Integrated Sustainability Management for Organizations

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Abstract

Purpose of this paper
The aim of this paper is to propose the Viable System Model as an effective model to base the analysis of organisational 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: ISO26000, ISO14001 and ISO14044. 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 analyzing the differences, similarities and complementarities in the context of each VSM component, and by identifying common invariant functions.

Findings
Twelve generic sustainability functions are identified. ISO 26000 has the widest scope; ISO14001 is focused primarily on internal measurement and control (System 3), while ISO14044 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 (if applicable)
Further research is needed to explore the specifics of integration.

Practical implications (if applicable)
This integration should not be based on creating distinct roles for each management layer.

What is original/value of paper
The paper uses the insights of organisational cybernetics to examine prominent sustainability standards and advance sustainability management at the business level.

Keywords: Viable Systems, Sustainability, Environmental management, Cybernetics, Governance

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 organisations 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, ISO26000, ISO14001 and ISO14001 are analyzed 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 (IMS) or Sustainability Management System (SMS) (Maas and Reniers, 2014; Ranängen and Zobel, 2014).

Finnvenden and Moberg (2005) use three classification attributes for environmental assessment tools: a) the *types of impacts* considered, b) the *object of study*, and c) 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: a) *Comprehensiveness*, b) *Integratedness*, and c) *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: a) to the *company system*, and b) 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 & Processes, as well as the Management & 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 organisations.

Figure 1 The VSM of the hypothetical Widget Co.

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

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:

a) qualitative assessment of the clause content[i],

b) identification of closely related VSM elements

c) description of relationship between the clause and the VSM elements.

Two types of relationships are described in the analysis:

- *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 ISO26000 clause *5-Recognising SR and engaging stakeholders*.
- *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:

a) a *VSM Relationship Table* showing the aforementioned type of relationships, (shown in Appendix II)

b) a *VSM Mapping Diagram* showing how each clause maps onto the VSM structure,

c) 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

d) 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 social responsibility 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 Figure 2 and Figure 3 respectively.

Figure 2 VSM Mapping Diagram of ISO 26000.
Orange elements represent the standard's clauses. Yellow elements represent the SR Core Subjects. Contributing elements are not shown for simplicity.

Figure 3 Variety Mapping Diagram of ISO26000
The number of arrows indicates the variety flowing in each information channel.

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 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:

- the organization's *stakeholders* (*5.3.2*),
- the organization's *sphere of influence* (*5.2.3, 7.3.3*),
- 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. 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 t**raining** that will build the capacity of Operations to manage demanding SR issues (*7.4.1*).

System 3 is also responsible for analyzing 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*), through performance **indicators** appropriate for each SR issue, along three different channels:

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

*ii) System 3**: sporadically, via SR audits and surveys (*7.7.4*)

iii) *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 organisation. 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).

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 Systems 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 Systems 1 – Recursion

In terms of SR, the Recursive System Theorem (Beer, 1979) implies that each Operational unit should develop *similar* SR functions to those analyzed 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). 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, 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

ISO14001 (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 ISO14001. The VSM interpretation of ISO 14001 is shown in Figure 4 and Figure 5. In terms of ISO 26000, ISO 14001 focuses on the Environment SR core subject, providing specific management guidance.

Figure 4 VSM Mapping Diagram of ISO 14001.

Figure 5 Variety Mapping Diagram of ISO14001

The EMS starts at the System 5 level which is responsible to determine the organization's environmental policy (*4.2*). This policy should: a) comply with legal and other requirements, b) undertake pollution prevention, and c) 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*). 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 organisation to external stakeholders.

ISO 14001 places great emphasis on System 3. First of all, it should assign resources, roles and responsibilities (4.4.1) relative to environmental management, 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 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 environmental management 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 environmental management standard that provides guidelines and requirements to perform a Life Cycle Assessment (LCA). LCA calculates the potential environmental impacts throughout a product's life cycle from raw material extraction (cradle) through production, use, end-of-life treatment, recycling and final disposal (grave). The VSM interpretation of ISO 14044 is shown in Figure 6 and Figure 7.

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[ii], 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 organisation, 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 is mainly provided by Systems 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 from public data sources that compile generic life-cycle data on multiple common processes (e.g. using an LCA software). If an organisation 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.

Figure 6 VSM Mapping Diagram of ISO 14044.

Figure 7 Variety Mapping Diagram of ISO14044

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 1. These functions were then used to map the three standards in order to explore their differences and complementarities.

Table 1 VSM Integration Table

ISO 26000 has the widest scope of the three standards, covers most of the VSM subsystems, and opens new horizons for Widget Co. Essentially the variety of its environmental niche has suddenly exploded and in order to restore Requisite Variety (RV), 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 organisation, depending on the number of SR issues the organisation 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 organisation.

In contrast, ISO14001 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 organisation (Figure 4 and Figure 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 organisation, as well as outside agents, as shown in Figure 6 and Figure 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 Systems 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 1. One way to visualise this is presented in Figure 8: each standard is presented as a distinct management layer, which needs to be integrated 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).

Figure 8 Integration of management layers

Integrating the layers of Figure 8, will be a difficult task for any organisation. 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) Management System.

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Appendix I: The Organizational Scenario

It must be noted that the internal elements of the company depicted in the diagram mainly refer to *processes* rather than organisational entities. There are two reasons for this. The first is that similarly labelled departments don't 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. realise 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 organisation's environment. In Widget Co., Assembly and Packaging depend on two separate supply chains consisting of two tiers: *direct suppliers* (material & 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 organisation. 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 realisation 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 System 3 and Systems 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 Q*uality 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 organisation, 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 organisation (inside and now). In contrast, System 4 includes processes, such as *Business Development*, *Research & Development*, *Marketing* and *Public Relations* that help the organisation **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 organisation.

