Multi-criteria analysis of the GRI sustainability reports: An application to Socially Responsible Investment.

The aim of this paper is to construct a support decision-making system to evaluate the different items of Corporate Social Responsibility. For this purpose, we propose a multicriteria model that runs on two levels of decision-making in accordance with the hierarchical structure designed by the Global Reporting Initiative (GRI). Tools for modelling preferences and aggregating information are used in this framework. Arrays of normalized scores reflecting the company performance in the Aspects and Categories of GRI are then made available for the stakeholders. The design of investment portfolios uses the obtained measures of sustainability objectives. The proposal enables more informed decision-making for investors with social concerns that prefer direct investment and wish to make their own financial decisions. The developed methodology has been applied to 8 Spanish companies, which have been selected for their relevance in the Spanish stock market.

Keywords: Corporate Social Responsibility, Sustainability Report, Global Reporting Initiative, Multi-criteria programming, Goal Programming, Socially Responsible Investment.

1. Introduction

An increasing number of companies are promoting their Corporate Social Responsibility (CSR) strategies as a response to investors who consider good business practices as a guarantee of good returns and to a variety of social, environmental and economic pressures of social groups. The latter involves aspects such as respect for human rights, decent work, gender equality in employment, racial equality and environmental and economic impacts. Their aim is to send a signal to the various stakeholders with whom they interact: employees, shareholders, investors, consumers, public authorities and non-governmental organizations (NGOs) in order to gain a good business reputation which will help them to attract potential public and private investors. In doing so, companies are investing in their future and they expect that the voluntary commitment they adopt will help to increase their profitability.

At present, a large number of standards, indicators, indices and codes of good conduct have been developed with standards being the most developed instruments as far as a tool to independently show the implementation of CSR in organizations by means of certification processes (Christmann and Taylor, 2006; Gilbert and Rasche, 2007; Etzion and Ferraro, 2010; Rasche et al, 2013; Kühn et al, 2014). The most important standards are: Global Reporting Initiative (GRI), the guidelines of which are the main international standard for preparing sustainability reports; ISO 26000 which is a guide resulting from a consensus among international experts representing the main stakeholders and is designed to encourage and promote the implementation of Social Responsibility best practices internationally; Standard SA 8000 of United Nations on working conditions (based on the International Labour Organization (ILO), the Declaration of Human Rights and the Convention on the Rights of the Child) and an independent control system for the ethical production of goods and services as well as suitable working conditions; AA 1000 is the development of an elaborate methodology that begins with the identification of the demands of stakeholders and is followed by the redefinition of values; SGE 21 is the first European system for social responsibility that voluntarily enables auditing processes and achieves certification in Management Ethics and Social Responsibility. Other standards or principles are: The Global Compact of the United Nations, SME ratings, the OECD (Organisation for Economic Co-operation and Development) Guidelines for Multinational Enterprises or the Principles of 'The Caux Round Table' (CRT).

Our paper provides a methodology to assess the CSR using multi-criteria techniques, in order to obtain a scoring that values the different items of good business practices. Although there are other works in the literature to obtain a measure of CSR (see, Cabello et al, 2014; Liern et al, 2015; Lamata et al, 2016). Cabello et al (2014) construct a synthetic indicator using the Reference Point Method which allows them to simultaneously handle all the environmental criteria, quality of the information criteria and financial criteria for US companies. They have based on the precise measures of CSR provided by MSCI ESG (former KLD). Liern et al (2015) obtain an integrative measure of CSR that allows the ranking of firms based on their social performance, incorporating all the available information from different sources (e.g. MSCI and Vigeo). Lamata et al (2016) propose a Fuzzy AHP-TOPSIS approach to obtain an overall indicator of the attractiveness of firms in terms of their social responsibility. They use the firms' evaluation provided by different independent rating agencies. However, as far as the authors know in any of the cited works, a quantitative analysis of the information contained in the CSR reports (a.k.a. sustainability report) of the companies has been carried out.

As we have indicated above, our information sources are the CSR reports of the companies using the GRI guidelines. CSR reporting is the practice of measuring, disclosing, and being accountable to internal and external stakeholders for organizational performance towards the goal of sustainable development. A sustainability report should provide a balanced and reasonable representation of the sustainability performance of a reporting organization (GRI, 2006). GRI uses a multi-stakeholder approach to developing guidance because sustainability issues connect finance with environmental and social matters.

To achieve the goal of providing a valuation model of the CSR, the information collected in the sustainability reports requires organization and the design of a valuation system for such information. In order to reach a figure (or figures) that sum up the CSR performance, it becomes necessary to handle multiple issues on a joint basis at different levels of decision-making. Approaches from multi-criteria decision making (MCDM) can help to take into account various incommensurable aspects and subjective preferences of the decision makers (DMs) and thus contribute to transparency and traceability of decision-making processes. Cvetkovic and Parmee (2002) have developed a modelling system of preferences for specifying the relative importance of various criteria by transforming several linguistic labels into real numbers. This approach has been used in this paper in order to weight the different attributes at each decision level.

Chatterji *et al* (2009) classified the motivations of Socially Responsible (SR) investors as financial, deontological, consequentialist, and expressive. The first motivation involves the belief that socially responsible companies will have better financial performance. Deontological investors are those who do not wish to earn from unethical conducts. The consequentialist investor expects his/her investments to have good consequences for sustainable companies and bad effects (reduce market share and raise the cost of capital) for unsustainable companies. Expressive investors are those that express their particular idiosyncrasy through their investments. Of course, SR investors can simultaneously belong to several of these prototypes. In order to support such investors in their decisions, we propose a portfolio selection model considering the sustainability of the investment as an objective in the process of portfolio construction. In the proposed model, the expected value at the end of the investment horizon (EVE) and the conditional value-at-risk (CVaR) have been used as financial criteria. These have been jointly incorporated with the sustainability objective into a Goal Programming (GP) model (Bilbao *et al*, (2012; Ballestero *et a*, 2012; Bilbao *et al*, 2016).

GP was proposed by Charnes and Cooper in 1961 to deal with multi-objective linear programming problems and further developed by several authors Ijiri (1965), Lee (1972), Ignizio (1976, 1982, 1983), Romero (2004), among others. GP has become one of the most popular techniques within the field of MCDM (see, Tamiz *et al*, 1998; Jones and Tamiz, 2002; Pérez-Gladish *et al*, 2007; Aouini *et al*, 2013). Over the years, the GP model has become the most widely used MCDM approach for portfolio selection problem. For a literature review on application of GP models to financial portfolio management from the 1970s to nowadays see Aouni, Colapino, and La Torre (2014). Instead of optimization, GP is based on satisficing philosophy, introduced by the Nobel Price of Economy Herbert Simon (1955), who conjectured that in complex decisional problems with conflicting objectives, the DM is not capable of optimizing simultaneously all objectives and she/he then proves more interested in reaching goals.

GP assumes that the DM is able to determine aspiration levels for each one of the relevant attributes of the problem and, in order to achieve a satisficing solution, any unwanted deviations (positive, negative or both) from these levels are minimized. GP models are classified according to the achievement function that is used to aggregate the unwanted deviations. In this paper, we used the Romero's extension (Romero, 2004) which is formed by hybridizing the main GP approaches, weighted and minmax.

The rest of the paper is organised as follows. In Section 2 a brief review of the research concerning sustainability reporting is carried out, as well the leading standard on sustainability reporting, the Global Reporting Initiative is summarised. Section 3 is devoted to a description of the proposed methodology for obtaining a corporate sustainability measure from the CSR reports. In Section 4, a sustainable portfolio

selection model based on Goal Programming (GP) is shown. An empirical application to the Spanish market is presented in Section 5. The paper ends with the main conclusions.

2. Sustainability reporting and the Global Reporting Initiative.

Sustainability reporting is nowadays the main tool for responding to stakeholder demands (Herremans *et al*, 2016). One of the most widespread definitions of corporate sustainability reports defines them as "public reports by companies to provide internal and external stakeholders with a picture of the corporate position and activities on economic, environmental and social dimensions" (WBCSD, 2002). The sustainability reporting is based on an ideal of transparency, "the report should reflect positive and negative aspects of the organization's performance to enable a reasoned assessment of overall performance" (GRI, 2006, p. 13). The lack of transparency makes the sustainability reports marketing tools aimed primarily at improving the firms' image and social legitimacy (Boiral, 2013). The characteristics and evolution of sustainability reporting can be consulted, for example, in Herzig and Schaltegger (2011) and KPMG (2008, 2011).

The necessity and suitability for companies to report their business activities can be explained by the resource dependence and the stakeholder theories (Herremans *et al*, 2016). Resource dependence theory studies a company's relationship with critical resource providers (Pfeffer and Salancik, 2003). The uncertainty about the access to the necessary inputs can become a motivation for engaging with the owners of these resources, with reporting being the first step for this engagement. Furthemore, according to stakeholder theory, those parties impacted by an organization's operations have a right to be informed and to demand certain standards of performance (Freeman, 1984; Mitchell *et al*, 1997). Stakeholder theory is used as one of the frameworks in CSR methods (see, Jamali (2008) for a literature review about the link between the stakeholder approach and CSR). Thus for example, ISO 26000 and GRI involve stakeholder analysis (Duckworth and Moore, 2010). "A primary goal of reporting is to contribute to an ongoing stakeholder dialogue. Reports alone provide little value if they fail to inform stakeholders or support a dialogue that influences the decisions and behaviour of both the reporting organization and its stakeholders" (GRI, 2002, p. 9).

Rogers and Wright (1998) identified four stakeholder groups: capital market stakeholders (mainly debt and equity holders), product market or consumer stakeholders (mainly those associated with primary business operations), internal organizational or labour stakeholders (such as current and potential employees), and political and social markets (in terms of compliance with society's demands and expectations). These authors argued that all stakeholders need good quality information in order to evaluate the company's performance and know whether it matches with their interests.

Of course, sustainability reporting is not free from criticism, and opinions exist whereby "others see them as vehicles for corporate greenwash, an opportunity for companies to exaggerate their social and environmental credentials without any genuine intention to change" (KPMG, 2013, p. 9). Furthermore, the resources used by companies in elaborating their reports prove to be another source of bad press for them. Boiral (2013) analyses whether sustainability reporting can be considered as a 'simulacrum' of firm behaviour that could be used to mask real social responsibility problems.

In summary, the why, who and how related to reporting the sustainability of an organization is in the spotlight of the relevant research focusing on current social reporting practices. The two first questions are closely related: the companies should report to satisfy the legitimate requests of their stakeholders. The "how" seems to be more complicated involving multiple aspects. The content of the report, the suitability or not of using a specialized language, the characteristics of the report (Herremans et al, 2007; KPMG, 2008, for views on this matter), the role of the assurance companies and the social media (see, Boiral, 2013) generate significant research work. For example, the GRI states that corporations "should design reports that respond to the maximum number of users without sacrificing important details of interest to a subset of user groups" (GRI, 2002, p. 30). However, Hess (2007) questioned this "clarity" principle promoted by the GRI and he considered that the "infomediarios" should inform other stakeholders who may lack the necessary expertise. Of course, studying the role of the social media/networks is a must because the use of information technologies has facilitated the exposure and broad propagation of knowledge on the unethical civic, political, environmental and social behaviour of corporations (Becker-Olsen et al, 2006; Michelini and Fiorentino, 2012). Likewise the development of the internet, including online reporting, has opened new and alternative sources of information on corporate sustainability (Gallhofer *et al*, 2006; Gallhofer and Haslam, 2006; Sikka, 2006).

