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Materiality Analysis in Sustainability Reporting: A Method for Making it Work in Practice

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Abstract
Sustainability reporting is the practice of measuring, disclosing, and being accountable to internal and external stakeholders for the company's ability to achieve sustainable development goals (SDGs) and manage impacts on society. According to the Global Reporting Initiative (GRI) G4 guidelines, the purpose of materiality analysis in sustainability reporting is to determine those economic, environmental and social issues that are the most significant to company and its stakeholders. A key challenge is to ensure completeness in covering all the aspects that are material from internal analysis, business strategy and stakeholder perspective. Thus, the views of different stakeholders need to be taken into account dealing with subjectivity of judgments. Current sustainability literature offers few studies aimed to support companies in materiality analysis through quantitative and practical approaches. Based on a critical review of these studies, the present paper provides suggestions for the development of a new and more effective method.

Keywords: Sustainability reporting, materiality analysis, stakeholder engagement, Global Reporting Initiative (GRI), decision support methods.

1. Introduction

Companies are increasingly becoming powerful actors in addressing the complex sustainability issues with which the world is confronted. Recently, the United Nations (UN) has recognized that "socially responsible and accountable private business activity, investment, and innovation are major drivers of productivity, employment and economic growth" (UN, 2017). Thus, companies can play a key role for achieving Sustainable Development Goals (SDGs) that UN have adopted as part of their new global "Agenda 2030"(UN, 2015). To this aim, companies are asked to continuously demonstrate their true commitment to sustainability, that is, their ability to meet the needs of current stakeholders without compromising the ability of future generations to meet their own needs (WCED, 1987).

In order to reduce the information asymmetry between company and stakeholders, every year more and more companies are voluntarily reporting sustainability information and increasingly they are using reporting frameworks, such as the Global Reporting Initiative (GRI) G4 guidelines (Gonzalez et al., 2017; Jain and Islam, 2016; Schadewitz and Niskala, 2010). GRI G4 provides companies with guidelines on how define sustainability report content, stressing the concept of materiality analysis. The purpose of materiality analysis is to determine what sustainability information are most significant to the

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companies and to their stakeholders (GRI, 2013b). Reporting on material aspects makes reports more relevant, more reliable and more transparent, enabling companies to better inform markets and society on their sustainability commitment (Hess, 2007).
According to GRI G4 guidelines (GRI, 2013a; 2013b), materiality analysis should be conceived as participatory process, involving interactive dialogue with stakeholders both internal and external to the organization. Material issues should be determined and prioritized in accordance with stakeholder needs and internal analysis regarding impacts on strategies, processes and competitive advantage. Therefore, a systematic approach is required in order to effectively address materiality analysis dealing with subjectivity of judgments, ensuring completeness in covering all material aspects and engaging with stakeholders (Calabrese et al., 2016; Zhou, 2011).
To date, few studies have inquired into quantitative methods and practical approaches for supporting materiality analysis. Based on a critical review of these methods, the present paper provides suggestions for the development of a new method for making materiality analysis work in practice.

2. Materiality Analysis in Sustainability Reporting

The concept of materiality derives from financial reporting where it is commonly considered as a threshold to influence the economic decisions of who use corporate budgets, especially investors (Messier et al., 2005). Recently the concept of materiality has been applied also in sustainability reporting (Jones et al., 2016). GRI G4 guidelines, which are the most adopted standard for sustainability reporting, defines material aspects as those that reflect the significant economic, environmental and social company's impacts or significantly influence stakeholders' assessments and decisions (GRI, 2013a; 2013b). The purpose of materiality analysis is, thus, to determine what really matters to company sustainability performance, commitment and strategies. To this aim, companies are asked to disclose sustainability information with an appropriate level of detail, according to its materiality assessment (GRI, 2013b). By focusing reports on material aspects, companies can save time, money and resources in carrying out reporting tasks. Indeed, SMEs can be particularly favored by materiality analysis since they usually face resource and capability constraints when implementing sustainability reporting (Arena and Azzone, 2012).
According to GRI G4 guidelines, materiality analysis should be performed through stakeholder engagement initiatives and strategic consideration of opportunities and risk related to sustainability aspects. The guidelines suggest using a materiality matrix approach to place aspects according to their significance for stakeholders and company's impacts. The matrix approach is proposed in order to prioritize aspects and determine a materiality threshold at which aspects are sufficiently significant to be reported. However, the guidelines do not provide any structured approach to perform this task. Consequently, companies face difficulties for making materiality analysis work in practice. First of all, materiality analysis requires companies to evaluate the significance of an aspect, identifying to whom it is significant and why. Indeed, materiality analysis is a highly subjective process in which personal opinions, experiences and expectations are key elements for evaluating the significance of aspects (Zhu, 2011). Real world decision-

