Improving corporate disclosure through XBRL: An evidence-based taxonomy structure for Integrated Reporting

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Abstract

Purpose – To examine the potential for eXtensible Business Reporting Language (XBRL) to go beyond static reporting. A taxonomy structure of information is developed for providing a knowledge base and insights for an XBRL taxonomy for Integrated Reporting (IR).

Design/methodology/approach – Design Science (DS) research, as a pragmatic exploratory research approach, is embraced to create a new "artefact" and thematic content analysis is used to analyse IR in practice.

Findings – Using XBRL for IR allows a shift from static and periodic reporting to more relevant and dynamic corporate disclosure for stakeholders, who can navigate and retrieve customized disclosure information according to their interest by exploiting the multidimensionality of IR and overcome some of its criticisms. The bi-dimensional taxonomy structure we present allows users to navigate disclosure from two different perspectives (*Content Elements* and *Capitals*), display specific themes of interest, and drill down to more detailed information; and, because of its evidence-based nature and levels of disaggregation, it can provide flexibility to preparers and users of information. Additionally, the findings demonstrate the need to codify sector-specific information for the *Content Elements*, so that to direct the efforts towards the development of sector-specific taxonomy extensions in developing an XBRL taxonomy for IR.

Research limitations – The limitations of DS research are, first, the artefact design and, second, its effects in practice. The first limitation stems from the social actors' perspective taken into account to develop the taxonomy structure, which derives from the analysis of the reporting practices rather than a pluralistic approach and dialogic engagement. The second limitation relates to the XBRL taxonomy development process because, since our study is limited to the "design" phase being codification and structuring the knowledge base for an XBRL taxonomy, there is a need to develop a taxonomy in XBRL and then apply it in practice to empirically demonstrate the potential and benefits of XBRL in the IR context.

Practical implications – The taxonomy structure is targeted at entities interested in designing an XBRL taxonomy for IR. This is a call for academics and practitioners to explore the potential of technology to improve corporate disclosure and open up new projections for resurging themes on Intellectual Capital (IC) reporting with prospects for IC "fourth-stage" research focused on IC disclosure.

Originality/value – This is an interdisciplinary research employing the DS approach, which is rooted in Information Systems research. It is the first academic study providing pragmatic results for using XBRL in the context of IC and IR.

Keywords:

Integrated Reporting; XBRL; corporate disclosure; Intellectual Capital disclosure; Design Science; computer-assisted content analysis

1. Introduction and background

Integrated Reporting (IR) is the most recent initiative aimed at seeking to improve corporate reporting. According to the International Integrated Reporting Council (IIRC), IR should provide, in a single document, a comprehensive representation of an organization's performance and the wide-ranging factors that affect the business's ability to create value over time (IIRC, 2013a). Thus, an integrated report should provide a multifaceted corporate report that includes financial and non-financial information.

Debate as to the ability of corporate reporting to be holistic, comprehensive, and multifaceted is not new in accounting and IC research. For example, Yongvanich and Guthrie (2006, p. 309) propose an "extended performance reporting framework (EPRF)" by demonstrating that IC, the Balanced Scorecard, and social and environmental reporting are complementary and can be integrated into a single framework to "empower stakeholders and facilitate change in the way organizations conduct their activities". Similarly, IR's integrated approach flows from earlier concepts such as "Triple-bottom-line" reporting, "One Report" (Eccles and Krzus, 2010b), and the Global Reporting Initiative (2013a).

Beattie and Smith (2013) highlight that the emergence of IR refocuses the debate on the role of IC and value creation in narrative reporting. IR and IC reporting have a strict relationship, since both aim at explaining – albeit from different perspectives – the value-creating potential of a firm not uncovered by financial information alone. Dumay (2016, p. 175) explains this relationship as follows:

> *When you take away the physical capitals of financial, manufactured and natural capital, the remaining three intangible capitals broadly align with IC's three capitals: human capital with human capital; social and relational capital with relational capital; and IC with structural capital. This has ushered in a new era of hope for the IC reporting faithful that IC reporting is firmly back on the agenda of companies, especially large listed companies, which are the target of the IIRC and <IR>.*

Consequently, Dumay (2016), in his critical reflections on the future of IC and IR, highlights a "newfound resurging interest in IC reporting, based on the current push for integrated reporting, which arguably contains IC information targeted at investors". However, by addressing why "many academics continue to ascribe to reporting models that receive little or no support in practice", he argues the need to shift away from reporting to more relevant disclosure by focusing on disclosing information that "'was previously secret or unknown', so that all stakeholders understand how an organisation takes into consideration ethical, social and environmental impacts" (Dumay, 2016, pp. 171, 168). Even though corporate disclosure and reporting are usually used synonymously, corporate disclosure has a broad meaning and goes beyond the boundaries of reporting. As Holland (2005, pp. 249, 264) argues, disclosure emphasizes the dynamic elements of "interaction and learning" between firm and market, and the "choice of disclosure channel", a "private information agenda", "knowledge intensive intangibles, stories, benchmarking, feedback, learning, outcomes, response and many other elements" aimed at dealing with information asymmetry.

This renewed and resurgent interest in making IC externally visible suggests a new approach is required. As Dumay (2016, pp. 163, 164) demonstrates, listed firms have lost interest in IC reporting with no known recent examples of standalone IC reports, with IC disclosures instead usually contained in other corporate communications such as press releases and electronic communications. This suggests a need to go beyond IC reporting (Edvinsson, 2013) by concentrating on discovering IC disclosure, shifting from a static and periodic reporting towards dynamic and relevant disclosure for stakeholders.

Using technology can facilitate such a shift (Dumay, 2016). Information and communication technologies have risen to the fore in the so-called digital reporting era, changing the ways in which companies relate to their stakeholders (Ghani *et al*., 2009; Hoffman and Mora Rodríguez, 2013). Beattie and Pratt (2003, p. 155) conclude that the potential benefits of web-based business reporting derive from the "different kinds of additional information that could be provided electronically", "the usefulness of different navigation and search aids", and "the portability of information under different formats". There are benefits in using web technology for reporting for both preparers and users who can take advantage of the web environment: the former experience improved corporate image and competitive advantage from their use; the latter can access on demand a large volume of information in their particular area of interest (Bonsón and Escobar, 2006).

eXtensible Business Reporting Language (XBRL) is a technological tool that can disseminate data by producing more relevant and customized information according to users' demands (Debreceny and Gray, 2001). Dunne *et al*. (2013, p. 169) identify XBRL as a second-generation digital reporting technology because, unlike first-generation technologies characterized by static PDF and HTML formats, it allows "more automated analysis and interrogation of the underlying information across multiple platforms" and a "new communication channel for interested parties".

Additionally, XBRL has some advantages for presenting information and jointly applying the guiding principles established by the IIRC in a trade-off between completeness and conciseness. For instance, de Villiers *et al*. (2014, p. 1046) observe that using "electronic forms of reporting allow[s] users of integrated reports to drill down to more detailed reports and other information on those elements reported in the integrated report in which they were most interested". XBRL is able to meet these challenges and support the adoption of IR in a way that better satisfies users' information needs through more effective, dynamic, and customized information retrieval. However, despite early claims for the potential of XBRL for IR (Eccles and Krzus, 2014; IIRC, 2011, 2013b; Monterio, 2013) and the proposed XBRL codification for IC (Ramin and Lew, 2015), its application in practice has not yet been addressed. Indeed, using such a technology requires a necessary definition of an XBRL taxonomy that is able to reflect a representation of IR information in XBRL language.

This study examines the potential for XBRL to overcome the weaknesses of static reporting, improve voluntary corporate disclosure, and emphasize and explore IC disclosure. To apply such a technology in practice, this paper develops a taxonomy structure from the suggested information shaping IR content from the IR guidelines, providing a knowledge base and insights for an XBRL taxonomy for IR. The research employs Design Science research as a pragmatic exploratory research approach to create a new "artefact" and an artificial phenomenon for solving a practical problem (van Aken, 2007; Hevner *et al*., 2004). This pragmatic research stems from the debate about whether academics should be considered "merely observers and evaluators of the practitioners' problem-solving activity" or also "problem solvers" (Holmström *et al*., 2009, p. 66). Having established a taxonomy structure, this provide a knowledge base and information model to build an XBRL taxonomy, which, drawing from previous experience, takes a mixed approach (top-down and bottom-up), similar to that adopted for developing the International Financial Reporting Standards'

XBRL taxonomy (Ramin and Prather, 2003). Thus, the study explores a new way of presenting and disclosing corporate and IC information by demonstrating the potential for XBRL technology to improve the relevance of voluntary corporate disclosure.

This paper is organized into seven sections. The next section describes the research approach – Design Science – and the related epistemological view we employ in the study. The remaining sections of the paper are explained in the next section along with the procedural steps of Design Science.

2. Epistemological and research approach: Design Science research

The need to improve existing situations prompts researchers to act. This aim is usually pursued by undertaking research based on explanatory and natural science paradigms (van Aken, 2007), according to which knowledge is developed and a social phenomenon is explained by starting with a theory that will "prove or disprove the hypothesis", or develop a new theory (Hevner and Chatterjee, 2010, p. 5). The logic of testing theories and developing new ones based on empirical evidence is dominant in academic research.

However, this epistemological view can be problematic for research aimed at creating novelties to solve problems for practitioners. This is because of the practical impossibility of observing and finding theoretical explanations for a phenomenon that does not exist and has not yet been manifested in practice. The dilemma thus created can be explained by the same philosophical and ontological differences between exploratory and explanatory research. As Holmstrom *et al*. (2009, p. 68) argue, "in explanatory research the phenomenon to be studied already exists out there, and the goal of the researcher is to develop an understanding of it"; alternatively, in exploratory research "the phenomenon must be created before it can be evaluated" and "the creation of artificial phenomena or simply artefacts (e.g., technologies) is essential". Therefore, the development of novelties – for example, models and applications – needs to employ epistemological paradigms based on exploratory research.

