholders to learn from each other about the way organisations can improve the way they deal with certain types of complex situations. This model can be viewed as a negotiative device, transitional object or boundary object (Ackermann and Eden, 2011b; Eden, 1995; Franco, 2013; Harwood, 2019).

 III *Making no assumption that an observer has an objective view or that different observers share the same worldview*: It is important to recognise that when addressing problematical situations that different stakeholders will bring different perspectives and that they will also not necessarily share the same worldview. The first point has implications for how content is elicited and managed and the second has implications for how the process is implemented (Espejo and Reyes, 2011, pp. 20–23)

 IV *Tailoring application to practical situations*: The VSM provides a robust framework for intervening in complex situations, but since every such situation will be different, no implementation will ever be the same. There is therefore a need to tailor the application of VSM through a process of conscious thought that seeks to balance rigour and relevance (Robey and Markus, 1998).

  V *Using methods and techniques creatively to examine the problematical situation*: Matching the approach to meet the needs of the complex situation will typically involve blending a number of specific methods. Such methodological pluralism should be based on an appreciation of their respective strengths and weaknesses (Howick and Ackermann, 2011; Jackson, 2001; 2003, pp. 305–311; 2019, pp. 601–604).

 VI *Extracting methodological lessons through reflection*: The use of the VSM as a PSM should yield research findings in addition to improving the problematic situation. These findings will typically be methodological in nature because they relate to the procedural nature of the intervention rather than the substantive nature of the problem, which will be different in every case (Ormerod and Pidd, 2006).

VII *Studying organisational interactions using VSM distinctions and principles, as an explicit epistemology to identify necessary interventions*: If the VSM is to be used as a PSM for studying organisational interactions and for identifying interventions, then the PSM should adhere to the distinctions and principles laid down by the VSM. Ensuring that the PSM as implemented adheres to the underpinning theory is critical not only for the validity of results but also for long-term credibility of the VSM – and PSMs in general – as a rigorous undertaking (Ackermann, Franco, Rouwette, and White, 2014; Jackson, 2019, p. 340).

3.4. Constitutive rules for a vsm epistemology

Mingers (2003) has defined epistemology as "*the forms of knowledge and knowledge creation that the method(ology) uses and forms of representation in modelling*". The epistemology developed by Checkland and Scholes (1990, pp. 288–289) to accompany the constitutive rules developed for SSM was described simply as the "*language through which a methodology's process makes sense*". Whilst Checkland Scholes point out that the constitutive rules for SSM could be used with other epistemologies they were not specific about the use of the VSM. As discussed above in the context of the System of Systems Methodologies there has been sufficient

---

[3] Literally by observation (e.g. ethnomethodology (Garfinkel, 1996)), or by a written account of the intervention in the style suggested by (Ormerod, 2014). The important thing is that there is empirical evidence arising from the conduct of the intervention (the process of the methodology) that would enable an observer to answer the question.

Table 1
Constitutive rules for an interpretive VSM methodology.

VSM Constitutive Rule	Linked SSM Constitutive Rule	Linked CSP Constitutive Rule	Linked GCD Constitutive Rule
i. Aiming to bring about improvements	1	1	1
ii. Using models as learning devices	2, 3b, 3c,3d		7
iii. Making no assumption that an observer has an objective view or that different observers share the same worldview	3a	8	5, 6, 8
iv. Tailoring application to practical situations	4		9
v. Using methods and techniques creatively to examine the problematical situation		2, 5, 6	3
vi. Extracting methodological lessons through reflection	5	9	4
vii. Studying organisational function using VSM distinctions and principles as an explicit epistemology to identify necessary interventions	2	1, 3,4	2

Table 2
Performative process description of a VSM epistemology.

Process	Sub-Process
Defining the system in focus	1. Organisational Identity–Establishing a purpose for the organisation (products or services), its stakeholders and its boundaries
	2. Levels of Recursive Organisation–Identifying the sub-organisations directly responsible for implementing core products or services and the larger system of which the system in focus is part.
Identifying & assessing the sub-systems within the system-in-focus	3. Operational Units (S1)–Delivering the products or services, with requisite variety to deal with their environment(s).
	4. Harmonisation (S2)–Preventing recurrent conflicts amongst primary units, by providing shared values, languages, standards and protocols for information, communications and processes.
	5. Self-Regulation and Synergies (S3)–Supporting self-regulation for each of the operational units and realising synergies amongst them for improved organizational performance.
	6. Monitoring (S3*)–Informal monitoring of operational performance.
	7. Adaptation (S4)–Making sense of environmental changes (constraints and opportunities), to shape strategy and long-term orientation.
	8. Identity and Closure (S5)–Creating corporate identity, ethos and policies to provide a consistent framework for operations.
Identifying & assessing the interactions within the system-in-focus	9. Resource Bargaining (S3–S1) – Negotiating expected results, and matching resources for each of the operational units.
	10. Inter-operational Management (S1–S2–S3) – Managing operational complexity and enabling effective decision making.
	11. Strategy Development Processes (S4–S3) – Combining internal and external perspectives on feasible and desirable future developments, to support strategy development for the organisation.
	12. Maintaining Balance (S5-S4-S3) – Balancing between present and future orientations and between internal and external perspectives in order to keep the organisation in homoeostatic balance with its niche.
	13. Recursive Governance – Ensuring that each embedded organisation operates as a viable system itself (with appropriate autonomy to self-govern).
	14. Algedonic Signals – Raising alarms to trigger interventions outside of the normal regulatory channels.

cause for concern about doing this and instead we have drawn on the empirical evidence presented in the literature of the use of the VSM as a PSM to develop our epistemology. This empirical grounding also goes some way towards avoiding an absurd interpretation of the constitutive rules presented above where the conclusion might be made that an engagement is evaluated as *not* a VSM intervention because only the VSM in its functionalist sense was used.

Therefore, drawing principally upon Beer (1985), Espejo and Reyes (2011) and Espinosa and Walker (2017), Schwaninger and Scheef (2016) we have identified 14 process elements through a close reading of the sources, grouped into 3 processes of enquiry, that from experience we find constitute a comprehensive performative epistemology for the VSM process. We believe the process elements we have identified are *representative* of the range of VSM practice but not an exact reproduction of the coverage in each of the sources we analysed, keeping with the requirement to capture process elements that would be generative of variability of practice rather than prescriptive of it. Each of these process elements is presented in Table 2.

The constitutive rules in Table 1 thus provide an *action framing,* an interpretive VSM methodology, for the 3 phases of enquiry that emerge from the epistemology. We focus the remainder of this section on a performative description of this epistemology, a description of what the consultant is doing that is specific to the VSM.

3.5. Process representation of the vsm epistemology

We have chosen to express this *performative* epistemology using a form of systems modelling called Hierarchical Process Modelling (HPM). HPM was originally conceived as a systems modelling approach with a strong process ontology and a calculus for assessing the probability of system failure (Hall, Blockley, and Davis, 1998). This modelling approach was developed over a number of years to support decision making under uncertainty in engineering management (Davis and Hall, 2003; Fletcher and Davis, 2003; Marashi and Davis, 2006) and eventually as a modelling approach to support problem structuring (Davis, MacDonald, and White, 2010).

An HPM is a conceptual model that consists of processes, described by verbal nouns,[4] structured into a hierarchical arrangement by composition and representing the minimum processes in a system required to achieve a purpose. The hierarchical label just describes the representational layout of the model on the page, the composition of processes in the hierarchical arrangement actually describes a containment relationship. A superior process on the page *contains* inferior processes: these are the sub-processes

---

[4] Gerunds, verbs in the present participle form in English i.e. verbs ending in '-ing'; having no subject and where the agent (performer) is not specified and expressing a continuous present tense. The verbal noun parts of the process descriptions are underlined in Table 2.
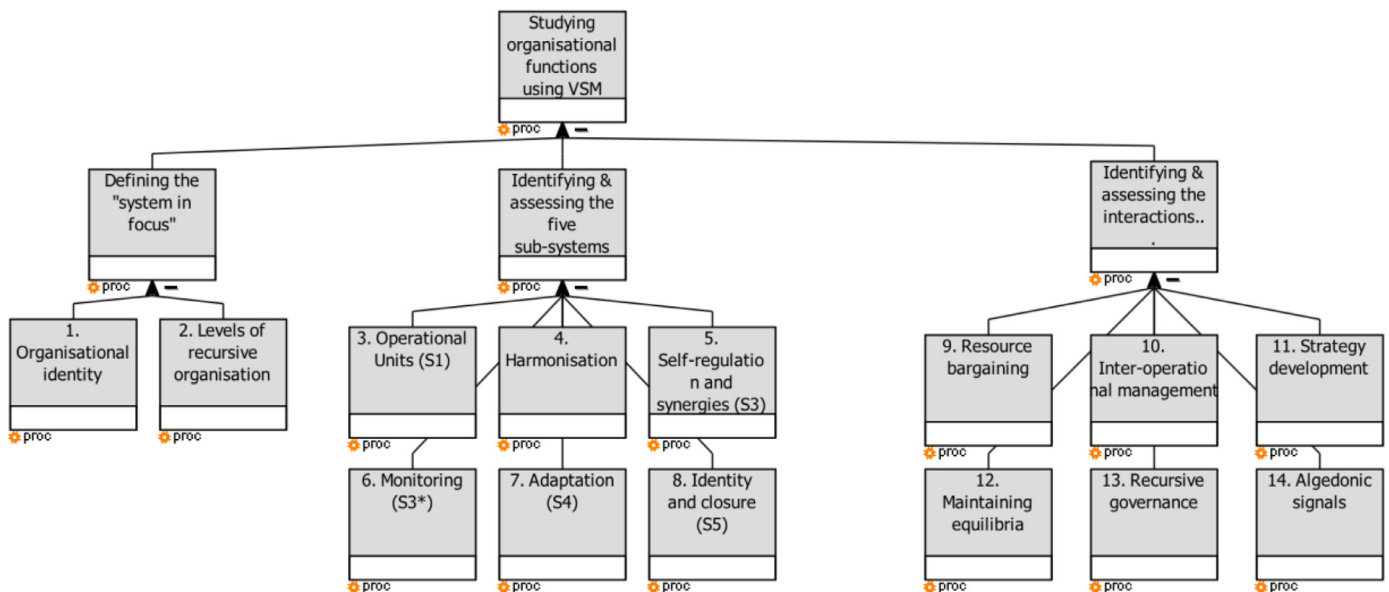
Fig. 2. The representation of the VSM epistemology constitutive rules as a Hierarchical Process Model.[5]

that are necessary and/or sufficient for the superior process to be successful. A hierarchical process model can thus be read down the page as finding successive answers as to *how* processes are to be implemented. Conversely, reading up the page provides answers as to *why* a process exists. The use of verbal nouns to label processes reinforces the strong process ontology to the point where almost anything can be modelled as a process. A simple example is a 'bus as a process', modelled as 'transporting passengers'. Here, the process ontology of the modelling approach affords a postponement in the *reification* of the process and preserves working at a conceptual level. The process could be realized by a bus, or anything else with similar functionality (e.g. taxi, private car, ...) depending on context and/or further refinement by sub-processes and need at the time the system needs to be realised. This property of the labelling of an HPM thus imbues the process description with flexibility and is thus 'generative' of interpretations in practical use in the sense we require of constitutive rules. The representation of the constitutive rules in Table 2 as an HPM is shown in Fig. 2.

