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**SUSTAINABLE SUPPLY CHAIN PERFORMANCE MEASUREMENT:
A MULTIPLE CASE STUDY APPROACH**

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1. Introduction

Since several years, companies face important pressures from various stakeholders to become more and more sustainable. This allowed to open a new set of practices for the management that quickly infiltrated all the business functions, including supply chain management. However, managing sustainability along the supply chain is far from being easy. Indeed, these practices have high costs, coordination can be highly complex, communication with suppliers can be difficult, competitive pressure may be too high, etc. (Seuring & Müller, 2008; Tay et al., 2014; Faisal, 2010; Carter & Rogers, 2008). But in order to develop a sustainable supply chain, one of the main driver is a formal performance management and measurement of sustainability along the supply chain. Monitoring, evaluation and reporting as well as metrics to quantify sustainability benefits for the supply chain are crucial conditions to have an effective sustainable supply chain (Carter & Rogers, 2008; Seuring & Müller, 2008).

The will of the corporate world to address this issue is rising since several years. For example, while the French luxury goods holding company Kering recently presented its methodology to measure sustainability along the supply chain (Gonzalez, 2015), Hilton, the hotel chain, also disclosed its proprietary sustainability performance measurement platform in the news (Gloudeman, 2015). Furthermore, Walmart recently granted \$875.000, coupled with a previous investment of \$2 million, to the University of Arkansas for The Sustainability Consortium. One of the key goal of this investment was to help companies to measure sustainability along the supply chains (Lewis, 2015).

This master thesis aims to explore the sustainable supply chain performance measurement (SSC/PM) issue. It is *“the evaluation of the supply chain according to its impact on sustainability: in economic, social and environmental dimensions, considering supply chain product, processes and outcomes”* (Cetinkaya et al., 2011, p. 57). There is a well-known interest for sustainable supply chain management but when researches focus on supply chain performance measurement, the discussions regarding sustainability indicators remain scarce (Hassini et al., 2012). Moreover, a lot of researches provide various insights regarding the inclusion of sustainability in supply chain management but fewer on the measurement within the specific function that is supply chain management (Taticchi et al., 2013). However, given the large spectrum of activities that supply chain management encompasses, professionals of this field are in a key position to have an effect on the Triple Bottom Line (Carter & Rogers, 2008). Furthermore, performance measurement systems (PMS) are needed to fully implement

sustainability within the supply chains (Hervani et al., 2005). Indeed, a SSC/PMS can be used for several purposes such as external communication to stakeholders, progress monitoring to improve internal performance, and compliance with regulations (Hervani et al., 2005). This is why this issue was explored.

More precisely, the goal of the research is to find out **how companies are measuring sustainability performance along the supply chain and how this process is managed**. The thesis tries to highlight what are the current trends regarding sustainability performance measurement for the supply chains as well as their managerial implications. Furthermore, the following sub research questions will be addressed in the thesis:

- 1) What are the measures (metrics and indicators) used in the SSC context and how are they defined?
- 2) How are they managed by the companies within the performance measurement systems?
- 3) What are the benefits but also the challenges that companies face when dealing with sustainable supply chain performance measurement?

Through multiple case study research, the thesis studies four large companies from different industries. “Alpha” which is a company that desires to remain anonymous, GSK Vaccines which is in the healthcare and pharmaceuticals industry, Solvay which is in the chemicals industry and bpost which is a postal service. The empirical part is based on several interviews conducted with CSR and supply chain specialists of each company in order to get acquainted with the corporate reality of the issue. Different industries are explored since there are industry-specific differences regarding the performance measurement (PM) (Cetinkaya et al., 2011). This choice allows to have a view on four different approaches developed within diverse industries.

From a managerial point of view, with this thesis, professionals of the field will be able to become acquainted with the practices developed by companies that are leading the way in sustainable supply chain performance measurement. Indeed, the four companies are large firms operating on a global scope and are significantly advanced regarding the subject. Furthermore, benefits and challenges that companies are facing to manage the issue are highlighted while some practical implications are also developed in the conclusion. This could help professionals to spot the areas of importance when developing a SSC/PMS. From a scientific point of view, thanks to the case study methodology, several theoretical propositions were developed. These are new insights regarding the topic and an original scientific contribution. Furthermore, these propositions could be tested in a larger scale academic research.

The thesis consists of four parts. The first is a literature review that allows to explore the history of the subject as well as the current academic trends. The second part focuses on the methodology that was developed to conduct this research. The third part displays the results of the case studies that were conducted in collaboration with the four firms. It is divided into four intra-case analysis that allow to develop deeply the individual cases. This leads to the fourth part that consists of a cross-case analysis which aims to investigate convergences and divergences between the cases. The last part is the conclusion which contains a brief summary of the research, the theoretical implications, the managerial implications and the limitations of the research as well as future research suggestions.

2. Literature review

This master thesis addresses the sustainable supply chain management performance measurement. It is necessary to explore all the terms of this subject in order to have a clear view on the question. This will be done as a review of the state-of-the-art literature in the field. The first section of the review defines Supply Chain Management (SCM) while the second extends this definition to the Sustainable Supply Chain Management (SSCM). The third section investigates the measures that are used to assess the sustainability performance of supply chains as well as different academic approaches to develop these measures. The fourth section explores how these measures are integrated in larger performance measurement systems (PMS) and how these systems are designed and managed. The last section considers the many challenges that companies face to develop an effective SSC performance measurement. This part shows the path that has been made to the definition of the research question as well as the relevance of the latter.

2.1. Supply chain management

Before jumping into the definition of Supply Chain Management, it is already important to define what a supply chain is. A first definition sees the supply chain as “*an integrated process wherein raw materials are manufactured into final products, then delivered to customers via distribution, retail, or both*” (Beamon, 1999, p. 275). This definition is quite simple and gives a raw idea of what a supply chain is, but it only takes into account the physical side of the supply chains. A definition by Chopra and Meindl (2009) shows better the complexity of what a supply chain can be by explicitly defining the supply chain as **all stages** involved, directly or indirectly, in fulfilling a customer request. Chopra and Meindl (2009) also present the typical stages in a supply chain as the suppliers, the manufacturer, the transporters, the warehouses, the retailers and also the customers. With this definition, the image of a chain of firms that bring a product to a final customer is clearer and is closer to the reality of a supply chain. However, an important component of a supply chain which has not been mentioned is the information flow between all the stages. Another definition characterizes the supply chain as “*all activities associated with the flow and transformation of good from raw materials stage (extraction), through the end user, as well as the associated information flow*” (Handfield & Nichols, 2001, p. 2). It is also specified that these flows go both up and down the supply chain.

But, Mentzer et al. (2001) give a definition, widely used in the literature, which encompasses all the characteristics previously cited in a simplified sentence. They define a

supply chain as “a set of three or more entities (organisations or individuals) directly involved in the upstream and downstream flows of products, services, finances, and/or information from a source to a customer” (Mentzer et al., 2001, p. 4). This definition encompasses the final consumer but also services and finances flows. Combining the different definitions, a generic representation of a supply chain can be drawn (see **Figure 1**). The different flows are represented (material, information and funds), along with the different links of the chain. The examples of external providers show the complexity that a supply chain can reach and therefore the chain may not only be seen as a chain but even as a network (Mentzer et al., 2001; Tancrez, 2013). This idea of a network is enhanced by the fact that some companies belong to different supply chains simultaneously while playing different roles in each chain (Mentzer et al., 2001; Hervani et al., 2005). Within this scope, it is also important to define the company which is at the centre of the supply chain, usually the firm which is taken as a focal point for a supply chain. A *focal company* is a firm that usually rules the supply chain, provides the direct contact to the client and develops the product or service offered (Handfield & Nichols, 1999; Schary & Skjott-Larsen, 2001). In **Figure 1**, the focal company is represented by the “Organisation” case.

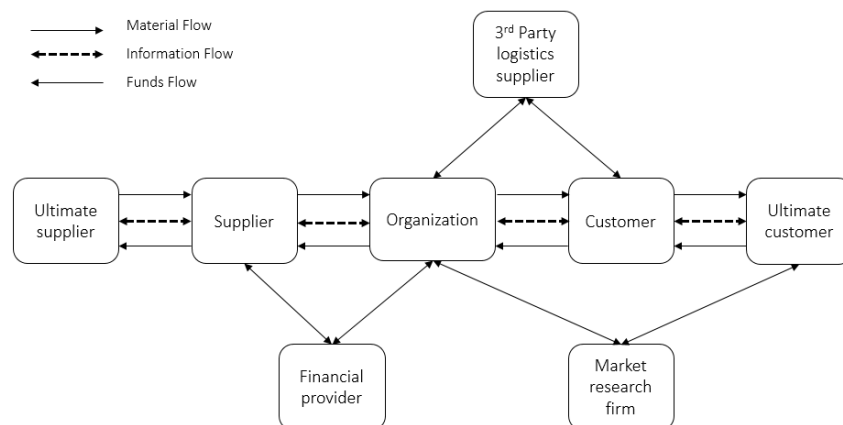


Figure 1 – Schema of a generic Supply Chain (Adapted from Beamon, 1999; Chopra & Meindl, 2009; Mentzer et al., 2001).

These supply chains exist whether they are managed or not managed at all (Mentzer et al., 2001). Indeed, some companies may not take care at all of the supply chain while other will manage the different stages of the chain in which they are located. This leads us to the definition of the management of all these stages of firms which is, now, widely known as Supply Chain Management (SCM). An early definition, from Tyndall et al., of what was called supply chain management logistics gave an interesting view about the management of the different flows: “the art of managing the flow of materials and products from source to user. [...] The SCM includes the total flow of materials, from the acquisition of raw materials to delivery of finished

products to the ultimate users, as well as the related counter flows of information that both control and record material movement” (as cited in Mentzer et al., 2001, p. 16). However, the definition which is commonly used in literature is the following, defining SCM as *“the systemic, strategic coordination of the traditional business functions and the tactics across these business functions within a particular company and across business within the supply chain, for the purpose of improving the long-term performance of the individual companies and the supply chain as a whole”* (Mentzer et al., 2001, p. 18). The latter puts more emphasis on the strategic coordination of business functions inside of a particular company, as well as a coordination of the businesses within the supply chain itself. It brings also an important element which is that SCM is a process which helps improving the performance of a focal company but, furthermore, by working together, SCM can improve the performance of every companies of the chain/network.

Supply chain management encompasses a lot of activities, among others there is procurement, distribution, production, product design, suppliers’ management, etc. Within this context, *“supply chain professionals are in an outstanding position to impact sustainability practices”* (Carter & Rogers, 2008, p. 361). Therefore, the sustainability issue has seen a growing interest in the field of SCM, both from the academic and corporate world (Seuring & Müller, 2008). This led to a new paradigm of SCM, incorporating the sustainable dimension within the “traditional” SCM, the Sustainable Supply Chain Management (SSCM).

2.2. Sustainable supply chain management

Sustainable development has its roots in the Brundtland report issued by the United Nations World Commission on Environment and Development (WCED) in 1987. This report, named *“Our Common Future”*, defined for the first time sustainable development as the *“development that meets the needs of the present without compromising the ability of future generations to meet their own needs”* (Our Common Future, 1987, p. 41). This definition is still vague but the report mentions several time the importance of the economic, social and environmental dimensions within sustainability. This is integrated in the *“Triple Bottom Line”* which is a central concept that helps to operationalize sustainability (Seuring & Müller, 2008). Sustainability consists of three dimensions which are the environmental, the social and the economic dimensions also known as *“People, Planet and Profit”* (Elkington, 1998). This framework is depicted in **Figure 2** and it shows that the intersection of these dimensions creates sustainability. Furthermore, this intersection creates a long term economic advantage and competitive advantage for the firm (Carter & Rogers, 2008).

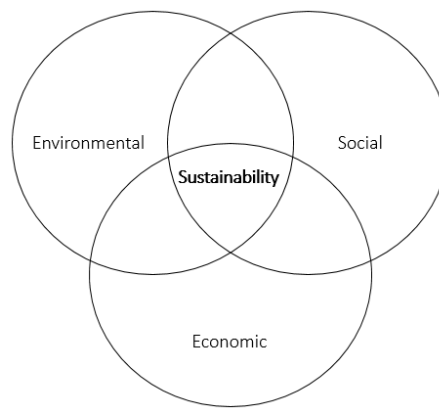


Figure 2 – The Triple Bottom Line (Source: Adapted from Carter & Roger, 2008).

These three pillars being identified, Carter and Rogers integrate them into SCM and define the Sustainable Supply Chain Management (SSCM) as “*the strategic, transparent integration and achievement of an organisation’s social, environmental, and economic goals in the systemic coordination of key interorganisational business processes for improving the long-term economic performance of the individual company and its supply chains*” (Carter and Rogers, 2008, p. 368). Taticchi et al. (2013) assume three managerial practices to achieve sustainability within the supply chains:

- The imperative to reduce negative environmental and social impacts;
- The consideration of every stages of the value chain for each product;
- A multi-disciplinary perspective which encompasses the entire product life cycle.

Seuring & Müller (2008) add that the goals related to the three dimensions are derived from customer and stakeholder requirements. Indeed, stakeholders is an important driver for implementing sustainability in supply chains. While there is an impression that external stakeholder pressure is the only driver of SSCM (Wolf, 2014), Seuring & Müller (2008) reviewed the literature about the topic and identified several pressures and incentives for adopting SSCM. Regulation is the most important one, followed by customer demands, response to stakeholders, environmental and social pressure groups, reputation loss but it is also motivated by the conviction that SSCM can bring a competitive advantage to the companies (Seuring & Müller, 2008).

Sustainable activities within the supply chain present various advantages such as costs savings due to reduced packaging waste, reduced health and safety costs, better working conditions, lower labour costs, future regulations proactively shaped, better product quality and better reputation (Carter & Rogers, 2008). It is, therefore, attractive to develop such practices

within companies but SSCM also has several barriers to its implementation and they are listed in **Table 1**. However, enablers and drivers also exist to facilitate the development of SSCM. Both can be classified according to their external or internal relation with the organisation.

Table 1 – Drivers and barriers towards SSCM

	Enablers/Drivers	Barriers
Internal	Top management commitment Employee involvement Training and education Performance management – Monitoring, evaluation, reporting and sanction – Metrics to quantify sustainability benefits in a SC Corporate culture supporting sustainable issue Risk management Availability of funds Having management systems implemented (such as ISO 14001, SA 8000) Specifying a SSCM strategy and aligning it with corporate strategy Internal CSR practices already in place Information sharing Communication and transparency in the SC Organisational size (big firm)	Higher costs Coordination complexity/effort Insufficient or missing communication in the SC Lack of management commitment Traditional accounting methods used in performance management Lack of training and education Lack of understanding of how to incorporate sustainability in SCM Other SCM priorities Lack of corporate structure and processes Organisational size (small firm)
External	<u>Stakeholders influence:</u> Government and regulations Pressure from NGOs Pressure from customers Pressure from competitors Pressure from investors Collaboration with suppliers	Government and regulations Competitive pressure Consumers desire for lower prices Poor supplier commitment Green washing from medias Less regulated industries
Source: Adapted from Seuring & Müller (2008); Tay et al. (2014); Faisal (2010); Carter & Rogers (2008)		

Plenty of drivers and barriers towards SSCM exist but one will be detailed in the following part of this literature review. Indeed, performance measurement of sustainability along the supply chain is crucial to manage data reflecting company performance and its impact on sustainability, data which are used to support actions from the firm (Cetinkaya et al., 2011). Furthermore, Handfield et al. suggest that companies with a formal monitoring and reporting system on CSR issues in their supply chain are likely to enjoy performance advantages along with a greater commitment from stakeholders (as cited in Keating et al., 2008). Therefore, this issue is developed in the following parts of this literature review.

2.3. Sustainable supply chain measures: metrics and indicators

According to Taticchi et al. (2013), popularity of performance measurement and management has notably increased in the last decades. Performance measurement is a “*process of quantifying efficiency and effectiveness of action*” (Neely et al., 1995, p. 80). Ahi and Searcy (2015) add that this process of measuring the efficiency and effectiveness of action can be done with *metrics* or *indicators*. Metrics are quantitative performance measures. Indicators are qualitative performance measures and have a broader focus (Ahi and Searcy, 2015).

A second categorization of measures differentiates *leading* and *lagging* measures. Leading indicators are the measures that drive future performance of the company, are *ex ante* and induce lagging indicators (Manuele, 2009; Caplice & Sheffi, 1995; De Rongé, 2014). For example, inventory level is a leading indicator. A high inventory level can both indicate that company's supply is too big for the market or that the demand is expected to increase (Kalen Smith, s.d.). This indicator can, indeed, predict future performance of the company but it must be accurately interpreted. On the contrary, lagging measures indicate the outcomes which are the results from past efforts and are *ex post*. For example, the number of sales is a lagging indicator as it is an historical result.

