

Sustainability Analysis of the Pharmaceutical Supply Chain

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Abstract

Current patterns of consumption and production are constantly contributing to growth of society awareness regarding sustainable development issue. The increasing environmental and social awareness of society is manifested in significant pressure which has been put on companies to implement more sustainable solutions. The pharmaceutical supply chain pays special attention to sustainability due to its nature of business; in this context, it has been developing a set of actions to achieve foreseen goals.

Given this context, we conducted a detailed study of sustainability in pharmaceutical supply chains in order to identify the main factors that determine sustainable operation of these systems. The identified factors are a set of categories, which cover the three sustainability dimensions. These categories were tested and validated through an interview and a content analysis of corporate sustainability reports from this sector. Applying the latter method it has also been found some relations between the sustainability dimensions, which enabled the identification of a set of interconnected categories.

The results demonstrate that leading companies in sustainability in the pharmaceutical sector have been committed to various initiatives to achieve their objectives and sustainability goals. They also found that although pharmaceutical companies belong to the same sector, they report sustainability issues differently, possibly the existence of external and internal conditions that influence the business strategy in the context of sustainable development.

Keywords: Pharmaceutical Supply Chain, Sustainable Supply Chain, Sustainability, Indicators, Categories of Sustainability.

1. Introduction

In recent decades there has been an increase in addressing matters related to sustainability. This is due to a greater environmental and social awareness of society. In this context, currently, companies are no longer considered as organizations that only produce and sale goods and services, they are now forced to take into account, in their activities, the sustainable development concept. So a *Triple Bottom Line* approach is a useful tool so as to achieve a sustainable supply chain, this means considering economic, environmental and social issues.

The sustainability awareness as a main theme for the supply chains performance has grown considerably in recent years due to strong external pressures from governments, consumers, media and non-governmental organizations (ONGs), as well as due to an awareness about the enormous potential and opportunities that the adjustment of this new paradigm can bring to supply chains (Seuring & Müller, 2008; Varsei et al., 2014).

Despite the increased focus on this topic in recent years, currently there are no standardized

methods to guide companies in integrating, measuring and communicating sustainability, which also applies to pharmaceutical companies (Gasparatos & Scolobig, 2012). An example of these methods to assess sustainability is the use of sustainability indicators. A number of indicators and metrics have been proposed by researchers over the years, but some of these metrics systems only cover certain aspects of sustainability and not all the three dimensions (environmental, social and economic) (Veleva & Ellenbecker, 2001). From all sustainability indicators *the Global Reporting Initiative* (GRI) stands out, since it is an easy to use method and therefore it is commonly applied by companies to report and monitor its progress in sustainable issues (Lozano & Huisinigh, 2011).

Some authors also highlights the need for evaluation metrics specific to certain industry sectors (Azapagic & Perdan, 2000; Te et al., 2014), since sustainable practices in a given industrial sector may not be applicable to other industries (Azapagic & Perdan, 2000). There is thus a need for more research on the development

of an appropriate model for performance evaluation in sustainable supply chains specific to certain sectors.

Pharmaceutical supply chains represent a great value business in all world. These supply chains have been developing a set of actions towards sustainability, which should be examined. Thus, the main objective of this work is the sustainability analysis in the pharmaceutical supply chains in order to identify the main categories, which determine a sustainable operation of these systems, and identify a suitable set of sustainability aspects to this sector to enable the assessment and the monitoring of sustainability in pharmaceutical companies. These aspects are likely to build the basis for a decision-making support system in the sustainable management of pharmaceutical supply chains.

2. Literature Review

2.1 Sustainability: Concept and definition

The Sustainability concept was formally accepted in 1987 when the *World Commission on Environmental and Development* (WCED) published the Brundtland Report titled "Our Common Future". In this report, the Commission defined sustainable development as "*development that meets the needs of the present without compromising the ability of future generations to meet their own needs*" (WCED, 1987).

