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Integrated sustainability management for organizations

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Abstract

Purpose – The purpose of this paper is to propose the Viable System Model (VSM) as an effective model to base the analysis of organizational sustainability (long-term viability). It is specifically proposed as a model to integrate the various sustainability tools, and as the basis for designing a unified Sustainability Management System.

Design/methodology/approach – The VSM is used as an organizational model to examine three prominent sustainability standards: ISO 26000, ISO 14001 and ISO 14044. A generic manufacturing company is used as a template; and its typical business processes are related to each of the VSM's components. Each clause of the three sustainability standards is then mapped on to the VSM model. These three models are integrated into one, by analysing the differences, similarities and complementarities in the context of each VSM component, and by identifying common invariant functions.

Findings – In all, 12 generic sustainability functions are identified. ISO 26000 has the widest scope; ISO 14001 is focused primarily on internal measurement and control (System 3), while ISO 14044 is a complex performance indicator at the System 3 level. There is a general absence of System 2. Each standard can be regarded as a distinct management layer, which needs to be integrated with the Business Management layer.

Research limitations/implications – Further research is needed to explore the specifics of integration.

Practical implications – This integration should not be based on creating distinct roles for each management layer.

Originality/value – The paper uses the insights of organizational cybernetics to examine prominent sustainability standards and advance sustainability management at the business level.

Keywords Governance, Sustainability, Environmental management, Cybernetics, Viable systems

Paper type Research paper

1. Introduction

In recent years, the emphasis on sustainable development is increasingly placed on the individual organization or company, as an important and necessary actor of change towards sustainability. In the current free market paradigm, corporations are indeed capable of significant impacts, on environmental, social and financial systems, often at a global scale. Following the Rio Conference (United Nations, 1997) and even before that (Asif *et al.*, 2013) several efforts were made to help organizations become more

sustainable, both at a theoretical and practical level. Concepts such as Corporate Sustainability (CS) or Corporate Social Responsibility (CSR), have been adopted by businesses worldwide (Montiel, 2008), and practices, such as Environmental Management (EM) and CS or CSR reporting are widely implemented.

The relevant literature however, suggests that a significant gap has been identified in the implementation of sustainability into every level of the organization so as to become part of its daily operations and management. Further, a multitude of approaches, theories, definitions, concepts and tools (Waage *et al.*, 2005) has created a confusing landscape for organizations wishing to implement more sustainable practices.

We consider that in order to deal effectively with these challenges, we need to consider these issues in the context of an appropriate model of an organization, capable of representing the key issues implicit in sustainability standards and related management functions. We have suggested elsewhere our own interpretation of Beer's Viable System Model (VSM), as a comprehensive way of modelling organizations to deal effectively with the complexity involved with sustainability issues (Espinosa and Walker, 2011).

In this paper we propose this interpretation of the VSM that explains sustainability as long-term viability – as a framework to respond to the aforementioned challenges. Three prominent sustainability standards, ISO 26000, ISO 14001 and ISO 14044 are analysed using the VSM, in order to establish its interpretive value as a common framework to study different tools.

2. Integrating sustainability
Ranängen and Zobel (2014) provide a comprehensive review of the literature on the efforts to integrate CSR in the everyday management of an organization. A common root for this integration is the Plan-Do-Check-Act (PDCA) cycle, which is the base of most Management Systems (MSs). A number of integration frameworks expand the scope of one of these MSs to cover more sustainability aspects, while others attempt to integrate multiple MSs into one Integrated Management System or Sustainability Management System (Maas and Reniers, 2014; Ranängen and Zobel, 2014).

Finnveden and Moberg (2005) use three classification attributes for environmental assessment tools: the types of impacts considered; the object of study; and whether the tools are analytical or procedural. Hacking and Guthrie (2008) attempt to provide a basis for comparing the different sustainability assessment techniques, by identifying the main features underlying. They employ three main properties for characterizing the assessment features: comprehensiveness, integratedness, and strategicness.

The above frameworks provide good understanding on how the various methods are differentiated; however, they do not provide an operational model that could help in their synergetic application. Working towards this direction, Robèrt (2000) introduced the Framework for Strategic Sustainable Development (FSSD), further elaborated by Robèrt *et al.* (2002), that attempts to operationally integrate the various sustainable development models and tools. Waage *et al.* (2005) and later Waage (2007) further elaborated on the FSSD by incorporating more tools, criteria and actions on the models framework, and by focusing on their impact on the product design process.

Closer to the logic of this paper is the analysis of sustainability tools or initiatives by Lozano (2012), which is based on how they relate: to the company system, and to the sustainability dimensions. For the company system, Lozano uses Porter's (1985) approach that distinguishes between primary activities (core competencies) and secondary (support) activities, which is similar to the VSM distinction of operational and meta-systemic management components within an organization. His analysis

concludes that most initiatives focus on the Operations and Processes, as well as the Management and Strategy elements of the organization, while most initiatives address the environment dimension of sustainability.

3. The organizational scenario

In order to illustrate the logic of VSM to facilitate the subsequent analysis of sustainability standards, the example of the hypothetical company "Widget Co." is used (Figure 1). Widget Co. is a manufacturer of widgets, a fictitious industrial product used by consumers. The model can easily be adapted for service providers, and other types of organizations.

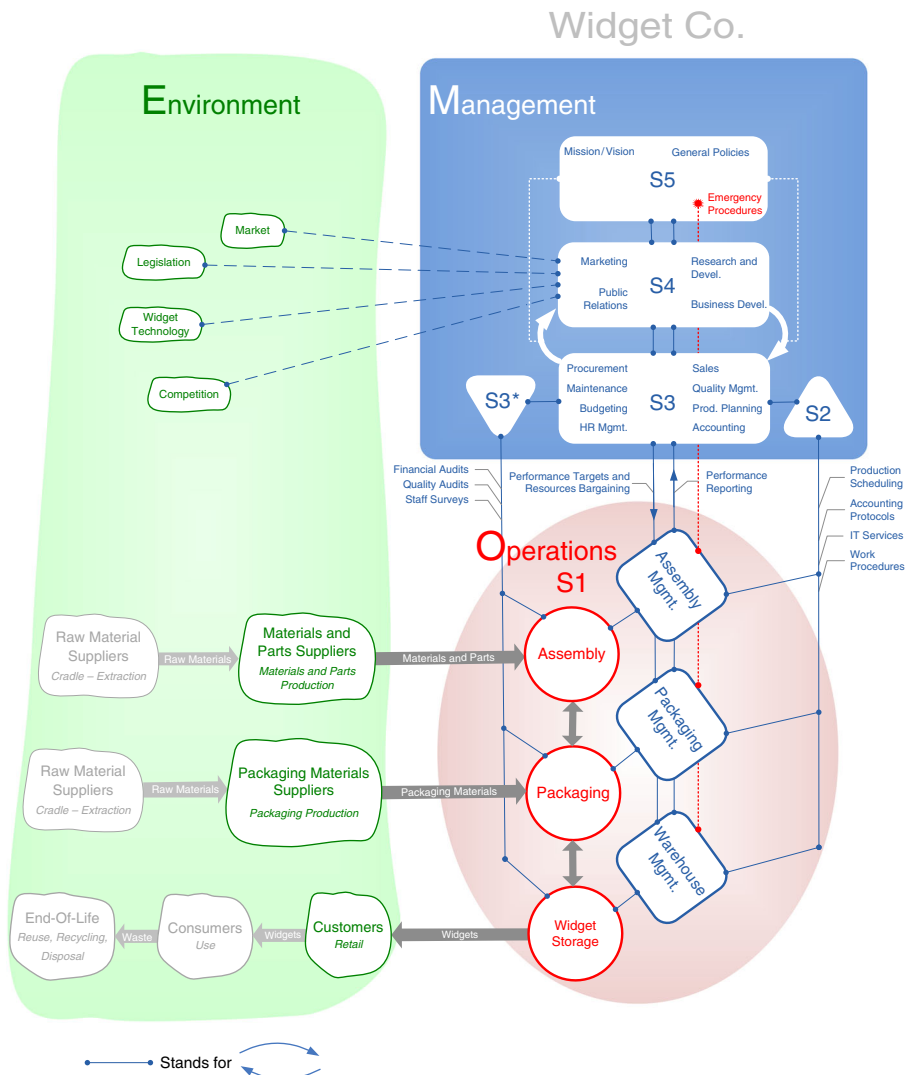The Organizational Scenario is explained in more detail in Appendix 1.

