THE MATERIALITY OF NON-FINANCIAL INFORMATION – EVIDENCE FROM THE INTERACTION OF FIRMS AND CAPITAL MARKET PARTICIPANTS WITH A SPECIAL FOCUS ON THE CHEMICAL SECTOR

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Abstract

Financial outcomes alone do not present a true and fair view of companies' business success. In recent years companies and users of corporate information have recognized that, besides traditional financial information, they also have to consider material non-financial information. Both financial and non-financial information indicate companies' current performance and are necessary to determine their future prospects. Especially investors, as one of the most important stakeholder groups for companies, have increased their use of non-financial information in their decision-making processes in recent years. This development is not surprising given that 1) the percentage of an entity's market value that is attributed to tangible assets has decreased sharply in the last decades and 2) non-financial information can provide a better understanding of risks, opportunities, and resource constraints beyond access to capital.

However, little is known about whether and to what extent users of company reports are actually influenced by non-financial information. Therefore, this dissertation investigates the following research question: Do capital market participants consider material non-financial information; if they do, how does this information influence their decision-making process? The focus on capital market participants is based on the fact that 1) this stakeholder group is one of the most important interest groups of companies and 2) this group should be the most familiar with reading and utilizing financial and non-financial information for their investment-related decisions.

The dissertation tackles this topic with three research papers. Based on a systematic literature review, the first paper investigates the current state of research on materiality within the accounting literature. The second paper analyzes the question and answer sessions of the quarterly result conference calls of ten globally operating chemical companies using a comprehensive three-step coding scheme. Based on the findings, an online experiment is

conducted in the third paper to investigate whether capital market participants consider non-financial information in their processes.

This dissertation provides a comprehensive overview of the current state of research on materiality in the accounting literature. The results of the dissertation contribute to the current research on materiality regarding non-financial information, because it is the first study to use chemical companies' quarterly conference calls with a focus on the non-financial information requested by analysts. The dissertation shows the added value and the importance of conference calls for companies and capital market participants as one of the most important communication tools. Environmentally and socially related topics, which would rather be considered as non-financial, were noticeably linked to financially related questions. This implies that analysts are able to transform these types of information into financial terms. Finally, the dissertation is the first to conduct an experiment to analyze how non-financial information influences investment decisions. The results provide the first evidence that capital market participants within the chemical sector consider non-financial information in their valuation and decision-making processes and that they react to information about non-financial company performance by adjusting their judgments.

Zusammenfassung

Finanzielle Ergebnisse allein präsentieren kein den tatsächlichen Verhältnissen entsprechendes Bild vom wirtschaftlichen Erfolg des Unternehmens. Diese Tatsache hat über die vergangenen Jahre hinweg bei Unternehmen und Nutzer von Unternehmensinformationen zur Erkenntnis geführt, dass neben traditionellen finanziellen Informationen auch wesentliche nicht-finanzielle Informationen berücksichtigt werden müssen. Sowohl finanzielle als auch nicht-finanzielle Informationen zeigen die aktuelle Entwicklung von Unternehmen und sind notwendig zur Bewertung der zukünftigen Entwicklung von Unternehmen. Vor allem Investoren, als eine der wichtigsten Anspruchsgruppen von Unternehmen, haben in den vergangenen Jahren verstärkt nicht-finanzielle Informationen in ihre Entscheidungsfindungsprozesse einbezogen. Diese Entwicklung ist aus zwei Gründen nachvollziehbar: 1) der prozentuale Anteil am materiellen Unternehmensmarktwert ist in den letzten Jahrzehnten deutlich gesunken und 2) nicht-finanzielle Informationen können ein besseres Verständnis von Risiken, Chancen sowie Beschränkungen über die reine Kapitalbeschaffung hinaus vermitteln.

Dennoch ist wenig darüber bekannt, ob – und in welchem Umfang – Nutzer von Unternehmensberichten durch nicht-finanzielle Informationen beeinflusst werden. Die vorliegende Dissertation untersucht daher folgende Forschungsfrage: Berücksichtigen Kapitalmarktteilnehmer nicht-finanzielle Informationen? Wenn ja, inwiefern beeinflussen solche Informationen den Entscheidungsfindungsprozess? Die Fokussierung auf Kapitalmarktteilnehmer ist wie folgt zu begründen: 1) Kapitalmarktteilnehmer sind eine der wichtigsten Anspruchsgruppen von Unternehmen und 2) diese Gruppe ist vertraut mit dem Lesen sowie der Verwendung und Bewertung finanzieller und nicht-finanzieller Informationen.

Die Dissertation bearbeitet dieses Thema mit drei Forschungsarbeiten. Basierend auf einer systematischen Literaturrecherche untersucht die erste Forschungsarbeit den aktuellen

Stand der Forschung zur Thematik Wesentlichkeit im Bereich Accounting. Die zweite Forschungsarbeit analysiert die im Rahmen der Quartalsberichterstattung abgehaltenen Telefonkonferenzen mit Analysten von zehn weltweit agierenden Chemieunternehmen. Die Analyse der von Analysten gestellten Fragen basierte auf einem umfangreichen drei-stufigen Kodierungsschema. Aufbauend auf diesen Ergebnissen wurde in der dritten Forschungsarbeit ein Online-Experiment durchgeführt, welches untersuchte, ob Kapitalmarktteilnehmer nicht-finanzielle Informationen in ihrer Entscheidung berücksichtigen.

Zum einen liefert diese Dissertation einen umfangreichen Überblick über den aktuellen Stand der Forschung zur Thematik Wesentlichkeit im Bereich Accounting. Zum anderen tragen die Ergebnisse der Dissertation zum aktuellen Forschungsstand der Thematik Wesentlichkeit nicht-finanzieller Informationen bei, da zum ersten Mal die von Analysten gestellten Fragen in – im Rahmen der Quartalsberichterstattung durchgeführten – Telefonkonferenzen von Chemieunternehmen Gegenstand der Untersuchung sind. Die Dissertation stellt den Mehrwert und die Wichtigkeit dieser Telefonkonferenzen mit Analysten, als eines der wichtigsten Kommunikationsinstrumente für Unternehmen und Kapitalmarktteilnehmer, dar. Umwelt- und sozialorientierte Themen, welche eher mit nicht-finanziellen Fragen in Verbindung gebracht werden, wurden jedoch eher in Verbindung mit finanziell orientierten Fragen gestellt. Das lässt darauf schließen, dass Analysten in der Lage sind, solche Informationen in finanzielle Aspekte zu transformieren. In dieser Dissertation wird auch zum ersten Mal ein Experiment genutzt, um zu untersuchen, wie nicht-finanzielle Informationen den Investitionsprozess von Kapitalmarktteilnehmern beeinflussen. Die Ergebnisse sind ein erster Beleg dafür, dass Kapitalmarktteilnehmer innerhalb des Chemiesektors nicht-finanzielle Informationen in ihren Bewertungs- und Entscheidungsfindungsprozessen berücksichtigen sowie ihre Entscheidungen entsprechend der nicht-finanziellen Leistung des Unternehmens anpassen.

1 Introduction

1.1 Materiality in corporate reporting

Accounting research examines the communication between various stakeholder groups (e.g., managers, auditors, information intermediaries, investors) and investigates the effects of regulatory regimes on this process. The vast majority of the accounting literature focuses on the reporting decisions made by managers and auditors as well as on their relationship to analysts' forecasts and value estimates, investors' trading decisions, and the resulting market prices (Libby, Bloomfield, & Nelson, 2002). Within accounting practice one of the most important concepts is the concept of materiality. Companies are required by national legislation and accepted standards to disclose material information in their company reports (Heitzman, Wasley, & Zimmerman, 2010). "Information is material – and therefore has relevance – if its omission or misstatement, individually or collectively, could influence the economic decisions of users taken on the basis of the financial statements." (Financial Reporting Council, 2014, p. 12) The content of company reports is a result of expert judgment of materiality and the evaluation of whether the report provides a fair view of the firm and was prepared in accordance with accounting principles (Gordeeva, 2011). The concept of materiality is therefore a fundamental part of accounting standards (Eccles, Krzus, Rogers, & Serafeim, 2012; Gordeeva, 2011; Messier, Martinov-Bennie, & Eilifsen, 2005) and has a long history in accounting and auditing legislation (Lo, 2010).

International organizations and especially US standard setters and regulators, such as the International Accounting Standards Board or the Financial Accounting Standards Board, have published rules and regulations with regard to materiality definitions and guidance (Heitzman et al., 2010). Mandatory disclosure rules are designed to ensure that the reported information conforms to certain regulations (Tasker & Johnson, 1998) and to help companies to focus their reporting activities (Gordeeva, 2011; Messier et al., 2005). Information that is disclosed in corporate reports has to be, amongst others, determined by materiality to provide

a true and fair view of the company as well as to comply with the law (Gordeeva, 2011; Heitzman et al., 2010).

The current materiality guidelines are principle-based and do not give specific guidance to companies on how to identify and evaluate whether the information is material or not (Tasker & Johnson, 1998). Furthermore, the materiality concept is well established for the more quantitative elements of financial reporting but less understood for the more qualitative elements of non-financial reporting (Adams & Simnett, 2011). However, non-financial information plays an increasingly important role in corporate reporting. The amount of qualitative and non-financial information within corporate reports has increased over the last years (KPMG International, 2013).

1.2 Material non-financial information and capital market participants

Financial outcomes alone do not present a true and fair view of the future business success of companies. While financial information indicates companies' current performance, non-financial information has to be considered to determine their future prospects (Rogers & Herz, 2013). Companies and users of corporate reports have recognized that they also have to consider non-financial information to reduce uncertainties and to understand better the risks and opportunities as well as the resource constraints beyond access to capital (Eccles et al., 2012; Hsu, Lee, & Chao, 2013).

A consequence of the increased interest in non-financial information is the rise of the publication of non-financial and often voluntary information in companies' annual reports or in designated sustainability reports (KPMG International, 2015). The demand for non-financial information has increased over the last years, as evidenced by the rise of non-financial disclosure standards such as the Global Reporting Initiative (GRI) and the mandatory disclosure of sustainability-related issues for capital market-oriented companies in the European Union (EU) starting in 2017 (European Parliament, 2014). As a consequence,

companies need to evaluate which non-financial information is material and should be disclosed. Therefore, the materiality of non-financial information is a highly relevant topic. Non-financial information offers a wide range of potential disclosures for a company. Guidance on determining which information is material is helpful for companies, enabling them to focus on the important issues, and for addressees of companies' reports, because it advocates more balanced reporting and thereby mitigates discretion (Deegan & Rankin, 1997).

As yet accounting research has not added much to this topic, except for the first evidence on the determinants of materiality disclosure (Fasan & Mio, 2016). However, in recent years investors, as one of the most important stakeholder groups for companies (Bowen, Davis, & Matsumoto, 2002; Eccles & Serafeim, 2013; Kimbrough, 2005; Tasker & Johnson, 1998), have increasingly included non-financial information in their decision-making processes (Global Sustainable Investment Alliance, 2015; Rogers & Herz, 2013). This development is not surprising given that 1) the percentage of an entity's market value that is attributed to tangible assets has decreased sharply in the last decades (Eccles, Serafeim, & Krzus, 2011) and 2) non-financial information can provide a better understanding of the risks, opportunities, and resource constraints beyond access to capital (Dhaliwal, Radhakrishnan, Tsang, & Yang, 2012). Furthermore, there is evidence that analysts' evaluations of companies disclosing both financial and non-financial information are positively related to the analysts' forecast accuracy (Lang & Lundholm, 1996). Theoretical and empirical studies support the notion of a significant association between non-financial performance and financial performance (Dhaliwal et al., 2012). These findings serve as the first evidence of the importance of material non-financial information for capital market participants.

2 Research approach

Capital market participants are one of the most important interest groups of materiality in corporate reporting (Bowen et al., 2002; Eccles & Serafeim, 2013; Kimbrough, 2005;

Tasker & Johnson, 1998). They use different types of material information in their valuation models, stock recommendations, and investment decisions (Gårseth-Nesbakk & Mellemvik, 2011; Morris, Nichols, & Pattillo, 1984). In recent years there has been increasing support for the notion that, besides traditional financial information, capital market participants also consider material non-financial information (Eccles et al., 2012; Hsu et al., 2013). However, little is known about whether and to what extent users of company reports are actually influenced by non-financial information. Therefore, this dissertation addresses the following research question:

Do capital market participants consider material non-financial information; if they do, how does this information influence their decision-making process?

The evaluation and decision-making process can be summarized in the following three steps: 1) gathering information outside the company (e.g., market data, information from competitors of the company), 2) gathering information inside the company (e.g., financial statements, the firm's strategy), and 3) evaluating the company based on this information. This process ultimately results in a decision (e.g., invest or divest) (Bradshaw, 2009; Penman, 2007). The dissertation at hand focuses solely on step two of the described process, collecting company-related material information, which is also depicted in Figure 1.
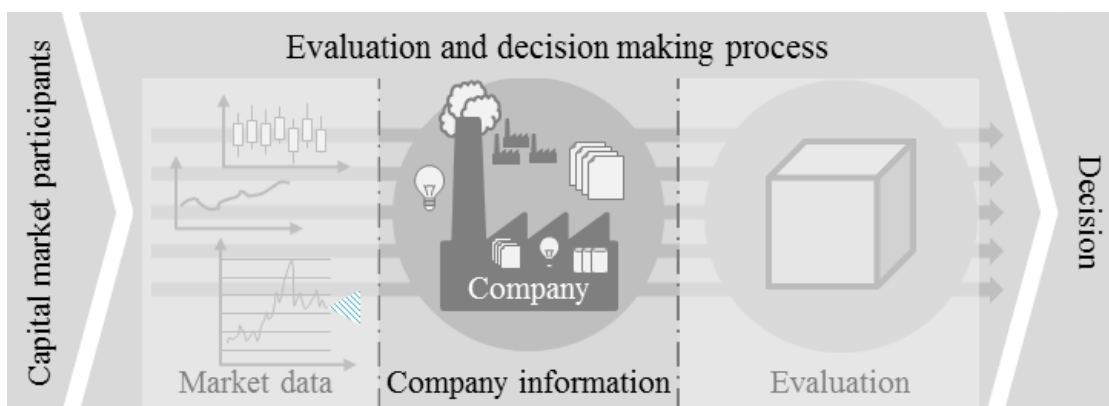
Figure 1: Evaluation and decision-making process by capital market participants
(Source: own illustration in accordance with Bradshaw, 2009 and Penman, 2007.)

3   Structure of the thesis and applied methods

The dissertation comprises three research papers that analyze the materiality of non-financial information in the evaluation and decision-making processes of capital market participants within the chemical sector. Thereby, the investigation starts with the analysis of the current state of research on materiality within the accounting literature. Afterwards the question and answer sessions of quarterly result conference calls of chemical companies, as one of the most important communication channels, are investigated to identify material information for capital market participants. Based on these findings, an online experiment is conducted to investigate whether capital market participants consider non-financial information in their decision-making processes. Figure 2 provides an overview and a summary of all three research papers, which are described in the following in more detail.

Materiality definitions and thresholds	**Material topics for analysts**	**Materiality of non-financial information**
Systematic literature research	Content analysis	Experimental setting
▪ Overview of current materiality definitions presented	▪ Conference call Q&A session analyzed	▪ 2 x 2 full-factorial, between-subjects online experiment
▪ Comprehensive review protocol developed	▪ 10 major chemical companies (worldwide)	▪ 121 participants
▪ 62 publications identified	▪ 110 conference call transcripts	▪ Four different cases of a fictitious chemical company developed
▪ Content analysis conducted	▪ Period between 2013-2015	▪ Quantitative and qualitative dimension considered
▪ Generic definition of materiality provided	▪ Comprehensive three-step coding scheme developed	▪ Focus on environmental topics energy and biodiversity
	▪ Network analysis conducted	

Focusing on professional capital market participants

Figure 2: Overview and summary of all three research papers

Companies use the materiality concept when they have to decide which information should be disclosed in their company reports to comply with reporting standards (Gordeeva, 2011; Heitzman et al., 2010). An integral part of the scientific debate on materiality is concerned with materiality definitions and thresholds (Iskandar & Iselin, 1999). Therefore, identifying the current state of research regarding materiality is the starting point and the basis

of the dissertation. *The first paper* systematically reviews the current literature on materiality as well as assesses whether and to what extent the scientific literature provides definitions and measurement approaches regarding materiality. Thus, the paper analyzes 62 publications with regard to materiality definitions and measurement approaches. The results show that the materiality understandings of financial and non-financial information are similar. However, there is little research on the materiality of non-financial information. The majority of the scientific literature is focused on the materiality of financial information. The review provides a methodology that helps to determine material information systematically based on three commonly used threshold groups.

Based on the findings of the first paper, the dissertation focuses on capital market participants, as one of the most important stakeholder groups that use financial and non-financial corporate reports as well as other company-related publications. The materiality concept is also well established within financial accounting, but, due to the non-existent guidance, practitioners have established materiality thresholds to identify or measure materiality (Fang & Jacobs, 2000). However, numerical thresholds alone are not an appropriate method to decide whether the information is material or not. The qualitative content of the information also has to be considered (Eccles et al., 2012). Therefore, as one instrument of communication between companies and capital market participants, chemical companies' quarterly conference calls are investigated to obtain an overview of the information that is requested by analysts during conference calls (*paper 2*).

The second paper uses the content analysis method to investigate which information is material for analysts based on 110 conference calls of chemical companies in the time period from 2013 to 2015. Analysts represent an important firm interest group, as they evaluate companies and provide stock recommendations to their clients. Furthermore, analysts serve as proxies for investors (Bradshaw, 2009). Therefore, it is important to know which information is material for them to enhance firms' communication and their valuation by analysts. The

paper develops a comprehensive coding scheme for the content analysis consisting of the three elements type (financial versus non-financial information), time (forward versus backward-looking), and topic (16 different topics classified into eight topics that would be considered as financially oriented and eight topics that would be considered rather as non-financially oriented) to analyze analysts' conference call questions. Additionally, the paper conducts a network analysis to investigate the relationships and interdependencies among the 16 selected topics.

The results of *paper 1* show that a piece of information can have different degrees of importance for different stakeholder groups (Heitzman et al., 2010). Therefore, one specific information item could have different materiality thresholds. *Paper 2* reports that capital market participants asked for non-financial information in the question and answer sessions of firms' conference calls. Despite the recent trends towards more non-financial disclosure, the depth and extent to which capital market participants utilize non-financial information in their decision-making process remain open questions (Holstrum & Messier, 1982; Ioannou & Serafeim, 2015). Theoretical and empirical studies support the notion of a significant association between non-financial performance and financial performance (Dhaliwal et al., 2012).

Based on an experimental setting, this relationship is investigated in *paper 3* for two environmental topics. Thereby, *paper 3* uses a 2×2 full-factorial, between-subjects experimental setting to analyze whether and how professional capital market participants react to manipulations along two dimensions (quantitative and qualitative) of materiality. Thus, the quantitative dimension covers small versus large changes in sustainability performance and the qualitative dimension compares a topic of potentially high interest with a topic of lower interest to capital market participants. The paper focuses on professional capital market participants (i.e., professional investors and financial advisors) as participants, because this group should be the most familiar with reading and utilizing financial and non-financial

information for their investment-related decisions and it is one of the most important stakeholder groups for companies. To achieve high external validity, the final sample comprised 121 participants with a financial working background who serve as proxies for professional investors as the most influential providers of financial capital. The experiment was administered online, and all the participants had access to exactly the same introduction to a fictitious multinational European chemical company. The chemical industry was deemed to be appropriate as the basis, because sustainability-related topics have been on the agenda of the industry for a long time and therefore it was expected that capital market participants are aware of these aspects.

4   Conclusion

4.1   Main findings and contribution

The three dissertation papers contribute to the current research on materiality regarding non-financial information in the chemical sector by providing the first evidence that capital market participants ask for and consider non-financial information in their valuations and decision-making processes. The dissertation provides a comprehensive overview of the current state of research on materiality. It shows the added value and the importance of conference calls for companies and capital market participants as one of the most important communication tools between the two parties. Finally, the dissertation provides the first evidence that capital market participants within the chemical sector consider non-financial information in their valuation and decision-making processes and that they react with regard to the actual non-financial company performance by adjusting their judgments. In the following the main findings and contribution of each paper are described in more detail.

Materiality definitions and thresholds

The results of *paper 1* show that the majority of publications refer to established materiality definitions provided by US institutions and legal standard setters with a financial background (e.g., the Financial Accounting Standards Board, the Securities and Exchange

Commission). However, international independent standard setters with a sustainability focus also provide materiality definitions (e.g., the Global Reporting Initiative). The results of the literature review indicate no major difference, except for addressing different stakeholder groups, between the materiality understanding of the more financially oriented standard setters and the more non-financially oriented standard setters. Based on these findings, the review provides a generic definition of materiality and therefore contributes to the materiality discussion (e.g., Fang & Jacobs, 2000). The majority of the scientific literature on materiality focuses on materiality thresholds, the effects of a change in accounting principles, errors discovered by auditors, and internal control weaknesses. Most of the literature offers a general and principle-based approach. Nearly all of these approaches are quantitative. Studies rarely apply qualitative assessments to identify material information. A methodology that systematically determines material information has not been identified.

The literature review (*paper 1*) indicates that the concept of materiality is well established for the more quantitative elements of financial reporting but less understood for the more qualitative elements of non-financial reporting (Adams & Simnett, 2011). Materiality has not only a quantitative but also a qualitative element (i.e., the topic dimension) (Eccles et al., 2012). Due to the non-existent guidance, practitioners have established materiality thresholds. These thresholds were developed based on personal experience and judgment rather than on scientific principles to identify or measure materiality. Therefore, considering the results of the review, the following three specific threshold areas can be identified: single explicit threshold, multiple explicit threshold, and threshold range. Although users' decision-making processes cannot be observed, the results of these decisions can be observed. It is therefore possible to determine the effect of investors' decisions by observing the movements of stock prices (Cho, Hagerman, Nabar, & Patterson, 2003). Finally, the review finds that experimental research designs are more appropriate to investigate the complexity of materiality than for example questionnaires (Iskandar & Iselin, 1999).

Material topics for analysts

The results of *paper 2* indicate that analysts requested more financial than non-financial information during the question and answer sessions of chemical companies' quarterly conference calls. However, the paper identified that the two non-financially oriented topics, Environmental and Social were noticeably linked to financial questions asked by analysts rather than linked to non-financial ones. This implies that analysts are able to transform this type of information into financial terms. Furthermore, analysts asked for more forward-looking than backward-looking information. However, the proportion of backward-looking questions was clearly high. This implies that backward-looking information is also informative for analysts. Finally, it is not possible to conclude that a financially or non-financially oriented question asked by an analyst has a more forward-looking than backward-looking time characteristic.