making problems involving subjective judgments are usually affected by uncertainty and vagueness (Ya and Ma, 2015). Therefore, new and more effective methods are needed for appropriately representing and handling stakeholder perceptions in materiality analysis (Ascough et al., 2008).
Moreover, in order to ensure completeness of analysis, GRI G4 guidelines recommend to take into account different stakeholder views. To achieve this aim, companies should adopt a constructive and contributory evaluation approach, aimed at mediating potential conflicts and divergences among stakeholders' opinions (Bellantuono et al., 2016; Elias et al., 2004). In addition, the consistency of judgments should be tested for avoiding or mitigating judgment contradictions (Alonso and Lamata, 2006).
Given the complexity of materiality analysis, a Multi-Criteria Decision Making (MCDM) method can effectively contribute to structure a transparent and reliable approach for performing such analysis (Cinelli et al., 2014). In general, MCDM methods are decision support tools allowing decision makers to rank and compare different alternatives according to multiple decision criteria. Given the multidimensional nature of sustainability, a MCDM method could be useful in order to evaluate and prioritize material aspects according to the overall company's economic, environmental and social impacts (Costa and Menichini, 2013). For analyzing significance of some sustainability aspects, such as social and ethical concerns, qualitative descriptions may be more effective than quantitative ones (Azapagic, 2003; Daub, 2007). Therefore, among the existing MCDM methods, those methods that allow comparing alternatives according with qualitative and quantitative criteria, result as more appropriate for analyzing materiality (Mardani et al., 2015).
To date, few studies have proposed a MCDM method for addressing materiality in sustainability reporting (Bellantuono et al., 2016; Calabrese et al., 2016; Hsu et al., 2013). In this paper, we review the aforementioned methods analyzing their core idea and comparing their advantages and disadvantages, in order to provide suggestions for the development a new and more effective method.

3. Comparison of MCDM Methods for Materiality Analysis

In this section, we summarize advantages and disadvantages of the MCDM methods proposed by Hsu et al. (2013), Calabrese et al. (2016) and Bellantuono et al. (2016). We compare the methods according to the key issues of materiality analysis previously discussed: multi-stakeholder engagement; mediating among different stakeholders' views; testing consistency of pair-wise comparisons; handling subjectivity; quantitative approach for deriving priorities; setting materiality thresholds; practical guidance on completeness of report content.
Table 1 presents the methods and their comparison.

Table 1. MCDM methods and comparison criteria.

Criteria	**Reference**		
	Hsu et al. (2013)	*Calabrese et al. (2016)*	*Bellantuono et al. (2016)*
MCDM method	Analytic Network Process (ANP) combined with Failure Modes and	Fuzzy AHP	Multi-Attribute Group Decision-

Criteria	Reference		
	Hsu et al. (2013)	*Calabrese et al. (2016)*	*Bellantuono et al. (2016)*
	Effects Analysis (FMEA)		Making (MAGDM)
Sustainability issues considered	Derived from: Dow Jones Sustainability Index (DJSI), Electronic Industry Citizenship Coalition (EICC), GRI guidelines, sustainability reports of companies belonging to the same sector of the company under analysis	Derived from GRI G4 guidelines	Derived from GRI G4 guidelines
Multi-stakeholder engagement	yes	yes	yes
Mediating among different stakeholders' views	no	no	yes
Testing consistency of pair-wise comparisons	yes	yes	yes
Handling subjectivity	yes	yes	yes
Quantitative approach for deriving priorities	yes	yes	not detailed
Setting materiality thresholds	no	yes	yes
Practical guidance on completeness of report content	no	yes	no

