Do companies disclose relevant information about intangibles? Insights from business model reporting and risk reporting

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Foreword

The debate over the valuation and reporting of intangibles, and whether a compelling case exists for a change in the way they are accounted for, is by no means a new issue. Indeed, as the importance of service-based organisations, driven by information and intellectual property, has grown within the global economy, an increasing focus has been placed on the intangible drivers of value within companies and how these act as indicators of the future prospects and underlying value of a business.

This continuing debate on intangibles has occurred against a wider context: (a) concerns voiced over the continuing relevance of financial statements to meet their dual objectives of valuation and stewardship under the International Accounting Standard Board (IASB)'s Conceptual Framework for Financial Reporting; and (b) a contemporaneous exponential rise in sustainability reporting where 'value' is interpreted not just in financial terms and relative to the interests of shareholders and investors but also from the much broader and more varied perspectives of wider stakeholders impacted both financially and non-financially by companies' operations. This broader view is at the heart of the new EU Corporate Sustainability Reporting Directive (CSRD) and its foundational concept of double materiality.

Preceding the inclusion in July 2022 of Intangibles within the IASB's research pipeline projects, resulting from its Third Agenda Consultation, EFRAG decided to add a research project on better information on intangibles to its own research agenda in August 2018, which culminated in the issuance of the discussion paper 'Better information on intangibles – which is the best way to go?' in August 2021.

ICAS independently published a positioning paper and call for research on intangibles in September 2019. Although this was wider in scope, in considering intangibles not only in the context of financial reporting but also broader narrative reporting, the reporting of KPIs and more comprehensive corporate reporting (e.g., integrated reporting and management commentary), the timing of the ICAS call complemented the EFRAG direction of travel. Under the ICAS call for research, two projects were selected for funding and support in 2020.

This research project, led by Chiara Crovini and Christian Nielsen from Aalborg University, Francesco Giunta from the University of Florence and Lorenzo Simoni from the University of Genoa, was thus funded jointly by EFRAG and ICAS. It sets out to investigate the role of intellectual capital (IC) in the value creation process and provide a baseline in Intangibles reporting for a sample of IC intensive high-tech companies by:

- examining whether, and to what extent, high-tech companies provide information about IC elements in the sections devoted to the business model (BM) and risks; and
- assessing the correspondence and level of integration between the IC elements disclosed in the BM section and those reported in the risk section.

James Baird
Chair of the ICAS Research Panel

Chiara Del Prete
EFRAG FR TEG Chairwoman

Executive summary

Background and research objective

For several decades, intangibles and knowledge-based resources have been a fundamental driver of value in modern economies (Porat and Rubin, 1977; OECD, 1981). In such economies, the intellectual capital (IC) – which refers to intangible factors such as know-how, relationships, expertise, and skills – has significantly contributed to competitive advantage and corporate performance (Edvinsson and Malone, 1997; Ittner et al., 1997; Stewart, 1997; Bontis, 2001).

Despite the importance of intangible resources, attempts to communicate IC in the annual report have repeatedly failed (Nielsen et al., 2017). Potential reasons for this failure may include costs or potential loss of competitive advantage related to the disclosure of proprietary information about resources, know-how, and process. The lack of guidance also plays a fundamental role. From a user's perspective, IC information may not be helpful if an entity does not clearly explain how IC contributes to value creation (Bukh, 2003; Beattie et al., 2013; Behn et al., 2019).

However, recent regulations have offered a framework for communicating IC and integrating it into the value creation process. The EU Directive 2014/95 and the UK Companies Act have required companies to disclose information about their business model (BM) and their relevant risks in the annual report. Because IC represents a very significant source of competitive advantage – especially in high-tech industries – companies should illustrate the most critical intangible factors' contributions to value creation in the report section devoted to the BM. Furthermore, academic literature indicates that the BM is a framework for the disclosure of IC (Beattie and Smith, 2013). IC, in turn, is crucial in the mobilisation and exploitation of the other drivers of value that configure the BM, including tangible assets (Dane-Nielsen and Nielsen, 2018).

In the report section devoted to risks, companies should also offer information about the most important IC elements and their effects on value creation[1]. Thus, companies should deliver an integrated communication where BM and risk reporting address the main IC elements contributing to value creation. In this context, when an IC element is identified as a critical element of the BM and consequently recognised as a key factor that drives value, risks related to the IC element should be disclosed in a dedicated section within the annual report.

[1] In this report, 'risk' is defined as the likelihood that the outcome from a process will not meet expectations (O'Donnell, 2005). This outcome in the academic field can be either positive or negative (Emblemsvåg and Kjølstad, 2002). In business practice, however, risk is intended solely in a negative sense, having only negative impacts.

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Thus, IC becomes the natural link between BM and risk reporting. Such context would make it easier for recipients of IC information, such as investors, to interpret that information. The European Financial Reporting Advisory Group (EFRAG) has recently recognised the importance of this link with a project focusing on the link between non-financial risks and BM as a tool for improving corporate reporting (EFRAG, 2021b). Other professional bodies, such as the International Integrated Reporting Council (IIRC) and the World Intellectual Capital Initiative (WICI), have developed frameworks for integrated communication, where the BM acts as a framework for all other non-financial items disclosed in the annual report (Holland, 2004; IIRC, 2013; Nielsen and Roslender, 2015; WICI, 2016; European Commission, 2017; FRC, 2018).

Against this backdrop, the aim of this project is twofold:

- First, it examines whether and to what extent high-tech companies provide information about IC elements in the sections devoted to the BM and risks.
- Second, it assesses the correspondence and level of integration between the IC elements disclosed in the BM section and those reported in the risk section.

Although our choice may hamper generalisation to other industries, we have examined high-tech companies because their success largely depends on their use of IC, and we expected to find good examples of IC disclosure. We have selected the three sectors identified as 'high-tech' by Eurostat: pharmaceuticals; computers and electronics; and air and spacecraft. Because the EU Directive 2014/95 should have been implemented by the end of 2017 by all member countries, we have examined the 2018 annual reports to confirm whether all the nations under investigation implemented such regulations.

This study makes three distinctive contributions by analysing: (i) IC disclosure in annual reports of high-tech companies in a mandatory context, (ii) IC disclosure in two specific sections of the annual report (i.e. business model section and risk section) to investigate the role of IC in the value creation process and the related risks, and (iii) the integration and level of correspondence of the IC information disclosed in these two sections.

Key findings

We have found that approximately 29% of companies do not disclose BM value drivers or risks in the narrative sections of their annual reports. Thus, there is a considerable number of non-compliant companies. The examination of companies disclosing both BMs and risks suggests that:

- Companies tend to disclose IC elements in both the BM and risks sections, albeit with some industry differences. However, such disclosures are generally limited.
- To disclose IC, it is more common for companies to use the section devoted to the BM rather than the risk section. This approach may be related to the fact that the BM is a concept that explains how a company generates value, and IC is mainly seen as a fundamental value driver.
- Information about IC elements in the risk section rarely contains forward-looking statements that might help users assess how a company is protecting itself from future developments of principal risks. In a few cases, companies use a neutral or even positive tone when describing the potential impact of IC risks on their operations.
- Only 40% of the IC elements disclosed as value drivers in the BM section are addressed in the section devoted to risks. Thus, the level of integration of non-financial information recommended by regulators has often been achieved only in part or not at all.