A concept to operationalize sustainability is the *Triple Bottom Line* approach (3BL), developed by Elkington (1994), which covers and balances both economic, environmental and social issues and where a minimum performance should be achieved in three dimensions (Carter & Rogers, 2008; Gimenez, Sierra, & Rodon, 2012; Seuring & Müller, 2008). In 1995, Elkington reshaped the three dimensions, defining them as "*People, Planet and Profits*" (Elkington, 2004).

The concept of business sustainability and corporate sustainability (*corporate sustainability*) has grown in recognition and importance (Labuschagne et al., 2005). This can be defined as the adoption of strategies and activities that meet the company's current needs and its *stakeholders* without compromising the ability of future *stakeholders* to meet their own needs (Dyllick & Hockerts, 2002). It is based on dialogue between the interested parts that corporate management should position itself and build its ways in the approach to sustainability, and set its priorities in order to create value for the company and for society (Carvalho et al 2010).

2.2 Supply Chain (SC)

Mentzer et al., 2001 defined supply chain as a set of three or more entities (organizations or individuals) directly involved in the flows upstream

or downstream products, services, financial and/or information from primary source to final client.

Today the supply chain concept emphasizes other aspects in addition to the materials flow, information and services such as the need for coordination within and between companies, collecting the interested parts needs (especially customers), the internal and external relationship management, so also emphasizes the value, efficiency and improvement of the overall performance in the supply chain (Ahi & Searcy, 2013).

Another important concept is the supply chain management (SCM). Mentzer et al., 2001 defined supply chain management "*as the systemic, strategic coordination of the traditional business functions and the tactics across These business functions Within a particular company and across businesses Within the supply chain, for the purposes of Improving the long -term performance of the individual companies and the supply chain as a whole*" (Mentzer et al., 2001). While the first concept refers only to distribution channels, the latter requires clear management efforts by organizations within the supply chain (Mentzer et al., 2001).

2.3 Sustainable supply chains

Ahi & Searcy (2013) from a literature review, defined sustainable supply chain management (SSCM) as: "*The creation of coordinated supply chains through the voluntary integration of economic, environmental, and social considerations with key inter-organizational 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 organization over the short - and long-term.*"

Unlike the concept of Supply Chain Management (SCM), which usually focuses on the business economic and financial performance, sustainable SCM (SSCM) is characterized by the integration of corporate responsibility commitments, ie, it deals with a wider set performance objectives, thus taking into account the economic, environmental and social sustainability (Carvalho et al., 2010; Seuring & Müller, 2008).

Organizations and their supply chain members are invoked by the pressure for sustainable practices. These pressures arise internally and from the external interested parts such as customers, shareholders, governments, non-governmental organizations (NGOs) and public authorities (Seuring & Müller, 2008; Varsei et al., 2014).

2.4 Sustainability Assessment

To achieve sustainability, goals should be evaluated. Waas et al., (2014) defines sustainability assessment as a process that aims to: (1) contribute to a better understanding of the sustainability meaning and its contextual interpretation; (2) integrate sustainability issues in decision making by identifying and assessing sustainability impacts (past and/or future); (3) and foster sustainability goals to be achieved.

It has been reported, in the literature, different approaches to measure, monitor and evaluate the progress of companies towards sustainability, using, for example, standards and codes, metrics of sustainability performance and sustainability indicators. However, despite numerous studies in this area, there is no agreed standard (Gasparatos & Scolobig, 2012).

A lot of organizations have developed a set of sustainability assessment indicators evaluating business performance. A set of indicators that can be applied to address the sustainability of business practices, are the indicators developed by the Global Reporting Initiative (GRI). GRI is the most widely known and used framework for voluntary reporting of sustainable performance by companies because of its ease of use and breadth, (Jagdev & Browne, 1998; Lozano & Huisinigh, 2011). These guidelines provide a framework for reporting including the three sustainability dimensions, ie the Economic (EC) Environmental (EN) and Social dimensions, the latter being divided into four categories: Labour Practices and Decent Work (LA) ; Human rights (HR); Society (SO); and Responsibility for products and services (PR) (Global Reporting Initiative, 2011).