3.6. Evaluating process performance

Hierarchical Process Models have a well-developed performance measure associated with each process that can be combined, hierarchically, into an overall assessment of system performance using Interval Probability Theory (IPT) or its variants (Hall et al., 1998; Marashi, Davis, and Hall, 2008). The measurement process uses interval numbers to express either beliefs or specific evidence about the performance of a process. The purpose of using interval numbers is to capture or represent fuzziness and incompleteness in our knowledge. The probability of the proposition E, the performance of a process, being true is defined by $P(E) = [S_n(E), S_p(E)]$, where $S_n(E)$ is the lower bound on that probability and $S_p(E)$ is the upper bound. Thus $S_n(E)$ represents the degree with which it is believed that E is true, $1 - S_p(E)$ the degree with which it is believed that E is false, and $S_p(E) - S_n(E)$ represents the extent of uncertainty in the knowledge of the proposition (Hall et al., 1998, p. 248). Therefore, our range of knowledge spans from complete uncertainty [0.0, 1.0], to perfect knowledge that the process 'failed' [0.0, 0.0], to perfect knowledge that the process 'succeeded' [1.0, 1.0]. Between these bounds the interval number can be used to define various points of performance and certainty in our knowledge.

These interval numbers can be expressed graphically using green for processes performing well, red for processes performing badly, and white to express the case that performance is unknown. When combined into a single element this gives rise to the notation being known colloquially as an *Italian Flag*,[6] as shown in Fig. 3.

Evaluating epistemic claims to membership of the class of VSM interventions can be decided at an overall level using the appropriate algorithm to propagate evidence values 'up' the model, or at the level of individual processes. The ability to express epistemic uncertainty, through use of scoring process performance as 'unknown', is valuable as none of the answers to the question of the performance of any given sub-process within the overall VSM process is likely to be categorical, but more likely to be a measure of strong or weak performance to a greater or lesser degree. Scoring the model like this presents the evidence in a useful way. The overall performance of the VSM process in this way will therefore contribute insight into the question of valid use,[7] whereas scoring of individual process performance will contribute to a reflective (or instructional) understanding of how well the VSM process has been implemented by looking at the amount of the process model that has been evaluated as unknown or performing badly.

3.7. Case study assessment method

The assessment method is designed to be carried out by practitioners who deliver the interventions and is thus a self-evaluation of their performance in executing all the processes in the performative model together with a judgement of the certainty of their evaluation. These are therefore subjective measures and only of value to the practitioner to help in judging their 'coverage' of the use of the VSM. In order to ensure some degree of consistency across assessments reported in the following section we developed

---

[5] Note that process descriptions in Fig. 2 have been shortened from those shown in Table 2 and Appendix A to fit them into the boxes of the PeriMeta modelling software.

[6] Note that if viewing Figs. 2 to 7 in black and white the Green region will correspond to the grey shading on the left, and the Red region to the slightly darker grey shading on the right.

[7] Thereby answering the existential question originally posed by Checkland and Scholes about use of SSM.

Fig. 3. Interval Numbers and the Italian Flag Notation.

The process performance has been evaluated with …	Judgement of Process Performance				
	Very poor performance	Poor performance	Neutral performance	Good performance	Very good performance
Very low uncertainty	[0.00, 0.00]	[0.33,0.33]	[0.50,0.50]	[0.67,0.67]	[1.00,1.00]
Minor uncertainty	[0.00, 0.25]	[0.25,0.50]	[0.42,0.58]	[0.50,0.75]	[0.75,1.00]
Moderate uncertainty	[0.00, 0.50]	[0.17,0.67]	[0.25,0.75]	[0.33,0.83]	[0.50,1.00]
High uncertainty	[0.00, 0.75]	[0.08,0.83]	[0.17,0.83]	[0.17,0.92]	[0.25,1.00]
Very high uncertainty	[0.00, 0.83]	[0.00,0.92]	[0.00,1.00]	[0.08,1.00]	[0.17,1.00]

Fig. 4. Italian Flag scoring schema for assessing the 'coverage' of the VSM epistemology. Interval Numbers are shown for completeness.

a leaf node scoring schema based upon a two-dimensional five-point Likert scale that combine to produce an overall judgement of process performance against each process in the VSM epistemology as a specific interval number. The first dimension ranks the practitioner's self-evaluation of process performance on the scale Very poor performance, Poor performance, Neutral performance, Good performance, to Very good performance. The second dimension ranks the practitioner's self-evaluation of their confidence in measuring process performance on the scale Very low uncertainty, Minor uncertainty, Moderate uncertainty, High uncertainty, to Very high uncertainty. This two-dimensional scale is shown in Fig. 4 as both the Italian Flag and the corresponding interval number. The scoring schema presents the practitioner with 25 choices for the self-assessment of performance for each of the processes in the model. Before finalising their respective assessments, the practitioners cross-briefed each other on their scores and supporting rationale to ensure the common application of these criteria.

The University of Bristol has developed software (PeriMeta) that enables the drawing of HPMs and the assignment of an interval number to describe the performance of each process in the model. The PeriMeta software provides various means for combining interval numbers 'upwards' in the HPM according to various propagation algorithms as described in (Marashi et al., 2008). For the assessments presented in the next section the leaf node scores were aggregated up the hierarchies using the Juniper algorithm in the PeriMeta software with necessity and sufficiency values set to 0.3 and 0.4 respectively and assuming no dependency between nodes Marashi et al. (2008). These assumptions and values are based on heuristics developed from the development of HPM as a PSM (Davis et al., 2010; Marashi, 2006; Marashi et al., 2008). Whilst these propagated values give an overall assessment of 'coverage' of the VSM epistemology they are not essential for the replication of this work by practitioners without access to the PeriMeta software.

We conclude this description of our methodology by stressing that the value of the approach is not in achieving absolute consistency of self-evaluation between practitioners nor of absolute determination of overall performance, although the latter can be achieved simply by use of the PeriMeta software. However, if consistency of self-evaluation is important then it would not be too difficult to achieve by providing more detail in the model shown in Fig. 2. The elegance of the use of HPM and the containment

relationship for sub-processes is that models can be extended by answering the 'how?' question for each sub-process in the model. This can be carried out by the practitioner in as much detail as is required.

4. Reflecting on practice: case studies

In this section, we detail the applications of VSM in three distinct settings and reflect upon how each application satisfies the VSM epistemology defined in the previous section through the use of a scored HPM. Each case study is drawn from published reports on VSM engagements by the authors and therefore have already been accepted as 'valid' use of the VSM – case study 1 (Lowe et al., 2016), case study 2 (Espinosa and Walker, 2013), and case study 3 (Espinosa et al., 2015). Evaluation of the cases has been made using the three sequential phases of enquiry set out in the definition of our VSM process epistemology shown in Table 2. Complete details of the scoring of the individual process elements for each case is given in Appendix A. Notable performance of process elements is called-out in each sub-section.

4.1. Case study 1 – Ministry of Defence

In 2014 the United Kingdom Ministry of Defence (MOD) decided to introduce a strategic business partner within the Defence Infrastructure Organisation (DIO) to act as the senior management team and inject knowledge and expertise developed in the private sector. The DIO is the part of the MOD that is responsible for building, maintaining and servicing the infrastructure needed to support the UK's Armed Forces and MOD as a whole. It enables MOD personnel – military and civilian – to live, work, train and deploy both in the UK and overseas. As part of the preparations for this introduction, staff at the Defence Science and Technology Laboratory (Dstl) were tasked to identify the strengths, weaknesses and uncertainties associated with the operation of the DIO in the context of the wider MOD Enterprise, together with candidate actions for intervention. Whilst the task was initially focussed on the DIO, the scope was expanded through boundary critique to include the elements of MOD Head Office that provide governance for the operation of the DIO ('Governor' role) and the Armed Forces (and other elements of MOD such as Defence Equipment and Support) that provide in-

frastructure requirements for the DIO to deliver against ('Customer' role). This broader scope of enquiry was referred to as the Infrastructure Delivery System and established the organisational identity (as per #1 in the performative epistemology).

The Dstl staff designed and implemented a structured approach to assessment, cognisant of the need to repeat this assessment over time to track progress. The structure was developed through the application of an adapted VSM at two different levels to recursively examine the Infrastructure Delivery System in the wider organisational context of the Defence Enterprise (as per #2 in the performative epistemology). This adaptation was driven by a difficulty that participants encountered in discriminating between Beer's S3, S3* and S2. They regarded these functions as largely indistinguishable within the role of management, and given an opportunity to respond to stakeholder feedback (and so strengthen the participative nature of the work), the Dstl staff elected not to persist beyond the first meeting in trying to untangle these functions and instead collapsed them into a single layer. The result was an adapted VSM focused on four key functions (with associated sub-functions): Strategic Leadership (Beer's S5); Strategy Formulation (Beer's S4); Operational Management (Beer's S3, S3* and S2) and Operational Delivery (Beer's S1). The assessments using this structure were undertaken via two workshops, one focussing on the Infrastructure Delivery System and the other focussing on the operational management of the enterprise (of which the infrastructure delivery systems is but one part).

In each workshop, the relevant sub-systems and the key interactions between them were assessed (as per #3 - #14 in the performative epistemology) by stepping through the structure outlined above and detailed in Lowe et al. (2016). The workshop participants were those stakeholders identified as having responsibility for and/or experience of key system elements, as well as those representing the Infrastructure customer base, principally the UK's Armed Services. It was important to ensure that the participants were both expert and representative of all sides (i.e. DIO, Governors and Customers). The role of the Dstl staff was then to act as a facilitation team to ensure that a balanced assessment was arrived at and that it was supported by objective evidence wherever possible (the open questions that were used to guide the facilitation have been detailed separately – see Appendix A of Lowe et al. (2016)). Throughout the workshops, participants collectively identified the strengths, unknowns or weaknesses from their personal perspectives and, after group discussion, each scored the relative weight of these on a scale and provide explanatory comments on individual assessment sheets. The scores and comments for each function and sub-function were subsequently collated and an 'Italian Flag' was drawn using the median values calculated from the individual scores. At the end of each workshop participants were asked to collectively identify their top priorities for action to either improve performance (and so minimize red assessments) or to reduce uncertainty (minimize white assessments).