Design science (DS) is a research approach aimed at achieving this purpose. Since this exploratory approach "is different from both theory-building and theory-testing approaches", DS has a pragmatic research interest aimed at creating an artefact for solving a practical problem with the ultimate goal of improving practice (Holmström *et al.*, 2009, p. 67). Piirainen and Gonzale (2013, p. 60) argue that DS is based on the same paradigms and purposes of the "constructive research approach" developed in management and management accounting literature, and also known as action research or "interventionist" research (see, e.g., Jönsson and Lukka, 2006). Indeed, the goal shared by these two approaches ("constructive research" and DS) is "using applicable theories, technical norms, or theories-in-use, with high industrial relevance to design practical solutions" (Piirainen and Gonzalez, 2013, p. 60). Consequently, DS researchers need to and must "first create the artificial phenomenon so that data to be analysed can be obtained" (Holmström *et al*., 2009, p. 69). Van Aken (2007, p. 69), following the seminal work on DS – *The Sciences of the Artificial* (Simon, 1996) – argues that while natural sciences aim to develop "valid knowledge on natural objects", DS does this on man-made artificial objects. Therefore, DS is a research approach that allows and needs the creation of a new artefact and an artificial phenomenon as a solution for problems recognized in practice.

DS research has been usefully employed in management (van Aken, 2007; Holmström *et al*., 2009), Information Systems (IS) research (see, among others, Hevner *et al*., 2004; Hevner and Chatterjee, 2010) and Accounting Information Systems (AIS) (Geerts, 2011, p. 143). Indeed, Hevner *et al*. (2004, p. 98), assert that "given the artificial nature of organizations and the information systems that support them, the design-science paradigm can play a significant role in resolving the fundamental dilemmas that have plagued IS research". Alles and Debreceny (2012, p. 88) argue that DS research should be an area of advantage for AIS researchers, since "much of the benefits of working with XBRL will come from innovative ways of integrating, analysing, manipulating and presenting data". Therefore, DS research is an opportunity for academics to address practitioners' needs, such as in corporate reporting and disclosure.

This study embraces this research approach by showing how XBRL can improve corporate reporting and IR. We employ a DS approach to develop a taxonomy structure for designing and developing an XBRL taxonomy for IR. Specifically, our research is based on the six steps of the framework proposed by Peffers *et al*. (2007) for undertaking DS research in IS:

1. "Problem identification and motivation";
2. "Define the objective of the solution";
3. "Design and development" of the artefact;
4. "Demonstration";
5. "Evaluation";
6. "Communication" through the publication of the results.

The next sections of the paper follow the steps above. In section 3 we extend the motivations argued in the introduction for understanding the problem to be solved through the research. Section 4 explains the objective of the solution deriving from the problem. Section 5 depicts the method we employ to design and develop the taxonomy structure (artefact). In section 6, we address the fourth and fifth steps by presenting the taxonomy structure, and evaluating its ability to be applied in practice for developing an XBRL taxonomy for IR. Finally, we present a discussion and conclusion in section 7.

3. "Problem identification and motivation": Integrated Reporting and XBRL

In this section we examine the academic literature and professional documents to address the first step of DS research, in order to understand why and how XBRL is useful for improving IR and corporate reporting. Along with the motivation presented in the introduction, this section addresses the "relevance cycle" at the base of DS, which explains the relevance of the problem deriving from business needs (Hevner and Chatterjee, 2010, pp. 16–19; Hevner *et al*., 2004).

3.1. Integrated Reporting and the challenges for improving corporate reporting

As discussed in the introduction, IR arises from the need for holistic, comprehensive, and multifaceted corporate reporting satisfying all stakeholders' needs (Abeysekera, 2013; Yongvanich and Guthrie, 2006). Indeed, an integrated report should provide broad information explaining the factors of value creation along with financial, social, and environmental implications (Abeysekera, 2013). However, the main challenge reporting faces is to provide relevant information to stakeholders. As Dumay (2016, p. 168) argues, this implies a need to go beyond reporting by focusing on corporate disclosure, as the supply of information "was previously secret or unknown, so that all stakeholders understand how an organisation takes into consideration ethical, social and environmental impacts". Therefore, there is a need to improve the relevance for stakeholders of corporate information provided.

Owing to the multidimensional characteristic of IR, an integrated report can be an opportunity to pursue this aim. Abeysekera (2013, p. 228) observes that IR is an attempt "to combine the reporting of different facets of organisational activities on a common platform with a unified objective". The IR Framework, released by the IIRC, defines an integrated report as "a concise communication about how an organization's strategy, governance, performance and prospects, in the context of its external environment, lead to the creation of value over the short, medium and long term" (IIRC, 2013a, p. 7). Its multifaceted nature means that typical IR information may be relevant to several different types of user. However, the IIRC recognizes investors and providers of financial capital as primary users of IR (IIRC, 2013a) and this narrow focus on investors threatens the relevance of information for all stakeholders.

In the IR Framework, the *Content Elements* (*CE*), representing the core categories of information of integrated reports, are: "Organizational Overview and the External Environment"; "Governance"; "Business Model"; "Risk and Opportunities"; "Strategy and Resource Allocation"; "Performance"; and "Outlook". Considering IR's purpose of explaining "how an organization creates value over time", the information belonging to these *CE* should highlight how it contributes to value creation. *Capitals*, according to the IR Framework, are where the value-creation process "manifests itself in increases, decreases or transformations of the capitals caused by the organization's business activities and outputs" (IIRC, 2013a, p. 10). Therefore, *Capitals* are seen as stocks of resources used and affected by an organization, and value creation is embedded in the value increase/decrease for each of them.

Although the IIRC recognizes several solutions to classification of the *Capitals* (IIRC, 2013c), the IR Framework adopts a categorization based on six capitals: *Financial Capital*; *Manufactured Capital; Intellectual Capital; Human Capital; Social and Relationship Capital; and Natural Capital*. Nevertheless, as asserted by the IR Framework, information regarding the *Capitals* should not be considered as belonging to, and disclosed within, specific and intended sections of the integrated reports (IIRC, 2013a, p. 12). Accordingly, *Capitals* can be seen as cross-sections of an integrated report.

The main disadvantage of this template proposed by the IIRC relates to the difficulty for report users in "navigating" the disclosure of different capitals and immediately retrieving information on a specific capital. Indeed, some companies (i.e. CCR S.A., Interserve Plc) have adopted solutions to facilitate the identification of these types of information within their integrated reports. And, considering the voluntary adoption of this template, some companies, such as Atlantia Spa (Integrated Report 2013[1]), have opted to structure their report according to the *Capitals* categorization, to highlight the IR Capitals structure. The need for electronic "tags" to signal information on certain capitals/resources is argued by Othman and Ameer (2009), who, by proposing a corporate social responsibility reporting format based on Earth, Water and Air, discuss the opportunity of using metadata, like XBRL, to signal, retrieve and manipulate data on these three environmental resources. Therefore, as the importance of information about the resources an organization uses, without any signalling or parsing instruments, the IIRC's guidelines obscure or de-emphasize information about intellectual and other capitals.

Another challenge related to IR derives from the application of specific Guiding Principles, like "Materiality", "Conciseness", "Completeness", and "Connectivity"[2] (IIRC, 2013a). The combined application of such principles aims to improve information relevance for users and prevent an integrated report from being just a simple "summary of information in other communications" (IIRC, 2013a, p. 8). As observed by de Villiers *et al*. (2014, p. 1046), the main distinguishing features of IR are its aim to provide a concise report that "would indicate an organisation's most material social, environmental and economic actions, outcomes, risks and opportunities in a manner that reflected the integrated nature of these factors for the organisation", and using "electronic forms of reporting to allow users of integrated reports to drill down to more detailed reports and other information on those elements reported in the integrated report in which they were most interested". Hence, it is necessary to seek a balance "between conciseness and the other Guiding Principles, in particular completeness and comparability" (IIRC, 2013a, p. 21) and find a solution to connect different types of relevant information and data.

In summary, the challenges to address are as follows: a) shifting from reporting to disclosure; b) overcoming the focus on investors to a more relevant disclosure for all stakeholders; c) emphasizing the disclosure of IC and other capitals; d) improving the navigability of data; e) applying the Guiding Principles of IR. Technological tools, like XBRL, are able to address these issues by improving "the ability to search, access, combine, connect, customize, re-use or analyse information" (IIRC, 2013a, p. 17) to better satisfy users' information needs.

3.2. XBRL's use beyond financial information

XBRL is a computer language for the electronic communication of business information. It provides major benefits in the preparation, analysis, and communication of business information[3]. As a subset of eXtensible Markup Language (XML), it consists of two main elements: collections of business reporting concepts, called "taxonomies", and electronic documents containing business information, called "instance documents". Within XBRL, each piece of financial data is assigned a unique, predefined data tag of a certain taxonomy, and these data tags act like barcodes, identifying the information's content and structure (Hodge *et al*., 2004). Moreover, the extensibility of the language allows users to define customized elements to meet their particular reporting requirements and needs.

The strength of XBRL relies on the taxonomy architecture, which contains the specific "tags" that are used for identifying individual items of data, their attributes, and interrelationships. Specifically, each XBRL taxonomy defines a "schema" of concepts (i.e., business terms) and dimensional information in the form of an unstructured list. As noted by Debreceny and Gray (2001), the representation of accounting, financial, and business information through XML and XBRL may overcome two problems that restrict the ability of the accounting profession and corporations to effectively disseminate financial information on the Internet. First, the identification and location of financial data (resource discovery) and, second, the subsequent identification of specific financial information or attributes (attribute recognition). Hence, from a data-centric perspective, the usefulness of XBRL taxonomies is twofold:

- identifying concepts ("tags") to be applied to items of financial and non-financial data, and also providing a range of information regarding each item (such as whether it is a monetary item, a percentage, or a fraction, etc.); and

- defining how items are related to one another, representing how they are calculated, and determining whether they fall into particular groupings for presentation purposes.

Previous studies on XBRL mainly focus on AIS and financial reporting (e.g., Alles and Debreceny, 2012; Bonsón *et al*., 2009; Valentinetti and Rea, 2012), although several applications beyond financial reporting have been identified in the literature (Baldwin *et al*., 2006; Debreceny and Gray, 2001; Perdana *et al*., 2015). For example, Doni and Inghirami (2011) discuss the implications of the adoption of XBRL language in strategic decision-making processes and evaluate the potential benefits to be derived from the XBRL coding of the Balanced Scorecard model. In doing so, the authors document the benefits of XBRL adoption for internal business reporting with a strong focus on strategic decision-making (p. 33). Therefore, in addition to its claimed benefits for external financial information, XBRL may also be usefully adopted for internal reporting and external non-financial reporting, since its potential is not narrowly limited to financial data.