2.5 Pharmaceutical Supply Chain

Shah (2004) defined the pharmaceutical industry as *"a complex of processes, operations and organisations involved in the discovery, development and manufacture of drugs and medications."*

The pharmaceutical industry has a long tradition in dealing with sustainability issues, from a need to protect the environment as a matter of health and safety. However, currently has been developing a holistic management approach that integrates the social, environmental and economic issues and the involvement of different stakeholders with interests in business activity (Peukert & Sahr, 2010).

Through a literature review regarding the sustainability assessment in this sector there was an increase of allusive publications the use of methodologies for assessing sustainability in this

sector and also that there is a greater number of publications related to the environmental pillar of sustainability.

3. Methodology

The methodology steps applied are described in the following paragraphs.

Step 1: Creating a representative sample: We identified a group of companies recognized by *Dow Jones Sustainability World Index* as leaders in sustainability in the pharmaceutical sector, in order to obtain a sample of significant companies in order to obtain the best practices in this sector (Table 1).

Step 2: Information analysis published by organizations regarding their performance against sustainability: At this stage we used the GRI 3.1 guidelines as a basis for categorizing the information, that is, during the analysis, the sustainability issues were associated to a representative GRI indicator. Thus, based on these guidelines, it was possible to analyze and compare the different supply chains.

Step 3: Description of the most critical indicators (identified in companies supply chains): The empirical data collected in the previous step was analyzed and described in depth.

Step 4: Creating sustainability categories: We proposed a set of relevant and meaningful categories, based on theoretical results, which may serve as a basis to describe and monitor the performance of the pharmaceutical supply chains face sustainability.

Step 5: Sustainability categories validation: the identified categories are validated to test their suitability to the desired objectives. This validation is performed by applying two different methods: content analysis, performed through a qualitative data analysis software program (NVivo) which analysis sustainability reports published by pharmaceutical companies and a semi-structured interview performed to a sustainability responsible in one national pharmaceutical company.

Step 6: Interconnections between the sustainability categories: In this step links between the three dimensions of sustainability in pharmaceutical supply chains were identified through a content analysis, carried out with the support of a data analysis *software*, NVivo.

Table 1: Pharmaceutical sector companies studied and their main data sources.

Company Data		Main data sources	
Name	Country	Title	Type
AbbVie	USA	- 2014 Corporate Responsibility - 2014 Annual report on form 10-k - 2014 Environment and Safety Performance	Non – GRI
AstraZeneca	United Kingdom	AstraZeneca Annual Report and Form 20-F Information 2014	Non – GRI
Bayer AG	Germany	Annual Report 2014	GRI - G3.1
GlaxoSmithKline (GSK)	United Kingdom	- Annual Report 2014 - Responsible Business Supplement 2014 - GlaxoSmithKline Corporate Responsibility Report 2014 – Environmental Metrics (Detailed)	Non – GRI*1
Novo Nordisk	Denmark	- Novo nordisk annual report 2014	Non – GRI
ROCHE	Switzerland	- Annual Report 2014	GRI - G4
Sanofi	France	- 2014 Corporate Social Responsibility Report - FORM 20-F 2014	GRI – G4

*1 GSK is not based on the GRI model in preparing its sustainability report, but does create a GRI index (based on GRI3.1) to show that aspects of the guidelines that covered in the report.

4. Main results

4.1 Characterization of pharmaceutical supply chains

This chapter presents the results obtained after a qualitative analysis of information published by the companies leading in sustainability in the pharmaceutical sector, regarding their performance against sustainability.

4.2 Strategic goals set by pharmaceutical companies

The strategy defined by the studied companies is in line with profitable growth that will increase the companies' value in a long term. Companies give particular importance to: (1) the development of new products and solutions with significant value for its users; (2) strengthening the commercial presence globally, particularly in emerging markets (eg Asia and Latin America); (3) allow greater access to pharmaceuticals overcoming accessibility barriers; (4) maximizing the potential of a talented and diverse workforce; and (5) lay a solid foundation for future growth.

In this context the application of sustainable business practices are essential to the future viability of this sector. In this way, companies in the study have been struggling to balance economic goals with social and environmental requirements in the development, manufacturing and marketing of their products.

These priorities were identified by the companies under study based on issues that are important to its business success as well as for its *stakeholders*.