The Italian Flag summaries, supported by evidence statements, together with the recommended actions were subsequently briefed to the Senior Customer who had not participated in either workshop. He readily accepted the findings and used them to define a major change programme. Stakeholder feedback confirmed the impact of the approach. For example: "*The Dstl work made a real difference in the success of the Defence Infrastructure System Programme definition stage. In particular it enabled us to arrive at an agreed maturity model much more quickly than would otherwise have been the case as many of the key stakeholders had already been through the thought process that led them to understand the functions within the system. In addition, your work with them around the Italian Flag assessment resulted in a common understanding of system weaknesses. This enabled us to reach a rapid and robust consensus as to the cur-*

rent state of the Infrastructure System and priorities for corrective action."

Fig. 5 displays our reflection on how this method compares to the VSM epistemology in a HPM format with the associated aggregations. It can be seen that whilst there is good coverage of the VSM epistemology (green) there are some shortfalls (red) where the scope of enquiry could and should be widened to yield better coverage. It can also be seen that there is a large degree of uncertainty (white) and in particular with regard to 'Identifying & assessing the five sub-systems' and 'Identifying & assessing the interactions within the system-in-focus'. This is due to the evidence gathered via the workshop being subjective in nature (stakeholder expert opinions) with only limited triangulation possible within the time available. Despite these shortcomings in coverage and depth, the bespoke method developed for this context can be seen to be representative of VSM practice.

4.2. Case study 2 – Ecovillage

The Ecovillage (EV) is a community developed in Ireland, intended to demonstrate that it is possible to build and live in a fully sustainable way, and operating in a non-hierarchical, self-organised and still effective way. From the beginning, the EV members decided to self-organise inspired in cooperatives' principles as many of them came from a cooperative background. Each new member would subscribe to existing working groups, to contribute to the project's development. Nevertheless, they were experiencing the tyranny of structureless, in a time in which the Irish economy was struggling, and they had pressures to progressing towards a more effective way of self-organisation, to complete the project's development. This is why during 2007–2010 Espinosa and Walker (2013) came as academic consultants leading a VSM project to support self-organisation while increasing organisational cohesion and performance. The General Assembly, in effect the democratic management body of the Ecovillage, approved their approach to organisational self-transformation as a learning process to agree on the key organisational tasks, rand the required roles and interactions to implement them effectively. During the first year the academic consultants visited regularly the EV and facilitated VSM workshops to go through all the stages of the Self Transformation methodology. Each of the workshops were facilitated by the consultants with the aim to reach agreement upon core structural and process changes required; and how they should be implemented. A Process Group with four community members facilitated implementation of the core agreed changes in continuous interactions with the consultants. After the first few years, all the stages of the 'Self Transformation Methodology' had been completed, an important amount of group learning about their organisation has been reported, and several changes and innovations had been implemented improving the community organisation. Espinosa and Walker (2013) provide a detailed report of the methodology used, the results achieved, and the impact of the intervention. Here we discuss the way the VSM methodology used resembles our suggested epistemology.

The first phase of enquiry was covered in the first workshop, when the consultants facilitated an agreement between the participants about the EV's identity. This was relatively straightforward, as the EV members had already discussed the EV identity extensively and there were not many apparent disagreements on it (this is represented in Box 1, by a compact green line). The second part of the workshop a more extensive discussion took place to agree on the operational activities (Systems 1) as distinct to meta-systemic activities. The members recognised their primary tasks (e.g. building individual houses, developing the infrastructure), were underpopulated by volunteers, while many other members were spending too much time and energy on less relevant ac-
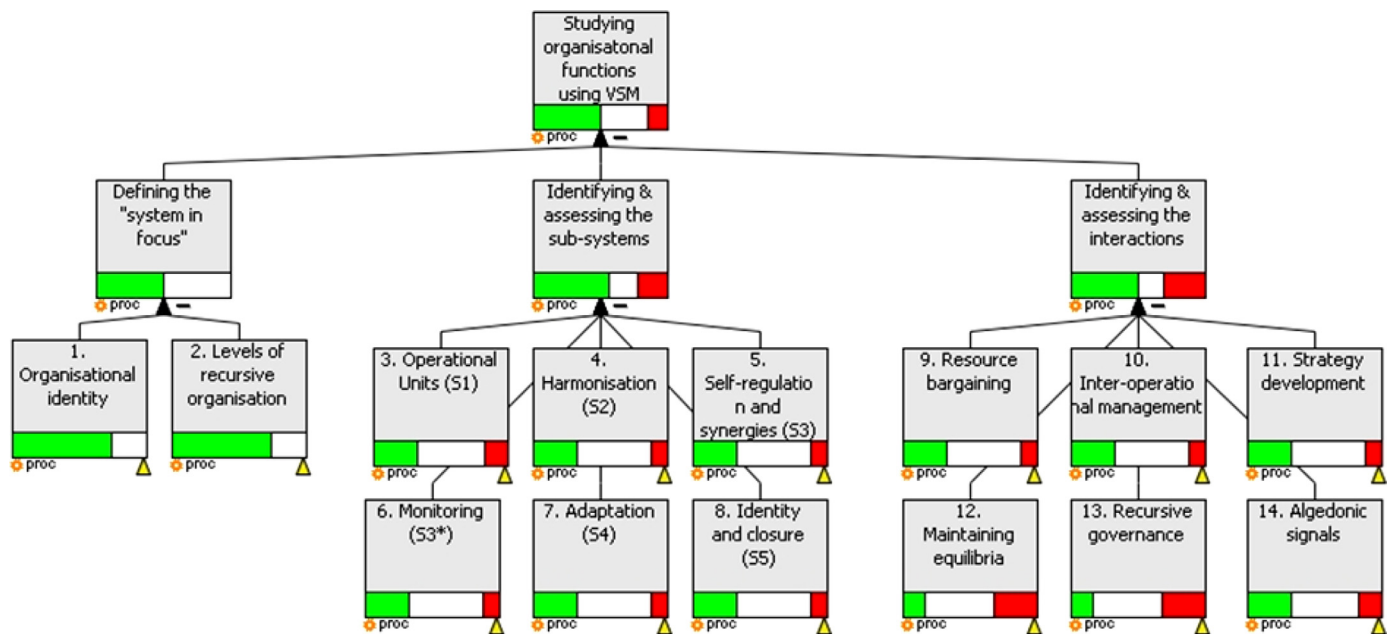
Fig. 5. Reflection on method developed for the MOD context.
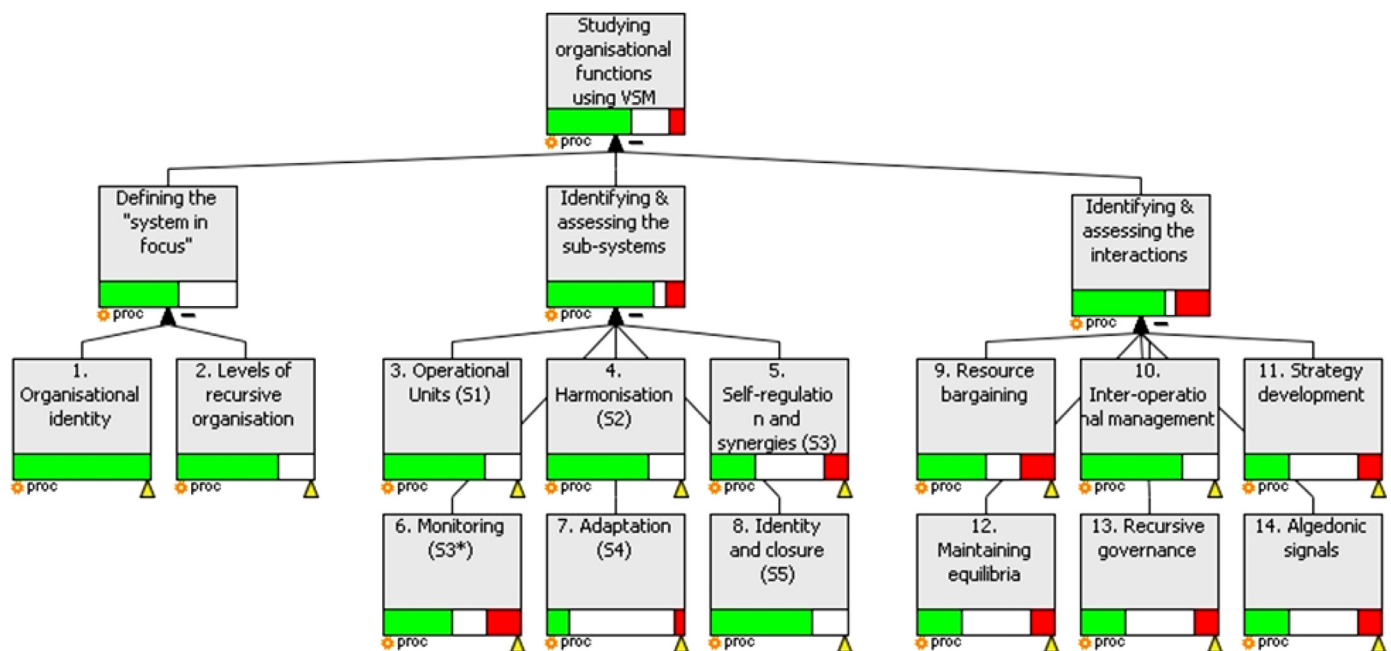

Fig. 6. Reflection on method developed for the EV context.

tivities. They reorganised their working teams to cover up System 1 tasks and to re-balancing participation on meta-systemic roles, which once implemented begun to show very positive effects on their capability to self-govern – see Fig. 6, Process 2 showing predominantly high coverage, with low uncertainty.

The second stage of enquiry happened over the next two workshops, when they reflected about their recurrent interactions between S1s and their meta-systemic roles and processes (S2 to S5). They identified and resolved S2 shortages e.g. lack of coordination and recurrent conflicts amongst members – see Fig. 6, Processes 3 and 4, showing mostly good coverage with little uncertainty. They agreed the need to redesign the S3 role, and appointed a manager who took this role following VSM criteria – see Processes 5 and 6 showing a good level of coverage with minor uncertainty.

The members also reflected on their interactions about strategy and policy. They reckoned the Board of Directors were overdoing their role and micro-managing and re-designed these roles accordingly, which had positive results – see Fig. 6, Process 8 showing very good coverage and little uncertainty. Only by the end of the second year the members questioned their adaptation capabilities and develop more robust S4 roles and mechanisms, which is reflected in Process 7 showing less coverage, and larger uncertainty.

In the third stage of enquiry, they made additional efforts to identify and address the S1 vs S3 interactions, but more could had been achieved regarding resource bargaining – see Process 9 showing good coverage but medium uncertainty. Inter operational management (S1/S3) and maintaining balance (S3/S4) was clearly addressed through the new 'Coordination Meetings' with represen-

tatives from all S1s, dealing with S3 and S4 issues in the design of the agendas – see the very good coverage and little uncertainty in Processes 10 and 12. Processes 11, 13 and 14 reveal that even if the interactions S3/S4, S3/S4/S5, and the management of algedonics were covered in this late stage of the methodology, there was a medium level of uncertainty as S4 remained underdeveloped, leaving several 'outside and then' issues still unresolved and not operating algedonic signals early enough.