Within the context of sustainability performance, McElroy and Van Engelen (2012) classify sustainability metrics in two categories: *absolute* and *relative*. Absolute metrics represent operational performance regarding the general level of performance in a specific area like the level of CO₂ emission (McElroy and Van Engelen, s.d.). Relative metrics represent operational performance in terms of how the performance in a specific area is correlated to a performance in another area like the correlation between water use and total production (Ahi and Searcy, 2015). However, according to the authors, organisation cannot only use relative and absolute metrics for the sustainability issues because these metrics are not linked to the sustainability context in which the organisation evolves. Therefore, McElroy and van Engelen (cited by Ahi and Searcy, 2015) present another category of sustainable metrics which are *context-based* metrics. According to McElroy and van Engelen, these metrics “*express organisational performance in terms of impacts on vital capitals, relative to norms, standards or thresholds for what such impact ought to be (for specific periods of time) in order to be sustainable (e.g., total water consumed per employee per year compared with a fair or equitable allocation of available renewable supplies)*” (cited by Ahi and Searcy, 2015, p. 65).

According to Björklund et al. (2012), indicators and metrics supporting future management are missing within the context of SSCM. In fact, measuring effects of past decisions is the dominant practice (Björklund et al., 2012) and, thus, the focus is on lagging indicators rather than on leading ones. Moreover, a study by Ahi and Searcy (2015) reveals that a majority of SSCM metrics presented in the related literature are quantitative and absolute, giving little attention to qualitative and relative ones. Finally, no context-based metrics have been identified. However, a complete set of these various metrics are necessary to have a comprehensive SSCM measurement and no type of metrics or indicators should be set aside, especially the context-based sustainability metrics (Ahi & Searcy, 2015). Indeed, according to Ahi and Searcy (2015), firms must connect the performance to the sustainability context in which they operate.

In the SSCM literature, little attention has been given to the social issues (Seuring & Müller, 2008; Ashby et al., 2012). The same observation is made regarding the performance measurement for SSCM. The social dimension of SSCM represents a small part of metrics identified (Ahi & Searcy, 2015). Possible causes are that environmental characteristics can provide measurable benefits as they are more aligned with supply chain performance while social sustainability is considered as vaguer (Banerjee, 2010). Indeed, social issues are frequently hard to measure, thereby quantitative metrics are less used to the benefit of qualitative metrics (Ahi & Searcy, 2015). Furthermore, according to Cetinkaya et al. (2011), social measurements are also often separated from performance measurements to be, for example, incorporated in the human resources section.

Hassini et al. (2012) also compiled various barriers to the development of reliable metrics within a SSCM environment. Firstly, there is a difficulty to agree on which specific metrics/indicators should be used to measure SSCM performance (Hervani et al., 2005; Ahi & Searcy, 2015). Secondly, supply chains involve various stakeholders and partners. This diversity of people through supply chains leads to situations where negotiations are necessary to agree on which metrics to use and based on which data (Hervani et al., 2005). Thirdly, according to Lehtinen and Ahola (2010), classical production measures have an intra-organisational scope and are incompatible with supply chain measures which have an inter-organisational scope. Fourthly, many environmental measures are linked to regulations but social and economic measures are not and this is thus difficult to impose compliance through the whole supply chain (Hassini et al., 2012). Finally, according to Schaltegger and Burritt (2014), metrics must be selected according to the sustainable strategy of the firm but firms from

the same supply chain may have different strategies, both general but also different sustainable strategies. This situation can create misalignments between parties' metrics of the supply chain (Hassini et al., 2012).

To develop sustainability measures, firms may rely on ISO 14031 which is a guideline providing key environmental metrics (Hervani et al., 2005). It is intended to be applicable to every organisation independently of its specific aspects and to give help on designing environmental performance evaluation (International Organisation for Standardization, 2013). But its focus is only on environmental characteristic and sidesteps the social one. Furthermore, it only gives guidelines and does not provide any performance levels. Reefke and Trocchi (2013) propose to select measures from EMAS or GRI. EMAS (for Eco Management and Audit Scheme) is a European environmental audit and management system allowing to evaluate, improve and report about firm's environmental policy (Belgium.be, s.d.). As ISO 14031, it does not address the complete TBL. On the contrary, Global Reporting Initiative (GRI) is a non-profit organisation that promotes sustainability in the economic world. They develop standards and guidelines to help companies to integrate sustainability (on the TBL sense) in their annual reports. However, according to Ahi and Searcy (2015), applying these standards to develop SSC measurement can be problematic because they are not designed to be used in a supply chain context.

On the contrary, Schaltegger and Burritt (2014), present three basic strategies in SSCM and propose to adapt the metrics and indicators to these strategies. Firstly, the *efficiency* approach in a SCM context recommends to decrease waste production and to consume less resources in each stage of the supply chain (Schaltegger and Burritt, 2014). Related metrics are ratios of the carbon footprint of a product, material concentration of a product which can be represented by the tons of materials per product unit ratio, the energy consumption of a product, etc. (Schaltegger and Burritt, 2014). Secondly, the *consistency* approach advises to substitute unsustainable materials with sustainable ones (Schaltegger and Burritt, 2014). Related metrics consist of quantity of non-natural materials, biodegradability of products, percentage of renewable energies used in the supply chain, etc. (Schaltegger and Burritt, 2014). Finally, the *sufficiency* approach prescribes the elimination of the products that do not have to be produced in order to decrease the impact of the supply chain (Schaltegger and Burritt, 2014). Related metrics can be the reduction of the number of products and parts of the products, etc. (Schaltegger and Burritt, 2014). The authors highlight the fact that these strategies are rarely used apart and are usually combined to each other.

However, these strategies seem to focus only on the environmental side of the TBL. Hassini et al. (2012) propose a process based on the TBL to develop indicators. **Figure 3** outlines this process. Each partner of the focal firm have to develop sub-indicators based on each dimension of the TBL and these sub-indicators are aggregated into a *composite indicator* (Hassini et al., 2012). Cetinkaya et al. (2011) provide examples of indicators for each dimensions which are summarized in **Table 2**. This framework has the advantages to take the three dimensions of sustainability and involve the various stages of a supply chain. But the sub-indicators are linked to partners' strategies and this can create inconsistency (Hassini et al., 2012). In the same vein, Varsei et al. (2014) also developed a framework for sustainability performance assessment for supply chains. They advocate to develop measures related to the TBL while taking into account the drivers as well as enablers of sustainable supply chains. The drivers being, according to the authors, stakeholders, institutional pressures and proactive measures. Enablers of SSC are resources, supply chain configuration and capabilities of the focal company (Varsei et al., 2014). They also presented the most important sustainability measures for supply chains. For the economic performance, Varsei et al. (2014) highlighted supply chain cost and supply chain service level to be the primary measures to use. For the social performance, they based their choice on GRI and highlighted four central measures: labor practices, human rights, and society and product responsibility. For the environmental part, the literature highlights that greenhouse gas emission is the most important measure but they also pointed out water usage, energy consumption, waste generation and the use of hazardous and toxic substances (Varsei et al., 2014).

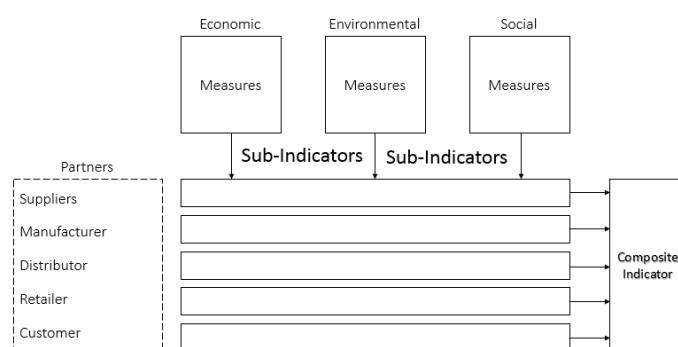


Figure 3 – Framework for sustainable supply chain metrics (Source: Adapted from Hassini et al., 2012).

Table 2 – Examples of SSC measures for each dimensions of the TBL with sub-categories

Economic dimension	
Categories	Examples of measures
Quality	Number of stock outs, Customer response time, Product lateness, On-time delivery (%), Delivery reliability, Customer satisfaction, Customer complains, Product availability
Efficiency	Cash-to-cash cycle, ROI, Inventory level, total logistics cost, value added productivity, Asset returns, Inventory utilization, Truck fill rate, Warehouse utilisation, Delivery cost
Responsiveness	Time to market, Production flexibility, Response time, Order cycle time, Track and trace performance, Order flexibility, Order fulfilment lead time
Environmental dimension	
Categories	Examples of measures
Emissions	CO2 produced per litre delivered, total CO2 emission in tons, reduction of CO2 emission (% or in tons)
Natural resources utilisation	Reduction of fuel utilisation, reduction of water utilisation per warehouse, reduction of need for road transport
Waste and recycling	% of packaging recyclable, % of packaging reused, reduction of equipment losses, reduction of cargo damage, reduction of spillages and leakages, reduction of obsolete, out of date items in warehouse
Social dimension	
Categories	Examples of measures
Health and safety	Number of employees/subcontractors/suppliers trained in health and safety procedures, number of accidents (within the company), number of accidents that involve third party, near misses, number of serious/fatal accident, reduction of spillage and leakages (chemical substances), reduced accident probability
Employees	% of production in EU, number of jobs created, number of workers trained to use new system, number of jobs reduced, number of people on long-term contracts, % of staff trained, number of drivers trained, staff retention, absenteeism
Noise	Noise reduction (time of truck delivery), noise reduction from warehousing operation, activities switched/created at industrial zones
Source: Adapted from Cetinkaya et al. (2011)	

In order to develop new specific measures for SSCM, Ahi and Searcy (2015) developed a complete framework based on a SSCM definition given by the same authors: [SSCM is] “*the creation of coordinated supply chains through the voluntary integration of economic, environmental, and social considerations with key inter-organisational business systems designed to efficiently and effectively manage the material, information, and capital flows associated with the procurement, production, and distribution of products or services in order to meet stakeholder requirements and improve the profitability competitiveness, and resilience of the organisation over the short- and long-term*” (Ahi and Searcy, 2013, p. 339). Their

proposition is to develop measures that address all the stakeholders of a SC (supplier, distributor, retailer, end-user, etc.) but also the broader sustainability context of a supply chain. Measures must, finally, address all the characteristics of SSCM mentioned in the above definition. The TBL, obviously, but also the efficiency, the long-term orientation, the volunteer one, the coordination perspective, etc. The authors created a framework, represented in **Figure 4**, to assess the measures and to develop new ones.

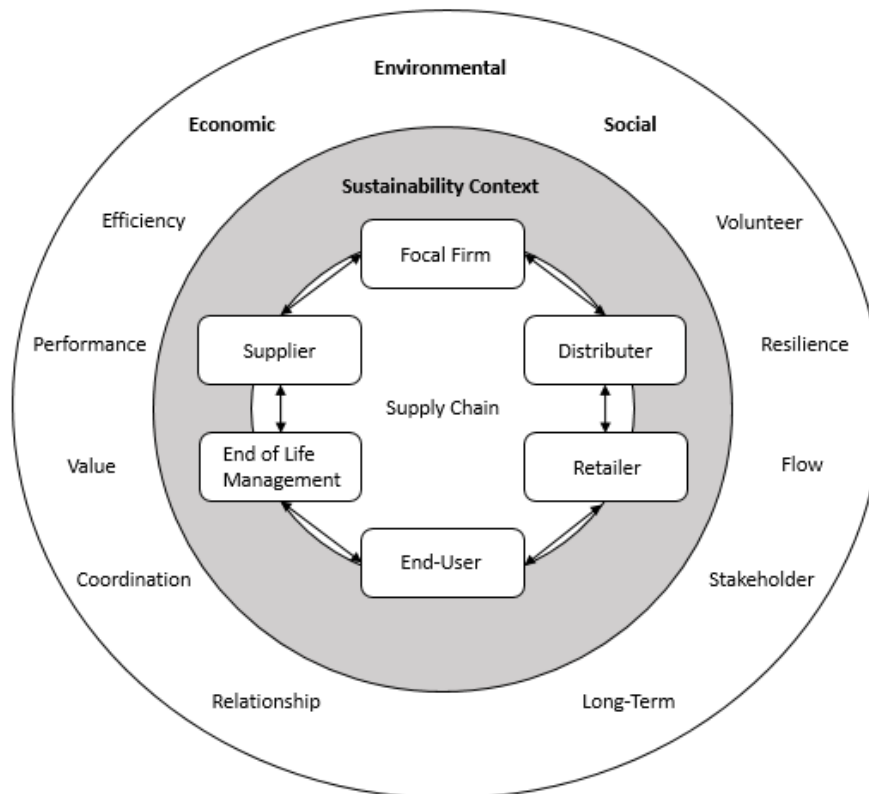


Figure 4 – Framework for measuring performance in SSCM (Source: Adapted from Ahi and Searcy, 2015).

2.4. Sustainable supply chain performance measurement systems

These metrics and indicators are ideally used in a performance measurement/management system (PMS) (Caplice & Sheffi, 1995) which is, according to Taticchi and Balachandran, a broad term to designate “*the process of using measurement information for supporting managers in decision-making processes aiming to link strategy to operations*” (as cited by Taticchi et al., 2013, p. 785). Commonly associated synonyms of PMS are *business dashboards* or *cockpit* but PMS is, more generally, related to the entire system of performance measures while dashboard is a term referring to the upper and directional part of the PMS (Tonchia & Quagini, 2010). Indeed, as **Figure 5** shows, measures are present at the three levels of an

organisation (i.e. operational, functional and strategic) and are part of a broad PMS. The elementary measures of the lower levels are aggregated in the strategic/managerial board afterwards (Tonchia & Quagini, 2010). Mendoza et al. (2005) identified several drifts when using PMS. Firstly, there can be an over-use of strategic measures while forgetting the operational levels and units information needs (Mendoza et al., 2005). The second drift is the over-use of operational dashboards which leads to a lack of coordination in performance management (Mendoza et al., 2005). Finally, a last drift is an excess of information for the managers in the directional scorecards when the information from various departments is not filtered, selected and hierarchized (Mendoza et al., 2005).

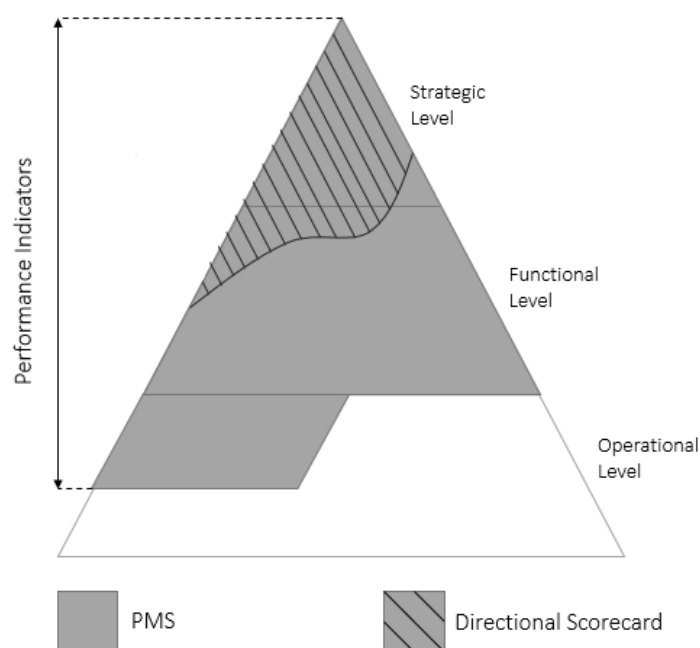


Figure 5 – PMS (company's scorecard) and the managerial scorecard (Source: Tonchia & Quagini, 2010).

However, in practice, PMS are rarely properly managed (Caplice & Sheffi, 1995). But, according to Gunasekaran and Kobu (2007), organizing measures into frameworks allows to identify success; identify customer needs; understand better processes; identify problems, bottlenecks, waste, and improvement possibilities; ensure factual decisions; enable and track progress; facilitate more open and transparent communication and cooperation. This allows to use measures as complement and support to each other while providing a balanced representation of the supply chain process to the decision makers (Caplice & Sheffi, 1995). The concept of *balance* refers to the importance to develop different metrics that provide a holistic perspective of the firm when metrics are tied together (Kaplan & Norton, 1996). According to

De Rongé (2014), this is a balance between financial and non-financial indicators; internal and external indicators; lagging and leading indicators. Even if this subject gained in attention from practitioners and academics, relatively little consideration has been given to sustainable supply chain performance measurement (SSC/PM) (Taticchi et al., 2013).

According to De Toni and Tonchia (2001), performance measurement systems went through an evolution these last decades as reflected in **Table 3**. Traditional PMS were based on cost efficiency and control while the more recent and innovative ones are value-based and include non-cost measures. A shift also occurred regarding the temporality. With innovative PMS, long term orientation prevails while traditional ones have a shorter term view. Another notable difference is that traditional PMS are function-based and compare the performance with standards while innovative PMS measure performance on a trans-organisational basis and monitor improvements (De Toni & Tonchia, 2001). This allows the evaluation but also an involvement from employees and the organisation as a whole (De Toni & Tonchia, 2001).