Several initiatives have adopted XBRL for external business reporting. In relation to IC, Ramin (2007) proposes the application of XBRL to IC reporting, categorizing and organizing intangible assets according to XBRL "elements" that can highlight how individual firms treat intangibles differently. Such an attempt to apply XBRL to IC reporting has been consequently pursued by the World of Intellectual Capital Initiative (WICI), which defined a WICI XBRL Taxonomy for IC information (Doni and Inghirami, 2011, p. 9). One of main advantage of this taxonomy stems from the attempted deep codification in XBRL of Key Performance Indicators (KPI) relevant for IC and the value creation story for different industries. These KPIs are grouped into categories of information such as "Brands and intellectual assets", "Customers", "People", and "Physical assets", and are related to the three capitals of IC – "Human Capital", "Organizational Capital", and "Relational Capital".[4] Thus, the WICI XBRL Taxonomy provides a set of KPIs, codified in XBRL language, to provide a certain standardization of quantitative information on IC.

Due to the spread of sustainability reporting and the Global Reporting Initiative's (GRI) guidelines, digital reporting and XBRL has gained interest of researchers and practitioners who highlight the opportunities lying in some technological applications to sustainability reporting. For example, Isenmann *et al.* (2007) analyse several advantages deriving from using online reporting and XML for sustainability communication, such as moving from a "one size fits all" to customised reports enacting a dialogical and interactive communication, and present a framework for "online sustainability reporting" in practice. In relation to using XBRL, Arndt *et al.* (2006) propose a reference architecture for developing an XBRL taxonomy for sustainability reporting according to the GRI G.3 guidelines. These studies represent initial attempts towards using digital reporting for sustainability reporting and the harmonization of sustainability report structures.

Similarly, the GRI XBRL Taxonomy is a further initiative aimed at XBRL codification of non-financial information and indicators on sustainability. The GRI guidelines provide a broad set of indicators for use in sustainability reporting. Such an XBRL taxonomy covers the standard disclosures in the G4, G3.1, and G3 Guidelines and provides all concepts necessary to create a GRI report (GRI, 2013b). Interestingly, while the G4 disclosure taxonomy consists of three main sections – "General standard disclosures", "Specific standard disclosures", and "Attachments: Assurance report and other documents" – the G3.1 and G3 disclosure XBRL taxonomy includes a number of indicators related to several aspects, including "Economic", "Environment", "Human rights", "Society", and "Product responsibility". Hence, the GRI taxonomy is designed to give organizations better control over the quality and integrity of their sustainability performance data, so as to provide a standardized XBRL codification of KPIs on sustainability matters.

The GRI has promoted several initiatives for using digital reporting and XBRL for sustainability information. Using metadata for reporting and data-manipulation, the GRI has initialised the "XBRL Reports Program"[5] to provide examples of XBRL reports produced according to the GRI XBRL Taxonomy. However, few pioneer companies have started to adopt the XBRL in sustainability reporting (e.g. SAP AG, CLP Holding Limited), and some of them have even abandoned it after few years. The abandonment is arguably due to the lack of open technical platforms for facilitating the spread of digital reporting.

Accordingly, the Digital Reporting Alliance is a recent initiative launched by the GRI to address the "next era of corporate disclosure". Acknowledging the demand for a digital and interactive corporate disclosure, this initiative aims to promote XBRL and create a platform for digital reporting, to provide a technical infrastructure for organizations and stakeholders[6]. The platform is an attempt to address the challenges of sustainability and non-financial reporting, which are the lack of structured and standardized data, and the demand of digital reports.

About the standardization of non-financial information, Monterio (2010b, p. 56) claims the need for a wide and common understanding of Environmental, Social and Governance (ESG) information, by arguing that the lack of "a common lingua franca around a generally accepted ESG reporting standard presents a significant obstacle to effective risk management". While several standards and guidelines (e.g. the GRI) have attempted to harmonize voluntary reporting practices, sustainability and non-financial information still suffers from a lack of comparability. Indeed, compared to financial reporting, which is highly regulated and standardised to provide comparability among industries and organisations, sustainability and IC are addressed, managed and reported differently by each entity because of their own organizational and business characteristics. Additionally, these differences among organizations may even depend on whether they belong to environmentally sensitive sectors (Morhardt, 2009). For example, a firm operating in the mining sector needs to provide environmental more and different information compared to firms less affected by ecological issues.

The standardization of non-financial information is also being addressed by the Sustainability Accounting Standard Boards (SASB), which is developing standards for non-financial reporting by providing material industry-specific metrics on environment, social, and governance aspects.[7] The SASB acknowledges the importance of standard metrics that are able to meet the particular characteristics of each sector. XBRL use implies, and requires in turn, a certain degree of standardization of information, since an XBRL taxonomy definition implicitly entails the establishment of certain reporting rules reducing reporters' discretion in reporting information. The new "Entity Specific Disclosures Task Force", formed in 2016 at XBRL International in response to the recognition that particular information is not covered in relevant public taxonomies, aims to "improve the handling of entity specific disclosures, including defining when best to use extensions" and to improve comparability.[8] Therefore, although the difficulties in codifying sustainability and IC information in a structured and standardised manner because of the voluntary nature and the themes of these reporting practices, using XBRL for non-financial disclosure takes advantage of a set of initiatives aimed at standardizing non-financial metrics and KPIs. At the same time, an XBRL taxonomy implies a deeper coding of non-financial information by taking into account entity-level specifications and variations, so as to meet the demand for a customised approach to information supply for both report preparers and users through using metadata.

3.3. Improving Integrated Reporting through XBRL

With the increase of IR practice, XBRL is seen as a means to integrate financial and non-financial information, by opening up opportunities for "Interactive Integrated Reporting Data" through XBRL (Monterio, 2010a, 2010b). Within the IR context, while the IIRC does not intend to provide another set of standardized KPIs, it refers to XBRL as one of the "standardized technology platforms that may be used for IR" because it improves the way information is created, processed, distributed, and analysed by providing standardized definitions, labels, calculations, references, and contexts applicable to individual numbers and narrative text (IIRC, 2013a, p. 35). Furthermore, some authors agree on the potential role of XBRL to support and enhance the IR initiative (Adams and Simnett, 2011; Bonsón, 2011; Eccles et al., 2010; Eccles and Krzus, 2010a; Monterio, 2010a, 2013b). In this context, XBRL is acknowledged as a potential enabler for IR (Monterio, 2014), because of its potential benefits for applying the Six Capitals model and the Guiding Principles of IR.

Mora Gonzálbez and Mora Rodríguez (2012) document a first attempt to apply XBRL for IR by presenting the AECA's (Asociación Española de Contabilidad y Administración de Empresas) proposal for XBRL taxonomy combining financial and non-financial information "for Corporate Social Responsibility reporting purposes" (p. 70) in relation to KPIs on financial, environmental, social, and corporate governance performance (p. 74). By focusing on these four performance dimensions, such a taxonomy does not consider and emphasize information on other non-physical capitals such as IC.

The usefulness of XBRL for multiple capitals-based disclosure has also recently been addressed by Ramin and Lew (2015), who develop a conceptual model for integrated capital disclosure and performance reporting to provide comprehensive and integrated disclosure on financial, sustainability and IC performance. Such a model consists of three (3Ps) "activity and business drivers" and "capital drivers" – Product, People, and Physical infrastructure – in which the IIRC's six *Capitals* are conceptually embedded (Ramin and Lew, 2015, p. 30). Based on this model, they propose a taxonomy containing multidimensional hyper-cubes for each of the 3Ps, allowing items to be separated according to the type of data used: monetary (value), quantity (objects), or descriptive (disclosure). Therefore, despite its different semantic dimension from IR, this taxonomy has the advantage of being able to tag and observe single data from multiple perspectives (dimensions), and take advantage of the separation between "objects" and "values" for reporting aims.

Regarding the Guiding Principles, and "Completeness" in particular, the categorization schemes of XBRL taxonomies define the specific tags for individual items of data. Thus, such a categorization is worth achieving for the Completeness principle because determines: 1) the extent of information disclosed by firms (i.e., the topics disclosed); and 2) the level of specificity and precision of each piece of information (i.e., segments and more detailed information for each topic). The "Conciseness" principle can be applied through the "nesting" of taxonomy items that are logically structured in multiple hierarchical levels. Indeed, such a structure allows the definition of an effective level of conciseness; each preparer may drill down on information through customized concepts (e.g., by industry, subsidiary, or division) or roll up the custom tags to their more concise parent items. Lastly, "Connectivity" is improved through the consistent semantic definitions of XBRL taxonomy items and explicit relationships between them (IIRC, 2013b, p. 35). The "Connectivity" can be achieved through defining relationships among the taxonomy concepts using “linkbases” as follows: logical relationships between concepts (*definition linkbase*); how elements are calculated (*calculation linkbase*); the relationships between the ways in which the concepts are ordered or nested (*presentation linkbase*); human readable names in different languages for each element (*label linkbase*); and references to external authoritative literature, such as laws or financial accounting practices (*reference linkbase*).

Additionally, XBRL is useful for improving transparency and comparability and, consequently, has the potential to overcome the main weaknesses and criticisms of the IR Framework’s principles-based approach. Flower (2015, p. 9) criticizes the principles-based approach because it avoids imposing onerous reporting obligations and leaves too much discretion to firms. Flower also argues that, while “it is certainly difficult to strike the right balance between detailed rules and broad principles”, there is “a significant danger that unscrupulous managers will use the discretion offered by the IIRC to not report on matters that they prefer to keep secret”. Requiring information providers to use common elements with defined meanings (i.e., an XBRL taxonomy) facilitates automated consumption of reports, therefore enhancing transparency and allowing information to be managed more effectively and efficiently (Bonsón *et al*., 2009; Debreceny *et al*., 2011, p. 653). As observed by Eccles and Krzus (2014, pp. 17, 265), using technology and XBRL provides an opportunity to improve corporate reporting and IR because they offer to deliver customizable reports that enable role-based or interest-based consumption, and “assuage concerns about report length and content”. Additionally, since they make business information machine-readable, XBRL and metadata allow for a reduction in the amount of manipulation and error in the data’s life cycle (Eccles and Krzus, 2014, p. 267). Therefore, XBRL has the potential in this context to improve corporate transparency, to face the challenge of codifying non-financial information on both IC and sustainability, and balancing the entities’ needs about disclosure practices and their comparability.