The paper confirms the research finding that not only typically financial information and topics but also non-financial information and topics are asked about during conference calls (Eccles & Serafeim, 2013; Tasker & Johnson, 1998). For the sample of chemical companies in the period under review, taking the analysts' questions as a baseline for discussing the results, it cannot confirm the research findings that 1) companies provide less financial and more forward-looking information when the company performance is poor, 2) the management focuses more on non-financial, forward-looking topics when the prior quarter's performance is poor, and 3) forward-looking disclosures are actually greater in the third and fourth quarters (Matsumoto, Pronk, & Roelofsen, 2011). The comprehensive coding scheme that is developed can be used to analyze further analysts' conference calls within the chemical sector or in other sectors when topic-related adjustments are made. Materiality is sector-specific (Eccles et al., 2012); therefore, the coding scheme and results of this analysis cannot necessarily be transferred to other sectors.

The results of *paper 2* contribute to the literature by providing the first indication of which topics are material within the chemical sector. Specifically, the topics regarding sales, margins, and performance considering the business activities of competitors, suppliers, and customers as well as raw material, retail, and spot market information are the most frequently asked about by analysts. A further contribution of *paper 2* is the result of a network analysis that shows the first insights into the relationship between the 16 different topics identified. The analysis presents which and how often the topics were asked about together with other topics in the same question. The results suggest that there are interdependencies between the identified topics. The network analysis results could be of interest to firms to enhance their current communication. By knowing which topics are related to each other, firms are able to adapt their communication activities, which may result in a better analyst valuation.

Materiality of non-financial information

The dissertation *paper 3* uses an experimental setting and shows that non-financial information can indeed influence the decisions of professional capital market participants. They react to both dimensions of materiality – quantitative and qualitative. The results indicate that the investment-related judgments of capital market participants receiving information indicating a stronger decrease in non-financial performance were more unfavorable than the judgments of capital market participants receiving information indicating a weaker decrease. This indicates that capital market participants not only react to non-financial information per se but also adjust their judgment according to the actual performance. Furthermore, the investment-related judgments of capital market participants receiving non-financial information on a topic of high materiality (i.e., energy) were more unfavorable than the judgments of capital market participants receiving non-financial information on a topic of low materiality (i.e., biodiversity). These findings underline the result of the materiality assessment analysis conducted of the ten companies under review. All the companies considered energy as a topic of high relevance and biodiversity as a topic of

rather low/medium relevance in the materiality assessment. The experiment considers this result and confirms it.

As described above, professional capital market participants consider the topic dimension, meaning the contextual content of the non-financial information provided, and translate the information into financial terms. Specific to the case, it seems to be easier to translate excessive energy use into a monetary impact (direct and indirect costs) than a high impact on biodiversity, so the former was apparently regarded as a topic of high materiality by the study's participants. The results contribute to the call for sector-specific thresholds by Eccles et al. (2012) by showing that for non-financial disclosures thresholds should also be topic-specific.

Furthermore, *paper 3* indicates that the combination of the qualitative and quantitative dimensions has an impact on investors' decisions. The results also show that the differences in the investment-related judgments among capital market participants receiving information indicating a strong or weak decrease in non-financial performance were larger if the respective report covered the topic of high materiality compared with a topic of low materiality. This shows that professional capital market participants indeed consider the two dimensions of materiality, performance and topic, simultaneously for non-financial information. Based on this finding, developing quantitative thresholds for non-financial information (addressing the performance dimension) can only be useful when it is specific to the different topics.

The results of *paper 3* contribute to the literature by providing the first experimental evidence of the materiality of non-financial information. By linking the materiality discussion to the decision usefulness theory, the results show that professional capital market participants indeed react to bad news of non-financial information, resulting in a lower evaluation of the investment's attractiveness and a higher evaluation of its riskiness. Therefore, non-financial

information can provide a better understanding of the risks, opportunities, and resource constraints beyond access to capital (Dhaliwal et al., 2012). Furthermore, the results of *paper 3* point out that two dimensions need to be considered when discussing the materiality of non-financial information: performance and topic. Thereby, the results contribute to the research on the nature of the disclosed items (Messier et al., 2005), especially regarding non-financial information (Iskandar & Iselin, 1999), and substantiate the arguments of Eccles et al. (2012) that the context of information also needs to be considered to determine what is material. The results serve as a starting point for the development of better guidance on the determination of non-financial materiality and offer a blueprint for the validation of companies' judgment of material topics.

The results are relevant for companies affected, for example, by the EU regulation concerning mandatory reporting of sustainability information (European Parliament, 2014), because they inevitably have to consider what to report and how to approach materiality in their disclosure. While validation of the materiality of all the different non-financial topics is complex, the results provide the first example of an experimental set-up to compare the relevance of two given topics. This moves beyond a simple questionnaire-based assessment of materiality and provides further insights into how materiality is perceived by report users.

4.2   Future research

The findings presented in this dissertation provide several opportunities for future research. First, future research should further investigate the differences between financial and non-financial materiality. The results of the dissertation point out that environmental and social topics, which are usually expected to have a non-financial character, have a noticeable impact on the financial aspects within the chemical sector (e.g., analysts' questions for financial consequences in *paper 2* or investment decisions in *paper 3*). Further research could investigate the reason for that result and how capital market participants transform the non-financial information of environmental and social topics into financial values in their

decision-making processes. On avenue is to analyze the black boxes in analysts' valuation processes, which lead to analysts' forecasts as well as to stock recommendations (Bradshaw, 2009). Since materiality is sector-specific (Eccles et al., 2012), the results are not necessarily transferable to other sectors. Further studies could deal with the influence of sector-specific characteristics on materiality along with investigations of the way in which different topics and representations of non-financial information are associated with materiality. A starting point might be to investigate within other sectors which non-financial information is material for users and is therefore needed for their decision-making process. Finally, research could investigate the relationships and interdependencies between topics within the chemical sector in more detail by focusing on the understanding of which and how topics are related to and influence each other and therefore the decision-making process of the users.

Second, future research could address materiality thresholds in more detail. None of the identified subjects and thresholds were investigated for non-financial information. Further research should investigate the circumstances under which the current materiality thresholds for financial information can be transferred to non-financial information or whether new materiality thresholds specific to non-financial information can be developed. Of course, newly developed thresholds for non-financial information must acknowledge sector-specific characteristics (Eccles et al., 2012). As a consequence, further research could consider that it might be possible to operationalize the materiality of non-financial information by developing industry-specific threshold values.

Third, the dissertation set a focus on capital market participants as one of the most important firm stakeholder groups (Bowen et al., 2002; Eccles & Serafeim, 2013; Kimbrough, 2005; Tasker & Johnson, 1998). Other stakeholders are likely to make different judgments based on the same information or might even need different material information for their decision-making process. Further research should also focus on different stakeholder groups or analyze a wider stakeholder perspective (Edgley, Jones, & Atkins, 2015).

5   Papers

Each of the papers is included in the annex to this dissertation. The submission status of the publications is as of June 5, 2017.

1) Schmiedchen, E. (2017). **The current state of research on materiality in financial and non-financial disclosure**, *Review of Accounting and Finance*, submitted.[1]

2) Schmiedchen, E. (2017). **What is material for analysts? A study of conference calls within the chemical sector**, *Social and Environmental Accountability Journal*, submitted.

3) Schiemann, F., Schmiedchen, E., Reimsbach, D., & Hahn, R. (2017). **When does sustainability matter for professional capital market participants? An experimental study on non-financial materiality**, *Accounting, Organizations and Society*, submitted.[2]

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[1] The paper was accepted and presented at the 19th Financial Reporting and Business Communication Conference in Bristol 2015.

[2] A modified version of the paper was accepted and presented at the 40th European Accounting Association Annual Congress in Valencia 2017. Furthermore, a modified version of this paper was accepted for the ENEAR Conference 2017.

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The current state of research on materiality in financial and non-financial disclosure: A systematic literature review

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Abstract

Materiality of information is a central element of the effective evaluation of a company's performance and key to steering long-term profitability. Guidance regarding materiality – especially in accounting and auditing – has been constantly developed over several decades. However, all current concepts are principle-based and do not provide specific guidance on how to identify and evaluate whether a piece of information is material or not. Users of corporate reports are interested in information which gives them a realistic evaluation of the business success of a company. This raises the question of how we define material information. This systematic literature review based on the methodology of Fink (2014) assesses whether, and to what extent, scientific literature provides definitions and measurement approaches regarding materiality. The results show that the materiality understanding of financial and non-financial information is similar. However, there is little research on the materiality of non-financials. The majority of scientific literature is focused on the materiality of financial information. The review provides a methodology which helps to systematically determine material information based on three commonly used threshold groups.

1   Introduction

Materiality is an important concept in management, accounting and auditing. It is also one of the most controversially discussed topics in the aforementioned research areas (Gordeeva, 2011; Messier, Martinov-Bennie, & Eilifsen, 2005) and has a long history in accounting, auditing and assurance standard-setting processes and jurisdiction (Eccles, Krzus, Rogers, & Serafeim, 2012; Lo, 2010). Recently, the International Accounting Standards Board (IASB) has published an exposure draft regarding the application of materiality in financial statements (IASB, 2015). Other internationally accepted standards, as well as national legislation, require companies to disclose material information in their reports (Heitzman, Wasley, & Zimmerman, 2010). Moreover, a recent study by Khan, Serafeim, and Yoon (2015) has also shown that focusing on material business activities has a positive impact on a company's performance compared to business activities without a focus on material topics. Examples of those most interested in the materiality concept include management, auditors, and investors (Gårseth-Nesbakk & Mellemvik, 2011; Morris, Nichols, & Pattillo, 1984).

According to Adams and Simnett (2011), the concept of materiality is well-established for the more quantitative elements of financial reporting, but less understood for the more qualitative elements of non-financial reporting. However, non-financial information plays an increasingly important role in corporate reporting. The amount of qualitative and non-financial information within corporate reports has increased in recent years (KPMG International, 2013). According to the Securities and Exchange Commission (SEC), 0.0005% of assets under management expressed concern about non-financial issues in the 1970s. Today, the number of assets under management in the US capital market is about eleven percent (Rogers & Herz, 2013). The literature acknowledges this increasing importance of non-financial information (Iskandar & Iselin, 1999) and calls for an investigation into how materiality is defined and measured (Brennan & Gray, 2005).

There is an increasing demand for material information from the capital market, and the need to identify material information in order to disclose a true and fair view of the company. However, there is no systematic overview of materiality. Therefore, the first step should be to investigate the current state of research regarding materiality in financial and non-financial reporting. To cover the current state of research, a broad-based systematic literature review in conjunction with a content analysis based on the methodology of Fink (2014) was carried out. Therefore, the paper addresses the following research questions:

1) What is the current understanding of materiality?
2) In which context is the concept of materiality applied in the scientific literature?
3) (How) Is materiality identified, measured, and evaluated?

The review builds on the databases of the Web of Science (WoS) Core Collection and the Business Source Complete (BSC). A review protocol was used to collect all relevant data in a standardized way. A content analysis was carried out in order to answer the research questions. This systematic literature review presents the current state of research and understanding regarding materiality. The review distinguishes between financial and non-financial information and presents similarities and differences between both. The review identifies three key findings.

First, a major difference between the materiality understanding of financial and non-financial information does not exist. Both consist of the three elements: subject, level of uncertainty, and reference base. The first two elements were introduced by Brennan and Gray (2005). The third element was identified during the review. Based on these results, I provide a generic materiality definition. Second, the majority of scientific literature on materiality focuses on materiality thresholds, the effects of a change in accounting principles, errors discovered by auditors, and internal control weaknesses. Third, a methodology which systematically determines material information has not been identified. Most of the literature

offers a general and principle-based approach. Studies rarely apply qualitative assessments to identify material information.

The review contributes to the materiality discussion by Fang and Jacobs (2000) that – based on non-existent guidance – practitioners have established materiality thresholds which are used to identify or measure materiality. Therefore, based on the results of the review, the following three specific threshold areas can be classified: single explicit threshold, multiple explicit threshold and threshold range. Furthermore, I confirm the results of Messier et al. (2005) that the effect of an item on income is one of the most important factors in determining materiality. The paper also contributes to further research approaches on materiality by identifying that materiality research moves from questionnaires and surveys to experimental designs. Such experimental research designs have proven to be more appropriate to investigating the complexity of materiality (Iskandar & Iselin, 1999). Finally, the review identifies current research gaps and potential research themes within the current literature. Therefore the results indicate that research regarding material non-financial information is missing or only rudimentary in the current literature.

This paper is structured as follows. The next section describes the theoretical background of materiality. Section 3 explains the methodology for the systematic literature review. Section 4 presents the results, and the fifth section discusses the findings and gives an outline of further research. The final section summarizes the results of this paper.

2   Theoretical background

Materiality definitions and guidance have been developed over time in various countries. International organizations, especially US standard setters and regulators, have published rules, regulations, and guidance with regard to materiality. All of these publications are principle-based and do not give specific guidance to companies on how to identify and evaluate whether the information is material or not. Iskandar and Iselin (1999) pointed out

that the majority of scientific materiality literature is focused on materiality thresholds regarding financial information. Furthermore, the literature is also focused on reporting content, changes in accounting principles, and findings during the assurance process. Messier et al. (2005) reviewed empirical research on materiality from 1982 onwards and focused their suggestions on auditing. Brennan and Gray (2005) conducted a literature review focused on materiality in accounting. The results show materiality definitions from the legal, accounting, and stock exchange environment. Both publications focus on financial aspects. However, the demand by stakeholders regarding material non-financial information is present, increasing, and will increase in the future (Iskandar & Iselin, 1999; KPMG International 2013; Rogers & Herz, 2013). To better understand the current materiality landscape, I provide an overview of current materiality definitions. Based on this overview, a materiality definition generated from the results of this literature review is proposed in section 4.

Materiality is part of accounting concepts and therefore it exists within clearly defined accounting standards such as the standards provided by the Financial Accounting Standards Board (FASB) or the IASB. Due to the importance of materiality, standard setters provide a number of definitions. Table 1 presents an overview of materiality definitions with regard to accounting and auditing. All of them have the backing of the law and therefore companies have to comply with these regulations (Eccles et al., 2012). Information disclosed in corporate reports should be determined by their materiality in order to comply with the law by providing a true and fair view of the company (Gordeeva, 2011). Furthermore, the SEC published a non-exclusive list of seven topics[1] to help companies identify their material information.

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[1] The seven topics are: 1) earnings information; 2) mergers, acquisitions, tender offers, joint ventures or changes in assets; 3) new products or discoveries or developments regarding customers or suppliers; 4) changes in control or in management; 5) change in auditors or auditor notification; 6) events regarding the issuer's securities; and 7) bankruptcies or receiverships (SEC, 2000).

Table 1: Materiality definitions with financial background

Author	Definition	Source
1) International definitions of materiality		
International Accounting Standards Board	"Omissions or misstatements of items are material if they could, individually or collectively, influence the economic decisions that users make on the basis of the financial statements."	International Accounting Standards Board 2011, p. 2
International Auditing and Assurance Standards Board	"Misstatements, including omissions, are considered to be material if they, individually or in the aggregate, could reasonably be expected to influence the economic decisions of users taken on the basis of the financial statements "	International Auditing and Assurance Standards Board 2009, p. 316
2) National definitions of materiality		
Australian Accounting Standards Board	"Information is material if its omission, misstatement or non-disclosure has the potential, individually or collectively, to: (a) influence the economic decisions of users taken on the basis of the financial report […]"	Australian Accounting Standards Board 2010, p. 7
Financial Accounting Standards Board	"The magnitude of an omission or misstatement of accounting information that, in the light of surrounding circumstances, makes it probable that the judgment of a reasonable person relying on the information would have been changed or influenced by the omission or misstatement."	Financial Accounting Standards Board 2008, p. 6
	"Information is material if omitting it or misstating it could influence decisions that users make on the basis of the financial information of a specific reporting entity."	Financial Accounting Standards Board 2010, p. 17
Financial Reporting Council	"Information is material – and therefore has relevance – if its omission or misstatement, individually or collectively, could influence the economic decisions of users taken on the basis of the financial statements."	Financial Reporting Council 2014, p. 12
Securities and Exchange Commission	"The term "material ", when used to qualify a requirement for the furnishing of information as to any subject, limits the information required to those matters about which an average prudent investor ought reasonably to be informed."	Securities and Exchange Commission 2002, p. 6
U.S. Supreme Court	An information is material "if there is a substantial likelihood that a reasonable shareholder would consider it important in deciding how to vote."	TSC Industries, Inc. v. Northway, Inc., 426 U.S. 438 at 449, 1976

Table 1 (continued)

Author	Definition	Source
U.S. Supreme Court	"[…] there must be a substantial likelihood that the disclosure of the omitted fact would have been viewed by the reasonable investor as having significantly altered the 'total mix' of information made available."	TSC Industries, Inc. v. Northway, Inc., 426 U.S. 438 at 449, 1976

The definitions presented in Table 1 consist of the following three comparable aspects for the evaluation of materiality definitions: subject of the definition, level of uncertainty, and reference base, where the reference base could change with a certain level of uncertainty. The first two aspects were introduced by Brennan and Gray (2005). The "subject of the definition" refers to the addressee of the information. The "level of uncertainty" describes how probable it is that the information influences the subject. The "reference base" describes the kind of foundation on which decisions or judgments are made.

According to the materiality definitions presented in Table 1, the subject of the definition is in three cases (33%) the (reasonable) investor respectively the shareholder. The other six (67%) definitions address the user (reasonable person) as recipient. The materiality definitions use different levels of uncertainty, where the most often mentioned levels are: could, substantial likelihood, reasonably, probable, and potential. All standards define the reference base in relation to the information provided by the company. In other words, the information is the basis for the decision-making process.

Financial outcomes alone do not present a true and fair view of the company in order to determine the likelihood of the future business success of the company. Financial information presents the current performance of a company, but also non-financial information has to be considered to determine the future prospects of a company (Rogers & Herz, 2013). Recent research shows that the number of published corporate reports which include non-financial information has significantly increased in recent years (KPMG

International, 2013). Companies and users of corporate reports have recognized that they also have to consider non-financial information in order to reduce uncertainties and better understand risks, opportunities, and resource constraints beyond access to capital (Eccles et al., 2012; Hsu, Lee, & Chao, 2013). Furthermore, growing interest in material non-financial information within the investment community encourages corporate reporting to be concerned with this type of information (KPMG International, 2013). This suggests that environmental, social, and governance information have to be determined with regard to their materiality based on their impact on value creation. Therefore, the next challenge is to identify material non-financial information (Eccles et al., 2012). The strong interest in this information from investors, the public, and the market also supports the movement to consider this information (Rogers & Herz, 2013).

Organizations such as AccountAbility, the Global Reporting Initiative (GRI), the International Integrated Reporting Council (IIRC), the Sustainability Accounting Standards Board (SASB) and the United Nations have developed and published their own definitions and guidelines regarding materiality for corporate reporting (e.g., Eccles et al., 2012; IIRC, 2013a). Table 2 presents the materiality definitions provided by AccountAbility, the GRI, the IIRC, and the SASB. The evaluation of the materiality definitions focusing on non-financial information was carried out again in accordance with the three introduced elements: subject, level of uncertainty, and reference base. The subjects of the definitions are the publishing organization itself, investors, and stakeholders. In four cases (67%) materiality is defined in relation to the information a company provides. The other two (33%) address the ability to create value. Both form the basis for the decision-making process. The level of uncertainty is similar to the financial materiality definitions and therefore contains terms such as: sufficiently important, substantively influence/affect, influence, and substantial likelihood.

Table 2: Materiality definitions with non-financial background

Author	Definition	Source
AccountAbility	"A material issue is an issue that will influence the decisions, actions and performance of an organization or its stakeholders."	Accountability 2008, p. 12
Global Reporting Initiative	"Materiality is the threshold at which Aspects become sufficiently important that they should be reported."	Global Reporting Initiative 2013a, p. 17
	"The report should cover Aspects that: ▪ Reflect the organization's significant economic, environmental and social impacts; or ▪ Substantively influence the assessments and decisions of stakeholders"	Global Reporting Initiative 2013b, p. 11
International Integrated Reporting Council	"A matter is material if it could substantively affect the organization's ability to create value in the short, medium or long term."	International Integrated Reporting Council 2013a, p. 33
	"[…] a matter is material if it is of such relevance and importance that it could substantively influence the assessments of providers of financial capital with regard to the organization's ability to create value over the short, medium and long term."	International Integrated Reporting Council 2013b, p. 2
Sustainability Accounting Standards Board	"[…] there must be a substantial likelihood that the disclosure of the omitted fact would have been viewed by the reasonable investor as having significantly altered the 'total mix' of information made available."	TSC Industries, Inc. v. Northway, Inc., 426 U.S. 438 at 449, 1976

In summary, the results show that both financial and non-financial standard setters have a similar understanding of materiality. Based on these findings, a generic definition of materiality is: "Omitting or misstating the reference base influences – with a certain degree of uncertainty – a subject's decision-making process." In contrast to the FASB or the IASB, guidelines on non-financial disclosure are not generally accepted and not mandatory (Eccles et al., 2012; Hsu et al., 2013), whereas the aim of both financial and non-financial standard setters is to enhance corporate reporting in order to help users of this information understand the current and future situation of a company. The materiality definitions show that investors and other users want to know how financial and non-financial information either interact with,

or influence, each other. Furthermore, they are interested in how this information is relevant for the long-term business success of a company and thus for their own decision-making processes.

3   Methodology

In order to get an understanding of the current state of research regarding materiality in conjunction with corporate reporting, a systematic literature review based on the methodology of Fink (2014) was carried out. She describes a literature review as "[…] a systematic, explicit, and reproducible method for identifying, evaluating, and synthesizing the existing body of completed and recorded work produced by researchers, scholars, and practitioners." (Fink, 2014)

The literature review is divided into seven steps. The first three steps comprise identifying and selecting research questions, and identifying relevant databases and search terms (Fink, 2014). As mentioned in the Introduction, the research questions are:

1) What is the current understanding of materiality?

2) In which context is the concept of materiality applied in the scientific literature?

3) (How) Is materiality identified, measured, and evaluated?

The databases WoS[2] and BSC[3] were identified and selected for the systematic literature research. In accordance with the above-mentioned research questions, materiality is the center of this review. The search term "material*" was used as the first search term to cover papers referring to "material information" and "materiality". The second search term considered notions with regard to corporate financial and non-financial reporting

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[2] Web of Science Core Collection provides reported scientific journals. See: http://rzblx10.uni-regensburg.de/dbinfo/detail.php?bib_id=slub&colors=&ocolors=&lett=f&tid=1&titel_id=2142.

[3] Business Source Complete is a scholarly business database. See: http://support.ebsco.com/help/?int=ehost&lang=en&feature_id=Databases&TOC_ID=Always&SI=0&BU=0&GU=1&PS=0&dbs=bth. Within BSC, the database Academic Search Complete was also taken into account. It is a scholarly, multi-disciplinary, full-text database. See: http://rzblx10.uni-regensburg.de/dbinfo/detail.php?bib_id=slub&colors=&ocolors=&lett=f&tid=1&titel_id=7941.

("accounting", "disclosure", "environment*", "IFRS", "intellectual capital", "measur*", "non-financial", "reporting", "social", "sustainability", "US-GAAP").