Figure 1.
The VSM of the hypothetical Widget Co.

4. VSM interpretation of sustainability standards

4.1 Interpretation method

The VSM interpretation method is based on a qualitative analysis of the standards'
clauses and sub-clauses, which involved three steps:

(1) qualitative assessment of the clause content[1];

(2) identification of closely related VSM elements; and

(3) description of relationship between the clause and the VSM elements.

Two types of relationships are described in the analysis:

(1) Responsibility: when a VSM element is mainly responsible for implementing the
activities described in a clause. For example, System 4 is responsible for the
activities in ISO 26000 clause *5-Recognising SR and engaging stakeholders*.

(2) Contribution: when a VSM element is contributing to the implementation of the
activities described in a clause. For example, System 2 is contributing to the
activities described in ISO 26000 clause *7.7.2 Monitoring activities on SR*.

The results of the VSM analysis for each standard are presented in four forms:

(1) a *VSM Relationship Table* showing the aforementioned type of relationships
(shown in Appendix 2);

(2) a *VSM Mapping Diagram* showing how each clause maps onto the VSM
structure;

(3) a *Variety Mapping Diagram* showing the flow of varieties among the various
VSM elements specific to the new systems implemented as a direct result of the
particular standard; and

(4) a *detailed description* of how the standard is integrated within an organization,
with references to related clauses (clause numbers in parentheses and italics).

ISO 26000 is interpreted in the next section, followed by ISO 14001 and ISO 14044.

4.2 ISO 26000

According to ISO 26000 standard on Social Responsibility (SR), the objective of SR is
to contribute to sustainable development (ISO, 2010). The standard provides guidance on
underlying principles, core subjects and issues pertaining to SR and on ways to integrate
socially responsible behaviour into the organization. Moreover, ISO 26000 uses its
framework of core subjects and integration practices in order to classify 40 cross-sectoral
and 35 sectoral voluntary SR initiatives and tools.

The VSM and variety mappings of ISO 26000 are shown in Figures 2 and 3, respectively.

The figures intend to graphically show the degree of complexity that an
organization faces when implementing ISO 26000 in VSM language. Figure 2 (as well as
Table AII, Appendix 2) indicates that the majority of ISO 26000 clauses relate to
Systems 4 and 5, as well as its Environment. This implies that the standard puts more
emphasis on the strategic transformation of an organization, through the realization of
SR issues and the developing of appropriate policies and adaptation strategies.

Figure 3, however, provides an alternative and complementary view: it shows the
variety channels between the various systems of an organization, and the degree of
complexity these system need to manage, when applying ISO 26000. First of all, System
1 (operations) has to manage new SR variety originating both from their niches, as well
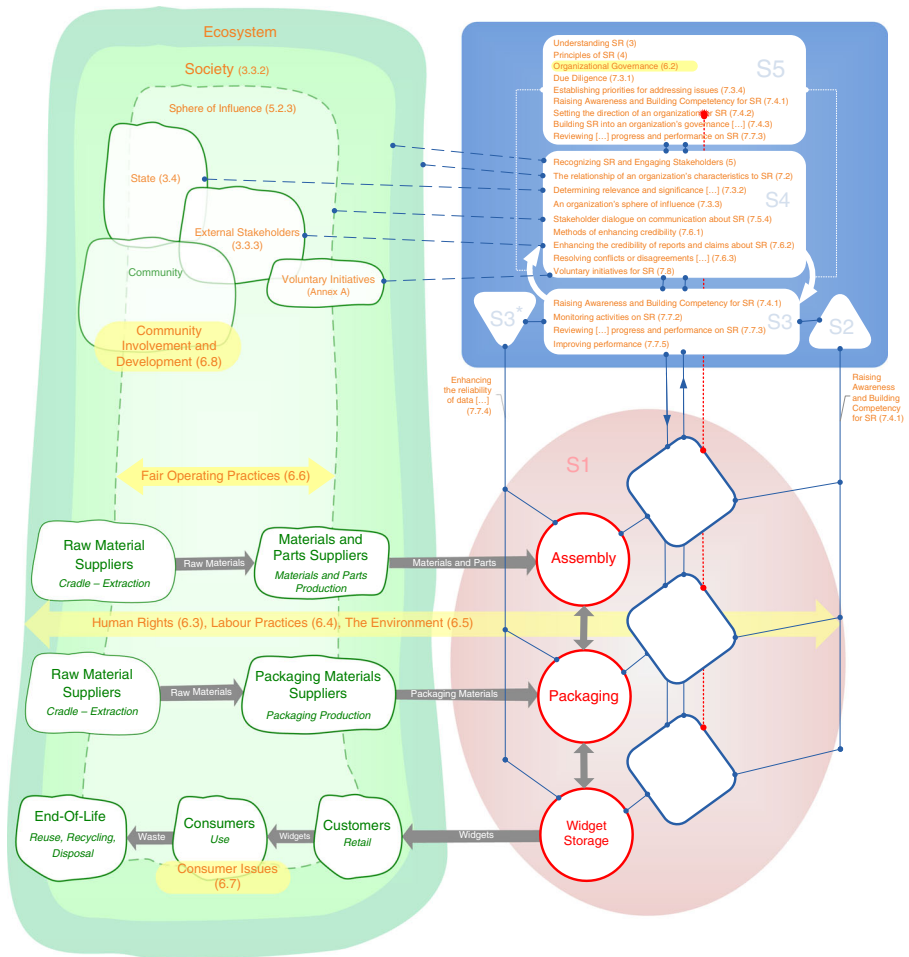
Figure 2.
VSM mapping
diagram of
ISO 26000

Notes: Orange elements represent the standard's clauses; yellow elements represent the SR core subjects; contributing elements are not shown for simplicity

as internally, which needs to be continuously handled by Systems 2, 3* and in particular System 3. System 4 is mainly burdened from new SR variety originating in the Environment, e.g. in identifying the organization's SR issues and engaging with Stakeholders, as well as variety relating to the organization's SR performance communicated by System 3. Variety is gradually filtered, so that System 5 only receives the information it needs to effectively fulfil its role. The above represent an ideal case, where all systems operate effectively and variety is balanced throughout the organization. These are explained in detail in the following sections.