Hence, XBRL allows for a move from static and periodic reporting towards dynamic and relevant disclosure for several stakeholders. The definition of an XBRL taxonomy for IR is also an opportunity to formalize both the detailed contents of an integrated report, that is, *what* to report, and its Guiding Principles, that is, *how* to report (Monterio, 2013a). At the same time, while the potential benefits of XBRL for IR are several and widely claimed, there are still some challenges to address before adopting in practice. One challenge is the need for a knowledge base to define the elements of an XBRL taxonomy (Monterio, 2013b, p. 65).

4. The “objectives of a solution” for a taxonomy development

As explained above, XBRL is a powerful technological tool for improving IR and overcoming the limits of reporting. However, its use in the IR context necessarily requires the definition of an XBRL taxonomy. Additionally, there are some challenges related to both the development of a taxonomy and the nature and characteristics of the integrated report discussed above.

There are several approaches to taxonomy development depending on the nature and the scope pursued by different XBRL initiatives around the world. For example, the first versions of the IFRS Taxonomy reflected the presentation and disclosure requirements of IFRS Standards as issued by the IASB. Since 2012, it has also included the “common practices”, that is, disclosures that are commonly reported by entities when applying IFRS, identified following an empirical analysis of IFRS financial statements (IASB, 2014). In the USA, the SEC commissioned XBRL US to develop the US

GAAP Taxonomy by analysing industry-level variation since the launching of the Voluntary Filing Program in 2005[9]. Thus, in the case of financial reporting, the XBRL taxonomy design has started from a representation of business facts that is codified, structured and consolidated into general accepted and mandatory accounting rules.

The main concern of this work is the knowledge representation required for an XBRL taxonomy, which can be described by a taxonomic explanation of ontologies. Having root into the philosophical view on the nature of reality, ontology has been defined as "an explicit specification of a conceptualization" (Gruber, 1993), as a semantic structure to encode rules shaping a structure of pieces of reality. Accordingly, knowledge in ontologies is formalised using five components: classes, relations, functions, axioms and instances; and, classes in the ontology are usually organized in taxonomies. Garcìa *et al.* (2006) highlight two main functions of ontologies: clarifying knowledge structure, i.e., obtaining vocabularies for representing knowledge, and enabling knowledge sharing. They also point out that shared ontologies can form the basis for domain-specific knowledge representation languages. In this context, XBRL taxonomies are both a reflection and construction of knowledge – as representations of a piece of reality. In turn, they are able to fulfil the functions above since they represent collection of business concepts – along with their attributes and interrelations – and stem from a well-defined, machine readable representation language, that is, XML.

The need for a knowledge base for an XBRL taxonomy is also addressed by Debreceny *et al*. (2009, pp. 117–126), who, by embracing an engineering approach, propose an iterative process model to develop an XBRL taxonomy that consists of three phases – "Predevelopment", "Development", and "Post-development" (p. 124). The first category includes the "Planning and analysis" and "Design" phases of the taxonomy, as preliminary phases before its development. While the first phase aims to establish the "taxonomy scope" (e.g., a taxonomy for national or international GAAP in the context of financial reporting), recognizing a set of regulations, accounting standards, or frameworks as sources of knowledge, the "Design" phase implies the reporting knowledge codification and modelling in a structured way to provide a knowledge base for the technical development of the taxonomy (pp. 117–120). Therefore, the "Design" phase provides the necessary input for the technical phases of "Development" ("Building" and "Testing"), as described in subsection 5.3. After "Development", the "Post-development" phase concerns "Publication and recognition" for public domain taxonomy, and finally "Usage and maintenance" of the XBRL taxonomy (Debreceny *et al*., 2009, pp. 122–123). Accordingly, developing an XBRL taxonomy for IR requires a preliminary reporting knowledge codification.

The development of an XBRL taxonomy requires a clear definition of concepts to report and a comprehensive list of their interrelationships. In a regulated reporting environment, this is primarily led by specific rules or standards (e.g., GAAP in financial reporting). In the case of IR, the design of a taxonomy according to what is established in the IR Framework is not sufficient for two main reasons. First, IR is a voluntary practice without regulatory force. Second, the IR Framework adopts a principles-based approach and is not intended to serve as a standard structure and rules for the contents of an integrated report (IIRC, 2013a, p. 24), so to allow disclosure differences among organizations. Therefore, analysing and capturing the reporting practices referred to in IR is necessary in order to define a usable and comparable structure for report preparers and users.

The aim of this study is to develop an evidence-based taxonomy structure of pieces of information, as necessary knowledge codification to design an XBRL taxonomy for IR. Specifically, according to the necessary elements for developing this taxonomy structure for IR, our objectives are:

1. to define the *items* of the taxonomy structure, as semantic labels for tagging information, and their hierarchical relations;
2. to identify an effective level of disaggregation for each *item*, that is, the hierarchical levels of the structure, so that to test the industry-level variations in the reporting practices as well.

Thus, the research objectives do not aim to build an XBRL taxonomy in all its technical aspects but, rather, to provide a knowledge base for the XBRL taxonomy design, by addressing what Debreceny *et al*. (2009, pp. 117–126) identify as the "Predevelopment" phase of the process to develop an XBRL taxonomy.

5. "Design and development" of the taxonomy structure ("artefact")

In this section, we deal with the third step of DS by describing the process and method we used for developing the evidence-based taxonomy structure ("artefact"). From this step, we begin to address the "Design cycle" and "Rigour cycle" of DS research (Hevner and Chatterjee, 2010; Hevner *et al*., 2004). The first cycle concerns the building and evaluation of the artefact according to the business needs identified in the environment. The second cycle connects the DS with experiences and expertise, and aims to provide a knowledge base for the artefact design.

To explain the design of the taxonomy structure, this section is organized according to the two objectives above. Subsection 5.1 explains the methodology we employed to analyse the reporting practices in order to define the *items* of the taxonomy structure and its hierarchy (Objective 1) and subsection 5.2 depicts the metrics and the data analysis for identifying the levels of disaggregation (Objective 2).

5.1. Method to define the taxonomy structure and its items

Concerning the first objective, to define a taxonomy structure for IR we need to analyse reporting practices. We employ content analysis as the methodology to empirically investigate corporate disclosure and reporting (Beattie *et al*., 2004; Dumay and Cai, 2014; Guthrie *et al.*, 2004). As noted by Weber (1990, p. 12), "a central idea in content analysis is that the many words of the text are classified into much fewer content categories … Each category may consist of one, several, or many words. Words, phrases, or other units of text classified in the same category are presumed to have similar meanings". Accordingly, this method for gathering data involves the codification of data into predefined categories to derive patterns from the presentation and reporting of information.

Specifically, we employ a computer-assisted thematic content analysis as suggested by Beattie *et al*. (2004). Thus, we use QSR NVivo[10] software to analyse the contents of integrated reports through the coding of text/data into pre-defined hierarchical structures of categories/concepts to derive patterns in the presentation and reporting of information. Such a hierarchical structure consists of a taxonomy of concepts derived from the corporate disclosure analysed. As Lock Lee and Guthrie (2010, p. 10) assert in relation to using "electronic taxonomies" as a tool for computer-assisted content analysis, taxonomies are "hierarchical structures with the more abstract terms being closer to the top of the hierarchy and more specialised or descriptive terms being found lower down in the hierarchy". These taxonomies are "developed from an analysis of existing content, looking for the best ‘descriptors’ that can be applied to a given body of text”, and are useful in providing “a navigation aid for those wanting to explore a body of text” because “users can drill down from quite abstract concepts through to quite specific topics” (Lock Lee and Guthrie, 2010, p. 10). This data collection and the related coding process for developing the taxonomy structure are conducted using a specific conceptual framework (“IR-3D” conceptual framework), which is described below.

5.1.1. “IR-3D” conceptual framework and coding scheme

The coding through NVivo can be described as the assignment of different types of attributes and tags to each part of text or piece of information. This requires a preliminary definition of a “coding scheme” based on a framework of concepts (Beattie *et al*., 2004) as a set of categories and types of information to use for coding the reports’ content.[11] Our framework – the *IR-3Dimension* – consists of three main dimensions (Figure I); each one has its own hierarchical structure of concepts and categories of information. Two dimensions are identified on the basis of the IR template of the IR Framework: *CE* and *Capitals*. The third dimension (“Type of information”), instead, is a variation of two dimensions proposed by Beattie *et al.* (2004) in their framework.[12] Thus, according to the IR Framework, the *CE* dimension represents the topics and the main categories of information of an integrated report, whereas the *Capitals* dimension matches the second perspective of the observation of that report, which is related to the concept of value creation. As shown in Figure I, each text unit (paragraph, sentences, or parts of sentences) is assigned to a category for each dimension of the hypercube.

Insert Figure I here

To code the collected reports through NVivo, we created three hierarchical structures of nodes for each dimension. For this purpose, a detailed analysis of the IR Framework was conducted to identify more detailed categories of information for each *CE* and *Capital*. For instance, the node (*item*) *Business Model* was split into four child nodes (*Input, Key Business Activities, Output, Outcome*), and, concerning *Natural Capital,* eight child nodes were created (*Air, Water, Land, etc.*). This coding scheme was shared, discussed, and revised by the authors both in the pre-coding phase and after the testing phase, in which we coded two reports. Additionally, a set of new nodes were created through an open coding process (Elo and Kyngäs, 2008, pp. 109–111) to capture categories of information not explicitly considered in the IR Framework (i.e., more detailed sector- and firm-specific information). Thus, the coding process enriched the coding scheme (taxonomy) with the creation of new nodes like an iterative process. Table I summarizes the final coding scheme’s structure.

Insert Table I here

5.1.2. Coding process, reliability, and validity of data

The reports were coded by a junior researcher with the aid of a second researcher and the supervision of a third senior researcher, a method that has been established as reliable (Guthrie *et* *al*., 2004; Krippendorff, 2013). Furthermore, the researchers preliminarily established a set of formal coding rules to achieve a reproducible analysis. Accordingly, they developed a coding rules chart, as a coding instrument, by defining the following issues:

1. the coding unit (paragraph of text);[13]
2. the description of the category of information represented by each node;
3. the rules to select the node for coding the text;
4. the steps to follow during the coding process to avoid errors and biases.

