

MANAGEMENT MODEL FOR THE DEVELOPMENT OF SOFTWARE APPLIED TO BUSINESS SUSTAINABILITY IN THE CONTEXT OF GLOBAL CLIMATE CHANGES

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ABSTRACT

This article introduces a social and environmental management model based on the results of an empirical study that was conducted using the grounded theory method. It outlines a social and environmental mapping of the different economic segments of the Brazilian business universe to support decisions that are inherent to the sustainable management of the supply chain of organizations in terms of clean development mechanisms. It is in this context that the concept is included for the architecture of software and a model of social and environmental balance to track the demands for carbon credit required by an organization in the scenario of its business and that of the national economy.

Keywords: software for tracking social and environmental liability; architecture of sustainability data; clean development mechanism (CDM); Certified Emission Reductions (CER); social accountability balance.

1. INTRODUCTION

The present study stemmed from the finding that organizations in the new business context share the understanding that there should be a common goal rather than a conflict between economic development and social and environmental responsibility, both in the present and for future generations. These converging pathways in the current scenario of global climate change are very colorfully dramatized.

The world of the present decade has indeed been affected by a planetary economy with scarce oil supplies and restrictions on greenhouse gas emissions. Facing these conditions usually means huge investments, especially in terms of the inevitable global climate changes. It is possible that the human population could reach as high as

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nine billion in the coming decade. It took quarter of a million years to reach the one billion mark, rising to two billion in 1927, four billion in 1974 and six billion in 1986. This context leads to changes in the behavior of consumers and the clients of organizations. This world, more densely populated and demographically unequal, will see significant traumas in the social and economic pyramid. Classes A and B may shrink while classes C and D grow, provoking changes in consumption and acquisition of goods produced by companies.

It is in this context that developing countries that are capable of implementing clean development mechanisms (CDM), such as Brazil, can make a contribution towards sustainability by reducing greenhouse gas emissions. In this scenario of sustainability, greater institutional interaction between government and the business community emerges due to the current climate changes. Given the new demands for ecological products that do not cause pollution, organizations from different economic sectors have to establish partnerships in joint projects throughout interconnected and sustainable supply chains (Tachizawa, 2011). The development of companies will also be heavily influenced by pressure from non-governmental organizations (NGOs), pressing them towards a future of sustainable development. To face this challenge, business organizations will be induced to rethink their operations. They will have to consider new strategies due to changing consumer behavior, partnerships with different government spheres, partnerships with other companies in the same business sector, joint action with NGOs, changes in how business organizations interact and communicate with the community and define strategies according to the characteristics of the economic sector in which they operate.

They must also consider the more rational and sustainable use of resources, which can now be expressed in tangible values by calculating a reduction in the emission of greenhouse gases. This calculation of unreleased or reduced amounts of gases has now become a commodity in the form of Certified Emission Reductions (CER), which can be directly traded between companies or as bonds traded on the market. In line with this scenario, the Human Development Index (HDI) was created by the United Nations Development Program (UNDP, 2008) for the purpose of challenging the narrow economic definitions of progress of which the GDP is composed. In addition to economic indicators, it includes social indicators and literacy statistics, life expectancy and buying power. The HDI has therefore become an important instrument for measuring living conditions, not only of countries, but also of smaller segments such as states, districts and towns.

It was in this context of the HDI that the idea arose to also include in the present article the use of clean development mechanisms (CDM) by Brazilian companies. The various economic operations of organizations were researched and related to their sustainability strategies. As a result of this analysis, a methodology was established for the social and environmental diagnosis and implementation of CDM, with a different focus for each type of organization in the Brazilian business sector. The reasons that justify its use as an instrument of management by companies are not only the result of compliance with current legislation, but mainly because of the possibility of directing decisions concerning sustainability so that they may converge with corporate goals.

2. THEORETICAL FOUNDATIONS

Problems such as famine, pollution, corruption, lack of ethics and environmental degradation have filled the pages of human history since the first cities were built in ancient times. To Henderson (2001), these problems have grown since the early nineteenth century as a result of changes in the scale of human values stemming from the Industrial Revolution. These changes, which are an essence of human history, have evolved into modern times as social responsibility.

This, in turn, can be understood as the form of management defined by the ethical and transparent relationship of a company with the general public and by the establishment of business goals that are compatible with the sustainable development of society. These goals should preserve environmental and cultural resources and respect diversity, while encouraging less social inequality (ETHOS, 2007). In this scenario the question of climate change and its major representative, the Intergovernmental Panel on Climate Change (IPCC, 1988) emerge. This institution was founded in 1988 by the United Nations Environment Program (UNEP) to provide the relevant scientific, technical and socio-economic information to help people understand climate changes, their potential impacts and the options to adapt to and mitigate them. It is an intergovernmental body that is open to the member countries of UNEP and the World Meteorological Organization (WMO).

Accordingly, at the national level, the Ministry of Science and Technology and the Ministry of the Environment set up the Brazilian Panel for Climate Changes. Along the same lines as the IPCC, this Brazilian initiative will bring together 300 renowned scientists and researchers from a number of important institutions such as the National Institute for Spatial Studies (INPE), EMBRAPA and universities. Known as the Brazilian IPCC, the panel intends to compile and analyze all Brazilian scientific production concerning a wide range of data on climate change in the country. The plan is to produce a report similar to that of the IPCC at the UN, but exclusively dedicated to the phenomenon in Brazil.

Indeed, the world scenario is stigmatized by a global economy with scarce oil resources, restrictions on greenhouse gases and huge demands for investments to deal with the impacts of climate changes. Developing countries can implement CDM projects that would make a contribution to global sustainability. This would result in a significant reduction and capture of greenhouse gases, which would lead to Certified Emission Reductions.

One of the main characteristics of these transition periods is the change in the concept “of what is important, what has value, the goals to be achieved and the means of measuring (indicators) the collective progress towards achieving these goals” (Henderson, 2001).

According to the Organization for Economic Co-operation and Development (OECD, 1993), an indicator should be understood as a parameter or value derived from a parameter that provides information about the state of a phenomenon that has far-reaching effects.