Following the fourth step of Fink's (2014) approach, the search results were limited to a processable number of results. The following practical screening criteria was applied. If the result of a query was above 300 hits, the query was narrowed down step-by-step for each search term, starting from the filter setting of "All text" to "Abstract" and finally to "Title" for the BSC database (from "Topic" to "Title" for the WoS database). Therefore, for the BSC database, in the first step both search terms were used in the field "All text". If the query resulted in more than 300 hits, the first search term was narrowed down from "All text" to "Abstract" while the second search term was unchanged. If the query resulted again in more than 300 hits, both search terms were narrowed down from "All text" to "Abstract". If the query again resulted in more than 300 hits, the first search term was narrowed down from "Abstract" to "Title" and the second search term was unchanged, and so on. A similar procedure was also applied to the WoS database.[4] Table 3 illustrates this procedure. For the WoS, the search considered only peer-reviewed journals included in the Social Sciences Citation Index. For the BSC, the search considered only scholarly (peer-reviewed) journals. The database Academic Search Complete, which could be additionally selected within the BSC database, was also considered. There were no restrictions made regarding the publication year or research design for both databases. Finally, only English publications were considered for analysis.

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[4] Some more restrictions had to be implemented here. The search combinations "material*" AND "measur*", "material*" AND "environment*" and "material*" AND "social" within the BSC database generated more than 300 hits. Therefore, these search combinations were used within the field "title". The search combinations "material*" AND "environment*" and "material*" AND "social" in the WoS database also generated more than 300 hits. Therefore these search combinations were used in the field "title".

Table 3: Database query procedure

Database	Search step	1st	2nd	3rd	4th	5th
WoS	1st search term	Topic	Title	Title	-	-
	2nd search term	Topic	Topic	Title	-	-
BSC	1st search term	All text	Abstract	Abstract	Title	Title
	2nd search term	All text	All text	Abstract	Abstract	Title

Notes:
The search within each database started at the 1st step with the mentioned search term combinations and fields. If the result of a query was above 300 hits the query was narrowed down by search fields and search term combinations. These restrictions of the explained procedure covered nearly all queries. Nevertheless, the author has had to make five exceptions. The search combinations "material*" AND "measur*", "environment*" and "social" within the BSC database generated more than 300 hits. Therefore, the search combinations "materiality" and "measur*", "materiality" and "environment*" and "materiality" and "social" were used in the field "title". Furthermore, the search combinations "material*" AND "environment*" and "social" within the WoS database generated more than 300 hits. Therefore, the search combinations "materiality" AND "environment*" and "materiality" AND "social" were used in the field "title".

In the fifth step, I decided – based on the methodological screening criteria – whether a publication was relevant or not (Fink, 2014). Therefore, the titles and abstracts of the results of step four were screened to identify relevant publications. Based on the described procedure, the systematic literature research identified 62 relevant publications. One publication was not available and therefore could not be considered. Table 4 shows an overview of the systematic literature review search procedure. The results of both database searches are presented in detail in Appendix 1 and Appendix 2.

Table 4: Overview of the search procedure

Search results	1474
▪ Studies excluded in the first screening step (based on information derived from title and abstract)	−1343
Search results considered for the second screening	131
▪ Studies excluded in the second practical screening step (based on information derived from full text)	−28
▪ Removing duplicates	−41
▪ Publications not available	−1
Studies analyzed in the review	61

Note:
The publication "Materiality disclosure and litigation risks: A Canadian perspective" by Cox, R., Dayanandan, A., & Donker, H. (2013) was not available for detailed research.

The sixth step was conducting a review by using a standardized review protocol (Fink, 2014). The review protocol enables the collection of all relevant data in a standardized way in order to answer the research questions and to identify the current state of research (Fink, 2014). The protocol consists of four parts. The first part is about bibliographic data and general information of the publication. This includes the name of the author(s), authors' affiliation, authors' origin, title, topic, year, and type of publication, as well as journal name and the journal Impact Factor. The second part is about the definition of materiality. It also investigates if there are any synonyms of materiality. The third part considers whether the publication mentions any procedures to measure or identify materiality, or a methodology to decide whether the information is material or not. This part also covers research gaps. Finally, the fourth part of the review protocol is only applicable for empirical papers. It includes information with regard to the sample, database, year, and statistical methods. The entire review protocol is presented in Appendix 3.

The last step was to synthesize the results (Fink, 2014). A content analysis in accordance with Krippendorff (2013) was carried out. The analysis is based on the review protocol described above. The software program MAXQDA[5] was used to support the content analysis. The results are presented in the next section.

4   Results

4.1   Bibliographic data

The publications identified in the systematic literature research cover 50 years. However, materiality has gained more attention in recent years. The majority (44 of 62) of the papers were published after 1990. The review identified 15 (25) papers which were published during the last five (ten) years. It is also noticeable that the materiality topic was more

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[5] MAXQDA is a software program for qualitative and mixed methods data analysis. See: http://www.maxqda.com/.

intensively discussed after materiality related events, such as the lawsuit of *TSC Industries, Inc. v. Northway, Inc.* in 1976, or the announcement of the Sarbanes–Oxley Act in 2002.

Table 5 presents descriptive statistics of the identified publications. Nearly three-quarter of the publications are journal articles. The remaining quarter consists of books, book sections, and articles in practitioner journals. The review identified 41 different journals. The majority (61%) is accounting and auditing related, followed by law-related journals (17%). Five journals are from the field of management and economics. The remaining journals are from other fields of research. Overall, 14 out of 41 journals have an Impact Factor. The largest proportion of the identified publications was written by authors who have an academic background (40). The rest were divided into publications with business-driven authors with no academic background (10) and publications which were written by authors with an academic and business background (5). All authors with no academic background are employed in auditing, assurance, or consulting companies. The authors of seven publications could not be categorized. The review identified 115 different authors, whereas three publications do not mention the author. The majority of the authors are located in English-speaking countries (80%), of which two-thirds are from the U.S.

Table 5: Identified journals including occurrence and ISI-Impact Factor

Journal name	Number of occurrence	Impact Factor 2013*	5-year Impact Factor*
Accountancy	1	0	0
Accountancy International	1	0	0
Accounting Forum	1	0	0
Accounting Horizons	2	0.787	1.711
Annals of the University of Oradea, Economic Science Series	1	0	0
Auditing: A Journal of Practice & Theory	3	0	0
Australian Accounting Review	1	0.825	0.693
Bank Accounting & Finance	1	0	0
Business Lawyer	5	0	0
Catholic University Law Review	1	0	0
Critical Perspectives on Accounting	1	0	0
Decision Sciences	1	1.561	3.025
DePaul Business & Commercial Law Journal	1	0	0
Economics & Management	1	0	0
Ekonomska Istrazivanja/Economic Research	1	0	0
European Accounting Review	1	0.942	1.519

Table 5 (continued)

Journal name	Number of occurrence	Impact Factor 2013*	5-year Impact Factor*
Finance & the Common Good/Bien Commun	1	0	0
Financial Accountability & Management	2	0	0
Financial Analysts Journal	1	1.077	1.055
Harvard Journal on Legislation	1	1.071	0.892
Harvard Law Review	1	6.567	4.166
International Journal of Disclosure and Governance**	1	0	0
Journal of Accountancy	3	0	0
Journal of Accounting and Economics	2	0	0
Journal of Accounting and Public Policy	1	1.115	1.444
Journal of Accounting Research	6	2.449	3.774
Journal of Accounting, Auditing & Finance	1	0	0
Journal of Applied Corporate Finance	2	0	0
Journal of Business Ethics	2	1.552	1.889
Journal of Business Finance & Accounting	2	1.261	1.240
Journal of Cleaner Production*	1	3.590	4.088
Journal of Corporation Law	1	0	0
Journal of International Accounting, Auditing and Taxation	1	0	0
Managerial Auditing Journal	1	0	0
Northwestern University Law Review	1	1.549	1.496
Pennsylvania CPA Journal	1	0	0
The Accounting Review	3	2.234	3.426
The British Accounting Review	1	0	0
The CPA Journal	1	0	0
The International Journal of Accounting	1	0	0
The Journal of Portfolio Management	1	0	0

Notes:

The Impact Factor for each journal was evaluated based on the JCR Social Sciences Edition. If a publication has no Impact Factor based on the JCR Social Sciences Edition, the publication was also evaluated based on the JCR Science Edition. Journals, which were evaluated based on the JCR Science Edition, are marked with a "". The journal of the publication, which was not available for this review, is marked with a "**". The results in the table are alphabetically sorted.*

4.2 Definitions

The results of the content analysis show that there is no difference between the meaning and understanding of the terms "materiality" and "material". The two terms are used as synonyms. Only eight publications mentioned synonyms for the term "materiality". The synonyms "important" (Fang & Jacobs, 2000; Hewitt, 1977; Pinsker, Pitre, & Daigle, 2009; Price & Wallace, 2002) and "significant" (Abdel-Khalik, 1977; Fang & Jacobs, 2000; Hewitt, 1977; Price & Wallace, 2002) were mentioned four times. The term "relevant" was mentioned twice (Popa, Bogdan, & Balaciu, w.y.; Rogers & Herz, 2013). The term "substantial" was

mentioned once (Price & Wallace, 2002). The results suggest that there was no need to investigate synonyms in more detail.

Table 6 summarizes the reference on which the materiality definitions are based. The majority of the publications refer to established materiality definitions provided by institutions and legal standard setters with a financial background (62%). Overall, the definition by the FASB was the most cited materiality definition (31%) followed by the SEC definition (15%) and the definition by the American Institute of Certified Public Accountants (AICPA) (8%). These results show that US standard setters and institutions are important within the materiality discussion. Two globally active standard setters – the International Federation of Accountants (5%) and the International Accounting Standards Committee[6] (3%) – were also cited. AccountAbility and the GRI were cited once as an example for a materiality definition with a non-financial background. In addition to institutions and organizations with financial or non-financial backgrounds, the materiality definition in *Kohler's Dictionary for Accountants* was cited five times (8%). Furthermore, since the establishment of the materiality concept in corporate reporting, many lawsuits focused on the question of whether certain information is material or not.[7] This is best illustrated by the U.S. Supreme Court lawsuit *TSC Industries, Inc. v. Northway, Inc.* in 1976 which was mentioned in eleven (18%) publications as very important in the context of materiality.

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[6] The International Accounting Standards Committee was replaced by the IASB in 2001.

[7] The publication by Hewitt (1977) gives an overview of past cases regarding materiality.

Table 6: Most important references for the definition of materiality

Reference	Source
1) Financial background	
Financial Accounting Standards Board	Acevedo (2005); Cho, Hagerman, Nabar, and Patterson (2003); Eccles et al. (2012); Gårseth-Nesbakk and Mellemvik (2011); Gordeeva (2011); Holder, Schermann, and Whittington (2003); Holmes (2008); Holstrum and Messier (1982); Kinney, Burgstahler, and Martin (2002); Mckee and Eilifsen (2000); Messier et al. (2005); Pany and Wheeler (1989); Park (2009); Pinsker et al. (2009); Roberts and Dwyer (1998); Seese and Doupnik (2003); Tuttle, Coller, and Plumlee (2002); W.A. (1997); Wright and Taylor (1982)
Securities and Exchange Commission	Eccles et al. (2012); Gårseth-Nesbakk and Mellemvik (2011); Holmes (2008); Hsu et al. (2013); O'Connor and Collins (1974); Pinsker et al. (2009); Rogers and Herz (2013); Rose, Beaver, Becker, and Sorter (1970); W.A. (1999)
American Institute of Certified Public Accountants	Abdel-Khalik (1977); Chewning, Pany, and Wheeler (1989); Frishkoff (1970); Holstrum and Messier (1982); Pinsker et al. (2009)
International Federation of Accountants	Edgley (2014); Edgley, Jones, and Atkins (2015); Popa, Span, Dumitru, Dumitru, and Filip (2013)
International Accounting Standards Committee	Gordeeva (2011); Iskandar and Iselin (1999)
2) Non-financial background	
AccountAbility	Edgley et al. (2015)
Global Reporting Initiative	Edgley et al. (2015)
3) Legal background	
TSC Industries, Inc. v. Northway, Inc.	Acevedo (2005); Dolan (1994); Edgley (2014); Fang and Jacobs (2000); Heitzman et al. (2010); Hewitt (1977); Horwich (2000); Miller (2000); Reiser (1977); Sauer (2007); W.A. (2012)
4) Cited authors	
Kohler	Edgley (2014); Frishkoff (1970); Hicks (1964); Ro (1982); Rose et al. (1970)
Fedders	Fang and Jacobs (2000)
Hendriksen and van Breda	Gårseth-Nesbakk and Mellemvik (2011)
Hicks	O'Connor and Collins (1974)
Karmel	Crusto (2005)

Notes:
Both parts, "Financial background" and "Legal background" show just a selection of the most mentioned references. Furthermore, to ensure a fair and true situation of the used terms each reference was just count once for a publication even it was mentioned more than once.

The generic definition of materiality presented in section 2 contains the three elements "subject", "reference base", and "level of uncertainty". The content of the materiality definitions of the publications identified by the literature review is analyzed in accordance with the generic definition provided there. The results are summarized in Table 7. By far the most often mentioned subject of the definitions was "person" (39%), followed by "investor" (25%) and "user" (23%). The definitions within the publications do not specify the subject person or user in more detail, which leaves some ambiguity over who the information might be material for. A person or user represents a broader group of relevant stakeholders, whereas investors represent a specific group of stakeholders. Consequently, a person or user could also be an investor. Therefore it can be assumed that investors are an important group within the materiality discussion. In regard to the reference base, around one-third of the publications are focused on the decision influenced by the provided information. Slightly fewer publications (30%) mentioned the judgment as reference base which is influenced by the available information. A few publications mentioned just the information (16%). These results indicate that material information is needed within a decision-making process or to make an informed judgment. Therefore, the information is the reference base. The specific terms used to describe the level of uncertainty are: substantial likelihood (25%), probable (18%) and reasonably (11%).[8] In summary, based on the generic definition provided in section 2 and in accordance with the review results, materiality is: "Omitting or misstating a piece of information does, with substantial likelihood, influence a person's decision-making process."

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[8] The level of uncertainty is intensively discussed in the research field of law. There are differences between the mentioned levels of uncertainty. However, these legal aspects are not part of this review and therefore they are not discussed in more detail. For more detailed information, please see e.g. Hewitt (1977).

Table 7: Most important subjects, reference base and levels of uncertainty

Reference value	Source
1) Subject of the definition	
Person	Acevedo (2005); Chewning et al. (1989); Crusto (2005); Eccles et al. (2012); Edgley (2014); Gårseth-Nesbakk and Mellemvik (2011); Gordeeva (2011); Hicks (1964); Holder et al. (2003); Hsu et al. (2013); Kinney et al. (2002); Mckee and Eilifsen (2000); Messier et al. (2005); O'Connor and Collins (1974); Pany and Wheeler (1989); Park (2009); Ro (1982); Roberts and Dwyer (1998); Rose et al. (1970); Seese and Doupnik (2003); Tuttle et al. (2002); van Braeckel and Bontemps (2006); W.A. (1999)
Investor	Dolan (1994); Eccles et al. (2012); Edgley (2014); Heitzman et al. (2010); Holstrum and Messier (1982); Horwich (2000); Messier et al. (2005); O'Connor and Collins (1974); Reiser (1977); Rogers and Herz (2013); Rose et al. (1970); Sauer (2007); W.A. (2012); Wallace, Carducci, and Dipillo (2008); Wright and Taylor (1982)
User	Abdel-Khalik (1977); Cho et al. (2003); Eccles et al. (2012); Edgley (2014); Edgley et al. (2015); Frishkoff (1970); Gordeeva (2011); Houghton, Jubb, and Kend (2011); Iskandar and Iselin (1999); Messier et al. (2005); Pinsker et al. (2009); Popa et al. (2013); Shafer (2002); W.A. (1997)
Shareholder	Acevedo (2005); Dolan (1994); Fang and Jacobs (2000); Hewitt (1977); Miller (2000)
Company	Edgley et al. (2015); Holstrum and Messier (1982); Houghton et al. (2011)
Stakeholder	Edgley et al. (2015)
2) Reference base[1]	
Decision[2]	Abdel-Khalik (1977); Acevedo (2005); Cho et al. (2003); Dolan (1994); Eccles et al. (2012); Edgley (2014); Edgley et al. (2015); Frishkoff (1970); Gordeeva (2011); Houghton et al. (2011); Iskandar and Iselin (1999); Messier et al. (2005); Miller (2000); O'Connor and Collins (1974); Pinsker et al. (2009); Reiser (1977); Sauer (2007); Shafer (2002); van Braeckel and Bontemps (2006); W.A. (1997)
Judgment[2]	Acevedo (2005); Chewning et al. (1989); Edgley (2014); Gårseth-Nesbakk and Mellemvik (2011); Gordeeva (2011); Hicks (1964); Holder et al. (2003); Holmes (2008); Hsu et al. (2013); Kinney et al. (2002); Mckee and Eilifsen (2000); Messier et al. (2005); Pany and Wheeler (1989); Ro (1982); Roberts and Dwyer (1998); Rose et al. (1970); Seese and Doupnik (2003); Tuttle et al. (2002)
Information	Dolan (1994); Eccles et al. (2012); Edgley (2014); Heitzman et al. (2010); Horwich (2000); Rogers and Herz (2013); Sauer (2007); W.A. (1999); W.A. (2012); Wallace et al. (2008)

Table 7(continued)

Reference value	Source
3) Level of uncertainty	
Substantial likelihood	Acevedo (2005); Crusto (2005); Dolan (1994); Eccles et al. (2012); Fang and Jacobs (2000); Heitzman et al. (2010); Hewitt (1977); Horwich (2000); Miller (2000); Park (2009); Reiser (1977); Sauer (2007); W.A. (1999); W.A. (2012); Wallace et al. (2008)
Probable	Acevedo (2005); Gårseth-Nesbakk and Mellemvik (2011); Gordeeva (2011); Holder et al. (2003); Holmes (2008); Hsu et al. (2013); Kinney et al. (2002); Mckee and Eilifsen (2000); Messier et al. (2005); Seese and Doupnik (2003); Tuttle et al. (2002)
Reasonably	Edgley (2014); Edgley et al. (2015); Messier et al. (2005); O'Connor and Collins (1974); Rose et al. (1970); Sauer (2007); Wright and Taylor (1982)

Notes:
In order to ensure a fair and true situation of the used terms, each reference was just count once for a publication (even it was mentioned more than once).
[1] *The reference base and the level of uncertainty show just a selection of the most mentioned references.*
[2] *The results indicate that material information is needed for a decision-making process or to make an informed judgment. Therefore, the real reference base is the information.*

In addition to the three elements of the materiality definition, Park (2009) emphasizes that the definition of materiality should also state whether it focuses on quantitative or qualitative aspects (or even both) in the decision-making process. The SEC noted in the *Staff Accounting Bulletin* 99 that both quantitative and qualitative issues have to be considered in assessing an item's materiality (SEC, 1999). Several other publications also mentioned that the materiality concept has to consider both quantitative as well as qualitative aspects to completely inform the target group (Brennan & Gray, 2005; Eccles et al., 2012; Miller, 2000; Park, 2009). Therefore, the reference base – as one of the three elements of the materiality definition – can be specified by the nature of a piece of information. If there is no distinction made between qualitative or quantitative content within the materiality definition, it is to be assumed that both are meant.

4.3 General data

The following part presents the identified materiality measurement approaches. The review shows that materiality is nearly exclusively discussed within the scope of mandatory

reporting. Materiality concepts provided by the FASB, the SEC, or other established standard setters do not deliver any guidance regarding how to measure materiality or how to decide whether a piece of information is material or not. The measurement approaches identified through the review do not go beyond rules of thumb, percentages, and numeric thresholds. Edgley (2014) refers to the fact that no source of guidance currently exists that codifies the concept precisely. However, according to Ro (1982), real information value is necessary for a piece of information to become material. Therefore, the established thresholds for materiality support practitioners in deciding whether the information is material or not (Fang & Jacobs, 2000). A threshold for material information is the minimum amount of omission or misstatement that would influence the judgment or decision of a user of this information (Holstrum & Messier, 1982). Based on certain thresholds, accountants and auditors developed rules of thumb for corporate reporting and auditing by which economically insignificant information could be excluded and economically significant information included (Fang & Jacobs, 2000). It is also taken into account that however large the *ex ante* magnitude of a piece of information is, if it is not material, it is not material at all and no further consideration is necessary (Ro, 1982).

The content analysis identified 20 publications (33%) which mentioned and discussed one or more specific thresholds for materiality. Based on the results of the review the following three specific threshold groups were classified: single explicit threshold, multiple explicit threshold, and threshold range. Table 8 summarizes the papers in relation to the three different threshold groups and their subject. The threshold groups differ in scale and subject from each other. The single explicit threshold refers to a relative value above which materiality is assumed. For example, items with more than five percent impact on income are material. Single explicit thresholds are mentioned by 15 publications (75%). The multiple explicit threshold defines two explicit thresholds for immaterial and material information respectively. For example, an item below five percent impact on income is immaterial and an

item above ten percent impact on income is material. Information between these two explicit thresholds is within a so-called "gray area" in which it is questionable whether the information is material or not (Wright & Taylor, 1982). Therefore, according to Wright and Taylor (1982), it is a matter of professional judgment to decide whether the information within this "gray area" is material or not. This group was mentioned by three publications (15%). The third group is the group threshold range. It was used by eight publications (40%) and defines the materiality of a piece of information when this information is within a specific range. For example, items between five and ten percent impact on income are material. It is in the eye of the beholder what threshold within the mentioned range is the appropriate one for the specific situation. This also means that items below five percent impact on income are definitely immaterial and items above ten percent impact on income are definitely material. Furthermore, the results show that income (measured as income, net income, and pre-tax income) is the most often used baseline to define a materiality threshold. Therefore, the results of the content analysis confirm the results provided by Messier et al. (2005), that the effect of an item on income is one of the most significant factors when it comes to determining materiality. Based on the results presented in Table 8, total assets is an important subject within the single explicit threshold group as well.