4.3 Critical activities identified by pharmaceutical companies

Companies in this sector are exposed to a number of events that could significantly affect the objectives achievement that are proposed. The

main risks identified by companies were: pressure from competitors and substitute products (generic drugs and/or biosimilars); the loss of intellectual property rights; the illegal trade of pharmaceutical products; the inability to attract, hire and retain skilled labor; risks related to information technology (IT); the commercial failure of new products; the disruption of the supply chain; governmental pressures; unfavorable political and socio-economic conditions; acquisitions and unsuccessful strategic collaborations; failures in outsourcing; failure to comply with laws, rules and regulations; changes in legislation; natural or man-made disasters; failures in occupational and environmental safety; and non-compliance of strategic priorities.

4.4 Sustainability indicators reported by companies according to the GRI

After the collection, compilation and analysis of sustainability information according to the GRI model, were identified the economic, environmental and social indicators as well as the sustainable practices applied by companies in this sector related to these indicators.

4.4.1 GRI economic indicators

Economic performance (EC1 and EC3)

Companies have variations in turnover (sales and services) over the years. A drop in sales of established products due to generic competition, supply interruptions and price pressures established by governments, are some of the causes reported by companies to the decrease in sales that occurs in some years analyzed in this study. By analyzing the operating and liquid results, in general, there was a decrease in these results both in relation to the year 2013 as the year 2010. Regarding the indicator EC3, companies have granted pension plans and other post-

employment benefits. In general, there has been an increase in liabilities of workers benefits.

Indirect economic impacts (EC8)

Pharmaceutical companies have been concerned with the economic development of local communities where companies operate. During 2014 the companies invested both financial and in human resources, for example: creating local employment; investment in programs aimed at training and education in health care for local communities; production places implementing closest to the patients; and investments in strengthening health infrastructures.

4.4.2 GRI environmental indicators

Energy (EN3)

All companies have shown concern and interest in efficient energy consumption. By analyzing the power consumption by the companies under study it was found that most companies had a decrease in consumption compared to the years 2010 and 2013.

Emissions (EN16, EN17 and EN18)

Most companies have shown an increase of greenhouse gas emissions compared to the years 2010 and 2013. Just Roche and Sanofi have shown a decrease in emissions over the years. Air emissions are mainly caused by energy production and consumption. In this way, companies have introduced initiatives in order to reduce energy consumption, for example: the implementation of energy saving measures in buildings and equipment; creating energy saving training programs; use of renewable energy sources, among others.

Water (EN8)

With regard to water consumption, in the studied companies we observed a decrease in consumption when comparing with the years 2010 and 2013. Some initiatives introduced by companies to reduce water consumption are, for example, the development of conservation plans for water so as to reduce consumption; and local monitoring and systematic audits to determine whether the implemented measures are in place and moreover to identify new opportunities to reduce consumption.

Waste (EN22)

About the waste production, companies have developed initiatives to reduce waste both their production and their supply chain, trying to avoid sending waste to landfills, and focusing on alternatives, such as reuse where possible, waste recycling and the energy generation from waste through incineration of these. The reduction of hazardous waste is another concern of this sector

due to the nature of pharmaceutical products that generate a lot of this waste. In the most companies in the study there was an increase in production waste.

Environmental management of the product (EN26)

Companies in this sector have been developing research about the long-term effects of their products on the environment and working to improve the environmental profile of its medicines, which demonstrates the concern to preserve the environment for future generations and at the same time protect the business against possible financial risks and long-term reputation.

4.4.3 GRI social indicators

• Labour Practices and Decent Work

Employment (LA1)

Most companies in the study had an increase in the number of employees compared to the years 2010 and 2013, as a result of increase of the productivity and expansion in international operations.

Safety and Health at Work (LA7 and LA8)

Companies have adopted a preventive approach, seeking to avoid accidents and minimize exposure to harmful agents, and have developed programs for employees in order to encourage them to improve their own health and well-being. By analyzing the global rate of days lost due to illness or accidents, in all companies under analysis we can see that there is a decrease since 2010 from 10% to 37%.