Therefore, the use of indicators that use the concept of sustainable development has become an international reference in the debate on development, showing above all

that increasing wealth is not always a sign of improved quality of life for the public at large.

Countries with high per capita incomes can have low development indicators, and vice versa.

The United Nations Commission on Sustainable Development in 1996 published a document entitled *Indicators of Sustainable Development: Framework and Methodology*, generally known as the Blue Book. This work introduced a set of 134 economic, social and environmental indicators (IBGE, 2004). ETHOS (2007) presents requirements for the use of indicators when the focus is sustainable development, in terms of measurability, availability of data, method of constructing metrics, monitoring, economic viability, commitment and legitimization by decision makers.

This context includes the ISO 9000 for quality and the ISO 14000 for the environment (Tachizawa, 2011), forms of social certification implemented in the United States and later on in Brazil, attesting to the fact that an organization, in addition to following correct internal procedures, it also engages in non-profit activities.

The OECD recommends that both public and private organizations should adopt principles that make their actions transparent. Social balance, as a tool that has so far been used little by organizations, is part of this transparency and freedom of information. However, the number of publications is growing every year (Raynard; Forstater, 2002). The Ethos Institute for Business and Social Responsibility (ETHOS, 2007) suggests a pattern of social balance, outlining the impacts of the company's activities on the society and showing its relationship with different audiences. This model also includes presenting the report as suggested by the Brazilian Institute of Social and Economic Analyses (IBASE, 2007), and constitutes an alternative for presenting its business activities through social balance.

The São Paulo Stock Exchange (Tachizawa, 2011), due to growing interest of investors to move to the so-called "green" portfolios and to meet the demand of banks, pension funds and resource managers, organized a social responsibility and sustainability index (the ISE, Business Sustainability Index) based on the Dow Jones Sustainability Indexes of the New York Stock Exchange (DJ-SI). The commitment to sustainability by the interested public redirects power into the hands of the buyer. In many economic sectors, the purchase market exists only because there are more competitors and a surplus or excess of supply. Buyers are learning to use this new power.

Accordingly, it has become of fundamental importance to perfect the storage and retrieval of information, which is the reason why Draper and Dunlop (2002) sought to develop methods of identifying and accessing information in companies that users deemed useful at the strategic level. In this scenario, understanding the need for information in an organization constitutes a dominant theme in the business community. The present study was motivated by the existence of a gap in what managers need in terms of sustainability and what happens in day-to-day operations. The aim of this study is to analyze the concept of a database containing a collection of similar records and the relationships they have with one another to enable businessmen to include the social and environmental aspect in the management processes of their organizations

3. RESEARCH METHODOLOGY

The empirical research data gathered throughout 2009 and obtained according to an inductive perspective formed the basis of this study. In this study, the grounded theory method (Glaser; Strauss, 1967) was employed. This is a mode of qualitative research that seeks to generate new theories through concepts, categories and properties.

The emphasis of grounded theory is on learning from data (interactive and conductive) generated by empirical research rather than from an existing (deductive) theoretical vision. Furthermore, the conceptual basis originating from the theoretical reasoning was used (see Topic 2). The major difference between grounded theory and other qualitative research methods is its specific focus on the development of a theory through a continuous interdependence between data collection and analysis. It is a method that provides a methodological structure that is frequently missing from other qualitative approaches without sacrificing its flexibility or scientific rigor. The grounded theory was developed for research into social sciences, stressing the inductive discovery of theories from systematically analyzed data. Other authors have developed and debated the method (Glaser; Holton, 2004; Strauss; Corbin, 1997) reaffirming that: (a) the main proposal of the method is the construction of theory and not only the coding and analysis of data; (b) as a general rule, the researcher should not define a conceptual framework that precedes the beginning of his research as a premise to ensure that the concepts may emerge without pre-defined conceptual bias; (c) the analysis and concept are obtained through constant data collection and comparison, in which every item of data is compared with existing constructs with a view to enriching an existing category, form a new one or establish new points of relationship between categories.

The universe of this study is a set of major organizations in the industrial, commercial and services sector that operate nationwide (Revista Exame, 2010). Data collection took place in the form of an electronic questionnaire forwarded to executives of the 1,150 biggest Brazilian companies as listed by the Melhores e Maiores (Biggest and Best) list of Exame Magazine (2010). To supplement the responses to the questionnaires, information was obtained from the corporate websites of the companies included in the research sample.

Responses from 458 companies out of the total of 1,150 were included in the study, the results of which are given in the Social Balance topic, and sustainability reports were accessed on the websites of the companies included in the sample for further analysis. Specific information obtained from the websites of ETHOS, IBASE, BOVESPA, IBGC, Revista Exame, Época and specialized business publications was also included. This information helped to develop the conceptual architecture of the system.

4. RESULT

For the conception of the architecture of social and environmental data, the study sought to analyze the responses of the 458 companies that answered the questionnaires (42% of the 1,150 previously selected companies), making it possible to understand the level of sustainability of organizations in the national economy.

Through the questionnaire and access to the company websites, data were obtained concerning the companies' sectors, which were predominantly industrial. The primary data showed that **65.7%** of all the companies in the sample are industrial, followed by the service sector at **21.6%** and commercial companies making up the remaining **12.7%** of the total.

To understand methodologically the proposal for the classification of organizations in terms of sustainability, a simple classification was considered at the outset (industrial, commercial and service organizations), with a more complete typology of organizations being adopted later, interlinked among themselves in the Brazilian business environment.

Organizations were considered industrial companies if they worked with steel, cement, paper and cellulose, operated in the metal and mechanical sector, metallurgy, the automotive sector and similar sectors (durable and consumer goods). They are companies that take inputs (raw materials in general) and transform them into finished products. Service providers are those that provide financial services (banks, finance companies, stockbrokers and insurance companies), engineering, publicity and advertising, hospitals, hotels and related companies. Commercial companies are those in wholesale and retail (stores, distributors and similar companies). Another factor included in the research had to do with a company's focus on sustainability, the data shown in Table 1.