Table 8: Different materiality thresholds

Subject	Threshold in percent	Source
1) Single explicit threshold		
Earnings per share	3	O'Glove and Olstein (1977)
	5	Eccles et al. (2012)[1]; Edgley (2014); Gleason and Mills (2002); Hsu et al. (2013)[1]
Income	2.5	Pinsker et al. (2009)
	4	Chewning et al. (1989); Holstrum and Messier (1982)
	5	Chewning et al. (1989); Gleason and Mills (2002); Holstrum and Messier (1982); Pinsker et al. (2009)
	10	Chewning et al. (1989); Pinsker et al. (2009)
	20	Chewning et al. (1989)
Net income	5	Acito, Burks, and Johnson (2009); Chewning et al. (1989); Park (2009)
	10	Tuttle et al. (2002)
Net income after taxes	4	Iskandar and Iselin (1999)
Pre-tax income	5	Mckee and Eilifsen (2000); Pany and Wheeler (1989); Park (2009)
Total assets	0.5	Mckee and Eilifsen (2000); Pany and Wheeler (1989); Pinsker et al. (2009)
	1	Pinsker et al. (2009)
	1.5	Pinsker et al. (2009)
	5	Gleason and Mills (2002)[2]; Houghton et al. (2011)
2) Multiple explicit threshold		
Income	< 4 to 5 and > 10	Holstrum and Messier (1982)
Net income	< 3 and > 5	Wright and Taylor (1982)
	< 4 to 5 and > 10	Chewning et al. (1989)
	< 5 and > 8	Wright and Taylor (1982)
	< 5 and > 10	Wright and Taylor (1982)
	< 5 and > 17	Chewning et al. (1989)
	< 6 and > 10	Wright and Taylor (1982)
3) Specific threshold range		
Earnings per share	5 to 10	Sauer (2007)
Income	2.7 to 7.3	Chewning et al. (1989)
	3 to 5	Chewning et al. (1989)
	5 to 10	Chewning et al. (1989)

Table 8 (continued)

Subject	Threshold in percent	Source
Net income	5 to 10	Edgley (2014); Sauer (2007)
	10 to 15	Patterson (1967)
Net income after taxes	5 to 10	Iskandar and Iselin (1999)
	10 to 15	Holstrum and Messier (1982)
Pre-tax income	5 to 10	Gordeeva (2011)
	5 to 15	Iskandar and Iselin (1999)
Total assets	0.5 to 1	Acevedo (2005)
	0.5 to 2	Gordeeva (2011)

Notes:
The table shows a selection of the identified thresholds based on different subjects. The majority of authors have not identified the thresholds by their own; the authors cited these thresholds form other authors. Thresholds which are defined by the authors are underlined.
[1] Actually the authors defined the threshold for "earnings before income taxes".
[2] Actually the authors defined the threshold for "assets".

The identified threshold areas "single explicit threshold" and "multiple explicit threshold", as a result of my systematic literature review, confirm the findings of Holstrum and Messier (1982) who mentioned that 1) items with more than ten percent effect of income would normally be considered material by all groups and 2) items that have less than a four or five percent effect would normally be considered immaterial by all groups. However, according to the SEC *Staff Accounting Bulletin 99*, such percentage or numerical thresholds (or the so-called rules of thumb) have no basis in accounting standards or law (SEC, 1999). Eccles et al. (2012) criticize numerical thresholds and argue that, to determine materiality, the magnitude as well as the nature of a piece of information must be considered. Therefore, the decision as to whether information is material or not is also a matter of professional judgment (Edgley, 2014). Accountants and auditors have to decide whether such information could influence the decision of the user (Gleason & Mills, 2002; Hicks, 1964; International Auditing and Assurance Standards Board, 2009; Roberts & Dwyer, 1998). Furthermore, according to Heitzman et al. (2010), based on the materiality of a piece of information, the materiality threshold is lower the greater the expected impact of this piece of information on

the specific interest group. Thresholds for non-financial information could not be identified during the review.

4.4   Empirical publications

The systematic literature review identified 14 publications with an empirical background. Appendix 4 summarizes the findings, methods, samples, years, and databases of the identified publications.

The review identified a diversity of different research areas which were addressed in these publications. Different materiality thresholds were also investigated within the various research areas. The rules of thumb were used to measure materiality or to identify material information. According to the empirical findings on materiality thresholds by Wright and Taylor (1982), an item's percentage effect on income is the most important factor in materiality judgments. Furthermore, auditors' perceptions of different materiality thresholds and items were also analyzed for different research areas. More than three quarters (79%) of the publications investigated company-specific information. The research was based on published information and company reports (e.g., quarterly reports, annual reports, footnotes). The other three publications investigated stocks, analysts' behavior and procedures, as well as conducting interviews with management in commerce. The methods applied differ between the publications. However, common empirical and statistical approaches were frequently used. Furthermore, an index of comparability was used twice to investigate country-specific accounting regulations. All empirical publications have a homogenous understanding of materiality, which is based on common materiality definitions and understandings. The results indicate that materiality is connected to many different research fields.

Another important result relevant for the materiality measurement discussion was provided by Cho et al. (2003). The authors investigated the investors' perceptions of materiality in the context of certain materiality criteria. The findings show that the

investigated materiality threshold levels are essentially lower than those discussed in the auditing literature and those which are used in practice. The threshold for pre-tax income is between 0.1% to 0.2%, which is considerably lower than the 5% to 10% and 15% discussed in the auditing literature as presented in Table 8. For total assets, the threshold from the investor perspective is between 0.01% to 0.025%, compared to 0.5% to 5% mentioned in auditing research (Cho et al., 2003) as presented in Table 8. Therefore, based on the results, it can be assumed that investors have lower threshold levels than currently acknowledged. This is further supported by Holstrum and Messier (1982), as well as Wright and Taylor (1982), who argue that users of information (e.g., investors) have lower materiality thresholds than preparers or auditors. The results raise the question of whether different stakeholder groups apply different materiality thresholds. However, there was no study which focuses on the implicit materiality thresholds of different stakeholders.

5   Discussion and further research

This section discusses the findings of the systematic literature review and the implications for further research. Therefore, this part is structured in accordance with the review protocol.

Section 2 mentions several definitions of materiality. Most are based on legal requirements for corporate reporting and auditing. The definitions provided by financial institutions and standard setters are also well accepted within the non-financial materiality discussion. However, all of the materiality concepts are principle-based. Guidance to determine materiality for any specific information does not exist. Preparers and auditors have to anticipate which information users consider to be material. The resulting ambiguity causes some problems (Morris et al., 1984). According to Reiser (1977), it is not possible to define materiality for each and every case. Objectives of the decision maker, factors relevant to the materiality decision, weights given to these factors, and the form of the decision model are components which affect the judgment or the decision-making process with regard to

materiality. The results of the review show that materiality is on the one hand well defined, but on the other hand a fuzzy concept. There is no "one-size-fits-all" approach for materiality. Different users have different information needs. For example, preparers' models of materiality are different from users' models (Morris et al., 1984). Therefore, a general approach does not support the materiality discussion. It can be assumed that different interest groups (e.g., users, preparers, auditors) have significantly different expectations (Wright, 1998) and specific information could have different thresholds among different stakeholders based on the expected impact (Heitzman et al., 2010). Thus, a fixed materiality standard for all users is not feasible (Ro, 1982). Further research should investigate which information is material for a specific stakeholder group. Empirical results suggest that capital market participants are such a group. They are often explicitly referred to in materiality definitions and they are also the most often mentioned specific target group for financial and non-financial corporate reports and other company related publications.

Independent of the audience of materiality models and approaches, another important topic to be considered is how to measure or evaluate whether the information is material or not. The disclosure decisions for practitioners are affected by: the direction of the news of the disclosed item, the magnitude of the disclosed information, the sensitivity of the company's equity returns to changes of the information, and the impact of the information on the company's default risk, because they all affect the materiality threshold (Heitzman et al., 2010). According to Cho et al. (2003) it is not possible to observe the users' decision-making processes. However, the results of users' decision-making processes can be observed. Decision effects with regard to a disclosure of the information could be observed based on events and occurrences which are the results of the decision-making processes by the users. For example, it is possible to observe the effect of investors' decisions by observing the movements of stock prices (Cho et al., 2003).

The review also identified several different materiality thresholds for several subjects regarding financial information. The next step could be to confirm the three suggested threshold groups for material financial information or to evaluate different thresholds. None of the identified subjects and thresholds were investigated for non-financial information. Further research should investigate under which circumstances the current materiality thresholds for financial information are equal for non-financial information, or whether if it is necessary to develop new ones. For this purpose, it is necessary to investigate which non-financial information is material for users and is therefore needed within decision-making processes. The results of the financial materiality discussion should be considered in this process. They identified several common materiality thresholds and measurement approaches, such as the ten different rules of thumb summarized by Pany and Wheeler (1989) which should support this process. Addressing the materiality of non-financial information also calls for the application of different research methods. Iskandar and Iselin (1999) found that materiality research approaches move from questionnaires and surveys to experimental designs. Experimental research designs are much more appropriate to investigate the complexity of materiality (Iskandar & Iselin, 1999). Further research approaches should consider this finding as well.

6   Conclusion

This review presents the current state of research on materiality regarding materiality definitions, as well as materiality measurement approaches for financial and non-financial reporting. The concept of materiality is important within practicing accounting, auditing and management. Practitioners within companies have to fulfill legal requirements and therefore they have to anticipate, evaluate, and disclose material information without knowing what the users of the information really want to know or on which basis they make their decisions. Therefore, it is important to understand how materiality is defined and how it can be measured. The systematic literature review, based on the methodology of Fink (2014),

comprehensively covers the literature with regard to the research area of materiality and identified 62 relevant publications. They cover accounting, auditing, law, and management topics. The review reveals that the majority of scientific literature on materiality is focused on materiality thresholds, effects of a change in accounting principles, errors discovered by auditors, and internal control weaknesses. Furthermore, the review has the following implications.

First, the majority of the publications have a similar materiality understanding. The review finds no evidence for the difference between the definition of materiality for financial and non-financial information. Even some non-financial institutions or standard setters refer to financial institutions or standards. The results indicate that materiality is interdisciplinary. However, material non-financial information is not well investigated within the current literature. Therefore, based on the increasing demand of such information by various stakeholders, especially capital market participants, further research should consider this field of research. Second, the review identified some approaches which try to evaluate and measure materiality. Nearly all of them are based on commonly used materiality thresholds, which are usually developed based on personal experience and judgment rather than on science. Furthermore, nearly all of these approaches are quantitative. Studies rarely applied qualitative assessments to identify material information. A more complex model which systematically determines material information has not been found. Most of the literature offers a general and principle-based approach. Materiality is based on the relevance of a piece of information in the eye of the beholder. This makes the materiality discussion difficult, because users' needs of such information are very different and their decision-making processes fuzzy. Therefore, future research could develop an enhanced model to determine which information is material for specific stakeholder groups, including thresholds, and the reason why this information is material. Additionally, existing or newly developed measurement approaches should be validated. Third, the review contributes to the materiality discussion by confirming

the results of Messier et al. (2005) that the effect of an item on income is one of the most significant factors when it comes to determine materiality. Furthermore, it contributes to the discussion by Fang and Jacobs (2000) that, based on non-existent guidance, practitioners have established materiality thresholds which are used in order to identify the materiality of a piece of information. The review has classified the following three commonly used specific threshold groups: single explicit threshold, multiple explicit threshold, and threshold range. Fourth, the review identifies potential research themes and provides an overview of research gaps within the current materiality literature. Based on these findings, research methods to identify and validate measurement approaches of materiality could be manifold and contain interviews, questionnaires, surveys, empirical models, or experimental settings.

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[9] All identified publications from the systematic literature review are marked with a "*" at the end.

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Appendix

Appendix 1: Research results of the database research Web of Science Core Collection

Topic	AND	Topic	Date	Results	Relevant	Used
"material*"		"accounting"	08/27/2014	647		
"material*"		"disclosure"	08/27/2014	430		
"material*"		"IFRS"	08/27/2014	13	0	0
"material*"		"intellectual capital"	08/27/2014	11	0	0
"material*"		"measur*"	08/27/2014	8,515		
"material*"		"non-financial"	08/27/2014	12	0	0
"material*"		"reporting"	08/27/2014	846		
"material*"		"US-GAAP"	08/27/2014	1	0	0
"material*"		"environment*"	03/01/2015	105,079		
"material*"		"social"	03/01/2015	18,304		
"material*"		"sustainability"	03/01/2015	3,824		

Title	AND	Topic	Date	Results	Relevant	Used
"material*"		"accounting"	08/27/2014	76	8	7
"material*"		"disclosure"	08/27/2014	59	15	15
"material*"		"measur*"	08/27/2014	657		
"material*"		"reporting"	08/27/2014	65	8	5
"material*"		"environment*"	03/01/2015	12,188		
"material*"		"social"	03/01/2015	1,352		
"material*"		"sustainability"	03/01/2015	422		

Title	AND	Title	Date	Results	Relevant	Used
"material*"		"measur*"	08/27/2014	110	0	0
"material*"		"environment*"	03/01/2015	2,689		
"material*"		"social"	03/01/2015	518		
"material*"		"sustainability"	03/01/2015	72	1	1

Title	AND	Title	Date	Results	Relevant	Used
"materiality"		"environment*"	03/01/2015	1	0	0
"materiality"		"social"	03/01/2015	0	0	0
			Sum	**420**	**32**	**28**

Note:
The table contains duplicates.

Appendix 2: Research results of the database research Business Source Complete

All text	AND	All text	Date	Results	Relevant	Used
"material*"		"accounting"	08/28/1014	212,312		
"material*"		"disclosure"	08/28/1014	82,066		
"material*"		"IFRS"	08/28/1014	2,114		
"material*"		"intellectual capital"	08/28/1014	4,970		
"material*"		"measur*"	08/28/1014	1,870,988		
"material*"		"non-financial"	08/28/1014	6,872		
"material*"		"reporting"	08/28/1014	223,447		
"material*"		"US-GAAP"	08/28/1014	661		
"material*"		"environment*"	03/01/2015	1,251,791		
"material*"		"social"	03/01/2015	854,543		
"material*"		"sustainability"	03/01/2015	76,386		

Abstract	AND	All text	Date	Results	Relevant	Used
"material*"		"accounting"	08/28/1014	16,152		
"material*"		"disclosure"	08/28/1014	7,359		
"material*"		"IFRS"	08/28/1014	131	5	4
"material*"		"intellectual capital"	08/28/1014	185	6	1
"material*"		"measur*"	08/28/1014	254,198		
"material*"		"non-financial"	08/28/1014	280	14	9
"material*"		"reporting"	08/28/1014	15,606		
"material*"		"US-GAAP"	08/28/1014	41	5	5
"material*"		"environment*"	03/01/2015	156,502		
"material*"		"social"	03/01/2015	64,061		
"material*"		"sustainability"	03/01/2015	7,320		

Abstract	AND	Abstract	Date	Results	Relevant	Used
"material*"		"accounting"	08/28/1014	4,206		
"material*"		"disclosure"	08/28/1014	3,336		
"material*"		"measur*"	08/28/1014	127,054		
"material*"		"reporting"	08/28/1014	2,846		
"material*"		"environment*"	03/01/2015	50,704		
"material*"		"social"	03/01/2015	19,818		
"material*"		"sustainability"	03/01/2015	2,164		

Title	AND	Abstract	Date	Results	Relevant	Used
"material*"		"accounting"	08/28/1014	444		
"material*"		"disclosure"	08/28/1014	88	20	17
"material*"		"measur*"	08/28/1014	14,426		
"material*"		"reporting"	08/28/1014	168	27	18
"material*"		"environment*"	03/01/2015	5,398		
"material*"		"social"	03/01/2015	1,369		
"material*"		"sustainability"	03/01/2015	27	2	2

Title	AND	Title	Date	Results	Relevant	Used
"material*"		"accounting"	08/28/1014	97	10	9
"material*"		"measur*"	08/28/1014	1,888		
"material*"		"environment*"	03/01/2015	988		
"material*"		"social"	03/01/2015	339		

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Appendix 2 (continued)

Title	AND	Title	Date	Results	Relevant	Used
"materiality"		"measur*"	08/28/1014	10	6	6
"materiality"		"environment*"	03/01/2015	6	3	3
"materiality"		"social"	03/01/2015	21	1	1
			Sum	**1,054**	**99**	**75**

Note:
The table contains duplicates.

Appendix 3: Review protocol

Bibliographic data

Author	Who is the author of the publication?
Author Affiliation	What institutional background does the first author of the publication have?
Author's country	Where does the author come from?
Year	In which year was the publication published?
Title	Which title does the publication have?
Type of the publication	To which category does the publication belong to (e.g., book, book chapter, journal, report, practitioner-related report)?
Journal	What is the name of the journal?
ISI-Impact Factor	What is the value of the ISI-Impact Factor in 2013?
Topic of the publication	What is the topic of the publication?

Definitions

Materiality	How the author defines materiality? Which author is cited?
Material	How the author defines materiality? Which author is cited?
Synonyms	Are there any synonyms with regard to materiality and/or material information relating corporate reporting? Which author is cited?

General data

Measurement	How does the author measure materiality and/or material information with regard to corporate reporting? Which author is cited?
Research gap	Is there any further research described which needs to be done?

Only for empirical publications

Sample	How large is the sample?
Database	Where is the database from (e.g., database, survey)?
Year	From which year is the database?
Statistic methods	Which statistical methods are applied?

Appendix 4: Results of the empirical publication analysis

Findings	Method	Sample (year)	Database	Source
Materiality is measured directly by evaluating decision effects.	Multivariate discriminant analysis	233 stocks (1962 through 1970)	-	Abdel-Khalik (1977)
Materiality considerations cited in authoritative guidance explain a large portion of the variation in firms' error correction decisions. Materiality judgments reflect both quantitative and qualitative considerations. Materiality guidance is too vague.	Error correction approach Logistic regression model	244 firms (2004 through 2005)	Analysts' Accounting Observer and Compustat	Acito et al. (2009)
The most frequently occurring items appearing in the reconciliations were adjustments for goodwill, deferred tax, pension costs and post-retirement benefits, asset revaluation and restructuring costs.	Index of comparability	All UK companies reporting to the SEC (1994)	-	Adams et al. (1999)
Average investors' materiality threshold for: pretax income, total assets and sales. Materiality threshold levels are essentially lower than those discussed in auditing literature and used in practice.	Earnings-response and sales-response model	31,470 firm-quarters (1998)	Compustat PC-Plus CD, I/B/E/S earnings forecast summary tape and CRSP Access	Cho et al. (2003)
The relative effect of changes in accounting to net income was the most significant classificatory variable. The size of the reporting company was a significant classificatory variable.	Descriptive statistics Multiple discriminant analysis Regression analysis	190 annual reports of companies (1963)	Jackson Library of Business at Stanford University	Frishkoff (1970)
The probability of disclosure increases in the relative amount of the claim or the expected loss. The amount accrued for the contingent liability increases in the amount of the expected loss.	Descriptive statistics	100 large industrial firms (from 1987 to 1995)	Compustat PST and the database of IRS	Gleason and Mills (2002)

Appendix 4 (continued)

Findings	Method	Sample (year)	Database	Source
The probability of disclosing advertising in the year after the rule change is increasing in the magnitude of advertising intensity in the year before.	Several empirical tests	Pre-FRR 44 disclosing sample n=1184 (1994)	Compustat, SDC and CRSP	Heitzman et al. (2010)
Disclosure of advertising, on average, is increasing in ERCs, firm size, industry concentration and the likelihood of a future debt issuance.		Non-advertising sample n=2578 (1994)		
The maximum probability of a gain from trading on prior knowledge of any surprise magnitude.	Frequency and statistical analyses	22,023 firm-years (from 1992 to 1997)	Compustat and CRSP	Kinney et al. (2002)
The S-shape is related empirically to the dispersion of analyst forecasts.				
There is no general rule such that values less than X percent are always immaterial and values greater than Y percent are always material.	Descriptive statistics	221 firm's annual report (1979/1980 or 1980/1981)	AICPA National Automated Accounting Retrieval System	Morris et al. (1984)
There appears to be no consensus of materiality judgments between groups or within groups.				
Among the various rules of thumb for calculating materiality, sizable differences can occur.	Calculated industry materiality averages	330 companies (1977 through 1986)	Standard and Poor's annual Compustat data base	Pany and Wheeler (1989)
Significant correlation between the materiality level and the sectors in which the audited companies operate, the auditor's experience in the field and the longevity of the relationship with the client.	Ordered Logit Model	247 active financial auditors (2011)	Members of the Chamber of Financial Auditors of Romania	Popa et al. (2013)
There is no correlation between the materiality level and the needs of the users of financial statements or the management objectives.				

Appendix 4 (continued)

Findings	Method	Sample (year)	Database	Source
Across two regions both the magnitude of operations and the level of country risk significantly affect financial analysts' judgments about firm risk. Materiality is often evaluated in quantitative terms, the qualitative. Criterion of country risk may dominate in importance.	Experimental approach	476 equity analysts	List from the AIMR	Seese and Doupnik (2003)
Raising general concerns regarding the likelihood of executives yielding to organizational pressures for the manipulation of financial results. Risk and materiality continue to influence judgments in a situation in which they should have no influence.	Case study	138 senior executives in commerce or industry (-)	AICPA members	Shafer (2002)
The impact of accounting differences between IASs and US GAAP is narrowing and suggest that the SEC should consider accepting IASC standards without condition.	Index of comparability	33 companies (1997)	List supplied by the SEC	Street et al. (2000)

Notes:
The identified publications were descending sorted by year (if there is more than one publication within a year the publications were alphabetically sorted). The content of the table is directly cited from the publications.

What is material for analysts? A study of conference calls within the chemical sector

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Abstract

The materiality concept is a key element of effective communication between companies and capital market participants. The paper focuses on analysts, who serve as proxies for investors and therefore represent one of the most important interest groups for companies. Analysts evaluate companies and provide their clients with stock recommendations. Therefore, it is important to know which information is material for them to enhance firms' communication and analysts' valuation. Based on a content analysis of 110 conference calls of chemical companies in the time period from 2013 to 2015, the paper investigates materiality for the three elements type, time, and topic. The results indicate that analysts consider 1) significantly more financial than non-financial information and 2) more forward-looking than backward-looking information in their valuation processes. The paper shows that 3) the non-financial topics environment and social were considered as financially rather than non-financially oriented, which implies increasing awareness of environmental and social information among capital market participants within the chemical sector. Finally, the paper presents the first network analysis to investigate the connections and interdependencies of the topics addressed within conference calls in the chemical sector.

1   Introduction

Mandatory disclosure rules are designed to ensure that reported information meets certain regulations and standards (Eccles & Serafeim, 2013). One of the most important concepts within accounting, which helps companies to focus their reporting activities, is the materiality concept (Gordeeva, 2011; Messier, Martinov-Bennie, & Eilifsen, 2005). The literature regarding materiality is especially focused on reporting content, changes in accounting principles, and findings during the assurance process (Iskandar & Iselin, 1999). However, current financial reporting does not capture all the information that a company has about its performance and future outlook (Tasker & Johnson, 1998). Therefore, companies use other communication channels to provide their interest groups with material information.

In recent years the conference call format has emerged as a communication instrument for companies to impart material information to one of their most important stakeholders – capital market participants (Bowen, Davis, & Matsumoto, 2002; Eccles & Serafeim, 2013; Kimbrough, 2005; Tasker & Johnson, 1998). It also provides an important possibility for analysts and investors to interact with companies (Mayew, Sharp, & Venkatachalam, 2013; Previts, Bricker, Robinson, & Young, 1994; Price, Doran, Peterson, & Bliss, 2012). Cho, Hagerman, Nabar, and Patterson (2003) argue that it is not possible to investigate which information is material for analysts based on their valuation models (directly) but rather which information analysts ask for via contact with the company (indirectly). Mayew et al. (2013) conclude that material information can be collected during a conference call. The fact that analysts participate in conference calls also indicates that these calls provide material information (Bassemir, Novotny-Farkas, & Pachta, 2013; Bowen et al., 2002; Frankel, Johnson, & Skinner, 1999; Mayew et al., 2013).