Concerning the third point, we established the use of only non-aggregate nodes (nodes without child nodes) for coding. Then, we identified the nodes to consider those that are mutually exclusive. In general, the nodes used for coding (non-aggregated nodes) belonging to the same dimension are mutually exclusive. However, we defined some exceptions to this rule to take into account and detect the linkages and connections between two or more *CE* (e.g., the linkage between *Strategy* and *Risk and Opportunities*). Indeed, according to the IR Framework, some nodes and types of information may belong to more than one *CE*. For example, the information related to "how to manage and mitigate risk and opportunities" occurs in two *CE* (*Strategy* and *Risk and Opportunities*).

Finally, each paragraph (coding unit) of the reports was coded at a specific node for each dimension. Considering the aim of this study, we excluded from the coding the following parts of the reports: the CEO's and President's letters; the presentation of the report; the assurance statement; and the financial statements (if disclosed in the reports).

5.1.3. Sample

The sample of integrated reports we investigate is issued by companies involved in the IIRC Pilot Programme at 31 July 2014. Therefore, our focus is on a group of companies approaching IR for the first time. First, to select the sample, we excluded all the non-listed companies. Then, we identified the six Supersectors using the "*Industry Classification Benchmark*" in which IR is more institutionalized and diffused – that is, the Supersectors with the highest number of firms that joined the IIRC Pilot Programme (*Utilities, Basic Resources, Banks, Industrial Goods & Services, Chemicals, and Food & Beverage*). For each company of the Supersectors above, we checked the availability of integrated reports (2013) on their institutional websites. Then, we selected only the reports of companies that declared they were preparing them according to the IR Framework and IIRC guidelines. Finally, we selected ten companies/reports (Table II) through a stratified random sampling from a population of 19 companies that belong to the six Supersectors above.

Insert Table II here

5.2. Levels of disaggregation of the taxonomy

After coding the reports, we obtained a structured list of *items* and the related hierarchical relationships for an XBRL taxonomy. To address the second objective of the study, we employ a quantitative technique to analyse data and define a proper level of disaggregation for each *item*. Each *item* represents a business concept to disclose and a text unit to tag in XBRL format. Since each *item* can be linked to a broad business topic, or a single business fact, it is necessary to identify an effective level of disaggregation. To do so, we define a metric based on the number of words for each *item* detected in each report (company). Our metric, "Relevance Index" (RI), is defined as follows:

$$\boldsymbol{RI = \frac{W_i}{W_c} * \frac{1}{Max\,(\frac{W_i}{W_c})}}$$

where:

$\boldsymbol{W_i}$: is the number of words given to a single *item* (node) "*i*";

$\boldsymbol{W_c}$: is the number of words given to a single *CE* (or *Capital* for the second dimension of the framework); and

$\boldsymbol{Max}\,(\frac{W_i}{W_c})$: is the maximum value of the percentage ratio $(\frac{W_i}{W_c})$ of the *items* ("*i*") on the same hierarchical level and belonging to the same *parent item.*

The RI represents the relevance of a single *item* (or business concept) within the broader disclosure referred to in its topic (*CE* or *Capital*). Relevance in this respect does not refer to relevance of information from a users' perspective. Instead, although the amount of information is considered in previous studies as a proxy measure of disclosure quality (e.g., Botosan 1997; Barth *et al*., 2003; Penman 2003; Beattie *et al*., 2004), the RI aims to measure the relevance that information providers confer on each business concept (*item*) within the reports. The value of the RI ranges from 0% (business concept not disclosed within the topic) to 100% (maximum relevance of the business concept in the topic). Table III shows an example of the metrics calculation employed for the items of the *Business Model* topic from the Itau Unibanco IR (2013).

Insert Table III here

According to the RI value obtained, we assign a score to each *item* according to the scale in Table IV. This scale is employed to identify four types of *item* to consider for the XBRL taxonomy, as discussed in detail in the next section.

Insert Table IV here

6. "Demonstration and evaluation" of the taxonomy structure for IR

This section deals with the fourth and fifth steps of our DS research. We demonstrate the effectiveness of our artefact and evaluate its usefulness in practice. Considering the first objective of our study, through the coding of the reports' content, we get a comprehensive list of *items* for an XBRL taxonomy for IR. This list of *items* is divided into two topic dimensions (*CE* and *Capitals*).

However, a list of *items* is not enough to design an XBRL taxonomy. This latter needs the definition of an effective level of disaggregation to achieve a hierarchical structure, that is, which *item* of the list needs a more detailed disaggregation in *child items* and which of them should be included without disaggregation. Such a disaggregation allows preparers and users of reports to derive significant benefits from this taxonomy structure: preparers can focus on the core business concepts without breaking down the information into useless detail (gaining efficiency in the reporting process); and users can have a complete and concise picture of information without any irrelevant levels of disaggregation (gaining effectiveness in accessing the information).

On the basis of the "General Nesting Scores" (GNS), as the average value of the single reports' nesting scores, we identify four types of *items* in our taxonomy. Tables V and VI show, respectively, the core *items* for the two dimensions of our taxonomy structure, along with the frequency distribution on the types of information (the third dimension of our IR-3D framework) for each core *item* in terms of percentage of coded units.[14] To identify these core *items*, we begin with the higher hierarchical levels by selecting *items* with a GNS of "4" and "3", along with their *child items*, and "2" without any disaggregation. Hence, *items* with a GNS of "1" are excluded because they can be aggregated, unless they belong to a *parent item* scored as "4" or "3". Therefore, these *core items* "must" compose an XBRL taxonomy for IR, since they need to be considered without any option of aggregation.[15]

Insert Table V here

Insert Table VI here

Items with a GNS of "4" are the most relevant *items* detected in each topic (*CE* or *Capitals*). Considering the amount of information ('RI') in these *items*, they need to be broken down into more detailed *child items* to allow the reader to navigate within the related disclosure and to easily identify more detailed and fragmented information. For example, the "*Governance Structure*" *item*, in the "*Governance*" content element, has a high relevance in term of amount of information (measured through "RI"), and needs to be broken down into *child items.* Its *child items* such as "Board", "Changes in the governance structure in the year" and "Regulatory requirements for governance structure" convey more detailed information for their *parent item*. Additionally, the "Board" *child item* is broken down (being scored as "4") into further several *child items* (e.g., "Board (directors) functions and responsibilities", "Board characteristics", "Board structure and composition").

The second type of *items* are those scored as "3", which can be disaggregated in a discretionary manner. For example, the "Forecasts and projections" *item* (in "Outlook") can be disaggregated in "Assumption and estimating methods", "External issues projections", and "Implication for the business model and performance”. The latter, in turn, can be broken down further into *child items* (e.g., “External outcome”, “Input”, and “Internal outcome”).

It is worth noting that some *items* scored as “4” or “3” do not present any further levels of disaggregation. An example is the “*Governance structure*” and “*Governance system” items*, in the “*Intellectual Capital*” topic. In these cases, it is possible to obtain a deeper level of detail by matching these *items* with those related that belong to the “*Governance*” topic within the *CE* dimension. This is one of the main advantages of the definition of a bi-dimensional taxonomy structure. Regarding the benefits of multidimensionality for the XBRL taxonomies, Piechocki *et al*. (2009, p. 224) assert that “the dimensional specification supports reporting of information across various dimensions” and “this allows for the reporting of data in a hypercube modelled in a taxonomy”. Similarly, “*Input*” in the “*Business model*” topic can be articulated into further *child items* based on the classification of *Capitals*, as representing the resources of an organization.

Finally, the *items* scored as “2” and “1” represent the less relevant *items* with an “RI” value less than 50%. Whereas the “2”-scored *items* must be included in the taxonomy structure, albeit without any further disaggregation, the “1”-scored *items* could be aggregated due to their low relevance. However, it should be noted that such low relevance is intended in relative terms, and is referred to among the other *items* within the same topic or *parent item.* This does not mean that the information regarding these business concepts lacks relevance for users. The choice to aggregate these *items* is due to a mere operative reason. Preparers should consider whether to aggregate these *items* or not*,* by balancing between the benefit and cost of providing them through more detailed levels of disaggregation. An example is the *items* scored as “1” in the “*External environment*” content element, which includes “*Environmental issue”*, “*Political context*”, *“Societal issues*”, and “*Technological issues”*. These *items* could all be merged into a more generic and residual item (e.g., “*Other issues”*) or in a further *item* called “Political, environmental, societal and technological context”. In this way, the information is not lost in the taxonomy, but is aggregated along with other pieces.

The pieces of information in the taxonomy structure are mainly qualitative information. Based on the frequency distribution on the types of information in Tables 5 and 6, we find that *CE* and *Capitals* are mostly non-financial and non-quantitative information. This is not surprising because of the nature and content of IR, and reveals some interesting insights for using XBRL for IR. Although the initiatives towards a standardization and quantification of non-financial information, such a poor use of quantitative data in practice reveals that organizations are more prone to approach such a voluntary reporting practice by using qualitative, instead of quantitative, information. This poses both challenges and opportunities for the development of an XBRL taxonomy for IR, because, while it would imply the need for further efforts to codify comparable and quantitative data for an XBRL taxonomy, at the same time, using XBRL can support such a harmonization. For example, based on our findings (Tables V and VI), the need of using quantitative information seems particularly significant in practice for the *items* belonging to the “*Business model*”, “*Performance*” and the “*Natural Capital*”. Therefore, some useful efforts might be directed to codify quantitative data for these classes of information.

6.1. Evaluation of "flexing" and consistency among sectors

One of the main features used to evaluate the quality and effectiveness of an XBRL taxonomy is the ability to "flex" to meet the particular reporting needs of information providers (Debreceny *et al.*, 2011). This is the main rationale for developing our taxonomy structure on the basis of the evidence from practice.

As shown above, our taxonomy structure is characterized by four types of *items* according to the GNS values (1, 2, 3, and 4), which represent the levels of disaggregation of the taxonomy. Here, we evaluate the ability of our taxonomy to fit and reflect the reporting practices in each sector, by testing whether its levels of disaggregation are consistent among sectors. To test the differences among sectors, we perform an analysis of variance (ANOVA) test by using the measure below:

$$C_j = \frac{\sum_{i=1}^{n} NS_{ij}}{n}$$

where:

$\boldsymbol{j}$ represents the single firm of the sample;

$\boldsymbol{i}$ represents the single *item* of the taxonomy structure;

$\boldsymbol{NS}$ is the Nesting Score;

$\boldsymbol{n}$ is the total number of *items* listed in the taxonomy structure for each dimension (*CE* – 174 items, and *Capitals* – 63 items);

$\boldsymbol{C_j}$ is the average value of the *items*' "Nesting Score" for each dimension (*CE* or *Capitals*). A higher value of C_j indicates a higher number of *items* with the upper scores retrieved in that report "*j*". Hence, a major degree of disaggregation should be reflected in the XBRL taxonomy structure for such report "*j*".