Implications

This research provides insights into how listed companies currently report their IC and how this disclosure is integrated with mandatory BM reporting and risk reporting. These aspects may be of particular importance for all listed entities in the UK and European Economic Area (EEA) countries, which must disclose their BMs in annual reports under recent regulations. Thus, our study contributes to understanding whether companies can use mandatory BM reporting to disclose IC, as postulated by theoretical contributions in the field (Bukh, 2003; Beattie and Smith, 2013; Dane-Nielsen and Nielsen, 2018).

Furthermore, the study contributes to risk reporting literature. Like BM reporting, risk reporting has become mandatory for listed companies in the UK and EEA countries. The examination of how companies address IC elements in risk reporting could provide useful information about the negative consequences of the loss of control over these elements and the incapacity to use them.

Finally, we consider BM reporting and risk reporting to be strictly intertwined. According to our proposal, companies should:

- offer a description of the main IC elements they rely on to create and deliver value when disclosing the BM; and
- illustrate the risks associated with the main IC elements that drive their company's value in the section devoted to risks.

According to the definition of 'materiality' provided by WICI (2016, p. 2), organisations should report on information representing the most significant intangibles for their value creation over time. Thus, the IC elements depicted as value drivers in the BM section should also be discussed when reporting on risk, thereby providing users with information about the potential loss of those elements' capacity to generate value.

Our results suggest that the linkage between BM reporting and risk reporting is rarely satisfactory. Thus, regulators might usefully develop some guidelines to help companies effectively represent their IC within these two sections of the annual report, using the BM to provide context for other kinds of information. A crucial issue that may explain the low level of disclosure of key IC elements in the risk section is related to proprietary costs, because companies do not want to show investors the threats to IC elements. This issue could be attenuated by an effective linkage between risks and BM. In addition, the exploitation of IC elements is often associated with uncertainty that may lead to positive or negative outcomes. Although the isolated illustration of IC risks may represent a concern for some entities, a clear representation of how those items generate value if successfully exploited through BM reporting may attenuate those concerns and provide users with a more reliable view of IC. Thus, improving the integration between information on IC value drivers and the related risks may provide meaningful information on the outcomes of the value creation process.

1. Research background

1.1. Disclosure of intellectual capital in the annual report

Modern economies are based mainly on intangibles and knowledge-based resources (Porat and Rubin, 1977; OECD, 1981); that is, they are economies '(...) directly based on the production, distribution and use of knowledge and information' (OECD, 1996, p. 3). In such economies, knowledge-based assets represent the primary source of a company's competitive advantage and are a significant driver of corporate performance (Edvinsson and Malone, 1997; Ittner et al., 1997; Stewart, 1997; Bontis, 2001). The contribution of intangibles to GDP has grown at a higher rate than that of tangible resources in recent decades. Corrado et al. (2016) have shown that in the period ranging from 2000 to 2013, the contribution of intangibles to GDP has exceeded that of tangible assets in the US (where intangibles account for 8.8% of GDP) and in many other developed countries, including the UK (9%), France (8.7%), and the Netherlands (8.5%).

The term 'intellectual capital' (IC) distinguishes those resources from tangible assets. IC refers to all intangible resources based on knowledge, such as know-how, relationships, expertise, and skills (Stewart, 1997). Those elements play an essential role in the mobilisation and exploitation of other assets as well. The successful use of various resources often requires intervention by people with specialised skills and knowledge. Due to their intrinsic nature and characteristics, IC elements are difficult to identify and measure, making it challenging to represent IC in financial statements. The value relevance of financial statements has declined over time due to their inability to capture IC (Lev and Zarowin, 1999). For this reason, narrative communication has emerged as the primary vehicle for IC disclosures (Holland, 2004). Narrative reporting aims to convey a story about the main sources of value creation for a company (Holland, 2004; Lev and Gu, 2016), and academics and practitioners alike have proposed various IC frameworks based on narratives (Edvinsson and Malone, 1997; Sveiby, 1997; Bontis, 2003).

Disclosure of information about IC has the power to mitigate the information asymmetries between companies and investors that are caused by the under-representation of intangibles in financial statements, as discussed above. Several academic studies have shown that IC disclosure is relevant for investors' decision making (Abeysekera, 2011; Gamerschalg, 2013; Biscotti et al., 2019).

Companies usually disclose information on IC voluntarily; regulatory attempts in this field have been limited and scarcely effective (Nielsen et al., 2017). The communication channel represents one of the main challenges related to IC disclosure. In the past, some companies developed separate IC statements, which did not meet their investors' demands because these statements were not adequately integrated with the overall picture of how a company achieves its competitive advantage (Bukh, 2003; Nielsen et al., 2017).

Recent frameworks (the International Integrated Reporting Council [IIRC], 2013) and regulations (UK Companies Act, 2013; EU Directive 2014/95) have stated that non-financial information should be presented in the narrative part of the annual report. According to both professional (IIRC, 2013; WICI, 2016) and academic literature (Beattie and Smith, 2013; Durst, 2013), the IC disclosure is likely to be found in two mandatory sections of the annual report: the section devoted to the BM and the section dedicated to risks.

1.2. The role of the business model and risk reporting in intellectual capital disclosure

In light of the failure of separate IC statements to convey meaningful information to investors, recent regulations in European countries and the UK have introduced some requirements that may spur companies to disclose IC in their annual reports. The EU Directive 2014/95 (Article 19a 1.a and 1.d) and the UK Companies Act require large companies to disclose their BM and risks in their annual reports. Article 19a of the EU Directive states that public-interest entities must disclose information 'necessary for an understanding of the undertaking's development, performance, position and impact of its activity', including 'a brief description of the undertaking's business model' (art. 19a, 1a). Those entities must also include 'the principal risks related to those matters linked to the undertaking's operations including, where relevant and proportionate, its business relationships, products or services which are likely to cause adverse impacts in those areas, and how the undertaking manages those risks' (art. 19a, 1d). Both sections serve to provide investors with information about a company's most important IC elements.

The BM is a schematic representation of how a company operates and creates values from its resources, activities, and relationships (Osterwalder and Pigneur, 2010; Massa et al., 2017). The various definitions of BM in the academic literature share the idea that BM represents how to execute a strategy to create value. It follows that the knowledge of the BM is deemed essential to understanding the roles that different kinds of assets play in value creation. That has led many authors in accounting to see the BM as an ideal framework for reporting (e.g., Bukh, 2003; Nielsen and Roslender, 2015).

The communication of the BM is intended to help external users contextualise other information disclosed in the annual report (Holland, 2004; EC, 2017; FRC, 2018). Because the BM shows how different resources and activities contribute to value creation, users can interpret financial results and non-financial information in light of the roles of various items in a company's value creation process.

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That is particularly true for IC elements. Although the mere description of an IC resource does not allow users to understand its role in creating value for the company, the BM offers the context needed to assess that role by illustrating how IC is managed and mobilised, and how it is linked to other types of capital (Mouritsen and Larsen, 2005; Bini et al., 2016).

The IIRC shares this view. In its framework (IIRC, 2013), it identifies six types of capital. Three of these refer to knowledge-based resources (intellectual capital, human capital, and social and relational capital), thus confirming IC's role in value creation. The BM is the illustration of how the six capital types are combined to create value. Several accounting scholars have discussed the linkage between BM and IC disclosure. Holland (2004) sees the BM as the tool that facilitates effective disclosure of information about IC in a coherent story of value creation. Similarly, Bukh (2003) argues that IC indicators are not useful if they are not contextualised in the value creation process.