Additional field research conducted by Cardoso evidenced that most people felt the changes had been positive. In the words of one of the members: *"I don't know to what extent this is due to the VSM but there seem to be a reduction in the number of difficult interpersonal relationship situations and improvement in our ability to resolve these. The eco-community seems to have become a more comfortable place"* (Espinosa, Cardoso, Arcaute, and Christensen, 2011).

As seen in Fig. 6 this VSM intervention yielded, in general, excellent coverage albeit with some shortcomings and uncertainties. However, despite these shortcomings, the methodology used can be seen to be highly representative of VSM practice.

4.3. Case study 3 – Latin American Corporation

Latin American Corporation (LAC)[8] is a large construction company in Colombia, focused on: office buildings; popular housing; roads and infrastructure; shopping centres, and jails. In 2013 LAC decided to progress their recently agreed strategy to expand operations to a few other countries in Latin American market. They hired a team of experts from Los Andes University School of Management to facilitate the alignment of their organisational structure with this strategy. The team, led by two senior consultants, with support from two then doctoral students started the project by doing a preliminary survey about strengths and limitations of the current structure, amongst a large number of workers (the company had around 5000 workers, of which around 1000 were permanent and the rest were sub-contracted for specific building projects). The team decided to design the project using the VSM, given the client's desire to follow a systemic approach to strategy implementation, and the proven strength of the VSM to support structural changes.

Based on preliminary survey findings and following VSM theory, the consulting team developed a structured survey and semi-structured interviews. For the survey they sent 300 questionnaires to people from different roles, from the different regions and countries where LAC was operating. The consulting team received more than 200 responses, which they used to conduct an in depth VSM diagnosis. They complemented the survey responses with more than 40 semi-structured interviews with a representative from each type of role from the different regions and project types. This allowed the team to identify the improvements to the current organisation most necessary to get it ready for expansion as planned.

To facilitate LAC's learning process about their required structural changes, the consulting team created an Executive Committee and a Technical Committee which organised and participated in the VSM workshops facilitated by the consulting team. Details of the process, methodology, results and impact have been provided in Espinosa et al. (2015). There follows a reflection on how this VSM methodology resembles our suggested epistemology.

The first stage of enquiry started by secondary research into the company policy, strategy and current structure, and the design and delivery of interviews and a survey. The consultants suggested a draft definition of identity and a draft unfolding of complexity, to start up the discussions hold at the first workshop; it included more than forty participants representing all the regional and in-

ternational branches, all types of projects, and key meta-systemic roles. While there wasn't much doubts on the agreed identity, deciding on a useful way of representing existing levels of organisation was far more challenging and demanded lots of (very fruitful) debate - see Fig. 7 expressing this as clearly high coverage with little uncertainty.

The second stage of enquiry successfully identified the main primary and meta-systemic roles and their patterns of interaction, using information from the surveys and the interviews, in an 'expert mode.' The resulting analysis of the interviews and surveys were 'decodified' into non VSM language and extensively discussed in the second day of the first workshop, to collectively decide on key changes identified for LAC. Fig. 7 illustrates this stage of enquiry as having a very good coverage and little uncertainty – even if more could had been done regarding S3*.

The technical team subsequently met regularly to identify possible action paths for adjusting current structures and to align them with their agreed strategy, developing in this way the third stage of enquiry. After a couple of months of debate and discussions with the directive team, a proposal for restructuring was agreed, that included designing and running a prototype of a redesigned process for a building project – their lowest recursive level of organisation. During the second workshop the participants worked in teams to generate agreements about the new structures, roles, processes and teams required to implement the strategy. Both workshops benefited from having established a good evidence-based data set from the team's preliminary analysis of surveys and interviews, and from the use of qualitative analysis software to collect and understand the data. It happened as a continued interaction between consultants and the Technical Committee, preparing a draft reorganisation proposal, including a prototype of the project's organisation, which addressed the main problems of interaction between roles. Participants in the second workshop discussed the prototype of the redesigned building process and agreed on additional changes to create a proper context for LAC's expansive strategy's implementation. Fig. 7, Processes 9, 10, 11 and 13 confirm this phase was properly covered and left little uncertainty. Retrospectively it looks as if more could had been done analysing the S3/S4 homeostat and emerging algedonic signals, as shown in the larger uncertainty on Processes 12 and 14.

The first workshop assessments showed a highly positive review from participants: more than 70% of them valued very positively their leaning about their structure and strategy alignment, felt highly committed to implement the agreed changes, and appreciated highly the opportunities for group agreements offered by the VSM methodology used. The second workshop also brought very positive results and more than 80% of participants expressed an even higher commitment to implementation of agreed changes.

In Fig. 7 we can confirm that this VSM intervention yielded high coverage with very few shortcomings and only minor or moderate uncertainty for an excellent overall process assessment. This reconfirms that the 'Self Transformation Methodology' (Espinosa and Walker, 2017) can be considered compatible with VSM theory.

4.4. Cross case learning

Whilst in all three cases the interventions can be seen to be representative of VSM practice, with strengths heavily outweighing the weaknesses and uncertainties, there is significant variation that is interesting to explore. We do this both from the perspective of the learning that each engagement can communicate into the community of VSM practice but also at the meta level of the roll that the performative epistemology plays (as expressed in the process models) in supporting the constitutive rules to achieve this methodological 'learning across'.

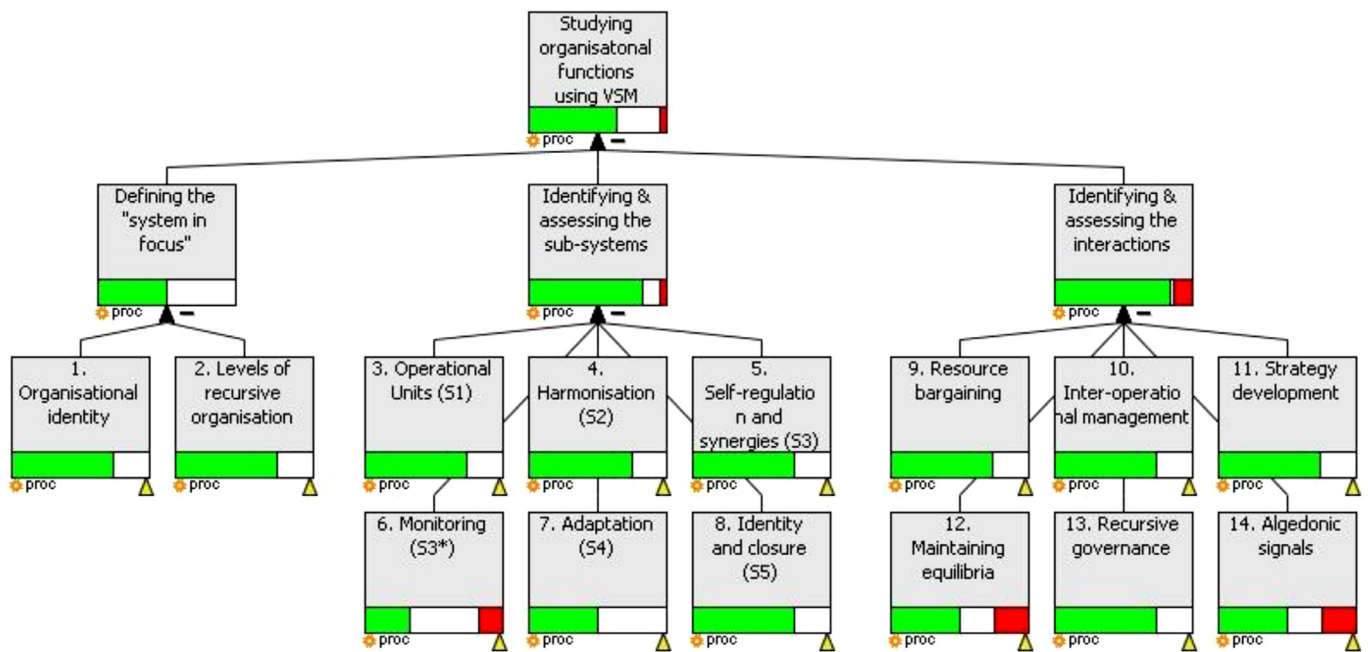[8] LAC is a pseudonym used to protect the company's identity.

Fig. 7. Reflection on method developed for the LAC context.

Setting aside defining the system in focus, which was done well in all cases, the degree to which the interventions identified and assessed the sub-systems and the interactions between them increase from MOD to EV to LAC. This variation may be attributable to the degree of participation in each case study, where the VSM approaches followed in the MOD and EV cases studies were adapted to incorporate participant feedback, the LAC approach had less participation (through only two workshops) so expert consultants had a freer role in design and implementation. While participation and adaptations are often critical to exploitation of such studying, they make the alignment with VSM distinctions and principles more challenging, as participants need to learn such distinctions to contribute to the analysis.

The degree to which the MOD case study aligns with VSM distinctions and principles is less than for the other two case studies. This correlates with the experience levels of the VSM consultants but could also be due to contextual constraints. For example, the MOD intervention was constrained by time which meant that the team was only afforded limited access to the stakeholder community and this is reflected in the universally higher uncertainty scores. This is in stark contrast to the EV intervention which took place over multiple years with very high levels of access and the LAC intervention which used organisation-wide surveys to bring stakeholder perspectives into workshops.

Overall, the identification and assessment of interactions between sub-systems was covered to a lesser degree than the identification and assessment of the sub-systems themselves. This is very common in VSM interventions and is reflected in the Italian Flag evaluations shown in all three cases, but in mitigation this is also true of some of the theoretical propositions focussed on the understanding of VSM theory in the identification of the key elements, rather than the interactions between them (e.g. (Schwaninger and Scheef, 2016)).

The assessments presented in Appendix A clearly demonstrate that the performative model of the VSM epistemology developed in Section 3 can be operationalised in an intuitive manner with a result that contributes to the practitioner reflecting on (their) practice. From a problem structuring perspective, those processes that were not performed well and/or with a high degree of un-

certainty provide the focus for the practitioners' methodological learning concerning use of the VSM. The assessment for the MOD case clearly reflects the original questioning reported by Lowe et al. (2016) about how far a VSM practitioner can 'deviate' in the use of the VSM for the intervention to be considered as a valid use of it. Here, we can turn the question around and regard the constitutive rules and the performative epistemology as being *generative* of the practitioners' behaviour. Therefore, the assessments for the LAC and EV case studies are also evidence that the constitutive rules and performative epistemology are generative of more 'conventional' use of the VSM in problem structuring practice and thus we can rule out the combination leading to absurd conclusions. The combination of the constitutive rules and performative epistemology for VSM practice thus is seen to fulfil the mechanism for 'learning across' that we see in our review. It also opens an interesting research path; to compare and contrast a wider range of VSM interventions using our suggested epistemology to generate deeper and more robust insights into practice grounded in the use of the VSM.