In this paper the CSR reports of the companies have been analysed following the GRI guidelines that appear to be the most popular and comprehensive CSR reporting framework in use today, the latter covering all three dimensions of sustainability and receiving worldwide recognition (Brown *et al*, 2009; GRI, 2011a; Searcy and Elkhawas, 2012). The aim is to create a common social and sustainability reporting framework for organizations, similar to financial reporting, in order to increase corporate transparency. Dialogue with multiple stakeholders is also a key component embedded in GRI, which has gained credibility particularly through involvement in global multi-stakeholder feedback processes (Toppinen and Korhonen-Kurki, 2013; Kaspereit and Lopatta, 2016). The GRI Sustainability Reporting Guidelines offer an international reference framework for all those interested in the disclosure of a governance approach and of the environmental, social and economic performance and impacts of organizations (Schwartz and Carroll, 2003). These performance indicators offer information that can be compared within an organization and between different organizations over time, thereby providing a means to share good practice and create processes to promote continuous improvement.

It is noteworthy that despite the good reputation of the GRI framework, several researchers have highlighted the limitations and potential negative consequences that accompany the use of GRI-based sustainability reporting. According to Gray and Milne (2002) an effective approach to sustainability reporting, would require "a detailed and complex analysis of the organization's interactions with ecological systems, resources, habitats, and societies, and interpret this in the light of all other organizations' past and present impacts on those same systems" (Gray and Milne, 2002, p.6). Also, Moneva *et al* (2006) demonstrate that the GRI approach has significant problems that may mask socially irresponsible actions. Similar arguments, becoming increasingly prevalent in the literature, primarily warning that this practice can actually lead to flawed decision-making (e.g. Laine, 2005; Crowther *et al*, 2006; Byrch *et al*, 2007; Aras and Crowther, 2008; McElroy *et al*, 2008; Morhardt, 2009). Boiral (2013) questions the reliability of the GRI's A or A+ application levels analysing 23 sustainability reports from firms in the energy and mining sectors by content analysis and counter accounting. Counter accounting in the area of sustainability reporting is defined by Boiral (2013) "as the process of identifying

and reporting information on organizations' significant economic, environmental and social issues that comes from external or unofficial sources (expert reports, research papers, online journals, studies from NGOs, government publications, legal proceedings, etc.) in view of verifying, complementing or countering organizations' official reports on their performance and achievements" (Boiral, 2013, p. 1037). The author finds that a total of 90 percent of the significant negative events were not reported, contrary to the principles of balance, completeness and transparency of GRI reports. Fonseca *et al* (2014) addressed possible improvements to sustainability reports based on GRI framework. Their study is focused on mining organisations and their approach is based on a qualitative methodology using the Bellagio Principles.

Figure 1 shows the number of companies in the world that follow the GRI guidelines for the development of their sustainability reports. As observed there has been a significant increase from 1999-2014 (317.27%).



Figure 1. Evolution of the number of companies in the world that follow the GRI guidelines for preparing Sustainability Reports. Source: Compiled from data Sustainability Disclosure Database.

GRI considers the three elements of the reporting process, i.e. *Reporting Principles, Reporting Guidance* and *Standard Disclosures* (including Performance Indicators) to be of equal weight and importance, that is to say, GRI also consistently emphasizes the similarity between social and financial reporting. Beyond its specific indicators, the GRI is a commitment to 6 reporting Principles: balance, comparability, accuracy, timeliness, reliability, and clarity. These principles help reporters define the report and indicator content, the quality of the report and grant guidance on how to set reporting boundaries. It is not essential that companies include in their reports a detailed list of the principles applied, but they should indicate why and where the principles have not been applied (Fernández-García, 2009). These principles are interrelated and can be framed within two main blocks (see Figure 2). The Guidelines identify information that is relevant and material to most organizations and of interest to most stakeholders for reporting the three types of Standard Disclosures (GRI, 2011a):

Strategy and Profile refers to disclosures that set the overall context for understanding organizational performance such as its strategy, profile, and governance.

Management Approach involves disclosures that cover how an organization addresses a given set of topics in order to provide the context for understanding performance in a specific area.

Performance Indicators are indicators that elicit comparable information on the economic, environmental, and social performance of the organization. In this paper the GRI G3.1 containing 134 indicators has been used.



Figure 2. Principles for defining report content and for ensuring report quality. Source: Own elaboration from the GRI G3.1.

The GRI G3.1 uses sustainability reporting in three *Dimensions*: Economic, Environmental and Social sustainability. These *Dimensions* are broken down in 3, 8 and 4 Categories respectively (see Table 1). The GRI Aspects are set out within each Category. This facilitates transparency and accountability by organizations and provides stakeholders a universally-applicable, comparable framework with which to understand the information disclosed.

Categories in each dimension of the Triple Bottom Line				
Economic Dimension Environmental Dimension Social Dimension				
Economic performance	Materials	Labour Practices and Decent Work		
Market presence Energy		 Human Rights 		
Indirect economic impacts	• Water	• Society		
-	 Biodiversity 	 Product Responsibility 		
	• Emissions, effluents and was	te		
	Compliance			
	Transport			
	• Overall			

Table 1. Categories of the evaluation of the transparency of the companies' profile.

Source: Own elaboration from GRI G3.1.

The organization's sustainability report presents information relating to material Aspects, namely those that reflect organization's significant economic, environmental and social impacts; or that substantively influence the assessments and decisions of stakeholders. The information reported for each identified material Aspect can be disclosed as *Indicators* (see, e.g. Table 2 for Labour Practices and Decent Work Category).

ASPECTS	CORE INDICATORS	ADDITIONAL INDICATORS
EMPLOYMENT	 LA1. Total workforce by employment type, employment contract, and region, broken down by gender. LA2. Total number and rate of new employee hires and employee turnover by age group, gender, and region. LA15. Return to work and retention rates after parental leave, by gender. 	LA3. Benefits provided to full-time employees that are not provided to temporary or part-time employees, by significant locations of operation.
LABOUR/MANAGEMENT RELATIONS	 LA4. Percentage of employees covered by collective bargaining agreements. LA5. Minimum notice period(s) regarding operational changes, including whether it is specified in collective agreements. 	
OCCUPATIONAL HEALTH AND SAFETY	 LA7. Rates of injury, occupational diseases, lost days, and absenteeism, and total number of work-related fatalities, by region and by gender. LA8. Education, training, counseling, prevention, and risk-control programs in place to assist workforce members, their families, or community members regarding serious diseases. 	LA6. Percentage of total workforce represented in formal joint management– worker health and safety committees that help monitor and advise on occupational health and safety programs. LA9. Health and safety topics covered in formal agreements with trade unions.
TRAINING AND EDUCATION	LA10. Average hours of training per year per employee by gender, and by employee category.	 LA11. Programs for skills management and lifelong learning that support the continued employability of employees and assist them in managing career endings. LA12. Percentage of employees receiving regular performance and career development reviews, by gender.

Table 2: Labour Practices and Decent Work Category: Aspects and Indicators.

DIVERSITY AND EQUAL OPPORTUNITY	LA13. Composition of governance bodies and breakdown of employees per employee category according to gender, age group, minority group membership, and other indicators of diversity.
EQUAL REMUNERATION FOR WOMEN AND MEN	LA14. Ratio of basic salary and remuneration of women to men by employee category, by significant locations of operation.

Source: Own elaboration from GRI G3.1

In the following section we present a system based on the GRI indicators. The tool will allow us to obtain a normalised performance measure of each GRI Aspect that shows how far/close a company is to a sustainable behaviour. At the second level of aggregation a normalised index of each GRI Category will be obtained. Our proposal offers a quantitative image of the information gathered in the CSR report that allows us to make a comparison between companies in both the Aspect and the Category levels. Furthermore, a tool is made available to the stakeholder for assigning preferential weights at all information levels.

3. A model for assessing the Corporate Social Responsibility relying on the GRI Initiative

Our proposal runs on the hierarchical structure of the GRI (Figure 3) and is developed in 6 steps. The necessary aggregation processes are carried out by setting preferential weights using linguistic labels for pairwise comparisons together with the Cvetkovic and Parmee algorithm for obtaining the weighting vector. Ordered weighted averaging aggregation (OWA) operators (Yager, 1996; Yager and Kacprzyk, 1997) are used in order to obtain both Aspect and Category scores for each company.

In order to conduct a thorough analysis of the degree of company CSR compliance by means of the sustainable development indicators that comprise a particular GRI-Category, we introduce new variables denominated sub-indicators. The use of sub-indicators facilitates the quantitative valuation of various features that are included in each indicator.

Set out below are the steps which must be followed in order to measure company sustainable behaviour.

Step 1: Designing sub-indicators.

The original GRI indicators associated with each Aspect are broken down into subindicators that seek to exploit the information presented in the corresponding indicator. The sub-indicators already have a valuation component (positive or negative) related to the company's behaviour. These sub-indicators are defined, based on the information used for the valuation, as annual growth rates, ratios, differences or discrete values.

For example, within the Labour Practices and Decent Work Category, the Diversity and Equal Opportunity Aspect (see Tables 1 and 2) is valuated with a single indicator, LA13 (Composition of governance bodies and breakdown of employees per employee category according to gender, age group, minority group membership, and other indicators of diversity). We propose to break down LA13 into sub-indicators that attempted to quantify whether the provided figures show responsible business behaviour in the egalitarian access to various job categories and types of employment. Thus, the 'relationship of full-time employment per part-time employment by gender' will be a subindicator associated to LA13 that would be defined as the difference between the ratios of full-time workers among part-time workers for both gender. In this case, we would obtain a sub-indicator of the type 'less is better', a smaller value representing a better performance of the relationship. Figures 3 and 4 show the structure of the information to be evaluated at different levels:



Figure 3. Processing of information on CSR behaviour. Source: Own elaboration from the GRI G3.1.

Step 2: Computing the companies' scores on each sub-indicator.

Based on the information shown in the company's sustainability reporting, the scores for each sub-indicator are computed and normalized between 0 and 1. With them, we have comparable information on the degree of compliance with respect to such subindicators. We denote by $v(J_i^m, e)$ the score obtained by the company e on the subindicator i of the Aspect m, J_i^m .

Step 3: Obtaining the relative importance weights of the sub-indicators.

For each set of sub-indicators associated with an Aspect, a preferential weighting system is designed that evaluates the importance of each sub-indicator for the DM. The preferential information from the DM is expressed by linguistic labels that qualify the pairwise comparisons of the sub-indicators. These labels will be modelled by fuzzy preference relations. An algorithm proposed by Cvetkovic and Parmee (2002) is applied to the information gathered from DM in order to determine the numerical value of each preferential weight (see the description of the algorithm at the end of this section)



Figure 4. Herarchical decomposition of the Category. Source: Own elaboration from the GRI G3.1.