It is therefore necessary to understand which information is material for conference call participants and therefore asked for during the call to be able to communicate effectively with them (Bradshaw, 2011). The presentation and discussion sessions of conference calls are

incrementally informative (Matsumoto, Pronk, & Roelofsen, 2011). Conference calls could result in the release of material information or at least the disclosure of some new information during the conference call (Bowen et al., 2002; Matsumoto et al., 2011). Consequently, it is suggested that conference calls enhance analysts' ability to evaluate a company and forecast the next quarter with greater accuracy (Bowen et al., 2002). The research results indicate that the parts of a conference call in which analysts interact with the company, especially during the question and answer session, are the most valuable parts. Due to the active participation of analysts, the discussion part of a conference call has greater information content (Matsumoto et al., 2011; Price et al., 2012). To narrow the investigation to the most material part, the paper focuses on the question and answer session.

Due to the importance of conference calls, this research investigated this type of communication and interaction with the aim of identifying material information for analysts. The paper analyzed 110 conference calls of ten chemical companies, which were published in 2013, 2014, and 2015. The analysis distinguished between financial and non-financial information and considered different time and topic characteristics. Thereby, the paper addresses the following research question: Which information is material for analysts? The review considered the suggestions by Bassemir et al. (2013) and Matsumoto et al. (2011) by using the content analysis method according to Krippendorff (2013) to investigate analysts' information needs and inquiries.

I developed a comprehensive coding scheme consisting of three elements (type, time, and topic) to analyze analysts' conference call questions. This coding scheme expands the two-element scheme that was used by Matsumoto et al. (2011) by adding the element topic. The coding scheme can be used for further future conference call research within the chemical sector or with topic-related adjustments for other sectors, because materiality is sector specific and not necessarily transferable (Eccles, Krzus, Rogers, & Serafeim, 2012). Furthermore, the review presents three key findings. First, analysts asked for more financial than non-financial

information. Second, analysts asked for more forward-looking than backward-looking information. Third, the topics environmental and social are considered to be financial rather than non-financial topics. Furthermore, the paper identified sixteen topic clusters with adequate sub-topics for the chemical sector and defined these as financial or non-financial topics. The review contributes to the research on materiality and conference calls in several ways. First, the findings confirm the research by Eccles and Serafeim (2013) and Tasker and Johnson (1998) that not only typically financial information and topics but also non-financial information and topics are asked about during conference calls. Second, a network analysis showed the relationships and interdependencies of the sixteen identified topics. This contributes to the understanding of how capital market participants process information by showing the relationships and connections between different topics, enabling companies to communicate more effectively with these stakeholders (Bradshaw, 2011). Furthermore, the results contribute to the research question of how analysts shape the information environment through their inquiries (Matsumoto et al., 2011) by showing for the chemical sector first evidence of the frequency with which certain topics are asked about and the way in which they are connected with each other.

The next section presents the prior literature on materiality, information regarding conference calls, and the role of financial analysts as well as the development of the hypotheses. The method of this paper is described in section 3. Section 4 presents the results of the content analysis, and section 5 summarizes and discusses the results of the paper and provides an outlook for further research.

2 Prior literature and hypothesis development

2.1 Prior research on materiality

The concept of materiality has primarily been discussed within accounting, auditing, and management research (Gordeeva, 2011; Messier et al., 2005). The concept has a long history in these areas and is part of several accounting and assurance standards and legislation

(Eccles et al., 2012; Lo, 2010). The results of the systematic literature review on materiality in the research field of accounting by Schmiedchen (2017) showed that especially US standard setters and institutions have an important role within the materiality discussion. They set standards, laws, and guidelines that are legally binding, and therefore companies have to comply with them (Heitzman, Wasley, & Zimmerman, 2010). However, the review also identified that these standard setters do not offer any guidance.

Companies use the materiality concept when they have to decide which information should be disclosed in their annual report to comply with the reporting standards (Gordeeva, 2011; Heitzman et al., 2010). Therefore, measurement approaches such as the rule of thumb, percentage, and numeric thresholds have been developed (Schmiedchen, 2017) by which immaterial information can be excluded and material information included (Fang & Jacobs, 2000). Such thresholds for financial information are for example: 1) items with more than a 10% effect on income are material for all groups and 2) items that have less than a 4 or 5% effect on income are immaterial (Holstrum & Messier, 1982; Schmiedchen, 2017). The materiality concept is also well established within the non-financial accounting and auditing field, in which specific thresholds for material non-financial items do not exist (Schmiedchen, 2017).

Numerical thresholds alone are not an appropriate method to decide whether information is material or not. The qualitative content of the information also has to be considered. To determine materiality, the magnitude as well as the nature of the information has to be evaluated (Eccles et al., 2012). The threshold for information to be considered as material information is the minimum amount of omission or misstatement that would influence the judgment or decision of a user of this information (Holstrum & Messier, 1982). However, it is not possible to define materiality for every case, which means that a "one-size-fits-all" approach does not exist (Reiser, 1977). This is also the case due to the different

expectations of different stakeholder groups regarding the impact of information; therefore, pieces of information differ in their materiality (Heitzman et al., 2010).

Research has indicated that capital market participants are one of the most important interest groups for materiality in conjunction with financial reporting. They are often explicitly mentioned within materiality definitions as well as a specific target group for financial and non-financial corporate reports and other company-related publications (Schmiedchen, 2017). Capital market participants use these different types of material information especially for their valuation models, stock recommendations, and investment decisions (Gårseth-Nesbakk & Mellemvik, 2011; Morris, Nichols, & Pattillo, 1984).

2.2   Conference calls

Conference calls are in most cases scripted telephone conferences between a company's top management and analysts from financial institutions (Eccles & Serafeim, 2013; Frankel et al., 1999). A typical conference call consists of two parts. The first part includes a 15-20-minute presentation by the management. The second part is a 30-45-minute question and answer session, in which typically a moderator assigns questions to the present board members or to the present top management team (Frankel et al., 1999; Kimbrough, 2005; Price et al., 2012; Tasker & Johnson, 1998). This is also the part that has greater information content (Matsumoto et al., 2011). The access to conference calls is in most cases limited by the hosting company, whereby capital market participants actively seek access and the company's members grant access by controlling who asks questions (Bassemir et al., 2013; Frankel et al., 1999; Mayew et al., 2013).

The conference call format has positive effects for companies and analysts (Frankel et al., 1999). From a company's perspective, conference calls save time and mitigate selective disclosure issues. The top management is able to talk to dozens of analysts and asset managers from different institutions simultaneously (Kimbrough & Louis, 2011; Tasker

& Johnson, 1998). The conference call is a mechanism for example to comment on the most recent quarterly, half-year, and annual reports. It offers the possibility to highlight implications for future performance and corporate development (Kimbrough, 2005). The Calls can also be used to explain the implications of unusual or extraordinary items or the extent to which earnings changes are permanent or transitory (Frankel et al., 1999). From analysts' perspective conference calls are a good opportunity to participate actively by asking follow-up questions, requesting more details, and questioning the management's interpretation of occurrences to gain information that addresses their most pressing current concerns (Matsumoto et al., 2011; Tasker & Johnson, 1998) or even to uncover information that was not mentioned in the earnings release (Bassemir et al., 2013). Analysts who participate in conference calls are both timelier and more accurate in their forecasts. They also profit from the questions of other analysts (Kimbrough, 2005; Mayew et al., 2013). They save time and travel expenses and receive information immediately after the official publication and at the same time as other analysts and investors (Frankel et al., 1999). Due to the fact that analysts for example provide earnings forecasts and stock recommendations, they could be considered as proxies for investors' expectations (Bradshaw, 2009).

Conference calls are one of the most important mediums for companies to communicate material information to capital market participants (Glaum & Friedrich, 2006; Kimbrough, 2005; Mayew et al., 2013; Previts et al., 1994; Price et al., 2012). The conference call format has become an increasingly common method of voluntary disclosure and an instrument to communicate with capital market participants to complement mandatory disclosures (Bowen et al., 2002; Bushee, Matsumoto, & Miller, 2003; Doran, Peterson, & Price, 2012; Eccles & Serafeim, 2013; National Investor Relations Institute, 2004). Furthermore, conference calls have an important role in voluntary disclosure by resolving the information asymmetry problem between managers and outside shareholders (Tasker & Johnson, 1998). Research has confirmed that material information can be collected during a

conference call (e.g., Mayew et al., 2013). Furthermore, indirect evidence indicates that conference calls introduce material information to the analyst community (Frankel et al., 1999). The fact that analysts participate in conference calls indicates that these calls provide material information and are therefore useful for them (Bassemir et al., 2013; Bowen et al., 2002; Frankel et al., 1999; Mayew et al., 2013).

2.3   The role of financial analysts and their information needs

A financial analyst is a capital market intermediary who collects, evaluates, and assesses companies to provide investors with company valuations and stock recommendations (Asquith, Mikhail, & Au, 2005; Simpson, 2010). Investors can use these recommendations to develop profitable trading strategies to increase their portfolio's value over time (Barniv, Hope, Myring, & Thomas, 2010). Based on the influence of analysts on investors, it is of interest to understand the role that analysts play and the information that they need (Simpson, 2010).

Analysts' valuation models attempt to estimate a company's intrinsic value or present the value of future cash flows by describing their expectation of the company's future earnings. Based on these results, analysts provide investors with recommendations to buy (sell) if the estimated value is above (below) the current stock price (Barniv et al., 2010). The valuation process is aimed at determining the fair value of a company based on the evaluation of fundamental data (Glaum & Friedrich, 2006). Analysts typically work for banks and other financial institutions and are among the primary users of financial statement information (Bradshaw, 2009).

The valuation process typically begins with collecting public historical and currently available information, such as financial data, companies' strategies, and competitive landscape information as well as information regarding corporate customers, geographical segments, and the quality of companies' management (Bradshaw, 2009; Glaum & Friedrich,

2006). The top five information types for analysts are recent developments and the outlook for the company's industry or sector, the company's annual earnings, the company's position in the market, the risks to which the company is exposed, and recent events affecting the company (Previts et al., 1994). Consequently, most analysts combine a top-down and a bottom-up approach in a fundamental analysis, which means that they investigate the development of the markets as well as the performance of individual companies (Glaum & Friedrich, 2006). Typically, they calculate the present value of the company's future cash flows or earnings or they carry out a balance sheet valuation.

Most methods that are used for valuing companies could be classified into one of the following three categories: earnings or cash flow multiples, discounted cash flow models, and asset multiples (Asquith et al., 2005; Demirakos, Strong, & Walker, 2004; Imam, Barker, & Clubb, 2008). The majority of analysts' reports also include a summary of earnings forecasts and price targets as well as additional data, for example accounting statement forecasts and segment data analyses, data regarding the relationship between the analyst's brokerage and the firm, data regarding the valuation methods employed, and the analyst's qualitative justifications for his or her stock recommendation (Asquith et al., 2005). Then, analysts analyze this information and derive quantified expectations of future earnings to transform these forecasts into company valuations that can be compared to the current trading price or result in stock recommendations that are released to investors or other clients (Bradshaw, 2009). These recommendations provided by analysts can be used by investors to develop trading strategies and support their decision-making processes (Barniv et al., 2010).

2.4 Hypotheses development

Research has indicated that analysts have a method and process to valuate companies and create stock recommendations. Penman (2007) introduced a five-step process for a fundamental analysis as a structured framework. These five steps are: 1) knowing the business, 2) analyzing information, 3) specifying, measuring, and forecasting value-relevant

payoffs, 4) converting forecasts into a valuation, and 5) trading on the valuation. Bradshaw (2009) also introduced a simple five-step schematic framework that shows how analysts process information. The analysts' valuation process that leads to forecasts and stock recommendations is a so-called black box for external parties (Bradshaw, 2009; Penman, 2007).

The problem with measuring what a user considers to be material is that it is not possible to observe which information is material for analysts based on their valuation models (directly); rather, it is necessary to investigate which information is requested via contact with the company (indirectly), for example during conference calls (Cho et al., 2003). The paper follows the structured five-step process framework introduced by Penman (2007). Based on the fact that steps three to five of the framework are black boxes (Penman, 2007), the paper focuses on steps 1) and 2) of the framework to generate testable hypotheses.

The first step, according to Penman (2007), is for analysts to become acquainted with the company's business, which includes for example the products, knowledge base, competitors, and market as well as regulatory constraints. The aim is to understand the company's strategy. The second step is the analysis of different information topics, which can come from many sources. These topics can be financial related (e.g., cash flows, earnings) and also non-financial related (e.g., consumer tastes, technological change, quality of management). The aim is to distinguish material information from non-material information. To fulfill steps 1) and 2), analysts use the opportunity of conference calls to ask questions, requesting more details and questioning the management's interpretation, or to uncover information that has not been mentioned yet (Bassemir et al., 2013; Matsumoto et al., 2011; Tasker & Johnson, 1998).

The hypotheses are formulated in relation to two elements of materiality: type and time of information (Matsumoto et al., 2011). Regarding the first element, the type of

information, analysts take financial as well as non-financial information into account to make resilient forecasts and stock recommendations (Bradshaw, 2009; Glaum & Friedrich, 2006; Previts et al., 1994). However, especially financial information (e.g., revenues, profit margins and return on sales, operating income, expenses) are value relevant for analysts (Simpson, 2010). The empirical evidence provided by Eccles and Serafeim (2013), by analyzing corporate reports and conference calls, also identified that over half of the topics were about financial performance (the most frequently mentioned terms were revenue, earnings, and margin). This evidence suggests that analysts are more likely to be interested in financial information than non-financial information. Consequently, the first hypothesis is:

Hypothesis 1: Analysts ask more questions regarding financial information than non-financial information in the question and answer session of a conference call.

Regarding the second element, the time of information, analysts need material information for their valuation processes regarding the company's future development (Barniv et al., 2010). The process starts by searching for all the available information on the historical and current performance of the company. Based on this historical and current information, analysts analyze the company's likely future prospects (Bradshaw, 2009; Glaum & Friedrich, 2006; Penman, 2007). Since historical information and current information are available via various company communication channels or other information platforms, analysts are interested in future-oriented company information to analyze the company's future prospects with greater certainty. Therefore, they need reliable forward-looking information more than backward-looking information (Bradshaw, 2009; Matsumoto et al., 2011). Based on these findings, I consider this element as the time of information; therefore, the second hypothesis is:

Hypothesis 2: Analysts ask more questions about forward-look information than backward-looking information in the question and answer session of a conference call.

Both elements – type and time – help analysts to enhance their valuation processes and optimize their forecast and recommendations and are therefore part of conference call questions. As a consequence, it is expected that the two elements interact with each other, which means that a question can consist of both elements: type and time (Matsumoto et al., 2011). In accordance with the discussions above, analysts need 1) financial rather than non-financial information and 2) forward-looking rather than backward-looking information for their valuation processes. Therefore, the third hypothesis is:

Hypothesis 3: The questions asked during a conference call question and answer session are ranked in ascending order financial forward-looking information, financial backward-looking information, non-financial forward-looking information, and non-financial backward-looking information.

3   Method

3.1   Sample

The review is based on conference calls of chemical companies. Table 1 shows the biggest[1] chemical companies worldwide that have a proportion of 75% or more in sales of chemicals. The original sample consisted of 20 chemical companies. However, transcripts of conference calls are not available for all the companies, and an initial search did not find any conference calls for companies from the Asian region. Therefore, the research did not consider the seven companies from this region. In addition, three out of the remaining 13 companies do not have a consistent set of transcripts for their conference calls in 2013, 2014, and 2015.[2] It is not clear why certain conference calls are available and others are not. To mitigate any concerns about selected publication of conference calls, these companies were not considered. The final sample consists of ten chemical companies (BASF, Braskem, Dow

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[1] Based on US Dollar sales in 2013.

[2] The search process was the same for every company. The search started on the company's home page followed by a search on the three home pages seekingalpha.com, edge.media-server.com, and alacrastore.com, which provide conference calls to their users.

Chemical, DSM, DuPont, Ecolab, LyondellBasell, PPG Industries, Solvay, and Syngenta). One half of the companies are located in Europe, four companies are located in the United States of America, and one company is from Brazil. Each company published four conference calls per year from 2013 to 2015, which leads to a total number of 110 conference calls. Out of 110 quarters, six had a negative net income result (marked in Table 1). The format and layout of the conference calls differ between the different companies as well as within the period under review.

Table 1: Sample of chemical companies

Company name	Headquarters	2013				2014				2015		
		Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3
AkzoNobel[1]	Netherlands	-	-	x	x	-	-	-	x	x	-	x
BASF	**Germany**	x	x	x	x	x	x	x	x	x	x	x
Braskem	**Brazil**	x[4]	x	x[4]	x	x	x	x	x	x	x	x
Dow Chemical	**USA**	x	x	x	x	x	x	x	x	x	x	x
DSM	**Netherlands**	x	x	x	x[3]	x[3]	x	x	x[4]	x[4]	x	x
DuPont	**USA**	x	x	x	x	x	x	x	x	x	x	x
Ecolab	**USA**	x	x	x	x	x	x	x	x	x	x	x
Evonik[1]	Germany	-	-	-	-	-	-	-	x	x	x	x
Lanxess[1]	Germany	-	x	x	-	-	-	-	x	x	x	x
LG Chem[1,2]	South Korea	-	-	-	-	-	-	-	-	-	-	-
Lotte Chemical[1,2]	South Korea	-	-	-	-	-	-	-	-	-	-	-
LyondellBasell	**Netherlands**	x	x	x	x	x	x	x	x	x	x	x
Mitsubishi Chemical[1,2]	Japan	-	-	-	-	-	-	-	-	-	-	-
Mitsui Chemicals[1,2]	Japan	-	-	-	-	-	-	-	-	-	-	-
PPG Industries	**USA**	x	x	x	x	x	x	x	x	x	x	x
PTT Global Chemical[1,2]	Thailand	-	-	-	-	-	-	-	-	-	-	-
Solvay	**Belgium**	x	x	x	x	x	x	x[4]	x	x	x	x
Sumitomo Chemical[1,2]	Japan	-	-	-	-	-	-	-	-	-	-	-
Syngenta	**Switzerland**	x	x[4]	x	x	x	x	x	x	x	x	x
Toray Industries[1,2]	Japan	-	-	-	-	-	-	-	-	-	-	-

Notes:
The bold marked chemical companies were considered for the analysis. The selection was based on the availability of conference calls within the investigation period. The search process was for every company the same. It started with a search on the company's homepage followed by the search on the three homepages seekingalpha.com, edge.media-server.com and alacrastore.com, which provide conference calls to their users.
In the following, the used symbols and footnotes were explained.
(x) A conference call transcript was available.
(-) A conference call transcript was not available.
[1] The company is not considered for the content analysis.
[2] The company is located in the Asian region.
[3] The conference call contains only the analysts' questions.
[4] Negative quarterly result on a net income base.

3.2   Content analysis and review protocol

The content analysis technique has been used in several studies to investigate the content of conference calls and analysts' information needs (Bassemir et al., 2013; Doran et al., 2012; Matsumoto et al., 2011; Price et al., 2012). Content analysis is the analysis of communicated information – in this paper conference calls of chemical companies – through classification, tabulation, tagging, and evaluation of its content elements and themes to ascertain which information is material for analysts (Price et al., 2012). In this paper, a content analysis of the selected conference calls, in accordance with Krippendorff (2013), was conducted to identify material topics for analysts. A review protocol was used to collect relevant data in a standardized way to analyze the material information within the identified conference calls and to answer the research question (Fink, 2014).

The protocol consists of two parts. The first part focuses on the analysts' information, which includes the total number of analysts in the call and the name of the analyst's company as well as the country of the company's headquarters. The second part contains information that is relevant to answering the research question and testing the hypotheses. In particular, three elements are investigated: type, time, and topic of information. In the following these three elements are explained in more detail.

The first element, type, considers whether an analyst's question shows a demand for financial or non-financial information (Matsumoto et al., 2011). The second element, time, captures whether the time reference of the analyst's question is forward-looking or backward-looking (Kimbrough & Louis, 2011; Matsumoto et al., 2011). The third element, topic, is concerned with the specific topic addressed by the analyst's question. Several studies have investigated the behavior and information needs of analysts (Asquith et al., 2005; Eccles & Serafeim, 2013; Glaum & Friedrich, 2006; Kimbrough & Louis, 2011; Previts et al., 1994). Based on these findings, the following topics in alphabetical order are considered for the elevation: Balance sheet, Cash flow, Competitors&market, Costs, Environment, Governance,

Government, In(de)vestment, M&A, P&L, Price, Regions, Restructuring, Sales&margin,

Social and Taxes.

Table 2 presents a description of each topic. The 16 topics could be divided into two

categories. The first category covers the topics that could be considered as being financially

oriented (Balance sheet, Cash flows, Costs, In(de)vestment, P&L, Price, Sales&margin and

Taxes), and the second category covers the topics that could be considered rather as non-

financially oriented (Competitors&market, Environmental, Governance, Government, M&A,

Regions, Restructuring and Social). However, this classification is not fixed, and it can differ

between questions. For example, on the one hand, if an analyst asks "Will the cost reduction

in operations influence your company's health and safety performance?" then the classified

financial topic "Costs" would be classified as non-financial. On the other hand, if an analyst

asks "How much money did your company spend in order to comply with environmental

regulations?" then the classified non-financial topic "Environment" would be classified as

financial. The selection is based on the definitions of each topic presented in Table 2. The

entire review protocol is presented in Appendix 1.

Table 2: Description of the used topics within the content analysis

Topic	Description
Balance sheet	The topic considers – like the balance sheet of an annual report – topics related to a financial statement that summarizes a company's assets, liabilities and shareholders' equity at a specific point in time.
Cash flow	The topic considers payments into or out of an e.g., business, project, or financial product.
Competitors&market	The topic considers business activities of competitors, suppliers and customers within one or more markets and/or segments. It also considers the development and/or activities of one or more markets/or segments. Thereby, the term market ranges from raw material markets to retail markets and also stock/spot markets.
Costs	The topic considers all types of costs (e.g., personnel costs, raw material costs).
Environment	The topic considers all types of environmental impacts, influences and company related issues.
Governance	The topic considers all aspects at management level e.g. strategic orientation and strategy development, company's reputation, board structure, company's portfolio and portfolio management as well as management compensation, dividend policy, corporate governance and risk management.

Table 2 (continued)

Topic	Description
Government	The topic considers all business activities of a company, which are related, influenced or affected by one or more governments (e.g., legislative processes), unions and other kinds of constitutional law or legislation. It considers also lawsuits.
In(de)vestment	The topic considers investments and/or divestments strategies, volumes and/or target. This also includes topics regarding the current and future status of investment and/or divestment projects and/or activities.
M&A	The topic considers activities in the field of merger and acquisition. Furthermore, also topics related to planned, actively operate and/or already completed partnerships, joint ventures and/or co-operations with suppliers, customers, businesses partners or third parties.
P&L	The topic considers – like the profit and loss statement of an annual report – the company's revenues and expenses during a particular defined period. It also considers income and write-offs (e.g., depreciation and amortization of various assets) excluding taxes.
Price	The topic considers purchase prices as well as sales prices and also contracts that define for example future raw material prices or related contracts with a price tag needed for business activities.
Regions	The topic considers content and questions regarding company's activities in a specific or general region(s). Furthermore, the topic also covers currency differences of and between different countries as well as country specific inflation rates.
Restructuring	The topic considers changes in production facilities, plants (e.g., raw material changes) and within the organization, segments, departments or units. It also considers changes regarding suppliers and/or customers. Furthermore, the topic considers synergies within the company as a whole and/or within specific parts of the company.
Sales&margin	The topic considers a broad range of sales, margin, volume, performance, growth and business development data and information.
Social	The topic considers social aspects e.g. employees, salary, pension, employee development and diversity.
Taxes	The topic considers any types of tax related matters for a company.