For example, the Business Development process may realise 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 organisation. This delicate balance determines the course and **strategy** of the whole organisation: if emphasis is placed on System 3 the organisation 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 organisation (white dashed lines Figure 1). Processes that shape the mission, vision and values of the organisation and related Policies that determine the way the whole organisation 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. Organisational 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 System 5 is therefore needed (dashed red line of central axis in Figure 1), which Beer called the *algedonic channel*.

Appendix II: VSM Relationship Tables

Table 2 VSM Relationship Table of ISO 26000

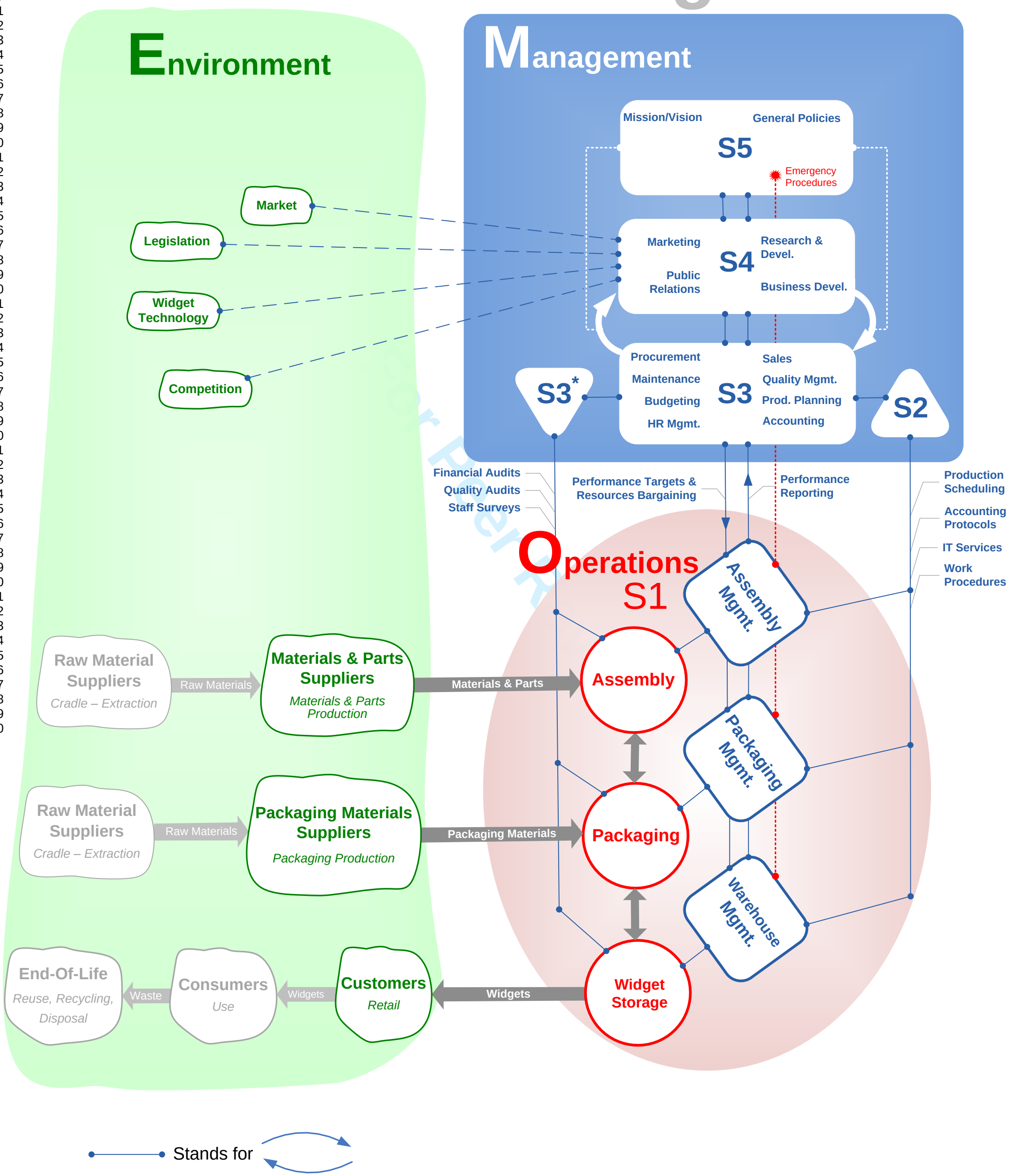
Table 3 VSM Relationship Table of ISO 14001