Table 3 – Comparison of traditional PMS and innovative PMS

Traditional PMS	Innovative PMS
Based on cost/efficiency	Based on value
Trade-off between performances	Compatibility of performances
Profit oriented	Client oriented
Short term orientation	Long term orientation
Individual measures	Team measures
Functional measures	Transversal measures
Comparison with standard	Monitoring improvements
Aim evaluating	Aim at evaluating and involving
Source: De Toni and Tonchia (2001)	

To assess the PMS itself, Beamon (1999) describes a generally accepted set of characteristics for an effective performance measurement system (PMS). Firstly, the *inclusiveness* ensures that PMS measures all processes of the supply chain (Beamon, 1999). Secondly, *universality* guarantees the comparison under various operating circumstances. Thirdly, *measurability* states that the data must be measureable. Finally, *consistency* ensures consistent measures with firm's strategy and objectives. Nevertheless, Caplice and Sheffi (1995), define a more advanced and also widely cited list of evaluation criteria for supply chain performance measurement systems. Firstly, a PMS must be *comprehensive*. It must adopt a stakeholder perspective and catch policy's effects on each of the significant stakeholders (Caplice and Sheffi, 1995; Björklund et al., 2012). Secondly, it must be *causally oriented*. PMS have to follow activities that influence current but also future performance and not only

focusing on historical performance (Caplice and Sheffi, 1995). The authors precise that by tracking the root causes of performance, it will raise long term objectives. PMS must also be *vertically integrated* and transfer the general strategy of the firm through all the decision makers in the organisation. The measures should be linked to all managerial levels: strategic, tactical and operational (Caplice and Sheffi, 1995). PMS also ought to be *horizontally integrated*. Authors state that PMS must contain all functions of the process and measure across the entire supply chain and not only the focal firm (Caplice and Sheffi, 1995; Björklund et al., 2012). PMS have to be *internally comparable*, meaning that it “*recognizes and allows for trade-offs between the different dimensions of performance*” (Caplice and Sheffi, 1995, p. 68). Finally, according to the authors, PMS must be *useful*. If PMS is comprehensible and not too complex, it will guide decision makers through their activities, if not, the system will not be adopted by managers (Caplice and Sheffi, 1995).

A PMS can be designed differently according to the organisation in which it is implemented. Tonchia and Quagini (2010) present three theoretical architectures of PMS. The first is a *vertical* architecture. In this case, the measures are defined at the three organisational levels: operational, tactical and strategic. A major drawback of this structure is that obtaining a good aggregation of indicators for the strategic level without losing too much information can be problematic (Tonchia & Quagini, 2010). The second is the *horizontal* architecture. The measures are defined according to the different organisational units and functions of the company. However, problems of communication and comprehension of information can occur between firm's functions (Tonchia & Quagini, 2010). The third is a *process-based* architecture. Measures are organized according to the processes of the firm and are, thus, cross-functional. In this case, the identification of performance's responsibilities can be difficult due to the inclusion of different business functions in a single process (Tonchia & Quagini, 2010).

Cetinkaya et al. (2011) presented four stages of SCM/PMS implementation in a company as shown in **Figure 6**. In the first stage, companies only measure their core processes which is generally the case for small and medium sized enterprises (SMEs) (Cetinkaya et al., 2011). In the second stage, companies also measure their supporting processes. In the third stage, firms measure outside their borders but only include the nearest partners of the SC (i.e. suppliers and customers) (Cetinkaya et al., 2011). This measurement is limited to the contact point or shared processes between the two companies. Examples of measures are supplier performance or customer performance (Cetinkaya et al., 2011). According to the authors, companies are in the last stage of development of a SCM/PMS when it covers all flows from raw material to final

customer. They argue that this model of four stages can be an evolutionary one for companies that could begin with a simple measurement of core processes and evolve to a whole end-to-end SC measurement.

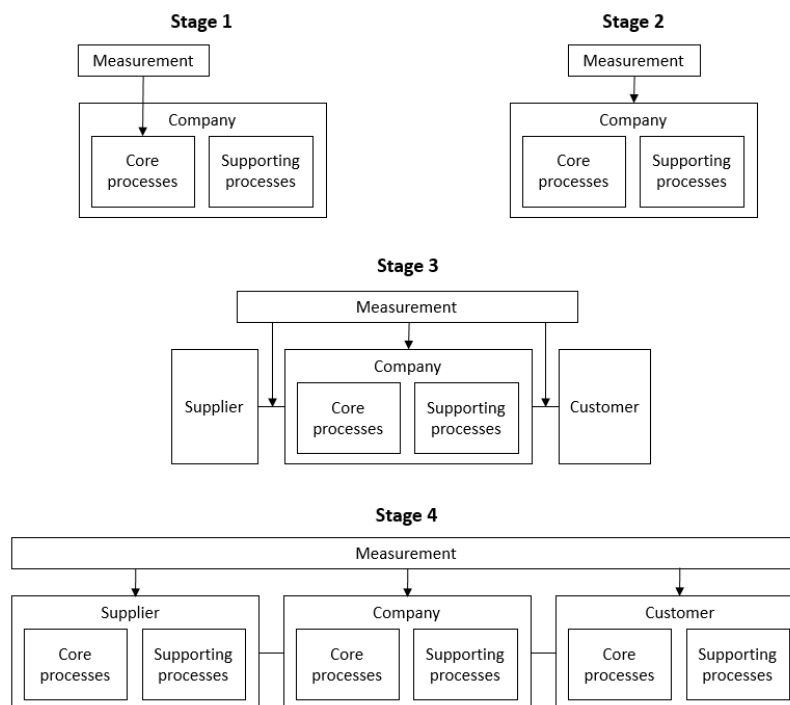


Figure 6 – Stage of performance measurement within a SC (Source: Cetinkaya et al., 2011).

Different researches have been conducted with papers providing guiding principles for particular issues related to SSC/PM, SSC/PM frameworks which integrate one or two dimensions of the Triple Bottom Line but there is no popular academic framework regarding the three dimensions of the TBL related to supply chains (Taticchi et al., 2013). However, taking into account the TBL and measuring performance of SC can bring several benefits to the company and the supply chain as a whole. According to Cetinkaya et al. (2011), an effective SSC performance measurement system allows to:

- Determine present impact and performance of the three perspectives, not only the financial view.
- Determine measures regarding various time periods. Because sustainability is a long term commitment and costs money, tracking performance allows to incorporate long-, mid- and short term measures.
- Track progress over time.
- Monitor strategy execution regarding the economic, social and environmental dimensions with Key Performance Indicators (KPIs).
- Manage and enhance processes by controlling processes and performance.

- Reduce risks.
- Motivate stakeholders of the company and the supply chain by setting goals to fulfil.
- Detect problematic parts of the supply chain and it thus allows to provide training for these parts (people, department, etc.).
- Inform employees which allows to improve their responsibility by making them aware of the impact of their decisions.
- Communicate with external stakeholders (NGO's, etc.) using performance measures.
- Aggregate metrics and indicators coming from different sources.
- Trace the products of the company.
- Link the measures with standards that already exist.
- Standardize performance measures with partners of the supply chain in order to have consistency between the organisations.
- Benchmark performance of the company in order to compare with the leading firms of the industry. However, it must be conducted carefully by taking into account the different factors influencing the different companies.

Estampe et al. (2013) identified 16 different performance frameworks to evaluate a supply chain's performance. Among the sixteen, six include a sustainability dimension in their evaluation of the supply chain and are, thus, SSC/PMS: AFNOR FD X50-605, SCM/SME, APICS, EFQM, SCOR and the balanced scorecard. AFNOR FD X50-605 is a standard developed in 2008 by a French normalization institute. The document presents a method to define logistics goals based on strategic ones, themselves being derived from the competitive advantages of the firm. It also presents the levers to reach these goals as well as the indicators to measure the performance (AFNOR, 2008). The standard models six processes of a supply chain: *"identification of needs and setting of objectives, logistics system design and development, production, sales and distribution, logistics support and control over global logistics process"* (Estampe et al., 2013, p. 254). SCM/SME is a questionnaire developed mainly for an industrial and SME context (Estampe et al., 2013). According to the authors, the framework's structure consists of demand management, distribution, import and export flows, stocks, production, sourcing, returns, after-sales support and traceability. APICS is a tool developed by a professional association fifteen years ago and evaluates innovation and customer service management, efficiency drivers, agility, risk control and sustainability (Estampe et al., 2013). The authors also mention the EFQM model which can be applied to supply chains. The last two PMS are the (Green) SCOR model and the famous balanced scorecard developed by Kaplan and Norton.

Even if no academic framework raised in popularity to measure supply chain's performance within a sustainability context, the two last tools are the most known (Taticchi et al., 2013; Cetinkaya et al., 2011). The balanced scorecard (BSC) being the sole academic model.

2.5. Balanced Scorecard

The balanced scorecard is a performance management tool which was developed by Kaplan and Norton in the nineties. This tool gained substantial success both within academic and professional worlds. Since then, the BSC was developed and customized for various application as for SCM (Brewer & Speh, 2001), for sustainability (Figge et al., 2002) but also for SSCM (Reefke & Trocchi, 2013). The BSC links short-term activities to long-term objectives (Reefke & Trocchi, 2013) and, thus, operational and strategic levels. The BSC contains four perspectives in which strategic objectives are formulated (Kaplan & Norton, 1996):

- The *financial perspective* evaluates whether the general strategy leads to economic success (Reefke & Trocchi, 2013);
- The *customer perspective* evaluates the main customer concerns (e.g. quality, service levels, etc.) and translates the strategic objectives of the company into specific objectives related to customers (Reefke & Trocchi, 2013; De Rongé, 2014);
- The *internal process perspective* translates customer requirements into key internal processes to improve the offer and customer satisfaction (Reefke & Trocchi, 2013);
- The *learning and growth perspective* evaluates the company's capacity to progress in order to improve key internal processes (Fernandez, n.d.).

According to Figge et al. (2002), there are three possibilities to include sustainability into a BSC. The first option is to include environmental and social dimensions into the existing perspectives (Figge et al., 2002). In this case, sustainability issues are managed like other strategic aspects of the organisation but it seems more adapted for firms which have a defensive strategy regarding sustainability as well as a cost control focus (Journeault, 2011). The second option is to create a specific BSC related to sustainability (Figge et al., 2002). The drawback of this design is that the specific scorecard is not linked to the main activities of the company and given that environmental and social dimensions are not linked to economic value creation, strategic needs are not addressed (Journeault, 2011). Finally, the third option is to add a non-market perspective which includes social and environmental aspects (Figge et al., 2002). This allows to emphasize the importance of social and environmental issues within the organisation

but related objectives and indicators remain ambiguous regarding this perspective (Journeault, 2011).

Within the context of SSCM, Reefke and Trocchi (2013) developed a SSCM/BSC with the “non-market” perspective. The authors adapted the process to develop a SCM/BSC of Figge et al. (2002) to the context of sustainability in supply chains. Reefke and Trocchi (2013) highlight six steps to create a SSCM/BSC:

- i. Define the SSCM strategy;
- ii. Define the scope of application;
- iii. Identify environmental and social exposure;
- iv. Determine strategic relevance of sustainability aspects;
- v. Define the cause-effect relationship;
- vi. Define measures and indicators.

A crucial aspect of a BSC approach is the cause-effect relationship between the four perspectives. As shown in **Figure 7**, the lower level perspectives induce performance of the upper level ones (De Rongé, 2014). Indeed, in this case, the non-market perspective constitutes the basis whence objectives of the other perspectives can be achieved (Reefke & Trocchi, 2013). A strategy map helps to illustrate this relationship (Kaplan & Norton, 1996).



Figure 7 – Cause-effect relationship between the five perspectives (Source: Reefke & Trocchi, 2013).

2.6. Problems and challenges to develop SSC/PMS

As developed above, measuring performance within a sustainable supply chain context can provide several benefits to companies and supply chains but these organisations have to deal with as many challenges as benefits that these practices bring. Several barriers in developing performance measurement systems in a sustainable supply chain context were identified.

Firstly, as said above, in a supply chain, the various organisations may have different objectives and would have different opinions on which measures to use (Brewer & Speh, 2001).

Furthermore, corporate cultures and sustainable strategies may also differ and, thus, create misalignment between performance measurements of supply chain's firms (Hassini et al., 2012). Indeed, Holmberg suggests that the lack of link between strategy and PMS is an important challenge which leads to the concentration on internal performance rather than supply chain performance (Holmberg, as cited in Cetinkaya et al., 2011). Cetinkaya et al. (2011) add that the industry of the company influences the choice of indicators and metrics. For example, measures for the automotive industry will be different from the food one (Cetinkaya et al., 2011).

Secondly, this misalignment can create a lack of trust and suspicion within supply chains (Brewer & Speh, 2001; Cetinkaya et al., 2011). Therefore, a trust must be built to share, acquire and monitor data as well as to build and use the measurement system (Brewer & Speh, 2001).

Thirdly, there are comprehension difficulties of inter-organisational measures for managers whose focus is on their organisation's internal systems (Brewer & Speh, 2001). As a challenge to overcome, Cetinkaya et al. (2011) also mention the language barriers between companies of a global supply chain.

Fourthly, managers and organisations want to be evaluated on measures they are able to control but inter-organisational measures are difficult to manage and control as they are not within the scope of these managers (Brewer & Speh, 2001).

Fifthly, information systems are rarely able to collect non-traditional information concerning the supply chain performance but even when it can, these data remain confidential and are scarcely communicated outside the company (Brewer and Speh, 2001; Cetinkaya et al., 2011). Furthermore, according to Morgan (2004), effectiveness of performance measurement may vary according to the size of the company. Indeed, large companies with advanced IT systems may capture the data concerning their activities but internally only or related to their closest partners (Cetinkaya et al., 2011; Morgan, 2004). On the contrary, small companies do not have time, resources and information to analyse their activities while medium-sized ones may have information but not the skills to analyse it (Cetinkaya et al., 2011; Morgan, 2004). Moreover, according to Folan and Browne, it could be difficult to create an inter-organisational PMS given that there could be data duplication, incompatibility or integration problems between SC companies even if companies have internal PMS (as cited in Cetinkaya et al., 2011).

Sixthly, there may be a lack of standardized measures while agreeing upon the units to use, structure or format may be difficult (Brewer & Speh, 2001). Within the context of SSCM, there is a lack of agreement on metrics to use regarding the environmental and social issues (Cetinkaya et al., 2011). An example given by the authors is the various approaches to measure CO₂ emission. Furthermore, a major problem is a lack of common approach not only for the measures but also regarding the measurement system, standards and tools across supply chains (Cetinkaya et al., 2011). The authors also highlight that industry-specific differences are significant (diverse standards, metrics, etc.).

Seventhly, there is a growing difficulty to link measures to customer or stakeholder value within a supply chain context, the definition of a customer inside a SC can be challenging (Brewer and Speh, 2001).

Eighthly, developing such a system can be difficult in a SC since boundaries are challenging to define as well as finding a starting point for the PMS (Brewer & Speh, 2001). Indeed, the global scope of supply chains makes it complicated to visualize the latter and thus to measure an unclear structure (Cetinkaya et al., 2011). There is also a lack of clarity regarding the object of the measurement, the timing of the measurement and the responsibility of the measurement in operational terms but also regarding who will support the costs of implementing the PMS (Cetinkaya et al., 2011; Morgan, 2004).

Finally, there is, in many cases, a lack of distinction between strategic, tactical and operational measures but also between internal, organisational and supply chain ones (Cetinkaya et al., 2011). Furthermore, according to the authors, the prevalence of financial measures is another important challenge for the development of SSC/PMS.

3. Methodology

“Case studies are a valuable way of looking at the world around us” (Rowley, 2002, p. 18).

A case study analysis was chosen to answer the research questions. Firstly, according to Yin (2009), a case study is the preferred method when “how” and “why” questions are asked. This method is suitable for our research given that it is aimed to discover how the sustainable supply chain performance is measured and how this process is managed. Secondly, as researchers, we have no control over the phenomenon that is studied as it is not a laboratory experiment. Indeed, SSC performance measurement is specific to an organisational context and when investigators have little control over events, case study is also the preferred method (Yin, 2009). Thirdly, SSC performance measurement is a contemporary phenomenon within a real-life context that leads also to case study as the ideal method. The goal of the research is to understand the process of SSC performance measurement in its context and investigating a phenomenon in its environment is an important strength of case studies (Rowley, 2002). Indeed, according to Benbasat et al. (1987), the case study approach lends itself to study the phenomenon in its natural setting allowing production of relevant theory by the observation of actual practices. It is also the adequate approach to study such a complex phenomenon when other methods do not allow us to rely on multiple sources of data or to have direct contacts with the interviewees (Yin, 2009). Finally, this kind of research allows exploratory investigations when the phenomenon is not totally understood in the first place (Benbasat et al., 1987).