4.2.1 System 5. Similar to viability, the sustainability, or SR, of an organization is ultimately determined by the activities of System 5. It provides the general direction or purpose of the whole organization (*7.4.2*) by determining its mission and vision. Therefore, System 5 should first of all understand the basic concepts of SR (*3*), and
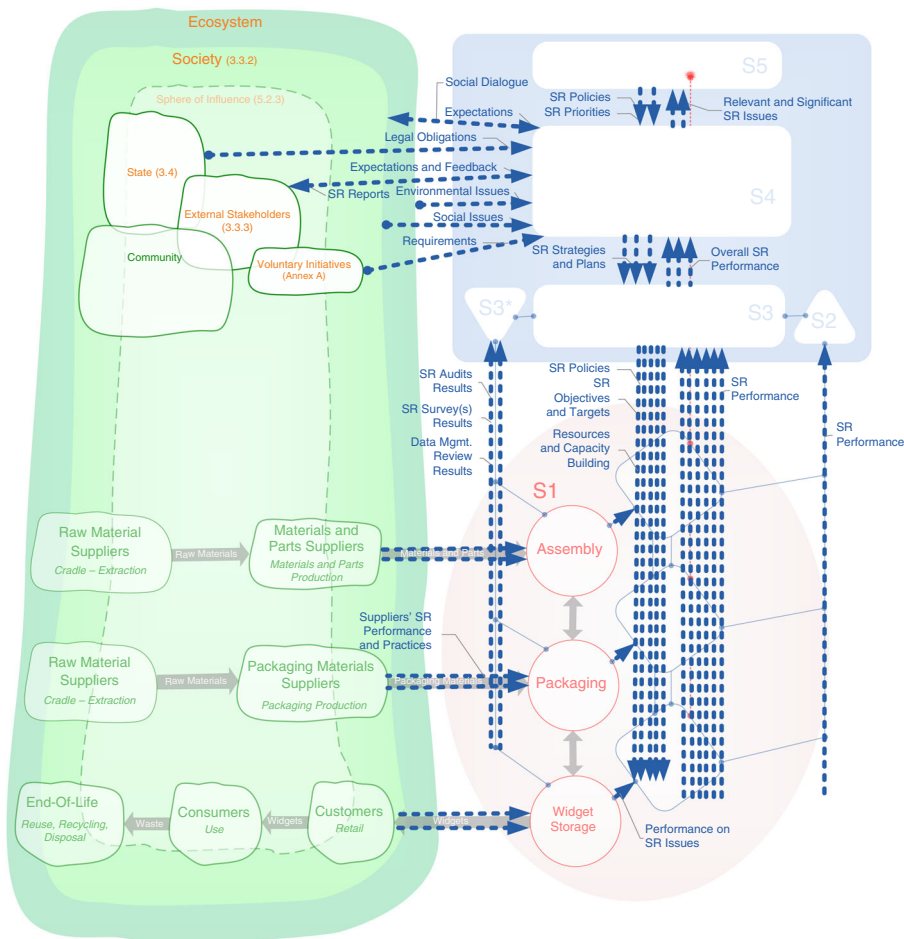
Note: The number of arrows indicates the variety flowing in each information channel

Figure 3.
Variety mapping
diagram of
ISO 26000

examine how they affect its purpose. In particular, it is important to gradually align the organization's purpose with the overarching objective of SR which is to contribute to Sustainable Development (ISO, 2010). Moreover, System 5 determines the ethos and values of the organization. ISO 26000 provides guidance on Seven Principles of SR (4) that should be followed as a minimum by every organization, as well as more specific SR principles (6) that could be incorporated in the policies of System 5. The Organizational Governance core subject (6.2), in particular, is the main responsibility of System 5, since it is about incorporating SR principles into decision making and implementation (7.4.3).

Finally, System 5 is responsible for promoting and integrating SR within the organization, by means of raising awareness on related issues (7.4.1). A high degree of commitment at the top of the organization, through serious adoption and implementation of SR principles and policies, sets an example for the whole organization. All of the above activities of System 5 should ideally build up a culture that encourages SR practices throughout the organization.

4.2.2 System 4. In the case of SR, System 4 needs to recognize how the organization relates to its external environment, and what are the SR impacts, interests and expectations (*6, 7.2*). In other words, System 4 needs to build a model of the external environment in relation to SR (Panagiotakopoulos, 2005). Building on the general concepts (*3*) and principles (*4*) of SR, this model needs to be relevant to the organization's particular operational context and include those issues (*6*) that are considered by the organization as significant (*7.3.2*). Three overlapping concepts are useful in setting the boundaries of System's 4 model:

(1) the organization's stakeholders (*5.3.2*);

(2) the organization's sphere of influence (*5.2.3, 7.3.3*); and

(3) the life-cycle (*6.5*) of the organization's products or services.

The practice of recognizing SR is essentially a process of widening the traditional model boundaries of System 4, across all of the above concepts, to consider more elements, issues and impacts, effectively increasing the variety it receives from its Environment (see Figure 3). The System 4 model of SR should also consider the organization's internal environment. This information can be compiled and provided by System 3, which holds an overall view of operations. The results of sustainability tools, such as Life Cycle Assessment (LCA) presented in § 4.4, are particularly useful here.

Having built the SR model, System 4 needs to identify the significant issues that need to be addressed by the organization (*7.3.2*), with the help of Systems 3 and 5. Specific SR strategies and programmes are then developed by System 4 with the aid of System 3 (*7.7.5*), for those issues identified as significant and according to their priority.

Apart from identifying the organization's stakeholders, System 4 needs to enter into a dialogue and build relationships, (*7.5.4*). These relationships will provide the organization with valuable information and alternative viewpoints on the dynamic and complex issues of SR and thus increase the variety of its SR model. In order for this relationship to be meaningful, the organization will have to be transparent (*4.3*) and provide information regarding its own SR issues. A common practice is the production of a sustainability or SR report (*7.6.2*). System 4 has to guarantee the credibility of such practices, by following established tools and guidance (*7.8*), such as the G4 Sustainability Reporting Guidelines (GRI, 2013) and examining the trustworthiness of certification schemes. Finally, System 4 should have in place mechanisms to resolve potential disagreements or conflicts with its stakeholders (*7.6.3*).

4.2.3 System 3. One of System's 3 responsibilities is to ensure that Operations follow SR policies (*7.4.3, 7.3.1*). This involves making them more specific to the operational context of each System 1, by providing specialized SR procedures, rules and directions. This may also involve integration of SR policies to System 3's own processes, such as HR management and procurement, which are responsible for managing different aspects of Operations, and providing the respective resources. A particular form of resource is the provision of training that will build the capacity of Operations to manage demanding SR issues (*7.4.1*).

System 3 is also responsible for analysing the SR plans and strategies of System 4 and deciding more specific operational plans, objectives and targets with each System 1 (*7.4.2*). It needs to encourage performance and self-regulation of Operations

(*7.7.2*, e.g. using such instruments as incentives and rewards for SR results), through performance indicators appropriate for each SR issue, along three different channels (see Figure 3):

(1) Central Channel: on a regular basis via performance reviews and reports by Systems 1 (*7.7.3*);

(2) System 3*: sporadically, via internal or external SR audits and surveys (*7.7.4*); and

(3) System 2: on a regular basis via IT or similar coordinating systems (e.g. Enterprise Resource Planning – ERP, databases, etc.).