Step 4: Computing the companies' scores for each Aspect.

To aggregate the scores of the company in each of the sub-indicators associated with an Aspect, an ordered weighted averaging aggregation (OWA) operator is used with OWA-weights \overline{w}_i^m . The OWA operator is applied on the multiplications of the scores obtained in Step 2 and the weights obtained in Step 3. Thus, the score of the company *e* in the Aspect *m* is calculated as:

$$P(m,e) = \sum_{i=1}^{l_m} \overline{w}_i^m b_i^m(e), \quad m = 1,...,M, \quad e = 1,...,E$$
with
$$\sum_{i=1}^{l_m} \overline{w}_i^m = 1, \quad 0 \le \overline{w}_i^m \le 1$$
(1)

being $b_i^m(e)$ the *i*-th largest $a_i^m(e) = \omega_i^m * \nu(J_i^m, e)$, that is, $\{b_i^m(e)\}_{i=1}^{q_m}$ is the series of $a_i^m(e)$ values reordered in descending order. ω_i^m is the weight of the sub-indicator J_i^m ,

 l_m is the number of sub-indicators of the Aspect *m*, *M* is the number of Aspects and *E* the number of companies.

Step 5: *Obtaining the relative importance weights of the Aspects that make up the Category.*

A similar procedure to that described in Step 3 is carried out for the final level of aggregation (i.e. the Category). The DM makes pairwise comparison of the Aspects associated with the same Category and assigns the suitable linguistic labels. Cvetkovic and Parmee algorithm is applied and the weights, p_m of each Aspect are obtained.

Step 6: *Computing the companies' scores on the analysed category.*

In order to aggregate the scores of the company on each Aspect, an OWA operator is used with OWA-weights q_m . OWA operator is applied on the multiplications of the scores obtained in Step 4 and the weights obtained in Step 5. The result (a value between 0 and 1, where a greater value signifies better CSR compliance), represents a quantification of the company's compliance in the chosen Category and it is denoted as a Category-Index:

$$CI(C,e) = \sum_{m=1}^{M} q_m Q(m,e), \qquad e = 1,...,E$$
 (2)

being Q(m,e) the *m*-th largest $R(m,e) = p_m * P(m,e)$, that is $\{Q(m,e)\}_{m=1}^{M}$ is the series of R(m,e) values reordered in descending order and p_m is the weight of the Aspect *m* of the Category *C*.

The methodology described in the previous steps has been gathered in Figure 5.



Figure 5. Methodology for evaluating CSR.

Description of the Cvetkovic and Parmee's algorithm for assigning preferential weights.

The application of the steps described above involves calculating weights that evaluate the relative importance of the sub-indicators and of the Aspects in order to make a comparison between them and undertake their subsequent aggregation. In this paper, we have applied the Cvetkovic and Parmee algorithm, which is a modelling system of preferences that allows determining the relative importance of various criteria. For this, linguistic relations of importance are transformed into real numbers (see Table 3):

Table 3. The linguistic relations and valuations.

Relation	Semantic	Valuation
~	is equally important	Е
$\prec(\succ)$	is less (more) important	$\gamma\left(\delta ight)$
≪ (≫)	is much less (more) important	$lpha\left(eta ight)$

where ε , γ and α are the preference parameters provided by the DM; δ and β are the complementary of γ and α , respectively:

$$0 \le \alpha < \gamma < \varepsilon = \frac{1}{2} < \delta \le \beta \le 1 \quad \text{with} \quad \gamma + \delta = 1 \quad \text{and} \quad \alpha + \beta = 1 \tag{3}$$

It is assumed that the preference relations \prec and \ll are transitive and asymmetric and the indifference relation \approx is reflexive and symmetric. Also it is assumed that \approx is congruent with \prec and \ll , i.e., if $x \prec y$ and $y \approx z$ then $x \prec z$ (analogously for the relation \ll) and the relation \ll is a sub-relation of \prec , i.e., if $x \ll y$ then $x \prec y$.

It is possible to define the dual predicates \succ (is more important) and >> (is much more important) in the following way:

 $x \succ y$ iff $y \prec x$ and $x \gg y$ iff $y \ll x$.

Considering a pair of criteria, I and J, one of the following relationships must be set:

• The relation $I \ll J$ will result in the following valuation:

$$\upsilon(I) = \alpha$$
 and $\upsilon(J) = \beta$.

• The relation $I \prec J$ will result in the following valuation:

$$\upsilon(I) = \gamma$$
 and $\upsilon(J) = \delta$.

• The relation $I \approx J$ will result in the following valuation:

$$\upsilon(I) = \upsilon(J) = \varepsilon$$

This method for assigning weights is very friendly even when there are a large number of criteria. The only requirement is to set the values for two parameters (α and γ).

Cvetkovic and Parmee algorithm

Let us consider the set of criteria $\{I_1, ..., I_m\}$, and perform the following procedure:

<u>Step 1</u> Initialise two matrices R and R_a of size $m \times m$ to the identity matrix E_m .

<u>Step 2</u> For all $i \le m$ and for all $j \le m$ such that $j \ne i$ do

<u>Step 2.1</u> If $R_a(i, j) + R_a(j, i) = 0$, the DM should indicate which one of the following relations holds:

- I_i is much less important than I_j $(I_i \ll I_j)$,
- I_i is less important than I_j $(I_i \prec I_j)$,
- I_j is much less important than I_i $(I_j \ll I_i)$,
- I_i is less important than $I_i(I_i \prec I_i)$,
- I_i is equally important than I_j $(I_i \approx I_j)$.

And hence the matrix R_a is updated in accordance with the following relationships:

if $I_i \ll I_j$ set $R_a(i, j) = 0$ and $R_a(j, i) = 2$, if $I_i \prec I_j$ set $R_a(i, j) = 0$ and $R_a(j, i) = 1$, if $I_j \ll I_i$ set $R_a(i, j) = 2$ and $R_a(j, i) = 0$, if $I_j \prec I_i$ set $R_a(i, j) = 1$ and $R_a(j, i) = 0$, if $I_i \approx I_j$ set $R_a(i, j) = 1$ and $R_a(j, i) = 1$.

<u>Step 2.2</u> Using the Warshall's algorithm (1962), compute transitive closure of R_a :

For $k \in \{1, ..., m\}$, For $jh \in \{1, ..., m\}$

For
$$ih \in \{1, ..., m\}$$

 $R_a(ih, jh) \leftarrow \min\{2, \max\{R_a(ih, jh), R_a(ih, k) \cdot R_a(k, jh)\}\}.$ (4)

The meaning of (4) is the following: if $R_a(ih, k)$ or $R_a(k, jh)$ is 0 (no path between *ih* and *k* or between *k* and *jh*), then $R_a(ih, jh)$ does not change, otherwise, use the transitivity properties of \prec and \ll .

<u>Step 3</u> Calculate *R* from R_a according to the following relations:

If	$R_a(i,j)=0$	and	$R_a(j,i)=2$	$\left(I_i \ll I_j\right)$	set	$R(i, j) = \alpha$	and	$R(j,i) = \beta$
If	$R_a(i,j)=0$	and	$R_a(j,i)=1$	$\left(I_i \prec I_j\right)$	set	$R(i, j) = \gamma$	and	$R(j,i) = \delta$,
If	$R_a(i,j)=2$	and	$R_a(j,i)=0$	$\left(I_{j} << I_{i}\right)$	set	$R(i, j) = \beta$	and	$R(j,i) = \alpha$,
If	$R_a(i,j)=0$	and	$R_a(j,i)=1$	$\left(I_{j}\prec I_{i}\right)$	set	$R(i, j) = \delta$	and	$R(j,i) = \gamma$,
If	$R_a(i,j) = 1$	and	$R_a(j,i)=1$	$\left(I_i \approx I_j\right)$	set	$R(i, j) = \varepsilon$	and	$R(j,i) = \varepsilon$.

<u>Step 4</u> For each criterion I_i compute normalised weight by:

$$w(I_{i}) = \frac{\sum_{\substack{j=1\\j\neq i}}^{m} R(i, j)}{\sum_{\substack{l=1\\j\neq l}}^{m} \sum_{\substack{j=1\\j\neq l}}^{m} R(l, j)}$$
(5)

Step 2.2 assures the transitivity of the relation. Transitivity plays a very important role in the algorithm itself. Its main advantage is that it solves the problem of inconsistent preferences while reducing the number of comparisons necessary for constructing a complete preference relation. Notice that if all the preference pairs are set equal to "equally important", then formula (5) gives equal weights for all criteria.

As input data, pairwise comparisons have been used for determining the relative importance of the criteria and the algorithm returns the weights assigned to them. In this study, we have applied this algorithm to obtain both the sub-indicator weights and the Aspect weights¹.

¹ This algorithm has been carried out using the MATLAB R2015a.

The proposed methodology in this section gives a quantitative view of the information gathered in the sustainability report. The stakeholder can "read" the companies' behaviour by normalised scores at both Aspect and Category levels. Also, the comparison between companies is achieved easily from the output of this methodology. The system is able to reflect the DM's concerns by setting of preferential weights. DM neutral is also modelled as a particular case. The system is transparent to the modelling carried out at each decision level and it permits us to work with generally accepted principles of sustainable corporates.

The presented modelling is interesting for all groups of stakeholders, especially the investors that now have available a measure of each company's corporate sustainability.

In the next section, the construction of a portfolio, taking into account both financial and sustainability objectives, is addressed. These sustainability objectives are build from the Category-Indexes determined in Step 6.

4. Designing a Socially Responsible Portfolio

The Forum for Sustainable and Responsible Investment (USSIF, 2014) defines Socially Responsible Investing (SRI), as an investment discipline that integrates environmental, social and corporate governance (ESG) considerations to generate long-term competitive financial returns and positive societal impact. It is a process of identifying and investing in companies that meet certain standards of CSR.

The interest in SRI has grown over the last years. In the United States, more than one out of every six dollars under professional asset management is now invested according to SRI strategies, \$6.57 trillion or more (USSIF, 2014). The volume growth of SRI is also larger than for the conventional asset class. In Europe, we see similar results, with the combined growth of SRI strategies outperforming the conventional market (Eurosif, 2014).

Below we build a sustainability objective for a portfolio based on the Category-Indexes for each component company, this being the first step in the portfolio design for which we use a GP approach.

Sustainability-criteria of a portfolio.

By considering an investment universe of *n* companies, a portfolio is represented by the *n*-dimensional vector $\mathbf{x} = (x_1, x_2, ..., x_n)$ where x_i denotes the number of shares invested in the company *i*. The *Category*-criterion for the portfolio \mathbf{x} is defined as a weighted average of the *Category*-indexes of the individual companies contained in this portfolio:

$$PCI(C, \mathbf{x}) = \sum_{i=1}^{n} CI(C, i) P_{iT} x_i$$
(6)

where CI(C,i) represents a quantification of the company's compliance in the Category *C*, the index of company *i* for the Category *C* (see Eq. 2), and P_{iT} denotes the share price at the investment date *T* of the generic *i*-th company. This linearity hypothesis for defining the sustainability performance of the portfolio is often used by practitioners to SR-rate financial indexes (see Drut, 2010; Dorfleitner and Utz, 2012; Bilbao-Terol *et al*, 2015).