Practically, case study evidence comes from six sources of data: document, archival records, interviews, direct observation, participant-observation and physical artefacts (Yin, 2009). According to the author, one of the most important source of data is the interview. Yin (2009), highlights two types of case study interviews: in-depth interview and focused interview. The *focused interviews* method was selected. These are open-ended interviews with questions being derived from the case study protocol but respondents are still able to add new topics, opinions and facts (Yin, 2009). This is a very flexible method for small-scale researches such as our thesis (Drever, 1995). The interviews lasted between 1 hour and 1.5 hour. A semi-structured guide has been developed in accordance with the thesis supervisor. The interview guide is divided into four general themes: the introduction, sustainable supply chain management, sustainability performance measurement and sustainable supply chain performance measurement. The guide can be found in the case study protocol in **Appendix A**

on page 73. It was slightly modified as the process of interviews was progressing and according to the person that was interviewed.

Since the literature review suggests that SSCM performance measurement discussions remain limited (Hassini et al., 2012) and its development differs according to the context and industry of the organisation (Cetinkaya et al., 2011), a multiple-case study was performed in order to investigate different ways of measuring sustainability along the supply chains. Moreover, given that the literature review predicts contrasting results according to the type and size of the organisation, which would be a *theoretical replication* (Yin, 2009), the author advises to conduct 4 to 6 case studies.

According to Yin (2009), the unit of analysis defines what the “case” is. In our situation, the unit of analysis is a company and this is thus a multiple-case study with a single unit of analysis. Therefore, a case study corresponds to a single company. The unit of analysis is the organisation but the data collection source has to be an individual. Indeed, the unit of analysis is different from the unit of data collection, **Figure 8** illustrates this rationale. Four companies were selected to be studied. The selection is based on theory. Indeed, according to Morgan (2004), SSC performance measurement depends on companies’ sizes. The larger they are, the more likely SSC performance measurement will be developed. Therefore, large companies were selected in order to draw better conclusions. With the aim to have an adequate sample, it was limited to the companies that expressly mention sustainable supply chain or sustainable purchasing practices on their web sites or for which a specific CSR supply chain function was identified. The concerned executives of the companies were approached by e-mail.

		Data Collection Source		
		From an individual	From an organisation	
Design	About an individual	Individual behavior Individual attitudes Individual perceptions	Individual employee records Interview with individual's supervisor; other employees	If case is an individual
	About an organisation	How organisation works Why organisation works	Personnel policies Organisation outcomes	If case is an organisation
				Study Conclusions

Figure 8 – Difference between unit of analysis and unit of data collection (Source: Yin, 2009, p.89).

The first company is Solvay. To collect the data three collaborators of Solvay were interviewed. The first is Albert Glissenaar who is the process and quality manager for the Supply Chain & Purchasing Excellence function. He is in charge of establishing common group procedures concerning issues such as suppliers' evaluation or corrective plans to take. The second is Jean-François Dehem who is the responsible of sustainability and innovation within the Supply Chain & Purchasing Excellence function. He is in charge of integrating sustainable development within purchasing activities. The last is Ute Hoelscher who is the responsible of the raw materials network and sustainability initiatives for evaluation standards of supply chain's partners. The interviews were conducted on the 24th of April 2015 at the Solvay headquarters in Brussels. The transcription of these interviews can be found in **Appendix C** on page 82.

The second company is a company that decided to remain anonymous. Further details are in the case study analysis. The CSR supply chain manager and the CSR specialist at corporate level were interviewed on the 4th of May 2015 at the headquarters of the company. The CSR supply chain manager's role is to perform risk analysis regarding suppliers as well as organizing suppliers' on-site audits. The CSR specialist has the central position to coordinate CSR strategy through the company. The transcription of these interviews can be found in **Appendix B** on page 76.

The third company is bpost. To collect the data regarding this company, Didier Dekeyzer was interviewed on the 3rd of June 2015 at the headquarters of the company in Brussels. He is the procurement director of bpost and he is in charge of the central procurement for bpost. This encompasses 6 business units and 95% of the bpost's purchases. Didier Dekeyzer also has green procurement initiatives within its department. The transcription of the interview can be found in **Appendix D** on page 88.

The fourth company is GSK Vaccines. Benoît Renson, who is an Environmental senior manager, was interviewed. He is in charge of the environmental management at the country level. Sven Alaerts, who is senior manager for environmental and sustainability at a global level for GSK Vaccines, was also interviewed. The interviews were conducted on the 11th of June 2015 at the headquarters of GSK Vaccines in Wavre. The interviewees did not allow us to record the interview so hand notes were taken. The answers were coded in a table that can be found in **Appendix E**, page 94.

In order to prepare the collection of evidences, a case study protocol was developed. This is a major way to increase the reliability of the thesis (Yin, 2009). According to the author, it must contain the procedures and rules to follow during data collection and is essential for a multiple-case study. The case study protocol can be found in **Appendix A** on page 73 and contains an overview of the project, field procedures, case study questions and a basic outline to guide in the case study report.

Once the data are collected through the interviews, they should be documented and coded (Voss et al., 2002). After each case visit, the tape recording was transcribed. It has been done as soon as possible (the following day) in order to maximize recall, to ease the follow-up and to fill the gaps in the data (Voss et al., 2002). Furthermore, the interviewees were allowed to review draft reports in order to increase the accuracy of the documentation (Voss et al., 2002).

Regarding the analysis, Eisenhardt (1989) elaborates two steps that are reflected in the structure of the thesis. The first step is to elaborate intra-case analysis in order to become closely familiar with each individual case study and to identify case specific patterns before trying to generalize across the cases (Eisenhardt, 1989). Therefore, the following section is divided into the different case analysis according to the company. The second step is a cross-case analysis. According to Voss et al. (2002), a systematic investigation of cross-case patterns is crucial to improve the generalization of conclusions that were drawn from intra-case analysis. This analysis is done through a table given that it is often one of the most effective method (Voss et al., 2002). This cross-case analysis allows to start to investigate similarities or differences between case studies (Yin, 2009; Voss et al., 2002). The pattern matching technique also permits to increase internal validity (Yin, 2009).

Yin (2009) highlights four tests to ensure the quality of a research design: reliability, internal validity, construct validity and external validity. *Reliability* demonstrates that the operations of a study can be repeated and still get the same results. *Internal validity* establishes causal relationships as opposed to spurious relationships. *Construct validity* establishes correct operational measures for the concepts that are studied. *External validity* defines the domain in which the study's findings can be generalized. In order to maximize the benefits from the sources of evidence, Yin (2009) built three principles. Firstly, it is important to use multiple sources of evidence in order to increase construct validity and reliability (Yin, 2009). Therefore, in addition to interviews, documentation was used. This is, according to the author, important to corroborate and increase reliability of evidences from other sources. It consists of documents

that come from the studied companies but also from their websites. Secondly, a case study database has been created in order to increase reliability (Yin, 2009). Every observations are stored on this case database: interview guide, transcriptions of the interviews, companies' documentation such as sustainability reports, etc. From this database, transcriptions of interviews are available in the appendixes above-mentioned. Thirdly, all these precautions being taken, it allows to maintain a "chain of evidence" and, thus, to increase reliability. According to Yin (2009), it allows an external reader "*to follow the derivation of any evidence from initial research questions to ultimate case study conclusion*" (Yin, 2009, p. 122). Furthermore, recurrent contacts with my thesis supervisor allowed a regular work review to increase the construct validity. **Table 4** summarizes the tactics used during the thesis to manage reliability and validity.

Table 4 – Tactics to manage reliability and validity through the thesis

	Research design	Case selection	Data collection	Data analysis
Reliability	Develop case study protocol	Selection based on sustainability reports and size	Use case study protocol Develop case study database	Have interviewees review draft case study report
Internal validity	Research based on theory developed in the literature review	N/A	Multiple interviewees	Do pattern matching
Construct validity	Supervisor review	N/A	Use multiple sources of evidence (triangulation) Establish chain of evidence	Supervisor review
External validity	N/A	Details of companies' context	N/A	Cross-case analysis
Source: Adapted from Yin (2009) ; Reuter et al. (2010) ; Gibbert et al. (2008)				

4. Within-case Analysis

4.1. Case study 1 – Alpha

Organisational context

For various reasons, this company decided to remain anonymous for this research. However, the company is still included within the scope of the thesis even if some contextualization was lost. It was asked that the firm could not, even indirectly, be recognized. Thus, the company was renamed “Alpha” and it was decided not to include related references in the bibliography. The following analysis is based on the interviews conducted with the CSR supply chain manager of the company and the CSR specialist at corporate level, the CSR report of the company and its website.

Sustainable development within the company

The interviewees define sustainable development as a process ensuring that, in the future, our children will have a planet at least in the same state than today. CSR being the way to achieve it. A definition which is close to the Brundtland Commission one. Nevertheless, the CSR strategy of the company is built around three pillars: Education; Communities and Environment. This can be linked to the TBL but the economic dimension is separated while two pillars represent the social dimension (Education and Communities). The Communities pillar aim is to invest in order to promote the Alpha’s technologies within their Communities. Regarding the Education pillar, it aims to educate people about their technologies. For these three pillars, several objectives are associated which are all linked to the company’s strategy and its industry. There is a clear strategic alignment between the sustainable development strategy and the sector of activity of the company.

Regarding the KPIs, there is an additional “General Information” part which can be seen as the economic dimension of the TBL. The company presents numbers such as total revenue or number of full time equivalents (FTE). These are **absolute metrics**.

For the social dimension, which encompasses the Education and Communities pillars, Alpha presents KPIs such as number of trained persons or amount of investment for the communities which are **absolute metrics**. However, they also show this investment as percentage of the net income which is a **relative metric**. There is another category which is separated from the three pillars but that can be linked to the social dimension of the TBL. Indeed, the company develop a complete set of KPIs regarding the working culture within

Alpha. These are mainly human resources indicators such as percentage of women in the company or illness rate. There is a mix of **absolute** and **relative metrics**.

The environmental dimension is much more developed and contains nine **absolute metrics**. Furthermore, the metric is divided into sub-metrics according to their scope. The first scope is the direct emissions of greenhouse gas from their own activities, mainly their truck fleet's emission. The second scope concerns the indirect emissions generated from its purchased electricity while the third scope concerns the emissions not controlled by the company such as the ones from business travels.

Finally, this general sustainable development strategy is supported by the willingness to increase sustainability consciousness along their supply chain. A specific category of KPIs is dedicated to this issue in the CSR report as developed in the following section.

Sustainable supply chain performance measurement

Alpha has a specific strategy developed for its supply chain regarding the sustainability. Their goal is to support social and environmental practices along their supply chain. This vision is reflected into two objectives: improving CSR standards of their suppliers and including CSR criteria for suppliers' selection. It concerns mainly the procurement and supplier management. The actions are twofold in this area. Firstly, suppliers have to fill a CSR self-assessment questionnaire issued by Alpha. According to the interviewees, a limit to this approach is that suppliers can still lie and this is why suppliers part of the short list of a call for competition are encouraged to fill in a questionnaire externally reviewed by a third party: the company EcoVadis. Secondly, on-site audits are performed by a joint organisation specific to Alpha's sector of activity. The audit organisation consists of ten companies. According to the interviewees, audits are more reliable at a first glance but audits have to be performed much deeper to be efficient and reliable.

Regarding the logistics part of the supply chain management, even if actions are taken, no formal monitoring exists. An exception is made for the greenhouse gas emissions of Alpha's truck fleet. They report their logistics greenhouse gas emissions in the CSR report, this is the first scope of CO₂ reporting above-mentioned.

“We have different actions such as eco-driving trainings but we do not have KPI which are following the trends at this level” – Interview Alpha.

The reporting is much more developed for the procurement. Indeed, in the CSR report, the supply chain has a specific part with its own KPIs. Their goal is to develop a sustainable supply chain and their public reporting consists of two indicators. The first is the number of suppliers at risk among the CSR assessed suppliers. The second is the percentage of suppliers at risk that have an improvement plan developed for their follow-up.

However, the interviewees point out that the main KPI that is taken into account internally is the success hit rate of the campaign. This is the percentage of suppliers who have responded to the self-assessment questionnaire. Their target are 40% of the suppliers and 50% of the total spend. Moreover, the company uses several other intern sub-indicators to evaluate the sustainability along their supply chain as depicted in **Table 5**.

Table 5 – Intern sub-indicators concerning sustainability within the supply chain.

<i>Number of suppliers at risk in the CSR assessed suppliers (externally reported)</i>
<i>Percentage of suppliers at risk with action plan (externally reported)</i>
Percentage of contracts which contain a CSR clause
Percentage of tenders which have implemented CSR criteria
Number of suppliers evaluated with EcoVadis
Percentage of suppliers evaluated with EcoVadis on the total number of Alpha suppliers
Number of on-site audits performed under the company's responsibility

The company is compliant with the GRI 3.0 and they will try to be compliant with GRI 4.0. The CSR supply chain manager selected the KPIs that are, according to him, the most important among the GRI 4.0 since they are the most in line with Alpha core business.

The CSR supply chain manager aims to add new KPIs next year (GRI 4.0 compliance) such as the number of Belgian (local) suppliers on the total number of suppliers, the number of suppliers at risk on a social level, the number of suppliers at risk on the environmental level, etc.

“Making a large selection is really demanding, contacting suppliers at risk and getting the responses. [...] But we will add other GRI criteria next year” – Interview Alpha.

Once suppliers have made their self-assessment through the CSR questionnaire, they can be reviewed by EcoVadis. EcoVadis is an external performance management provider regarding the sustainability along the supply chain. The review of EcoVadis leads to a scorecard summarizing the sustainability performance of the suppliers. The EcoVadis framework is based

and developed around ISO 26000 (EcoVadis, s.d.). According to the interviewees, this evaluation by EcoVadis is not automatic but can be obtained by three ways. The first is mandatory for the suppliers at risk identified during the annual campaign who are part of the top 40 suppliers of the company (the others may still refuse the assessment but will be handicapped during Calls for competition). The second is through the contract, given that the buyer is free to ask an EcoVadis scorecard when the spend is over €125.000. The last is through the tender process. The scorecard (see **Figure 9**) summarizes the suppliers' CSR performance based on 21 indicators (EcoVadis, s.d.). The indicators are aggregated on four categories (Environment, Labor practices, Fair business practices and Suppliers) and the scores vary between 1 and 100. The "Suppliers" category helps to have a view on CSR practices of the second tier suppliers of Alpha. The interviewees highlight the importance to have differentiated scorecards and criteria according to the sector of activity the supplier belongs to. This allows EcoVadis to establish an individual comparison regarding the sector's benchmark as shown in **Figure 9**. The scorecard also shows the different strengths and weaknesses of the supplier as well as corrective action plans that are deployed (EcoVadis, s.d.). Alpha is itself assessed by EcoVadis and have, thus, a CSR scorecard related to its supply chain. Finally, the interviewee points out the extensive work that is needed to develop such a scorecard.

"It takes, on average, three to four Alpha people to fill in the scorecard then EcoVadis needs 1 month to assess a scorecard and provide a rating" – Interview Alpha.

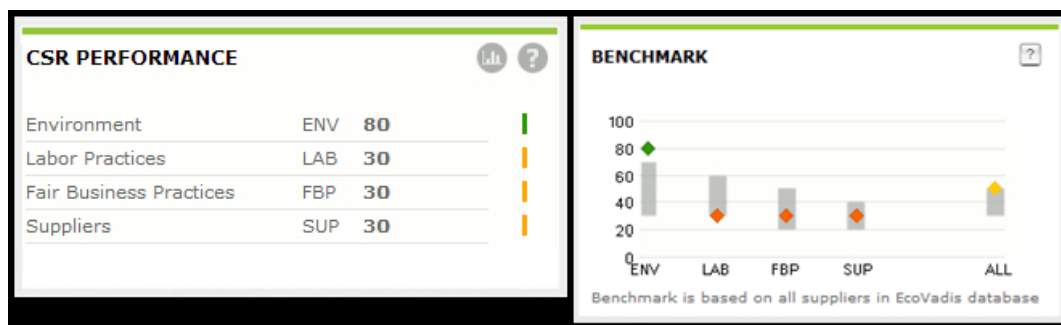


Figure 9 – Suppliers' CSR scorecard (Source: EcoVadis, s.d.).

Alpha measures on a broader scope its supply chain through a vendor performance report. This scorecard measures the performance of its supply chain partners and encompasses four categories (Security of supply, Quality, Business commitment, and Sustainability) with its sub-indicators as shown in **Table 6**. Each category has a score between 1 and 100 and accounts for 30% of the total score, except the sustainability one which accounts for 10%. Therefore,

sustainability is a key dimension that is included in the general supply chain performance measurement.

Table 6 – Vendor performance report of Alpha.