This information allows System 3 to continuously negotiate with Systems 1 issues of sustainability performance, and intervene in Operations to modify their SR implementation plans only if it is affecting the viability of the whole organization. Beer suggests that monitoring of performance on the Central, as well as on the System 2 channel, should be as close to real-time as possible (Beer, 1979) (high varieties in Figure 3).

Finally, System 3 compiles and processes the performance information and forwards it to System 4. This information should not be too detailed, but rather provide a high-level view of Operations that will allow System 4 to update its SR model.

4.2.4 System 2. In terms of SR, System 2 involves practices that deal with resolving conflicts of interest that emerge in the implementation of SR policies and programmes. This includes negotiation processes among System 1 that make sure no operational unit will be in a disadvantaged position. System 2 also ensures the consistent management of SR issues across Operations. This may involve the adoption of specific data collection and measurement protocols, operating procedures, as well as other forms of standardization. Information Technology (IT) applications are particularly useful in this respect, as specialized software tools are now available that help organizations collect SR data in a consistent manner (Jamous *et al.*, 2012), which is an otherwise challenging task for organizations with a large number of dispersed operational units.

There is an important informal bottom-up aspect that can be identified as a System 2 function. Operations, and in particular employees, develop their own work ethic and culture, in parallel, or irrespective of organizational rules and edicts. In other words, they develop their own shared understanding or awareness on specific issues, allowing them to self-organize and find solutions to common problems. It is a common practice that organizations start their SR transformation journey, by identifying individuals that are aware and active in certain SR issues and empowering them to bring about change (*7.4.1*) (Taylor *et al.*, 2012).

As Beer (1985) notes, it is also useful to think about the work environment that will foster a certain kind of culture, such as one for SR, for example through posters, announcements, etc. Several SR programmes focus on creating these kinds of environments to raise awareness and drive engagement on specific SR issues. Again, IT can be very useful in creating an SR culture, for example through relevant employee forums, social media (Reilly and Weirup, 2012) or even gamification (Stevens, 2013).

4.2.5 System 1 – recursion. In terms of SR, the Recursive System Theorem (Beer, 1979) implies that each operational unit should develop similar SR functions to those analysed in the paragraphs above at the lower level of recursion (*7.4.3*). The focus of these functions should be adapted to the particular lower-level context and purpose of the operational unit.

4.2.6 SR issue management. Three of the ISO 26000 SR core subjects, namely Human Rights (*6.3*), Labour Practices (*6.4*) and Environment (*6.5*) relate to operations and

respective local environments (see Figure 2 and respective varieties in Figure 3). The remaining three core subjects, namely Fair Operating Practices (*6.6*), Consumer Issues (*6.7*) and Community Involvement and Development (*6.8*), are related to specific elements of the organization's environment mainly affecting System 4 (see Figure 3), while Organizational Governance (*6.2*) is related to the whole organization and in particular System 5.

ISO 26000 provides general principles and considerations for each core subject, and specific actions and expectations for the related SR issues (36 issues in total). Similar to the analysis of the previous paragraphs, the clauses of each issue could be interpreted with the same method by the VSM.

4.3 ISO 14001

ISO 14001 (ISO, 2004), is a standard that sets the requirements for an environmental management system (EMS), which should take into account legal requirements, and information about the organization's significant environmental impacts, in order to develop and implement an environmental policy and relevant objectives. The standard requires that the EMS continually improves, following the PDCA cycle. An organization's EMS can be certified as being in conformance with ISO 14001. The VSM interpretation of ISO 14001 is shown in Figures 4 and 5. In terms of ISO 26000, ISO 14001 focuses on the Environment SR core subject, providing specific management guidance.

Figure 4 (as well as Table AIII, Appendix 2) indicates that ISO 14001 puts more emphasis on Systems 3 and 4. Moreover, Figure 5 shows that the general variety pattern is similar to that of ISO 26000 (Figure 3), however, since ISO 14001 focuses only on Environmental issues, channels carry less variety (indicated by fewer arrows). On the other hand, ISO 14001 is more specific on the information carried by those channels, e.g. in the Legal Requirements relating to System 4 and the issues of environmental performance management relating to System 3, such as roles and responsibilities, resources and training, objectives and targets, operational criteria and corrective actions. The VSM offers complementary criteria to deepen into issues of measurement and tools for diagnosing and managing operational and managerial complexity.

The EMS starts at the System 5 level which is responsible to determine the organization's environmental policy (*4.2*). This policy should: comply with legal and other requirements, undertake pollution prevention, and demonstrate continual improvement. System 5 is also responsible for the high-level management review of the whole EMS (*4.6*), with the help of Systems 3 and 4. The outputs of these reviews are potential changes to the environmental policy, objectives and targets.

System 4 is focused on developing the environmental part of the SR model of the organization (4.2.2). This model should include environmental aspects (causes), related to Operations, and environmental impacts (effects) related to the environment (*4.3.1*). ISO 14001 places great emphasis on the legal and other requirements that should be continuously identified by System 4 (*4.3.2* and Figure 5). The outcome of this model is the development of environmental objectives, targets and programmes (*4.3.3*) that fulfil the environmental policy commitments, taking into account the related Best Available Technologies (*A 3.3*). Finally, System 4 is responsible to communicate the environmental performance of the organization to external stakeholders (see Figure 5).

ISO 14001 places great emphasis on System 3. First of all, it should assign resources, roles and responsibilities (4.4.1) relative to EM, and provide appropriate training (4.4.2), in order for employees to carry them effectively. Then, it should establish specific operational rules, procedures and criteria that ensure the proper implementation of the environmental policy, objectives and programmes (*4.4.6*), along with emergency
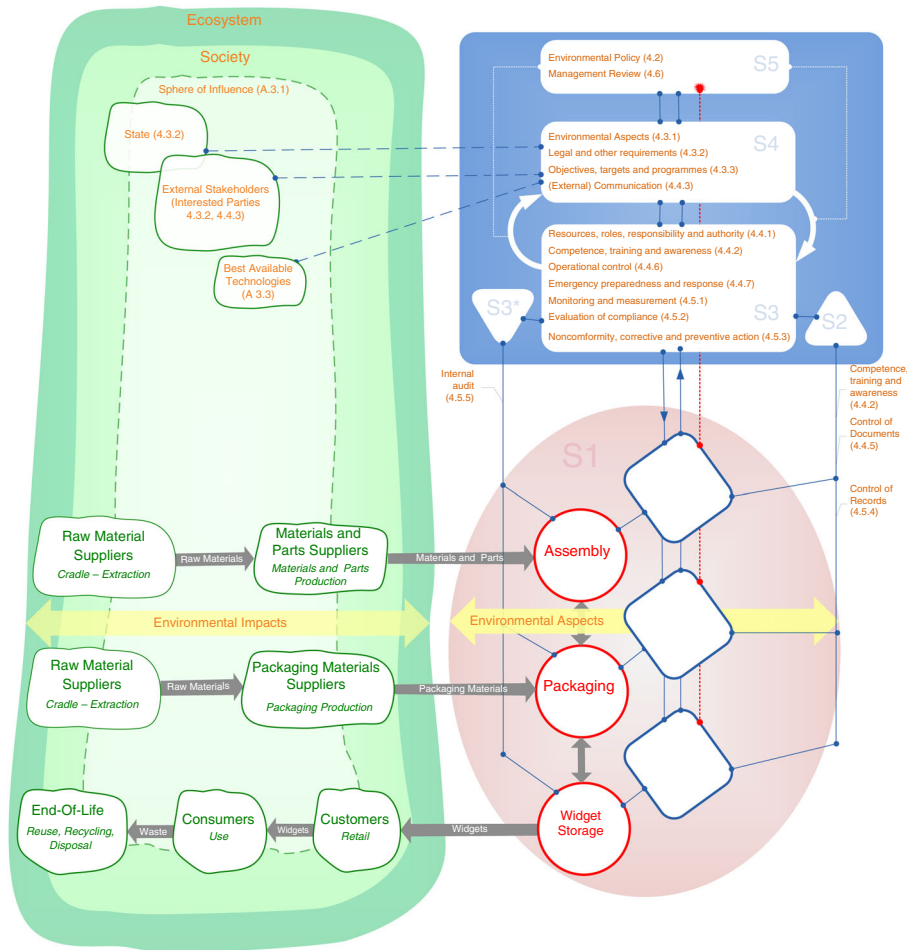
Figure 4.
VSM mapping
diagram of
ISO 14001