5. Discussion

Our original research questions were concerned with how the VSM is used in practice and how much adaptation is acceptable before the model being used to support interventions, in terms of organisational and process design, is no longer considered to be the VSM. These questions mirrored the existential concern of Checkland and Scholes for SSM. Since actual use of the VSM in practice suggests both a departure from its 'apparent' functionalist roots and deviations from its precise structure thus leading to questions about just how far it is possible to adapt the VSM before it either ceases to have meaning or, worse, is a dangerous departure leading the practitioner into uncharted territory. These are not new questions, they echo long-standing concerns about how the VSM is being used in practice. In his most recent writing on VSM philosophy and theory Jackson (2019, pp. 299–311) notes that he first commented on the "*battle for the 'soul of the VSM'*" (pp307) in (1992). In this earlier research note, Jackson states that the functionalist interpretation of how to use the VSM is "*sensi-*

bly rejected by sophisticated users of the model" and argues for accepting a structuralist, over interpretivist, understanding of its use. However, the emergence of pluralism and routine use of multi-methodology in the intervening years has led Jackson (2019) to his position that the functionalist core of the VSM model can be integrated into a generic interpretivist methodology, which has led to the approach we have taken in this paper.

However, despite this continued use of constitutive rules and their undoubted pedagogic benefit, little has been said about the generative property of constitutive rules and their effect on a community of practice 'grounded' in a specific intervention technique such as the VSM. Searle's original work on constitutive rules (Searle, 1995) and the example he provides of the emergence of constitutive (as opposed to regulative) rules for the game of chess (*ibid,* pp. 27–28), highlights the need for a more sophisticated appreciation of their value to analysis. Superficially, it would seem that a game is either a game of chess or it is not – i.e. a binary categorisation – and it is the constitutive rules that actually define the game 'chess'. However, many variants of the game of chess exist, and we see that a fundamental property of constitutive rules is to foster their continuous and ongoing interpretation i.e. the most important characteristic of constitutive rules is that they have *generative* properties. We would therefore expect the constitutive rules for the VSM to be similarly generative of a wide range of practice, which indeed is the fact established empirically by our extensive review and then examined in detail via the three case studies presented above. Thus, central to the idea of formulating constitutive rules for a VSM process is the filling of a gap in our knowledge between current practice and the existing literature about the VSM i.e. *codifying* the constitutive rules that have *generated* this variability in practice. Indeed, a key aspect of any PSM use is methodological learning (Yearworth and White, 2014, p. 939) and therefore conclude that these constitutive rules *must* exist, they are the primary cause of both the diversity of *moves* made by VSM practitioners and the enabler of 'learning across' behaviours.

Our research questions thus developed to embrace the idea of exploring how the VSM is actually being used in practice as a PSM, and with what variability, through the standardized analysis of three case studies. To do this, we adopted a performative stance and asked the question – what is it that a VSM practitioner is *doing* when they are using the VSM as a PSM? By developing constitutive rules and an explicit epistemology for the VSM we were able to express a *performative model*, expressed as an HPM that could be used in two different ways; either as a means of guiding the practice of the consultant ('designing') or supporting methodological learning or ('reflecting'). Using this specific performative interpretation of the VSM process offers a better context for the practitioner to more precisely judge their performance in assessing organisational diagnostic archetypes, as Beer and others suggested (Espinosa and Walker, 2017, pp. 485–492). Deficiency in one or more areas of the model – that is, evaluations of process performance that appeared predominately in the very poor performance to very high uncertainty sections of Fig. 4– would be an indication that some aspect of the VSM was not being used, or perhaps the absence was just due to the focus of the practitioner being placed elsewhere. If the performative model is treated as a device to help reflect on practice, then the practitioner would be able to decide for themselves whether this was a weakness, deliberate omission, or oversite. The model just flags up the need for attention. Again, we emphasise that a practitioner does not have to satisfy all 14 processes to be confident of having used the VSM as a PSM appropriately, just to be confident of having used it comprehensively. This affordance (i.e. being comprehensive) would be most relevant to a novice practitioner, because an expert practitioner would be more likely to home in on the problem area very quickly. This is

very much how Checkland viewed the use of the constitutive rules for SSM (Checkland, 1981, pp. 252–254).

The use of the performative model to evaluate three recent cases studies has demonstrated the model being used in this reflexive mode. It is clear from the scored HPMs that whilst the performance of the top-level process ⟨*Studying organisational functions using VSM distinctions and principles*⟩ is qualitatively similar in each case – mostly green, some white and some red, the variation that exists across case studies is a useful stimulus for methodological learning. We find that whilst the precise quantitative measures of overall performance that have been extracted are interesting, the real value comes from using the measures into the assessment of performance at the 14 'leaf nodes', especially where performance is either categorically highly uncertain or categorically poor. Whilst the top-level measures provide a figure of merit on overall performance of the consultant using the methodology it is the leaf node assessments that are the most important feature of the model when used reflexively.

The idea of using a process model with an explicit representation of process performance to construct a performative epistemology is apparently innovative in the field of Soft OR/PSMs and we can see no reason why it could not be applied to other specific epistemologies such as that developed for SSM by Checkland and Scholes. For example, one area of further work could be to translate the guide to cognitive mapping compiled by Ackermann and Eden (2011a, pp. 315–330), to support their SODA/JourneyMaking methodology, into a performative epistemology expressed as an HPM. Another area for further work is to explore the idea of categorical failure i.e. if *any* of the leaf-node processes have very poor coverage then that should lead to the overall assessment that the consultant's intervention has *not* been consistent with the VSM. The current model when implemented in software uses the Juniper algorithm with default values for necessity and sufficiency (Fletcher and Davis, 2003; Marashi, 2006; Marashi et al., 2008), however a more stringent test for validity can be obtained by using a necessity value approaching 1.0, which has the effect of strongly propagating poor performance through the model (Yearworth, Lowe, Schien, and Walworth, 2015).

Another finding from this work is the role that constitutive rules play in binding the VSM community of practice together and enabling it to learn across applications in disparate contexts. In addition to the benefits to VSM pedagogy seen from the case studies, we see that constitutive rules do not just generate the range of empirical examples of VSM work that we see reported but also define the *extent* or *boundary* of what might be considered as *legitimate* VSM consultancy. These constitutive rules are part and parcel of the creation of the *social ontology* of VSM practice (Searle, 2006). Until now, the role that constitutive rules have been playing in PSM practice generally has not been made explicit. Whilst Checkland (1981, pp. 252–254), Checkland and Scholes (1990, pp. 284–290), Jackson (2001; 2003, pp. 305–311; 2019, pp. 601–604), and Yearworth and White (2014) have all made explicit reference to their use this has mostly been concerned with pedagogic, existential and methodological concerns. Using Searle's lens of social ontology on a VSM community of practice leads us to return to our original research aims and look at the role of the constitutive rules in re-interpreting our original research question as "*what counts as VSM practice?*" The constitutive rules we have surfaced can thus be seen as the generative mechanism that leads to the performative actions undertaken by individual practitioners when engaged in the VSM consulting process, and by which actions the VSM community of practice knows and recognises itself. We believe that further codification of VSM practice would be a useful endeavour, both to improve our methodological understanding of what it is that VSM practitioners are doing when they are working

with clients, but also to set our understanding on more a rigorous observational basis.

Mutual recognition of what counts as something is central to a social ontology. Therefore, the constitutive rules described here help define what a client might expect from a consultant who claims to be delivering a 'VSM' engagement. This expectation would be formalised into a statement of the obligations, duties, requirements, rights etc. – which Searle (2006, p. 18) refers to as *deontic* powers – that would need to exist between the client and the consultant for the engagement to take place. A comprehensive review of these deontic powers in the social ontology of operational research consultancy in general has been provided by the Transformation Competence Perspective (TCP) (Ormerod, 2008).

We find that constitutive rules are generative of the variability in problem structuring practice and that the specificity of that practice being labelled as a VSM engagement is dependant on the degree with which the Italian Flag evidence in the HPM is confirmatory. The acceptable boundaries on variability (in problem structuring) and specificity (to the VSM) will in all likelihood emerge from the ongoing negotiation between the client and consultant concerning the nature of the engagement. The essence of our deontological argument, building on Searle (2006, p. 18), is grounded in a solid view of competence of the OR practitioner (Ormerod, 2008). However, we can also see that what we find out about in terms of 'what counts' to the client will eventually come down to practitioner's reflections on an engagement and what they choose to say about it in publication. From the client's perspective, they are unlikely to be concerned with the questions addressed in this paper and instead will be focussed on issues of trust and mutual agreement on the criteria for judging a 'successful' intervention (Tully, White, & Yearworth, 2018). Further, we can also see that both client and consultant would experience an 'holistic' VSM engagement without this manufactured separation between interpretivist constitutive rules and a VSM epistemology and their joining together as multimethodology. VSM practice is *inherently* a multimethodology. However, we have introduced this *analytical* separation between the problem structuring part and the VSM epistemology precisely because we needed to understand how the former's constitutive rules are generative of the *range* of engagement practice, whereas the epistemology is generative of the *degree* of VSM-ness. We therefore finally return to questions of pluralism, multimethodology, and the Soft OR project. We believe the conclusions from our work tell us that pluralism is important and that multimethodology is still the most practicable way of delivering interventions in complex systems. Mixing approaches is not just limited to the engagement itself but also in the process of methodological learning (Yearworth and White, 2014). In his treatment of VSM philosophy and theory Jackson (2019, pp. 299–311) refers specifically to the concept of the VSM as an hermeneutic enabler and notes that the recent methodological developments by Espejo and Reyes (2011) and Espinosa and Walker (2017) have "*sought to "soften" the way the approach is used as a means of easing the problems often associated with its implementation.*" We believe that Jackson (2019, p. 525) would regard this work as an example of 'enhanced OR', but we are comfortable with its positioning as Soft OR. We see the main contribution of this work as supporting practitioners by encouraging the wider and better use of the VSM in preparing organisations to maintain performance in uncertain futures.

6. Conclusions

This work has addressed a gap in the knowledge base about the constitutive rules that underpin VSM practice. It is these generative rules that account for the *variability* practice that we have observed empirically in our review and in the assessment of three case studies. The casting of an explicit epistemology for the VSM performatively as an HPM has provided a means for assessing the *specificity* of a particular intervention being considered as a VSM engagement – supported through the use of evidence as interval numbers and propagation of that evidence in the HPM. The combination of variability in problem structuring and specificity to the VSM afforded by the constitutive rules and the performative epistemology *in combination* provides insight into the social ontology of VSM practice and the boundaries of what should be considered acceptable practice from a competence perspective.