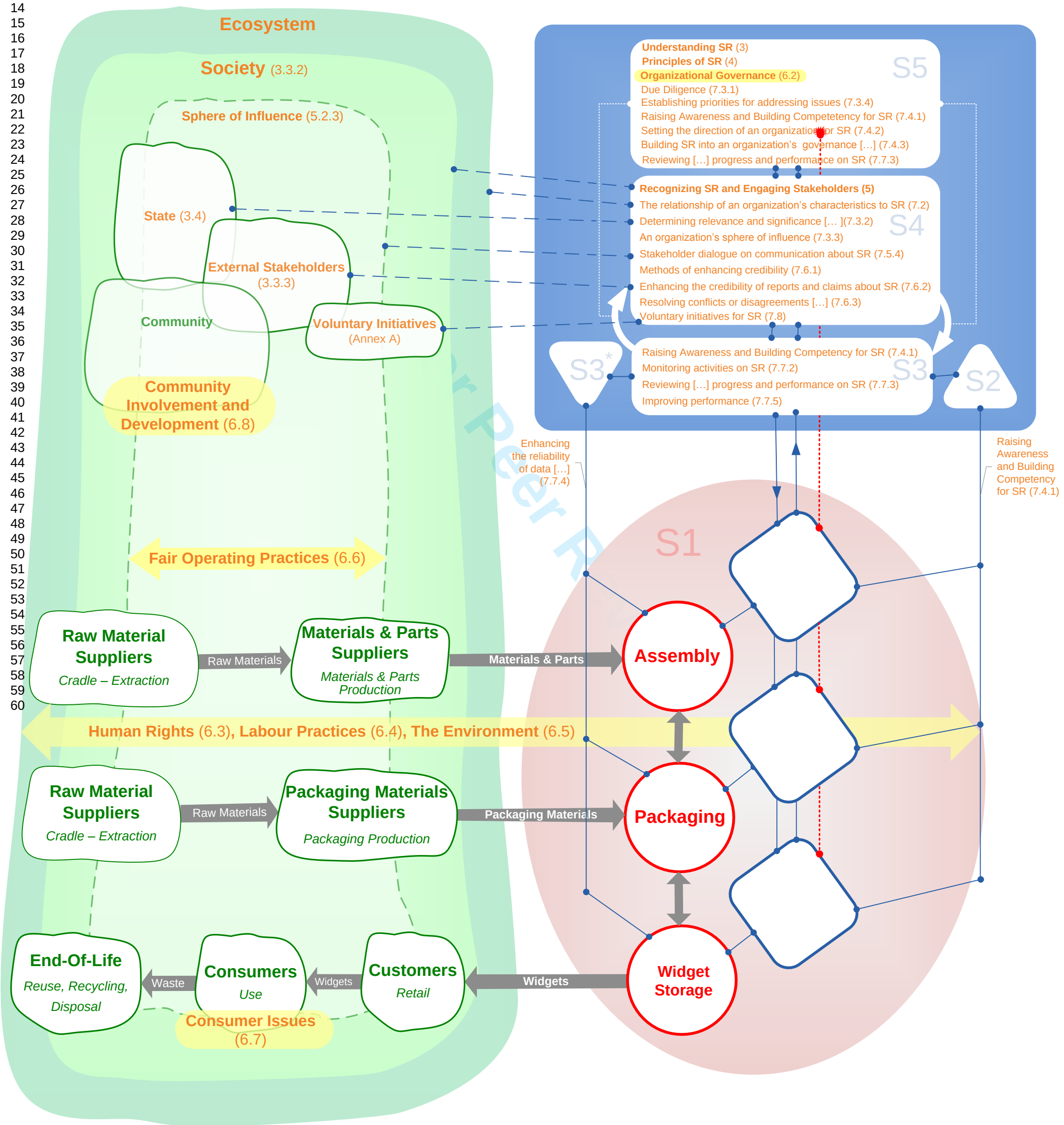
Table 4 VSM Relationship Table of ISO 14044

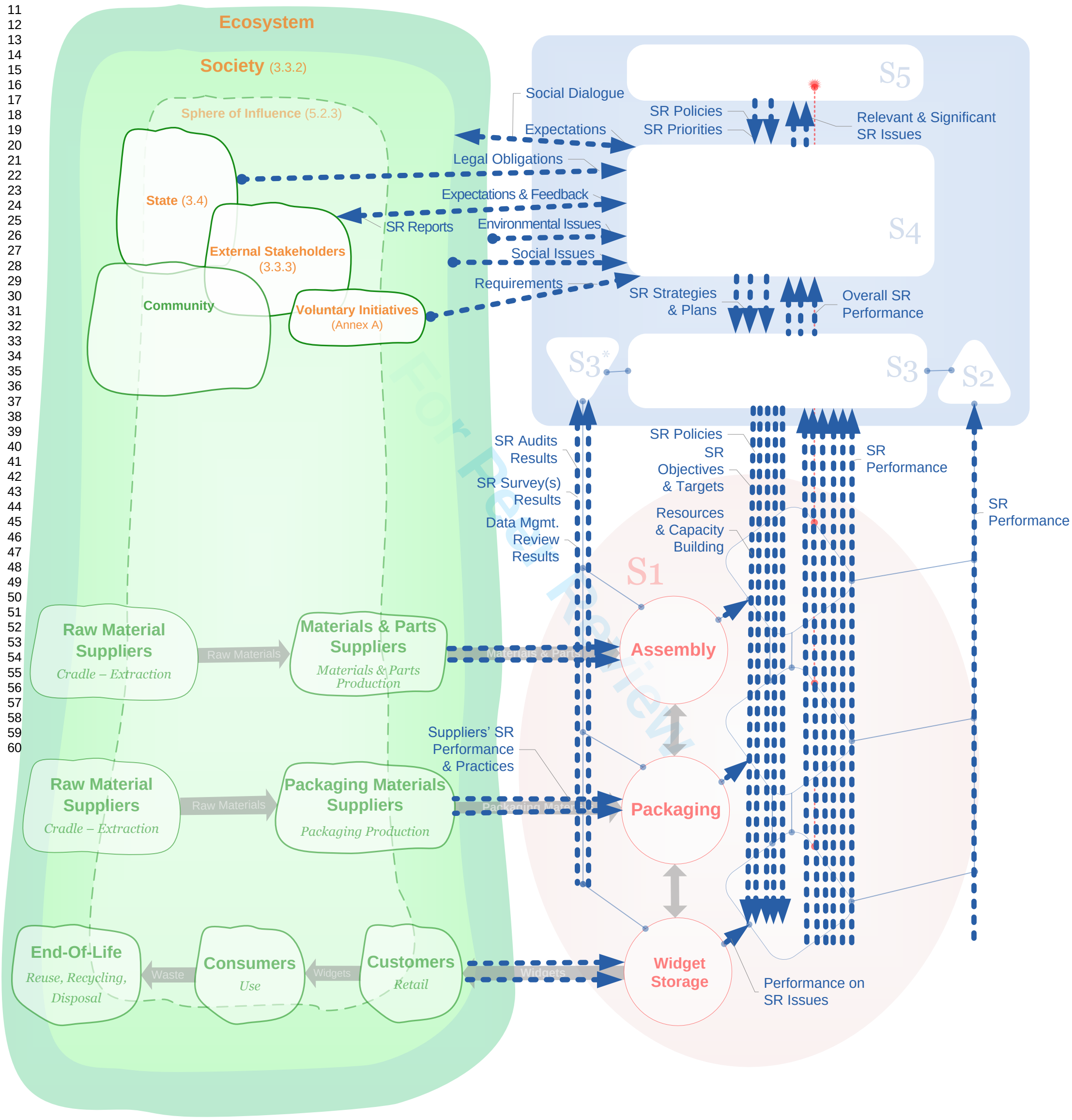
[i] The analysis of clause content is crucial, since certain clause titles may be misleading in regards to VSM mapping. For example, clause 7.7.5 Improving Performance suggests a System 3 relationship, but its content is more related to System 4.