As regards the financial criteria, we will use the Expected Value at the End (*EVE*) as a reward measure and the Conditional Value-at-Risk (*CVaR*) as a risk measure. The minimization of the *CVaR* is carried out following the model proposed by Rockafellar and Uryasev (2000):

$$\min \operatorname{CVaR}_{\alpha}(\boldsymbol{x}) \cong \begin{cases} \min \ \boldsymbol{\xi} + (1-\alpha)^{-1} \sum_{j=1}^{J} \pi_{j} z_{j} \\ s.t. \quad z_{j} \ge \sum_{i=1}^{n} (-y_{ij} x_{i}) + C_{0} - \boldsymbol{\xi} \\ z_{j} \ge 0 \end{cases}$$
(7)

where $\alpha \in (0,1)$ is any specified confidence level, π_j is the probability of the scenario *j*, z_j are dummy variables to solve the optimization problem and *J* is the number of scenarios. We work with scenario-dependent prices at the end of the period (y_{ij} is the price of the share company *i* in the scenario *j*) and available capital C_0 .

With regard to the constraints, the usual ones have been considered; the budget constraint and short sales are not allowed:

$$X = \begin{cases} \sum_{i=1}^{n} P_{iT} x_{i} = C_{0} \\ x_{i} \ge 0 \end{cases}$$
(8)

After defining the objectives and constraints our portfolio selection model is as follows:

$$\begin{cases} \min \quad CVaR(\mathbf{x}), \\ \max \quad EVE(\mathbf{x}) = \sum_{i=1}^{n} E[P_i] x_i, \\ \max \quad PCI(C_r, \mathbf{x}) = \sum_{i=1}^{n} CI(C_r, i) P_{iT} x_i, \quad r = 1, 2, ..., R \\ s.t. \quad \mathbf{x} \in X \end{cases}$$
(9)

where $E[P_i]$ is the expected share price of the company *i*. In this model we considered *R* Categories that have given *R* sustainability objectives. Multi-objective model (9) will be solved applying the Extended Goal Programming (EGP) model by Romero (2004). EGP has been chosen due to its flexibility because it hybridises the two main GP approaches, weighted and minmax. Model (9) is then formulated as follows:

$$\begin{cases} \min \lambda \left(\omega_{CVaR} p_{CVaR} + \omega_{EVE} n_{EVE} + \sum_{r=1}^{R} \omega_{C_r} n_{C_r} \right) + (1 - \lambda) D \\ \text{s.t.} \\ \xi + (1 - \alpha)^{-1} \sum_{j=1}^{J} \pi_j z_j + n_{CVaR} - p_{CVaR} = k_{CVaR}, \\ \sum_{i=1}^{n} E[P_i] x_i + n_{EVE} - p_{EVE} = k_{EVE}, \\ \sum_{i=1}^{n} CI(C_r, i) P_{iT} x_i + n_{C_r} - p_{C_r} = k_{C_r}, \quad r = 1, 2, ..., R, \\ z_j \ge \sum_{i=1}^{n} (-y_{ij} x_i) + C_0 - \xi, \quad z_j \ge 0, \\ \omega_{CVaR} p_{CVaR} \le D, \\ \omega_l n_l \le D, \quad l \in \{EVE, C_1, C_2, ..., C_R\} \\ n_g, p_g \ge 0, \quad g \in \{CVaR, EVE, C_1, C_2, ..., C_R\} \\ \mathbf{x} \in X, \end{cases}$$

(10)

As can be seen, k_g is target level for the goal g, n_g , p_g are negative and positive deviations from target value of the goal g, $\omega_g = u_g/N_g$ where the parameters u_g and N_g are the weights reflecting preferential and normalising purposes attached to the achievement of the goal g. The problem admits a feedback to the investors allowing them to change their aspirations levels and weights until the current solution is accepted.

In the next section, the modelling presented in Sections 3 and 4 will be applied to the Spanish market.

5. Application: Labour Practices and Decent Work of Spanish companies

The previously exposed methodology has been used for analysing 8 Spanish companies the main economic and financial features of which are shown in Table 4. These companies were selected due to their relevance in the Spanish market, all of them listed on the IBEX 35 index, as of June 31, 2014. Firstly, a brief content analysis (Krippendorff, 2004) of the corporate sustainability reports of these companies has been carried out.

COMPANY	Sector	Subsector	Market Capitalisation (in Mill €) (5/2015)
COMPANY 1	Basic Materials, Industry and Construction	Construction	4,002.44
COMPANY 2	Financials and Real Estate	Banks and Savings Banks	57,201.12
COMPANY 3	Oil & Energy	Electricity and Gas	38,624.77
COMPANY 4	Consumer Goods	Textile, Clothing and Footwear	89,930.99
COMPANY 5	Consumer Services	Leisure, Tourism and Hospitality	1,831.921
COMPANY 6	Financials and Real Estate	Banks and Savings Banks	94,993.32
COMPANY 7	Basic Materials, Industry and Construction	Construction	2,024.42
COMPANY 8	Technology and Telecommunications	Telecommunications and Others	67,952.62

Table 4. Economic and financial characteristics of the companies.

Source: Morningstar Direct and Bank of Spain.

Content Analysis of the Sustainability Reports

A content analysis on sustainability reports was conducted to address how the GRI guidelines were used in the elaboration of the sustainability reports. A review of company websites revealed that all analysed companies published a sustainability report at the time of the analysis. All available reports were downloaded from the companies' websites, saved, and the weblink and the date of the downloaded reports were recorded. After, each

report was manually reviewed in order to identify any references to the GRI. All reports were identified for 2011 and 2012.

Table 5 shows the name and length of report in the content analysis sample. The lack of homogeneity in report names and lengths has been found and analysed in the literature (see, e.g. Searcy and Elkhawas, 2012; Roca and Searcy, 2012; Windolph, 2011). The references to the GRI in the CSR reports are gathered in Table A4 in Appendix. In the search we have used terms as "GRI", "Global Reporting Initiative", GRI guidelines", GRI indicators", "GRI protocol", "LA1", ..., "LA15". All reports contain the term "GRI", "Global Reporting Initiative".

COMPANY	Report Name (2011)	Report Name (2012)	Report pages (2011)	Report pages (2012)
1	Sustainability Report 2011	Sustainability Report 2012	224	281
2	2011 Corporate	2012 Corporate	68	67
	Responsibility Annual	Responsibility Annual		
	Report	Report		
3	Sustainability Report 2011.	Sustainability Report	255	221
	A comprehensive focus on	2012. A comprehensive		
	COMPANY 3's economic,	focus on COMPANY 3's		
	social and corporate	economic, environmental,		
	governance performance.	social and corporate		
		governance performance.		
4	Annual Report 2011	Annual Report 2012	300	322
5	Annual Report 2011	Annual Report 2012	75	73
	Corporate Responsability	Corporate Responsability		
6	Sustainability Report 2011	Sustainability Report 2012	72	103
7	2011 Corporate	Consolidated Annual	130	175
	Responsability Report	Report 2012		
8	2011 Sustainability Report	2012 Corporate	90	86
	Together transforming	sustainability Report. The		
	development.	future is commitment.		

Table 5. Name and length of the companies CSR reports.

Situation of the Spanish labour market

This study focuses on the '*Labour Practices and Decent Work*' (LPDW) Category within the Social Dimension. The current situation of Spanish labour market is extremely worrisome, due to the strong job destruction during the period of crisis -between 2007 and 2013- when the Spanish labour market lost 3.44 million jobs. Spain has a long history in high unemployment rates: "Spain has always been the unemployment 'sick man' of the European Union" (García Montalvo, 2015). This has been blamed on the rigidity of the Spanish labour market. However, according to Suárez-Corujo (2013), perhaps the reason is more related to the type of industry and businesses that characterize the Spanish economy. Of course, the illness was exacerbated by the global financial and economic crisis.

From 2010 onwards, the Spanish Governments have carried out several labour reforms with the aim of developing tools of internal flexibility within companies. The ultimate goal would be to increase the competitiveness of the firms and to adapt working conditions, as an alternative to job destruction. A first labour reform in 2010 (Royal Decree-law 10/2010) increased severance pay for temporary contracts and generalised the severance pay subsidy scheme to all employers and types of dismissal for permanent contracts signed after the date of approval of the reform. A second deeper reform, backed by the European Commission and the European Central Bank, was undertaken in February 2012 (Royal Decree-law 3/2012). This reform consisted of two main elements. First, it gave priority to collective bargaining agreements at firm level over those established at the sectorial or regional level and made it easier for firms to opt-out from a collective agreement and implement internal flexibility measures as an alternative to job destruction. In addition, the previous practice of extending collective bargaining agreements after their end date in the case that no new agreement could be signed by the social partners, was limited to a maximum period of one year. Second, the provisions of Spain's Employment Protection Legislation (EPL hereafter) were significantly modified, reshaping the definition of fair economic dismissal, reducing monetary compensations for unfair dismissal and eliminating the requirement of administrative authorisation for collective redundancies (OECD, 2013).

The employment policies implemented in Spain since the onset of the crisis have been very criticised by social agents. The 2012 reform has led to labour rupture: "The new legal frame causes a rupture of the characteristic balance of power between employers and employees that lies in the roots of Labour Law" (Suárez-Corujo, 2013). For this researcher the main axes of these legal changes can be summarised in four points: easier hiring through instability, more intense internal flexibility through company imposition, a new (and devalued) collective bargaining system and a new regulation of dismissal (an easier and cheaper layoff).

The latest figures of Spanish labour market seem to support job creation but with low wages, growing instability, increasing part-time contracts and strong migration of welleducated young workers, in addition to an increase in unpaid overtime.

LPDW for Spanish companies

We have chosen the LPDW Category within the Social Dimension because of its relevance due to the current situation of the Spanish labour market, but we note that the proposed methodology could be applied to any Category. The specific Aspects under the LPDW Category are based on internationally recognized universal standards: the ILO Tripartite Declaration Concerning Multinational Enterprises and Social Policy, and the Organisation for Economic Cooperation and Development (OECD) Guidelines for Multinational Enterprises (see GRI G3.1 for more details). The GRI LPDW *Indicators* are shown in Table 2. In order to evaluate the CSR performance of the companies and carry out a comparison between them, we have used their CSR reports for the years 2011 and 2012. As we have previously commented, these reports have been obtained from company websites and analysed according to the GRI G3.1 guidelines. We have associated 43 sub-indicators (see Table 6) to the original 15 indicators included in the LPDW Category.

Table 6. Number of sub-indicators per GRI indicator in LPDW Category.

Aspects and indicators					
Employment		Labour/Management Relations	Occupational Health and Safety		
LA1	3 sub-indicators	LA4 1 sub-indicator	LA6 3 sub-indicators		
LA2	4 sub-indicators	LA5 1 sub-indicator	LA7 6 sub-indicators		
LA3	1 sub-indicator		LA8 1 sub-indicator		
LA15	3 sub-indicators		LA9 2 sub-indicators		
		Diversity and Equal Opportunity	Equal Remuneration for Women		
Training and Education		Diversity and Equal Opportunity	and Men		
LA10	6 sub-indicators	LA13 4 sub-indicators	LA14 3 sub-indicators		
LA11	1 sub-indicator				
LA12	4 sub-indicators				

Source: Own elaboration from GRI G3.1.