Acknowledgements

Appendix A

Defence infrastructure case study assessments

The assessments made for the Defence Infrastructure case study against the VSM epistemology (together with the associated supporting rationale) are displayed below in Table A1.

Table A1
Reflection and self-assessment on method developed for the Defence Infrastructure context

VSM Epistemology	Assessment		
1. Organisational Identity	🟩		
Excellent coverage (green) with minor uncertainty (white) The purpose of the organization was clearly established and set in the context of the wider enterprise. Stakeholder involvement was comprehensive but not exhaustive (workshop participant limited to key representatives only).			
2. Levels of Recursive Organisation	🟩		
Excellent coverage (green) with minor uncertainty (white) The sub-organisations responsible for delivering key VSM functions were identified and their contributions assessed in the workshop settings. The operation of the DIO was set in wider context of the MOD enterprise			
3. Operational Units (S1)	🟩		🟥
Good coverage (green) with minor shortfalls (red) and moderate uncertainty (white) The ability of the operational units to deal with the variety of their environments was assessed but the evidence gathered was subjective with only limited triangulation possible.			
4. Harmonisation (S2)	🟩		🟥
Good coverage (green) with minor shortfalls (red) and moderate uncertainty (white) The ability of the DIO to coordinate the operations of primary units so as to avoid conflict was assessed but the evidence gathered was subjective with only limited triangulation possible.			
5. Self-regulation and Synergies (S3)	🟩		🟥
Good coverage (green) with minor shortfalls (red) and moderate uncertainty (white) The ability of the DIO to support self-regulation of the operational units and to realise synergies between them in order to meet stakeholder needs was assessed but the evidence gathered was subjective with only limited triangulation possible.			
6. Monitoring (S3*)	🟩		🟥
Good coverage (green) with minor shortfalls (red) and moderate uncertainty (white) The ability of the DIO to monitor performance independently of management communication channels was assessed but the evidence gathered was subjective with only limited triangulation possible.			
7. Adaptation (S4)	🟩		🟥
Good coverage (green) with minor shortfalls (red) and moderate uncertainty (white) The ability of the DIO to understand its external environment and to identify the implications for its current and future operations was assessed but the evidence gathered was subjective with only limited triangulation possible.			
8. Identity and Closure (S5)	🟩		🟥
Good coverage (green) with minor shortfalls (red) and moderate uncertainty (white) The ability of the DIO to establish a clear identity and to produce policy that provides a consistent framework for its operation was assessed but the evidence gathered was subjective with only limited triangulation possible.			
9. Resource Bargaining (S3-S1)	🟩		🟥
Good coverage (green) with minor shortfalls (red) and moderate uncertainty (white) The ability of the DIO to allocate and balance resources in accordance with was assessed but the ability of operational units to negotiate these expected results was not. As before the evidence gathered was subjective with only limited triangulation possible.			
10. Inter-operational Management (S1-S2-S3)	🟩		🟥
Good coverage (green) with minor shortfalls (red) and moderate uncertainty (white) The ability of the DIO to leverage information systems in order to inform decision making was a major focus of the assessments but the interplay between S3 and S2 was not explicitly addressed (recall that Beer's			

Table A1 (*continued*)

S2, S3 and S3* were collapsed into a single layer). Also, as before the evidence gathered was subjective with only limited triangulation.			
11. Strategy Development Processes (S4-S3)	🟩		🟥
Good coverage (green) with minor shortfalls (red) and moderate uncertainty (white) The ability of the DIO to make strategy by combining both external and internal perspectives was assessed but the evidence gathered was subjective with only limited triangulation possible.			
12. Maintaining Dynamic Equilibria	🟩		🟥
Limited coverage (green) with major shortfalls (red) and moderate uncertainty (white) The ability of the DIO to balance 'inside and now' against 'outside and then' was only partially assessed. Also, as before the evidence gathered was subjective with only limited triangulation.			
13. Recursive Governance	🟩		🟥
Limited coverage (green) with major shortfalls (red) and moderate uncertainty (white) The autonomy afforded to sub organisations within the DIO was assessed but this was not a major focus of inquiry. Also, as before the evidence gathered was subjective with only limited triangulation.			
14. Algedonic Signals	🟩		🟥
Good coverage (green) with minor shortfalls (red) and moderate uncertainty (white) The ability of individuals and sub-organisations within the DIO to transmit alarm signals outside management communication channels and so trigger interventions was assessed but the evidence gathered was subjective with only limited triangulation possible.			

EcoVillage case study assessments

The assessments made for the Ecovillage (EV) case study against the VSM epistemology (together with the associated supporting rationale) are displayed below in Table A2.

Table A2
Reflection and self-assessment on method developed for the EV context

VSM Epistemology	Assessment
1. Organisational Identity	🟩
Excellent coverage (green) with very low uncertainty (white) The first stage of the first workshop was to decide on the organisational identity. As the EV had developed several workshops to agree on their vision and mission, this stage was done promptly and the identity statement later ratified at their General Assembly.	
2. Levels of recursive organisation	🟩
Excellent coverage (green) with minor uncertainty (white) The first workshop also resulted in agreements about the levels of organised primary activities of the EV. This produced a dramatic change as they agreed on their main primary activities – at that stage of development of the community, and shortly after reorganised themselves accordingly; this replaces the self-appointed way of belonging to teams they used to use before that has left many gaps in accountability for primary operational tasks requiring participants.	
3. Operational Units (S1)	🟩
Excellent coverage (green) with minor uncertainty (white) In the next workshops participants developed a first assessment of the operational shortages of the newly formed S1s, focusing on understanding the way each team dealt with environmental variety, have access to required resources, and exercise their autonomy for decision making. The core issues delimiting operational performance at each level of organisation were discussed and prioritised by each team's participant. Between the consulting workshops, operational managers and coordinators started to implement the suggested changes and to generate better spaces for collective decisions inside the teams.	
4. Harmonisation (S2)	🟩
Excellent coverage (green) with minor uncertainty (white) Even if the EV members shared a very strong sustainable ethos, translated into their eco-charter and that in itself created a less conflictive decision environment, they realised the many ways in which better information sharing, process standards and collective knowledge and information management could be improved and implemented most of the agreed changes over time.	
5. Self-regulation and Synergies (S3)	🟩⬜🟥
Good coverage (green) with minor shortfalls (red) and moderate uncertainty (white) A continuous difficulty faced by the community members was the lack of more effective S3, in particular, regarding accountability and resource negotiations. Over time they created the Coordination Meeting, which included a representative from each S3 meeting regularly to inform progress and request support to address ongoing difficulties or challenges. They also developed other S3 mechanisms for managing resources and responding to the Assembly on operational results. There were suggestions to develop a more effective performance management system, but it didn't get fully implemented.	
6. Monitoring (S3*)	🟩⬜🟥
Good coverage (green) with minor shortfalls (red) and minor uncertainty (white) During the workshops, we identified situations that were getting out of control and suggested monitoring mechanisms to generate early alarms to managers. Some of them were put into practice during the intervention.	
7. Adaptation (S4)	🟩⬜🟥
Good coverage (green) with minor shortfalls (red) and major uncertainty (white) One of the main agreements was on the need to develop the nearly non-existent S4 roles and mechanisms. By the end of the second year the consultants participated in a strategy workshop which helped to address their needs for innovation and further development. More formal S4 related roles were decided and implemented.	

Table A2 (*continued*)

8. Identity and Closure (S5)	🟩	

Excellent coverage (green) with minor uncertainty (white)

All the EV members shared a strong sustainability ethos which is at the heart of the community identity, their main S5 mechanisms, the Assembly (inc. all members) and the Board (elected by the members every two years) worked transparently and democratically. The VSM diagnosis identified as one core diagnostic point the Board micromanaging; and that was corrected over time.

9. Resource Bargaining (S3-S1)	🟩	🟥

Good coverage (green) with minor shortfalls (red) and minor uncertainty (white)

Existing resource bargaining needed improvements in general, as well as the accountability systems and processes. The process group leaded development of better structured, more agile and inclusive decision-making schemes. Some of them however were never fully implemented.

10. Inter-operational Management (S1-S2-S3)	🟩	

Excellent coverage (green) with minor uncertainty (white)

Most of the core identified weaknesses were about the decision making and information management support for the S1 S2 S3 inter-operational management.

11. Strategy Development Processes (S4-S3)	🟩	🟥

Good coverage (green) with minor shortfalls (red) and moderate uncertainty (white)

Evidence of lack of a strong S3-S4 process was assessed and solutions for a more inclusive and innovative decision process were agreed, including the creation of a Navigation Team (S4) and the adjustment of Coordination meetings, by including S3 and S4 issues in the agenda for each meeting.

12. Maintaining Dynamic Equilibria	🟩	🟥

Good coverage (green) with minor shortfalls (red) and moderate uncertainty (white)

The VSM project identified and supported changes in this homeostatic mechanism in particular in the relationships between the Coordination Group, the new Navigation Group, and the Board. However, the lack of development of proper S4 roles and mechanisms left this aspect not fully unattended during the first stages of the VSM intervention.

13. Recursive Governance	🟩	🟥

Good coverage (green) with minor shortfalls (red) and moderate uncertainty (white)

As the intervention was done during the ecovillage's development project, the emphasis was on the only existing level of recursive organisation. Nevertheless, after the 3rd year, new levels of organised complexity have emerged and we supported initial rethinking about the embedded levels of recursive organisation.

14. Algedonic Signals	🟩	🟥

Good coverage (green) with minor shortfalls (red) and moderate uncertainty (white)

During the workshops some examples of algedonic signals were discussed; over time a few mechanisms to identify them and deal with them were also discussed and implemented.

Latin american corporation case study assessments

The assessments made for the Latin American Corporation (LAC) case study against the VSM epistemology (together with the associated supporting rationale) are displayed below in Table A3.