Table 1. Social and environmental actions measured in the study

<u>DESCRIPTION</u>	<u>SERVICES</u>	<u>INDUSTRIAL</u>	<u>COMMERCIAL</u>
Education	36,4%	44,7%	29,5%
Environment	11,9%	75,8%	43,1%
Health	37,8%	22,3%	35,4%
Community action	44,3%	31,1%	49,8%

Source: data obtained from empirical research

The responses showed a preponderance of actions to protect the environment by industrial companies (75.8%). The other companies, services (11.9%) and commercial (43.1%), placed less emphasis on the environment. Other social and community actions (volunteering, culture, safety, social inclusion, people with special needs, children and teenagers, senior citizens and animal protection) were quite evenly spread, with slightly more emphasis on the part of the commercial and service sectors.

In other words, "social and environmental demands and effects" vary depending on the sector to which a company belongs (see Table 2).

Table 2. Environmental management practices

social and environmental practices	Services	Industry	Trade
a) recycling of waste	low	high	media
b) waste disposal	null	high	low
c) control of waste and vibration	null	high	low
d) reducing the use of raw materials	low	high	average
e) energy conservation	null	high	average
f) recovery and recycling of liquid discharges	high	average	average media
g) requirement for suppliers and distributors with environmental preservation procedures	low	high	average media
h) water conservation	high	average	low

Source: data obtained from empirical research

In the evaluation of future stages of social and environmental management, as shown in Table 3, the companies emphasize the improvement of management practices and increased investments, including in CDM.

Table 3. Goals and expectations of social and environmental management

Description of the factors analyzed	Services	Industry	Trade
a) monitoring of environmental management	low	very high	average
b) increasing investments in environmental management	null	high	low
c) environmental auditing practices	null	high	low
d) use the results of environmental management and institutional marketing strategy	low	very high	average
e) preparation of the organization to achieve environmental labeling	null	high	average
f) adoption of clean development mechanism, CDM	low	high	low

Source: data obtained from empirical research

Investments for the coming years in technology to reduce noise losses and waste were the most emphasized, as shown in Table 4. The organizations under study in the Brazilian business universe were grouped into types: service, industry and commerce, in accordance with their affinity with the factors that were researched. This focus showed that in the services sector, organizations can have a “null” impact on the environment. These organizations, when scrutinized closely, reveal that through bank loans they may have participated in the degradation of the environment. For instance, if the loans are authorized for organizations in the agribusiness segment and the contracts do not include criteria for sustainability.

Table 4. Future investments in social and environmental management

Requirements and social effects	Services	Industry	Trade
a) procedures for reduction of losses and waste	low	high	media
b) procedures for noise reduction	null	high	low
c) industrial solid waste disposal	null	high	low
d) energy conservation	low	very high	media
e) treatment and monitoring of liquid effluents	null	high	media
f) training of manpower	high	media	media
g) monitoring of effluent gases and related gases?	low	high	media
h) optimization of design, product and packaging	high	media	low
i) adoption of clean development mechanism, CDM	low	high	low

Source: data obtained from empirical research

For this reason, these consolidated (passive social and environmental) factors show that the companies in the sample adopt, to a greater or lesser extent (depending on their size and line of business), procedures that are inherent to social and environmental management, such as: a) reducing the amount of raw materials required for manufacturing products or substituting the source of energy to reduce pollution levels; b) reducing the use of energy (conservation) required to manufacture products and reducing the amount of water (by conservation, recovery or recycling) required to manufacture a product; c) changing the composition, design and packaging of a product to make its use less harmful to health and the environment; d) monitoring, recovering and recycling gas emission and liquid discharge in industrial activities; and noise and vibrations; e) improving stocking, transport, handling distribution and disposal of dangerous products or materials and their packaging and disposing effectively of them, recycling solid residue, scrap, waste and garbage in general; f) providing training courses and a labor development program for social and environmental management procedures; g) choosing suppliers and distributors that have good social and environmental management practices.

4.1. Different effects of sustainability

The social and environmental characteristics measured in the study showed different sustainability requirements for each type of company (see Table 5). The results of the analysis of these factors of influence made it possible to identify the intrinsic social and environmental characteristics of each type of organization.

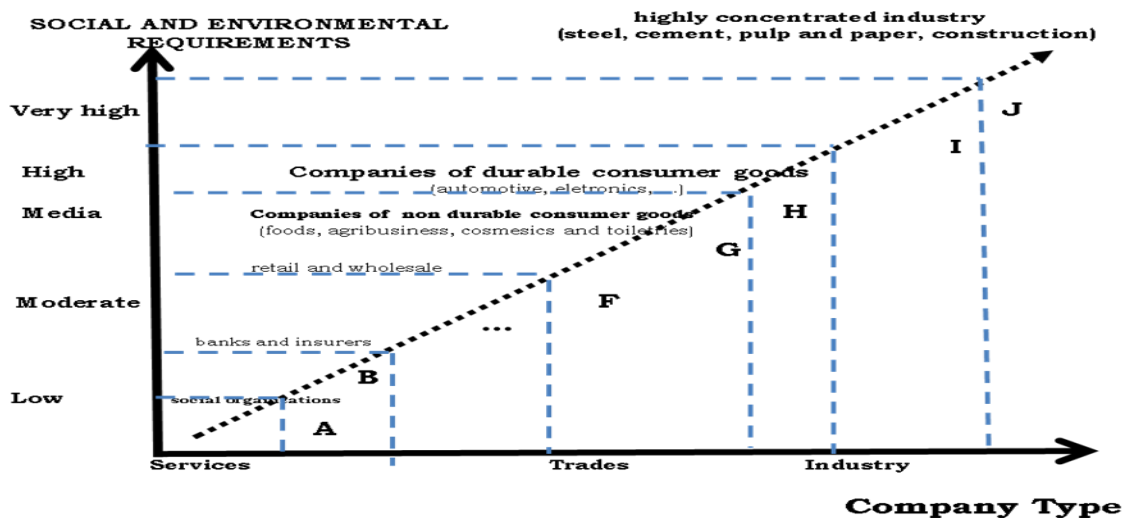
Table 5. Social and environmental characteristics measured in the study