(Source: Asquith et al., 2005; Eccles & Serafeim, 2013; Glaum & Friedrich, 2006; Kimbrough & Louis, 2011; Previts et al., 1994.)

3.3 Coding procedure

The paper aims to identify the information that analysts request during the question and answer session of conference calls, focusing exclusively on analysts' questions. The coding procedure followed the review protocol and was supported by the software program MAXQDA.[3]

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[3] MAXQDA is a software program for qualitative and mixed-methods data analysis. For additional information please see: http://www.maxqda.com/.

A question can consist of one or more sentences. Each question was analyzed and tagged. Each tagged question consists of at least one code for each of the three elements type, time, and topic of information. Therefore, a question has a minimum of three tags (e.g., type = financial; time = forward-looking; topic = P&L). The maximum number of tags that a question can theoretically have is 20 (type of information = financial and non-financial; time = backward-looking and forward-looking; topic = all 16 topics). This procedure was used to code each of the 2,824 questions within the 110 analyzed conference calls.

4   Results

4.1   Analyst data

In sum 1,346 analysts participated in the 110 analyzed conference calls.[4] This is an average of twelve analysts per call. The content analysis identified 77 different banks or financial institutions, which participated at least once in one of the 110 analyzed conference calls. Of the eleven conference calls conducted by Solvay, which cover 79 analysts, nine do not specifically mention the participating analysts, and therefore it was not possible to identify the analyst's company. Furthermore, in eight other cases, it was not possible to identify the company of the analyst. These companies were summarized in the category "unknown." Therefore, the further result presentation, which focuses on analyst data, considers 1,267 analysts who are clearly assigned to a company.

The results show that 59% (749 observations) of the analysts work for companies that are located in North America and South America, of which 93% (694 observations) are located in the U.S. Overall, the proportion of the whole sample of analysts working for US banks and financial institutions is 55%. Analysts working for European banks and financial institutions account for the second-largest proportion with 38% (477 observations). The top

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[4] The amount of analysts who participated in the conference calls could be higher, because this number just represents the participants who ask a question within the call. Besides analysts who are able to ask a question within the call, there could be other analysts in the call who just listen and have no active role. This number differs from company to company, and it is not possible to identify the number of all conference call participants.

three countries within Europe with the largest proportion of analysts participating in the investigated conference calls are Germany (12%; 158 observations), Switzerland (9%; 115 observations), and France (7%; 91 observations). The Asian region has the smallest proportion (3%; 33 observations). There are no analysts who work for banks and financial institutions located in Africa. Table 3 shows the top ten identified analysts' companies, the company's origin, and the number of observations. Appendix 2 shows all the identified analysts' companies, the company's origin, and the number of observations.

Table 3: Top ten identified financial institutions during the content analysis[1]

No.	Name of the bank	Headquarters	Amount
1	Bank of America Merrill Lynch	USA	82
2	Citigroup	USA	81
3	Goldman Sachs	USA	78
4	UBS	Switzerland	73
5	Deutsche Bank	Germany	68
6	Morgan Stanley	USA	59
7	Barclays	UK	53
8	Jefferies & Company	USA	47
9	Wells Fargo	USA	44
10	JP Morgan	USA	40

Notes:
In eight cases it was not possible to identify the company of the analyst.
[1] For nine conference calls of Solvay, which cover 79 analysts, it was not possible to identify the analyst's company.

The analysts' data show that nine of the top ten companies identified in the analysis (except Jefferies & Company) are among the largest investments banks worldwide by mergers and acquisitions, equity capital markets, and debt capital markets and loans in 2015, according to Dealogic (2016).

4.2   Content data

Table 4 shows the coding results of the content analysis of the conference calls. As described in section 3.3, each relevant question was tagged at least once for each of the three elements type, time, and topic of information. The content analysis identified overall 2,824 questions within the 110 analyzed conference calls. For the 2,824 questions, a total of 11,858

tags were made, of which 3,484 (29.4%) tags refer to the element type, 3,223 (27.2%) tags refer to the element time, and 5,151 (43.4%) tags refer to the element topic. Appendix 3 shows a detailed table for each selected company per year.

Table 4: Overall coding results of the content analysis of the conference calls

Type	Overall tags (in %)		Mean	Tags over years (in %) 2013		2014		2015[1]	
Financial	2,029	(58)	0.718	756	(37)	741	(37)	532	(26)
Non-financial	1,455	(42)	0.515	530	(36)	547	(38)	378	(26)
	3,484			**1,286**		**1,288**		**910**	
Time									
Forward-looking	1,793	(56)	0.635	679	(38)	675	(38)	439	(24)
Backward-looking	1,430	(44)	0.506	506	(35)	510	(36)	414	(29)
	3,223			**1,185**		**1185**		**853**	
Topic									
Balance sheet	100	(2)	0.035	47	(47)	32	(32)	21	(21)
Cash flows	117	(2)	0.042	50	(43)	30	(26)	37	(32)
Competitors&market	1,064	(21)	0.376	374	(35)	402	(38)	288	(27)
Costs	269	(5)	0.096	105	(39)	86	(32)	78	(29)
Environmental	64	(1)	0.023	27	(42)	30	(47)	7	(11)
Governance	341	(7)	0.120	133	(39)	117	(34)	91	(27)
Government	45	(1)	0.017	14	(31)	26	(58)	5	(11)
In(de)vestment	174	(3)	0.062	70	(40)	65	(37)	39	(22)
M&A	239	(5)	0.085	88	(37)	88	(37)	63	(26)
P&L	266	(5)	0.095	98	(37)	90	(34)	78	(29)
Price	353	(7)	0.125	122	(35)	144	(41)	87	(25)
Regions	549	(11)	0.194	165	(30)	221	(40)	163	(30)
Restructuring	448	(9)	0.159	167	(37)	154	(34)	127	(28)
Sales&margin	1,062	(21)	0.376	409	(39)	379	(36)	274	(26)
Social	32	(1)	0.011	14	(44)	14	(44)	4	(13)
Taxes	28	(1)	0.010	16	(57)	8	(29)	4	(14)
	5,151			**1,899**		**1,886**		**1,366**	

Notes:
The table shows the overall coding results of the content analysis of the conference calls. Thereby, 2,824 questions were identified. The three introduced elements type, time and topic are presented including their sub-categories in the first column. All tags made during the content analysis are presented in the second column including the percentage distribution and the sum of tags for each element. The 3rd column presents the mean of the results of column two.
[1] *For 2015 conference calls for quarter 1, 2 and 3 were considered.*

The result of the element type of 3,484 tags is divided into 2,029 tags (58%) regarding financial information and 1,455 tags (42%) regarding non-financial information. Table 5 shows that 1,358 (out of 2,824) questions were exclusively tagged as financial, 784 questions were exclusively tagged as non-financial, and 682 questions were tagged as financial and non-

financial. The Wilcoxon signed-rank test was performed to analyze the result. By equalizing the difference values and ranking the original sample data, as described by Lee (2014), the result of the test (z = 10.74) shows that analysts ask significantly (p < 0.01) more questions regarding financial information than regarding non-financial information in the sample, and therefore hypothesis 1 can be confirmed.

Table 5: Wilcoxon Signed-Rank Test results for the elements time and type of information

Type	Possible tags	Effective tags	Mean
Financial	2,824	2,029	0.72
Non-financial	2,824	1,455	0.52

Wilcoxon Signed-Rank Test

Sum of positive value =	1,358
Sum of negative value =	784
Sum of zero value =	682
Considered value (n) =	2,142
Rang for n =	1071.5
Multiplied positive rang sum (r(+)) =	1,455,097
Test statistic (z) =	**10.74**[*]

Time	Possible tags	Effective tags	Mean
Forward-looking	2,824	1,793	0.63
Backward-looking	2,824	1,430	0.51

Wilcoxon Signed-Rank Test

Sum of positive value =	1,383
Sum of negative value =	1,020
Sum of zero value =	421
Considered value (n) =	2,403
Rang for n =	1,202
Multiplied positive rank sum (r(+)) =	1,662,366
Test statistic (z) =	**6.41**[*]

Notes:
*The basis of the calculation of the test statistic (z) is the Wilcoxon Signed-Rank Test. The symbols ***, ** and * indicate significance at p < 0.01, < 0.05 and < 0.1.*

The result of the element time of 3,223 tags is divided into 1,793 tags (56%) regarding forward-looking information and 1,430 tags (44%) regarding backward-looking information.

The results presented in Table 5 show that 1,383 (out of 2,824) questions were tagged as forward-looking, 1,020 questions were tagged as backward-looking, and 421 questions were tagged as having both characteristics. To answer hypothesis 2, the Wilcoxon signed-rank test was conducted. The result of the test ($z = 6.41$) shows that analysts ask significantly ($p < 0.01$) more forward-looking questions than backward-looking questions, and therefore hypothesis 2 can be confirmed.

The results in Table 6, based on a simple question count, show that 700 questions were tagged exclusively as financial and forward-looking, 479 questions were tagged as financial and backward-looking, 352 questions were tagged as non-financial and forward-looking, and 320 questions were tagged as non-financial and backward-looking. Based on these results, hypothesis 3 can be confirmed. However, there seems to be no correlation between the two elements type and time. The correlation coefficients of financial and forward-looking (backward-looking) as well as of non-financial and forward-looking (backward-looking) are close to zero: 0.067 (–0.046) and –0.014 (0.050).

Table 6: Code relation matrix for time and type of information

	Backward-looking	Forward-looking	Financial	Non-financial
Backward-looking		414	1,003 (479)	774 (320)
Forward-looking	−0.7325***		1,337 (700)	919 (352)
Financial	−0.0464**	0.0667***		674
Non-financial	0.0499***	−0.0144	−0.5898***	

Notes:
*This table presents the code relation results (upper triangle) regarding the relationship of the elements time and type. The figures show how often the respective combination was tagged within the same question including tags of the other element characteristic. The figures in brackets show the number of tags excluding tags of the other element characteristic. The lower triangle shows the correlation results of each relation between the two characteristics. The symbols ***, ** and * indicate significance at p < 0.01, < 0.05 and < 0.1.*

In the following the results for the element topic are discussed (presented in Table 4 as well as in Appendix 3). The result of 5,151 topic tags within the analysis shows that the questions asked by analysts consider on average 1.8 topics. Based on the number of tags, Competitors&market (1,064 tags) and Sales&margin (1,062 tags) are by far the most

frequently mentioned topics. Further important topics are Regions (549 tags), Restructuring (448 tags), Governance (341 tags), and Price (353 tags). The topics Government (45 tags), Social (32 tags), and Taxes (28 tags) were asked about least by the analysts. Based on the topic tags, it is also possible to analyze the interdependencies and connections between the topics. Table 7 shows the frequency and Spearman correlation of two topics with one another. The results show that ten out of 120 topic combinations were not tagged at all. All the other 110 combinations were tagged at least once, and the combination of the topic Competitors&market and the topic Sales&margin has the most tags (466). The result of the Spearman correlation also shows a significant ($p < 0.01$) positive relationship. Overall 1,659 (58.7%) of the 2,824 analyzed questions are tagged with at least one of the two most important topics.

Finally, in section 3 a classification of the 16 selected topics was presented. The categorization was investigated, and the results for the topics for each category, financial and non-financial, are presented in Table 8, which shows a significant ($p < 0.01$) positive relationship for six out of eight as financially oriented classified topics (except In(de)vestment and Taxes) and the type financial. In contrast the results show a significant ($p < 0.01$) positive relationship for six out of eight as non-financially oriented classified topics (except Environmental and Social) and the type non-financial. These two topics, Environmental and Social have a negative correlation with the type non-financial. Both topics have a significant ($p < 0.05$) positive correlation with the type financial.

Table 7: Topic code relation matrix

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
1 Balance sheet		12	4	3	0	25	0	3	16	4	2	5	2	5	4	1
2 Cash flows	0.0749***		5	5	1	8	0	7	10	10	2	1	8	10	1	1
3 Competitors &market	-0.1329***	-0.1439***		58	33	81	17	29	31	37	126	326	124	466	3	5
4 Costs	-0.0493***	-0.0378**	-0.1082***		5	30	1	14	5	29	33	31	58	58	10	3
5 Environ-mental	-0.0292	-0.0199	0.0439**	-0.0091		3	2	0	2	3	6	20	6	35	5	0
6 Governance	0.0766***	-0.0336*	-0.1046***	-0.0089	-0.0343*		2	23	39	13	15	37	79	46	4	0
7 Government	-0.0249	-0.0272	-0.0039	-0.0329*	0.0174	-0.0310*		3	2	0	2	10	1	12	0	2
8 In(de)-vestment	-0.0252	-0.0020	-0.1108***	-0.0132	-0.0390**	0.0096	0.0012		20	13	5	21	36	30	1	1
9 M&A	0.0519***	0.0001	-0.1546***	-0.0772***	-0.0292	0.0325*	0.0002	0.0279		11	3	16	28	25	1	2
10 P&L	-0.0357*	-0.0070	-0.1584***	0.0143	-0.0248	-0.0709***	-0.0420**	-0.0174	-0.0504***		17	36	18	76	5	2
11 Price	-0.0608***	-0.0682***	-0.0149	-0.0100	-0.0144	-0.0935***	-0.0324*	-0.0746***	-0.1034***	-0.0672***		67	53	102	0	3
12 Regions	-0.0698***	-0.0980***	0.2180***	-0.0621***	0.0456**	-0.0793***	0.0062	-0.0475***	-0.0977***	-0.0514***	-0.0041		76	222	0	8
13 Re-structuring	-0.0728***	-0.0569***	-0.0937***	0.0529***	-0.0272	0.0718***	-0.0490***	0.0336*	-0.0348*	-0.0809***	-0.0092	-0.0248		88	3	2
14 Sales& margin	-0.1289***	-0.1255***	0.0981***	-0.1155***	0.0538***	-0.1830***	-0.0323*	-0.1076***	-0.1702***	-0.0683***	-0.0677***	0.0279	-0.1613***		3	4
15 Social	0.0519***	-0.0056	-0.0624***	0.0790***	0.0961***	0.0016	-0.0139	-0.0135	-0.0205	0.0226	-0.0405**	-0.0525***	-0.0191	-0.0623***		1
16 Taxes	0.0002	-0.0030	-0.0408**	0.0039	-0.0152	-0.0370**	0.0429***	-0.0108	-0.0047	-0.0079	-0.0054	0.0232	-0.0240	-0.0481**	0.0231	

Notes:
This table presents the code relation results (upper triangle) for two different topics. The figures show how often two topics were tagged within the same question. The lower triangle shows the correlation results of each relation between two topics. The symbols ***, ** and * indicate significance at $p < 0.01$, < 0.05 and < 0.1.

Table 8: Topics in relation to type and time of information

Topic	Type				Time			
	Financial		Non-financial		Backward-looking		Forward-looking	
	# (%)	Spearman	# (%)	Spearman	# (%)	Spearman	# (%)	Spearman
Financial oriented								
Balance sheet	94 (81)	0.0901***	22 (19)	-0.1132***	55 (47)	0.0167	61 (53)	-0.0139
Cash flows	110 (87)	0.0992***	17 (13)	-0.1551***	60 (44)	0.0009	77 (56)	0.0076
Costs	240 (69)	0.1152***	109 (31)	-0.0726***	130 (42)	-0.021	181 (58)	0.0214
In(de)vestment	107 (46)	-0.059***	126 (54)	0.1071***	69 (35)	-0.0563***	128 (65)	0.0536***
P&L	264 (87)	0.1915***	39 (13)	-0.2411***	131 (43)	-0.0126	174 (57)	0.0037
Price	281 (62)	0.058***	174 (38)	-0.019	172 (43)	-0.0187	231 (57)	0.0108
Sales&margin	968 (71)	0.323***	399 (29)	-0.2175***	542 (44)	0.004	690 (56)	0.0188
Taxes	22 (71)	0.015	9 (29)	-0.0388**	14 (40)	-0.0013	21 (60)	0.0239
Non-financial oriented								
Competitors&market	749 (52)	-0.0261	679 (48)	0.1884***	575 (47)	0.0501***	657 (53)	-0.0293
Environmental	55 (65)	0.0477**	30 (35)	-0.0142	35 (43)	0.0123	46 (57)	0.0265
Governance	163 (38)	-0.1952***	268 (62)	0.1991***	177 (45)	0.0095	214 (55)	-0.0096
Government	20 (36)	-0.0847***	36 (64)	0.0763***	29 (49)	0.0343*	30 (51)	0.0067
M&A	107 (37)	-0.1831***	183 (63)	0.1524***	137 (49)	0.0407**	144 (51)	-0.0205
Regions	403 (55)	0.0145	331 (45)	0.0854***	326 (50)	0.0851***	325 (49)	-0.0445**
Restructuring	241 (42)	-0.1757***	336 (58)	0.2009***	231 (44)	0.0051	292 (56)	0.0119
Social	29 (73)	0.0447**	11 (27)	-0.0367*	14 (37)	-0.0147	24 (63)	0.0256
Sum	**3,853 (61)**		**2,769 (39)**		**2,697 (44)**		**3,295 (56)**	

Notes:
The table show for each of the 16 topics how often this topic was tagged the other two elements and their characteristics including the percentage distribution within the element type respectively time as well as the complying Spearman correlation coefficient and significance level. The symbols ***, ** and * indicate significance at $p < 0.01$, < 0.05 and < 0.1.

4.3 Additional analysis

Based on the topic tags, the 16 topics were investigated further to identify potential interdependencies between two topics. To analyze these relationships and interdependencies, a network analysis was performed. Based on the results presented in Table 7, a core-periphery analysis was conducted. The result is presented in Table 9 and shows that the topic Competitors&market, with 1,345 tags, has the majority of connections to other topics, followed by the topic Sales&margin with 1,182 tags. These two topics, with 466 tags, were also the two most often tagged topics in a question at the same time, followed by Competitors&market and Regions with 326 tags and Sales&margin and Regions with 222 tags. Therefore, the topics Competitors&market and Sales&margin are the core topics. Besides the connection to each other, both core topics have the same three peripheral topics, Regions, Price and Restructuring, which were asked about the most along with the respective core topics Competitors&market (Regions 362, Price 126, and Restructuring 124 tags) and Sales&margin (Regions 222, Price 102, and Restructuring 88 tags).

Besides the two core topics, all the other 14 topics are peripheral topics. Out of the 14 peripheral topics, Regions (876 tags), Restructuring (582 tags), Price (436 tags), Governance (405 tags), and Costs (343 tags) are the top five. Restructuring, Regions and Governance are by classification more non-financially oriented topics, and Price and Costs are more financially oriented topics. Based on the results presented in Table 9, a network analysis was conducted with the software tool UCINET.[5] Figure 1 illustrates the result of the network analysis.

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[5] UCINET is a software program for the analysis of social network data. For additional information please see: https://sites.google.com/site/ucinetsoftware/home.

Table 9: Results of the Core-Periphery analysis

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
1 Competitors&market		466	4	58	33	5	17	29	31	37	126	326	124	81	3	5
2 Sales&margin			5	58	35	10	12	30	25	76	102	222	88	46	3	4
3 Balance sheet				3	0	12	0	3	16	4	2	5	2	25	4	1
4 Costs					5	5	1	14	5	29	33	31	58	30	10	3
5 Environmental						1	2	0	2	3	6	20	6	3	5	0
6 Cash flows							0	7	10	10	2	1	8	8	1	1
7 Government								3	2	0	2	10	1	2	0	2
8 In(de)vestment									20	13	5	21	36	23	1	1
9 M&A										11	3	16	28	39	1	2
10 P&L											17	36	18	13	5	2
11 Price												67	53	15	0	3
12 Regions													76	37	0	8
13 Restructuring														79	3	2
14 Governance															4	0
15 Social																1
16 Taxes																

Notes:
This table presents the Core-Periphery analysis results (upper triangle) for two different topics. The figures show how often two topics were tagged within the same question. The result presentation is based on the software UCINET. The analytical method of the Core-Periphery analysis was used for this analysis. Thereby, the two core topics are Competitors&market and Sales&margin and the 14 periphery topics Balance sheet, Cash flows, Costs, Environmental, Governance, Government, In(de)vestment, M&A, P&L, Price, Regions, Restructuring, Social and Taxes were identified.
(Source: own illustration in accordance with the result presentation tool for Core-Periphery analysis by UCINET.)
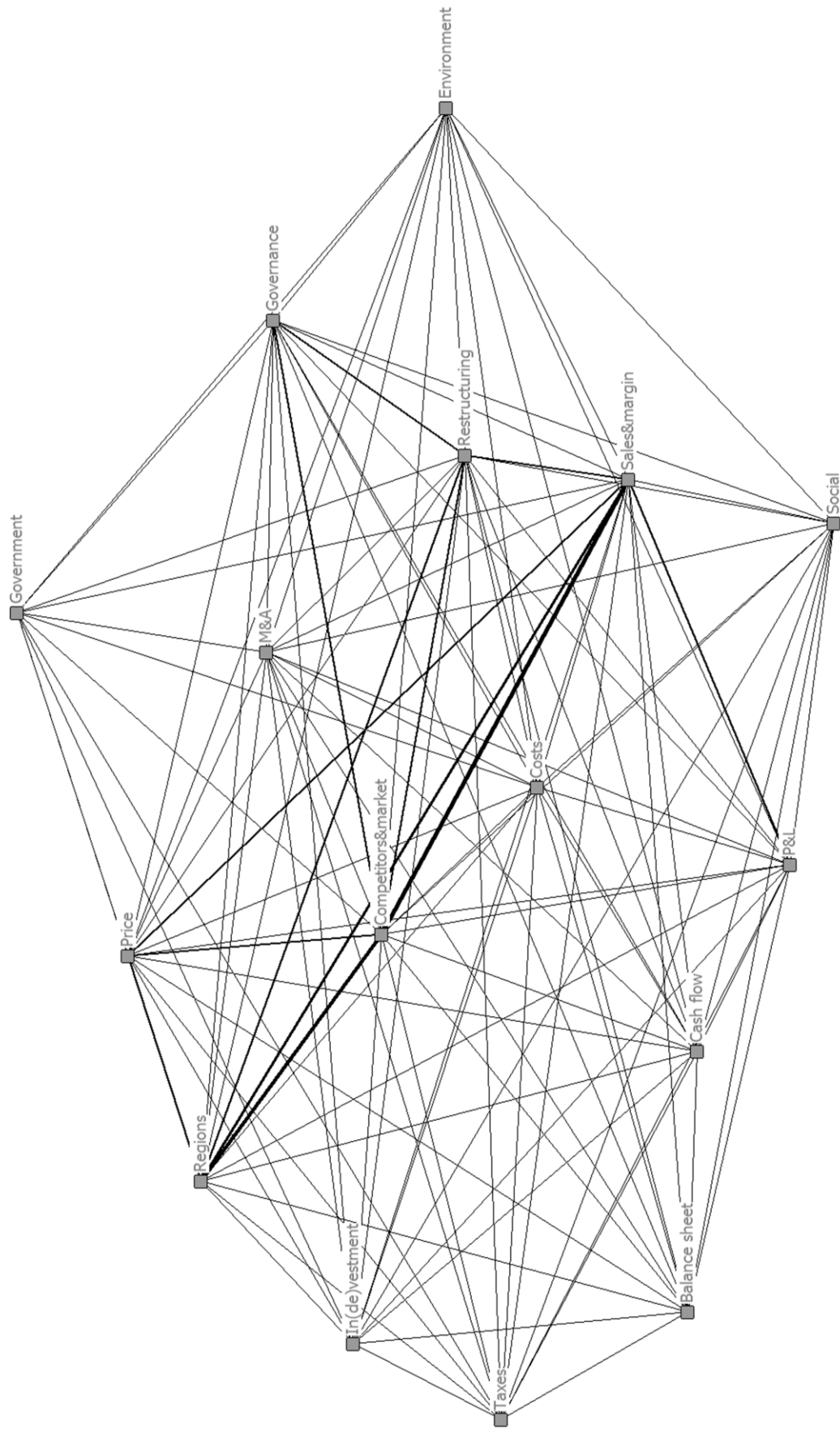
Figure 1: Result of the topic network analysis
(*Source: presentation tool for Core-Periphery analysis by UCINET.*)

The thickness of the arrows symbolizes the frequency of the tagging, and the arrangement of the topics illustrates the relation of each topic to another topic. This means that, if the number of tags between two topics is high, the topics are presented close to each other (e.g., Competitors&market to Costs [58 tags] and Sales&margin to Costs [58 tags]). This close relationship is also indicated by a thicker arrow (e.g., Competitors&market to Regions [326 tags] in contrast to Regions to In(de)vestment [21 tags]). If a topic is not tagged with another topic at all, the distance between them is large and of course there is no connection (e.g., Government to Balance sheet or Government to Social).