4. Discussion

4.1 Materiality analysis based on ANP method

The study of Hsu et al. (2013) proposes a structured approach for materiality analysis based on the calculation of risk priority numbers. The Failure Modes and Effects Analysis (FMEA) is the approach utilized to establish the evaluation criteria, such as occurrence, severity and detection. The Analytic Network Process (ANP) is used to determine the relative importance of each criterion. The values of risk priority are calculated as weighted average of occurrence, detection and severity indices. Occurrence values are determined as the percentage of concerned stakeholders. Detection values are determined as the level of stakeholder concerns. Severity values are determined as the severity of effects on strategic engagement objective. All the evaluations of FMEA indices are based on five-point scale and judgments are provided by internal managers. Stakeholders, such as labor union of employees, customers, community, investors, suppliers, non-government organizations and media, are directly involved in the step of issue prioritization. Each stakeholder is asked to express its concerns or interest regarding issues using a five-point scale.

Advantages:

1. The integration of ANP and FMEA helps to overcome the limit of FMEA technique that implies same weights for all decision-making criteria. In addition, the use of ANP method allows dealing with interactions and dependencies among the considered decisional criteria (Sarkis and Sundarraj, 2002);

2. Given the low number of criteria involved, ANP method is easy to implement;
3. According to the recommendations of Dyer and Forman (1992), the method adopts geometric means to summarize managers' judgments and avoid decision makers bias;
4. Sustainability issues are derived from standard instruments and guidelines (e.g. GRI and Dow Jones Sustainability Index (DJSI)). This enables comparisons among companies regarding material aspects and sustainability performance;
Disadvantages:
1. The method allows involving stakeholders in the prioritization of sustainability issues but there are no mechanisms for conflicts management and testing consistency of judgments;
2. Although FMEA is feasible to set thresholds, the method does not provide any structured approach for supporting companies to fix materiality thresholds;
3. Due to the absence of a structured approach for fixing materiality thresholds, the method results as not completely suitable for achieving resource-use optimization.

4.2 Materiality analysis based on fuzzy AHP method

The study of Calabrese et al. (2016) proposes a structured approach for materiality analysis based on Analytic Hierarchy Process (AHP) method integrated with fuzzy logic. Triangular fuzzy Numbers (TFNs) are used to represent and handle linguistic judgments. The method allows obtaining a ranking of GRI G4 aspects and indicators. The relative weights of items depend on their relative significance to the company's impacts and to stakeholders.
Advantages:
1. The method allows involving stakeholders in decision-making providing a structured approach for testing consistency of stakeholders' judgments;
2. The method is designed to synthesize different stakeholders' judgments, addressing the multi-stakeholder issue of materiality analysis;
3. The use of fuzzy logic allows effectively deal with subjectivity (Mardani et al., 2015);
4. Sustainability issues are derived from GRI G4 guidelines. This enables comparisons among companies regarding material aspects and sustainability performance;
5. The method establishes a prioritization of GRI G4 aspects and indicators in terms of materiality. Thus, companies are enabled to establish a threshold of completeness below which sustainability aspects and indicators can be described with few details in the sustainability report, as they are not substantially material; the ex-ante choice of a level of completeness allows focusing reporting activities mainly on the more material aspects and indicators and thus optimizing the use of limited resources;
6. Due to the structured approach for the analysis of completeness, the method is particularly suitable for companies with limited resources and expertise to dedicate to reporting activities, such as SMEs. Nevertheless, the method can be applied to companies of any size or sector.
Disadvantages:
1. The method employees aspects and indicators as presented in the GRI G4 guidelines. Thus, the high number of pair-wise comparisons requires considerable time efforts for the method application;
2. Despite the method is designed to synthesize different stakeholders' judgments, it

does not take into account different weights of importance for the different involved stakeholders. Thus, the method is not completely suitable to handle potential divergences among stakeholders' opinions.

4.3 Materiality analysis based on MAGDM method

The study of Bellantuono et al. (2016) proposes a Multi-Attribute Group Decision-Making (MAGDM) method to support stakeholder engagement and determine material issues.