Requirements and social effects	Services	Industry	Trade
a) sustainability in the supply chain	low	high	media
b) impact of production on the environment	null	high	low
c) impact of the product in the environment	null	high	low
d) suppliers comply with social and environmental requirements	low	high	media
e) ISO14000environmental standards	null	high	media
f) ISO16000social responsibility standards	high	media	media
g) OHSAS18000safety standard	low	high	media
h) publication of systematic social reporting (Ethos, GRI ..)	high	media	low

Source: data obtained from empirical research

Social and environmental management practices, as shown in the research data, are strategies that the companies adopt differently. For instance, according to the data from the questionnaires, industrial companies show greater concern over environmental protection norms (ISO14000) and norms of hygiene and safety at work (OHSAS 18000). On the other hand, norms such as the ISO16000 are utilized in all the organizations, with special emphasis on the financial services sector (high social and environmental demand). Meanwhile, in industrial and commercial companies, this demand is lower, given the specific nature of their business operations. Correlating the data measured in the study (Tables 1-5) for each type of company (see Figure 1) and for each economic sector that was analyzed different effects of sustainability were found. Figure 1 shows the different social and environmental effects in the companies from the three economic sectors under study.

Figure 1. Social and environmental effects for the respective economic sectors



Source: data obtained from empirical research

In Figure 1, axis “x” represents the type of company and “y” represents the degree of social and environmental effect potentially caused by the organization.

Analyzing the different types of organizations, there are service companies with almost null social and environmental effects, with their strategies being limited to institutional marketing practices in terms of publishing their social balances and social projects in the fields of education, culture, volunteer work and related actions.

At the other extreme, there are industrial companies that are potentially the cause of the highest social and environmental impacts, such as manufacturers of steel, cement, paper and cellulose, energy and similar products.

Between these two extremes are the other types of companies (commercial companies, producers of durable consumer goods, etc.) that are normally capable of adopting social and environmental strategies that are compatible with the degree of environmental impacts caused by their processes and social strategies, meeting the expectations of the community in which they are located.

4.2. Social and environmental variables and types of organizations

The social effects on firms, a result of the analysis developed in the previous section, could be graded in 10 types according to their economic activities and therefore, according to their industry. Companies ranging from low socio-environmental impact, as a natural outgrowth of its economic activities, which take ethical behavior compatible with this minor requirement in terms of social responsibility, even highly concentrated sector companies, which adopt the assessment of impacts of products, processes and facilities (systematic), seeking to anticipate public demands. Social organizations, service companies, and equivalent organizations were grouped in Table 6, as explained below.

Table 6. Service organizations in the context of sustainability (Perceived characteristics of the factors under study)

<p>Social organizations (type A): The organization assumes responsibility towards society and take actions on the consistent exercise of citizenship to their economic activities. The promotion of ethical behavior is also compatible with your line of business, low environmental impact and negligible demand in terms of social responsibility. This is the case of cooperatives and associations, social organizations and related activities. Governments are the exception in your federal, state and municipal levels. At the municipal level include the cases of municipalities, generating potential carbon credit projects, emissions of greenhouse gases (GHGs) and CDM.</p> <p>Business Services (type B): The organization recognizes the impacts of its processes, with isolated actions in order to minimize them. Emphasizes ethical behavior, companies usually required for specialized services, engineering and architecture firms, auditing and consulting, advertising agencies and advertising, tourism, workshops and other organizations.</p> <p>Financial institutions (Type D): The organization adopts practices to mitigate the social and environmental impacts of its services, processes and facilities. The organization promotes ethical behavior. Companies providing financial services, banking, insurance and services in general.</p> <p>Hospitals and Hotels (type E): The organization adopts practices to mitigate the social and environmental impacts of its services, processes and facilities. The organization is leading issues of community and industry. Encouraging people to participate in efforts for social development is systematic. There are ways implemented in assessing and improving the organization performance in the exercise of citizenship and to address their public responsibilities. Positioning normally required for hotels, hospitals and providers of leisure and entertainment.</p>

Source: data obtained from empirical research

The social and environmental impact on companies, as a result of the analysis in the previous topic, was graded into ten types, in accordance with their economic activities and, therefore, their economic sector. This ranges from companies with a low social and environmental impact, as a natural result of their economic activities that behave ethically and compatibly with this requirement in terms of social responsibility, to companies in the highly concentrated sector, which evaluate the impacts of their (systematized) products, processes and facilities in a drive to anticipate public demands. Commercial companies (retailers, wholesalers and similar companies), in the analysis conducted in Topic 4.1, were highlighted as shown in Table 7.

Table 7. Commercial organizations in the context of sustainability

<u>TYPE OF ORGANIZATION STUDY</u>	<u>PERCEIVED CHARACTERISTICS OF THE FACTORS UNDER STUDY</u>
Business for sale (type C):	
	<p>The organization adopts practices to mitigate the potential social and environmental impacts of products sold. It tends to exert some leadership on issues of interest to the community and environmental projects (recycling, environmental education and community campaigns and the like). Retail organizations (small and large), wholesale (large and medium-sized), supermarkets, distributors, gas stations and the like. Their social effects are felt in the hiring of goods (with certified wood furniture, goods with a green seal and the like) and services (social and environmental certification of suppliers), along with companies from other productive activities. The final consumer pressure to increase progressively, with customers demanding more and more environmentally friendly and green products. This pressure is passed on socio inversely with industrial companies and service providers. Global organizations such as Carrefour and Wal-Mart, for example, are influenced by the purchasing power of its consumers who demand organic and environmentally friendly products. This makes such organizations purchase only from suppliers previously certified.</p>

In the industrial category, as shown in Table 8, companies generally require international green seal certifications or their equivalent, such as SA8000, AA1000, ISO14000 and congeners (international norms of social responsibility and environmental protection which have been standardized in Brazil by the ABNT – Brazilian Association of Technical Norms).

In this segment there are potential alternatives to reduce the greenhouse effect by reducing emissions and increasing energy efficiency through the use of renewable sources of fuel, improved technology and systems for the transport sector and production processes in general.