Training and Education (LA11)

The industries in this sector have implemented initiatives aimed at the development of professional careers. These initiatives aim to ensure growth and increased sustainability of individual staff investment and, in turn, the organization success. Examples of these initiatives are: availability of adequate resources, including a wide range of activities and experiences that promote learning opportunities, development capabilities and core competencies in employees (eg, classroom courses and e-learning). Leadership development programs give employees the skills they need to become effective leaders (eg, coaching programs); creating international programs of professional rotation or volunteer programs to provide individual development.

Diversity and equal opportunities (LA13)

The companies in the study also demonstrate the objective of maximizing the potential of a diverse workforce. Some initiatives that have been developed are, for example, the creation of

opportunities for women and people of other nationalities in management positions or in key positions in the company; promoting equal pay for men and women, providing a fair return; development of training programs in support of women in business, with individual coaching and group sessions; employment opportunities for people with disabilities.

• **Human rights**

The companies under study respect and promote international human rights throughout all the supply chain by integrating human rights considerations into policies, processes and practices based on the Universal Declaration of the United Nations Human Rights principles.

Investment practices and acquisitions (HR2)

Companies in study conduct assessments of human rights to suppliers evaluated as "high-risk" or considered strategically important for business. To the suppliers who do not meet the minimum standards corrective action plans are implemented in order to address non-compliance. If it does not, businesses are closed.

Freedom of association and collective bargaining agreements, child labor and forced labor/slave (HR5, HR6 and HR7)

All companies in the sample support freedom of association and collective bargaining, and the elimination of all forms of forced labor or child labor. Most companies did not identify cases where there is a significant risk of violation of these aspects.

• **Society**

Community (SO1)

The companies have been involved in a variety of community and philanthropic projects, with involvement in social, educational, humanitarian and cultural causes, in order to contribute to the stability and prosperity of the communities where they are located. This is exemplified by the following initiatives: access to health programs; awareness campaigns and screening in the communities; professionals' health training; and responses to humanitarian emergencies, such as natural disasters. In order to maximize the support impact, companies in this sector have created partnerships with local and global organizations and encouraging employees to participate in volunteer programs.

Corruption (SO3)

The analyzed companies have been developed training programs which provide practical guidance for employees and managers on the Conduct Code.

Public Policy (SO5)

Companies in this sector have played an active role with governments, policy makers and professional associations in order to advocate for policies that protect their patient's interests, but also their business. *Lobbying* activities are guided by a set of principles laid down by the respective companies, in order to guarantee the integrity, openness, transparency and consistency in business activities in this sector. The companies studied issue related policy positions, for example, patient access to pharmaceuticals, clinical trials, personalized health care, regulation of medical devices and *in vitro* diagnostic tests and other issues.

• **Product Responsibility**

Customer Health and Safety (PR1)

Throughout the product life cycle, this is weighed against the possible risks to consumer health and the environment. Before the pharmaceutical product reaches maturity, it is subjected to a rigorous approval process, through clinical trials and preclinical, in order to prove their safety and efficacy. The evaluation is applied throughout the product lifecycle. With the increasing number of reported cases of pharmaceutical products counterfeits, the companies in the sample have developed initiatives in order to combat the forgery of its pharmaceutical products such as, for example: strengthening supply chain monitoring; or collaborations with international trade associations, regulatory organs and government agencies in order to strengthen the regulation.

Labelling of Products and Services (PR3)

Because this sector is strictly regulated, information on products and services (through labeling, information leaflets or other information media), is mandatory. Thus all use information and other relevant information for the consumer must be provided on the package label and package inserts.

Marketing Communications (PR6)

The pharmaceutical industry is governed by strict rules and guidelines for the products sales and marketing. The industry of this sector takes into account policies and procedures that are in accordance with the principles of the industry code, such as the marketing codes of PhRMA, EFPIA and IFPMA. Some companies have their own Conduct Code corresponding to marketing and sales. These codes include rules which governing the distribution of advertising materials and product samples, cooperation with health authorities and also the interaction with healthcare professionals or patient groups to be responsibly, ethically and legally conducted.

Table 2: Economic, Environmental and Social indicators which were reported for all pharmaceutical companies.