Scorecard Category	Metrics
<i>Security of supply</i>	- Delivery excellence - Business continuity - Financial risk
<i>Quality</i>	- Complaint management - Procure to pay - Product/Service - Assurance
<i>Business commitment</i>	- Total cost of ownership - Resource allocation - Innovation - Strategic alignment
<i>Sustainability</i>	- Compliance to CSR policy - Safe and healthy work practices

Concerning the communication, the CSR supply chain manager has an annual reporting that includes his KPIs. These measures are transmitted to the external audit that validates the annual numbers in order to be publicly published in the CSR report. Within the supply chain, according to the interviewee, there are at least two annual meetings with the top 40 suppliers of Alpha. During these meetings, Alpha communicates the evolution of suppliers on a yearly basis and displays another scorecard that includes EcoVadis scores as well as audit scores.

The global reporting for the CSR is a mix of **vertical** and **horizontal** architecture, mainly for **lagging quantitative metrics**. Indeed, as stated above, the CSR report displays aggregated numbers which are the results of past efforts of the company. This is true for the three pillars of Alpha's sustainability strategy. On the other hand, CSR performance is also measured **horizontally** to be included in the CSR report afterwards. This is true for the supply chain function. Supply chain has 7 KPIs and reports centrally the two first KPI of the **Table 1**. Furthermore, Alpha has specific scorecards for the performance of its supply chain partners. The scorecards are developed by EcoVadis and summarize 21 indicators within 4 strategic categories. These individual **indicators** are fully aligned with the general performance measurement of suppliers given that result of EcoVadis scorecards are fully part of the Sustainability score. Indeed, "Compliance to CSR policy" within the "Sustainability" indicator per supplier includes EcoVadis scorecard result and on-site audit result.

The company measures the sustainability performance internally through its own KPIs but also with the EcoVadis assessment that brings a complete scorecard of its CSR performance. Furthermore, Alpha measures the performance of its direct suppliers with a certain vision on its second tier suppliers. These measurements are more developed for the procurement side than the logistics one of the supply chain. However, it can be assumed that Alpha is between the third and the fourth stage on the four stage model of SCM/PMS by Cetinkaya et al. (2011). There is no formal monitoring regarding the customers of the focal company except the one presented in the second section of this part. Indeed, customers of Alpha are also the final consumers of the supply chain.

Advantages and challenges of sustainable supply chain performance measurement

The main advantage highlighted by the interviewees is that measuring sustainability performance allows to praise the good suppliers and warn the bad one. Furthermore, it allows to benchmark the supplier base and to compare them, compare a buying category or the industry category. A limit to this advantage is that suppliers have to answer self-assessment questionnaires and to be part of the EcoVadis initiative.

“We are able to compare them as long as suppliers answer to the questions every year and play the game. Which is the case for our top 40 suppliers. [...] For the others, there is another strategy staggered over time” – Interview Alpha.

As broader advantages of a CSR strategy, the interviewees mention the advantage of reducing the reputational risk by having a reliable long term supplier base.

In order to develop a performance measurement for a sustainable supply chain, the challenge is twofold. Indeed, according to the interviewee, the first step is to have reliable data and an IT system that allows to have these data. The second step is to have, from these data and the IT system, the right KPIs which would be the indicators that are the most representative.

“GRI is based on ISO 26000 and the latter states that the most representative KPI for the specific company must be used, not any KPI” – Interview Alpha.

4.2. Case study 2 – bpost

Organisational context

Bpost is a Belgian public limited company in law created in 1992 which is derived from the Belgian postal service created in 1830. Its core activities are postal services (national and international) as well as banking services. The company employed 27.479 collaborators in 2014 (bpost, 2014) and manages 670 postal offices, 270 logistics platforms and 5 sorting centres. In 2014, bpost displayed a € 572 million EBITDA and a net income of € 295.5 million (bpost, 2014). Bpost is still a public company being owned at 51.04% by the Belgian State but the firm also entered in the BEL 20 index on the 24th of March 2014 (bpost, 2014). The activities of the company are structured around three pillars: the commercial entities, the operational entity, and the corporate entities. The commercial entities encompass three business units which are the Mail & Retail Solutions, the Parcels, and the International postal service. The operational one consists of the Mail & Service Operations. The corporate entities include two business units: the Service Operations, Finance, ICT, and the Human Resources. In order to realize its mission that is to be the most reliable and solid postal operator, bpost developed a corporate strategy which is based on 4 pillars. These pillars, displayed in **Table 7**, allow to create value for all stakeholders and an appropriate reward to the shareholders (bpost, 2015).

Table 7 – Four strategic pillars of bpost

1. Focus on core competencies (mail business)
2. Innovate/Grow within core competencies
3. Control costs and improve productivity
4. Involve stakeholders
Source: Adapted from bpost (2015).

Sustainable development within the company

Bpost defines the sustainable development with the 3 Ps: People, Planet and Profit. They correspond to the TBL as defined by Elkington in 1998. Their sustainable development strategy is built around these three pillars to which the company added two more pillars, Paper and Proximity, because they are two specific priorities of a mail operator (bpost, 2015). These five pillars are, thus, central to the sustainability strategy of the company.

In their annual report, bpost's sustainability reporting is structured around the TBL. This reporting is divided into *Economic*, *Social* and *Environmental* performance indicators and relies on the GRI guidelines.

The *Economic* dimension is reported through the classical **absolute lagging metrics** such as revenues, operational costs or profit.

The *Environmental* dimension is also based on GRI guidelines and each indicator is presented as an “evolution”. Indeed, bpost displays **metrics** such as the consumption of paper, the electricity consumption, the CO² emissions or the recycled wastes but the metrics are compared to their past performance since 2011. Even if they are compared to their past performance, these are **absolute lagging metrics**.

The *Social* dimension is built similarly to the *Economic* one. Indeed, indicators such as number of collaborators, turnover rates or diversity in gender are displayed compared to their past performance. These are also **absolute lagging metrics**.

In order to support this sustainability strategy, bpost has a CSR governance structure. **Figure 10** displays this structure which encompasses two steering committees (bpost, 2014). The one concerning sustainability has a specific “Sustainable Procurement” organisation that frames the initiatives developed in the following section.

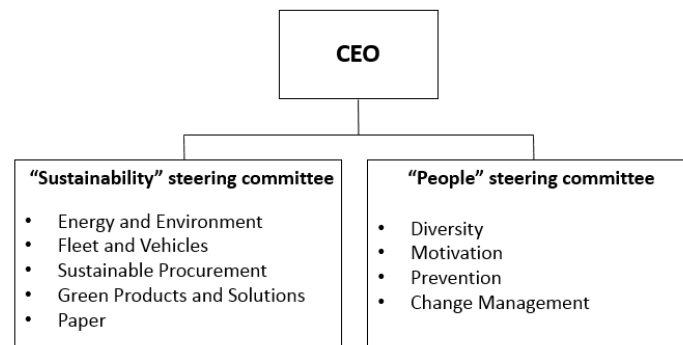


Figure 10 –CSR governance structure of bpost (Source: Adapted from bpost, 2014).

Sustainable supply chain performance measurement

A section related to the supply chain itself is present in the CSR report. There is no formal metric but the GRI table refers to different sections of the CSR report. The indicators show initiatives in the sustainability field and are displayed in **Table 8**. These indicators are linked to the suppliers, the customers and the logistics of bpost. This encompasses the whole supply chain.

Table 8 – Sustainability performance of bpost’s supply chain.

<i>Performance indicators related to the Human Rights</i>
Child labour
Forced labour
<i>Societal performance indicators</i>
Program and evaluation practice and activities’ impacts on communities management
<i>Performance indicators related to the product responsibility</i>
Practices related to the client satisfaction
<i>Logistics and transport indicators</i>
Vehicles fleet composition
Buildings’ environmental impact
Source: Adapted from bpost (2014).

In addition to this, the procurement department uses a dashboard in order to measure its performance. The dashboard consists of four distinct parts. Sustainable initiatives and measurements are integrated into these four main KPIs when it is relevant. This dashboard is schematically shown in **Table 9** below.

Table 9 – Procurement dashboard of bpost.

1. Planning
2. Compliance with regulations
– At the product level
– At the supplier level
3. Internal customer satisfaction
4. Early involvement and Expertise

Bpost operates in a public regulated environment. In this context, procurement procedures are not the same than in the private market. Indeed, when a business unit launches a project and needs to buy products, the department has to initiate a procedure through public markets. According to the interviewee, this kind of procedure is much more time consuming than “classical” private ones. Once the Requests for information are sent, bpost has to wait 22 days for the candidatures to come. Only after this, specifications sheet are sent with a time period for questions. Once it is done, bpost selects the best candidates and has to communicate the decision to all the suppliers. There is another 15 days period during which complaints can be filed. After this period, the contract can be signed. In addition to this, there are test periods. This is why the department commits itself to respect a given planning and the **Planning** dimension is a crucial KPI.

The ***Compliance with regulations*** indicator is where sustainability is included and measured. It has two components, there is a product as well as a supplier approach. On one hand, the product approach measures if the purchased product respects all the regulations. This is checked with the specification sheet where buyers include selection and exclusion criteria regarding sustainability. On the other hand, the supplier approach aims to assess the suppliers' performance regarding their sustainability. This assessment is done by EcoVadis, the same external company than for the first case study. A complete evaluation of suppliers with contracts above €170.000 are made twice a year. This approach is discussed in more details below. In a nutshell, according to the interviewee these are the two sustainability parameters that are measured for the supply chain: whether the product is sustainable and whether the supplier operates in a sustainable way (assessed by EcoVadis).

The ***Internal customer satisfaction*** is measured with a 5 questions survey that is conducted with the stakeholders of each project that exceeds €170.000. This indicator is established on a scale from 1 to 7.

The ***Early involvement and Expertise*** indicator is also twofold. According to the interviewee, the early involvement of the procurement department in the various projects is crucial because of the long lead time caused by the public markets process. Therefore, it is measured whether procurement is involved in time. Moreover, the expertise of the department is also measured. It is done through a list of competences that buyers should have. Green procurement competence is one of them.

This scorecard concerns the performance measurement of the procurement department but bpost also measures the performance of the suppliers. Procurement department manages a dashboard for each *strategic* supplier but if the business units need an assessment for a *tactical* supplier, it can be done within a week. An example is displayed in **Figure 11**. Bpost provides scores for different dimensions of the supplier's operations: Performance, Contract, Relationship and Risk. On top of that, the supplier is ranked according to its performance (Platinum, Silver, etc.). The CSR scorecard provided by EcoVadis is also integrated in this scorecard. It includes the general performance (CSR score) but also a more disaggregated one with the scores of the four dimensions of EcoVadis. Bpost is also assessed and an example of a scorecard can be found on **Appendix F**, page 97. This report also assesses the level of sustainability of their procurement organisation.

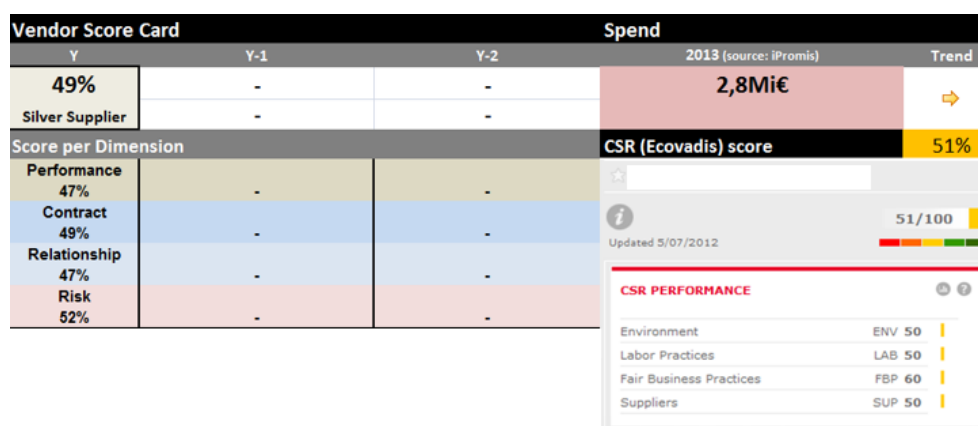


Figure 11 – Example of a supplier scorecard.

The interviewee justifies the use of an external company for the SSC/PM in five points. Firstly, it allows a benchmark for each sector of activity. Indeed, this approach allows to have a large number of suppliers in each sector and a global sustainability level can be extracted to compare suppliers.

“EcoVadis allows to have a measure of the sector level that we could not have internally. For example, if a supplier have a 30% score, it is not really good but if the average score of the sector is 20%, this is better.” – Interview bpost.

Secondly, this assessment is standardized. According to the interviewee, there is a standardization of the questions as well as of the answers and the scoring is accepted because it is a standard that is more and more present in Europe.

“If it was done internally, standardization would be much more complicated” – Interview bpost.

Thirdly, the interviewee highlights the fact that this approach allows to save a lot of time. Indeed, suppliers only fill in the EcoVadis’ survey once a year and do not have to do multiple assessments for all the different clients they have. Furthermore, the responsibility is transferred to EcoVadis regarding the management and follow-up of evaluations.

Fourthly, according to the interviewee, the externalization allows the assessment to be done by real specialists who have an expertise in this field. This is possible because SSC/PM is their core business while it would only be a support activity if it was internalized within bpost.

Finally, according to the interviewee, there is a clear profitability that needs to be taken into account. Indeed, it is twofold. On one hand, performing this performance measurement internally would cost much more regarding human resources. The interviewee points out that

several employees would be needed to handle this issue. On the other hand, all the costs would be charged to bpost, however the EcoVadis assessment is currently paid by the suppliers.

“At the beginning there was a cost but currently there is no more cost. In the past, we paid EcoVadis to assess our suppliers but currently our suppliers pay themselves for the assessment. The cost is between €300 and €1000. This is not huge compared to the amounts of the contracts.” – Interview bpost.

As it is developed above, the upstream supply chain is well measured by an external company and bpost is itself also assessed internally and externally regarding its procurement process. With respect to the downstream supply chain, bpost measures internally the CO² emissions of its fleet and buildings and reports it at the corporate level with the CSR report. But a wider organisation compiled these results: the International Post Corporation (IPC). According to the interviewee, this is an international group of postal services from all over the world (around 80% of the world's postal services are covered) that is responsible for various issues. One of its responsibility is to report the CO² emissions of postal fleets and buildings through a scorecard. This is solely related to the carbon emissions issue.

As developed in the second section, bpost measures its core and support processes regarding sustainability. They measure carbon emissions of the downstream supply chain but also follow indicators such as customer satisfaction. They also measure the performance of their suppliers and given that they have an organisation approach (like Alpha) but also a product approach to measure sustainability performance, it can be assumed that bpost is closer to the fourth stage of the Cetinkaya model (2011).

To communicate this measurement, bpost has a communication channel with all the buyers. There are communications every month and sustainability issues come up 2 or 3 times per year. According to the interviewee, these moments are made to communicate the assessments but also to help reminding collaborators the importance of sustainability for the company.

Advantages and challenges of sustainable supply chain performance measurement

The main benefit highlighted by the interviewee is the satisfaction of the external demand. Indeed, reporting the sustainable supply chain performance is crucial to be recognized by the external stakeholders. It deeply influences buyers and companies. They perform these performance analysis with EcoVadis because more and more stakeholders are asking for this.

Regarding the challenges, the interviewee points out that the sustainability issue has to stay at the core of the company in the long run. Furthermore, another challenge is related to the public markets. Indeed, the balance between *green* and dividends has to be maintained and this can be done with the help of the government and Europe. According to him, politics must financially foster sustainability initiatives.

“This green parameter has to stay alive within the company” – Interview bpost.

4.3. Case study 3 – Solvay

Organisational context

Solvay is a Belgian chemical group acting on an international scale. The Group employs about 26.000 people in 119 sites within 52 countries (Solvay S.A. (1), 2014). Its headquarters is based in Brussels. In 2014, the net sales of the company were €10.21 billion while its adjusted REBITDA was around €1.78 billion (Solvay S.A., 2015). Solvay is, as bpost, present in the BEL 20. The company was founded in 1863 by the Solvay brothers around a new industrial process to manufacture sodium carbonate: the ammonia-soda process. This product is essential for the production of glass, textiles and soap. This allowed the quick expansion of the company. After years of changes, diversification and evolutions, Solvay is now one of the top three leaders in the chemicals industry. In 2013, Solvay expressed its on-going transformation which is based on a reorganisation of its product portfolio with a reduced capital intensity as well as a higher ROI (Boksenbaum-Granier, A. & Bartunek, R.-J, 2014). Nevertheless, Solvay is currently divided into 17 Group Business Units (GBUs) which are specialized in various chemicals productions. Products of Solvay are used in diverse markets: consumer goods and healthcare; agri-food, animal food and agriculture; automotive and aeronautics; energy and environment; construction; electricity and electronics as well as in the industrial sector.

Sustainable development within the company

Interviewees define the sustainable development as the Triple Bottom Line. Indeed, the company takes the economic, social and environmental dimensions into account for its sustainable strategy, known as the *Solvay Way*.