preparedness and response procedures (*4.4.7*). Next, System 3 needs to close the loop
by establishing monitoring and measurement processes of environmental performance
of Operations (*4.5.1*), and by performing an Internal System 3* Audit (*4.5.5*). This
information is used to evaluate the compliance of Operations to legal and other
requirements (*4.5.2*), to identify non-conformities and to develop related corrective and
preventive actions (*4.5.3*) in order to mitigate environmental impacts.

System 2 relates to establishing consistent EM practices, such as common procedures,
proper control of documents and records (*4.4.5, 4.5.4*), as well as to raising awareness on
significant environmental aspects (*4.4.2*). Finally, at the Systems 1 level, each operational
unit is responsible to autonomously monitor and manage its specific environmental aspects.

4.4 ISO 14044
ISO 14044 (ISO, 2006) is an EM standard that provides guidelines and requirements to
perform a LCA. LCA calculates the potential environmental impacts throughout a
product's life cycle from raw material extraction (cradle) through production, use, end-of-

Figure 5.
Variety mapping
diagram of
ISO 14001

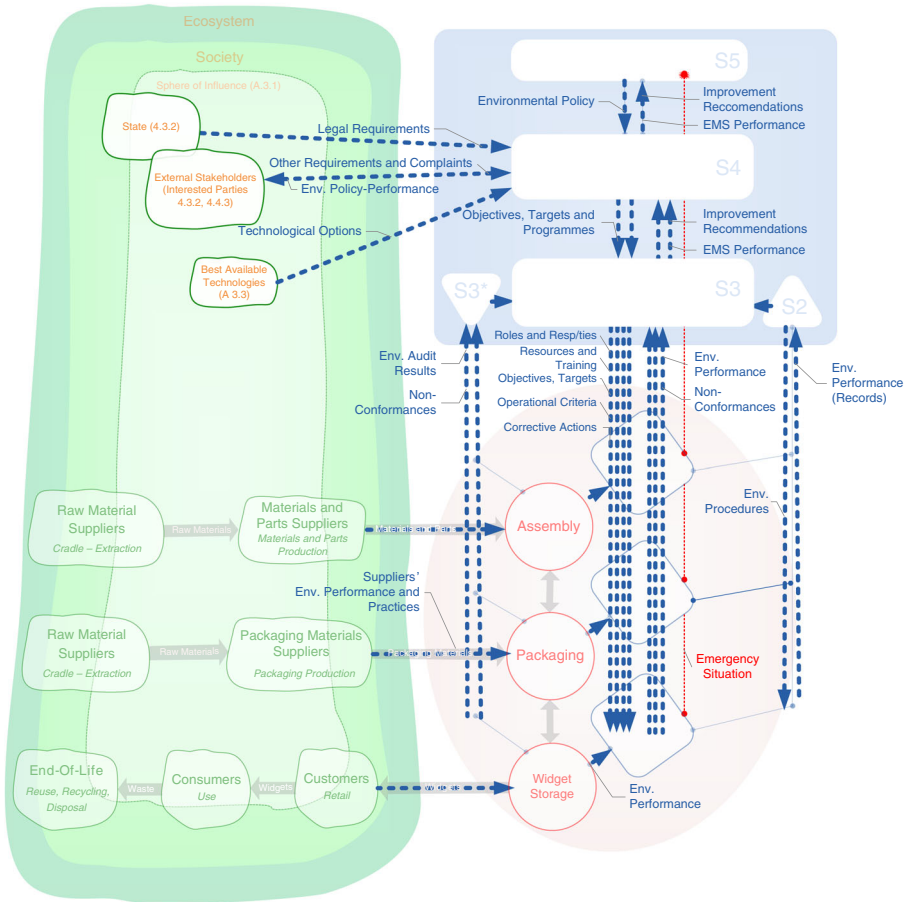life treatment, recycling and final disposal (grave). The VSM interpretation of ISO 14044 is shown in Figures 6 and 7. They indicate that ISO 14044 mainly focuses on System 3, and its need to collect LCI Data (variety) from the internal and external environments.

An LCA study usually initiates at the System 5 level, which determines its goal (4.2.2), e.g. intention to certify a product with an ecolabel. Next, System 4 is responsible for determining the scope of an LCA, which includes the product to be studied, the functional unit[2], the system boundary (included life-cycle processes), the limitations of the study, etc. These could be pre-determined by an external body, such as an ecolabel awarding organization, otherwise System 4 should make sure the scope is appropriate for the intended application and audience of the LCA.