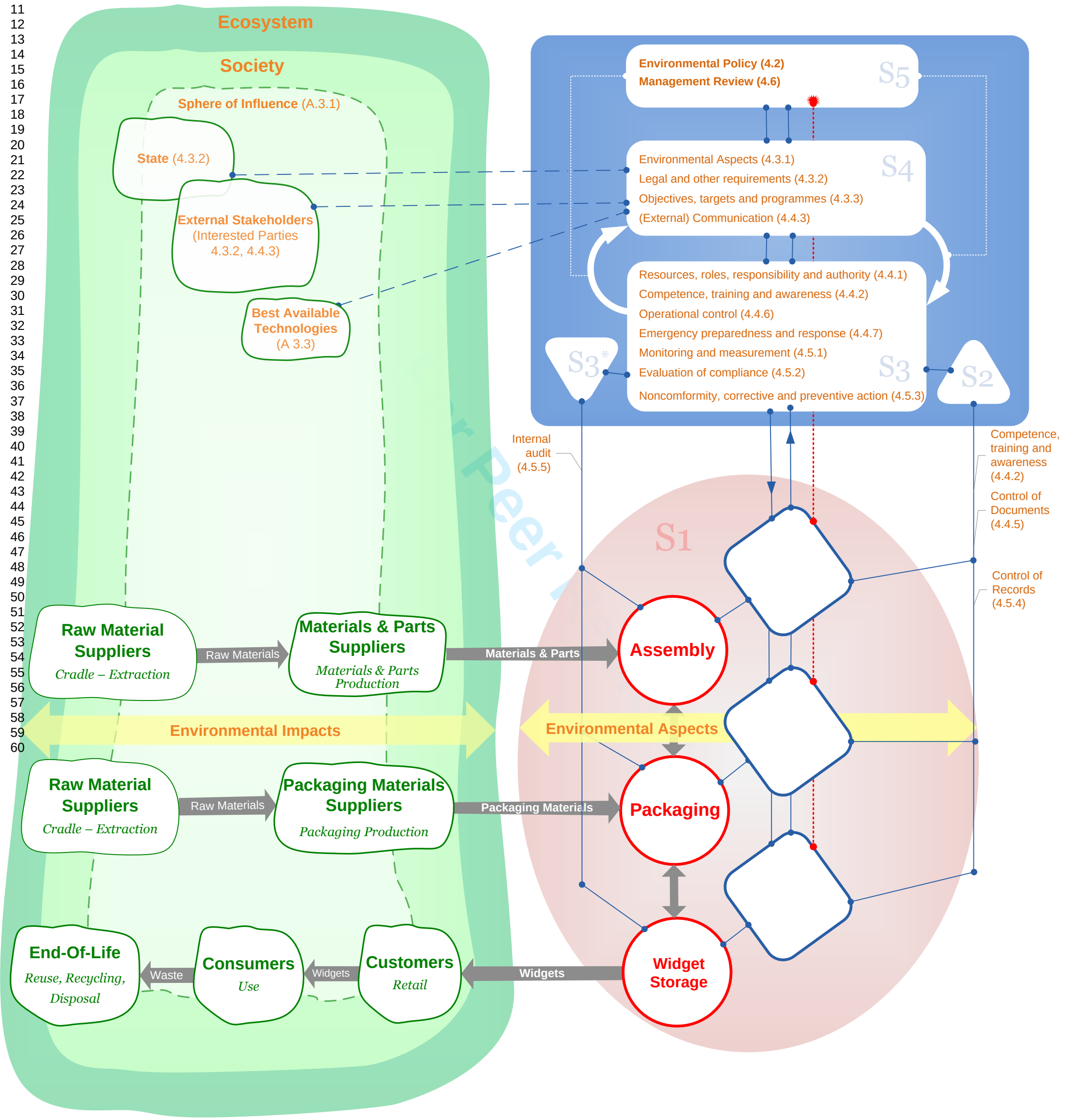
[ii] This is the reference to which input and output data of the product system are normalized.