Table 8. Industrial companies in the context of sustainability

<u>TYPE OF ORGANIZATION</u>	<u>PERCEIVED CHARACTERISTICS OF THE FACTORS UNDER STUDY</u>
<i>Companies of average social and environmental effect (Type F):</i>	The organization adopts social and environmental practices to reduce the average impact of its products, processes and installations. It seeks to anticipate public concern. The company publishes social balances and adheres to previously set standards. This stance is required of companies that produce building materials, textiles, hygiene and cosmetic products or operate in the automotive sector.
<i>Non-durable consumer goods industry (Type G):</i>	The evaluation of the impact of products, processes and installations needs to be systematized in an attempt to anticipate public concern. The company normally needs international certifications (green seal or equivalent certifications), such as the SA 8000, AA 1000 and similar certificates. This is the case of companies in economic sectors such as food, agribusiness and other activities which have a high environmental impact.
<i>Durable consumer goods industry (Type H):</i>	The evaluation of the impact of products, processes and installations needs to be systematized in an effort to anticipate public concern. International green seal certification is normally used, such as the SA 8000, AA 1000. This is the case of companies that belong to economic sectors such as car manufacturing, car parts, plastic and rubber, electronic goods, metallurgy, heavy construction and other activities that have significant environmental impact.
<i>Industries that have a high social and environmental impact (Type I):</i>	The evaluation of the impact of products, processes and installations needs to be systematized in an effort to anticipate public concern. International green seal certification is normally used, such as the SA 8000, AA 1000. Corporate governance principles should be adopted and the standards cumulatively structured in the previous types of company should be adhered to. At this level, responsibility should be considered as a requirement to be “demanded” from large organizations, whose social and environmental characteristics mean that this stance is necessary. This is the case of companies that produce paper and cellulose, tobacco, pharmaceuticals, drinks, light chemicals and other similar products that have a considerable impact on the environment. These companies have highly concentrated capital and are large companies whose shares are traded on the stock market.
<i>Industries that have very high social and environmental impact (Type J):</i>	The company needs international green seal certification, such as the SA 8000, AA 1000. This is the case of companies that belong to economic sectors such as agribusiness, steelworks, petrochemicals, heavy chemicals, mining, hydroelectric plants, thermoelectric plants and nuclear power plants, cement, armaments and ammunition, agro-toxics, transgenic seeds and others with a very high impact on the environment. Industrial companies are big users of electricity, which makes a significant impact on the country’s energy matrix. These companies have highly concentrated capital and are large companies whose shares are traded in the stock market.

Source: data obtained from empirical research

In this type of organization, the commercial activities and services of those belonging to the agribusiness sector normally supplement their supply chain (i.e., although classified in the industrial segment, these organizations usually pervade the three supply chains). This agribusiness sector, which includes livestock and agriculture in general, suffers greatly from the influence of legal variables (Código Florestal in Brazil, 1965). Industrial companies are disciplined by these laws. Naturally, they use up large amounts of raw materials from forests and are obliged to concentrate their activities within a radius in which exploitation and transport are deemed economical. This requires them to provide an organized service to ensure the planting of new areas of forest either on their own land or on the land of third parties to replace the resources they consume while exploring the land.

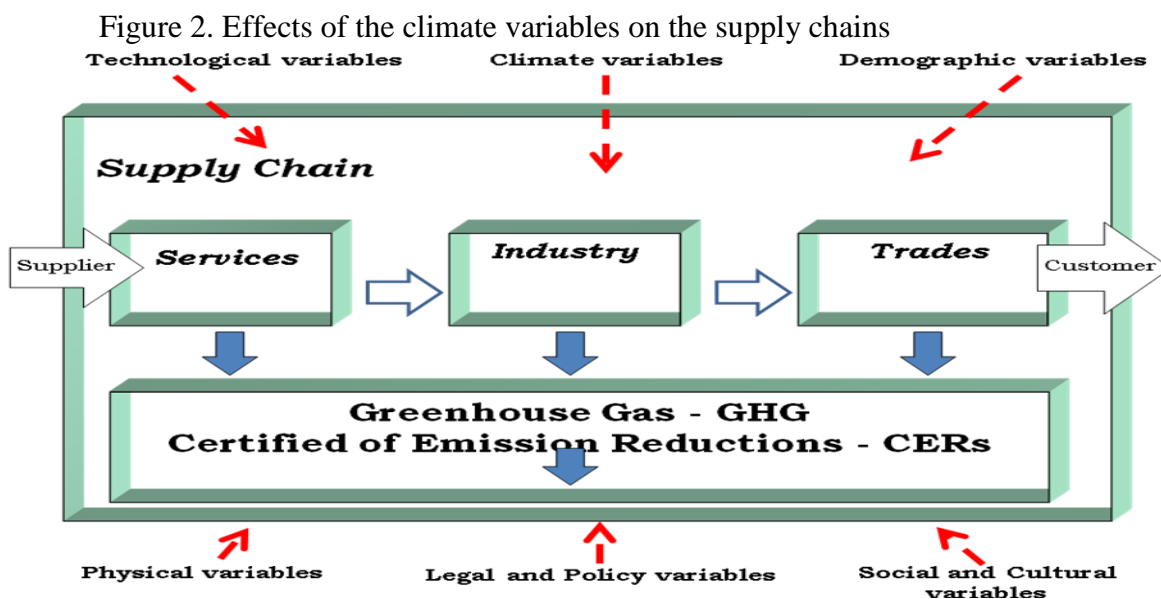
These effects, which originated from legal variables (see Figure 2), can be combined with technological variables that can either positively or negatively affect the supply chain. For example, the forests that are planted to meet the requirements of legislation that curtail highly concentrated industrial activity can result in global environmental benefits. In other words, technology such as the reuse of eucalyptus bark discarded by the paper and cellulose industry can be used to produce ethanol (clean and renewable energy). Discarded materials can also be used as raw materials for the production of bio-plastics.

Steelworks, transport companies and others, using vegetable coal, wood or other raw materials from the forests, are obliged to maintain their own forests for rational exploration or to grow forests to supply their own industry, be it directly or through the ventures in which they take part. Companies that have a high social and environmental impact (type “j”, as shown in Table 9) need to adopt CDM and monitor greenhouse gas emissions or the impacts of environmental exploration (both of which are included in ISO 14000). Paper and cellulose companies, for instance, can use discarded eucalyptus bark to produce ethanol.