Gri Indicators	Pharmaceutical Companies						
	GRI			Non – GRI			
	Roche	Bayer	Sanofi	GSK	Novo Nordisk	AbbVie	AstraZeneca
EC1	√√	√√	√√	√√	√√	√√	√√
EC3	√√	√√	√√	√√	√√	√√	√√
EC8	√√	√√	√√	√√	√√	√√	√√
EN8	√√	√√	√√	√√	√√	√	√
EN16	√√	√√	√√	√√	√√	√√	√√
EN17	√√	√√	√√	√√	√	√	√√
EN18	√√	√√	√√	√√	√√	√√	√√
EN22	√√	√√	√√	√√	√√	√	√
EN26	√	√√	√√	√√	√√	√	√√
LA1	√	√√	√	√√	√√	√	√
LA7	√√	√	√	√√	√√	√	√
LA8	√√	√√	√	√√	√√	√√	√√
LA11	√√	√√	√	√√	√√	√√	√√
LA13	√	√	√	√√	√	√	√√
HR2	√√	√	√√	√√	√√	√	√√
HR5	√√	√√	√	√√	√	√	√
HR6	√√	√√	√	√√	√	√	√
HR7	√√	√√	√	√√	√	√	√
SO1	√√	√√	√	√√	√	√√	√√
SO3	√√	√√	√√	√√	√√	√	√
SO5	√√	√√	√√	√√	√√	√√	√
PR1	√√	√√	√√	√√	√√	√√	√√
PR3	√√	√√	√	√√	√√	√	√√
PR6	√√	√√	√√	√√	√√	√√	√√

Note: √√ reported; √ partially reported.

4.5 Other sustainability areas

After the analysis, were identified a set of issues that were not covered by the GRI guidelines, but had some prominence in the sustainability reports. A set of topics targeted to this sector, related to the ethics in research were also identified.

Research and competitiveness

Innovation is considered a key aspect for the development, growth and competitiveness of pharmaceutical companies. Investment in innovation and knowledge shows a strong concern with improving the company's operations in customer value and enhances the ability to anticipate business, which is essential in creating differentiators and key factors for sustainability. Companies have invested in the most innovative scientific solutions that meet the society and provide an advantage over available treatments.

Stakeholder's participation

The companies in this sector show the importance of stakeholder's participation in its decisions and its activities. They consider that the engagement with stakeholders is essential to understand their expectations, needs and concerns in order to incorporate their feedback on the strategies and business of the company, in order to solve common problems and develop long-term solutions.

• **Ethics in research**

Ethics in clinical trials

Pharmaceutical companies are committed to high standards of scientific and ethical conduct in all clinical trials, as well as with the transparency of records and the results of these. Some initiatives in this area are, for example, compliance with international standards and applicable local laws; external monitoring system (inspections by the health authorities) and local domestic (internal audits) to ensure compliance with the rules of ethics and applicable law; adoption of principles and national and international standards for the

sharing and publication of clinical trial data and information.

Animal welfare

Pharmaceutical companies in this study has the commitment to the responsible use of laboratory animals and their welfare. The companies maintain high ethical standards in relation to animal testing and conduct internal reviews to all new types of animals' experiments, making sure they are in compliance with laws and external regulations. These standards are also required from subcontractors who carry out research on company name. Other initiatives taken by the companies under study are, for example: the implementation of the 3Rs principle (Replacement, Reduction, Refinement); compulsory training and continuous assessment for all employees involved in conducting animal research; support and participation in initiatives for the development of valid alternatives to animal testing.

Bioethics

A theme also addressed by some companies under study is the fulfillment of ethical regulations in areas such as stem cell research, the use of genetic technologies in biomedical research and the use of genetically modified organisms in the production of pharmaceuticals products and the use of biological material human. The companies in the study, which present activities in these areas, demonstrate concern for compliance with laws and regulations as well as national and international standards.