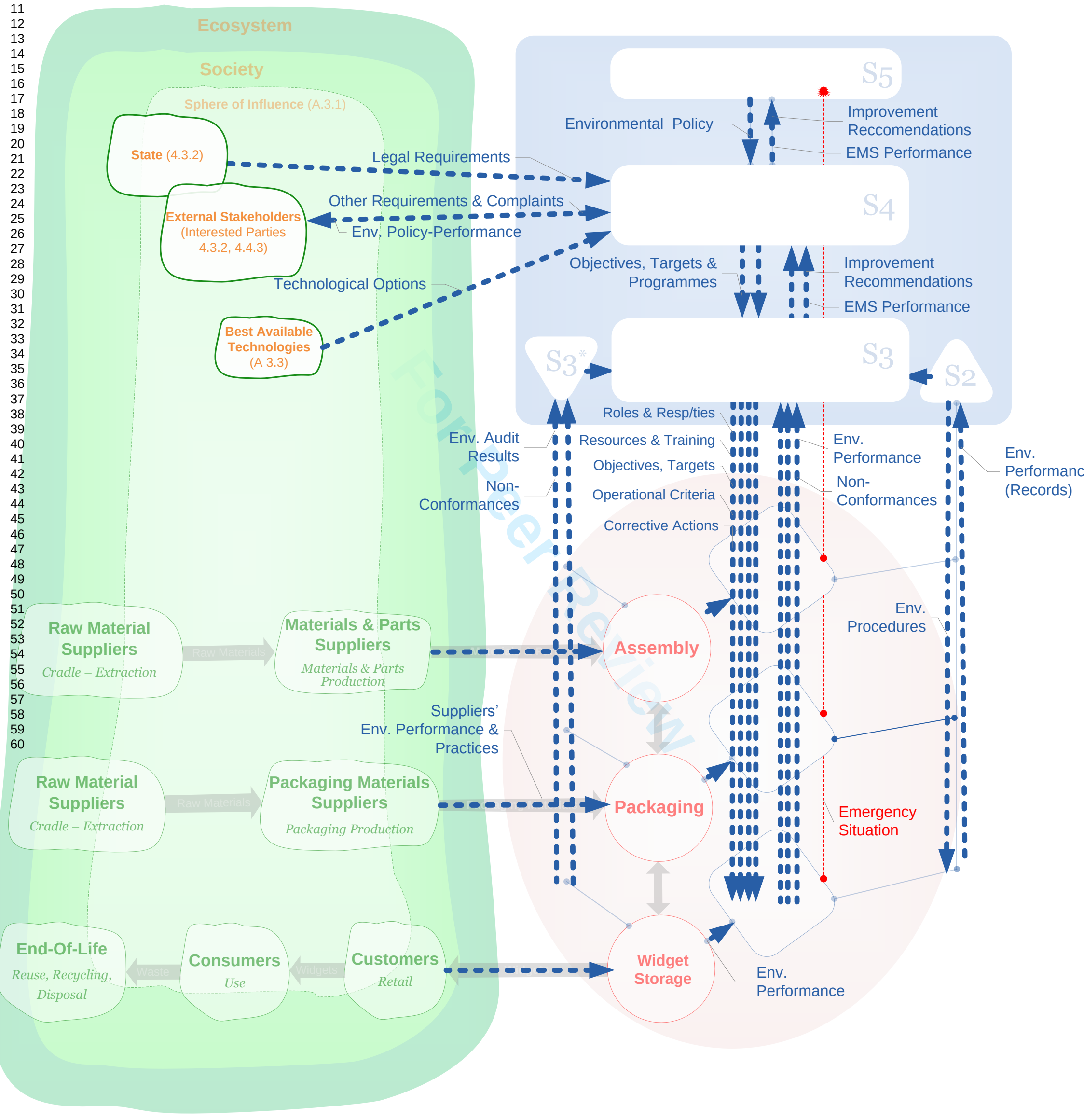
Widget Co.