We apply this measure to obtain four variables for each type of *item* (1, 2, 3, and 4) representing the level of disaggregation of our taxonomy structure. Finally, to perform the ANOVA, we use a dataset formed by the variables described in Table VII.

Insert Table VII here

Using the "SEC" variable as an independent variable and the others as dependent variables, the ANOVA test suggests significant results for two variables: the average value of the *items* "NS" of the *CE* dimension ("CE" variable); and the average value of the *items* with a "GNS" equal to "3" for the *CE* dimension ("CE3" variable). Therefore, these findings indicate significant differences occurring for only these two variables.

The ANOVA test's results for the variable "CE" are depicted in Table VIII. Considering the hypothesis underpinning the ANOVA, since the *p*-value (0.0013) is less than 0.05, we can reject the null hypothesis that there are no differences between the groups (sectors). Considering the other parameters, we also obtain a satisfying adjusted *R*-squared (92%) for the model. Moreover, Bartlett's test shows that one of the assumptions of ANOVA (equal variance across groups) is not violated. Accordingly, we can assert that the different levels of disaggregation are affected by sectors for only the taxonomy *items* of the *CE* dimension. Instead, we do not find significant differences between groups for the *Capitals* dimension ("CAP" variables). Therefore, while the taxonomy disaggregation for the *Capitals* dimension is able to capture the reporting practices in all sectors, our results signal sector-specific disaggregation needs for the *CE* dimension.

Insert Table VIII here

Accordingly, there is room for taxonomy extensions to meet these disaggregation needs. These extensions reflect the *items* scored as "3" ("GNS"), which can be disaggregated using discretion into more detailed *child items* (see Table IV). Indeed, Table IX shows the ANOVA test's results for the "CE3" variable. For this variable, we obtain significant statistical results (a *p*-value equal to 0.0088) that show the presence of differences among sectors. This indicates that the effective level of disaggregation for these *items* and their discretional disaggregation depend on sector-specific needs. For example, firms belonging to the "*Basic Resources*" and "*Chemicals*" sectors (see mean values in Table IX) would be more prone to disaggregate these *items*. In summary, while the *Capitals* dimension of our taxonomy structure reflects reporting practices in each sector, the application of the *CE* dimension needs some extensions, represented by the *items* with GNS "3", to achieve effective levels of disaggregation. In other words, compared to the *Capitals* dimension, the *CE* dimension is affected by sector-level variations which reflect sector-specific needs.

Insert Table IX here

7. Conclusion

In this study we argue for the potential of XBRL to go beyond corporate reporting, by facilitating the shift from a static and periodic reporting to more relevant and dynamic corporate disclosure for stakeholders. Indeed, XBRL facilitates automated consumption of reports and allows information to be managed more effectively and efficiently (Bonsón *et al*., 2009; Debreceny *et al*., 2011). Hence, the technology provides the advantage of producing more relevant and customized information that is more accurately matched to users' demands.

In the context of IR, using XBRL is able to overcome some of the criticisms levelled at IR. One is that IR is mainly for investors and, therefore, is unable to provide relevant information to all stakeholders. XBRL allows all stakeholders to navigate and retrieve customized disclosure of information according to their interest by exploiting the multidimensional contents of IR. This emphasizes and makes visible information such as intellectual and other *Capitals*. Indeed, an XBRL taxonomy allows stakeholders to navigate, locate, and extract IC disclosure effectively. Additionally, the nesting of an XBRL taxonomy for IR has further advantages for applying the Guiding Principles of IR such as the balance between "Conciseness" and "Completeness", since it allows better navigation quality for users. Therefore, using XBRL presents an opportunity to improve the stakeholder relevance of disclosure by satisfying specific stakeholders' information needs.

In this paper, DS research is used to develop a taxonomy structure and knowledge representation for designing an XBRL taxonomy for IR. This evidence-based taxonomy structure is formed by two dimensions: the *CE* dimension, which represents the topics and the main categories of the information of integrated reports, and the *Capitals* dimension, which represents the information related to the Six Capitals of the IR Framework. Each dimension consists of a hierarchical structure of *items* (business concepts), which represents a knowledge base and information model for an XBRL taxonomy for IR. Thus, the multidimensional structure allows users to navigate disclosure from two different perspectives (*Content Elements* and *Capitals*), display specific themes of interest, and drill down to more detailed information. As Debreceney *et al*. (2009, p. 129) point out, the XBRL taxonomy multidimensionality allows us to "break down the information into subsets of interest to the end-user" by "querying and displaying information according to defined breakdowns". Therefore, the taxonomy structure is an information model to code, tag, and observe a single piece of information from two perspectives – the *Content Elements* and *Capitals* dimensions (the latter serving as cross-sections of IR), so that users can navigate disclosure according to specific themes of interest and drill down to more detailed information.

The main benefit of our taxonomy structure derives from its evidence-based nature. This allows the XBRL taxonomy to reflect and adhere to actual reporting practices. Additionally, the levels of disaggregation of our taxonomy, represented by the four types of *items*, provide an effective and flexible application of the XBRL taxonomy to preparers. In turn, users can perform effective data manipulation and disclosure retrieval by choosing a level of detail according to their preferences. Specifically, we find that, while the *Capitals* dimension of our taxonomy is able to reflect reporting practices in each sector, revealing consistency among sectors, the *CE* dimension, instead, is affected by sector-level variations. This demonstrates the importance of coding sector-specific information for the *CE*, and the need to direct efforts towards the development of sector-specific taxonomy extensions in developing an XBRL taxonomy for IR.

Additionally, albeit the efforts and initiatives towards a standardization and quantification of non-financial information, the poor use of quantitative information in approaching IR in practice poses both challenges and opportunities in developing an XBRL taxonomy for IR. While it demonstrates the need for further efforts to codify comparable and quantitative information, using XBRL, in turn, can support a sort of harmonization. In this regard, an XBRL Taxonomy for IR can fruitfully take advantage of its integration with other existing taxonomies (e.g., the WICI and GRI taxonomies), which already include an agreed-upon set of KPIs codified in XBRL. Additionally, it should be conceived as complementary to the XBRL taxonomies for financial reporting, because IR does not intend to replace financial reports, which are in practice mandatory and independent, and having their own structure and contents. Therefore, the development of an XRBL taxonomy for IR cannot avoid relationships to other existing taxonomies.

To conclude, using XBRL in corporate disclosure, like IR, has potential benefits in disclosing IC information. It facilitates the resurging interest in IC information as a result of IR and reinforces calls for IC research to make IC externally visible by focusing on IC disclosure characterizing "the fourth stage” of IC research. As Dumay (2016, p. 168) concludes, in this stage there is a need “to abandon reporting, and concentrate on how an organisation discloses ‘what was previously secret or unknown’, so that all stakeholders understand how an organisation takes into consideration its ethical, social and environmental impacts”.

This research has several practical implications. The motivations leading this pragmatic research derive from problems observed in practice. We demonstrate the importance of XBRL for improving corporate reporting in practice and its potential to provide more relevant disclosure for all stakeholders. This reflects on the opportunity to apply such a technology to go beyond the boundaries of reporting and take advantage of the potential of IR. By this, the “artefact” of this DS research (the taxonomy structure for XBRL) is useful for institutions or entities interested in designing an XBRL taxonomy for IR. Therefore, this study is a call for academics and practitioners to explore the potential of technology for improving corporate disclosure. At the same time, we demonstrate how using new technologies opens up new fields of IC research by shifting the attention on IC disclosure, so that we move towards “the fourth stage” of IC (Dumay, 2016, p. 168).

The limitations of DS research belong to two categories: the artefact design and its effects in practice. The first limitation stems from the social actors’ perspectives, which are taken into account to develop the taxonomy structure. The artefact’s shaping uses a voluntary standard-setter’s perspective (the IIRC) and the firms’ perspective derived from the analysis of reporting practices. Even though this approach is employed to facilitate XBRL taxonomy adoption in practice, it tends to discourage a pluralistic approach and dialogic engagement (see Blackburn *et al*., 2014). As Blackburn *et al*. (2014, p. 85) highlight, compared to Participatory Design, which emphasizes the social-political dimension of a design process, DS focuses on the design of the artefact and its technical aspects. Furthermore, Ramin and Reiman (2013, p. 381) observe, “XBRL taxonomies are dictionaries which the XBRL languages uses” and their development and adoption involve several actors like “different organisations, including regulators, specific industries or even companies”. Therefore, to develop an XBRL taxonomy, the enacting of a participatory process embedding different social actors’ perspectives is important.

The second limitation relates to the XBRL taxonomy development process. This study focuses on the “design” phase of codification and structuring of the knowledge base (“information model and taxonomy architecture”), as an output for “building” and “testing” the XBRL taxonomy, which requires complex tasks and technical skills in converting the “information model” into XBRL language and files (Debreceny *et al*., 2009, pp. 119–125). Therefore, to allow a shift from a normative level of the potential of XBRL in the IR context to empirical demonstrations of its actual benefits, our artefact and the knowledge provided need to be converted into a taxonomy in XBRL and then applied in practice. This study is a first attempt toward the development of an XBRL taxonomy for IR, which is an iterative and complex process. Thus, future research can contribute to such a process by developing and testing our taxonomy structure, and through engaging in dialogic and participatory processes.