Table A3
Reflection and self-assessment on method developed for the LAC context

VSM Epistemology	Assessment
1. Organisational Identity	🟩🟩⬜
Excellent coverage (green) with minor uncertainty (white) The first stage of the first workshop was to decide on the organisational identity. As LAC has recently agreed their espoused identity (including vision and mission) this stage was done very effectively without major disagreements among representatives of all the stakeholders.	
2. Levels of Recursive Organisation	🟩🟩⬜
Excellent coverage (green) with minor uncertainty (white) Several sessions on the first workshop focused on collective agreements about the levels of recursive organisation. Facilitated by the VSM team, small groups discussed first, the levels of recursive organisation and agreed on a way of mapping them. Once agreed the recursive mapping, small teams discussed the diagnostic points per operational units; and prioritised them (using an Italian flag's colour code). Very intense discussions and considerations about the different mappings took place. A final mapping integrating the most useful suggestions was then agreed and used as the basis for later analyses.	
3. Operational Units (S1)	🟩🟩⬜
Excellent coverage (green) with minor uncertainty (white) An in-depth assessment of main challenges and dilemmas faced by S1s, at each level of organisation was the focus of the afternoon session on the 1st day of the 1st. Workshop. Previous cybernetic analysis of S1, using the collected data, was focused on understanding: variety management of S1; availability of resources and skills to do their tasks; levels of autonomy for decision making. The core issues delimiting operational performance at each level of organisation were discussed and prioritised by each team's participant.	
4. Harmonisation (S2)	🟩🟩⬜
Excellent coverage (green) with minor uncertainty (white) As many problems found at LAC happened through lack of autonomy at the operational level, there was a generalised feeling that more could be done on issues as coordinating agendas and criteria between for example, design and building teams, sales and building teams, purchasing and building teams. In depth discussions happened in both workshops around the identified issues and possible solutions or required changes.	
5. Self-regulation and Synergies (S3)	🟩🟩⬜
Excellent coverage (green) with minor uncertainty (white) In depth discussions around ways to improve current interactions between the managerial teams and the operational management teams was conducted. Some of the suggested solutions required of more in-depth organisational changes (e.g. clarification of relationships and communication mechanisms between building an investment sectors of the businesses) which were commanded for further study to a team of volunteers, sometimes including the VSM consultants.	
6. Monitoring (S3*)	🟩⬜🟥
Good coverage (green) with minor shortfalls (red) and moderate uncertainty (white) Monitoring mechanisms and practices were assessed in the survey and interview and were discussed in the workshop. Some solutions and proposals to improve existing mechanisms and practice were agreed.	
7. Adaptation (S4)	🟩⬜
Excellent coverage (green) with moderate uncertainty (white) One of the main agreements was on the need to improve S4 roles and mechanisms, in particular the Innovation and Creativity roles. Very precise and detailed recommendations for the development of new innovation and corporate education roles were agreed through the workshops and further elaborated afterwards.	
8. Identity and Closure (S5)	🟩🟩⬜

Table A3 (*continued*)

Excellent coverage (green) with minor uncertainty (white) As a family business the owners had created a very strong identity and ethos, which was embedded in most of the workers. The study found LAC very effective in creating policy and ethos. Even if they still felt they could improve their ability to pick up algedonic signals.	
9. Resource Bargaining (S3-S1)	🟩
Excellent coverage (green) with minor uncertainty (white) Existing resource bargaining works well in general, but the managerial variety at lower levels of recursion is constrained by the involvement of the owners in most decisions. A more agile, frequent and decentralised resource bargaining scheme was discussed and possibilities for implementation assessed.	
10. Inter-operational Management (S1-S2-S3)	🟩
Excellent coverage (green) with minor uncertainty (white) Both the interviews and survey provided extensive and clear data on existing issues with inter-operational management. During the workshops such issues were prioritised by participants and solutions were jointly explored and decided upon. The prototype for a building project was designed to improve importantly the relationships between Systems 1, 2 3 and 3*	
11. Strategy Development Processes (S4-S3)	🟩
Excellent coverage (green) with minor uncertainty (white) Evidence of lack of clear S4 roles and weak S3-S4 processes was assessed in the initial stages; participants and consultants had long discussions aimed at designing more appropriate S4 roles and re-orienting the S3/S4 decision making spaces to achieve a more balanced strategy and innovation development processes.	
12. Maintaining Dynamic Equilibria	🟩🟥
Good coverage (green) with minor shortfalls (red) and minor uncertainty (white) The study produced strong evidence to suggest the need to improve homeostasis in the S3/S4/S5 in particular at the level of project; there were also some suggestions to improve the balance in this homeostats at the regional and national levels, which were originally accepted by the participants.	
13. Recursive Governance	🟩
Excellent coverage (green) with minor uncertainty (white) In depth analysis on operational autonomy supported the discussions at the workshops. Strong agreements were achieved after the second workshop when deciding on experimenting with a few initial prototypes of the more autonomous and hopefully effective building team process designed for the lowest levels of recursive organisation.	
14. Algedonic Signals	🟩🟥
Good coverage (green) with minor shortfalls (red) and minor uncertainty (white) During the data analysis and the workshops some examples of algedonic signals were identified and mechanisms to address them were also suggested.	

D. Lowe, A. Espinosa and M. Yearworth / European Journal of Operational Research 287 (2020) 1014–1035

References

Achterbergh, J., & Vriens, D. (2002). Managing Viable Knowledge. *Syst Res Behav Sci, 19*(3), 223–241. doi:10.1002/sres.440.

Ackermann, F. (2012). Problem structuring methods 'in the Dock': arguing the case for Soft OR. *Eur J Oper Res, 219*(3), 652–658. doi:10.1016/j.ejor.2011.11.014.

Ackermann, F., & Eden, C. (2011a). *Making strategy: Mapping out strategic success* (2nd ed.). London: SAGE.

Ackermann, F., & Eden, C. (2011b). Negotiation in Strategy Making Teams: group Support Systems and the Process of Cognitive Change. *Group Decision and Negotiation, 20*(3), 293–314. doi:10.1007/s10726-008-9133-y.

Ackermann, F., Franco, L. A., Rouwette, E., & White, L. (2014). Problem structuring research and practice for the next decade: looking back to go forward. *EURO Journal on Decision Processes, 2*(3–4), 165–172. doi:10.1007/s40070-014-0037-6.

Ashby, W. R. (1958). Requisite variety and its implications for the control of complex systems. *Cybernetica, 1*(2), 83–99.

Batista, L., Davis-Poynter, S., Ng, I., & Maull, R. (2017). Servitization through outcome-based contract – A systems perspective from the defence industry. *International Journal of Production Economics, 192*, 133–143. doi:10.1016/j.ijpe.2016.12.005.

Beer, S. (1975). *Platform for change*. Chichester: Wiley.

Beer, S. (1979). *The heart of enterprise*. Chichester: Wiley.

Beer, S. (1981). *Brain of the firm* (2nd ed.). Chichester: Wiley.

Beer, S. (1984). The viable system model - its provenance, development, methodology and pathology. *Journal of the Operational Research Society, 35*(1), 7–25.

Beer, S. (1985). *Diagnosing the system*. Chichester: Wiley.

Beer, S. (1994). *Beyond dispute: The invention of team syntegrity*. Chichester: Wiley.

Bennett, N., & Lemoine, G. J. (2014). What VUCA really means for you. *Harvard Business Review* (JAN-FEB). https://hbr.org/2014/01/what-vuca-really-means-for-you.

Bititci, U. S., Carrie, A. S., & McDevitt, L. (1997). Integrated performance measurement systems: a development guide. *International Journal of Operations and Production Management, 17*(5), 522–534. doi:10.1108/01443579710167230.

Brocklesby, J. (2012). Using the Viable Systems Model to examine multi-agency arrangements for combatting transnational organised crime. *Journal of the Operational Research Society, 63*(3), 418–430. doi:10.1057/jors.2011.43.

Burrell, G., & Morgan, G. (1979). *Sociological paradigms and organisational analysis: Elements of the sociology of corporate life*. Ashgate.

Checkland, P. (1981). *Systems thinking, systems practice*. Chichester: Wiley.

Checkland, P., & Scholes, J. (1990). *Soft systems methodology in action*. Chichester: Wiley.

Christopher, W. F. (2007). *Holistic management: Managing what matters for company success*. Hoboken, N.J.: Wiley; Chichester: John Wiley [distributor].

Davis, J., MacDonald, A., & White, L. (2010). Problem-structuring methods and project management: an example of stakeholder involvement using Hierarchical Process Modelling methodology. *Journal of the Operational Research Society, 61*(6), 893–904. doi:10.1057/jors.2010.12.

Davis, J. P., & Hall, J. W. (2003). A software-supported process for assembling evidence and handling uncertainty in decision-making. *Decis Support Syst, 35*(3), 415–433. doi:10.1016/s0167-9236(02)00117-3.

Eden, C. (1995). On evaluating the performance of 'wide-band' GDSS's. *Eur J Oper Res, 81*(2), 302–311. doi:10.1016/0377-2217(93)E0241-O.

Edson, M., & Klein, L. (2016). Problem Structuring and Research Design in Systemic Inquiry. In M. Edson, P. Buckle Henning, & S. Sankaran (Eds.), *A Guide to Systems Research: Philosophy, Process and Practice* (pp. 59–80) Eds. Singapore: Springer.

Espejo, R., Bowling, D., & Hoverstadt, P. (1999). The viable system model and the Viplan software. *Kybernetes, 28*(6–7), 661–678. doi:10.1108/03684929910282944.

Espejo, R., & Reyes, A. (2011). *Organizational Systems: Managing Complexity with the Viable System Model*. Heidelberg: Springer.

Espinosa, A., Cardoso, P. P., Arcaute, E., & Christensen, K. (2011). Complexity approaches to self-organisation: a case study from an Irish eco-village. *Kybernetes, 40*(3), 536–558. doi:10.1108/03684921111133737.

Espinosa, A., & Duque, C. (2018). Complexity management and multi-scale governance: a case study in an Amazonian indigenous association. *Eur J Oper Res, 268*(3), 1006–1020. doi:10.1016/j.ejor.2017.07.049.

Espinosa, A., Harnden, R., & Walker, J. (2008). A complexity approach to sustainability – Stafford Beer revisited. *Eur J Oper Res, 187*(2), 636–651. doi:10.1016/j.ejor.2007.03.023.

Espinosa, A., & Porter, T. (2011). Sustainability, complexity and learning: insights from complex systems approaches. *Learning Organization, 18*(1), 54–72. doi:10.1108/09696471111096000.

Espinosa, A., Reficco, E., Martínez, A., & Guzmán, D. (2015). A methodology for supporting strategy implementation based on the VSM: a case study in a Latin-American multi-national. *Eur J Oper Res, 240*(1), 202–212. doi:10.1016/j.ejor.2014.06.014.

Espinosa, A., & Walker, J. (2013). Complexity management in practice: a Viable System Model intervention in an Irish eco-community. *Eur J Oper Res, 225*(1), 118–129. doi:10.1016/j.ejor.2012.09.015.

Espinosa, A., & Walker, J. (2017). *A Complexity Approach to Sustainability: Theory and Application*. London: World Scientific Press.

Fletcher, A., & Davis, J. (2003). Dialectical evidence assembly for discovery. In G. Grieser, Y. Tanaka, & A. Yamamoto (Eds.), *Proceedings of the 6th International Conference on Discovery Science (DS 2003)* (LNCS 2843, pp. 100–113) Eds.. Sapporo, Japan: Springer.

Flood, R. L., & Jackson, M. C. (1991). *Creative problem solving: Total systems intervention*. John Wiley and Sons.

Franco, A. (2013). Rethinking Soft OR interventions: models as boundary objects. *Eur J Oper Res, 231*(3), 720–733. doi:10.1016/j.ejor.2013.06.033.