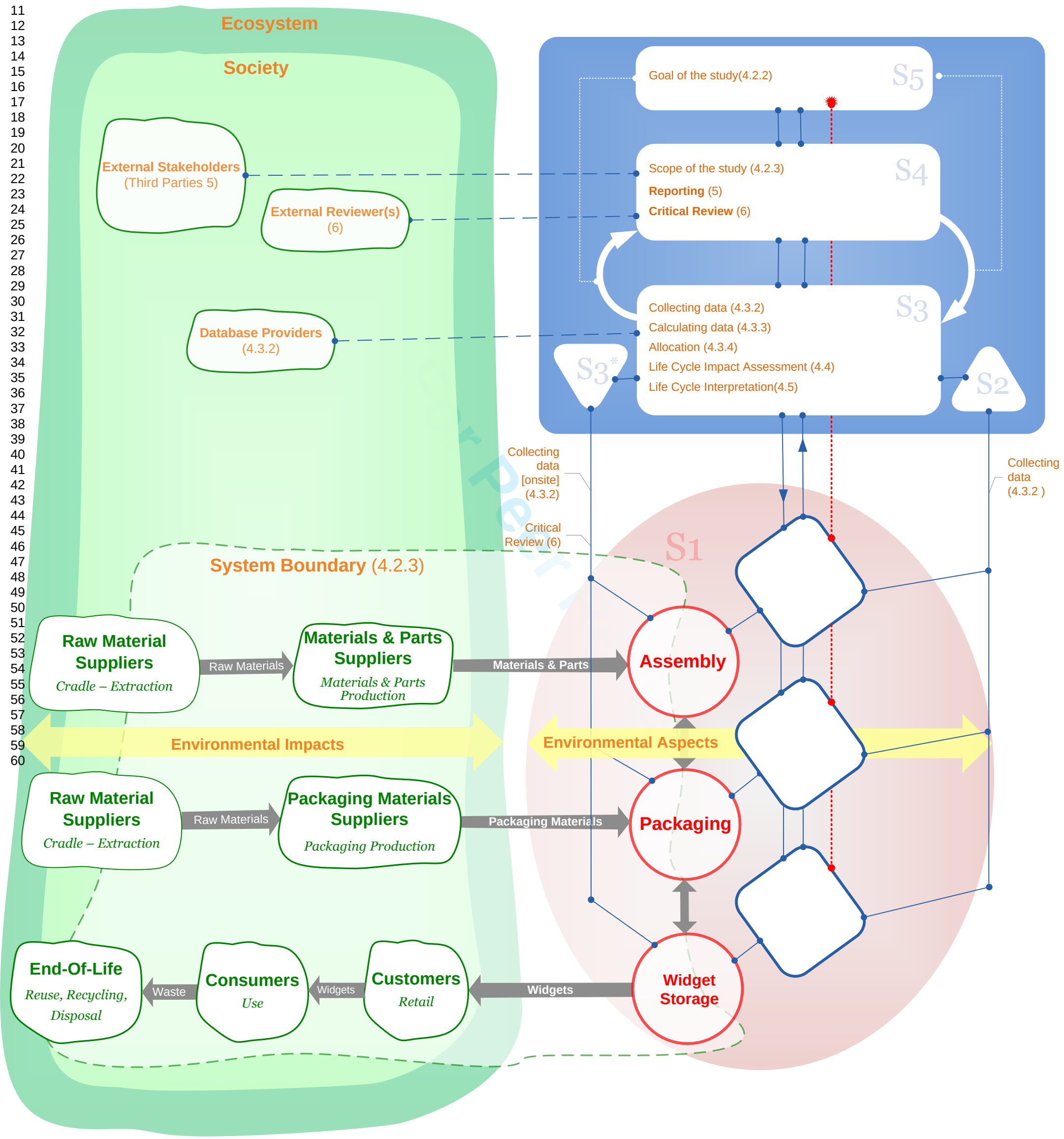

Environment
Market
Legislation
Widget Technology
Competition
Management
Mission/Vision
General Policies
S5
Emergency Procedures
Marketing
Research & Devel.
S4
Public Relations
Business Devel.
Procurement
Maintenance
Budgeting
HR Mgmt.
S3
Sales
Quality Mgmt.
Prod. Planning
Accounting
S3*
S2
Financial Audits
Quality Audits
Staff Surveys
Performance Targets & Resources Bargaining
Performance Reporting
Production Scheduling
Accounting Protocols
IT Services
Work Procedures
Operations S1
Assembly Mgmt.
Packaging Mgmt.
Warehouse Mgmt.
Assembly
Packaging
Widget Storage
Raw Material Suppliers
Cradle – Extraction
Raw Materials
Materials & Parts Suppliers
Materials & Parts Production
Materials & Parts
Raw Material Suppliers
Cradle – Extraction
Raw Materials
Packaging Materials Suppliers
Packaging Production
Packaging Materials
End-Of-Life
Reuse, Recycling, Disposal
Waste
Consumers
Use
Widgets
Customers
Retail
Widgets
Stands for