“There are always three dimensions for the sustainable development: environment, society and economic. It cannot be sustainable if there is no money involved as well as it cannot be sustainable if the company does not take into account the world around her and if the company destroys the environment” – Interview Solvay.

Solvay developed a sustainable development strategy with various goals regarding six main themes: Energy and climate; Water consumption; Emissions and effluents; People safety; Sustainable Portfolio Management (SPM); Learning and development.

“Solvay developed a strategy with six central actions and to be able to operationalize this vision and strategy, the company developed a tool, a methodology. This is the Solvay

Way. This is the internal tool which allows the group to progress in the sustainable development. It concerns all the departments.” – Interview Solvay.

The TBL is the basis for the reference framework on which the Solvay Way is grounded. As shown in **Figure 12**, the framework takes into account the TBL as well as six stakeholders of the company: Suppliers; Communities; Employees; Investors; Customers and Planet.

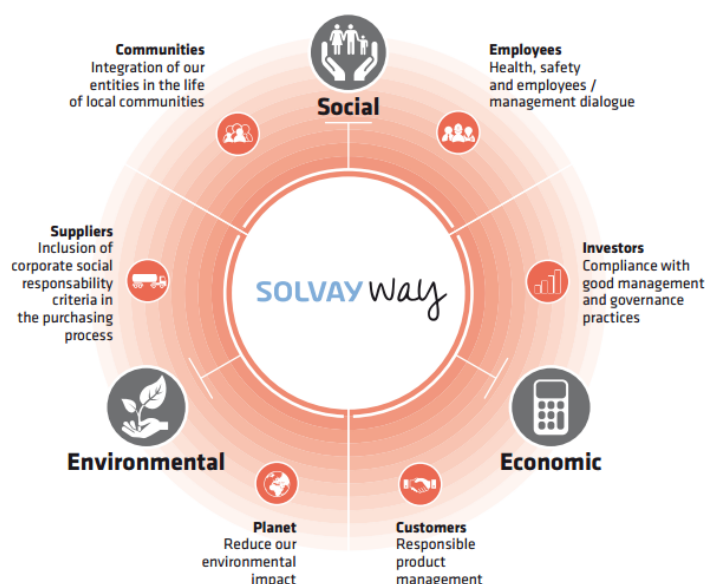


Figure 12 – Framework of the Solvay Way (Source: Solvay S.A. (1), 2014).

Regarding the reporting, Solvay has a global sustainability program as well as specific sustainability programs for each function of the company. The global program for the group is divided between the three dimensions of the TBL.

The Economic dimension reporting is divided between two categories: Research & Innovation management and Economic performance (Solvay S.A. (1), 2014). Regarding the first category, Solvay discloses the following numbers: the number of persons employed within the R&I staff; the number of intellectual property agreement and cooperation agreements; the number of first patent filings and the new sales ratio. This ratio is calculated by adding the current annual sales of new commercialized products and significantly improved products to the total annual sales (Solvay S.A. (1), 2014). For the second category, the economic performance, Solvay discloses the distribution of its generated value which is divided into wages, taxes, operating costs, payments to providers of funds and economic value retained. Solvay also discloses human capital return on investment along with total revenue and expenses. The totality of the metrics are **absolute**.

The Environment dimension reporting is far more developed than the previous and provides details on ten categories: Environmental management, Materials and Energy, Water, Biodiversity, Emissions, Effluents and waste, Soil management; Products and services, and Transports. The totality of the measures are **quantitative** one, named **metrics** in the literature. The majority of the metrics are on an **absolute** basis while a few ones are **relative**.

The Social dimension reporting is also well developed, on the contrary to what Seuring and Müller (2008) and Ashby et al. (2012) concluded. It is more clearly based on the GRI framework and is divided into four categories: Labor practices and decent work, Human rights, Society, and Product responsibility.

This global reporting for the Solvay Group is based on the GRI framework and clear links are made regarding the initiatives' guidelines. Most of the measures are **absolute metrics** but **qualitative indicators** are not set aside as developed below for the stakeholder-based reporting.

Sustainable supply chain performance measurement

Regarding the supply chain organisation, Solvay has 17 Group Business Units, each one having its specific supply chain organisation. Besides of this, there is a Purchasing & Supply Chain Excellence Function which works as a group support function for the business units. Together, they form the Supply Chain Committee.

As mentioned above, there is a cross-function reporting for sustainability issues but there is also a function-based program.

“There is a global strategy for sustainability but there is also a specific part for the supply chain.” – Interview Solvay.

For each stakeholder of the Solvay Way framework, there are several practices identified which are measured. In total, there are 49 practices which are attributed to the different parts of the company. Within these 49 practices, 5 are directly linked with the Purchasing & Supply Chain Excellence Function. The stakeholders that are attributed to the supply chain function are the Suppliers. As shown in **Table 10**, Solvay established three main practices with its sub-indicators.

Table 10 – Purchasing & Supply Chain Sustainable development indicators

Defining prerequisites and integrating them into the supplier selection process
– Defining prerequisites, selecting suppliers accordingly
Evaluating buyers' CSR performance
– Training and assessing buyers
Managing and assessing suppliers' CSR performance, optimizing relationships
– Managing and evaluating supplier performance
– Developing partnerships for innovation
– Ensuring balanced relationships with suppliers
Source: Solvay S.A. (1) (2014)

Given that these measures are qualitative, they are **indicators**. Furthermore, they are measured on a four-level scale. According to the CSR report of Solvay (2014), the first level is “*Launch*”. This level is reached when the organisation is mainly responsive to the stakeholders’ expectations, here the suppliers. The second level is “*Deployment*”. This level is reached when the company develops a structured dynamic with suppliers while resources and managers are also mobilized. The third level is “*Maturity*”. This level is reached when action plans bring measurable progresses and employees are also mobilized. The fourth and last level is “*Performance*”. It is reached when the company is recognized as a best-in-class one and when the results are sustainable. The results are aggregated in “radar” graphs for each stakeholder. For example, **Figure 13** shows the results for the customers and the suppliers.



Figure 13 – Customers (in purple) and Suppliers (in brown) KPI (Source: Solvay S.A. (1), 2014).

The first indicator related to purchasing and supply chain is *Defining prerequisites, selecting suppliers accordingly*. Firstly, suppliers have to comply with the Code of Conduct

issued by Solvay. Furthermore, according to the interviewees, Solvay assesses suppliers' CSR maturity through different tools, both internal and external. On one hand, the "non-critical" suppliers are assessed with CSR questionnaires which are analysed by the buyers. On the other hand, Solvay assesses maturity level of "critical" suppliers with a formalized assessment which is developed by the organization "Together for Sustainability" (TFS). TFS is a shared structure to develop sustainability within chemicals' supply chains. Solvay was a founding member of the initiative and it consists, now, of 12 firms. The assessments of the suppliers are done, as Alpha and bpost, through EcoVadis. According to the website of TFS, using such an external and collaborative tool allows to decrease the workload of sustainability reporting for the suppliers. Indeed, suppliers share their results with their different customers in the chemical industry. Furthermore, EcoVadis has technology and sustainability knowledge (TFS Initiative, 2013). Finally, they summarize the suppliers' and buyers' benefits of using this third party in **Table 11**.

Table 11 – Benefits of using EcoVadis.

Suppliers	Buyers
Avoid multiple questionnaires	Manage risks
Identify improvement areas	Access reliable information
Benchmark practices with sector	Identify opportunities with suppliers
Source: Adapted from TFS Initiative (2013).	

The second indicator is *Training and assessing buyers*. It consists of trainings of the buyer of the organisation regarding sustainability issues. According to the interviewees, this ensures that CSR is grounded in the daily life of the buyers.

The third indicator is *Managing and evaluating supplier performance*. This consists of developing action plans to progress with the suppliers regarding the sustainability issues.

"This is a bit the result of the first indicator. Based on the results of the questionnaire and the assessment of the supplier, we agree on an action plan with the supplier. Either we decide not to work with the supplier, or the supplier has a good CSR maturity level and decide to go further. Thus, we develop a joint action plan to make him progress." – Interview Solvay.

The fourth indicator is *Developing partnerships for innovation*. It aims to progress towards a collaborative step with the suppliers in order to develop common innovative projects regarding CSR.

The last indicator is *Ensuring balanced relationships with suppliers*. Solvay desires to ensure a balanced relationship with suppliers and uses supplier satisfaction survey regarding collaboration between the two partners.

“We are not here to squeeze our suppliers, we want a successful relationship.” – Interview Solvay.

At Solvay, the supply chain function is separated between two sides: purchasing and supply chain. For the company, supply chain concerns the logistics processes such as carrying products. Purchasing is mainly the supplier management process. Within this Purchasing & Supply Chain Excellence function, the measurement concerning sustainability issues is mainly done for the purchasing side regarding the suppliers. Indicators concerning water or energy consumption is related to the industrial departments. Indeed, the largest part of these are attributed to the production as it consumes a lot more energy than the supply chain. Thus, the strategic management of these issues are under the responsibilities of the production.

“Gas emissions from transportation are peanuts compared to the consumption during production.” – Interview Solvay.

However, there is still measurement of sustainability for the logistics process at the Group level. Indeed, the Purchasing & Supply Chain Excellence Function has a dashboard summarizing the key performance indicators (KPIs) to follow at the Group level for the supply chain which concerns logistics processes according to the company. It allows the company to facilitate the benchmark while improving supply chain maturity as well as service level (Solvay S.A. (2), 2014). As **Figure 14** shows, there are six themes: Customers; Suppliers; People; Benefits; Planning and Sustainability.

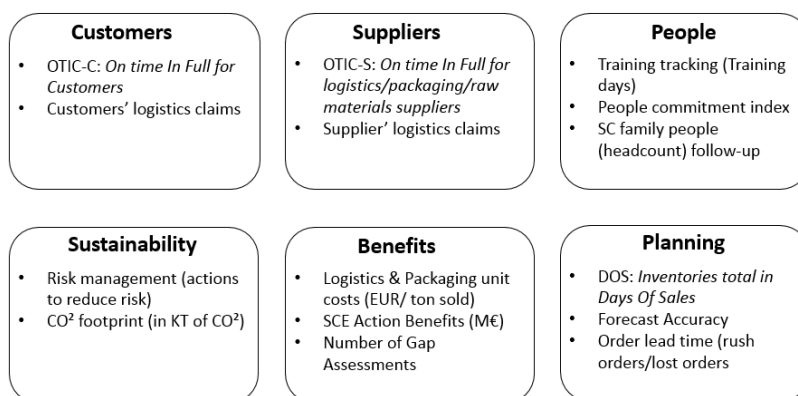


Figure 14 – Supply Chain Excellence: KPIs (Source: Solvay S.A. (2), 2014).

Regarding sustainability, there is a measurement of two categories. The first one is the risk management regarding sustainability within the supply chain. It assesses the actions which are taken to reduce risk regarding sustainable supply chain. The second one is the CO² footprint related to the transportation. This **metric** can, thus, be reported at the group level within the CSR report. This sustainability part only concerns the environmental dimension. However, the social dimension is also followed under the “People” category. This class contains the training level of employees, the people commitment index and another one related to the family of the employees. Finally, the other indicators are all related to the economic dimension.

Within the supply chain management function, there are two type of reporting. The first is related to the purchasing and supplier management activities. As developed above, the reporting is done through **qualitative indicators** which can also be characterized as **leading indicators**. Indeed, these indicators show actions that are taken to drive future sustainable performance of the company (e.g. ensuring a balanced relationship with suppliers). Furthermore, this is a **horizontal** architecture of the performance management system given that each stakeholder is assigned to a different function of the organisation. The second reporting is a global program presenting mainly **quantitative metrics** which can be characterized as **lagging** ones. Indeed, the metrics are the results of past efforts such as the emissions of CO² gas during the year. In this reporting, the supply chain performance regarding the logistics activities are summarized at a strategic level. The CO² metrics are gathered from the operational level to the dashboard of the supply chain function to be, finally, integrated in the final CSR report. Thus, this is a **vertical** architecture of the logistics part of the sustainable supply chain performance measurement. Finally, the interviewees stressed the importance of **context based** indicators even if no *real* one was identified.

Solvay measures sustainable performance of core processes as well as support processes. Taking into account its different stakeholders, the company also measures the sustainable performance of customers and suppliers. Even if only written information from the CSR report regarding the customers’ side of the supply chain were identified, the measurement is done through the *Solvay Way* and this part is attributed to the Sales organisation of Solvay. Based on the four stages model of SCM/PMS by Cetinkaya et al. (2011), given that the company measures internal performance (core and support processes) and the performance of their closest partners (customers and suppliers), it can be assumed that Solvay is at the fourth stage for the measurement of its sustainable supply chain.

According to the interviewees, the indicators are firstly selected internally in order to have indicators that suit the company at best. But Solvay makes an effort to align both internal and external indicators given by the GRI. It can be seen in the CSR report where all internal indicators are matched with GRI ones. The reason is that Solvay wants their progress to be recognized externally.

“We try to align internal and external indicators. In the CSR report, we are always referencing GRI indicators. Because we try to progress internally but it must be recognized externally.” – Interview Solvay.

The results are communicated firstly internally and then externally through the CSR report. The interviewees highlighted the importance to have solid numbers and not only vague actions. It is communicated internally through intranet and newsletters. According to the interviewees, it is crucial to share the information to every stakeholders permanently in order to ground the sustainability within the company.

“It is crucial to communicate permanently (both internally and externally) in order to make it clear to every stakeholders that it is not a one-shot but that it is grounded in the Solvay strategy”. – Interview Solvay.

Advantages and challenges of sustainable supply chain performance measurement

According to the interviewees, the main advantage of measuring the sustainable supply chain performance is to track the progress, without it they would not know if there is a progression in their sustainable strategy. Furthermore, they highlighted that it allows Solvay to assess their suppliers but above all, they are able to compare suppliers with each other.

Different challenges were also stressed. The first is that the general approach of sustainability must be perceived as an integral part of global strategy of the company. In order to foster it, 10% of the managers' bonus depend on the Solvay Way results. The second challenge concerns the managerial implications. Indeed, as Solvay is a global company, the sustainable strategy has to be well communicated to the local branches. Information Systems integration is crucial in this area, particularly regarding the performance measurement. According to the interviewees, the IT combination of different branches is a key challenge to extract and display data and results for everyone within the company.

“It is a central issue that people could visualize what is happening regarding sustainability.” – Interview Solvay.

Thus, the interviewees highlighted that there must be an internal coherence regarding the sustainable performance measurement between all the Solvay units across the world. But an external coherence with all the supply chain partners is also necessary. They pointed out the cultural differences regarding CSR. Indeed, Europe is very much more aware than other countries. According to the interviewees, there should be an alignment between supply chain partners regarding sustainable actions to take and its measurement.

4.4. Case study 4 – GSK Vaccines

Organisational context

GlaxoSmithKline (GSK) is a public limited company founded in 2000 by the merger of Glaxo Wellcome and SmithKline Beecham. Its headquarters is based in London. GSK is a healthcare company that operates at a global level. The company has R&D centres around the world, 84 manufacturing sites in 36 countries, operates commercially in 150 countries and has around 10.000 collaborators (GSK, 2015). The company consists of three business branches: Pharmaceuticals, Consumer Healthcare, and Vaccines. The Pharmaceuticals branch develops a large portfolio of medicines to treat acute and chronic diseases such as HIV or asthma. The Consumer Healthcare's focus is on pain relief, oral health, nutrition, skin health and respiratory with products such as Sensodyne, Panadol or Parodontax. The Vaccines one, on which this analysis is focused, produces and distributes a portfolio of more than 30 vaccines that prevent diseases such as hepatitis, rotavirus, tetanus or rubella (GSK, 2015). In 2014, GSK displayed a turnover of £23.006 billion and an EBIT of £2.968 billion (GSK, 2014). GSK Vaccines accounts for 14% of the Group which corresponds to £3.2 billion of turnover (GSK, 2015).

Sustainable development within the company

GSK uses the TBL as definition for sustainability. People, Planet, Profit. However, the interviewees highlight that within the company, for the organisation of functions, the definitions are different. Indeed, GSK has an “EHS & Sustainability” function, EHS stands for “Environmental, Health, and Safety”. This function is responsible for the sustainability issues at different levels, from local to global. The company differentiates the “Environmental” and “Sustainability” terms. For GSK, the term “Environmental” has to be understood as the legal compliance regarding environment. “Sustainability” encompasses the compliance side but includes the idea of proactivity in the sustainable domain.

The company has a sustainability strategy based on four pillars: “Health for all”, “Our behaviour”, “Our people”, and “Our planet”. The “Planet” pillar aims to find out GSK's impacts on the environment (GSK (2), 2015). The “People” one represents the social goals within the company and regarding the employees. The “Behaviour” pillar aims to embed the company's values throughout the business (GSK (2), 2015). The “Health for all” includes objectives regarding the innovative products development and the healthcare access improvement for patients around the world (GSK (2), 2015).