In a similar way to the BM, risks can offer valuable information about the role of IC. 'Risk' has been defined in various terms by different disciplines. In finance, risk can be defined as the probability that actual results will differ from expected results (i.e. deviation from the mean, considering both upside and downside variations). In the accounting research field, risk can be defined as the likelihood that the outcome of a process will not meet expectations (O'Donnell, 2005). It occurs whenever there are one-to-many relations between a decision and possible future outcomes, which can be either positive or negative (Emblemsvåg and Kjølstad, 2002). In this view, risk is related to the probability of certain events that determine potential future effects. Several authors in the accounting field have underlined how a broader definition of risk is preferable as it is crucial to understand the uncertainty behind the manifestation of an event and its consequences (Aven, 2012; Crovini and Ossola, 2021). However, most studies provide a negative definition of risk as the potential for loss or threats to business activity (Aven, 2012; Elshandidy et al., 2018).

According to Elshandidy et al. (2018), it is fundamental to specify the underlying concepts and meanings of risk, risk types, and risk measurements to ensure a useful and informative risk disclosure. The risk perspective chosen strongly influences the way risk is analysed, and it may have severe implications for risk management and decision making (Aven, 2012).

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Non-financial regulations have required large companies to disclose information about the main risks confronting them. Several studies have documented a significant association between risk disclosure and investors' assessment of risk (Campbell et al., 2014), price reactions, and trading volumes (Hope et al., 2016). Because a company's value depends primarily on its IC, the development and exploitation of IC may represent an opportunity for a given company. However, it could also threaten value creation if a company fails to protect its intangibles and fails to ensure that these contribute to the value creation process. For these reasons, companies should provide investors with information on the risks associated with their IC.

In the absence of non-financial disclosure requirements, early studies on IC disclosure have examined the whole annual report. However, the literature maintains that to be effective, IC disclosure should allow users to understand how IC contributes to value creation. A scattering of information throughout the whole annual report, without a clear illustration of how IC is exploited to create value, may not be sufficient for IC reporting to achieve this aim of user comprehension (Bini et al., 2016). Studies that document the failure of early IC reporting attempts have supported this view (Nielsen et al., 2017). The introduction of mandatory BM reporting and risk reporting in the annual report may allow companies to link IC directly to value creation, thereby offering an opportunity to enhance IC disclosures. Against this backdrop, the first research question addressed in this report can be formulated as follows:

RQ1: Do companies disclose relevant information about key IC elements in the sections of the annual report devoted to BM and risks?

By answering this question, we aim to contribute to IC disclosure literature by examining the role of BM reporting and risk reporting in communicating IC in the annual report.

1.3. The link between business model and risks

Companies can use the section devoted to the BM and risks to communicate IC; according to regulators' recommendations, these two sections should be linked and internally consistent. Although integration of non-financial information is seen as a crucial qualitative aspect (IIRC, 2013; Sukhari and De Villiers, 2019), few studies have examined the level of integration of IC disclosure. Several authors have examined the connections between BM and other pieces of information. Assuming the BM as the pivotal element of non-financial information disclosure, Bini et al. (2019) have examined the association between BM disclosure and non-financial KPIs reported. Sukhari and DeVilliers (2019) have analysed the linkage between BM reporting and the strategic objectives disclosed through a sample of South African companies that are required to prepare an integrated report. Considering the role of BM as a framework for non-financial items (Beattie and Smith, 2013) and the characteristics of risk reporting (Crovini and Ossola, 2021), we argue that the two concepts are interrelated and that an explicit linkage between BM and risk reporting can contribute to the successful integration of information.

Both BM reporting and risk reporting are linked to value creation. Whereas the BM explicitly defines and illustrates the primary value drivers for a business, risk reporting addresses the main elements that may affect a company's capacity to exploit and protect these value drivers. Suppose a company depicts an item as a value driver in the BM section. In that case, the company should offer information about the risks related to that item in the risk reporting section of the annual report. If a value driver is not addressed in the risk section, the information is incomplete and incoherent. In the same vein, an element depicted in the risk section but not in the BM does not offer information that allows users to assess the role of that element in value creation. Accordingly, if a company relies on an IC element to create value and discloses that element as a value driver in the BM section, the same item should be addressed in the section devoted to risks, which should indicate the outcomes that might derive from the company's inability to exploit and defend that value driver.

Regulators have emphasised the strict relationship between BM and risks and recommend linking the discussion of risks to the BM. The FRC has recognised this strict link between risk and BM in its guidance for strategic reports. Paragraph 7A.32 states: 'Where relevant, the description of the principal risks and uncertainties facing the entity should include linkage to and discussion of the entity's strategy and/or business model.' Similarly, the guidelines on non-financial reporting developed by the EC (2017) indicate that entities 'are expected to explain how risks may affect their business model' (paragraph 4.4).

This integrated communication is in line with proposals by academics (e.g. Bukh, 2003; Holland, 2004; Nielsen and Roslender, 2015; Bagnoli et al., 2021), regulators (FRC, 2018; EC, 2017), and professional bodies (e.g. IIRC, 2013). However, at present, no studies have investigated the integration of IC in BM and risk reporting and the correspondence between elements reported in the BM section and the risk reporting section. Thus, our second research question is:

RQ2: Is there a correspondence between the information on the IC elements disclosed through BM reporting and the information reported when reporting on risks?

2. Research design

2.1. Dataset

The study has focused on listed companies operating in intangible-intensive industries. Some authors have argued that the market value of companies operating in intangible-intensive industries largely depends on IC (Hulten and Hao, 2008) and that such companies disclose more information on IC than do companies operating in other sectors (e.g., Bozzolan et al., 2003; Oliveira et al., 2006). We have focused on high-tech industries, identified as intangible-intensive sectors and emerging industries characterised by high growth rates and market potential (PwC, 2012) because it is more likely that we will find good IC reporting practices in those industries.

We have referred to the classification developed by Eurostat to identify high-tech industries, which draws upon the European Classification of Economic Activities (NACE) to distinguish high-tech sectors from others. In line with that definition, we have classified pharmaceuticals (NACE-REV 21), computers and electronics (NACE-REV 26), and air and spacecraft (NACE-REV 30.30) as high-tech industries.

We have analysed high-tech listed companies based in the UK, France, Germany, the Netherlands, Norway, and Denmark. The UK, France, and Germany represent three of the most important economies in the European area. The UK is of utmost importance to our study, as it has become the first country to regulate BM and risk disclosures. The other countries have implemented the EU Directive 2014/95 on non-financial reporting. The Netherlands, Norway, and Denmark are EEA countries that have adopted the EU Directive 2014/95, which requires the inclusion of BM reporting and risk reporting in annual reports. IC is considered to play an important role in those economies (Lin and Edvinsson, 2008). Moreover, the UK, France, the Netherlands, and Denmark have been classified among the countries with the highest percentage contributions of intangibles to GDP (Corrado et al., 2016).

Overall, we have identified 216 high-tech companies. In some of those companies' annual reports, we could find no information about the BM or risks. Although non-financial regulations do not indicate a minimum level of disclosure regarding BM and risks, those companies could be considered non-compliant. We have thus excluded them from our sample. The final dataset features 154 companies. Table 1 shows the companies' breakdown by country and industry.

	Pharmaceuticals	Computers and electronics	Air and spacecraft	Total
Denmark	5	4	0	9
France	10	15	6	31
Germany	8	23	1	32
Netherlands	1	4	0	5
Norway	4	7	0	11
United Kingdom	22	39	5	66
Total	**50**	**92**	**12**	**154**

Table 1: Companies breakdown by industry and country

We have analysed the 2018 annual reports of the selected firms, using content analysis. Whereas UK companies have been reporting on BM and principal risks since 2013, other European countries implemented the EU Directive 2014/95 in 2017. Thus, we have focused on 2018, operating on the assumption that, by then, all the analysed companies will have acquired some expertise in reporting the BM and principal risks in the annual report.