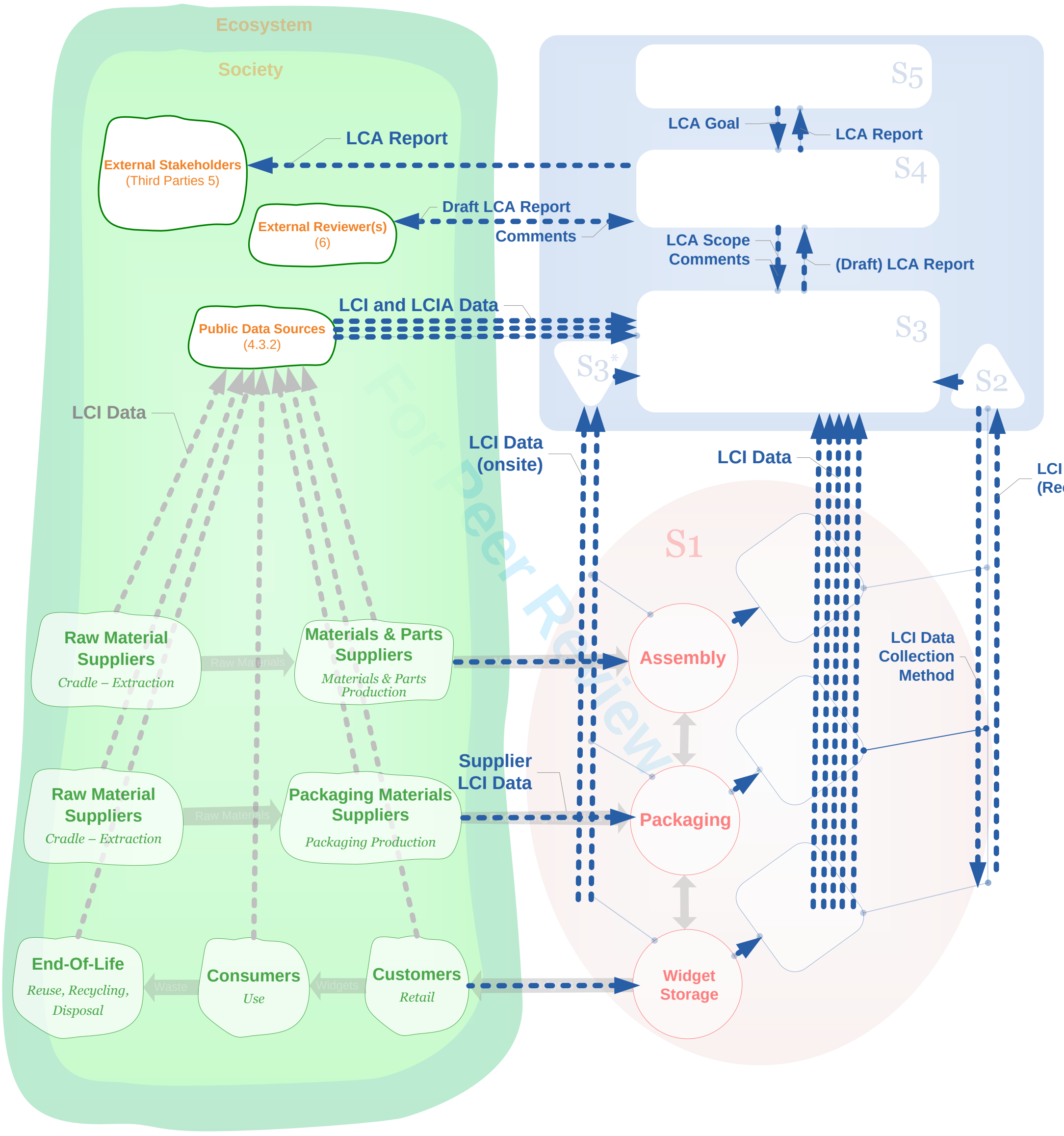

Ecosystem
Society (3.3.2)
Sphere of Influence (5.2.3)
State (3.4)
External Stakeholders (3.3.3)
Community
Voluntary Initiatives (Annex A)
Community Involvement and Development (6.8)
Fair Operating Practices (6.6)
Raw Material Suppliers
Cradle – Extraction
Raw Materials
Materials & Parts Suppliers
Materials & Parts Production
Materials & Parts
Assembly
Human Rights (6.3), Labour Practices (6.4), The Environment (6.5)
Raw Material Suppliers
Cradle – Extraction
Raw Materials
Packaging Materials Suppliers
Packaging Production
Packaging Materials
Packaging
End-Of-Life
Reuse, Recycling, Disposal
Waste
Consumers
Use
Widgets
Customers
Retail
Widgets
Widget Storage
Consumer Issues (6.7)
S5
Understanding SR (3)
Principles of SR (4)
Organizational Governance (6.2)
Due Diligence (7.3.1)
Establishing priorities for addressing issues (7.3.4)
Raising Awareness and Building Competetency for SR (7.4.1)
Setting the direction of an organization for SR (7.4.2)
Building SR into an organization's governance […] (7.4.3)
Reviewing […] progress and performance on SR (7.7.3)
S4
Recognizing SR and Engaging Stakeholders (5)
The relationship of an organization's characteristics to SR (7.2)
Determining relevance and significance […](7.3.2)
An organization's sphere of influence (7.3.3)
Stakeholder dialogue on communication about SR (7.5.4)
Methods of enhancing credibility (7.6.1)
Enhancing the credibility of reports and claims about SR (7.6.2)
Resolving conflicts or disagreements […] (7.6.3)
Voluntary initiatives for SR (7.8)
S3*
Raising Awareness and Building Competency for SR (7.4.1)
Monitoring activities on SR (7.7.2)
S3
Reviewing […] progress and performance on SR (7.7.3)
Improving performance (7.7.5)
S2
Enhancing the reliability of data […] (7.7.4)
Raising Awareness and Building Competency for SR (7.4.1)
S1


Ecosystem
Society (3.3.2)
Sphere of Influence (5.2.3)
State (3.4)
External Stakeholders (3.3.3)
Community
Voluntary Initiatives (Annex A)
Raw Material Suppliers
Cradle – Extraction
Raw Materials
Materials & Parts Suppliers
Materials & Parts Production
Raw Material Suppliers
Cradle – Extraction
Raw Materials
Packaging Materials Suppliers
Packaging Production
End-Of-Life
Reuse, Recycling, Disposal
Waste
Consumers
Use
Widgets
Customers
Retail
Widgets
S5
S4
S3*
S3
S2
S1
Social Dialogue
Expectations
Legal Obligations
Expectations & Feedback
SR Reports
Environmental Issues
Social Issues
Requirements
SR Policies
SR Priorities
Relevant & Significant SR Issues
SR Strategies & Plans
Overall SR Performance
SR Audits Results
SR Survey(s) Results
Data Mgmt. Review Results
SR Policies
SR Objectives & Targets
Resources & Capacity Building
SR Performance
SR Performance
Suppliers' SR Performance & Practices
Assembly
Packaging
Widget Storage
Performance on SR Issues
For Peer Review


Ecosystem
Society
Sphere of Influence (A.3.1)
State (4.3.2)
External Stakeholders
(Interested Parties
4.3.2, 4.4.3)
Best Available
Technologies
(A 3.3)
Environmental Policy (4.2)
Management Review (4.6)
S5
Environmental Aspects (4.3.1)
Legal and other requirements (4.3.2)
Objectives, targets and programmes (4.3.3)
(External) Communication (4.4.3)
S4
Resources, roles, responsibility and authority (4.4.1)
Competence, training and awareness (4.4.2)
Operational control (4.4.6)
Emergency preparedness and response (4.4.7)
Monitoring and measurement (4.5.1)
Evaluation of compliance (4.5.2)
Noncomformity, corrective and preventive action (4.5.3)
S3*
S3
S2
Internal audit (4.5.5)
Competence, training and awareness (4.4.2)
Control of Documents (4.4.5)
Control of Records (4.5.4)
S1
Raw Material Suppliers
Cradle – Extraction
Raw Materials
Materials & Parts Suppliers
Materials & Parts Production
Materials & Parts
Assembly
Environmental Impacts
Environmental Aspects
Raw Material Suppliers
Cradle – Extraction
Raw Materials
Packaging Materials Suppliers
Packaging Production
Packaging Materials
Packaging
End-Of-Life
Reuse, Recycling, Disposal
Waste
Consumers
Use
Widgets
Customers
Retail
Widgets
Widget Storage


Ecosystem
Society
Sphere of Influence (A.3.1)
State (4.3.2)
External Stakeholders
(Interested Parties
4.3.2, 4.4.3)
Best Available
Technologies
(A 3.3)
Legal Requirements
Other Requirements & Complaints
Env. Policy-Performance
Technological Options
S5
S4
S3*
S3
S2
Environmental Policy
Improvement
Reccomendations
EMS Performance
Objectives, Targets &
Programmes
Improvement
Recommendations
EMS Performance
Roles & Resp/ties
Resources & Training
Objectives, Targets
Operational Criteria
Corrective Actions
Env. Audit
Results
Non-
Conformances
Env.
Performance
Non-
Conformances
Env.
Performanc
(Records)
Env.
Procedures
Emergency
Situation
Raw Material
Suppliers
Cradle – Extraction
Raw Materials
Materials & Parts
Suppliers
Materials & Parts
Production
Assembly
Suppliers'
Env. Performance &
Practices
Raw Material
Suppliers
Cradle – Extraction
Raw Materials
Packaging Materials
Suppliers
Packaging Production
Packaging
End-Of-Life
Reuse, Recycling,
Disposal
Waste
Consumers
Use
Widgets
Customers
Retail
Widget
Storage
Env.
Performance
For Peer Review


Ecosystem
Society
External Stakeholders
(Third Parties 5)
External Reviewer(s)
(6)
Database Providers
(4.3.2)
Goal of the study(4.2.2)
S5
Scope of the study (4.2.3)
Reporting (5)
Critical Review (6)
S4
Collecting data (4.3.2)
Calculating data (4.3.3)
Allocation (4.3.4)
Life Cycle Impact Assessment (4.4)
Life Cycle Interpretation(4.5)
S3
S3*
S2
Collecting data [onsite] (4.3.2)
Critical Review (6)
Collecting data (4.3.2)
S1
System Boundary (4.2.3)
Raw Material Suppliers
Cradle – Extraction
Raw Materials
Materials & Parts Suppliers
Materials & Parts Production
Materials & Parts
Assembly
Environmental Impacts
Environmental Aspects
Raw Material Suppliers
Cradle – Extraction
Raw Materials
Packaging Materials Suppliers
Packaging Production
Packaging Materials
Packaging
End-Of-Life
Reuse, Recycling, Disposal
Waste
Consumers
Use
Widgets
Customers
Retail
Widgets
Widget Storage