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[1] Atlantia – Integrated Report 2013 (http://www.atlantia.it/en/sustainability/integrated-report.html)
[2] The other Guiding Principles are: Strategic focus and future orientation; Stakeholder relationships; Reliability and completeness; Consistency and comparability.
[3] http://xbrl.org/GettingStarted
[4] See http://www.wici-global.com/framework. To visualize the WICI XBRL taxonomy, visit: https://bigfoot.corefiling.com/yeti/resources/yeti-gwt/Yeti.jsp
[5] See https://www.globalreporting.org/services/Analysis/Pages/default.aspx
[6] See https://www.globalreporting.org/information/news-and-press-center/Pages/GRI-launches-Digital-Reporting-Alliance.aspx
[7] See http://www.sasb.org/
[8] Source: https://www.xbrl.org/entity-specific-disclosures-task-force-gains-momentum/
[9] See https://www.sec.gov/spotlight/xbrl/voluntary-disclosure.shtml
[10] http://www.qsrinternational.com/
[11] Beattie *et al*. (2004, p. 205) propose a "comprehensive four-dimensional framework for the holistic content analysis of narrative, based on the coding of topic and three type of attributes". Although the topic dimension is based on the "Jenkins Report" published by the American Institute of Certified Public Accountants, the three attribute dimensions aim to capture "the time orientation, financial/non-financial and quantitative/qualitative attributes of each text unit".
[12] The reason for adding this third dimension is to identify the characteristics of data for each class of information (i.e., textual or numerical data, financial or non-financial data).
[13] Even if the paragraph is selected for the coding unit, the splitting of paragraphs is allowed if their contents are related to more than one topic or attribute. Indeed, as asserted by Beattie *et al*. (2004), splitting the coding unit as necessary into multiple units means "each text unit represents a single piece of information that was meaningful in its own right, given the context in which it was presented".
[14] The *items* deriving from the open coding are highlighted with a grey background in Tables V and VI. For the frequency distribution on the types of information shown in the tables, we used the number of coded units instead of the number of words to reduce the effect of the length of textual data compared to the quantitative information.
[15] For conciseness the extended and complete version of the taxonomy structure, along with all the NS and GNS, is not presented here but is available on request.

Figure I. IR-3D conceptual framework (coding scheme) representation

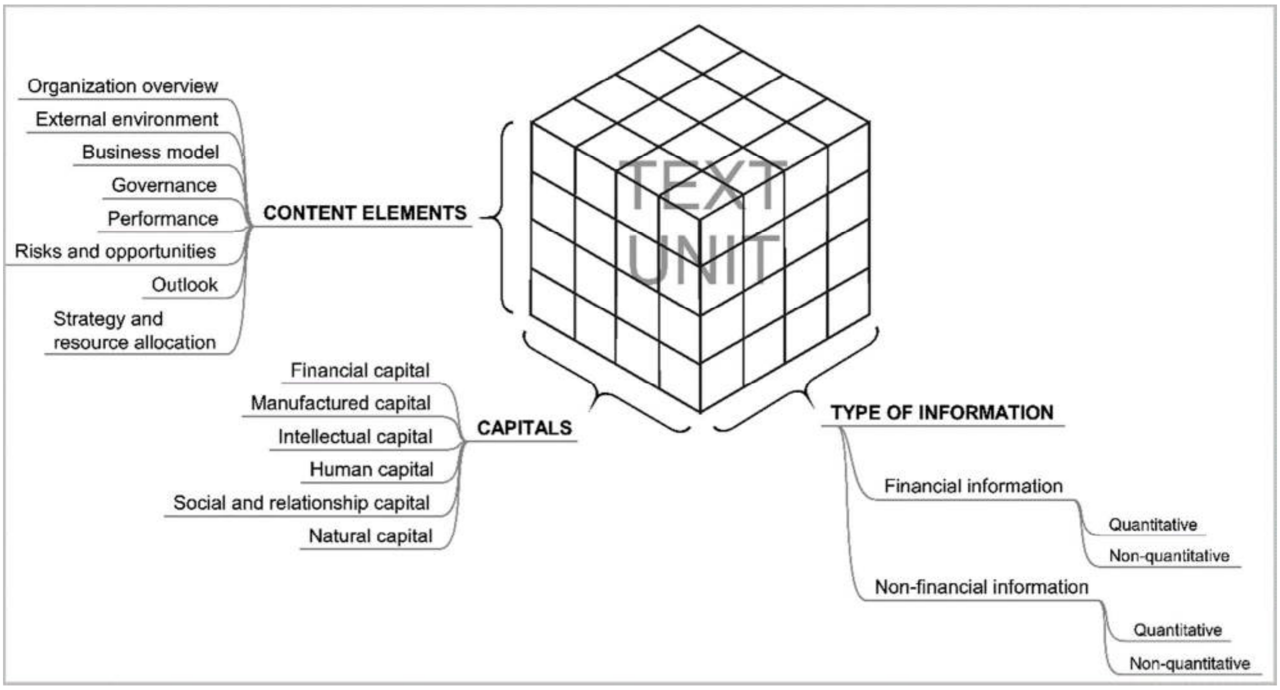

Table I. Summary of nodes' composition

Dimensions	*N. of hierarchical levels*	*N. of nodes*	*N. of aggregate nodes ([a])*	*N. of new nodes added during the coding process*
CONTENT ELEMENTS	7	181	46	91
CAPITALS	5	70	14	30
TYPE OF INFORMATION	3	7	3	0

([a]) *The aggregate nodes are usually used to work with a hierarchy of nodes. Those allow for "gathering all the material in child nodes and rolling it up to the parent node" (http://help-nv10.qsrinternational.com/desktop/procedures/aggregate_nodes.htm)*

Table II. Sample of companies

Company	**Country**	**Industry (ICB)**	**Supersector (ICB)**
Itau Unibanco	*Brazil*	*Financial*	*Banks*
National Australia Bank Limited	*Australia*	*Financial*	*Banks*
AngloGold Ashanti Limited	*South Africa*	*Basic Materials*	*Basic Resources*
Gold Fields	*South Africa*	*Basic Materials*	*Basic Resources*
AkzoNobel N.V.	*Netherlands*	*Basic Materials*	*Chemicals*
SASOL	*South Africa*	*Basic Materials*	*Chemicals*
CCR S.A	*Brazil*	*Industrial*	*Industrial Goods & Services*
Interserve Plc	*United Kingdom*	*Industrial*	*Industrial Goods & Services*
CPFL Energia	*Brazil*	*Utilities*	*Utilities*
Terna	*Italy*	*Utilities*	*Utilities*

Table III. Explanation of metrics calculation

Itau Unibanco (Integrated Report 2013)	**Number of words (W)**	**Wi / Wc**	**RI**	**Nesting Score**
CONTENT ELEMENTS	**7920**			
BUSINESS MODEL (Wc)	**695**	**100%**		
Input	75	11%	19%	1
Key Business activities	38	5%	9%	1
Innovation	*11*	*2%*	*69%*	*3*
Knowledge and specialised skill deployment	*0*	*0%*	*0%*	*1*
Management activities	*2*	*0%*	*13%*	*1*
Other material activities for long-term success	*16*	*2%*	*100%*	*4*
Planning of products	*9*	*1%*	*56%*	*3*
Product manufacturing	*0*	*0%*	*0%*	*1*
Products design	*0*	*0%*	*0%*	*1*
Revenue generation	*0*	*0%*	*0%*	*1*
Outcome	177	25%	44%	2
External outcome	*154*	*22%*	*100%*	*4*
Internal outcome	*23*	*3%*	*15%*	*1*
Output	405	58%	100%	4
By-products (waste, emissions, etc…)	*0*	*0%*	*0%*	*1*
Products	*0*	*0%*	*0%*	*1*
Services	*405*	*58%*	*100%*	*4*

Table IV. Nesting Score explanation

"RI" value range	Nesting Score	Description of the implication for the taxonomy structure
75% < RI ≤ 100%	**4**	*Item that **must** be disaggregated in more detailed child items*
50% < RI ≤ 75%	**3**	*Item that **can** be disaggregated in more detailed child items*
25% < RI ≤ 50%	**2**	*Item **without** any disaggregation in child items*
0% ≤ RI ≤ 25%	**1**	*Item that **can** be **aggregated***

Table V. Core items of the taxonomy structure (CE dimension)

Code	Items	General Nesting Score	Frequency distribution "Type of information"			
			Non-financial		Financial	
			Quant.	Non-Quant.	Quant.	Non-Quant.
	CONTENT ELEMENTS					
BM	**BUSINESS MODEL**		*13%*	*60%*	*17%*	*9%*
BM.1	Input	3	13%	60%	18%	9%
BM.2	Key business activities	3	2%	82%	11%	6%
BM.2.1	*Innovation*	2	1%	94%	3%	2%
BM.2.2	*Management activities*	2	1%	97%	1%	2%
BM.2.3	*Product manufacturing*	3	2%	94%	2%	2%
BM.3	Outcome	2	14%	54%	20%	11%
BM.4	Output	2	23%	76%	1%	0%
EE	**EXTERNAL ENVIRONMENT**		*5%*	*91%*	*3%*	*1%*
EE.1	Economic and commercial context	2	0%	93%	7%	0%
EE.2	Key stakeholder needs and interests	2	0%	100%	0%	0%
EE.3	Legal and regulatory context	2	0%	100%	0%	0%
EE.4	Market and competition	3	13%	80%	4%	4%
GO	**GOVERNANCE**		*1%*	*97%*	*2%*	*0%*
GO.1	Governance structure	4	0%	100%	0%	0%
GO.1.1	*Board*	4	0%	100%	0%	0%
GO.1.1.1	*Board (directors) functions and responsibilities*	2	0%	100%	0%	0%
GO.1.1.2	*Board structure and composition*	2	0%	100%	0%	0%
GO.1.1.3	*Board's committees*	3	0%	100%	0%	0%
GO.1.1.4	*Profile of each director*	3	0%	100%	0%	0%
GO.1.1.4.1	*Experience & competence*	4	0%	100%	0%	0%
GO.2	Internal auditing and monitoring mechanisms	2	2%	98%	0%	0%
GO.3	Remuneration & incentives	3	3%	88%	8%	1%
GO.3.1	*Remuneration in the year*	2	6%	77%	17%	0%
GO.3.2	*Remuneration system*	4	2%	96%	2%	0%
GO.3.2.1	*Remuneration policies and approach*	4	2%	96%	2%	0%
GO.3.2.1.1	*Components (variables) of remuneration*	3	2%	93%	5%	0%
GO.3.2.1.2	*Remuneration policies for directors and managers*	3	2%	98%	0%	0%
GO.4	Standards and principles	3	0%	100%	0%	0%
GO.4.1	*Code of conduct (or Ethics)*	2	0%	100%	0%	0%
GO.4.2	*External standards*	3	0%	100%	0%	0%
GO.4.2.1	*External regulatory requirements*	3	0%	100%	0%	0%
GO.4.2.2	*Voluntary standards and practices exceeding legal requirements*	2	0%	100%	0%	0%
GO.4.3	*Internal standards and principles*	3	0%	100%	0%	0%
OO	**ORGANISATIONAL OVERVIEW**		*16%*	*66%*	*17%*	*0%*
OO.1	Key quantitative information	2	25%	50%	25%	0%
OO.2	Market position	2	0%	96%	4%	0%
OO.3	Markets	2	10%	52%	38%	0%
OO.4	Operating structure	2	6%	93%	2%	0%
OO.5	Organisation's culture, ethics and values	2	3%	97%	0%	0%
OO.6	Principal activities	3	2%	97%	2%	0%
OU	**OUTLOOK**		*8%*	*78%*	*9%*	*5%*
OU.1	Challenges and uncertainties	2	0%	95%	0%	5%
OU.2	Forecasts & projections	3	13%	68%	15%	5%
OU.2.1	*Implication for the business model and performance*	3	15%	64%	17%	5%
OU.2.1.1	*Input*	3	1%	66%	27%	5%
PE	**PERFORMANCE**		*13%*	*56%*	*19%*	*11%*
PE.1	Stakeholders' relationships	2	2%	90%	6%	2%
PE.2	Strategic objective achieved for the period	4	15%	52%	21%	12%