2.2. Content analysis and the intellectual capital framework

Content analysis of annual reports in the search for IC elements features two stages: first, we have searched for IC items disclosed as elements of the BM; second, we have focused on the section devoted to risks. We have then compared the items disclosed in the two sections to assess correspondence.

When firms reported their BM in a specific section of the annual report, we have analysed that section (Bini et al., 2016, 2019). When a separate part of the document was not identifiable, we have considered the whole management commentary while isolating pieces of information related to the BM (Bini et al., 2019). The unit of analysis is the text unit (Husin et al., 2012), which is a 'group of words containing a "single piece of information" that is meaningful in its own right' (Beattie et al. 2004, p. 216). Even though we have not considered the level of specificity of the information as determined by previous scholars (Campbell et al., 2014; Hope et al., 2016) who counted the number of words and extension of disclosure, the use of text units reduces subjectivity in coding complex sentences. When a single sentence includes information about different categories, text units allow us to code additional information in several different categories. Otherwise, the entire sentence should be classified according to the dominant class (Beattie and Thomson 2007).

To detect the presence of IC elements in the BM and risk sections, we have referred to the most widely used IC framework, which divides IC into three categories: structural capital (SC), relational capital (RC), and human capital (HC) (Edvinsson and Malone, 1997; Bontis, 2003; Bozzolan et al., 2003). This classification represents the cornerstone of IC both among practitioners and among scholars, and it has been widely used to assess IC in accounting studies. More recent frameworks also consider this model. For instance, the framework developed by WICI (2016) uses the same classification, while three of the six capital types included in the Integrated Reporting Framework can be related to the IC mentioned above. The types labelled by the IIRC as 'human capital' and 'social and relational capital' correspond to HC and RC, respectively. The IIRC has labelled another capital as 'intellectual capital', which includes the elements classified as SC in previous frameworks. Some scholars have built on this framework to identify sub-categories within the three main areas (e.g., Bontis, 2003; Bozzolan et al., 2003). We have also considered the sub-elements identified by these authors. Table 2 illustrates the framework used by this study.

The identification of IC elements as value drivers in the BM section considers the contribution of IC items to value creation. Thus, in line with Bini et al. (2019), mere descriptions of results achieved, generic statements, and disclosures that reflect mere intentions or aspirations – without any explanation of how an element contributes to create value – have been excluded. Because the FRC recommends connecting disparate pieces of information in different parts of the report (FRC, 2018, §8.5), we have examined all disclosures directly or indirectly linked to the description of BM. Explicit references (i.e. page numbers) usually provide direct links. Below, we provide an example of IC disclosure in the BM section (titled 'Our dynamic business model') of the 2018 annual report of Diurnal Group.

'Diurnal's team has considerable expertise in the selection of formulation technologies and approaches and combining these to give the desired therapeutic profile and also to create a novel, patentable product.'

(Diurnal Group 2018 annual report, p. 14)

The company refers to expertise as a source of value for the company. According to our IC framework, this element can be classified as human capital in the sub-category 'know-how' (Bozzolan et al., 2003).

The analysis of the section devoted to risks represents the second phase. We have used the same IC framework to code the elements reported in the risk section. We have also used Beretta and Bozzolan's framework on risk reporting (2004). Specifically, based on the way in which the term 'risks' is adopted in this study, we have considered the economic sign reported in the description of risks (Beretta and Bozzolan, 2004).

The economic sign offers information about the direction of risks' expected impact on the firm's value creation. In line with the framework developed by Beretta and Bozzolan (2004) and used in the risk reporting field (e.g. Hill and Short, 2009), we have classified the description of an IC element in the risk section as positive, negative or equal (the latter being used when both positive and negative sentences are provided). Where a company describes an item but does not offer information about its expected impact, we have considered the sign to be non-disclosed.

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MACRO-ELEMENTS (Sveiby, 1997; Edvinsson and Malone, 1997)					
HUMAN CAPITAL		STRUCTURAL CAPITAL		RELATIONAL CAPITAL	
Sub-elements	*Source*	*Sub-elements*	*Source*	*Sub-elements*	*Source*
1. Know-how	Bozzolan et al. (2003)	**1. Patents**	Bozzolan et al. (2003), Guthrie et al. (2004)	**1. Brands**	Bozzolan et al. (2003), Guthrie et al. (2004)
2. Education	Bozzolan et al. (2003), Guthrie et al. (2004)	**2. Copyrights**	Bozzolan et al. (2003)	**2. Customers**	Bozzolan et al. (2003), Guthrie et al. (2004)
3. Employees	Bozzolan et al. (2003), Guthrie et al. (2004)	**3. Trade-marks**	Bozzolan et al. (2003)	**3. Customer loyalty**	Bozzolan et al. (2003)
4. Work-related knowledge	Bozzolan et al. (2003), Guthrie et al. (2004)	**4. Corporate culture**	Bozzolan et al. (2003), Guthrie et al. (2004)	**4. Customer satisfaction**	Guthrie et al. (2004)
5. Work-related competence	Bozzolan et al. (2003)	**5. Management processes**	Bozzolan et al. (2003), Guthrie et al. (2004)	**5. Company names**	Guthrie et al. (2004)
6. Training	Guthrie et al. (2004)	**6. Information systems**	Bozzolan et al. (2003), Guthrie et al. (2004)	**6. Distribution channels**	Bozzolan et al. (2003), Guthrie et al. (2004)
7. Entrepreneurial spirit	Guthrie et al. (2004)	**7. Networking systems**	Bozzolan et al. (2003), Guthrie et al. (2004)	**7. Business collaborations**	Bozzolan et al. (2003), Guthrie et al. (2004)
		8. Research projects	Bozzolan et al. (2003)	**8. Research collaborations**	Bozzolan et al. (2003)
		9. Management philosophy	Guthrie et al. (2004)	**9. Financial contracts**	Bozzolan et al. (2003)
				10. Licensing agreements	Bozzolan et al. (2003), Guthrie et al. (2004)
				11. Franchising agreements	Bozzolan et al. (2003)

Table 2: Framework for IC disclosure analysis

Research design

Risk mitigation activities and hedging strategies are other relevant aspects considered by risk reporting studies. Beretta and Bozzolan (2004) take into account the outlook orientation that characterises the illustration of mitigation activities and the management approach towards risk.

We have followed Beretta and Bozzolan (2004) and have coded information about mitigation strategies into four categories:

- Programs: companies offer forward-looking information on the actions taken to mitigate risk in the future.
- Hypothesis–expectation: companies offer information only on general hypothesis and expectations about the future. They present alternatives and mitigation strategies that might be carried out if an event happens.
- Actions or decisions taken: a company focuses on what it did to mitigate risk in the past.
- Actual state: a company offers information about risk mitigations in place in the present and when the annual report was prepared.

Below is an example of how an item described in the risk section of the annual report has been coded as IC. In the section of the 2018 annual report titled 'Principal risk and uncertainties', EKF Diagnostics Holdings identifies the following risk:

'Lack of retention of key employees affects the continuity and effectiveness of on-going relationships with key customers and suppliers.'