5   Discussion and conclusion

In this paper, I conducted an in-depth examination of chemical company conference call transcripts to explore the content of these calls with the aim of investigating which information is material for analysts. The result of this paper will support companies in improving their disclosure processes. The investigation is based on a content analysis of 110 conference calls of the ten biggest chemical companies in Europe and North/South America in the period between 2013 and 2015. Due to the conference call participation of large financial institutions, the selected sample reflects a reliable population of the chemical industry. The participation of these institutions implies coverage for the company and contributes to the understanding that conference calls are an important instrument for analysts to confirm information or to gather additional information to improve their valuation models and client stock recommendations.

The paper focuses on the chemical sector. Since materiality is sector specific, the results are not necessarily transferable to other sectors (Eccles et al., 2012). The developed coding scheme, consisting of three elements (type, time, and topic), can be used for further research within the chemical sector or with topic-related adjustments for other sectors as well. The results provide a better understanding of the information needs of chemical analysts, who serve as proxies for investors. Therefore, the results provide a starting point for further

research. The paper also contributes to the understanding of step 1) and 2) of the framework by Penman (2007). These two steps are the foundation of the following steps of creating forecasts and providing stock recommendations (Penman, 2007) which are currently rather a black box for external parties (Bradshaw, 2009).

The paper tested three hypotheses. First, the results show that analysts ask significantly more questions regarding financial than non-financial information in the question and answer session of a conference call (hypothesis 1). This result is in line with prior research (e.g., Asquith et al., 2005; Glaum & Friedrich, 2006; Imam et al., 2008; Previts et al., 1994). However, not only financial information and topics were asked about during the conference calls – a substantial amount of non-financial information and topics were also requested by analysts. Surprisingly, the topics Environmental and Social contained more questions about financial information than about non-financial information. This implies that analysts are able to transform social and environmental issues into financial terms. Eccles, Serafeim, and Krzus (2011) supported this suggestion by pointing out that these rather non-financial topics can be quantified and integrated into analysts' valuation models. The authors also mentioned that environmental information could be quantified more easily than social information and that environmental information therefore has a stronger level of interest than social information. The results of the paper are in line with this argument, because overall 85 environment-related questions were asked compared with 40 social-related questions.

Second, the paper indicates that analysts ask significantly more questions about forward-looking than backward-looking information in the question and answer session of a conference call (hypothesis 2). The analysts' target is to analyze various data and derive quantified expectations of the future earnings of a company. Therefore, the results confirm that forward-looking information supports firm valuation processes more than backward-looking information. However, it is still surprising to find a relatively large proportion of backward-looking questions. This implies that backward-looking information is also

informative for analysts. Also, research has shown that companies provide backward-looking information in conference calls' presentation and discussion part (Bowen et al., 2002; Matsumoto et al., 2011). Matsumoto et al. (2011) found that companies provide less financial and more forward-looking information when the company performance is poor, which is in line with the management focusing more on non-financial, forward-looking topics when the prior quarter's performance was poor. This finding cannot be confirmed by this analysis which takes the analysts' questions as a baseline for discussing the results. However, it has to be noted that the number of quarters with poor performance (= quarterly loss) was very low (six out of 110). Another finding, that forward-looking disclosures are actually greater in the third and fourth quarters (Matsumoto et al., 2011), could not be confirmed by the selected sample of chemical companies, the selected time period and based on analysts' questions.

Third, it was expected that analysts ask more questions about financial and forward-looking information followed by (in this order) financial and backward-looking, non-financial and forward-looking, and non-financial and backward-looking information in the question and answer session of a conference call (hypothesis 3). Based on a question count, the assumption can be confirmed. The result is in line with the above mentioned findings that analysts 1) take financial rather than non-financial information into account and 2) rely on forward-looking information more than on backward-looking information (Eccles & Serafeim, 2013; Simpson, 2010). However, the correlation coefficients show values close to zero. This indicates that it is not possible to conclude that a financially (non-financially) oriented question asked by an analyst has a forward-looking rather than a backward-looking time characteristic.

In addition to the hypothesis tests, the paper contributes to the literature by providing the first indication of which topics are material within the chemical sector based on the frequency with which they were asked about during the question and answer session of the conference calls provided by chemical companies. The results show that analysts ask the most questions about the topics of sales, margins, and volume, which is in line with prior research

(e.g., Eccles & Serafeim, 2013; Simpson, 2010). However, topics like performance (considering the effects of competitors, suppliers, and customers), raw material, retail, and spot market information are also frequently asked about by analysts. This suggests that these topics are either material for chemical analysts within their valuation process or poorly disclosed in chemical companies' reports. Further research could investigate this finding for the chemical sector in more detail.

Finally, to communicate with capital market participants in a more effective way, it is important for companies to know which topics they will address (Bradshaw, 2011). The result of the network analysis shows the first insights regarding the relationship between different topics within the chemical sector as well as the complexity of analysts' questions. The results suggest that there are interdependencies between the identified topics and the analysts' consideration of them in their valuation processes. The network analysis results could be a starting point for firms to enhance their current communication. By knowing which topics are related to each other, firms are able to prepare their communication activities to present information as well as to answer questions from capital market participants in a more appropriate way, which may result in a better analyst valuation result.

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Appendix

Appendix 1: Review protocol for the conference calls

Analyst data	
Company of the analyst	Who is the analyst working for?
Number of analysts	How many analysts participated at the conference call?

Content data	
Type	
Financial	The content of the question is based on financial developments, effects, impacts, results etc.
Non-financial	The content of the question is based on non-financial developments, effects, impacts, results etc.
Time	
Forward-looking	The content of the question is future oriented.
Backward-looking	The content of the question is past and/or present oriented.

Topics[1]
Balance sheet
Cash Flow
Competitors&market
Costs
Environment
Governance
Government
In(de)vestment
M&A
P&L
Price
Regions
Restructuring
Sales&margin
Social
Taxes

Note:
[1] *The content is presented in alphabetical order. A detailed description of each topic is presented in Table 2.*

Appendix 2: Identified financial institutions during the content analysis[1]

No.	Name of the bank	Headquarters	Amount
1	Bank of America Merrill Lynch	USA	82
2	Citigroup	USA	81
3	Goldman Sachs	USA	78
4	UBS	Switzerland	73
5	Deutsche Bank	Germany	68
6	Morgan Stanley	USA	59
7	Barclays	UK	53
8	Jefferies & Company	USA	47
9	Wells Fargo	USA	44
10	JP Morgan	USA	40
11	Credit Suisse	Switzerland	39
12	Susquehanna Financial Group	USA	38
13	RBC Capital Markets	Canada	31
14	Redburn	UK	29
15	Nomura	Japan	28
16	Kepler Cheuvreux	France	27
17	Berenberg Bank	Germany	26
18	BNP Paribas	France	23
19	Piper Jaffray	USA	23
20	Credit Agricole Securities	France	22
21	Robert W. Baird & Co. Incorporated	USA	22
22	Alembic Global Advisors	USA	19
23	Longbow Research LLC	USA	19
24	ABN Amro	Netherlands	18
25	Sanford C. Bernstein & Co[2]	USA	17
26	SunTrust	USA	15
27	Baader Bank	Germany	14
28	Macquarie Capital	Germany	12
29	MainFirst Bank AG	Germany	12
30	Canaccord Genuity	Canada	11
31	Liberum Capital	USA	11
32	Société Générale	France	11
33	William Blair & Company L.L.C.	USA	11
34	Commerzbank	Germany	10
35	GAMCO Investors, Inc.	USA	10
36	Oppenheimer & Co. Inc.	USA	10
37	Glen Hill Investments	USA	9
38	KeyBanc Capital Markets	USA	9
39	Stifel, Nicolaus & Co.	USA	9
40	First Analysis Securities Corporation	USA	8
41	GBM	Mexico	8
42	HSBC	France	8
43	Northcoast Research	USA	7
44	DZ Bank AG	Germany	6
45	Revere Associates	USA	6

Appendix 2 (continued)

No.	Name of the bank	Headquarters	Amount
46	Warburg Research	Germany	6
47	Credit Lyonnais Securities Asia	Hong Kong	4
48	Global Hunter Securities	USA	3
49	Kempen & Co N.V.	Netherlands	3
50	Raymond James Financial, Inc.	USA	3
51	Vontobel Financial Products GmbH	Germany	3
52	Bloomberg L.P.	USA	2
53	Broadarch Capital, LLC.	USA	2
54	BTG Pactual	Brazil	2
55	Cowen Group, Inc.	USA	2
56	ING Groep N.V.	Netherlands	2
57	Morningstar, Inc.	USA	2
58	Rabobank Groep N.V.	Netherlands	2
59	Banco Santander, S.A.	Spain	2
60	Vontobel Holding AG	Switzerland	1
61	BGC Partners, Inc.	USA	1
62	Bice Vida	Chile	1
63	Chemspeak LLC	USA	1
64	Davy Research	Ireland	1
65	HQ Equita	Germany	1
66	G-Research	UK	1
67	Banco Itaú BBA SA	Brazil	1
68	KBC Group	Belgium	1
69	LarrainVial	Chile	1
70	Pala Asset	Switzerland	1
71	Pentwater Capital Management LP	USA	1
72	Petercam	Belgium	1
73	SNDC Investment Hong Kong	Hong Kong	1
74	TIAA-CREF	USA	1
75	Tipp Hill Capital Management, LLC	USA	1
76	Big Tree Capital Partners, LLC	USA	1
77	UBP	Switzerland	1
78	Unkown[3]	Unknown	8

Notes:

In eight cases it was not possible to identify the company of the analyst.

[1] *For nine conference calls of Solvay, which cover 79 analysts, it was not possible to identify the analyst's company.*

[2] *In 2015, Alliance Capital bought Sanford C. Bernstein LP. Since then, the new name is Alliance Bernstein L.P.*

[3] *In eight cases it was not possible to identify the company of the analyst. These companies were summarized in term "unknown".*

Appendix 3: Detailed coding results of the content analysis of the conference calls

Company	BASF			Braskem			Dow			DSM			DuPont			Ecolab			Lyondell Basell			PPG Industries			Solvay			Syngenta		
Year 20xx	13	14	15	13	14	15	13	14	15	13	14	15	13	14	15	13	14	15	13	14	15	13	14	15	13	14	15	13	14	15
Questions	120	126	76	37	32	26	79	76	68	114	96	64	83	76	60	135	148	97	114	111	97	167	166	114	85	85	78	100	118	74
Financial	87	82	55	22	13	10	47	45	28	87	78	48	49	52	38	98	96	83	85	81	66	137	133	93	65	61	56	79	100	55
Non-financial	54	64	31	20	22	16	41	41	43	58	45	29	48	41	43	75	98	51	68	73	64	91	80	45	41	43	36	34	40	20
Forward-looking	89	87	44	27	26	15	53	63	41	72	58	42	60	59	44	88	79	68	70	74	63	92	88	37	54	50	45	74	91	40
Backward-looking	52	71	40	20	15	13	36	16	35	63	54	29	33	29	23	67	85	50	55	55	44	102	104	93	45	47	45	33	34	42
Balance sheet	2	2	2	67	48	39	4	2	1	5	4	3	4	4	1	12	4	1	9	5	4	7	6	4	3	2	2	0	4	2
Cash flows	6	7	6	3	0	1	3	2	1	8	5	8	4	1	2	5	3	1	3	1	4	6	5	4	7	5	6	8	3	5
Competitors&market	20	31	13	1	0	1	54	25	11	45	37	17	25	24	20	53	72	61	57	54	42	92	98	61	16	17	23	35	48	28
Costs	12	10	11	5	9	5	17	7	4	3	4	7	7	7	8	6	11	9	27	16	7	12	15	15	16	10	8	13	9	6
Environmental	3	3	1	3	0	1	6	2	3	3	1	0	1	2	0	2	4	0	2	2	1	3	4	3	1	3	0	8	8	1
Governance	1	2	1	2	0	0	16	8	7	7	9	3	16	13	25	17	7	11	33	31	28	38	30	12	5	5	4	3	8	3
Government	3	4	0	5	3	3	3	3	0	2	1	1	1	0	0	0	2	1	0	3	0	0	3	0	2	3	1	0	10	2
In(de)vestment	15	17	7	3	2	0	31	16	10	4	3	1	0	0	2	8	6	4	7	5	7	3	2	2	6	12	4	6	7	4
M&A	7	9	3	5	3	3	35	11	12	12	6	6	5	8	2	14	18	7	6	8	6	24	14	9	4	5	6	0	4	8
P&L	1	8	11	5	4	4	25	8	10	14	19	10	6	3	3	4	7	3	13	4	8	7	1	1	20	16	15	20	18	18
Price	12	24	9	5	4	3	30	7	13	22	14	11	13	11	3	8	20	9	13	15	19	10	10	7	17	14	9	13	16	8
Regions	12	39	19	7	7	2	15	5	4	11	11	7	16	15	7	29	39	23	28	32	33	50	54	53	3	13	4	5	8	7
Restructuring	13	16	17	6	6	3	57	18	25	11	4	4	5	7	11	13	17	14	40	42	40	37	21	8	8	10	8	20	7	4
Sales&margin	57	29	23	2	5	8	71	37	20	43	32	17	31	23	21	68	59	55	28	31	25	70	77	57	31	34	25	37	70	31
Social	4	1	0	7	4	5	6	2	2	0	1	1	3	2	0	1	1	0	0	1	0	1	1	0	0	2	1	2	2	0
Taxes	0	0	2	1	1	0	1	1	0	0	0	0	3	2	0	2	1	1	0	2	1	1	0	0	1	1	0	1	2	0

Note:
For the year 2015, conference calls for quarter 1, 2 and 3 were considered.

When does sustainability matter for professional capital market participants? An experimental study of non-financial materiality

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Abstract

With the rise of non-financial disclosures, companies face the challenge of identifying which sustainability-related information is material and therefore should be disclosed. Reporting guidelines and academic literature offer little guidance for determining non-financial materiality. We use an experimental setting to analyze whether and how professional capital market participants react to manipulations in two dimensions of materiality: a quantitative dimension covering small versus large changes in sustainability performance and a qualitative dimension that compares a topic of potentially high interest with a topic of lower interest to capital market participants. We find that investors adjust their investment decisions in both dimensions, separately as well as combined. This study thus provides the first evidence of the materiality of non-financial information. The results serve as a starting point for developing better guidance for determining non-financial materiality and offer a blueprint for validating companies' judgment of material topics.

1   Introduction

In recent years, investors have increasingly included non-financial information in their decision-making processes (Global Sustainable Investment Alliance, 2015; Rogers & Herz, 2013). This is not surprising, given that the percentage of an entity's market value attributed to tangible assets has decreased sharply in the last few decades (Eccles, Serafeim, & Krzus, 2011). A consequence of the increased interest in non-financial information is the rise of the publication of non-financial and often voluntary information in companies' annual reports or in designated sustainability reports[1] (Higgins, Milne, & van Gramberg, 2015; KPMG International, 2015). Accordingly, the reporting guidelines from organizations such as the Global Reporting Initiative (GRI), the International Integrated Reporting Council (IIRC), and the Sustainability Accounting Standards Board (SASB) have evolved.

The recent development of mandatory disclosure in the European Union (EU) (European Parliament, 2014) is further evidence of the growing importance of non-financial disclosure. As a consequence, companies need to evaluate which non-financial information is material and should be disclosed. Therefore, the materiality of non-financial information is a highly relevant topic. To date, accounting research has not added much to this topic, except for the first evidence of the determinants of materiality disclosure (Fasan & Mio, 2016). However, little is known about whether and to what extent users of company reports are actually influenced by non-financial information.

Nevertheless, the materiality of non-financial information is an important issue for companies. On the one hand, the demand for non-financial information has increased over the last few years, as evidenced by the rise of non-financial disclosure standards such as the GRI and the mandatory disclosure of sustainability-related issues for capital market-oriented

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[1] Following prevalent practice in research and management we use the term sustainability reporting as synonymous with corporate social responsibility reporting, corporate citizenship reporting or similar terms. See, e.g., Hahn & Kühnen, 2013.

companies in the EU starting in 2017 (European Parliament, 2014). On the other hand, non-financial information offers a wide range of potential disclosures for a company. Therefore, guidance for determining which information is material is helpful for companies to focus on the important issues and for addressees of companies' reports because the guidelines advocate more balanced reporting (Deegan & Rankin, 1997) and thus mitigate discretion.

It is important to know how the primary users of sustainability reports perceive the materiality of different type of information and to what extent the users' decision-making is influenced by non-financial information. However, there is limited evidence of the importance of non-financial information, and the existing evidence thus far relies mainly on questionnaires (e.g., Deegan & Rankin, 1997; O'Dwyer, Unerman, & Hession, 2005). This research instrument has some notable shortcomings when investigating the concept of materiality (e.g., Iskandar & Iselin, 1999). Holm and Rikhardsson (2008), for example, illustrate that investors, when asked directly, value environmental information as of low importance, but still use this information in their decision-making processes in an experimental setting. Therefore, questionnaires cannot unequivocally clarify whether and to what extent investors consider non-financial information in their decision-making. To overcome such limitations, experimental research designs could be appropriate. However, few researchers have analyzed under experimental conditions whether capital market participants actually use sustainability information in their decision-making processes (Arnold, Bassen, & Frank, 2012; Holm & Rikhardsson, 2008; Martin & Moser, 2016). To tackle these limitations and fill the gap, we conducted an experiment with professional capital market participants to test whether investors' decision-making is influenced by the materiality of non-financial information. Our theoretical arguments are based on the decision usefulness theory that suggests capital market participants adjust their behavior by making inferences about the nature and types of information they receive. Accordingly, we manipulate two dimensions of materiality, that is, qualitative (i.e., a topic of high materiality and low materiality) and

quantitative dimensions (i.e., how the company performed in sustainability issues relative to its peers), in a 2×2 full-factorial, between-subjects design and investigate how professional capital market participants rate the investment according to a stock recommendation and the attractiveness of the investment.

The findings indicate that participants react to both dimensions of materiality. The participants adjust their recommendation and their evaluation of the attractiveness of the investment for a company with a lower non-financial performance downward, and this is even more pronounced when the lower performance occurs for a topic of high materiality.

We contribute to the understanding of the materiality of non-financial information in three ways. First, we address the need for more research on the materiality of non-financial information (Messier, Martinov-Bennie, & Eilifsen, 2005). With the experimental setting, we enhance the methodological basis and show that non-financial information can influence the decisions of professional capital market participants. Second, we provide strong support for the argument that materiality has a quantitative and a qualitative dimension (Eccles, Krzus, Rogers, & Serafeim, 2012). It is not sufficient to rank only the importance of financial versus non-financial information (see, e.g., Deegan & Rankin, 1997), within non-financial information, there are topics that can be relevant to investors. Third, our results are relevant for companies affected, for example, by the EU regulation that requires sustainability information be reported (European Parliament, 2014), because they inevitably have to consider what to report and how to approach materiality in their disclosure. Although validating the materiality of all different non-financial topics is difficult, not least because the relevance of many topics depends on the specific characteristics of a company and its environment, we provide the first example of an experimental setup to compare the relevance of two given topics. This experiment goes beyond a simple questionnaire based assessment of materiality and provides further insights into how materiality is perceived by report users.

The remainder of the paper is structured as follows. We start by describing the research background for the materiality of non-financial information, focusing on prior literature and the role of materiality in financial and non-financial reporting guidelines. Based on this background and the decision usefulness theory, we develop hypotheses. After describing the experimental setup and participants, we report and discuss the results.

2 Research background and hypothesis development

2.1 Materiality in reporting guidelines and research

The concept of materiality is a fundamental part of accounting and assurance standards (Eccles et al., 2012) and it also has a long history in accounting and auditing (Lo, 2010). Standard setters in the realm of financial accounting, such as the International Accounting Standards Board (IASB) and the Financial Accounting Standards Board (FASB), provide definitions of materiality. Although the precise wording differs slightly between the standard setters, all definitions rely on whether an information item impacts the decision-making process of the potential or actual user. IAS 1.7, for example, states: "Omissions or misstatements of items are material if they could, individually or collectively, influence the economic decisions that users make on the basis of the financial statements." (IASB, 2011, p. 2) Companies constantly need to consider what is material when deciding which information should be disclosed in annual reports to comply with financial accounting regulations (Heitzman, Wasley, & Zimmerman, 2010). Thus, disclosing material information is a prerequisite to provide a true and fair view of the company (Gordeeva, 2011).

Beyond the sphere of classic financial accounting, the materiality principle plays a central role in the discussion about additional types of corporate disclosure, especially regarding sustainability reporting. For the area of sustainability reporting, the widely recognized guidelines of the GRI characterize materiality as being achieved when a report covers aspects that "reflect the organization's significant economic, environmental and social impacts; or substantively influence the assessment and decisions of stakeholders." (GRI,

2013, p. 17) Similar to the definition of materiality in financial accounting, there is a focus on whether the decision-making processes (the assessment) of users (stakeholders) of an information item are influenced. However, the guidelines for material non-financial disclosure such as the GRI are not mandatory for companies (Eccles et al., 2012; Hsu, Lee, & Chao, 2013). Nevertheless, all types of standard setters aim at enhancing corporate reporting to present a true and fair view of the current situation of the company.