GSK reports its sustainability performance at a Group level with different approaches. Firstly, the company reports its progress regarding its sustainability strategy with qualitative **indicators**. This reporting is built around the four pillars that are explained above. For each pillar, various commitments are stated by the company. For example, the “Planet” pillar has four commitments: “Aiming to be carbon neutral”, “Reducing our water impact”, “Reducing our waste”, and “Building sustainability in our supply chain” (GSK (2), 2015). To measure the progress of the commitments, the company uses four qualitative indicators that are displayed in **Table 12**. For each commitment, the report displays progress made the previous year and refer to sections in the report for more details. Secondly, the company reports quantitative **metrics** regarding these four pillars. These are past performance and, thus, **lagging metrics** which are displayed with performances since 2011. These are **absolute lagging metrics**. Finally, the company has a complete GRI index because their CSR report is not based on the GRI guidelines. The index shows the elements of the GRI that are covered in the CSR report in order to help the comparison with other companies (GSK (3), 2015).

Table 12 – Indicators used to report the sustainability strategy progress of GSK.

Indicator	Meaning
<i>Work to do</i>	Work is needed to get the commitment on schedule
<i>On track</i>	Work is ongoing
<i>Progressing well</i>	Able to demonstrate clear deliverable and good progress towards completing the commitment
<i>Completed</i>	The commitment has been completed
Source: Adapted from GSK (2), 2015.	

Sustainable supply chain performance measurement

Downstream and upstream supply chain processes have a separated function within GSK Vaccines. According to the interviewees, the measurements are done inside these functions with classical economic indicators such as developed by Cetinkaya et al. (2011). *Days payable outstanding*, *Forecast accuracy* or *On-time In-full* are examples of such indicators. The sustainability performance measurement which covers the whole supply chain is done by the EHS & Sustainability function which is separated from the other functions.

The principal measurement across the supply chain is done through a carbon footprint analysis. According the interviewees, the report is divided into six categories which are used as the principal indicators:

- CO² (Scope 1, 2 and 3),
- Raw materials,
- Commuting,
- Wastes,
- Logistics,
- Contract manufacturing (emissions of third parties).

It displays the emissions from these various categories and encompasses the whole supply chain from the raw materials to the distribution. The interviewees point out that it is very complicated to develop such indicators on a yearly basis but the “big picture” remains the same.

Furthermore, the company has an online platform for displaying the different dashboards from all the functions in the organization. This platform is accessible by all the employees directly on the intranet. The platform is divided into four big categories: “Supply”, “Quality”, “People”, and “EHS”. With these “Supply” and “EHS” categories, the sustainability issues’ reporting are clearly separated from the day-to-day activities of the supply chain. The indicators in the EHS category is a summary the footprint analysis. This is a more strategic reporting with four **metrics**:

- Waste to landfill,
- Waste generated & % recycled,
- CO² emissions,
- Improvement by site.

GSK Vaccines follows ISO 14001 but the interviewees highlight that sometimes internal standards are maybe more adapted to the business. Furthermore, they choose indicators when they are measurable and when the company can have an impact. Indeed, according to the interviewees, GSK cannot have an impact on some sustainability areas.

GSK Vaccines also uses an external tool to measure its suppliers’ sustainability performance: Ecodesk. Ecodesk is global service that allows to measure sustainability along the whole supply chain. It is based on an open cloud platform that allows to centralize environmental and social metrics of the company’s supply chain (Ecodesk, 2015). Firstly, companies have to create a “free” profile to share their internal data regarding sustainability. From there, Ecodesk offers a complete set of sustainable supply chain management tools. Various modules can be used through different “packages”. There is an internal sustainability performance management system which can be used through the different sites of the company. There is also a supplier assessment scorecard which works in the same way than EcoVadis. Furthermore, supply chain dashboards are also proposed by Ecodesk. There is a standard

sustainability metrics dashboard regarding suppliers, a conflict minerals dashboard, social and governance dashboard but they also propose bespoke dashboards (Ecodesk, 2015). The service provider also offers various services such as custom-made SSC projects.

According to the interviewees, the rationale behind the use of an external service provider to measure sustainability performance of the suppliers is threefold. Firstly, doing this internally is resource-consuming. It is much simpler and less costly to do it externally. Indeed, only one person has to manage this. Secondly, GSK uses it because it already exists and suppliers already use it for other companies. Thirdly, Ecodesk are specialists while GSK does not have this level of competences.

They use this tool to measure the parts of emissions, wastes, etc. that are imputable to GSK. It measures the “link” between GSK and its supplier. However, the interviewees, highlight that Ecodesk is not the rule for every suppliers. Indeed, this is more a Group initiative and they use it with the suppliers GSK Vaccines has in common with GSK Pharmaceuticals. Further work needs to be done to integrate this process to every suppliers.

GSK Vaccines measures its core processes and support ones regarding sustainability. The footprint report allows to measure the whole supply chain. Since the firm measures the contact point and shared processes between the two companies, it can be assumed that GSK is at the third stage of development for its SSC/PM (Cetinkaya et al., 2011).

Advantages and challenges of sustainable supply chain performance measurement

Regarding the benefits of measuring the sustainability performance of the supply chain, the interviewees claim that it allows to make the corporate level more aware of the issue in terms of money. Furthermore, investing this field allows the company to identify risks, which is crucial for its supply chain as the suppliers are not easily substitutable in this business. Finally, the sustainability issues are an important part in the tenders for suppliers and third parties. Having data to communicate is, thus, crucial.

First and foremost, the interviewees state that a major challenge to develop such measurement is to have internal competences to understand and interpret the metrics regarding sustainability. Furthermore, as GSK is a very large company, developing such procedures of measurement takes a lot of time. Finally, according to the interviewees, a company culture built around the sustainable development is central. They point out that currently GSK Vaccines has other priorities before sustainability, which slows down the initiatives.

5. Cross-case Analysis

This analysis will take the form of a systematic investigation of common patterns across the cases (Voss et al., 2002). The analysis is based on a table which summarizes the most important facts of each case (see **Table 13**). Indeed, according to Voss et al. (2002), this is the most effective method to investigate the convergences and divergences between the different cases.

5.1. Sustainability performance measurement

Throughout the within-case analysis different ways of measurement regarding sustainability were described. Two main reporting were identified. Firstly, Solvay and GSK have a global sustainability strategy that is deployed around the globe through all the subsidiaries. To track the progress and follow the actions and initiatives that are taken, the two companies have qualitative indicators which are measuring the progress of the company regarding their general sustainability strategies. The supply chain issues are included in this measurement for Solvay while GSK has one related indicator which is currently in revision. This performance measurement is based on the global strategy and it seems to be linked with the size of the companies. Indeed, GSK and Solvay are sensibly larger than Alpha and bpost. This leads to the following proposition:

Proposition 1: Larger firms are more likely to have performance indicators which are tracking the progress of their sustainability strategies.

Secondly, the four case studies measure sustainability performance with quantitative measures. This quantitative measurement is based on the GRI, except for GSK. However, GSK gives an index table for the GRI guidelines in order to facilitate the comparison with other companies. Those were always quantitative and they are named metrics by the theory. These reports display metrics related to past performances and are, thus, lagging metrics. However, only few relative metrics have been observed, the majority are absolute metrics. This GRI reporting, while not being mandatory, is done because it is a worldwide recognized standard that is accepted in every industry. However, the theory fosters the use of a mix between the different metrics and indicators, from lagging and leading ones, to absolute, relative and context-based measures. Nevertheless, more absolute lagging metrics were identified in the case studies. This leads to our second proposition:

Proposition 2: CSR performance is more likely to be reported with absolute lagging metrics.

Table 13 – Sustainable supply chain performance measurement characteristics of each case.

	Alpha	Bpost	Solvay	GSK Vaccines
Industry	N/A	Postal services	Chemicals	Healthcare (vaccines)
Sustainability measurement	- Absolute and relative lagging metrics - Based on GRI	- Absolute lagging metrics - Based on GRI	- Progress indicators for its internal sustainability position - Absolute lagging metrics (few relatives) - Based on GRI	- Progress indicators for its internal sustainability position - Absolute lagging metrics - GRI index table
Upstream SSC measurement	- Specific KPIs under the management of the CSR SC manager - External tool to measure suppliers' sustainability performance - Based on ISO 26000 - Individual supplier scorecard with a "Sustainability" dimension	- External tool to measure suppliers' sustainability performance - Based on ISO 26000 - Individual supplier scorecard with a "Sustainability" dimension	- Progress indicators directly linked with sustainable supply chain - External tool to measure suppliers' sustainability performance - Based on ISO 26000 - Industry specific organisation supports this process (TFS)	- External tool to measure suppliers' sustainability performance - Footprint report for the whole supply chain - Dashboard with the general KPIs of the footprint report
Downstream SSC measurement	- Not tracked	- Tracked by an industry specific organisation (IPC) - Indirect indicators related to practical initiatives	- Supply chain dashboard with a "Sustainability" dimension	- Footprint report for the whole supply chain - Dashboard with the general KPIs of the footprint report
Benefits	- Benchmark and compare suppliers - Reward suppliers - Reduce reputational risk - Reliable long term supplier base	- Recognition of external stakeholders	- Track progress - Benchmark and compare suppliers	- Awareness raising for corporate level - Identify risks - Important for tenders
Challenges	- Reliable data - IT integration - Have the right KPIs	- Sustainability must be perceived as a core part of the company - Governments support	- IT integration - Internal and External coherence in SSC/PM - Communication across the group - Sustainability must be perceived as a core part of the company	- Time consuming - Competences to understand metrics - Sustainability must be perceived as a core part of the company

5.2. Sustainable supply chain performance measurement

The four companies have different approaches for measuring the sustainability performance of their supply chains. With two companies (Alpha and Solvay), there are supply chain positions linked to the sustainability issues. In Alpha, there is the “CSR Supply Chain Manager” and Solvay has Jean-François Dehem who is responsible of sustainability and innovation within the Supply Chain & Purchasing Excellence function. These two functions are related to the upstream supply chain, the supplier management. The CSR SC manager of Alpha is responsible for specific KPIs related to the suppliers’ sustainability assessment which is included in the individual supplier scorecards in a “Sustainability” dimension. The Solvay function is responsible for the progress indicators that are directly linked with the sustainability within the upstream supply chain. Bpost also uses an individual scorecard for each supplier for contracts above €170.000 and includes the sustainability performance in the overall performance measurement. GSK Vaccines reports this performance with a carbon emission footprint analysis that encompasses the upstream and downstream supply chain. Furthermore, the EHS & Sustainability team updates a dashboard which includes strategic KPIs regarding this report.

On top of that, each company has a common pattern. Indeed, the four case studies use an external service provider to measure their sustainable supply chain performances. Alpha, Solvay and bpost are using the tool developed by EcoVadis which allows to measure the performance of the suppliers, the upstream supply chain. It allows the production of a sustainability dashboard based on ISO 26000. The dashboard is built around audits and CSR questionnaires verifications. This performance is then included in individual scorecards for Alpha and bpost. GSK uses another tool: Ecodesk. It is a potentially more developed platform than EcoVadis if it was used at its full capacity. Indeed, in addition to internal sustainability performance reporting and the same kind of supplier scorecard than the one proposed by EcoVadis, Ecodesk offers different packages to have a complete SSC performance measurement system. It is used by GSK to collect data regarding its suppliers, which is again related to the upstream supply chain. The interviewees highlight different reasons for this outsourcing: the standardization of the measurement, the saved time for the internal teams, the benchmarking and comparison possibilities of the supply base, the third party has higher competences than within the companies, and significant costs can be saved internally. This outsourcing does not seem to be linked with the size of the companies given that the four firms are different. Of course, they are all large firms and this kind of project is set up when the

companies have a certain maturity but it seems to be more linked with the internal will to develop sustainability. Indeed, the costs of these platforms are relatively low which allows almost every company to participate in this kind of initiative as long as the “sustainability factor” of the companies is enough advanced. This common pattern leads to a third proposition:

Proposition 3: The performance measurement of sustainability within the upstream supply chain tends to be outsourced with external tools.

These outsourcing initiatives concern only the upstream supply chain performance measurement and management. The downstream sustainable supply chain is differently managed across the four companies. Indeed, Solvay has a dashboard that is more focused on the downstream supply chain (but still includes a category for the suppliers). The dashboard includes a sustainability category that measures CO₂ footprint and the risk management. The performance of bpost is tracked by an industry-specific organization mainly for the CO₂ footprint and has also indicators that refer to practical initiatives taken regarding the downstream flow of the postal service. GSK has the same monitoring tools than for the upstream supply chain as they are covering the whole supply chain with one initiative. Finally, Alpha does not track this performance at all. With respect to the above mentioned upstream initiatives regarding the SSC/PM, it can be assumed that the downstream supply chain is less organized than the upstream one. Indeed, while the upstream SC seems to be organized around common external initiatives and processes, this is not the case for the downstream one. This leads to our fourth proposition:

Proposition 4: The performance measurement of sustainability within the upstream supply chain is more structured than the sustainability performance measurement within the downstream supply chain.

Alpha works in partnership with an organization that is common for ten companies within the same industry than Alpha. They coordinate sustainability audits of common suppliers of the companies. This allows the firms to monitor their sustainable supply chain performance based on the same methodology. This joint methodology decreases the costs for all the partners while also decreasing a certain workload for the suppliers. Bpost is part of the International Post Corporation. This organization that gathers 24 postal services around the globe disposes of a sustainability management program and tracks the greenhouse gas emissions of these postal services. Solvay is also a partner of the Together for Sustainability (TFS) initiative. It a collaborative approach which works in the same way than the Alpha one. Their goal is to assess and improve sustainability practices within the chemicals' supply chains by establishing a

global audit program (TFS Initiative, 2013). TFS enunciates the benefits of working with this kind of partnership in **Table 14**.

Table 14 – Benefits of a collaborative approach to manage sustainability within supply chains.

Avoid double audits and assessments
Improve and assure quality of assessment and audit results
Sharing of assessment and audit results with multiple customers on one platform
High quality through selected and qualified partners
Engaging with customers on sustainability requirements and challenges
Building up long-term business relationships with customers
Lowering risks in relation to sustainability requirements
Knowing sustainability performance allows to improve performance
Source: TFS Initiative (2013).

These industry specific partnerships and organizations help to develop common approaches to measure SSC performance and foster synergies between companies. This leads to a fifth proposition:

Proposition 5: SSC/PM is more developed when there are industry specific partnerships between the companies.

6. Conclusion

In this thesis, the subject of SSC/PM was developed. Firstly, a literature review allowed to get acquainted with the topic. From there, the aim was to analyse this question through a multiple case study. Therefore, the approaches of four companies regarding this issue were studied. The four cases are “Alpha”, bpost, Solvay and GSK Vaccines. The research focused on how these companies are measuring their sustainable supply chain performance and how this process is managed. The findings of this research are multiple.

Firstly, theoretical propositions were developed regarding the general performance measurement of sustainability. On one hand, larger firms are more likely to have performance indicators which are tracking the progress of their sustainability strategies. On the other hand, the CSR performance of the companies is more likely to be reported with absolute lagging metrics.

Secondly, contrasts were observed between the downstream and the upstream sustainable supply chain performance measurements. Indeed, the performance measurement of sustainability within the upstream supply chain is likely to be outsourced with external platforms. Furthermore, the performance measurement of sustainability within the upstream supply chain is more structured than the sustainability performance measurement within the downstream supply chain.

Finally, it was observed that industry specific partnerships between companies such as TFS or IPC allow to have a more developed sustainable supply chain performance measurement.

6.1. Implications and recommendations

Based on these findings, some practical implications and recommendations can be outlined for the corporate world. There are areas in which case studies were successful but also some areas in which improvements can be made.

A first recommendation for companies would be to enhance the basic sustainability reporting which is heavily based on absolute lagging metrics. Indeed, a mix between lagging, leading, absolute, relative, context-based, qualitative and quantitative measures are more likely to report effectively the performance (Ahi & Searcy, 2015). A starting point could be to report the progress of the sustainability strategy of firms with leading qualitative indicators like Solvay does. The ultimate goal would be to report context-based indicators which are, according to Ahi

and Searcy (2015), critical to connect the company's performance to the environment in which it operates.

Furthermore, companies should develop a sustainability performance measurement process specific for the supply chain function. The key is to include this performance in the more classical and economic indicators. This would contribute to integrate sustainability at the same level as the other aspects of the supply chain and of the firms' strategies. This could be developed through the creation of a corporate position that links both CSR and supply chain domains. Two of the case studies have CSR supply chain managers who are able to mix CSR issues with supply chain ones.

The companies must not hesitate to rely more and more on external service providers to manage the SSC performance. These firms have the knowledge and are specialists to develop such projects while these competences maybe difficult to develop internally. Furthermore, this kind of approach is substantially less costly than developing it internally. The two platforms discovered with this thesis are good examples that are showing the existence and effectiveness of such tools. This can be a simple way to have a view on their supply chain. Finally, another recommendation would be to use the full potential of these service providers, not only for information gathering but also to *manage* the sustainable development all along the whole supply chain. In fact, a strategy can be developed from that. Improvement plans or strategic objectives can be drawn from a SSC/PM.