These factors of sustainability that are under study (passive social and environmental factors) were later broadened to enable the grouping of ten types of organizations as proposed below.

4.3. Types of organizations and interface between supply chains

In this drive to harmonize the production of goods and services with environmental preservation and social well-being, in accordance with the research data, the supply chains of the national economy are influenced by external variables (demographic, climate, technological and other such as physical, cultural, legal, political and social). These supply chains cover the whole productive cycle of the country in the form of service, industry and commerce. They are interlinked in a perpetual change that affects each supply chain differently, as summarized in Figure 2, below.



Source: data obtained from empirical research

These external impacts directly impact the country's economy and indirectly impact the different lines of business (supply chains). These effects vary depending on the economic sector, as shown in this study. One supply chain, such as the agribusiness chain, for example, suffers different effects of green house gases in its farming segment, acquiring supplies (fertilizers and labor) and trading its harvested crops. In this supply chain, preserving the forests is clearly important as they provide environmental services in the form of input such as pollination, pest control and control of invasive species.

Thus, if more GHG, such as carbon dioxide (CO₂), are released into the atmosphere, they will cause the global temperature to rise, and this in turn will affect farming. In other words, high temperatures can drastically reduce the productive potential of farming cultures. There are also physical variables such as urban agglomeration, which leads people to leave the countryside and migrate to the cities. In addition to affecting the agribusiness chain, this leads to increased energy consumption.

This requires the country to adopt a stance to neutralize or minimize these effects and, therefore, the actions of companies so that in their supply chain they can: a) protect the climate system based on equity and in accordance with their common, but different, responsibilities; b) take the initiative to combat climate change and its effects; c) promote sustainable development and measures to combat climate change, preserving business and international trade; d) draft and publish the inventories of their sectors concerning gas emissions (so that they can be assembled Ci, o que sera que eles querem dizer com assembled? on a national level) and encourage programs to reduce these emissions.

They could also finance projects to reduce or trade the volumes of reduction in emissions resulting from the initiatives taken by companies and jointly enable countries to transact them reciprocally. They could also reduce emissions by increasing energy efficiency and using renewable sources and fuels and adopting better technologies and systems for the transport sector and production in general. They could also improve education, train and raise awareness of the problem of climate change and cooperate in a full, open and immediate exchange of scientific, technological, technical and socio-economic information on the subject. Other effects in business organizations may be

coached in terms of the need to coordinate mitigation and adaptation policies, which will result in global benefits. They can also take into account the fact that the impacts that will result from climate changes will create risks and business opportunities and the operational and trade levels for the company, the local community and at a global level in the consumer market, in both developed and developing countries.

The perceived impacts of risk may be greater in developing markets due to the low capacity of these markets to adapt to the impacts of climate change. Key drivers in the planning of this adaptation include competitive advantages, reduced costs, corporate responsibility, pressure from investors and shareholders, regulations and laws and the capacity for consumers to adapt. The suggested typology can help identify demands for carbon credits (Certified Emission Reductions - CER) and reductions in greenhouse gas (debt in relation to environmental liabilities) by each economic sector and consequently the country. Figure 3, below, shows the aggregation of these demands for each economic sector.

The consolidation of the supply chains of each economic sector and the sum of all these sectors in the country result in a national inventory of greenhouse gas emissions. Improving environmental quality and the sustainability of productive processes can mitigate the harmful impact of GHG on the planet's climate.

Any attempt to alter the current model of energy consumption, based on fossil sources and deeply rooted in the productive process, ends up being hindered by the enormous economic implications. In this sense, the organizations from different economic sectors (services, industry and commerce) are influenced by the scientific evidence concerning the links between the greenhouse effect and climate changes. The resulting need to reduce CO₂ and the growing demands of society for environmental quality encourage greater sustainability in the production processes of these organizations.

4.4. Analysis of sustainability

This proposed typology is particularly useful for identifying opportunities for developing a CDM project that can be related to more than one type of organization (or economic sector): the generation of energy (both renewable and non-renewable), distribution of energy, demand for energy (energy efficiency and conservation projects), manufacturing industries, chemical industries, construction, transport, mining and mineral production, metals, fugitive emissions from fuels, fugitive emissions from the production and consumption of halocarbons and sulfur hexafluoride, use of solvents, management and treatment of residues, reforestation and forestation and farming.

The CDM, in this proposition, is a consistent instrument for diffusing and acquiring clean and productive technologies that, in another context, would cost much more to transfer and acquire. Energy intensive industries, for example, with high use of capital and little labor (such as steel, paper and cement) have many opportunities to increase efficiency.

The benefits of a public policy in energy efficiency can be aimed at the industrial sectors with lower economic potential and greater capacity to distribute wealth through providing employment. For larger intensive energy companies, the return on savings made through energy efficiency are profitable. .

The implications resulting from the accountability balance sheet and the Social and environmental Development Index - SDI of each sector make it possible to improve corporate practices in which business strategies increasingly depend on sustainability. Likewise, if the social and environmental databases include the geographic location of companies, sustainability could be monitored by region (the north of the country, for example, could be monitored for an undesirable surge in industrialization).

As the proposal is to create a database of Brazilian companies, a historical analysis of the SDI of these companies could be conducted, both in terms of aggregate statistics of the national economy and a given economic sector, showing which meet the proposed social and environmental goals. This could be done by consolidating the balance sheets of all the organizations in an economic sector and, at a higher level, consolidating the balance data by each type of organization proposed in the present study. This could be done at four levels: 1) at the first level where the balanced sustainability of the organization would be, which is the object of this study; 2) at the second level where the aggregate balanced sustainability data of the organizations in the sector under analysis are (for example, steelworks); 3) at the third level where the aggregate balanced sustainability data of the organizations belonging to the social and environmental sector under analysis are (for example, organizations in the highly concentrated segment); 4) and at the fourth level where the consolidated balanced data of all the sectors of the national economy could be.