In order to illustrate the information obtained from the CSR reports, we present the data of COMPANY 7 for the LA1 indicator corresponding to the *Employment* Aspect (see Table 7). It can be observed that the open-ended contracts have increased by 3 percentage points in 2012 compared to 2011.

Table 7. Distribution per contract type for COMPANY 7.

	Distr	ibution per Contrac	t Type 2012	
	Spain	Foreign	%Spain	%Foreign
Open-ended	10,884	4,081	75.9	52.7
Fix-term	3,459	3,657	24.1	47.3
Total	14,343	7,738	100	100
	Distr	ibution per Contrac	t Type 2011	
Open-ended	9,929	4,510	73.1	66.0
Fix-term	3,660	2,323	26.9	34.0
Total	13,589	6,833	100	100

Source: Own elaboration from COMPANY 7 sustainability report.

The GRI framework promotes a standard of information disclosure for reporting on an organization's economic, environmental, and social performance. It is suitable for use by all types of organizations and greatly accepted worldwide (Brown *et al*, 2009). Therefore, the degree of adherence to the GRI guidelines in developing their CSR reports will be assessed in our methodology. Thus, sub-indicators analysing whether the company provides information and to what extent are established in this paper. A description of sub-indicators associated to the *Employment* Aspect is shown in Table 8 and Appendix (see Tables A1-A3).

Table 8: Decomposition of LA1 indicator and calculus of the sub-indicator scores.

	LA1 (3 sub-indicators)			
Total workf	orce by employment type, employment contract, and region, bro	ken down b	y gender.	
LA1-I	Ratio of fix-term contracts to open-ended contracts in new employee hires.	Score	Ideal = mi Anti-ideal value	nimum value ≡ maximum
This sub-in This sub-in "COMPAN required fix The ideal vo	dicator is of the "less is better" type. dicator has a correcting factor on the "Score" for the companies Y 5" equal to 0.5. They belong to sectors which activity presents -term hires. alue is fixed equal to 0 and the anti-ideal value equal to 20 (a lar	s "COMPAl strong seas ge enough i	NY 7" equal sonality and number).	to 0.8 and therefore it is
• L.	yee miles oss open-ended contracts: creation of low quality employee (it is pat the company does not improve the labour market).	considered	Score =	Anti-ideal
• L th	oss fix-terms contracts: creation of high quality employee (it is c hat the company improves the labour market).	onsidered	Score =	Ideal
• Ε ΔFTC ΔΟΕC	Score =	$=\frac{\Delta FTC}{\Delta OEC}$		
Job destrue	ction			
• L	oss open-ended contracts or no new hires.		Score =	$= 20 + \frac{\Delta OEC}{OEC(2012)}$
• L	Score	$=\frac{\Delta OEC}{\Delta FTC}$		
• N 1a	Score =	$0 + \frac{\Delta OEC}{OEC(2012)}$		
LA1-II	Ratio of employment type (part-time to full-time) on the workfo	rce.	Score	Ideal ≡ minimum Value Anti-ideal ≡ maximum Value

This sub-indicator is of the "less is better" type.

Whether the part-time employment is less than the full-time employment, it is considered that the company has a good performance.

 $Score = \frac{Part-time employment (2012)}{Full-time employment (2012)}$

LA1-III	LA1-III Ratio of contract type (Open-ended / Fix-term) on the workforce.		Ideal ≡ maximum Value Anti-ideal ≡ minimum Value			
This sub-indicator is of the "more is better" type. Whether the open-ended contracts are greater than the fix-term contracts, it is considered that the company has a good performance.						
	Score = $\frac{OEC(2012)}{FTC(2012)}$					

All scores on the sub-indicators have been normalised between [0,1] using:

Score – Anti-i	deal
Ideal – Anti-io	leal

where 'Ideal' is the better score and 'Anti-ideal' the worst one (see, Table 8 and Tables A1-A3 in Appendix). Thus, we obtain normalised scores with 0 being the worst and 1 being the best value.

As noted above, the Cvetkovic and Parmee algorithm has been used in order to obtain the weights of relative importance between both the sub-indicators and the Aspects. The analyst should establish the linguistic labels which express the necessary pairwise comparisons.

By way of illustration we focus on the LA13 indicator (*Composition of governance* bodies and breakdown of employees per employee category according to gender, age group, minority group membership, and other indicators of diversity) within Diversity and Equal Opportunity Aspect. LA13 has been broken down into four sub-indicators:

- LA13-I: Ratio between full-time and part-time employees according to gender.
- LA13-II: Composition of governance bodies according to gender.
- LA13-III: Composition of executives/managers according to gender.
- LA13-IV: Composition of technical staff according to gender.

Assuming that LA13-I, is 'more important' than the other sub-indicators, LA13-II is 'equally important' as LA13-III, and 'more important' than LA13-IV (see Table 9). These linguistic relationships are transformed into pairs of real numbers verifying Step 3 of the Cvetkovic and Parmee algorithm (see Table 10).

Table 9: Matrix R_a of linguistic relations.

Sub-indicators LA13-I LA13-II LA13-III LA13-IV

LA13-I		more	more	more				
LA13-II	less		equal	more				
LA13-III	less	equal		more				
LA13-IV	less	less	less					
Table 10: Matrix R .								
Sub-indicators	LA13-I	LA13-II	LA13-III	LA13-IV				
Sub-indicators LA13-I	LA13-I 0.5	LA13-ΙΙ δ	LA13-III δ	LA13-IV δ				
Sub-indicators LA13-I LA13-II	LA13-I 0.5 γ	LA13-II δ 0.5	LA13-III δ 0.5	LA13-IV δ δ				
Sub-indicators LA13-I LA13-II LA13-III	LA13-I 0.5 γ γ	LA13-II δ 0.5 0.5	LA13-III δ 0.5 0.5	LA13-IV δ δ δ				

This preferential set provides the following weights for the sub-indicators associated to the *Diversity and Equal Opportunity* Aspect:

$$w(\text{LA13-I}) = \frac{3\delta}{6} ; w(\text{LA13-II}) = \frac{0.5 + \gamma + \delta}{6}$$
 (11)

$$w(\text{LA13-III}) = \frac{0.5 + \gamma + \delta}{6}$$
; $w(\text{LA13-IV}) = \frac{3\gamma}{6}$; (12)

and then the following relationship is obtained for all feasible values of the parameters γ and δ :

$$w(LA13-I) > w(LA13-II) = w(LA13-III) > w(LA13-IV)$$
 (13)

Therefore, for the *Diversity and Equal Opportunity* Aspect, the most important subindicator for the DM is LA13-I, followed by LA13-II and LA13-III sub-indicators that have the same importance with the least important being LA13-IV. It is worth noting that it is not necessary to establish the importance relation between LA13-III and LA13-IV, because it has been determined by computing the transitive closure. Table 11 displays the weight values of the sub-indicators setting $\gamma = 0.35$, $\alpha = 0.05$:

Table 11. Normalised weights of the sub-indicators of the Diversity and Equal Opportunity Aspect.

Sub-indicators	LA13-I	LA13-II	LA13-III	LA13-IV
Weights (ω_i^m)	0.325	0.25	0.25	0.17

The same methodology is applied for obtaining the normalised weights of the 6 Aspects that compose the LPDW Category. Firstly, the DM should set the relative importance of the *Employment* Aspect with the rest. If the pairwise comparisons between the *Employment* Aspect with the others are established as displayed in the first row of Table 12, it would only be necessary to fix the comparison between the *Labour/Management Relations* and *Training and Education* Aspects (see Table 12). The other pairwise relations are obtained by applying the transitivity, duality and reflexivity properties (Table 13).

ASPECTS	Employme nt	Labour/Managem ent Relations	Occupatio nal Health and Safety	Trainin g and Educati on	Diversity and Equal Opportuni ty	Equal Remunerati on for Women and Men
Employment		more	equal	more	equal	equal
Labour/Managem ent Relations Occupational Health and Safety Training and Education Diversity and Equal Opportunity				more		
Equal						
Remuneration for						
Women and Men						

Table 12. Comparison matrix between the Aspects.

Table 13. Overall matrix of comparison between Aspects by applying the Cvetkovic and Parmee

algorithm.

ASPECTS	Employm ent	Labour/Manag ement Relations	Occupatio nal Health and Safety	Trainin g and Educati on	Diversity and Equal Opportuni ty	Equal Remunerati on for Women and Men
Employment		more	equal	more	equal	equal
Labour/Managemen t Relations	less		less	more	less	less
Occupational Health and Safety	equal	more		more	equal	equal
Training and Education	less	less	less		less	less
Diversity and Equal Opportunity	equal	more	equal	more		equal
Equal Remuneration for Women and Men	equal	more	equal	more	equal	

The least important Aspect for the DM is *Training and Education* and the most important ones are *Employment, Occupational Health and Safety, Equal Remuneration for Women and Men and Diversity* and *Equal Opportunity*. Table 14 exhibits the weights computed by the Cvetkovic and Parmee algorithm:

ASPECTS	Employment	Labour/Management Relations	Occupational Health and Safety	Training and Education	Diversity and Equal Opportunity	Equal Remuneration for Women and Men
Weights	0.1867	0.1367	0.1867	0.1167	0.1867	0. 1867

By applying the proposed methodology to the companies of our database, COMPANY 1 emerges as that of the best performance with respect to the *Employment* Aspect. This company has high scores in all sub-indicators and it is the only one which obtains positive scores on the sub-indicators of the LA15 indicator (*Return to work and retention rates after parental leave, by gender*). The other companies scored 0 in these sub-indicators because they either show no information for them or did so only partially and hence it is not possible to obtain the corresponding scores (see Table 15). COMPANY 1 is followed by companies 2, 3 and 7. COMPANY 8 is the one with the worst performance, due largely to the lack of information (see Table 16).

COMPANY	LA1_I	LA1_II	LA1_III	LA2_I	LA2_II	LA2_III	LA2_IV	LA3	LA15_I	LA15_II	LA15_III
1	0.97	0.86	0.08	0.54	0.03	0.88	1	1	0.50	0.97	0.99
2	1	0.24	0.45	0.54	1	0.82	0.58	0	0	0	0
3	0.60	1	1	0.03	0	1	0.60	0.50	0	0	0
4	0.99	0	0.07	1	0.05	0.00	0	1	0	0	0
5	0.03	0	0.02	0.04	0	0.94	0.95	0.50	0	0	0
6	0.23	0	0.43	0.06	0	0.69	0.52	0	0	0	0
7	0.96	0.73	0	0.88	0.27	0	0.87	1	0	0	0
8	0	0	0.31	0	0	0	0	0.50	0	0	0
$\omega_i^m(\mathbf{I})$	0.1155	0.1264	0.1073	0.1727	0.1155	0.1264	0.0418	0.0091	0.0855	0.05	0.05
$\omega_i^m(\mathrm{II})$	0.0909	0.0909	0.0909	0.0909	0.0909	0.0909	0.0909	0.0909	0.0909	0.0909	0.0909

Table 15. Normalised scores of the sub-indicators of Employment Aspect for each company.