According to the propositions, companies seem to have a more developed SSC/PMS when industry-specific partnerships are in place. This is true for both upstream and downstream supply chains. Developing such organisations could be a good way to foster sustainability along supply chains as well as its performance measurement. Indeed, it could allow synergies and the sharing of good practices within the different industries.

Finally, the upstream supply chain performance measurement regarding sustainability that is well structured around external tools and organizational functions. In the same vein, the development of such a structured SSC/PM for the downstream supply chain has to be fostered too. This could also begin with the creation of corporate positions related to the issue.

6.2. Limitations and future research

Although the thesis reaches its goal to provide insights on how the SSC/PM is managed within different companies, the research still have limitations. Moreover, these limitations can provide guidance for further researches.

Firstly, the number of cases is limited to four while Yin (2009) advises to study from four to six companies in order to draw significant conclusions. Given the necessary lead time to meet the contact persons, starting earlier to contact companies that fitted the research design would have allowed to increase the number of case studies. This would have given deeper insights regarding the research question. Secondly, the focus of the research was on focal companies. However, Seuring (2008) recommends to include partners of each supply chain in case study researches. This would have allowed to investigate how the performance measurement was integrated in the whole supply chain. Finally, a different number of persons was interviewed within the four companies. Indeed, three collaborators of Solvay, two of GSK and Alpha, and one of bpost. However, this difference can provide variability in the validity of each company since interviewing less collaborators can limit the data to the sole observations of a single person while missing other aspects of the research (Yin, 2009).

Even if the research still focuses on four different industries, expanding the research to other industries in which the supply chain function is central to the company, could lead to further insights. Furthermore, since this research topic is still limited (Taticchi et al., 2013), future research can be conducted in order to test the above-developed theoretical propositions in a larger cross-industry empirical study.

To conclude, developing such process of measuring the sustainability performance of a supply chain can bring significant benefits to the companies as the various interviewees pointed out. However, to carry out this kind of project, it is still important to take into account the different challenges that were highlighted throughout the thesis. Such challenges encompass but are not limited to making the right choice regarding the KPIs that are used, ensuring the consistency of the approach across the whole company and supply chain as well as a good communication regarding the progresses and methodologies, guaranteeing the integration of IT to manage a complex system but above all, the key is to place sustainability at the core of the company. Moreover, performance measurement is only the first step. Indeed, companies have to collect these data but they also need to be communicated and used (Cetinkaya et al., 2011) in order to drive and manage the sustainable supply chain performance at its full possibilities.

References

- Abassi, M., & Nilsson, F. (2012). Themes and challenges in making supply chains environmentally sustainable. *Supply Chain Management: An International Journal*, 17(5), pp. 517-530.
- AFNOR. (2008). *FD X50-605 Management de la logistique - Performance logistique : de la stratégie aux indicateurs - Approche générale*. Retrieved Mars 2, 2015, from AFNOR Groupe: <http://www.boutique.afnor.org/norme/fd-x50-605/management-de-la-logistique-performance-logistique-de-la-strategie-aux-indicateurs-approche-generale/article/715392/fa135828#>
- Ahi, P., & Searcy, C. (2013). A comparative literature analysis of definitions for green and sustainable supply chain management. *Journal of Cleaner Production*, 52, pp. 329-341.
- Ahi, P., & Searcy, C. (2015). An analysis of metrics used to measure performance in green and sustainable supply chains. *Journal of Cleaner Production*, 86(1), pp. 1-18.
- Ashby, A., Leat, M., & Hudson-Smith, M. (2012). Making connections: a review of supply chain management and sustainability literature. *Supply Chain Management: An International Journal*, 17(5), pp. 497-516.
- Banerjee, S. (2010). Who sustains whose development? Sustainable development and the reinvention of nature. *Organization Studies*, 24(1), pp. 143-180.
- Beamon, M. (1999). Measuring supply chain performance. *International journal of operations & production management*, 19(3), pp. 275-292.
- Belgian Government. (n.d.). *EMAS et ISO 14001*. Retrieved Février 22, 2015, from Belgium.be: http://www.belgium.be/fr/environnement/consommation_durable/labels_ecologiques/emas/
- Benbasat, I., Goldstein, D., & Mead, M. (1987). The Case Research Strategy in Studies of Information Systems. *MIS Quarterly*, 11(3), pp. 369-386.
- Björklund, M., Martinsen, U., & Abrahamsson, M. (2012). Performance measurements in the greening of supply chains. *Supply Chain Management: An International Journal*, 17(1), pp. 29-39.
- Boksenbaum-Granier, A., & Bartunek, R.-J. (2014). *SOLVAY : Solvay grimpe, envisagerait la vente d'Acetow*. Retrieved Avril 28, 2015, from Les Echos / Bourse: <http://bourse.lesechos.fr/infos-conseils-boursiers/infos-conseils-valeurs/infos/solvay-grimpe-envisagerait-la-vente-d-acetow-1012134.php>
- Bpost. (2014). *Rapport Annuel 2014*. Bruxelles: Bpost.
- Bpost. (2015). *Bpost, les apporteurs de demain*. Retrieved Juin 1, 2015, from Bpost: <http://www.bpost.be/sites/default/files/BPOST-broch-FRA.pdf>
- Bpost. (2015). *Responsabilité sociétale d'entreprise*. Retrieved Juin 2, 2015, from Bpost: <http://www.bpost.be/site/fr/postgroup/greenpost/index.html>
- Brewer, P., & Speh, T. (2001). Adapting the balanced scorecard to supply chain management. *Supply Chain Management Review*, 5(2), pp. 48-56.
- Brundtland Commission. (1987). *Our Common Future*. Oxford: Oxford University Press.
- Caplice, C., & Sheffi, Y. (1995). A review and evaluation of logistics performance measurement systems. *The International Journal of Logistics Management*, 6(1), pp. 61-74.

- Carter, C., & Rogers, D. (2008). A framework of sustainable supply chain management: moving toward new theory. *International Journal of Physical Distribution & Logistics Management*, 38(5), 360-387.
- Cetinkaya, B., Cuthberston, R., Ewer, G., Klaas-Wissing, T., Piotrowicz, W., & Tyssen, C. (2011). *Sustainable Supply Chain Management - Practical Ideas for Moving Towards Best Practices*. Berlin: Springer.
- Chopra, S., & Meindl, P. (2009). *Supply Chain Management: Strategy, Planning and Operation* (4 ed.). Upper Saddle River, NJ: Pearson Education.
- De Rongé, Y. (2014). *Pilotage de la Performance*. Syllabus, Louvain School of Management.
- De Toni, A., & Tonchia, S. (2001). Performance measurement systems - Models, characteristics and measures. *International Journal of Operations and Production Management*, 21(1/2), pp. 46-71.
- Drever, E. (1995). *Using Semi-Structured Interviews in Small-Scale Research. A Teacher's Guide*. Edinburgh: Scottish Council for Research in Education.
- Ecodesk. (2015). *Features*. Retrieved Juin 13, 2015, from Ecodesk: <https://www.ecodesk.com/products-services#>
- EcoVadis. (n.d.). *EcoVadis SP*. Retrieved Mai 6, 2015, from EcoVadis - Sustainable Supply Management: <http://www.ecovadis.com/website/l-en/ecovadis-sp.EcoVadis-6.aspx>
- Eisenhardt, K. (1989). Building theory from case study research. *Academy of Management Review*, 14(4), pp. 532-550.
- Elkington, J. (1998). *Cannibals with Forks: the Triple Bottom Line of 21st Century Business*. New Society Publishers.
- Estampe, D., Lamouri, S., Paris, J.-L., & Brahim-Djelloul, S. (2013). A framework for analyzing supply chain performance evaluation models. *International Journal Production Economics*, 142(2), pp. 247-258.
- Faisal, M. (2010). Sustainable supply chains: a study of interaction among the enablers. *Business Process Management Journal*, 16(3), pp. 508-529.
- Fernandez, A. (n.d.). *Les 4 perspectives du Balanced Scorecard*. Retrieved Mars 29, 2015, from Piloter la performance: <http://www.piloter.org/balanced-scorecard/balanced-scorecard-perspectives.htm>
- Gibbert, M., Ruigrok, W., & Wicki, B. (2008). What Passes as a Rigorous Case Study? *Strategic Management Journal*, 29(13), pp. 1465-1474.
- Gloudeman, N. (2015). *Hilton, WWF take on unsustainable seafood and water use*. Retrieved Juin 8, 2015, from GreenBiz: <https://www.greenbiz.com/article/hilton-wwf-take-unsustainable-seafood-and-water-use>
- Gonzalez, N. (2015). *Supply Chain Sustainability Takes Center Stage in Cannes*. Retrieved Juin 8, 2015, from TriplePundit: <http://www.triplepundit.com/2015/05/supply-chain-sustainability-takes-center-stage-cannes/>
- GSK (2). (2015). *Responsible Business Supplement 2014*. Retrieved Juin 13, 2015, from <http://www.gsk.com/media/611598/gsk-responsible-business-supplement-2014.pdf>

- GSK (3). (2015). *Global Reporting Initiative (GRI) Index*. Retrieved Juin 13, 2015, from GSK: <https://www.gsk.com/media/626928/2014-global-reporting-initiative.pdf>
- GSK. (2014). *Financial Statements*. Retrieved Juin 10, 2015, from GSK: <http://www.gsk.com/media/605794/financial-statements-2014.pdf>
- GSK. (2015). *What we do*. Retrieved Juin 10, 2015, from GSK: <http://www.gsk.com/en-gb/about-us/what-we-do/>
- Gunasekaran, A., & Kobu, B. (2007). Performance measures and metrics in logistics and supply chain management: a review of recent literature (1995–2004) for research and application. *International Journal of Production Research*, 45(12), pp. 2819–2840.
- Handfield, R. B., & Nichols, E. L. (1999). *Introduction to supply chain management*. Upper Saddle River, NJ: Prentice-Hall.
- Hassini, E., Chirag, S., & Searcy, C. (2012). A literature review and a case study of a sustainable supply chains with a focus on metrics. *International Journal of Production Economics*, 140, pp. 69-82.
- Hervani, A., Helms, M., & Sarkis, J. (2005). Performance measurement for green supply chain management. *Benchmarking: An International Journal*, 12(4), pp. 330-353.
- International Organization for Standardization. (2013). *ISO 14031 - Environmental management - Environmental performance evaluation - Guidelines*. Retrieved Février 22, 2015, from ISO: http://www.iso.org/iso/home/store/catalogue_tc/catalogue_detail.htm?csnumber=52297
- Kaplan, R., & Norton, D. (1996). Using the balanced scorecard as a strategic management system. *Harvard Business Review*, pp. 75-85.
- Keating, B., Quazi, A., Kriz, A., & Coltman, T. (2008). In pursuit of a sustainable supply chain: insights from Westpac Banking Corporation. *Supply Chain Management: An International Journal*, 13(3), pp. 175-179.
- Lehtinen, J., & Ahola, T. (2010). Is performance measurement suitable for an extended enterprise ? *International Journal of Operations & Production Management*, 30(2), pp. 181-204.
- Lewis, G. (2015). *Walmart Foundation Announces Additional Grant to Sustainability*. Retrieved Mai 16, 2015, from University of Arkansas: <http://news.uark.edu/articles/27583/walmart-foundation-announces-additional-grant-to-sustainability>
- Linton, J. D., Klassen, R., & Jayaraman, V. (2007). Sustainable supply chains: An introduction. *Journal of Operations Management*, 25(6), pp. 1075-1082.
- Manuele, F. (2009). Leading and lagging indicators: Do they add value to the practice of safety? *Professional Safety*, 54(12), pp. 28-33.
- McCormack, K., Bronzo Ladeira, M., & Valadares de Oliveira, M. (2008). Supply chain maturity and performance in Brazil. *Supply Chain Management: An International Journal*, 13(4), pp. 272-282.
- McElroy, M., & Van Egelen, J. (2012). *Corporate Sustainability Management: The Art and Science of Managing Non-Financial Performance*. London, UK: Earthscan.
- McElroy, M., & Van Engelen, J. (n.d.). *Context-Based Metrics: Between the relative and the absolute falls the shadow*. Retrieved Avril 28, 2015, from Corporate Responsibility Magazine: <http://www.thecro.com/content/context-based-metrics>

- Mendoza, C., Delmond, M.-H., Giraud, F., Löning, H., & de Font Réaulx, A. (2005). *Tableaux de bord et balanced scorecards*. Paris: Groupe Revue Fiduciaire.
- Mendoza, C., Giraud, F., Löning, H., Delmond, M.-H., & De Font Réaulx, A. (2005). *Tableaux de bord et balanced scorecards*. Pays: Groupe Revue Fiduciaire.
- Mentzer, J., DeWitt, W., Keebler, J., Min, S., Nix, N. W., Smith, C. D., & Zacharia, Z. G. (2001). Defining Supply Chain Management. *Journal of Business Logistics*, 22(2), pp. 1-25.
- Meredith, J. (1998). Building operations management theory through case and field research. *Journal of Operations Management*, 16, pp. 441-454.
- Neely, A., Gregory, M., & Platts, K. (1995). Performance measurement system design A literature review and research agenda. *International Journal of Operations & Production Management*, 15(4), pp. 80-116.
- Reefke, H., & Trocchi, M. (2013). Balanced scorecard for sustainable supply chains: design and development guidelines. *International Journal of Productivity and Performance Management*, 62(8), pp. 805-826.
- Reuter, C., Foerstl, K., Hartmann, E., & Blome, C. (2010). Sustainable global supplier management: The role of dynamic capabilities in achieving competitive advantage. *Journal of Supply Chain Management*, 46(2), pp. 45-63.
- Rowley, J. (2002). Using case studies in research. *Management Research News*, 25(1), pp. 16-27.
- Schaltegger, S., & Burritt, R. (2014). Measuring and managing sustainability performance of supply chains: Review and sustainability supply chain management framework. *Supply Chain Management: An International Journal*, 19(3), pp. 232-241.
- Schary, P., & Skjott-Larsen, T. (2001). *Managing the global supply chain* (2 ed.). Copenhagen: Copenhagen Business School Press.
- Seuring, S. (2008). Assessing the rigor of case study research in supply chain management. *Supply Chain Management: An International Journal*, 13(2), 128-137.
- Seuring, S., & Müller, M. (2008). From a literature review to a conceptual framework for sustainable supply chain management. *Journal of Cleaner Production*, 16, pp. 1699-1710.
- Smith, K. (n.d.). *List of 16 Major Leading & Lagging Economic Indicators*. Retrieved Février 28, 2015, from Money Crashers: <http://www.moneycrashers.com/leading-lagging-economic-indicators/>
- Solvay S.A. (1). (2014). *Dedicated to building a model of sustainable chemistry - 2014 GRI Annual Report*. Brussels: Labrador.
- Solvay S.A. (2). (2014). *Supply Chain Excellence - Handbook 2014*.
- Solvay S.A. (2015). *About Solvay*. Retrieved Avril 28, 2015, from Solvay: <http://www.solvay.com/en/about-solvay/index.html>
- Tancrez, J.-S. (2013). *Supply Chain Management*. Syllabus, Louvain School of Management.
- Taticchi, P., Tonelli, F., & Pasqualino, R. (2013). Performance measurement of sustainable supply chains. *International Journal of Productivity and Performance Management*, 62(8), pp. 782-804.

- Tay, M. Y., Rahman, A. A., Abdul Aziz, Y., & Sidek, S. (2014). A review on drivers and barriers towards sustainable supply chain practices. *International Journal of Social Science and Humanity*, 5(10), pp. 892-897.
- TFS Initiative. (2013). *Assessment Process*. Retrieved Jun 1, 2015, from Together for Sustainability: http://www.tfs-initiative.com/assessment_process.html
- Tonchia, S., & Quagini, L. (2010). *Performance Measurement - Linking Balanced Scorecard to Business Intelligence*. Berlin: Springer.
- Tyndall, G., Gopal, C., Partsch, W., & Kamauff, J. (1998). *Super-charging Supply Chains: New Ways to Increase Value Through Global Operational Excellence*. New York, NJ: John Wiley & Sons.
- Varsei, M., Soosay, C., Fahimnia, B., & Sarkis, J. (2014). Framing sustainability performance of supply chains with multidimensional indicators. *Supply Chain Management: An International Journal*, 19(3), pp. 242-257.
- Voss, C., Tsikriktsis, N., & Frohlich, M. (2002). Case research in operations management. *International Journal of Operations & Production Management*, 22(2), pp. 195-219.
- Wolf, J. (2014). The relationship between sustainable supply chain management, stakeholder pressure and corporate sustainability performance. *Journal of Business Ethics*, 119(3), pp. 317-328.
- Yin, R. (2009). *Case Study Research: Design and Methods* (4e ed., Vol. 5). Thousand Oaks, CA: SAGE INC.