The bulk of the ISO 14044 LCA activities lie with System 3. It is responsible for collecting data and performing the necessary calculations, i.e. conducting the Life Cycle Inventory (LCI), as well as Life Cycle Impacts Assessment (LCIA) phases of an LCA. LCI data are mainly provided by System 1 through the Central Channel, or through direct data collection onsite. LCI data about upstream and downstream life-cycle phases, are either collected directly (e.g. through appropriate supplier and client questionnaires), or indirectly
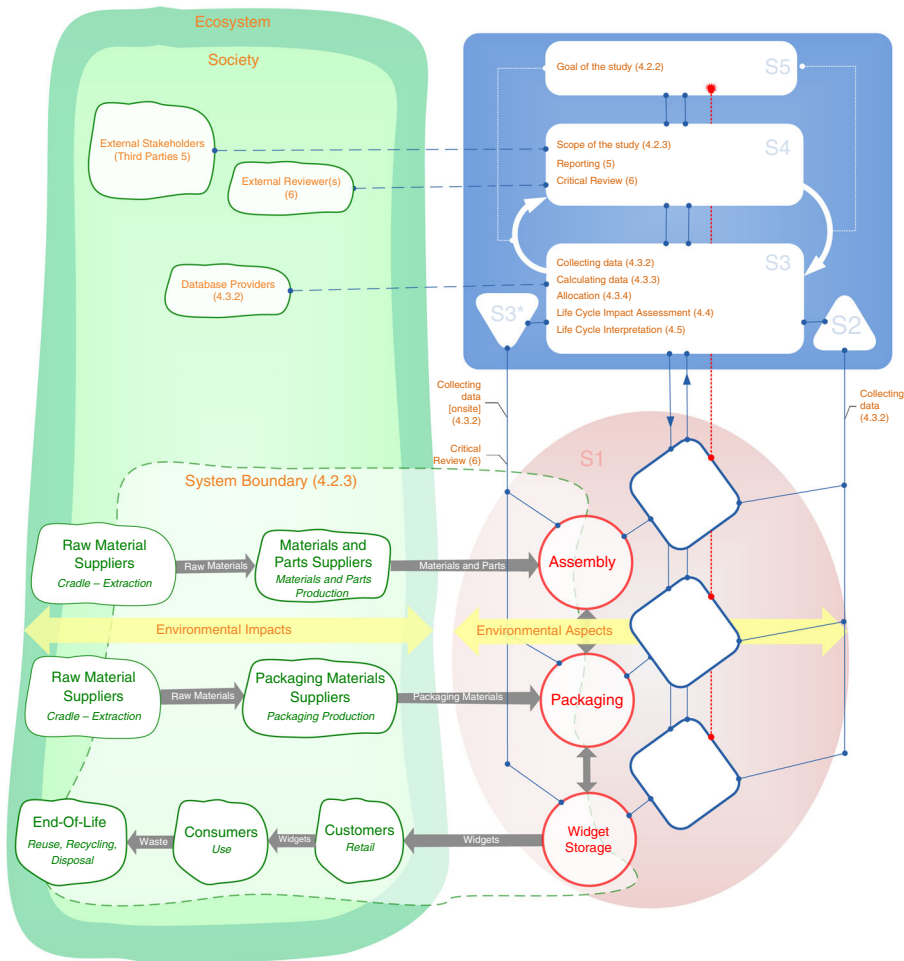
Figure 6.
VSM mapping
diagram of
ISO 14044

from public data sources that compile generic life-cycle data on multiple common processes (e.g. using an LCA software). If an organization performs LCA studies on a regular basis, System 2 will ensure that common data collection methods are implemented. Moreover, environmental records can provide an alternative source of LCI data.

LCA is cyclical process. Once, System 3 has produced a draft LCA study, System 4 is responsible for doing a Critical Review (6), which may also involve external reviewers and require and internal audit. This review may result in modifications of all aspects of the LCA, from calculations and data collection, to the goal and scope of the study. Finally, System 4 is responsible for communicating the LCA results to third parties.

5. Towards integrated sustainability management
Based on the VSM interpretation of ISO 2600, which has the widest scope, a number of generic SR functions per VSM system were identified, as shown in Table AI. These functions were then used to map the three standards in order to explore their differences and complementarities.
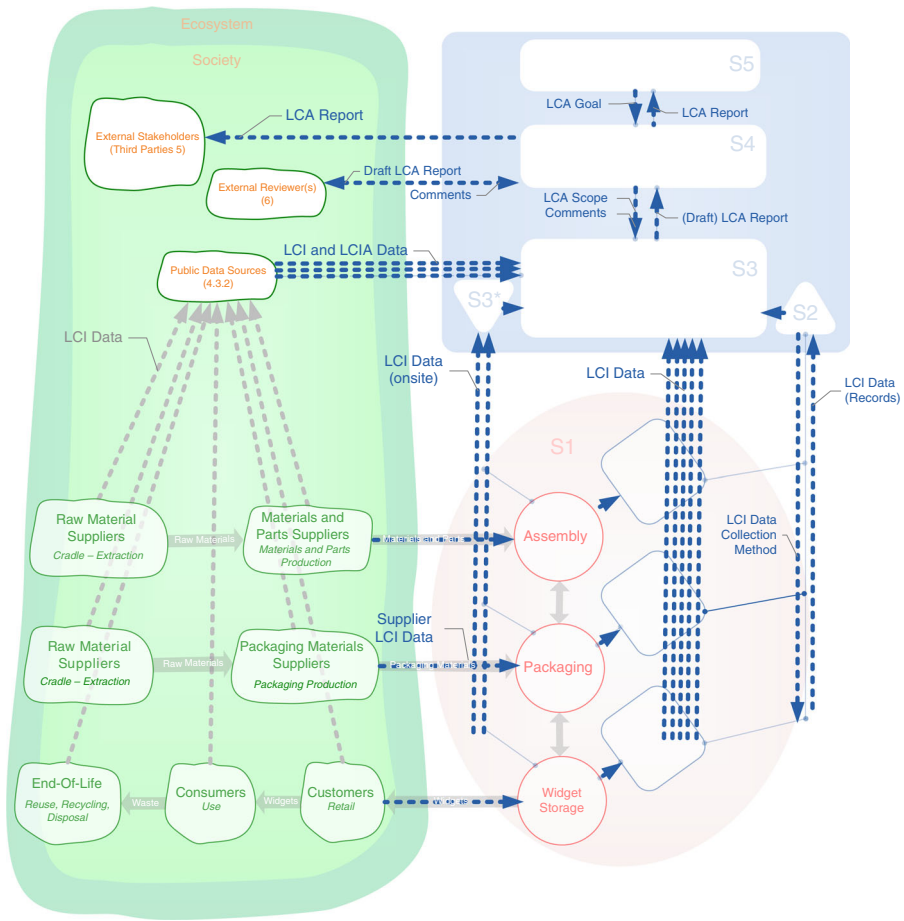
Figure 7.
Variety mapping
diagram of
ISO 14044

ISO 26000 has the widest scope of the three standards, covers most of the VSM sub-systems, and opens new horizons for Widget Co. Essentially the variety of its environmental niche has suddenly exploded and in order to restore Requisite Variety, there is an urgent need to ramp up the variety of its operation in order to cope with these new levels of environmental variety. This can be seen in Figure 3 where a lot variety is flowing both inside and outside the organization, depending on the number of SR issues the organization identifies as relevant. Moreover, ISO 26000 places a lot of emphasis on the roles of Systems 4 and 5 in safeguarding the SR of the organization.

In contrast, ISO 14001 focuses only on the environment core subject of ISO 26000. Therefore, the respective System 4 model has less variety, since it considers fewer items, resulting in less information flowing in and out of the organization (Figures 4 and 5). On the other hand, ISO 14001 provides more guidance in terms of System 3 and the internal measurement and control of environmental performance.

Finally, ISO 14044 is mainly focused on System 3, since LCA is essentially a more complex performance indicator, requiring challenging data collection and calculations.

Nevertheless, an LCA study may well involve the whole organization, as well as outside agents, as shown in Figures 6 and 7.

A common characteristic of the three standards is the absence of an explicit System 2. The Management Consistency and Employee Culture are only indirectly dealt with, while Conflict Management is completely absent in all three standards. A possible explanation is that these standards were developed based on a traditional top-down management model, rather than an autonomic management of System 1, which demands a more rigorous System 2.