Most companies have a good performance in the *Labour/Management Relations* Aspect. COMPANY 1 is the best, followed by companies 2, 5, and 7 (see Table 16). As in the case of the previous Aspect, COMPANY 8 is the worst company, again due to lack of information in their CSR reports (see Table A5 in Appendix).

Regarding the *Occupational Health and Safety* Aspect, the best company is COMPANY 3 that obtains high scores in all sub-indicators, followed by COMPANY 7 (see Table 16). The worst one in this Aspect is the COMPANY 4, because the information necessary to evaluate the sub-indicators is not reported or reported only partially (indicator LA7 is not available). In general, the studied companies do not follow the GRI guidelines when presenting this information (see Table A6 in Appendix).

COMPANY 1 is the top-rated company on the *Training and Education* Aspect, followed by companies 7, 3 and 5 (see Table 16). COMPANY 2 has the worst score because it does not report the information needed to evaluate the sub-indicators associated to this Aspect. It is noted that the companies do not follow the GRI framework when reporting the information on the *Training and Education* Aspect (see Table A7 in Appendix).

COMPANY 3 excels in *Diversity and Equal Opportunity*, followed by COMPANY 1 and COMPANY 2 (see Table 16). COMPANY 4 and COMPANY 7 have the worst scores because they do not report the information needed to evaluate the sub-indicators (see Table A8 in Appendix).

And lastly, COMPANY 3 is the best on the *Equal Remuneration for Women and Men* Aspect with COMPANY 1 ranking second (see Table 16). Companies 4, 5 and 7 have the worst scores because they do not report the required information; LA14 is not available (see Table A9 in Appendix).

COMPANY 3 presents the CSR report most adapted to the GRI framework, while the COMPANY 4 and COMPANY 8 do not follow the outline provided by the GRI guidelines, which largely explains the bad scores they have obtained in each sub-indicator.

From the data in Table 16, the LPDW-index has been computed as the aggregated scores on the 6 Aspects according to the DM preferences $(\omega_i^m(I))$. The results are displayed in the last column of Table 16.

COMPANY	Employ ment	Labour/ Management Relations	Occupational Health and Safety	Training and Education	Diversity and Equal Opportunity	Equal Remuneration for Women and Men	LPDW-index
1	0.628	0.999	0.293	0.722	0.832	0.433	0.628
2	0.531	0.825	0.086	0.054	0.418	0.217	0.531
3	0.464	0.694	0.818	0.415	0.972	0.500	0.464
4	0.310	0.630	0.044	0.086	0.048	0.000	0.310
5	0.176	0.825	0.262	0.395	0.329	0.000	0.176
6	0.192	0.690	0.221	0.334	0.188	0.217	0.192
7	0.431	0.825	0.511	0.432	0.055	0.000	0.431
8	0.038	0.429	0.163	0.114	0.282	0.217	0.038

Table 16. Scores of the companies on each Aspect and LPDW-index.

The best performing company according to the LPDW-index is COMPANY 3 presenting good results for the 6 Aspects. Noteworthy is its good behaviour regarding *Diversity and Equal Opportunity* and *Equal Remuneration for Men and Women* that are the most important Aspects for the DM (with weights equal to the maximum weight). Instead, it does not achieve the best value for *Training and Education* although this Aspect was less important. The second best company is the COMPANY 1, followed far behind by companies 7 and 2. The LPDW-index allows us to obtain a ranking of companies. This could be very useful for investors concerned with the behaviour of companies in relation to *Labour Practices and Decent Work*.

Equal weights, both for sub-indicators and Aspects, give the results displayed in Table 17. We will denominate this setting as the baseline case.

Table 17. Scores of the companies on each Aspect and LPDW-index (equal weights).

COMPANY	Employ ment	Labour/Man agement Relations	Occupational Health and Safety	Training and Education	Diversity and Equal Opportunity	Equal Remuneration for Women and Men	LPDW-index
1	0.711	0.999	0.305	0.660	0.836	0.333	0.641
2	0.421	0.75	0.083	0.030	0.511	0.167	0.327
3	0.431	0.649	0.796	0.351	0.747	0.5	0.579
4	0.284	0.600	0.038	0.061	0.268	0	0.208
5	0.226	0.750	0.263	0.324	0.253	0	0.303
6	0.175	0.647	0.178	0.239	0.145	0.167	0.258
7	0.428	0.75	0.63	0.405	0.256	0	0.411
8	0.074	0.33	0.111	0.115	0.217	0.167	0.169

In this case, the best performing company according to the LPDW-index is COMPANY 1 presenting good results for the 6 Aspects. It is followed by companies 3 and 7.

As commented earlier, the above Category-Index for each company will allow us to build a sustainability objective to be taken into account when selecting a portfolio with characteristics of social responsibility. This study focused on the '*Labour Practices and Decent Work*' Category within a Social Dimension and thus we work with only one sustainability objective, the LPDW-criterion for the portfolio x, PCI(LPDW, x).

Portfolio selection with the LPDW objective

In order to apply the model for portfolio selection presented in Section 4 we have collected information regarding the financial behaviour of the studied companies. The information provided by the cloud-based investment analysis platform Morningstar Direct (Morningstar Ltd) has allowed us to construct a database containing 3,314 observations corresponding to daily closing prices from 24/05/2001 to 03/03/2014 for the 8 companies (see Figure 6 and Table 18). We have set an estimation interval equal to one week and the investment date is 26/02/2014, therefore, 662 weekly observations are available (i.e. T is equal to 662). The investment horizon has been fixed to one week. We have worked with non-overlapping weekly compounded returns².



Figure 6: Historical series of the companies' prices.

COMPANY	Q1	Q2	Q3	Mean	Skewness	Kurtosis
1	-0.0236	0.00037	0.02491	0.00046	-0.51456	7.31728
2	-0.0281	0.00036	0.02573	-0.0008	-0.06998	4.90255
3	-0.0153	0.00161	0.02084	0.00030	-0.27285	8.48893
4	-0.0160	0.00235	0.02347	0.00266	-0.63996	7.96740
5	-0.0298	0.00066	0.02597	-0.0017	-0.50249	8.26426
6	-0.0251	0.00194	0.02392	-0.0007	-0.35067	5.83124
7	-0.0307	0.00072	0.02982	-0.0007	0.094088	5.00685
8	-0.0186	0.00162	0.01766	-0.0006	-0.26435	4.72154

Table 18. Summary of the descriptive statistics of the weekly compounded returns.

² This application has been carried out using the environment MATLAB R2015a

The investor could establish the aspiration levels for her financial goals from the efficient frontier $EVE - CVaR_{\alpha}$ (we assume $C_0 = 100, \alpha = 0.9$ and we consider the equally probable scenarios, therefore: $\pi_j = \frac{1}{J}$) (see Figure 7). The range of the sustainability criterion allows setting an aspiration level for its goal.



Figure 7. Approximation of the efficient frontier (100 portfolios).

Ideal point $(EVE, CVaR_{\alpha}) = (100.333, 5.032)$

Once all constituent elements have been determined, the following EGP model (Romero, 2004) is solved:

$$\begin{cases} \min \lambda \left(\omega_{1} p_{1} + \omega_{2} n_{2} + \omega_{3} n_{3} \right) + (1 - \lambda) D \\ s.t. \\ \xi + (1 - \alpha)^{-1} \sum_{j=1}^{J} \pi_{j} z_{j} + n_{1} - p_{1} = k_{1}, \\ \sum_{i=1}^{n} E[P_{i}] x_{i} + n_{2} - p_{2} = k_{2}, \\ \sum_{i=1}^{n} CI (LPDW, i) P_{iT} x_{i} + n_{3} - p_{3} = k_{3}, \\ z_{j} \ge \sum_{i=1}^{n} (-y_{ij} x_{i}) + C_{0} - \xi, \quad z_{j} \ge 0, \\ \omega_{1} p_{1} \le D, \quad \omega_{2} n_{2} \le D, \quad \omega_{3} n_{3} \le D, \\ x \in X, \quad n_{r}, p_{r} \ge 0, \quad r = 1, 2, 3 \end{cases}$$
(14)

We have implemented the model (14) for two cases according to the two LPDW vectors shown in Tables 16 and 17, i.e. the portfolio corresponding to the LPDW-Index built according to Table 14 and the portfolio corresponding to the baseline case (equal

weights at all levels). The OWA operator used is the arithmetic averaging operator in all cases.

In both cases, the financial targets are chosen at the top of the efficient frontier, the *EVE* and *CVaR* of the portfolio P90 (*EVE*=100.3165, *CVaR*=5.9683), therefore a very financial risky profile is used. For the sustainability target, the midpoint of the range of the sustainability criterion (ideal+anti-ideal/2) is chosen. The normalising parameters N_l are set equal to the corresponding aspiration level and the weights attached to the achievement of the goal *l*, are set equal to 1. Tables 19 and 20 show the optimal portfolios when parameter λ varies from 0.1 to 1 with step equal to 0.1. These results display the lack of sensitivity of the model 14 facing the λ changes in this range. Notwithstanding, another solution very close to that of Tables 19 and 20 is obtained for $\lambda = 0$ (see Tables A10 and A11 in Appendix). These optimal portfolios show a small improvement in the worst criterion (*EVE*) at expense of making the others criteria worse. Null value for parameter λ turns the EGP model to a minimax model.

Table 19. Optimal portfolio I (different weights for LPDW-criterion and $\lambda \in (0,1]$).

COMPANY	LPDW- index	Investment	Criterion	Criterion value	k _l	$\omega_l = 1/k_l$
1	0.629	43.03	CVaR	5.9683	5.9683	0.1676
3	0.657	9.48	EVE	100.2358	100.3165	0.0100
4	0.171	47.49	LPWD	41.4338	41.4338	0.0241

COMPANY	LPDW-	Investment	Criterion	Criterion	k	$\omega = 1/k$
	index			value	κ_l	$\omega_l - 1 / \kappa_l$
1	0.641	41.65	CVaR	5.9683	5.9683	0.1676
3	0.579	4.42	EVE	100.25	100.3165	0.0100
4	0.208	53.93	LPWD	40.4885	40.4885	0.0247

Table 20. Optimal portfolio II (baseline case and $\lambda \in (0,1]$).

As we can see in Tables 19 and 20, the two optimal portfolios invest in the same companies but for different amounts. Notice that the portfolio P90 also invests in the same companies according to the composition (7.34, 2.22, 90.44). The compositions displayed in Tables 19 and 20 show that the introduction of the CSR objective increases the investment in Companies 1 and 3 that present the best results for the LPDW-index. In the optimal portfolio II, the invested amounts in the Companies 1 and 3, decrease with respect to portfolio I. This is because in case I the investor weighs up several sub-indicators and

Aspects in which COMPANY 4 reaches low scores (compare the scores of the COMPANY 4 in case I and II for the *Diversity and Equal Opportunity* Aspect).

Both portfolios have the same risk, the *CVaR* reaching its target exactly (*CVaR*-portfolio 90). The *EVE* and the degree of sustainability achieved by the portfolio vary depending on the LPDW-index used. The portfolio associated to the baseline case is slightly better in financial terms.