(EKF Diagnostics Holdings 2018 annual report, p. 16)

The company refers to the dependence on personnel as a risk. According to our IC framework, this element has been coded as human capital information in the sub-category 'employees' (Bozzolan et al., 2003; Guthrie et al., 2004). The description focuses on the negative impact of the risk connected to the loss of key employees. Consequently, we have considered the economic sign as disclosed and negative (Beretta and Bozzolan, 2004). In the same section, the company affirms that:

'The risk is minimised by ensuring that a minimum of two individuals manage every relationship with key customers and suppliers. In addition, in retaining the key employees, incentivisation packages are offered through a mixture of sales commission, and profit related bonuses.'

(EKF Diagnostics Holdings 2018 annual report, p. 16)

Research design

Following Beretta and Bozzolan (2004), we have considered this information to describe what the company has done to mitigate the risk. Thus, we have classified the risk mitigation description as 'actions taken to mitigate the risk'.

We then assessed the level of correspondence and integration between the two sections. If both sections describe the same IC item, we have considered that item as matching. We have referred to IC sub-categories to identify the presence of the same element across the two sections. Below is an example of how an IC element has been reported in both the BM and risks sections. In the BM section of the 2018 annual report, Gresham Technologies states:

'Our software is built on modern architecture using agile methodologies and latest technologies, allowing us to rapidly address existing and emerging market requirements.'

(Gresham Technologies 2018 annual report, p. 8)

The company refers to proprietary software as a source of value. According to our IC framework, this element can be classified as an internal structure in the sub-system 'intellectual property' (Bozzolan et al., 2003; Guthrie et al., 2004). In the risk reporting section, the company also states that:

'Issues or failures with our software products or services could lead to failed implementations, project delays, cost overruns, data loss, security issues, customer dissatisfaction, early termination, service level breaches and contractual claims, all of which could adversely impact the Group's revenues, earnings and reputation.'

(Gresham Technologies 2018 annual report, p. 16)

The same element addressed in the BM section (software) is mentioned as a source of risks. Thus, the IC disclosure in the BM is related to that in the risk section. Regarding the latter, the description emphasises the negative impact of the risk connected to this element. Consequently, we have considered the economic sign as disclosed and negative (Beretta and Bozzolan, 2004). The company also states that it mitigates this risk through 'robust quality assurance and project governance processes' (Gresham Technologies 2018 annual report, p. 16). Following Beretta and Bozzolan (2004), we have classified this information under the category 'actions taken to mitigate the risk'.

3. Results

We have collected information about the number of text units concerning IC items disclosed by each company when reporting BM and risks. We have also considered another essential dimension of non-financial disclosure: completeness (Bini et al., 2016). 'Completeness of information disclosed' refers to the areas covered by disclosure. Most of the studies investigating IC disclosure have built disclosure indexes measuring the completeness of the information provided. IC disclosure indexes are usually computed as the ratio between the number of items of an IC framework disclosed and the total items in the same framework (Petty and Guthrie, 2000; Treblanche and De Villiers, 2019). In line with previous research, we have assessed the completeness of information by calculating the ratio between IC sub-elements in our framework (Table 2) disclosed by a company, and the number of all IC sub-elements.

The use of two different measures allows researchers to capture two different dimensions of disclosure. Whereas text-unit count measures the extension of disclosure, the ratio between the categories disclosed and the total number of IC sub-elements measures the scope of disclosure (Treblanche and De Villiers, 2019).

3.1. Non-disclosing companies

By examining companies' reporting practices, we can see that 28.7% fail to disclose either the BM or risks – or both – in their annual report. Notwithstanding the freedom and discretion permitted by regulations, a non-disclosing company can be considered non-compliant.

The composition of non-disclosing companies by country and industry has revealed that all of the companies based in the Netherlands disclose both the BM and risks. However, there are only five high-tech listed companies in that country. After the Netherlands, Germany has the next-lowest percentage of non-disclosing companies (11%) among the sampled countries.

A sector breakdown shows 69.4% of non-disclosing companies operate in the computers and electronics industry, while 25.8% operate in the pharmaceutical industry. Only three companies in the air and spacecraft industry do not disclose information about BM or risks, accounting for 4.8% of non-disclosing companies.

Results

3.2. Intellectual capital in business model and risk sections of the annual report

The analysis of IC in the BM section and the risk section of the annual report has shown that disclosing companies tend to use those two sections to convey information about IC. The most frequently disclosed IC category is structural capital (SC) in both the BM and risk sections (see Table 3). This result holds when examining pharmaceuticals as well as air and spacecraft; however, computers and electronics companies disclose more information about relational capital (RC) than SC in the section devoted to the BM. When considering the sub-elements, 'research' is the most frequently disclosed item in the description of the BM and risks (Tables A1 and A2 in the Appendix).

Air and spacecraft companies tend to disclose more IC items than companies in other industries. An ANOVA analysis shows that this difference is highly significant when comparing IC disclosure in the BM by air and spacecraft companies with computers and electronics companies ($p<0.01$ for the total amount of IC items, HC items, and SC items). On average, companies operating in the air and spacecraft sector disclose more information on know-how, employees, corporate culture, and processes as part of their BM (Table A1 in the Appendix). A potential explanation is that these drivers are harder to copy for companies in that industry, thus reducing costs of disclosure. Although research projects and collaborations are widely covered in BM disclosure and risk disclosure, some items appear to be covered most often in the sections devoted to risks. In particular, employees and patents are among the most frequently disclosed items in risk disclosure.

Results

	Business Model			Risk reporting		
	HC	SC	RC	HC	SC	RC
By industry						
Pharmaceuticals	1.60	2.50	2.18	0.80	2.54	1.50
Computers and electronics	1.33	1.86	1.92	1.15	2.34	1.48
Air and spacecraft	2.50	4.00	2.50	1.00	2.25	1.67
By country						
Denmark	1.22	2.44	2.33	0.78	3.22	1.00
France	1.42	1.87	1.65	1.19	2.55	1.97
Germany	1.06	2.19	1.78	1.16	2.81	1.5
Netherlands	2.40	3.60	2.00	1.60	3.40	2.80
Norway	1.00	1.91	1.46	0.09	1.00	1.36
United Kingdom	1.85	2.26	2.41	1.03	2.17	1.27
Total	**1.52**	**2.19**	**2.04**	**1.03**	**2.40**	**1.50**

Table 3: Mean values of IC text units disclosed in BM and risk sections

Analysis of completeness of information indicates that on average, companies have covered fewer than one-third of the items in our framework for all three categories (Table 4). Air and spacecraft is again the industry with the highest levels of IC disclosure. However, ANOVA reveals that this difference is statistically significant only when the air and spacecraft sector is compared to computers and electronics and only when considering BM disclosures ($p<0.01$).

Higher values of IC information reported in the BM section, compared to the section devoted to risks, may indicate that IC items depicted as value drivers in the BM section are not discussed and reported in the section dedicated to risks.

Results

	Business Model			Risk reporting		
	HC	SC	RC	HC	SC	RC
By industry						
Pharmaceuticals	21.43%	20.44%	18.55%	10.86%	23.33%	12.72%
Computers and electronics	18.17%	18.24%	16.30%	15.84%	22.83%	12.25%
Air and spacecraft	33.33%	29.63%	20.45%	14.29%	22.22%	13.64%
By country						
Denmark	17.46%	18.52%	17.17%	11.11%	33.33%	8.08%
France	18.89%	18.28%	13.49%	15.67%	22.22%	16.42%
Germany	14.29%	20.14%	15.06%	16.07%	25.00%	12.50%
Netherlands	34.29%	28.89%	16.36%	22.86%	33.33%	21.82%
Norway	14.29%	19.19%	13.22%	1.30%	11.11%	12.40%
United Kingdom	24.46%	20.03%	21.07%	14.29%	22.05%	10.61%
Total	**20.41%**	**19.84%**	**17.36%**	**14.10%**	**22.94%**	**12.51%**

Table 4: Completeness of IC disclosure in BM and risk sections

By analysing the characteristics of information depicted in the risk section according to our framework, we have found that, in a few cases, companies use a neutral or positive connotation when depicting the outcomes related to the exploitation of IC elements (Table 5). However, most descriptions have a negative economic sign, as expected. Moreover, most of the descriptions connected to IC elements in the risk section of annual reports are not forward-looking disclosures, but are instead reports of actions taken in the past.