In conclusion, it is suggested that an organization wishing to adopt the three standards presented here will need to integrate them across the VSM sub-systems and the SR generic functions of Table AI. One way to visualize this is presented in Figure 8: each standard is presented as a distinct management layer, which needs to be integrated
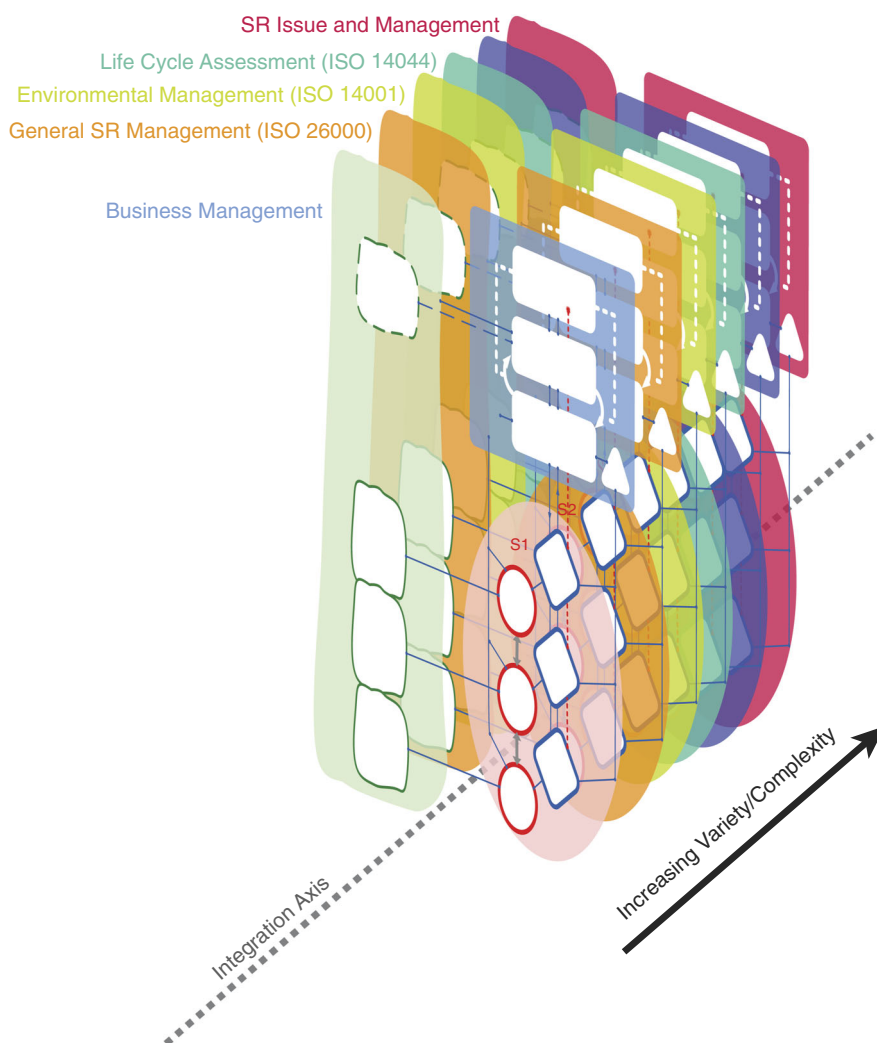
Figure 8.
Integration of management layers

with the usual Business Management layer (Section 3), as well as any other management layer relating to a specific SR issue (paragraph 4.2.6). For example, System 3 might need to simultaneously monitor and control the performance of System 1 in terms of:

- Production Output (Business Management).
- Human Rights (ISO 26000 – SR Issue 1).
- Environmental Non-Conformances (ISO 14001).
- Environmental Impacts (ISO 14001 and ISO 14044).
- Labour Practices (ISO 26000 – SR Issue 2).

Similar will be the case for all the systems and variety channels across the integration axis of Figure 8.

Integrating the layers of Figure 8, will be a difficult task for any organization. Further research is needed to explore the specifics of this integration. The authors believe that this integration should not be based on creating distinct roles for each management layer, but rather incorporating these in the day-to-day Business Management, resulting in a unified (Sustainability) MS.

Notes

1. The analysis of clause content is crucial, since certain clause titles may be misleading in regards to VSM mapping. For example, clause 7.7.5 Improving Performance suggests a System 3 relationship, but its content is more related to System 4.

2. This is the reference to which input and output data of the product system are normalized.

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Appendix 1. The organizational scenario

It must be noted that the internal elements of the company depicted in the diagram mainly refer to processes rather than organizational entities. There are two reasons for this. The first is that similarly labelled departments do not perform the same processes in all companies. For example, the accounting process may be performed by a "Finance", or an "Accounting" department. The second reason is that depending on the size of the company, a single person (e.g. Head of Department), or a whole team could be responsible for a process or processes. Thus, in a small company a "General Manager" could perform most processes in the Management part (blue square) of Figure 1, while in a large company several teams would be needed to perform the same processes.

Operations

Starting from Operations (red ellipse), this consists of the production departments or processes (S1s), which are necessary to manufacture widgets, i.e. Realize the company's purpose. Each production department is controlled by a dedicated and semi-autonomous local management unit (blue square) that ensures its proper operation. In order to operate, a department depends on material and other flows (grey arrows) that are provided from suppliers located at the organization's environment. In Widget Co., Assembly and Packaging depend on two separate supply chains consisting of two tiers: direct suppliers (material and parts and packaging suppliers), with which the company interacts directly, and indirect suppliers (raw material suppliers), located further upstream in the supply chain. This is of course a simplification, as more complex arrangements are possible with suppliers forming networks rather than chains and supplying more than one department. Internally, production departments are interacting, through material and other flows (grey vertical arrows), according to the specific production arrangement of the company. At the end of this arrangement is the widget storage department, which ships completed widgets to customers.

System 2

System 2 includes processes, such as Production Scheduling, Accounting Protocols, IT services and Work Procedures that support the harmonious co-operation of production departments and ensure the cohesiveness of the organization. For example, if Assembly faces a technical problem and needs to go offline, an effective Production Scheduling process, will ensure that the rest of the departments are notified on time and their operation is not seriously affected.

System 3

System 3 manages the overall performance of Operations, by creating synergy. This is first of all performed through the Production (or tactical) Planning process, by means of allocating specific performance targets to each production department. Moreover, System 3 processes, such as Budgeting, Procurement, Human Resources management and Maintenance distribute to production departments the resources and services (money, materials, employees and machine services) that are necessary for the realization of their performance targets. Since the performance of a department (or any system) is a function of resources available to it, performance targets and resources should be jointly negotiated between Systems 3 and 1, in what Beer called a resource bargaining process.

However, System 3 needs to have information on the performance of each production department, for example, via a routine performance reporting process. This process will first of all include appropriate output performance indicators for each department, such as number of units assembled, packaged and stored. It may also include efficiency indicators in relation to the various resources provided, such as cost per unit, materials consumption, workdays and number of machine failures. Beer called this process the accountability loop, which can support the autonomy of Operations, when effectively implemented.

In addition to performance reporting, System 3 needs an alternative more reliable view of Operations. This is provided by System 3* processes, such as Quality and Financial audits, as

well as Staff Surveys that sporadically provide direct information on the status of production departments, without the interference of local management units.