5. Conclusions

One of the most important challenges of sustainable development is the responsible management by companies of their economic, environmental and social impacts. This involves implementing a disclosure policy for all their stakeholders. Accordingly, the development of a transparent CSR report should become a common practice of companies. With this aim in mind, the GRI approach emerges with the mission to provide a reliable and credible framework for the development of CSR reports that can be used by companies regardless of their size, sector or location.

In this paper, the CSR performance is studied following the standards set out in the GRI guidelines and using the CSR reports as a source of information. For this a special methodology has been elaborated that allows us to score the corporate behaviour with respect to internationally agreed principles of sustainability. We have used several mathematical tools in order to obtain a ranking model for companies. We have analysed the items (indicators) that appear in the CSR reports and then sub-items (sub-indicators) have been proposed to quantify the goodness of the figures for all Aspects within the LPDW Category. Thus, the LPDW-Index has been constructed taking into account the evolution of the figures, the quality of generated employment, initiatives for equal opportunity and diversity, etc.

The aggregation of all obtained figures for the sub-indicators has been addressed in two steps. First, the preferential weights using fuzzy importance relations are determined and, secondly, the OWA operators have been used as operators for aggregating the information. Lastly, each company obtains a 6-dimensional array with components taking values between 0 and 1, from which their LPDW-index is calculated.

It should be noted that the characterization of each company is based on objective data, -obtained from its CSR reports- based on the stakeholder's own considerations –when she/he builds hierarchies and chooses which values are 'good' and which are 'bad' for the sub-indicators– and finally, on personal options based on the importance of the analysed criteria.

From the analysed information in the CSR reports we can conclude that in general the studied companies do not follow fully the recommendations of the GRI guidelines. They usually only report information concerning number of employees, type of contract and working day and very little of the Diversity and Equal Opportunity in the workforce. Notable exceptions are COMPANIES 1, 3 and 7. COMPANY 1 and COMPANY 3 have achieved the best results regarding the LPDW Category.

The results enable more informed decision-making for investors with social concerns that prefer direct investment and want to make their own financial investment. A key factor for that these investors may have valuable information about the companies in which to invest, it would be the global acceptance of the GRI guidelines as a way of addressing the elaboration of the CSR reports. This paper presents a new methodology for SR investors in order to select portfolios with CSR objectives. SRI has a strong subjective component associated with investor idiosyncrasy. Therefore, it is important that the used methodology and information are transparent and easy to interpret. In this regard, the mathematical tools provide these features.

We hope most companies report in accordance with the GRI Guidelines. This would aid SR investors who wish to control their investments directly and may also facilitate the construction of the model. Note that the heterogeneity in the CSR reports hinders comparisons and introduces 'noise'. Therefore, the analyst is forced to interpret and make up for these deficiencies.

Acknowledgment:

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Appendix

Table A1: Decomposition of LA2 indicator.

	LA2 (4 sub-indicators)						
Total number	and rate of new employee hires and employee turnover by age grou	ıp, gender, ar	nd region.				
LA2-I	Rate of new employee hires	Score	Ideal \equiv maximum Value Anti-ideal \equiv minimum Value				
This sub-ind Whether the re	licator is of the "more is better" type. tte is positive, it is considered that the company has a good perform	nance.					
	Value = $\frac{\text{number of contracts (2012) - number of on number of contracts (20)}}{\text{number of contracts (20)}}$	of contracts (12)	(2011)				
LA2-II	Comparison of new employee hires by gender	Score	Ideal ≡ maximum Value Anti-ideal ≡ minimum Value				
This sub-ind Closer to 1 Va	licator is of the "more is better" type. lue better performance, it is considered that the company has a goo	od performa	nce.				
	If no new employee hires \Rightarrow Sector	core = 0					
	If $NWH > NMH \implies Score = -$ If $NWH < NMH \implies Score = \frac{1}{2}$	NWH NMH NMH					
NWH: New wo NMH: New m	oman hires an hires	wwn					
LA2-III	Percentage change in young (under 30) employees during the years 2011-2012 in the workforce.	Score	Ideal = maximum Value				
This sub-in Whether the p	dicator is of the "more is better" type. ercentage of young (under 30) employees increases, it is considered	d that the cor	npany has a good performance.				
Score	= % young employees in the workforce $(2012) - \%$ young	g employees	in the workforce (2011)				
LA2-IV	Turnover	Score	Ideal ≡ minimum Value				
Anti-ideal = maximum Value This sub-indicator is of the "less is better" type. A high turnover rate can indicate levels of uncertainty and dissatisfaction among employees.							
Table A2: Decomposition of LA3 indicator.							
	LA3		I				
Benefits provided to full-time employees that are not provided to temporary or part- time employees, by significant locations of operation. Ideal \equiv maximum Value Anti-ideal \equiv minimum Value							
This sub-ind	licator is the of "more is better" type.						

Greater number of social benefits reported by the company, better performance.	
We have taken into account that it is an additional indicator. In this case we have	2 if all
analysed whether the company reports it and to what degree.	1 if partial 0 if null

Table A3:	Decomposi	ition of	LA15	indicator.
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LA15 (3 sub-indicators)							
Return to we	ork and retention rates after parental leave, by gender.						
LA15-I	Growth rate of the percentage differences, in levels, to return to work between sexes.	Score	Ideal ≡ minimum Value Anti-ideal ≡ maximum Value				

This sub-indicator is of the "less is better" type.

The lower the rate, the less the difference, in levels, return to work, by gender. Equitable gender choice for maternity and paternity leave is very positive for the company and their employees. More men taking advantage of leave entitlements has a positive effect for women in taking such leave without prejudicing their career path. Interannual variation of ratios by gender.

$$Score = \frac{\left(\frac{WPL(2012)}{WEPL(2012)} - \frac{MPL(2012)}{MEPL(2012)}\right) - \left(\frac{WPL(2011)}{WEPL(2011)} - \frac{MPL(2011)}{MEPL(2011)}\right)}{\left(\frac{WPL(2011)}{WEPL(2011)} - \frac{MPL(2011)}{MEPL(2011)}\right)}$$

WPL: Number of women who took the parental leave WEPL: Number of women entitled to parental leave MPL: Number of men who took the parental leave MEPL: Number of men entitled to parental leave

LA15-II	Retention ratio of men	Score	Ideal ≡ maximum Value Anti-ideal ≡ minimum Value
This sub-in	dicator is of the "more is better" type.		
	Score = number of men who are working 12 months after preserved on the second seco	arental leantal leantal leantal leantal leantal	ave ended ended
T 4 4 7 TT	Detertion action of memory	Saara	Ideal ≡ maximum Value
LA15-111	Retention ratio of women	score	Anti-ideal ≡ minimum Value
This sub-in	dicator is of the "more is better" type.	score	Anti-ideal ≡ minimum Value

Theme	Representative references
GRI Application levels of the reports	In line with the commitments established by the GRI, COMPANY 1 believes that applying the criteria established by the GRI – G3.1 guidelines enables its report to qualify for an A+ . COMPANY 1 Just one month after the launch of version 3.1 of the Global Reporting Initiative (GRI) in 2011, COMPANY 1 was the first company to obtain the maximum score for this demanding standard for sustainability report. COMPANY 1
	This report has been prepared at Global Reporting Initiative G3 (GRI) Application level B and was also independently reviewed to achieve level B+. COMPANY 2 The reliability and comparability of the information supplied in financial year 2012 have continued to be strengthened, resulting in this report once again meeting the requirements for application level A+ among the various application levels defined by the GRI, which is the designation for advanced organisations with verification by GRI itself as well as external independent assurance. COMPANY 3 The A+ Self-Assessment of the COMPANY 5 Sustainability Report has been corroborated by KPMG, and subsequently GRI has reviewed the whole process, assigning the report the highest possible rating (A). COMPANY 5
	Furthermore, we have continued to submit our efforts in CSR to external verifications, with level A+ reporting level under the GRI methodology. COMPANY 7 The reliability and comparability of the information supplied in 2011 have continued to be strengthened, resulting in this report once again meeting the requirements for application level A + among the various application levels defined by the GRI, which is the designation for advanced organizations with verification by GRI itself as well as external independent verification. COMPANY 3 This model is fully compliant with the DISL and GRI A+ COMPANY 8
Other standards	The level of application of the new standard was confirmed by GRI and externally verified. COMPANY 1 To check the reliability of the information, the correct application of the AA1000 APS standard's principles . COMPANY 1 A trusted company: Sustainability information provided in accordance with GRI and AA1000 standards
	and externally verified in accordance with ISAE 3000 . COMPANY 3 15 of the GRI indicators identified in the materiality analysis carried out by COMPANY 4 were analysed by KPMG auditors, pursuant to regulation ISAE 3000 . In the GRI index of this Report, which also doubles as a Report on Progress, the different parts of the document related to each of the Global compact principles are indicated. COMPANY 4
	This year, the Report has been assured by an independent auditing firm (KPMG) and its Assurance report can be found in one of the sections of this chapter. COMPANY 5 This document has been prepared in accordance with the latest prototype framework, published by the International Integrated Reporting Council (IIRC), www.theiirc.org, at the time of writing. COMPANY 7 The Report has been prepared following the standards of the internationally recognised Global Reporting Initiative (GRI) and the principles of inclusiveness, relevance and capacity of response proposed by the AA1000 APS rules of AccountAbility. COMPANY 6
	The content and methodology of the processes for identifying aspects to be evaluated in materiality tests are mainly based on the guide for preparing the Global Reporting Initiative (GRI), the Discussion Paper from the Integrated Reporting Council (IIRC) and the principles found in AA1000 Accountability Principles Standard of Accountability. COMPANY 4
	As in previous years, in drawing up this Report, COMPANY 6 has taken into account current regulations, guidelines and recommendations by benchmark international organisations such as the Global Reporting Initiative (GRI), Global Compact and AccountAbility AA1000. COMPANY 6 verified externally according to the AA1000 criteria framework. COMPANY 8
Stakeholders/enga gement/dialogue	When deciding upon the relevance and materiality of the content to include, special attention was given to the opinions of leading stakeholders , extending the engagement process in line with the recommendations of the Sustainability Reporting Guidelines (version 3, 2006) of the Global Reporting Initiative (GRI) G3 and the new AA 1000 APS (2008) Account Ability Principles Standard and the AA 1000 AS (2008) Assurance Standard. COMPANY 2
	to the financial sector supplementary indicators and thus relevant aspects raised by stakeholders . COMPANY 6. The Annual Report contains the most important social, economic and environmental indicators and allows stakeholders to assess the Group's performance during the financial year. When interpreting the definition of "stakeholder" appearing in the GRI Guide in the context of our organisation, it becomes apparent that there are numerous groups which, in one way or another, may be affected by our activities, and similarly numerous are those which may significantly affect the conduct of our business. COMPANY 7 The company has structured its process of stakeholder engagement to give it a twofold focus. COMPANY 1
	The pilot projects for implementing the social impact evaluation methodology launched in 2012 include the validation of dialogue mechanisms with local communities. COMPANY 1 COMPANY 8's firm commitment to its stakeholder groups translates into an innovative and constant dialogue .COMPANY 8
Indicators LA1LA15	Adopted GRI Version 3.1 as the standard model, with the full set of indicators. COMPANY 7 Any limitations on the scope of the information or changes to the criteria applied with regard to the previous report are reflected in the corresponding section of the report and in the table of performance indicators of the Global