This consolidation of social and environmental balanced data can help determine how to measure the stage of development of the country or a particular organization. It is a new form of measurement that places emphasis on the social and environmental aspect and sustainability and placing less emphasis on economic factors in a macroeconomic evaluation. Indeed, in addition to the economic variable there are the climatic, technological and demographic variables, in addition to others, that are directly affected by the current era of climate changes and global warming. This reflects on the repositioning of business organizations in terms of partnerships with different government spheres (federal, state and local), partnerships between companies in the same economic sector, joint actions by companies and NGOs, the changing behavior of consumers and clients, changes in how business organizations interact and communicate with the community and other related changes.

The institutional interaction between governments and companies should change drastically due to climate changes. Taking the example of type “j” organizations, companies that make a huge social and environmental impact, there may be a change in energy consumption (steelworks and aluminum producers) that will require an energy matrix that will include alternative sustainable sources of energy such as wind, solar, biofuels, etc.

Companies that operate in the same economic sector, such as the manufacture of durable consumer goods (cars, car parts, plastics and rubber, electric and electronic goods and metals) which, according to the typology proposed in this study make similar social and environmental impacts, can work together to find a common solution to deal with global climate changes. In other words, given the demand for ecological and non-polluting products, they can establish partnerships in the form of joint market projects throughout interlinked sustainable supply chains (specifications for parts to be fitted to a vehicle would be passed back down the supply chain until they reach the primary manufacturer of the basic raw materials).

The performance of companies should be highly influenced by pressure from NGOs driving them toward a future of sustainable development.

CDM projects and the CER market stemmed from a global initiative to improve the environment and has become a way of reducing greenhouse gases and resulted in the Earth Summit in Rio de Janeiro in 1992. Therefore, the question of quality and sustainability, as outlined in this article, is a key part of this process. By adding commercial value to the results of gas emissions, the CDM immediately presses for greater competitiveness in conservation practices and the use of renewable energy sources. When the country is pressured by increased demand for energy resources (especially electricity), a range of new opportunities is opened up to the business community.

Businesses and ventures aimed at the energy sector, with absolutely consistent economic and environmental resources, could be decisive when it comes to the energy resources required for development and urgently bridging the regional gaps in Brazil. The CDM is also a powerful tool when it comes to diffusing and acquiring more productive and clean technologies that, in another context, would cost far more. The general interest in the efficiency of results of CDM projects opens up important access to innovative and modern practices, resulting in evident gains in productivity and increasing business competitiveness.

In addition to the prior definition of the main sectors of national interest for developing CDM projects, it is also essential for the business community, with its concern over competitiveness, to participate effectively and regularly in the process.

Especially in the early stages, the development of CDM projects and the CER market, given their originality, will require considerable pooling of knowledge and capacity to meet their requirements and needs. It is a process that can only be learned by doing and which requires constant interaction and cooperation between public and private interests. This is a basic factor for Brazil to have a good position in the CER market and for the positive development of CDM projects. Due to the changing way in which business organizations interact and communicate with the community, they will seek to promote their business actions in the form of a social and environmental balance rather than financial statements (traditional financial statements in the form of balance sheets).

4.5. Social and environmental database

This typology makes it possible to design a database and collect information concerning the business sustainability of the companies under study in the same virtual location. It is clear from the results of the study that any organization, no matter what its managerial style is, has social and environmental “effects” that differ as a natural result of its economic sector. These effects, according to the diagnosis of sustainability proposed in this study, can be represented in the form of social and environmental liabilities. To combat these effects, the company needs to implement counteractions in the form of duties and obligations (social and environmental assets).

4.5.1. Conceptual architecture of the database

The social and environmental database is centered on the formulation of a social and environmental development indicator that would reflect the stage of development of

an organization in terms of sustainability. In other words, the modeling of this architecture can be consolidated in the form of a balance sheet (Chart 1), with different focuses of sustainability for different organizations.

The social and environmental balance sheet, made up of assets and liabilities, can be structured in the form of an electronic spreadsheet, containing a double entry diagram (“T” model). This would show on the one hand the social and environmental effects of the organization (the analysis factors are quantified, *a priori*, as liabilities), and on the other hand the sustainability decisions made by the organization management, with the corresponding economic burden (social and environmental costs, counted *a posteriori* as assets) to meet the social and environmental demands resulting from its supply chain (see Table 3).

Chart 1 – Example of Social and Environmental Balance Sheet

ACTIVE (burden business, the basis for cost appropriation)	Mark with X	PASSIVE (social and environmental effects)
1. Sustainability and Clean Development Mechanism - CDM 1.1. Environmental and Social Responsibility standardization (ISO14000, 16000, SA8000 ...), OHSAS18000	0,08 X	Different community and external audiences in need of a better social image and information about the company's performance. Requirement to implement projects to reduce emissions through increased energy efficiency with the use of renewable fuels and innovative technologies and processes. information about the company's performance. Requirement to implement projects to reduce emissions through increased energy efficiency with the use of renewable fuels and innovative technologies and
1.2. Sustainability of Supply Chain and Clean Development Mechanism - CDM	X	
1.3. Governance (IBGC, Bovespa, the Dow Jones Sustainability-ISE)	-	
2. Human capital 2.0. training and development 2.1. Employees 2.2. customers 2.3. suppliers 3. career planning 3.1. top management 3.2. operational level 3.3. integration with training and performance evaluation 4. plan for jobs, wages and benefits 4.1. variable remuneration 4.2. profit sharing 4.3. integration training	0,1 X X X 0,06 X X X 0,03 X -	Company with the economic activity of high environmental impact (of their production processes and facilities). High degree of automation in the control of energy generation and distribution. Supply chain social and environmental effects to be monitored with suppliers and customers
5. Talent Management 5.1. Internet recruitment 5.2. listen, HR database 5.3. IT support 6. organizational configuration 6.1. matrix structure for projects 6.2. organization by processes 7. programs for organizational climate 7.1. systematic research 7.2. sporadic research 8. social actions 8.1. racial diversity 8.2. volunteering 9. Transparency and ethics 9.1. social balance 9.1. social and environmental report 10. ethical position 10.1. code of ethics for customers and suppliers 10.2. code of ethics for relations with governments	0,05 - - X 0,05 - - 0,01 X 0,08 X 0,09 X X 0,01 X X	

Source: data obtained from empirical research

The *liability* should mirror the typology set in Tables 6-8, while the *asset* is the sustainability measures that should be taken by the organization (see Tables 1-5).