As System 3 processes focus on different aspects of the organization, they thus employ different processes along the three available channels connecting it to Operations, i.e. 1-3, 2-3 and 3*-3. All these processes need to be connected and holistically managed and this is usually the responsibility of a General or Production Manager.

System 4
Systems 1-2-3 are mainly concerned with current affairs happening in the internal part of the organization (inside and now). In contrast, System 4 includes processes, such as Business Development, Research and Development, Marketing and Public Relations that help the organization adapt to the changing external environment (outside and future). These processes investigate or interact with external entities, such as the market, competition, legislation, emerging technologies, etc., continuously trying to identify opportunities and threats that may affect the viability of the whole organization.

For example, the Business Development process may realize that competitors are about to introduce a new kind of widget in the market that threats to put Widget Co. out of the market in a couple of years. As a response, this process could come up with a plan that will allow Widget Co. to produce the new type of widget on time to beat competition. In order to do so, it will need to gather more information from the external environment and other System 4 processes. In addition, in order for this plan to be realistic, it will also need to obtain information from the internal environment about the current situation (financial, technological, etc.) of the company, which can be provided by System 3.

System 5
The effective interaction (pair of white arrows in Figure 1) and balance between Systems 3 and 4 is of paramount importance to the viability of the organization. This delicate balance determines the course and strategy of the whole organization: if emphasis is placed on System 3 the organization will be more static and focused on efficiency; if it is placed on System 4 it will be more dynamic and focused on development. The role of System 5 is to manage the interaction of these two systems and decide on the right balance for the organization (white dashed lines Figure 1). Processes that shape the mission, vision and values of the organization and related Policies that determine the way the whole organization should operate are part of System 5. For example, Widget Co. may have an anti-corruption policy that should be respected by all members of the company. Organizational entities such as a Board of Directors or the President are usually responsible for System 5 processes.

Finally, Operations may face emergency situations that could threaten the viability of the whole company, such as a fire incident in the widget storage department that destroys a significant part of production. In these situations a fast intervention from System 5 is usually needed, which would have to bypass the slower intermediate processes between of Systems 1 and 5 described above. An emergency direct connection between Systems 1 and 5 is therefore needed (dashed red line of central axis in Figure 1), which Beer called the algedonic channel.

VSM system	Generic SR function	ISO 26000	ISO 14001	ISO 14044
System 5	Alignment of purpose	3, 4, 6.2, 7.3.1, 7.3.2, 7.3.4, 7.4.2, 7.4.3, 7.7.3 7.4.1	4.2, 4.6	4.2.2
	Creation of SR culture	–	–	–
System 4	Development of SR model	5, 6.3-6.8, 7.2, 7.3.3	4.3.1, 4.3.2	4.2.3, 6
	Planning of SR strategies and improvement programmes	7.3.2, 7.7.5	4.3.3	–
	Stakeholder engagement	7.5.4, 7.6.1, 7.6.2, 7.6.3, 7.8	4.4.3	5
System 3	Implementation of SR policies	7.4.1,	4.3.1, 4.3.3, 4.4.1, 4.4.2, 4.4.6, 4.4.7	–
	Implementation of SR strategies and improvement programmes	7.4.2, 7.7.5	–	–
	Monitoring of SR performance	7.7.2, 7.7.3	4.5.1, 4.5.2, 4.5.3	4.3.2, 4.3.3, 4.3.4, 4.4, 4.5
System 3*	Monitoring of SR performance	7.7.4	4.5.5	4.3.2, 6
System 2	Conflict management	–	–	–
	SR management consistency	–	4.4.5, 4.5.4	4.3.2
	Employee culture	7.4.1	4.4.2	–

Table AI.
VSM integration
table

Appendix 2. VSM relationship tables

ISO 26000 clause	System 5	System 4	System 3	System 3*	System 2	System 1
3 Understanding SR	R					
4 Principles of SR	R					
5 Recognizing SR and engaging stakeholders		R				
6 Guidance on SR core subjects						
6.2 Organizational governance	R	C	C	C	C	C
6.3 Human rights		R	R			
6.4 Labour practices		R	R			
6.5 The environment		R	R			
6.6 Fair operating practices		R				
6.7 Consumer issues		R				
6.8 Community involvement and development		R				
7 Guidance on integrating SR throughout an organization						
7.2 The relationship of an organization's characteristics to SR	C	R	C			
7.3.1 Due diligence	R	C	C	C	C	C
7.3.2 Determining relevance and significance of core subjects and issues […]	C	R	C			C
7.3.3 An organization's sphere of influence		R	C			
7.3.4 Establishing priorities for addressing issues	R	C	C			
7.4.1 Raising awareness and building competency for SR	R		R		C	
7.4.2 Setting the direction of an organization for SR	R	C	C			
7.4.3 Building SR into an organization's governance systems and procedures	R	C	C	C	C	C
7.5.4 Stakeholder dialogue on communication about social responsibility		R				
7.6.1 Methods of enhancing credibility		R	C			
7.6.2 Enhancing the credibility of reports and claims about SR		R				
7.6.3 Resolving conflicts […] between an organization and its stakeholders		R				
7.7.2 Monitoring activities on SR			R	C	C	C
7.7.3 Reviewing an organization's progress and performance on SR	R	C	R			
7.7.4 Enhancing the reliability of data […] collection and management			C	R	C	
7.7.5 Improving performance		R	R			
7.8 Voluntary initiatives for SR	C	R	C			

Notes: R, responsible VSM element; C, contributing VSM element

Table AII.
VSM Relationship
table of ISO 26000

ISO 14001 clause	System 5	System 4	System 3	System 3*	System 2	System 1
4.2 Environmental policy	R					
4.3 Planning						
4.3.1 Environmental aspects		R	R			C
4.3.2 Legal and other requirements		R	C			
4.3.3 Objectives, targets and programmes		R	R			
4.4 Implementation and operation						
4.4.1 Resources, roles, responsibility and authority			R			
4.4.2 Competence, training and awareness			R		C	
4.4.3 Communication		R				
4.4.4 Documentation						
4.4.5 Control of documents					R	
4.4.6 Operational control			R			
4.4.7 Emergency preparedness and response	C		R	C		C
4.5 Checking						
4.5.1 Monitoring and measurement			R			
4.5.2 Evaluation of compliance			R			
4.5.3 Nonconformity, corrective action and preventive action			R			
4.5.4 Control of records					R	
4.5.5 Internal audit				R		
4.6 Management review	R	C	C			

Notes: R, responsible VSM element; C, contributing VSM element

Table AIII.
VSM relationship table of ISO 14001

ISO 14044 clause	System 5	System 4	System 3	System 3*	System 2	System 1
4.2 Goal and scope definition						
4.2.2 Goal of the study	R					
4.2.3 Scope of the study		R				
4.3 Life cycle inventory analysis (LCI)						C
4.3.2 Collecting Data			R	C	C	C
4.3.3 Calculating Data			R			
4.3.4 Allocation			R			
4.4 Life cycle impact assessment (LCIA)			R			C
4.5 Life cycle interpretation			R			
5 Reporting		R				
6 Critical review		R				

Notes: R, responsible VSM element; C, contributing VSM element

Table AIV.
VSM relationship table of ISO 14044

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