Ecosystem
Society
S5
LCA Goal
LCA Report
S4
External Stakeholders
(Third Parties 5)
LCA Report
External Reviewer(s)
(6)
Draft LCA Report
Comments
LCA Scope
Comments
(Draft) LCA Report
LCI and LCIA Data
Public Data Sources
(4.3.2)
S3
S3*
S2
LCI Data
LCI Data
(onsite)
LCI Data
LCI
(Rec
S1
Raw Material
Suppliers
Cradle – Extraction
Raw Materials
Materials & Parts
Suppliers
Materials & Parts
Production
Assembly
LCI Data
Collection
Method
Supplier
LCI Data
Raw Material
Suppliers
Cradle – Extraction
Raw Materials
Packaging Materials
Suppliers
Packaging Production
Packaging
End-Of-Life
Reuse, Recycling,
Disposal
Waste
Consumers
Use
Widgets
Customers
Retail
Widget
Storage

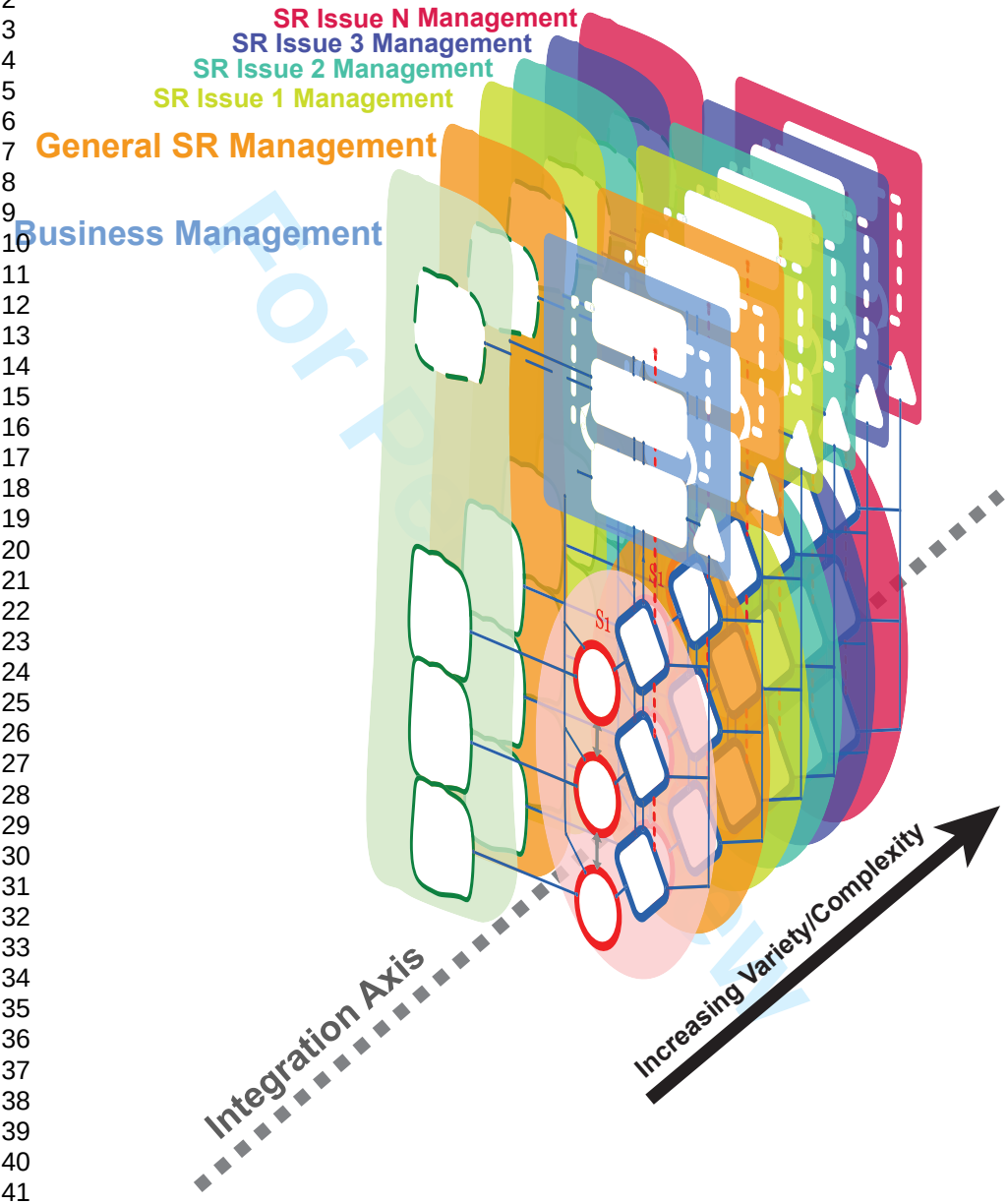


Table 1 VSM Integration Table

VSM System	Generic SR Function	ISO 26000	ISO 140001	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	4.2, 4.6	4.2.2
	Creation of SR Culture	7.4.1	-	-
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 1 VSM Relationship Table of ISO 26000

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			

R: Responsible VSM element, C: Contributing VSM element

Table 1 VSM Relationship Table of ISO 14001

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**			I
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			

R: Responsible VSM element, C: Contributing VSM element

Table 1 VSM Relationship Table of ISO 14044

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)						I
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**			I
4.5 Life cycle interpretation			**R**			
5 Reporting		**R**				
6 Critical review		**R**				

R: Responsible VSM element, C: Contributing VSM element