PE.2.1	*Objective achieved description*	4	*8%*	*54%*	*19%*	*19%*
PE.2.1.1	*External outcome*	3	*33%*	*51%*	*16%*	*0%*
PE.2.1.2	*Input*	3	*19%*	*51%*	*31%*	*0%*
PE.2.1.3	*Internal outcome*	3	*19%*	*51%*	*30%*	*0%*
PE.2.1.4	*Key business activities*	3	*7%*	*50%*	*43%*	*0%*
PE.2.1.5	*Output*	2	*49%*	*51%*	*0%*	*0%*
RO	**RISK AND OPPORTUNITIES**		***0%***	***94%***	***1%***	***4%***
RO.1	Risk management system	2	*0%*	*99%*	*0%*	*1%*
RO.2	Specific risks and opportunities	4	*0%*	*93%*	*2%*	*4%*
RO.2.1	*Key opportunities*	2	*2%*	*91%*	*4%*	*2%*
RO.2.2	*Key risks*	4	*0%*	*93%*	*2%*	*5%*
RO.2.2.1	*External risks*	3	*1%*	*92%*	*2%*	*5%*
RO.2.2.2	*Internal risks*	2	*0%*	*95%*	*2%*	*3%*
RO.2.2.3	*Manage and mitigate key risks*	3	*1%*	*92%*	*1%*	*6%*
RO.2.2.3.1	*External outcome*	2	*0%*	*86%*	*0%*	*14%*
RO.2.2.3.2	*Input*	2	*0%*	*88%*	*0%*	*12%*
RO.2.2.3.3	*Key business activities*	3	*0%*	*96%*	*1%*	*3%*
ST	**STRATEGY AND RESOURCE ALLOCATION**		***13%***	***71%***	***9%***	***7%***
ST.1	Strategic objectives	2	*23%*	*58%*	*14%*	*5%*
ST.2	Strategy to achieve objectives	4	*6%*	*81%*	*5%*	*8%*
ST.2.1	*Changes in business model*	3	*8%*	*76%*	*6%*	*10%*
ST.2.1.1	*External outcome*	2	*17%*	*80%*	*2%*	*2%*
ST.2.1.2	*Input*	3	*5%*	*80%*	*7%*	*8%*
ST.2.1.3	*Key business activities*	3	*0%*	*95%*	*1%*	*4%*
ST.2.2	*How to mitigate or manage risk and opportunities*	3	*2%*	*89%*	*3%*	*6%*

Table VI. Core items of the taxonomy structure (Capitals dimension)

Code	Items	General Nesting Score	Frequency distribution "Type of information"			
			Non-financial		Financial	
			Quant.	Non-Quant.	Quant.	Non-Quant.
	CAPITALS					
FC	**FINANCIAL CAPITAL**		*1%*	*47%*	*33%*	*19%*
FC.1	Costs and financial resources	3	*1%*	*49%*	*32%*	*18%*
FC.2	Debt	2	*0%*	*28%*	*40%*	*32%*
FC.3	Equity	2	*3%*	*51%*	*33%*	*14%*
FC.4	Revenue, earning and cash	3	*1%*	*49%*	*32%*	*18%*
HC	**HUMAN CAPITAL**		*15%*	*84%*	*1%*	*0%*
HC.1	People & ethical values	2	*18%*	*82%*	*0%*	*0%*
HC.2	People & governance framework	2	*0%*	*100%*	*0%*	*0%*
HC.3	People & strategy	4	*6%*	*93%*	*1%*	*0%*
HC.3.1	*People development*	3	*16%*	*80%*	*4%*	*0%*
HC.3.2	*People skills*	2	*13%*	*86%*	*2%*	*0%*
HC.3.3	*People's competencies, capabilities & experience*	3	*0%*	*100%*	*0%*	*0%*
HC.3.3.1	*Governance*	3	*0%*	*100%*	*0%*	*0%*
HC.4	People health & safety	2	*26%*	*74%*	*0%*	*0%*
IC	**INTELLECTUAL CAPITAL**		*1%*	*96%*	*2%*	*1%*
IC.1	Organisational (structural) capital	4	*1%*	*96%*	*2%*	*0%*
IC.1.1	*Governance structure*	4	*0%*	*100%*	*0%*	*0%*
IC.1.2	*Procedures and protocols*	4	*2%*	*96%*	*2%*	*1%*
IC.1.2.1	*Governance system*	4	*2%*	*96%*	*3%*	*0%*
IC.1.2.2	*Process and operation*	2	*2%*	*94%*	*2%*	*2%*
MC	**MANUFACTURED CAPITAL**		*22%*	*71%*	*5%*	*2%*
MC.1	Buildings, plants and production	4	*24%*	*71%*	*4%*	*2%*
MC.2	Infrastructures	2	*13%*	*72%*	*13%*	*2%*
NC	**NATURAL CAPITAL**		*25%*	*71%*	*4%*	*0%*
NC.1	Air	3	*31%*	*68%*	*1%*	*0%*
NC.2	Energy resources	2	*26%*	*69%*	*5%*	*0%*
NC.3	General effect on environment	3	*9%*	*80%*	*10%*	*1%*
NC.4	Minerals and raw materials	2	*31%*	*68%*	*1%*	*0%*
NC.5	Water	2	*27%*	*71%*	*1%*	*1%*
SC	**SOCIAL & RELATIONSHIP CAPITAL**		*4%*	*85%*	*8%*	*3%*
SC.1	Social license	4	*4%*	*85%*	*8%*	*3%*
SC.1.1	*Stakeholders' relationships*	4	*4%*	*83%*	*9%*	*3%*
SC.1.1.1	*Community*	4	*3%*	*81%*	*13%*	*2%*
SC.1.1.2	*Customers*	2	*9%*	*87%*	*4%*	*0%*
SC.1.1.3	*Employee and labour representatives*	2	*5%*	*87%*	*7%*	*1%*
SC.1.1.4	*Government and regulatory bodies*	2	*1%*	*84%*	*8%*	*7%*
SC.1.1.5	*Suppliers*	2	*7%*	*89%*	*3%*	*1%*

Table VII. Description of variables used for the ANOVA test

Variables	Variable descriptions
SEC	Categorical variable representing the five sectors. It is used as independent variable (groups) for the ANOVA test.
CE	Average value of the items “Nesting Score” of the CE dimension.
CE1	Average value of the items with a “GNS” equal to “1” for the CE dimension.
CE2	Average value of the items with a “GNS” equal to “2” for the CE dimension.
CE3	Average value of the items with a “GNS” equal to “3” for the CE dimension.
CE4	Average value of the items with a “GNS” equal to “4” for the CE dimension.
CAP	Average value of the items “Nesting Score” of the Capitals dimension.
CAP1	Average value of the items with a “GNS” equal to “1” for the Capitals dimension.
CAP2	Average value of the items with a “GNS” equal to “2” for the Capitals dimension.
CAP3	Average value of the items with a “GNS” equal to “3” for the Capitals dimension.
CAP4	Average value of the items with a “GNS” equal to “4” for the Capitals dimension.

Table VIII. ANOVA test results for CE by sector

SEC	Summary of CE Mean	Std. Dev.	Freq.
Banks	1.75	0.04933305	2
Basic resources	2.1453488	0.01644435	2
Chemicals	2.125	0.07811059	2
Industrial G&S	1.8691860	0.02877753	2
Utilities	1.8837209	0.03288862	2
Total	1.9546512	0.16663961	10

Analysis of Variance

Source	SS	df	MS	F	Prob > F
Between groups	0.239203585	4	0.059800896	27.9	0.0013
Within groups	0.010715238	5	0.002143048		
Total	0.249918823	9	0.027768758		

Bartlett's test for equal variances: chi2(4) = 1.8079 Prob>chi2 = 0.771

Number of obs = 10   *R*-squared = 0.9571
Root MSE = .046293   Adj *R*-squared = 0.9228

Source	Partial SS	df	MS	F	Prob > F
Model	0.239203585	4	0.059800896	27.9	0.0013
sec	0.239203585	4	0.059800896	27.9	0.0013
Residual	0.010715238	5	0.002143048		
Total	0.249918823	9	0.027768758		

Table IX. ANOVA test results for CE3 by sector

SEC	Summary of CE3 Mean	Std. Dev.	Freq.
Banks	2.24	0.09065096	2
Basic resources	3.1923050	0.16317894	2
Chemicals	3.385	0	2
Industrial G&S	2.8333350	0.19943939	2
Utilities	2.6282049	0.30822075	2
Total	2.856411	0.4484046	10

Analysis of Variance

Source	SS	df	MS	F	Prob > F
Between groups	1.63997908	4	0.40999477	12.09	0.0088
Within groups	0.169621063	5	0.033924213		
Total	1.80960014	9	0.201066683		

Bartlett's test for equal variances: chi2(3) = 0.9626 Prob>chi2 = 0.810

Number of obs = 10 | *R*-squared = 0.9063
Root MSE = .184185 | Adj *R*-squared = 0.8313

Source	Partial SS	df	MS	F	Prob > F
Model	1.63997908	4	0.40999477	12.09	0.0088
sec	1.63997908	4	0.40999477	12.09	0.0088
Residual	0.169621063	5	0.033924213		
Total	1.80960014	9	0.201066683		