	Reporting Initiative (GRI). COMPANY 6
UN Global	COMPANY 6 ENVIRONMENTAL INDICATORS: derived from the use of courier services, required by
Compact	the GRI standard in its financial services sectoral supplement (FSSS), have not been included. COMPANY 6 The limitations and scope of the information, are reflected in the corresponding section of the report and the table of GRI performance indicators. COMPANY 6
Sustainable	This Report is the seventh edition of COMPANY 5' Corporate Responsibility Report, elaborated annually since 2006, a document which reflects the evolution and consolidation of our sustainable approach as a strategic pillar of our management. COMPANY 5
	The company is involved in actions intended to promote regulations consistent with the sustainable development of the water and energy sectors by submitting proposals. COMPANY 1 Within the 14 projects identified with impact in sustainability , it is worth noting the advances made in methodologies for identification and quantification of reputational risks stand out. COMPANY 1 For example, in 2011, dialog with investors and analysts allowed COMPANY 1 to present its sustainability activities and to exchange perspectives with them, as it responded to their requests for information and to know their expectations on responsible corporate behavior. COMPANY 1 The focus of sustainability as a motor of responsible management and a lever of progress. COMPANY 8
Investor	The corporate website includes all the relevant information for shareholders and investors and is a vehicle of communication with shareholders, providing them with current information on all significant aspects of the Group. The Shareholders' Office dealt with more than 1,000 petitions from individual investors during 2012. This information is accessible immediately on the corporate website and is distributed to a database of investors and analysts with more than 1,200 records. COMPANY 4 COMPANY 4, for the tenth and eleventh consecutive years, is listed on the FTSE4Good Sustainability Indexes and Dow Jones Sustainability Indexes , respectively. COMPANY 4 Reputational risk or opportunity: The opinions of various of COMPANY 1's stakeholder groups as a result of its action or inaction on climate change may influence our customers and investors as well as COMPANY 1's growth. COMPANY 1always with a view to providing the information needed for decisions on investing in the company.
	COMPANY 8
Transparency	Our transparency in communicating and reporting is essential. COMPANY 1 COMPANY 3 also asks a specialised external firm to review the proceedings of the General Shareholders' Meeting, including the processing of absentee votes and of proxy-voting and the counting of votes on proposed resolutions, in order to safeguard shareholders' rights and guarantee transparency . COMPANY 3 For COMPANY 8, business transparency and managing integrity, as covered by its Business Principles, permit the generation of trust in the markets and between stakeholders and the company. COMPANY 8 COMPANY 4's Annual Report addresses its economic, social and environmental performance for the purposes of achieving the maximum transparency in its relationship with all its stakeholders . COMPANY 4

Tables of results:

Table A5. Normalised scores of the subindicators of the Labour/Management Relations Aspect.

Labour/Management Relations Aspect $_{V}(J_{i}^{m}, e)$						
COMPANY	LA4	LA5				
1	0.999	1				
2	1	0.5				
3	0.798	0.5				
4	0.7	0.5				
5	1	0.5				
6	0.793	0.5				
7	1	0.5				
8	0.66	0				
$\omega_i^m(\mathrm{I})$	0.65	0.35				
$\omega^m_i(\mathrm{II})$	0.5	0.5				

Table A6. Normalised scores of the subindicators of the Occupational Health and Safety Aspect.

Occupational Health and Safety Aspect $V(J_i^m, e)$

COMPAN	Y L	A6 I	LA6 II	LA6 III	LA7 I	LA7 II	LA7 III
1	0) —	0	0	0.50	0.99	0
2	0		0	0	0	0	0
3	1		0	1	1	1	1
4	0)	0	0	0	0	0
5	1		0.08	0.60	0.63	0.85	0
6	0)	0	0	0	0	0.14
7	1		1	0.40	0.61	0	0.39
8	0		0	0	0.18	0.82	0
$\omega_i^m(\mathbf{I})$	0.	.0220	0.0538	0.0583	0.1356	0.1356	0.0811
$\omega_{i}^{m}(\mathrm{II})$	0.	0833	0.0833	0.0833	0.0833	0.0833	0.0833
1				0.00000	0.00000	0.00000	0.00000
COMPAN	Y L	.A7_IV	LA7_V	LA7_VI	LA8	LA9_I	LA9_II
COMPAN 1	Y L 0	.A7_IV	LA7_V 0	LA7_VI 0	LA8 0.67	LA9_I 1	LA9_II 0.50
COMPAN 1 2	Y L 0 0	.A7_IV	LA7_V 0 0	LA7_VI 0 0	LA8 0.67 1 1	LA9_I 1 0	LA9_II 0.50 0
COMPAN 1 2 3	Y L 0 0 0.07	_A7_IV	LA7_V 0 0 1	LA7_VI 0 0.99	LA8 0.67 1 1	LA9_I 1 0 1	LA9_II 0.50 0 0.50
COMPAN 1 2 3 4	Y L 0 0 0.07 0.13	_A7_IV	LA7_V 0 0 1 0	LA7_VI 0 0.99 0	LA8 0.67 1 0.33	LA9_I 1 0 1 0	LA9_II 0.50 0 0.50 0 0.50 0
COMPAN 1 2 3 4 5	Y L 0 0 0.07 0.13 0 0	_A7_IV	LA7_V 0 0 1 0 0	LA7_VI 0 0.99 0 0	LA8 0.67 1 1 0.33 0	LA9_I 1 0 1 0 0 0	LA9_II 0.50 0 0.50 0 0
COMPAN 1 2 3 4 5 6	Y L 0 0 0.07 0.13 0 1	.A7_IV	LA7_V 0 0 1 0 0 0 0	LA7_VI 0 0.99 0 0 0 0	LA8 0.67 1 1 0.33 0 1	LA9_I 1 0 1 0 0 0 0	LA9_II 0.50 0 0.50 0 0.50 0 0 0 0 0
COMPAN 1 2 3 4 5 6 7	Y L 0 0 0.07 0.13 0 1 0.50 1	.A7_IV	LA7_V 0 0 1 0 0 0 1 1	LA7_VI 0 0.99 0 0 0 0 0 0	LA8 0.67 1 1 0.33 0 1 0.67 1 0.67 1	LA9_I 1 0 1 0 0 0 1 0 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1	LA9_II 0.50 0 0.50 0 0 0 0 1
COMPAN 1 2 3 4 5 6 7 8	Y L 0 0 0.07 0.13 0 1 0.50 0	.A7_IV	LA7_V 0 0 1 0 0 0 1 0 0 1 0	LA7_VI 0 0.99 0 0 0 0 0 0 0 0 0	LA8 0.67 1 1 0.33 0 1 0.67 0.33 0 1	LA9_I 1 0 1 0 0 0 1 0 0 1 0 0 0 0 0 0 0	LA9_II 0.50 0 0.50 0 0 0 0 0 0 1 0 0
	Y L 0 0 0.07 0.13 0 1 0.50 0 0.1242 0	2.47_IV	LA7_V 0 0 1 0 0 0 1 0 0.1356	LA7_VI 0 0.99 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0.1242	LA8 0.67 1 1 0.33 0 1 0.67 0.33 0 0 0 1 0.67 0.33 0 0 0 0	LA9_I 1 0 1 0 1 0 0 0 0 0 0.0220	LA9_II 0.50 0 0.50 0 0.50 0 0 0 0 0 0 0 0.0220 0

Table A7. Normalised scores of the sub-indicators of the Training and Education Aspect.

Training and Education Aspect $V(J_i^m, e)$.							
COMPANY	LA10_I	LA10_II	LA10_III	LA10_IV	LA10_V	LA10_VI	
1	1	0.99	0	0.23	1	0.98	
2	0.33	0	0	0	0	0	
3	1	0.98	0.09	0	0	0	
4	0.33	0	0	0	0	0	
5	0.67	1	0	0	0	0.96	
6	0.67	0.98	0	0	0	0.97	
7	0.67	0.98	1	1	0.07	0	
8	0.33	0	0	0	0	0	
$\omega_i^m(\mathrm{I})$	0.1618	0.1155	0.0773	0.0773	0.0773	0.1155	
$\omega_i^m(\mathrm{II})$	0.0909	0.0909	0.0909	0.0909	0.0909	0.0909	
COMPANY	LA11	LA12_I	LA12_II	LA12_III	LA12_IV		
1	0.40	0.67	1	1	0		
2	0	0	0	0	0		
3	0.60	0.67	0	0	0.52		
4	0	0.33	0	0	0		
5	0.60	0.33	0	0	0		
6	0	0	0	0	0		
7	0.40	0.33	0	0	0		
8	0.60	0.33	0	0	0		
$\omega_i^m(\mathrm{I})$	0.0473	0.0964	0.0773	0.0773	0.0773		
$\omega_i^m(\mathrm{II})$	0.0909	0.0909	0.0909	0.0909	0.0909		

Table A8. Normalised scores of the sub-indicators of the Diversity and Equal Opportunity Aspect.

Diversity and Equal Opportunity Aspect $V(J_i^m, e)$					
COMPANY	LA13_I	LA13_II	LA13_III	LA13_IV	
1	0.849	0.993	0.714	0.789	
2	0.82	0.485	0.739	0	

3	0	0.99	1	1
4	0.999	0.071	0	0
5	0	0.016	0.997	0
6	0	0	0.578	0
7	0.923	0	0	0.099
8	0	0	0.868	0
$\omega_i^m(\mathbf{I})$	0.025	0.325	0.325	0.325
$\omega_i^m(\mathrm{II})$	0.25	0.25	0.25	0.25

Table A9. Normalised scores of the subindicators of the Equal Remuneration for Women and Men

Equal Remuneration for Women and Men Aspect $v(J_i^m, e)$				
COMPANY	LA14_I	LA14_II	LA14_III	
1	1	0	0	
2	0.5	0	0	
3	0.5	1	0	
4	0	0	0	
5	0	0	0	
6	0.5	0	0	
7	0	0	0	
8	0.5	0	0	
$\omega_i^m(\mathbf{I})$	0.4333	0.2833	0.2833	
$\omega_i^m(\mathrm{II})$	0.3333	0.3333	0.3333	

Table A10. Optimal portfolio I (different weights for LPDW-criterion and $\lambda=0$).

COMPANY	LPDW- index	Investment	Criterion	Criterion value	k _l	$\omega_l = 1/k_l$
1	0.629	43.18	CVaR	5.973	5.9683	0.1676
3	0.657	9.427	EVE	100.236	100.3165	0.0100
4	0.171	47.55	LPWD	41.4006	41.4338	0.0241

Table A11. Optimal portfolio II (baseline case and $\lambda = 0$).

COMPANY	LPDW- index	Investment	Criterion	Criterion value	k _l	$\omega_l = 1/k_l$
1	0.641	41.76	CVaR	5.9722	5.9683	0.1676
3	0.579	4.22	EVE	100.2503	100.3165	0.0100
4	0.208	54.02	LPWD	40.4618	40.4885	0.0247

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