Franco, L. A., & Montibeller, G. (2010). Facilitated modelling in operational research. *Eur J Oper Res, 205*(3), 489–500. doi:10.1016/j.ejor.2009.09.030.

Garfinkel, H. (1996). Ethnomethodology's Program. *Soc Psychol Q, 59*(1), 5–21. doi:10.2307/2787116.

Hall, J. W., Blockley, D. I., & Davis, J. P. (1998). Uncertain inference using interval probability theory. *International Journal of Approximate Reasoning, 19*(3–4), 247–264. doi:10.1016/S0888-613X(98)10010-5.

Hart, D., & Paucar-Caceres, A. (2017). A utilisation focussed and viable systems approach for evaluating technology supported learning. *Eur J Oper Res, 259*(2), 626–641. doi:10.1016/j.ejor.2016.10.056.

Harwood, S. A. (2012). The management of change and the Viplan Methodology in practice. *Journal of the Operational Research Society, 63*(6), 748–761. doi:10.1057/jors.2011.73.

Harwood, S. A. (2018). In search of a (WEF) nexus approach. *Environmental Science and Policy, 83*, 79–85. doi:10.1016/j.envsci.2018.01.020.

Harwood, S. A. (2019). A question of interpretation: the Viable System Model (VSM). *Eur J Oper Res, 274*, 1198–1201. doi:10.1016/j.ejor.2018.10.054.

Howick, S., & Ackermann, F. (2011). Mixing OR methods in practice: past, present and future directions. *Eur J Oper Res, 215*(3), 503–511. doi:10.1016/j.ejor.2011.03.013.

Jackson, M. C. (1988). An appreciation of stafford beer's 'viable system' viewpoint on managerial practice. *Journal of Management Studies, 25*(6), 557–573. doi:10.1111/j.1467-6486.1988.tb00047.x.

Jackson, M. C. (1992). The soul of the viable system model. *Systems Practice, 5*(5), 561–564. doi:10.1007/BF01140507.

Jackson, M. C. (1993). The System of Systems Methodologies - A Guide to Researchers. *Journal of the Operational Research Society, 44*(2), 208–209. doi:10.1057/jors.1993.42.

Jackson, M. C. (2001). Critical systems thinking and practice. *Eur J Oper Res, 128*(2), 233–244. doi:10.1016/s0377-2217(00)00067-9.

Jackson, M. C. (2003). *Systems thinking: Creative holism for managers*. Chichester: John Wiley.

Jackson, M. C. (2006). Beyond problem structuring methods: reinventing the future of OR/MS. *Journal of the Operational Research Society, 57*(7), 868–878. doi:10.1057/palgrave.2602093.

Jackson, M. C. (2019). *Critical Systems Thinking and the Management of Complexity*. Chichester: Wiley-Blackwell.

Jackson, M. C., & Keys, P. (1984). Towards a System of Systems Methodologies. *Journal of the Operational Research Society, 35*(6), 473–486. doi:10.1057/jors.1984.101.

Lane, D. C. (1994). With a Little Help from Our Friends - How System Dynamics and Soft OR Can Learn from Each Other. *Syst Dyn Rev, 10*(2–3), 101–134.

Leydesdorff, L., & Nerghes, A. (2017). Co-word maps and topic modeling: a comparison using small and medium-sized corpora (N < 1,000). *J Assoc Inf Sci Technol, 68*(4), 1024–1035. doi:10.1002/asi.23740.

Lowe, D., Martingale, L., & Yearworth, M. (2016). Guiding interventions in a multi-organisational context: combining the Viable System Model and Hierarchical Process Modelling for use as a Problem Structuring Method. *Journal of the Operational Research Society, 67*(12), 1481–1495. doi:10.1057/jors.2016.6.

Marashi, E., & Davis, J. P. (2006). An argumentation-based method for managing complex issues in design of infrastructural systems. *Reliability Engineering & System Safety, 91*(12), 1535–1545. doi:10.1016/j.ress.2006.01.013.

Marashi, S. E. (2006). *Managing Discourse and Uncertainty for Decision-making in Civil and Infrastructure Engineering Systems*. University of Bristol (PhD).

Marashi, S. E., Davis, J. P., & Hall, J. W. (2008). Combination methods and conflict handling in evidential theories. *International Journal of Uncertainty Fuzziness and Knowledge-Based Systems, 16*(3), 337–369. doi:10.1142/s0218488508005315.

Maturana, H. R. (1975). The organization of the living: a theory of the living organization. *Int J Man Mach Stud, 7*(3), 313–332. doi:10.1016/S0020-7373(75)80015-0.

McCulloch, W. S. (1965). *Embodiments of mind*. Camb.: MIT Press.

Mingers, J. (2000). Variety is the spice of life: combining soft and hard OR/MS methods. *International Transactions in Operational Research, 7*(6), 673–691. doi:10.1111/j.1475-3995.2000.tb00224.x.

Mingers, J. (2001). Multimethodology- Mixing and Matching Methods. In J. Rosenhead, & J. Mingers (Eds.), *Rational Analysis for Problematic World Revisited*. Chichester: Wiley.

Mingers, J. (2003). A classification of the philosophical assumptions of management science methods. *Journal of the Operational Research Society, 54*(6), 559–570. doi:10.1057/palgrave.jors.2601436.

Mingers, J., & Brocklesby, J. (1997). Multimethodology: towards a framework for mixing methodologies. *Omega-International Journal of Management Science, 25*(5), 489–509. doi:10.1016/s0305-0483(97)00018-2.

Mingers, J., & Gill, A. (1997). *Multimethodology: The theory and practice of integrating management science methodologies*. Chichester: John Wiley & Sons.

Naughton, J. (1977). *The Checkland Methodology: A Reader's Guide*. Milton Keynes: Open University.

Ormerod, R., & Pidd, M. (2006). The OR/MS contribution to strategy development and policy-making. *Journal of the Operational Research Society, 57*(1), 117–120. doi:10.1057/palgrave.jors.2602063.

Ormerod, R. J. (2008). The transformation competence perspective. *Journal of the Operational Research Society, 59*(11), 1435–1448. doi:10.1057/palgrave.jors.2602482.

Ormerod, R. J. (2014). The mangle of OR practice: towards more informative case

studies of 'technical' projects. *Journal of the Operational Research Society, 65*(8), 1245–1260. doi:10.1057/jors.2013.78.

Pickering, A. (1993). The mangle of practice - agency and emergence in the sociology of science. *American Journal of Sociology, 99*(3), 559–589. doi:10.1086/230316.

Pickering, A. (1995). *The mangle of practice: Time, agency, and science.* ChicagoLondon: University of Chicago Press.

Pollack, J. (2009). Multimethodology in series and parallel: strategic planning using hard and soft OR. *Journal of the Operational Research Society, 60*(2), 156–167. doi:10.1057/palgrave.jors.2602538.

Preece, G., Shaw, D., & Hayashi, H. (2013). Using the Viable System Model (VSM) to structure information processing complexity in disaster response. *Eur J Oper Res, 224*(1), 209–218. doi:10.1016/j.ejor.2012.06.032.

Preece, G., Shaw, D., & Hayashi, H. (2015). Application of the Viable System Model to analyse communications structures: a case study of disaster response in Japan. *Eur J Oper Res, 243*(1), 312–322. doi:10.1016/j.ejor.2014.11.026.

Rittel, H. W. J., & Webber, M. M. (1973). Dilemmas in a general theory of planning. *Policy Sci, 4*(2), 155–169. doi:10.1007/BF01405730.

Robey, D., & Markus, M. L. (1998). Beyond Rigor and Relevance: producing Consumable Research about Information Systems. *Information Resources Management Journal, 11*(1), 7–16. doi:10.4018/irmj.1998010101.

Schwaninger, M. (1990). Embodiments of organizational fitness: the Viable System Model (VSM) as a guide. *Systems Practice, 3*(3), 249–264. doi:10.1007/BF01062731.

Schwaninger, M. (2006). *Intelligent organizations: Powerful models for systemic management.* Berlin; London: Springer.

Schwaninger, M., & Pérez Ríos, J. (2008). System dynamics and cybernetics: a synergetic pair. *Syst Dyn Rev, 24*(2), 145–174. doi:10.1002/sdr.400.

Schwaninger, M., & Scheef, C. (2016). A Test of the Viable System Model: theoretical Claim vs. Empirical Evidence. *Cybern Syst, 47*(7), 544–569. doi:10.1080/01969722.2016.1209375.

Searle, J. R. (1995). *The construction of social reality.* London: Allen Lane.

Searle, J. R. (2006). Social ontology: some basic principles. *Anthropological Theory, 6*(1), 12–29. doi:10.1177/1463499606061731.

Smith, C. M., & Shaw, D. (2019). The characteristics of problem structuring methods: a literature review. *Eur J Oper Res, 274*(2), 403–416. doi:10.1016/j.ejor.2018.05.003.

Tavella, E., & Papadopoulos, T. (2015). Expert and novice facilitated modelling: a case of a Viable System Model workshop in a local food network. *Journal of the Operational Research Society, 66*(2), 247–264. doi:10.1057/jors.2013.187.

Tavella, E., & Papadopoulos, T. (2017). Applying OR to problem situations within community organisations: a case in a Danish non-profit, member-driven food cooperative. *Eur J Oper Res, 258*(2), 726–742. doi:10.1016/j.ejor.2016.08.065.

Tully, P., White, L., & Yearworth, M. (2019). The Value Paradox of Problem Structuring Methods. *Systems Research and Behavioral Science, 36*(4), 424–444. doi:10.1002/sres.2557.

Ulrich, W. (1981). A critique of pure cybernetic reason: the Chilean experience with cybernetics. *Journal of Applied Systems Analysis, 8*(1), 33–59.

White, L., & Taket, A. (1996). The end of theory? *Omega-International Journal of Management Science, 24*(1), 47–56. doi:10.1016/0305-0483(95)00048-8.

White, L., Yearworth, M., & Burger, K. (2015). Understanding PSM interventions through sense-making and the mangle of practice lens, *15th International Conference on Group Decision and Negotiation (GDN 2015). Vol. 218. Lecture Notes in Business Information Processing* (Vol. 218, pp. 13–27). Warsaw, Poland: Springer. doi:10.1007/978-3-319-19515-5_2.

Yearworth, M., Lowe, D. A., Schien, D., & Walworth, T. (2015). From deciding to acting: Hierarchical process modelling for problem structuring. In *Paper presented at the Calculating and Communicating Uncertainty (CCU2015).*

Yearworth, M., & White, L. (2014). The non-codified use of problem structuring methods and the need for a generic constitutive definition. *Eur J Oper Res, 237*(3), 932–945. doi:10.1016/j.ejor.2014.02.015.

Yolles, M. (2001). Viable boundary critique. *Journal of the Operational Research Society, 52*(1), 35–47. doi:10.1057/palgrave.jors.2600069.