Note: the table reports the percentage of items covered for each category.

	Positive	Equal	Negative	Not disclosed
Economic sign	5.89%	9.77%	75.23%	9.10%
	Programs	**Hypotheses**	**Actions**	**Actual state**
Outlook orientation	13.65%	9.50%	54.75%	22.09%

Table 5: Characteristics of risk descriptions related to IC

3.3. Level of integration between business model reporting and risk reporting

To answer our second research question on the correspondence and level of integration between BM reporting and risk reporting, we have analysed whether and to what extent IC elements depicted as value drivers in the BM section have been disclosed in the section devoted to risks. In our view, information about risks is informative if it sheds light on the key value creation items outlined in the BM section. To this end, we have calculated the ratio between the number of IC elements addressed in both sections and the number of IC elements disclosed in the BM section.

Our results show that companies are far from providing a fully integrated disclosure of IC in the BM and risk sections. The most frequently disclosed sub-elements in the risk section – namely research project, patents, and employees – are those that show the highest correspondence levels (Table A3 in Appendix). At the industry level, the correspondence between the two sections varies from 26.05% among pharmaceutical companies regarding HC to 56.78% of companies in the computers and electronics sector regarding SC. However, ANOVA tests have revealed that the differences are not statistically significant. Although air and spacecraft companies disclose more IC elements in BM reporting and risk reporting, they show the lowest level of integration between the two sections. In particular, air and spacecraft companies show low levels of integration regarding know-how, employees, culture, and processes, which are widely disclosed as BM elements (see Appendix).

At the country level, companies based in the Netherlands show the highest correspondence levels. However, those companies address only about half of the BM section's elements in risk reporting. ANOVA tests show that differences between the Netherlands and other countries are not statistically significant; however, the difference between Norway and the UK regarding relational capital is significant.

	Risk elements connected to BM			
	HC	SC	RC	Overall
By industry				
Pharmaceuticals	26.05%	54.15%	38.83%	42.76%
Computers and electronics	37.14%	56.78%	30.49%	38.51%
Air and spacecraft	29.76%	34.47%	36.11%	34.43%
By country				
Denmark	21.43%	51.85%	41.11%	36.87%
France	33.71%	66.06%	44.00%	47.94%
Germany	53.43%	50.14%	36.15%	44.90%
Netherlands	25.33%	57.67%	83.33%	55.71%
Norway	0.00%	23.48%	25.00%	19.98%
United Kingdom	33.42%	57.88%	26.44%	36.21%
Total	**32.72%**	**54.39%**	**33.65%**	**39.58%**

Table 6: Correspondence between BM and risk sections

4. Discussion and conclusions

The examination of high-tech companies' IC disclosures has revealed several patterns. According to the most well-known literature, high-tech companies could benefit from disclosing detailed information about IC, whether by signalling their performance, legitimising their actions, or other means. Another factor that may incentivise IC disclosure is institutional pressure. If most companies in an industry tend to offer a comprehensive IC disclosure, a company will likely align its own disclosure practices to match those of competitors. Companies are often reticent to be the 'first mover', and they tend to pursue a sort of 'mimetic isomorphism' (Di Maggio and Powell, 1983), thus conforming to the practices of other companies.

In contrast to previous studies, which have mainly examined voluntary IC disclosure in the annual report or separate IC statements, we focus on the opportunity to use mandatory BM reporting and risk reporting to communicate IC. Results have indicated that, despite the mandatory requirements for analysed companies to disclose information about BM and the requirement to disclose principal risks, many entities do not disclose such information. Several potential explanations exist for non-compliance. First, revealing commercially sensitive information about the main value drivers, including IC and their contribution to value creation, can result in the loss of significant competitive advantage. Second, existing regulations do not adequately sanction non-compliant companies (De Villiers et al., 2018). Third, companies may not be aware of the importance of providing uninformed investors or users, who resort to the annual report to obtain information that can be used for evaluation purposes, with information about key value drivers. These include IC elements and how they contribute to creating value and the risks related to those items. Fourth, companies may experience difficulties in articulating their sources of value creation.

In focusing on disclosing companies, our findings have shown that high-tech companies tend to disclose IC elements in the BM section of the annual report. Thus, IC elements are represented as a source of value creation. However, the quantity and scope of IC disclosures are limited, as only some items of the most well-known IC frameworks are covered. This finding confirms previous research that has documented generally low levels of BM disclosures in annual reports (Bini et al., 2016), which is likely due to proprietary costs that may prevent a company from offering an extensive disclosure of its key value drivers. Regarding the scope of IC disclosure, a possible explanation for the partial disclosure of the items defined in the framework could be that not all the items have the same importance for all the companies.

Discussion and conclusions

Differences regarding the disclosure of IC categories have emerged. In particular, SC emerges as the most frequently reported item. SC includes patents, copyright, and research and development activities. This result has confirmed the importance of research activities and IP protection mechanisms for high-tech companies.

On average, companies operating in the air and spacecraft industry disclose more IC elements than companies operating in other sectors. A possible explanation is that their proprietary costs are lower than those of other industries. In this industry, IP does not play the same role as it does in the pharmaceutical or computers and electronics industries. The broader disclosure of hard-to-imitate items such as know-how, culture, and processes by air and spacecraft companies appears to confirm this view. Moreover, the air and spacecraft industry has high barriers to entry and few players. Thus, those companies may have fewer obstacles and more incentives to disclose proprietary information.

Like BM reporting, risk reporting has become mandatory for large companies in the UK and EEA countries. The examination of how companies address IC elements in risk reporting could provide useful information about the uncertain outcomes associated with the exploitation of these elements, which in some cases can be hard to manage and protect.

Our results have suggested that companies also disclose IC in the section devoted to risks. However, both the quantity and the scope of IC disclosures in risk reporting are lower than IC disclosure in BM reporting. That is because, whereas information reported in the BM section explains how IC generates value and enhances investors' understanding of a company's capability to gain and defend its competitive advantage, information disclosed in the risk section may expose the company to adverse reactions by the market (Lim and Tan, 2007).

We have shown that the two sections are scarcely interrelated. Many elements depicted as value drivers that characterise a company's BM are not addressed in the section devoted to risks. This result confirms previous studies that have emphasised a scarce integration among different non-financial items disclosed in the annual report (e.g. Sukhari and De Villiers, 2019). One possible explanation is that companies are not aware of the benefits of providing investors with an integrated disclosure wherein the BM acts as a framework for other information disclosed (FRC, 2018). Another explanation is that preparers do not want to offer information about risks associated with exploiting the main IC value drivers.