The sum of the metrics (central column where the incidence is marked with an X) of the ten factors of influence (sum of the subtotal of the items) is:

$$0.03 + 0.06 + 0.08 + 0.10 + 0.05 + 0.05 + 0.01 + 0.08 + 0.09 + 0.10 = 0.65$$

This steelwork's "0.65" SDI (Chart 1) shows that there is a discrepancy between what would normally be required from a company with high social and environmental effects and which compensatory practices are actually adopted (including CDM), owing to the particular nature of this organization.

Depending on the company's economic sector, cost requirements can be changed, since they vary because of the characteristics of the supply chain. These characteristics would encourage the company to adopt CDM, with strategies varying depending on the type of organization. Another implication of the social and environmental balance is the need for or excess of carbon credits required by the organization or, on a larger scale, by the sector as a whole to meet the requirements of zero carbon emissions (an asset equivalent to environmental liability).

4.5.2. Systemic Architecture

As a result of the analysis conducted in this study, a typology of organizations has been proposed to serve as a foundation for a sustainability database and possible software for social and environmental inspection.

The unique metric of each company under study collected *a posteriori* from compliance with the established requirements as an environmental asset may vary in the SDI ranges of each economic sector. For instance, type A companies show **SDIs** ranging from **0-1**; type 2 companies have values of **1.1-2.0** and so forth up to the levels of type J companies, which range from **9.1-10**. Following the social and environmental diagnosis, an SDI database can be prepared (see Table 9) of the companies of the Brazilian business universe, classified by economic sector *a priori* (with SDIs varying in previously established ranges), using the analyzed factors of environmental liabilities.

Table 9. Database with SDI metrics

TYPE	SETOR	SDI
A	Social organization	0 a 1
B	Trades	1,1 a 2
C	Comercial	2,1 a 3
D	Financial	3,1 a 4
E	Hospital and Hotel	4,1 a 5
F	Mediun effect environmental	5,1 a 6
G	Non durable goods	6,1 a 7
H	Durable goods	7,1 a 8
I	High effect environmental	8,1 a 9
J	Very high effect environmental	9,1 a 10

Source: data obtained from empirical research

Sector

Commercial

Average environmental effect

High environmental effect

Very high environmental effect

An alternative form of costing could simply be adding the absolute total of the elements that comprise the social and environmental assets and including the costs of sustainability. However, in this proposal, it was decided to mark these costs as a benchmark of the management of the company in the form of an SDI.

In other words, the SDI, as proposed in this model, is an indicator derived from the expected social and environmental performance of the companies that make up the economic sectors under analysis. This would enable the establishment of a scale on which to place the companies at their different stages of sustainability. The sustainability balance sheet, composed of assets and liabilities, could be structured as a spreadsheet, including a double entry diagram ("T"- shaped model).

This would show, on the one hand, the social and environmental impact of the organization (factors that would be computer, a priori, as liabilities). On the other hand, it would show the sustainability decisions of the organization, and their corresponding economic burden (Ci, nao consigo entender essa infos em parentheses which would be computer a posteriori as assets). This would enable a comparison of the social and environmental requirements of the supply chain.

In this way it would be possible to calculate the social and environmental costs of an organization and the organizations that belong to the same economic sector.

Depending on the economic sector, an organization can alter its cost requirements, as these vary due to the nature of the supply chain. A specialized services company, for instance, would not need ABNT/ISO14000 CDM, nor would it require norms of good corporate governance. Instead, it could concentrate on other requirements that are better suited to this type of company, such as corporate citizenship, training programs for suppliers and ISO16000. Using this view of the sustainability balance, an example may be given of a type **J** company, which is an organization with a huge social and environmental impact. For example, in the case of financial institutions (banks, etc.), whose characteristics do not require much emphasis on environmental protection, there would be no requirement for ISO14000.

5. CONCLUSIONS

The proposed model would reflect the stage of sustainability of the organization under study and outline social and environmental mapping of the different economic sectors in Brazil. This mapping is founded on a social and environmental diagnosis to support decisions concerning sustainable management of the supply chains of organizations.

The implementation of this model by companies and, consequently, in the context of the supply chain and, on a broader scale, of the country, can provide technical aid to nationwide training in CDM. This would enable directives for economic, social and environmental development in terms of: more energy sources and the use of renewable energy and fuel; conservation of energy and increased energy efficiency; substitution of fossil energy sources for renewable sources or sources with lower gas emissions and optimization of emissions in transport systems; co-generation of electricity and increased availability of energy through renewable sources, non-emission or low potential emission; reforestation and recovery of deforested or degraded areas, compatibility with the national and regional definitions of the use of soil and protected areas.

The model can also help to define corporate strategies for dealing with the impact of climate changes on business operations. It also opens up possibilities for companies to decide on the rational and sustainable use of resources as it is now possible to compute tangible values in the form of reduced green house gas emissions. This calculation of avoided or recovered emissions would become a commodity. These commodities (tons of avoided or recovered CO₂ gas emissions) can lead to CER being directly traded between companies or as bonds in the market. For companies and countries with goals to reduce emissions, the flexibility mechanisms of the Kyoto Protocol open up alternative choices for the improvement of the cost-benefit ration of the investments required to adapt to the new standards (changes in production processes

or the acquisition of CER in the market as a result of CDM). These early credits, as defined by the Protocol, can be duly used to boost financing for public and private projects to reduce greenhouse gas emissions.

This approach suggests that different management focuses should be adopted for sustainability by different types of organizations since they suffer different social and environmental effects depending on their line of business. Another implication resulting from the social and environmental balance is the viability of adopting CDM and the need for or surplus of carbon credits required by the organization or by the economic sector as a whole in order to comply with zero carbon emission requirements. Likewise, there are alternative ways of demonstrating the stage of development of the country or individual organization, not only from an economic point of view, but in terms of sustainability and levels of social and environmental progress in macro-national and corporate terms.

Future studies can be conducted to confirm whether information concerning sustainability helps government regulators and inspectors to monitor progress and evaluate the use of a database containing the geographical location of organizations to monitor development on a regional basis.

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