In short, companies define a set of strategic objectives to achieve sustainability, however, companies in this sector are exposed to a set of circumstances that could significantly affect the realization of these goals. In this way, companies are challenged to acquire and develop skills in order to manage these risks and to respond to the sustainability demands which can help companies to hold opportunities for creating competitive advantages. To achieve a sustainability of a system is necessary to be able to assess this achievement, so are used a set of sustainability indicators. From these indicators it can identify opportunities for improvement. This whole process requires the stakeholders' involvement.

4.6 Validation of identified categories

After content analysis it was found that, in general, all threads are validated by both methods, however, due to the lack of interviews and taking into account that the only interviewed company is not a pharmaceuticals manufacturing company (midstream), it is not possible to ascertain this situation.

In general, despite the companies belong to the same sector, there is a heterogeneity in relation to the reported sustainability issues. The most reported aspects in this study were "Economic performance", "Innovation and Competitiveness" and "Emissions". However, it was found that these aspects are in line with the strategic priorities identified earlier.

From the results it was also found that there is a differential distribution regarding the approaching sustainability issues among business groups which were recognized as the most sustainable in comparison with that which showed no recognition. Thus, it was possible to deduce that the presence of a greater coverage of sustainability issues in their reports may be related to the fact that companies present external recognition by sustainability indexes.

Shortly, the results demonstrate that despite of these companies belong to the same sector, they have different priorities possibly due to the existence of internal and external conditions that influence the business strategy in the context of sustainable development.

4.7 Assessment of 3BL interdependencies in the pharmaceutical sector

The concept of sustainable development seeks to reconcile the economic, social, and environmental conservation development objectives. It was possible to find examples of pharmaceutical companies that have achieved this goal. The analysis of sustainability reports content, using a qualitative analysis software, helped to better understand the interdependencies between the different dimensions of sustainability, portrayed in those companies' reports. By analyzing the results we detect three types of interrelations: (1) interrelation within the same dimension, for example, environmental or social; (2) interrelation of the issues between two dimensions (eg, a particular issue in environmental concerns related to the social dimension); (3) interrelation of the questions that relate to all three dimensions (economic, environmental and social). Examples found in the reports are presented in the following paragraphs.

The following relationships within the same dimension were found:

- Environmental dimension: Greenhouse gases and energy;
- Social dimension: Product innovation and the health care availability.

The following relations between dimensions:

- Economic and environmental dimension: (1) Eco-efficiency and cost/income; (2) Waste reduction and cost/income; (3) Emissions reduction and costs; (4) Environmental protection and indirect economic impacts.

- Economic and social dimension: (1) Product responsibility and inherent costs; (2) Health and safety in relation to operating costs; (3) Access to the health care and indirect economic impacts.
- Environmental and social dimension: (1) Environment, health and safety; (2) Product responsibility and environmental responsibility; (3) Stakeholders and the environment; (4) Innovation and the environment.
- Relations between the three dimensions: (1) Innovation, environment and operating costs; (2) Product liability, operating costs and environmental impact.

This list can serve as a basis for a sustainability integration into management practice and also allows a comparative evaluation between management alternatives, since understanding of the interconnection of several criteria allows to predict how a particular decision will influence every sustainability aspects.

5. Conclusion

In this work was presented a detailed study of sustainability in the pharmaceutical supply chains, in order to identify the main factors that determine a sustainable operation in these systems. After reviewing the information, published by the organizations regarding their performance against sustainability it was concluded that the leading companies in sustainability in the pharmaceutical sector, identified in this study, have been committed to various initiatives to achieve its objectives and sustainability goals. In this context, were identified sustainable practices implemented by these companies. From this study, it was proposed and validated a set of sustainability categories (economic, environmental and social), which may serve as a basis to describe and monitor the performance of the pharmaceutical supply chains face sustainability. We also identified a set of interconnected categories, it is concluded that the identification of such category would be useful for implementing the sustainability of an integrated manner in the management of pharmaceutical companies.

Shortly, these metrics can support pharmaceutical organizations as to help decision makers to identify critical areas, improving capacity, but also help in the evaluation of alternatives in terms of sustainable development.

For future research would be interesting to develop, together with the companies, a set of indicators for the specific new categories of sustainability of this sector identified in this work and apply these categories to a multi-criteria model in order to test its consistency and capacity.

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