Discussion and conclusions

Because our findings are limited to three high-tech sectors, there may be some barriers to applying them to other industries. However, this research contributes to the literature on IC in several ways. First, it provides insights into how listed companies currently report on their IC and how this disclosure is integrated with mandatory BM reporting. Many authors have already run content analysis to identify intellectual capital (IC) elements in the annual report. Some scholars have also addressed the linkage between IC and business models (BM) (see Bukh, 2003; Beattie and Smith, 2013; Dane-Nielsen and Nielsen, 2018). However, to the best of our knowledge, Bini et al. (2016) is the only study that empirically investigates how companies use BM disclosure to convey information about how IC elements create value. This aspect can be of particular importance, since large companies in the UK and all the EEA countries must disclose the BM in the annual report since the implementation of recent regulations. Thus, our study contributes to understanding whether the annual report section devoted to BM is used to disclose IC. Whereas most previous studies – which argue that the BM and IC are strictly related concepts – are limited to the conceptual level, we offer insights into current practices through empirical investigation.

This research also contributes to the debate on integrated thinking and reporting by providing insights into internal consistency and integration of annual reports. Academic literature, professional bodies and standard setters have argued that companies should offer an integrated and internally consistent non-financial disclosure in the annual report, where the BM acts as a framework for other kinds of information (Holland, 2004; IIRC, 2013; Nielsen and Roslender, 2015; WICI, 2016; European Commission, 2017; FRC, 2018). EFRAG has recently recognised the importance of this link, and has established a project task force on preparatory work to elaborate on EU non-financial reporting standards. This task force has also investigated the link between non-financial risks and BM as part of sustainability reporting standard-setting. Other professional bodies, including the IIRC and WICI, have developed frameworks for integrated communication.

5. Policy implications

The results of this study may be of interest to professional bodies and standard setters. Policymakers could address some critical issues that have emerged from this study in an attempt to improve existing regulations and frameworks. In 2020, EFRAG received a mandate from the European Commission to undertake preparatory work for possible EU sustainability reporting standards in a revised EU Non-financial Reporting Directive. EFRAG was asked to explore what these standards might look like and to propose a roadmap for their development. In the EFRAG report about proposals for a relevant and dynamic EU sustainability reporting standard-setting, IC is indicated as the main category of the intangible dimension of sustainability reporting and proposed as a key dimension of disclosure (EFRAG, 2021a). Encouraging companies to disclose information about IC could improve managers' awareness of the importance of properly exploiting and communicating those resources.

The first issue that regulators should consider is how to build an effective sanctioning mechanism that is able to deter non-compliance. Currently, sanctioning mechanisms differ from country to country. Whereas in some jurisdictions, fines and sanctions for non-compliant entities have been well defined, in others, no specific sanctions have been determined or an entity may be sanctioned only upon request by stakeholders. Harmonising sanction mechanisms among countries where non-financial regulations have been implemented represents a crucial challenge for UK and EU policymakers.

The second issue is related to BM reporting and risk reporting. Regarding the first concept, EFRAG (2021a) indicates the absence of a well-established framework to consider different BM and value creation mechanisms as a potential obstacle to BM reporting. This study suggests that regulators could provide more detailed guidance to companies on how BM could be disclosed in the management report. Regarding risk reporting, companies appear reluctant to disclose risks related to IC, which may represent commercially sensitive information affecting their competitive advantage. However, companies could mitigate this threat by explaining that the exploitation of various IC elements entails significant uncertainty and carefully illustrating how they mitigate those risks. Actions that will allow entities to mitigate IC risks in the future are not always accurately depicted in risk reporting. Moreover, negative information conveyed in risk reporting could be balanced by the illustration, through BM disclosure, of how IC elements contribute to value generation. Building a link between risk reporting and BM reporting could help provide meaningful information on IC's effects on the value creation process and improve the integration between information on BM value drivers and related risks.

Policy implications

In this way, regulators and professional bodies involved in the development of integrated reporting models could help companies overcome some of the obstacles associated with the disclosure of information about risks, thus offering more integrated communication about IC. This would make it possible to address another issue that emerges in this report – integration of information. EFRAG (2021a) has indicated that making an explicit connection between BM reporting and risk reporting that affect value creation is an important step in developing a standard on disclosure, using the BM as a lens to integrate the narrative information. From this perspective, the standard may address how an entity can effectively present the links between BM reporting and risk reporting.

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Appendix

Table A1 – Sub-elements disclosed in business model description

SUB-ELEMENT	INDUSTRY			COUNTRY						TOTAL
	Air and spacecraft	*Computer and electronics*	*Pharmaceuticals*	*Denmark*	*France*	*Germany*	*Netherlands*	*Norway*	*UK*	
Know-how	0.67	0.34	0.52	**0.33**	0.42	0.31	0.80	0.27	0.48	0.42
Education	0.08	0.02	0.02	**0.11**	0.06	0.00	0.00	0.00	0.02	0.03
Employees	0.83	0.28	0.50	**0.33**	0.42	0.28	0.20	0.36	0.47	0.40
Work-related knowledge	0.25	0.25	0.08	**0.00**	0.23	0.13	0.60	0.09	0.23	0.19
Work-related competence	0.42	0.26	0.28	**0.33**	0.13	0.22	0.20	0.09	0.41	0.28
Training	0.42	0.15	0.14	**0.11**	0.13	0.09	0.40	0.18	0.21	0.17
Entrepreneurial spirit	0.00	0.02	0.06	**0.00**	0.03	0.03	0.20	0.00	0.03	0.03
Patents	0.25	0.28	0.36	**0.11**	0.45	0.16	0.40	0.18	0.35	0.31
Copyrights	0.00	0.00	0.00	**0.00**	0.00	0.00	0.00	0.00	0.00	0.00
Trade-marks	0.08	0.07	0.02	**0.00**	0.16	0.09	0.00	0.00	0.00	0.05
Corporate culture	0.83	0.30	0.44	**0.44**	0.03	0.16	1.60	0.55	0.55	0.39
Management processes	1.00	0.34	0.26	**0.00**	0.29	0.63	0.00	0.09	0.39	0.36
Information systems	0.17	0.08	0.02	**0.22**	0.10	0.06	0.20	0.00	0.03	0.06
Networking systems	0.17	0.04	0.06	**0.00**	0.03	0.09	0.20	0.09	0.05	0.06
Research projects	0.67	0.70	1.22	**1.56**	0.55	0.91	1.20	0.91	0.86	0.86
Management philosophy	0.33	0.05	0.12	**0.11**	0.26	0.09	0.00	0.09	0.03	0.10
Brands	0.08	0.22	0.16	**0.22**	0.16	0.13	0.40	0.27	0.20	0.19
Customers	0.42	0.21	0.18	**0.22**	0.29	0.09	0.20	0.00	0.27	0.21
Customer loyalty	0.17	0.03	0.00	**0.00**	0.03	0.06	0.00	0.09	0.02	0.03
Customer satisfaction	0.50	0.41	0.34	**0.44**	0.19	0.44	0.00	0.27	0.52	0.40
Company names	0.08	0.03	0.00	**0.11**	0.00	0.00	0.00	0.00	0.05	0.03
Distribution channels	0.17	0.22	0.30	**0.33**	0.23	0.19	0.20	0.09	0.29	0.24
Business collaborations	0.50	0.60	0.76	**0.78**	0.45	0.63	0.80	0.55	0.73	0.64
Research collaborations	0.25	0.12	0.26	**0.22**	0.19	0.19	0.20	0.18	0.15	0.18
Financial contracts	0.17	0.00	0.00	**0.00**	0.00	0.00	0.00	0.00	0.03	0.01
Licensing agreements	0.00	0.08	0.14	**0.00**	0.10	0.06	0.20	0.00	0.12	0.09
Franchising agreements	0.00	0.01	0.04	**0.00**	0.00	0.00	0.00	0.00	0.05	0.02