Advantages:

1. The method proposes a structured approach to prioritize stakeholders according to their relevance (i.e. salience) for evaluating materiality of economic, environmental and social sustainability dimensions. The prioritization process is based on dominance indices and it allows obtaining relative weights to use for calculating aggregate values of materiality;
2. The comparison procedure, used to calculate the salience values of stakeholder, involves internal decision makers such as entrepreneurs and top managers. In order to check the consistency of their comparisons, the method suggests a consistency test as proposed by Aguaron and Moreno-Jiménez (2003). In case of inconsistency, the method proposes to follow the adjusting procedure presented in Wu and Xu (2012);
3. The method proposes to calculate materiality thresholds using the Euclidean norm;
4. Sustainability issues are derived from GRI G4 guidelines. This enables comparisons among companies regarding material aspects and sustainability performance.

Disadvantages:

1. In order to handle subjectivity, the method proposes to calibrate the set of verbal labels used for assessing materiality. The company's computational efforts could be high depending on the number of labels used and stakeholders involved;
2. The approach used to check and adjust consistency of salience judgments could require high computational efforts, since it is based on pair-wise comparisons among stakeholders' salience. The higher is the number of stakeholder involved, the higher is computational effort required. The computational effort further increases if the salience of stakeholders is evaluated with respect to each aspect.

5. Recommendations

Based on what discussed in the previous sections, it emerges that some criticalities affect materiality analysis and existing MCDM methods for performing such analysis. A new method for making materiality work in practice should overcome these shortcomings. To this aim, we provide some recommendations:

Recommendation 1: *accuracy -computational efforts trade-off*

The new method should provide a reduced computational effort to facilitate the method implementation. A high number of pair-wise evaluations could make decision makers fatigued and the effectiveness of materiality analysis could decrease. For this reason, when high number of criteria and alternatives are involved, MCDM based on pair-wise comparisons (e.g. fuzzy AHP) are integrated with consistency tests aimed at ensuring coherence and accuracy of judgments. The accuracy-computational efforts trade-off

would be particularly beneficial for companies with limited time and resources to devote to reporting activities, such as SMEs. The trade-off could be achieved by avoiding analytic approaches that require comparisons in pairs. In this case, however, appropriate approaches to ensure consistency of judgments, should be employed.

Recommendation 2: *multi-stakeholder engagement - different stakeholders' views trade-off*

The new method should balance the potential conflicts between judgments of different stakeholders involved. The opinion of different stakeholders should be taken into account according to their knowledge and relevance for materiality assessment of each sustainability aspect.

Recommendation 3: *multidimensionality*

The method should combine two perspectives of assessment: significance of economic, environmental and social company's impacts and influence on stakeholders' decisions and evaluations. The double perspective of assessment should be adopted for each sustainability dimension (i.e. economic, environmental and social dimension). The method should allow analyzing dimensions both separately and aggregately. Therefore, the new method should be structured as a MCDM method.

Recommendation 4: *handling subjectivity*

The new method should appropriately deal with ambiguity, uncertainty and fuzziness that affect stakeholder perceptions.

Recommendation 5: *completeness of report content*

The new method should provide practical guidance for making reporting process as efficient as possible. In particular, the method should provide guidance on:

- how to identify sustainability aspects in order to ensure comparability of results;
- how to set threshold values for selecting material aspects;
- how to decide the level of coverage meaning the amount of data, narrative explanation and performance indicators to be disclosed for each material aspect.

Conclusions

Sustainability reports should provide stakeholders with information that allow evaluating the company's long and short-term social, environmental and economic performance. To this aim, companies need to focus their sustainability reports on the matters that are truly critical to the achievement of organizational goals and to the management of economic, environmental and social impacts. This means that companies must adopt a 'materiality' approach in the process of defining sustainability report content. This analysis allows optimizing time and resources to devote to sustainability reporting. In addition, materiality analysis allows focusing on sustainability aspects that are the most crucial for the short and long-term success of their business. Thus, the analysis enables companies to improve their strategies and objectives for sustainability.

Despite these advantages, some critical issues affect materiality analysis. To date, few studies propose a structured approach for overcoming these criticalities. Among them, only three studies consider a MCDM method. In order to develop a new and more effective method for making materiality work in practice, we provide suggestions on: *accuracy-computational efforts trade-off; multi-stakeholder engagement - different stakeholders' views trade-off; multidimensionality; handling subjectivity* and *completeness of report content.*

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