Appendix

Table A2 – Sub-elements disclosed in risk description

SUB-ELEMENT	INDUSTRY			COUNTRY						TOTAL
	Air and spacecraft	*Computer and electronics*	*Pharmaceuticals*	*Denmark*	*France*	*Germany*	*Netherlands*	*Norway*	*UK*	
Know-how	0.25	0.17	0.04	**0.00**	0.32	0.28	0.00	0.00	0.03	0.14
Education	0.00	0.01	0.00	**0.00**	0.03	0.00	0.00	0.00	0.00	0.01
Employees	0.50	0.70	0.70	**0.78**	0.58	0.75	0.80	0.09	0.77	0.68
Work-related knowledge	0.00	0.05	0.02	**0.00**	0.03	0.03	0.40	0.00	0.03	0.04
Work-related competence	0.17	0.13	0.04	**0.00**	0.10	0.09	0.20	0.00	0.14	0.10
Training	0.08	0.09	0.00	**0.00**	0.13	0.00	0.20	0.00	0.06	0.06
Entrepreneurial spirit	0.00	0.00	0.00	**0.00**	0.00	0.00	0.00	0.00	0.00	0.00
Patents	0.25	0.51	0.66	**0.89**	0.65	0.50	0.80	0.36	0.47	0.54
Copyrights	0.00	0.01	0.02	**0.00**	0.03	0.00	0.20	0.00	0.00	0.01
Trade-marks	0.00	0.05	0.06	**0.11**	0.16	0.00	0.20	0.00	0.02	0.05
Corporate culture	0.17	0.18	0.06	**0.22**	0.03	0.06	0.60	0.18	0.18	0.14
Management processes	0.58	0.27	0.28	**0.11**	0.68	0.41	0.00	0.00	0.17	0.30
Information systems	0.50	0.50	0.58	**0.78**	0.39	0.75	1.00	0.00	0.50	0.53
Networking systems	0.00	0.02	0.02	**0.11**	0.00	0.06	0.00	0.00	0.00	0.02
Research projetcs	0.58	0.75	0.86	**1.00**	0.48	1.03	0.60	0.45	0.82	0.77
Management philosophy	0.17	0.03	0.00	**0.00**	0.13	0.00	0.00	0.00	0.02	0.03
Brands	0.08	0.12	0.10	**0.00**	0.26	0.03	0.40	0.09	0.08	0.11
Customers	0.17	0.29	0.18	**0.00**	0.23	0.25	0.00	0.36	0.29	0.25
Customer loyalty	0.08	0.02	0.00	**0.00**	0.03	0.06	0.00	0.00	0.00	0.02
Customer satisfaction	0.50	0.16	0.16	**0.11**	0.13	0.16	0.40	0.18	0.23	0.19
Company names	0.00	0.01	0.02	**0.00**	0.00	0.00	0.00	0.00	0.03	0.01
Distribution channels	0.00	0.14	0.32	**0.22**	0.23	0.25	0.20	0.09	0.15	0.19
Business collaborations	0.67	0.58	0.52	**0.67**	0.71	0.66	1.20	0.45	0.41	0.56
Research collaborations	0.00	0.05	0.08	**0.00**	0.16	0.03	0.20	0.09	0.02	0.06
Financial contracts	0.08	0.00	0.02	**0.00**	0.03	0.00	0.00	0.00	0.02	0.01
Licensing agreements	0.00	0.10	0.10	**0.00**	0.16	0.06	0.40	0.09	0.06	0.09
Franchising agreements	0.08	0.00	0.00	**0.00**	0.03	0.00	0.00	0.00	0.00	0.01

Appendix

Table A3 – Correspondence levels for each sub-element

Notes: NA indicates that the correspondence level cannot be calculated as a sub-element has not been disclosed as part of the BM

SUB-ELEMENT	INDUSTRY			COUNTRY						TOTAL
	Air and spacecraft	*Computer and electronics*	*Pharmaceuticals*	*Denmark*	*France*	*Germany*	*Netherlands*	*Norway*	*UK*	*Overall*
Know-how	28.57%	31.03%	2.27%	**0.00%**	45.83%	50.00%	0.00%	0.00%	5.56%	19.83%
Education	0.00%	50.00%	0.00%	**0.00%**	50.00%	NA	NA	NA	0.00%	25.00%
Employees	37.50%	70.00%	76.00%	**66.67%**	37.50%	77.78%	100.00%	0.00%	86.21%	68.10%
Work-related knowledge	0.00%	11.36%	0.00%	**NA**	0.00%	0.00%	66.67%	0.00%	3.57%	8.93%
Work-related competence	20.00%	39.13%	15.38%	**0.00%**	25.00%	50.00%	100.00%	0.00%	26.92%	29.27%
Training	20.00%	28.57%	0.00%	**0.00%**	25.00%	0.00%	50.00%	0.00%	21.43%	19.23%
Entrepreneurial spirit	NA	0.00%	0.00%	**NA**	0.00%	0.00%	0.00%	NA	0.00%	0.00%
Patents	0.00%	76.92%	88.89%	**100.00%**	78.57%	60.00%	100.00%	50.00%	78.26%	76.60%
Copyrights	NA	NA	NA	**NA**	NA	NA	NA	NA	NA	NA
Trade-marks	0.00%	16.67%	100.00%	**NA**	40.00%	0.00%	NA	NA	NA	25.00%
Corporate culture	21.43%	23.33%	11.31%	**16.67%**	0.00%	25.00%	29.17%	0.00%	21.30%	18.90%
Management processes	30.56%	26.04%	27.27%	**NA**	57.14%	25.00%	NA	0.00%	18.52%	27.03%
Information systems	100.00%	57.14%	0.00%	**0.00%**	66.67%	50.00%	100.00%	NA	100.00%	60.00%
Networking systems	0.00%	25.00%	0.00%	**NA**	0.00%	33.33%	0.00%	0.00%	0.00%	11.11%
Research projects	42.86%	72.03%	64.17%	**57.41%**	67.86%	66.00%	60.00%	44.44%	75.00%	67.14%
Management philosophy	75.00%	20.00%	0.00%	**0.00%**	50.00%	0.00%	NA	0.00%	50.00%	30.77%
Brands	0.00%	20.00%	25.00%	**0.00%**	20.00%	0.00%	100.00%	33.33%	15.38%	20.69%
Customers	20.00%	11.76%	66.67%	**0.00%**	14.29%	33.33%	0.00%	NA	38.89%	29.03%
Customer loyalty	0.00%	66.67%	NA	**NA**	0.00%	100.00%	NA	0.00%	0.00%	40.00%
Customer satisfaction	66.67%	25.00%	28.13%	**25.00%**	16.67%	30.77%	NA	33.33%	32.35%	30.17%
Company names	0.00%	0.00%	NA	**0.00%**	NA	NA	NA	NA	0.00%	0.00%
Distribution channels	0.00%	30.00%	33.33%	**66.67%**	28.57%	33.33%	100.00%	0.00%	21.05%	29.73%
Business collaborations	40.00%	43.97%	45.31%	**53.33%**	59.09%	50.00%	66.67%	33.33%	36.90%	44.25%
Research collaborations	0.00%	27.27%	15.38%	**0.00%**	16.67%	16.67%	100.00%	50.00%	10.00%	18.52%
Financial contracts	50.00%	NA	NA	**NA**	NA	NA	NA	NA	50.00%	50.00%
Licensing agreements	NA	71.43%	42.86%	**NA**	100.00%	50.00%	100.00%	NA	37.50%	57.14%
Franchising agreements	NA	0.00%	0.00%	**NA**	NA	NA	NA	NA	0.00%	0.00%

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