An essential part of the scientific debate on materiality deals with materiality thresholds (Iskandar & Iselin, 1999), because accounting and sustainability standards do not provide further support for the operationalization of materiality. For issues of financial accounting, Holstrum and Messier (1982) define the threshold for information to be considered material as "[…] the minimum amount of omission or misstatement that would influence the judgment of a reasonable user of financial information." (p. 46) Accordingly, for financial statements, a single threshold (e.g., a specific percentage of net sales or net income) could be applied to identify which information is material. In general, the quantitative dimension of the materiality concept is well established in financial reporting (Adams & Simnett, 2011). However, a piece of information can be of different importance for different stakeholder groups (Heitzman et al., 2010). Therefore, a specific information item could be subject to several different materiality thresholds.

The argument that different stakeholder groups apply different thresholds hints at the second dimension of materiality: content-specific criteria. Eccles et al. (2012) argue that numerical thresholds alone are not appropriate for deciding whether certain information is material or not. The qualitative content of the information also determines its materiality. This is especially relevant for non-financial information, because certain topics are more important to a company and its stakeholders than others. For example, water or energy consumption might be more relevant for companies in the manufacturing sector than for companies in service industries. Therefore, the quantitative and qualitative nature of an information item

must be considered to determine materiality. In the former dimension, the *performance* is at the center of thinking (e.g., how much water was used in the last fiscal year?). The latter dimension captures the qualitative content, meaning the *topic*, of the information (e.g., is water consumption a topic that should be disclosed in the first place?).

Although materiality is specific to stakeholder groups, research on materiality focusses mainly on investors and analysts (Gårseth-Nesbakk & Mellemvik, 2011; Morris, Nichols, & Pattillo, 1984). There is increasing support for the notion that, apart from traditional financial data, investors and analysts also consider material non-financial information when forecasting a firm's future financial performance (Eccles et al., 2012; Hsu et al., 2013). This is not surprising given that non-financial information can provide a better understanding of the risks, opportunities, and resource constraints beyond access to capital (Dhaliwal, Radhakrishnan, Tsang, & Yang, 2012). Furthermore, there is evidence that analysts' ratings of companies that disclose financial and non-financial information are positively associated with analysts' forecast accuracy (Lang & Lundholm, 1996). Theoretical and empirical studies support the notion of a significant association between non-financial performance and financial performance (Dhaliwal et al., 2012). Taken together, these findings serve as the first indication of the materiality of non-financial information for capital market participants.

Despite the recent trends toward increased non-financial disclosure, the depth and extent to which capital market participants utilize non-financial information in the decision-making process remains an open question (Holstrum & Messier, 1982; Ioannou & Serafeim, 2015). In a study by Holm and Rikhardsson (2008), investors rated environmental information as of low importance while Eccles et al. (2011) indicate that capital market participants seem to take the time and effort to search for non-financial data (similar to Rogers & Herz, 2013). In addition, recent literature shows that professional auditors acknowledge the materiality of non-financial information but to a smaller extent than the materiality of financial information (Moroney & Trotman, 2016).

Against the background of these inconclusive findings, we shed some light on the question of how the two dimensions of materiality, performance and topic, are associated with investment related judgments of professional capital market participants. This helps to understand not only whether non-financial information is material per se but also the roles of the dimensions of materiality.

2.2 Theory and hypotheses development

Companies publish a variety of sustainability-related information. However, the number of sustainability topics that may be relevant raises the question which of these topics are material for the decision-making process of report users such as capital market participants (Khan, Serafeim, & Yoon, 2016). Thus, it is necessary to understand how capital market participants process non-financial information (Simpson, 2010). To develop hypotheses, we build upon the decision usefulness theory (Staubus, 2000), which is closely linked to the concept of materiality. The decision usefulness criterion states that capital market participants will generally react to positive and negative decision-useful information in the proposed direction. For sustainability information, this criterion would imply, for example, that analysts provide negative recommendations for companies that report a decrease in sustainability performance and investors are willing to buy shares of the company only at a significantly lower price.

Decision usefulness is an objective of the financial accounting standards stated explicitly by the IASB (2010) and the FASB (1978). Although not uncontested, decision usefulness has played a central role in accounting research and in financial accounting policy making over the last 40 years (Beaver & Demski, 1974; Williams & Ravenscroft, 2015). For example, decision usefulness is the basis for discussions about earnings quality (Dechow, Ge, & Schrand, 2010) and is used to compare different measurement concepts of financial accounting (Gassen & Schwedler, 2010) or helps to analyze the consequences of accelerated filing deadlines (Doyle & Magilke, 2013). However, decision usefulness is not restricted to

financial accounting. This idea has also been used in the realm of non-financial reporting. For example, Tschopp and Nastanski (2014) compare different sustainability reporting standards and evaluate them based on the criterion of decision usefulness.

The link between decision usefulness and materiality is straightforward. The decision usefulness theory addresses capital market participants and their investment-related decisions as the focal point. Materiality, as established above, is concerned with the influence of information on the decision-making of users of the company reports. Therefore, materiality and decision usefulness have a large overlap when focusing on capital market participants as users of company reports and their economic decisions. For this group, information that is decision useful is, by definition, also material. In other words, if capital market participants receive negative non-financial information and react in the expected direction, for example, by adjusting investment prices downward, then this information is decision useful and material.

To analyze the materiality of sustainability-related information, we build upon the decision usefulness theory and focus specifically on negative information, because previous researchers have shown that capital market participants react more strongly to negative information than to positive information (Arnold et al., 2012; Cho, Lee, & Pfeiffer, 2013). In addition, some authors suggest that investors consider sustainability information primarily from a risk perspective, meaning negative sustainability information indicates a potential risk leading to a negative reaction while positive information merely indicates the absence of a related risk and does not necessarily lead to a positive reaction (Murray, Sinclair, Power, & Gray, 2006; Solomon, Solomon, Norton, & Joseph, 2011). Therefore, when studying the materiality of sustainability information, a starting point is to focus on the risk avoidance function of sustainability disclosures.

Previous empirical researchers (e.g., Arnold et al., 2012; Ioannou & Serafeim, 2015; Milne & Patten, 2002) provide initial evidence of capital market participants reacting to sustainability information. However, this research does not address the two dimensions of materiality (performance and topic) and its impact on capital market participants' decisions. With our experimental setting, we focus on the performance dimension by manipulating the extent to which the sustainability performance of a company decreases. For the topic dimension, we manipulate the sustainability topic for which information is provided.

Based on the decision usefulness theory in connection with the stronger impact of negative sustainability information as proposed by the risk avoidance function of sustainability disclosures, we expect that information about decreasing sustainability performance leads to less favorable investment-related decisions. Regarding the quantitative dimension of materiality, in the case of a stronger decrease in sustainability performance, capital market participants are expected to adjust their investment decisions downward more strongly. Accordingly, we formulate the first hypothesis:

Hypothesis 1 (Performance): Investment-related judgments by capital market participants who receive information indicating a strong decrease in non-financial performance will be unfavorable compared with those by capital market participants who receive information indicating a weak decrease.

Capital market participants need forward-looking information for their models and decision-making processes (Barniv, Hope, Myring, & Thomas, 2010). Sustainability information can provide such information, for example, by highlighting potential risks. For some sustainability topics, the risks are more clearly developed and better understood than for other topics. Therefore, sustainability topics can be decision-useful for capital market participants. For example, intensive debates about climate change lead to the development of specific voluntary disclosure standards, such as the Carbon Disclosure Project (CDP), and to

the implementation of emission trading schemes. The increased interest in this area of sustainability led to a better understanding of the monetarization of this issue. The discussions about International Financial Reporting Interpretations Committee 3 (Ascui & Lovell, 2011; Bebbington & Larrinaga-González, 2008) show that even accounting standard setters were considering how to monetarize carbon emissions. Matsumura, Prakash, and Vera-Muñoz (2014) show that the firm value of Standard & Poor (S&P) 500-firms decreases by about USD 212,000 for every additional thousand metric tons of total carbon emissions. However, there are other sustainability topics, such as biodiversity or human rights, which are hard to measure and the monetization of which is not as straightforward or for which suggestions about the financial impacts on companies are rare. Furthermore, standards of the same quality as the CDP or comparable accounting standards do not exist (Eccles et al., 2012). We expect the topic of the reported sustainability information will have an impact on the investment decision. Thus, we formulate the following for the experimental setting:

Hypothesis 2 (Topic): Investment-related judgments by capital market participants who receive negative non-financial information on a topic of high materiality will be unfavorable compared with those by capital market participants who receive negative non-financial information on a topic of low materiality.

As a consequence of these discussions, we also expect the two dimensions of materiality to interact with each other. That means, in accordance with the decision usefulness theory, we expect information will become even more important (i.e., it has a more negative impact on investment-related decisions made by capital market participants) if a considerably worse performance in quantitative aspects is shown for a highly material topic as opposed to a small decrease in performance for a topic of low materiality. Accordingly, investment-related decisions would be influenced to the highest (lowest) extent for information that is large (small) and that addresses the topic of high (low) materiality. Therefore, we formulate the third hypothesis:

Hypothesis 3 (Interaction of performance and topic): The differences in investment-related judgments between capital market participants who receive information indicating a strong or weak decrease in non-financial performance will be larger if the respective report covers a topic of high materiality compared with a topic of low materiality.

3 Method

3.1 Participants

We focus on professional capital market participants (i.e., professional investors and financial advisors) as participants, because this group should be most familiar with reading and utilizing financial and non-financial information for investment-related decisions. To achieve high external validity, 121 participants with a current financial background of work who served as proxies for professional investors comprised the final sample, because this group represents the most influential providers of financial capital (Ferreira & Matos, 2008). We recruited them via email, telephone calls, and personal contact. Of the 121 participants, 73 (46) were male (female), 60.33% (38.02%), while two participants chose not to answer this question. Seventy-one participants provided information on their age with a mean of 41.70 years and a mean work experience in their professional role of 10.55 years from 99 responses. Most of the participants worked in Germany (62.80%). The remainder of the participants worked in Austria (14.05%), England (14.05%), Italy (3.31%), Spain (3.31%) and Switzerland (2.48%). Results of a chi-squared test did not show significant differences regarding the dependent variables between the group of German-based and other participants.

3.2 Experimental design and procedure

The experiment followed a 2×2 full-factorial, between-subjects design (Figure 1). All participants had access to the same general introduction to the fictitious company Alpha Company and its financial highlights, including the statement of income and the statement of cash flows (see Appendix 1 and Appendix 2 for more details). Alpha Company was described as a STOXX 50 listed multinational European chemical company that manufactures plastics,

chemicals, and agricultural products. The chemical industry was deemed appropriate as the background because sustainability-related topics have been on the agenda of the industry for a longer time, and thus, we expect professional capital market participants to be aware of these aspects.

All participants were randomly assigned to one of the experimental groups. The two manipulated variables were (non-financial) *performance* and (non-financial) *topic*. All other factors, such as the presentation format and the financial information content were held constant in all experimental conditions. The experimental material was modeled following actual reports from a real-life company. A Kruskal-Wallis test did not reveal statistically significant differences between the four groups in terms of personal characteristics ($p > 0.1$).

Topic

		Biodiversity	Energy
Rating differences	**Low**	*Bio-low*	*Energy-low*
	High	*Bio-high*	*Energy-high*

Figure 1: Experimental groups

Following Elliott, Jackson, Peecher, and White (2014), we report the rating score for Alpha Company's non-financial performance. All participants received a table that reported this score in either of the two experimental conditions for the topic. For the independent variable *performance*, we manipulated the difference between Alpha Company's non-financial performance score and the industry average score. After an identical initial value in all experimental conditions of 62 in 2014 (industry average 65), Alpha Company's score declined to 60 in the *low* condition and 42 in the *high* condition (the industry average remained at 65) for 2015. Alpha Company's non-financial topic score is thus always below

the industry average score, because, in line with prior research, we expect a higher (perceived) impact of negative information (Arnold et al., 2012; Murray et al., 2006; Solomon et al., 2011; see also the reasoning above).

For the independent variable *topic,* the two groups in the left half of Figure 1 received non-financial information on the topic "biodiversity" as an issue of low materiality, while the two groups in the right half received non-financial information on the topic "energy" as an issue of high materiality. The two topics were chosen based on a qualitative content analysis of ten annual or sustainability reports from companies in the chemical industry issued in 2015, which was conducted as a pre-study. From the reports, we specifically analyzed the materiality process and the justification for materiality issues. All reports followed the recent guidelines of the GRI in the 3.1 or 4 version (for a critical discussion of the GRI guidelines, see, e.g., Milne & Gray, 2013) and included paragraphs on how the company determined the materiality of issues to report and a list or matrix of issues with higher and lower materiality. Constant throughout the reports, energy (or energy consumption) was presented as a topic of high materiality, and biodiversity was named as an issue of medium or low materiality for the respective company in the chemical industry so that they are appropriate as manipulations for materiality in the experiment. In addition, the SASB published a Materiality Map[TM][2] focusing on investor interest and evidence of the financial impact of different sustainability topics and for a number of industries (Khan et al., 2016). In line with our finding, for chemical industries the SASB identifies "Energy management" as an issue of high materiality and "Biodiversity impacts" as an issue of low materiality.

The information provided to the participants was accompanied by a narrative section that explained, the respective performance score relied on two key performance indicators (i.e., "renewable resources" and "production site near protected areas" for the topic

[2] See http://materiality.sasb.org/, last accessed April 6, 2017.

biodiversity or "carbon emissions" and "energy-efficiency" for the topic energy). Thus, the presentation format and the information extent were kept constant over all experimental conditions.

The experiment was administered online. The experimental task required the participants to complete several steps. After accessing the webpage, the participants first read the instructions and the brief introduction to the fictitious company Alpha Company. To prevent any prior knowledge of the company affecting the participants' judgment, we disguised the company's identity (as similarly in Holm & Rikhardsson, 2008 and Reimsbach & Hahn, 2015). Afterward, participants accessed the experimental material as described above, depending on which of the four experimental conditions to which they were randomly assigned. Then, the participants had to provide investment-related judgments. Throughout these judgments and decision-making processes, participants had access to the reports, so that they could obtain the required information to complete the task. Finally, there were empty lines for the participants to comment on their judgments (also see Andersson & Hellman, 2007).[3] After the participants completed this task, the reports were no longer accessible, and participants were asked to respond to manipulation checks concerning the topic in their respective reports and the non-financial performance score. Specifically, participants were asked to identify out of a list of six options (i.e., human rights, water, biodiversity, product stewardship, energy, and corporate governance) which non-financial topic was included in their respective report. Only two participants failed to answer this question correctly, and they were excluded from the analysis, leading to the final sample of 121 responses. Finally, participants were asked to answer (non-mandatory) demographic questions (e.g., age, work experience, gender, native language).

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[3] The comment option was used by only five participants. Three comments mentioned they would have liked to receive additional information regarding the competitors' financial data and the business model. Two comments specifically addressed the evaluation of riskiness (definition of riskiness and additional industry data to better evaluate the riskiness). Overall, no comment addressed problems with the non-financial topics, and the proportion of comments (less than 5% of all participants) was very low.

We pretested the experiment to assess its internal consistency and plausibility (Wason, Polonsky, & Hyman, 2002). Twenty-eight professionals with a current capital market work background completed the pretest and suggested minor changes to the material to enhance its understandability and ensure the level of appropriateness and realism.

3.3   Dependent variables

The dependent variables were all geared toward capturing investment-related judgments. We used *analyst recommendation* as the primary variable. We asked participants what recommendation they would deem fair and appropriate on a five-point scale, ranging from "strong sell" to "strong buy" (for a similar procedure, see Ghosh & Wu, 2012). As the participants were professional capital market participants, they should be familiar with this rating task and scale. We measured *investment attractiveness* as an additional investment-related judgment. Here, we followed Cianci and Kaplan (2008) and asked participants to rate the company in terms of investment attractiveness using a scale ranging from 0 (absolutely not investable) to 100 (top investment). Finally, as a robustness check, we also measured the *perceived investment risk* which should be a major factor in the process of making investment-related judgments. Similar to Maines and McDaniel (2000), participants assessed the risk of an investment in Alpha Company relative to the average firm of equivalent size in the same industry on a scale ranging from 0 (very low risk) to 100 (very high risk).

To directly capture the perceived materiality of the disclosed information, we also asked participants to rate the relevance of financial (*financial relevance)* and non-financial information (*non-financial relevance)* for their judgment and decision-making on a scale ranging from 0 (not at all relevant) to 8 (extremely relevant; for a similar procedure, see Lachmann, Stefani, & Wöhrmann, 2015).

4   Results

H1 posits that investment-related judgments will be less (more) favorable by investor groups who receive information indicating a strong (weak) decrease in non-financial performance. The mean *analyst recommendation* was 2.76 in the low decrease conditions and 2.00 in the high decrease conditions (see Panel A, Table 1). The mean perceived *investment-attractiveness* was 42.11 for the participants who received information indicating a low decrease in non-financial performance, and 26.47 for those who received information on a high decrease (see Panel A, Table 2). Finally, the mean *perceived investment risk* was also much higher in the high decrease conditions (58.28) compared to the low decrease conditions (41.75, see Panel A in Table 3). These findings are directionally consistent with H1. The ANOVA results further indicate that the effects of the magnitude of the non-financial performance decrease on participants' *analyst recommendation* (Panel B in Table 1), on participants' perceived *investment-attractiveness* (Panel B in Table 2), and on the *perceived investment risk* (Panel B in Table 3) were all statistically significant ($p < 0.01$). Based on the plotted data (see Figure 2) and an additional series of post-hoc tests (i.e., Scheffé, Bonferroni, and Games-Howell),[4] H1 is supported.

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[4] We conducted an additional series of post-hoc tests (i.e., Scheffé, Bonferroni, and Games-Howell). The tests indicated that the mean difference in *analyst recommendation*, *investment-attractiveness*, and *perceived investment risk* is statistically significant ($p < 0.05$) for all weak decrease (biodiversity and energy) versus strong decrease (biodiversity and energy) treatments.

Table 1: Analyst recommendation

Panel A: Descriptive statistics (analyst recommendation[a]) (mean [SD])

		n	Biodiversity	n	Energy	n	∑
			Non-financial topic				
Non-financial performance	**Low decrease**	34	2.82 [0.46]	29	2.69 [0.54]	63	2.76 [0.50]
	High decrease	31	2.16 [0.58]	27	1.81 [0.74]	58	2.00 [0.68]
	∑	65	2.51 [0.64]	56	2.27 [0.77]	121	2.40 [0.70]

Panel B: Results of ANOVA (analyst recommendation[a])

Source	df	Sum of squares	Mean square	F	p-value[d]	Partial eta squared
Corrected model	3	19.54	6.51	19.37	0.000	0.331
Topic[b]	1	1.73	1.73	5.14	0.025	0.042
Performance[c]	1	17.74	17.74	52.65	0.000	0.310
Topic x performance	1	0.34	0.34	1.01	0.318	0.009
Error	117	27,682.68	236.60			

Panel C: Planned contrast test of interaction[e]

Contrast 1 (Topic by performance interaction)	1	18.84	18.84	55.91	0.000	0.323

[a] We asked participants what recommendation they would deem fair and appropriate on a five-point scale, ranging from "strong sell" (1) to "strong buy" (5).
[b] Topic is 1 if participants received information on the topic energy and 0 otherwise.
[c] Performance is 1 if participants received information indicating a strong decrease in non-financial performance and 0 otherwise.
[d] p-values are two-tailed.
[e] We use contrast weights of –3 for the energy-high condition, –1 for the bio-high condition and +2 for all other conditions (i.e., bio-low, energy-low).

Table 2: Investment attractiveness

Panel A: Descriptive statistics (non-financial relevance[a]) (mean [SD])

		n	Biodiversity	n	Energy	n	∑
			Non-financial topic				
Non-financial performance	**Low decrease**	34	38.18 [17.24]	29	46.72 [11.97]	63	42.11 [15.54]
	High decrease	31	31.94 [14.70]	27	20.18 [16.84]	58	26.47 [16.68]
	∑	65	35.20 [16.26]	56	33.93 [19.65]	121	34.61 [17.84]

Table 2 (continued)

Panel B: Results of ANOVA (non-financial relevance[a])

Source	df	Sum of squares	Mean square	F	p-value[d]	Partial eta squared
Corrected model	3	10,528.06	3,509.35	14.832	0.000	0.276
Topic[b]	1	77.01	77.01	0.325	0.569	0.003
Performance[c]	1	8,067.63	8,067.63	34.098	0.000	0.226
Topic x performance	1	3,093.39	3,093.39	13.074	0.000	0.101
Error	117	27,682.68	236.60			

Panel C: Planned contrast test of interaction[e]

	df	Sum of squares	Mean square	F	p-value	Partial eta squared
Contrast 1 (Topic by performance interaction)	1	9,621.95	9,621.95	40.67	0.000	0.258

[a] We asked participants to assess the company's investment attractiveness. Participants answered on a scale ranging from 0 (absolutely not investable) to 100 (top investment).
[b] Topic is 1 if participants received information on the topic energy and 0 otherwise.
[c] Performance is 1 if participants received information indicating a strong decrease in non-financial performance and 0 otherwise.
[d] p-values are two-tailed.
[e] We use contrast weights of –3 for the energy-high condition, –1 for the bio-high condition and +2 for all other conditions (i.e., bio-low, energy-low).

Table 3: Perceived investment risk

Panel A: Descriptive statistics (perceived investment risk[a]) (mean [SD])

			Non-financial topic				
		n	Biodiversity	n	Energy	n	∑
Non-financial performance	Low decrease	34	38.53 [16.68]	29	45.52 [11.52]	63	41.75 [14.84]
	High decrease	31	54.35 [15.48]	27	62.78 [17.72]	58	58.28 [16.95]
	∑	65	46.08 [17.86]	56	53.84 [17.08]	121	49.67 [17.86]

Panel B: Results of ANOVA (perceived investment risk[a])

Source	df	Sum of squares	Mean square	F	p-value[d]	Partial eta squared
Corrected model	3	10,039.30	3,346.43	13.86	0.000	0.262
Topic[b]	1	1,783.11	1,783.11	7.38	0.08	0.059
Performance[c]	1	8,218.97	8,218.97	34.04	0.000	0.225
Topic x performance	1	15.63	15.63	0.06	0.801	0.001
Error	117	27,682.68	236.60			

Table 3 (continued)

Panel C: Planned contrast test of interaction[e]

Source	df	Sum of squares	Mean square	F	p-value[d]	Partial eta squared
Contrast 1 (Topic by performance interaction)	1	8,957.93	8,957.93	37.10	0.000	0.241

[a] *We asked participants to assess the risk of an investment in Alpha Company relative to the average firm of equivalent size in the same industry on a scale ranging from 0 (= very low risk) to 100 (= very high risk).*
[b] *Topic is 1 if participants received information on the topic energy and 0 otherwise.*
[c] *Performance is 1 if participants received information indicating a strong decrease in non-financial performance and 0 otherwise.*
[d] *p-values are two-tailed.*
[e] *We use contrast weights of 3 for the energy-high condition, 1 for the bio-high condition and –2 for all other conditions (i.e., bio-low, energy-low).*

Panel A: *Analyst recommendation*
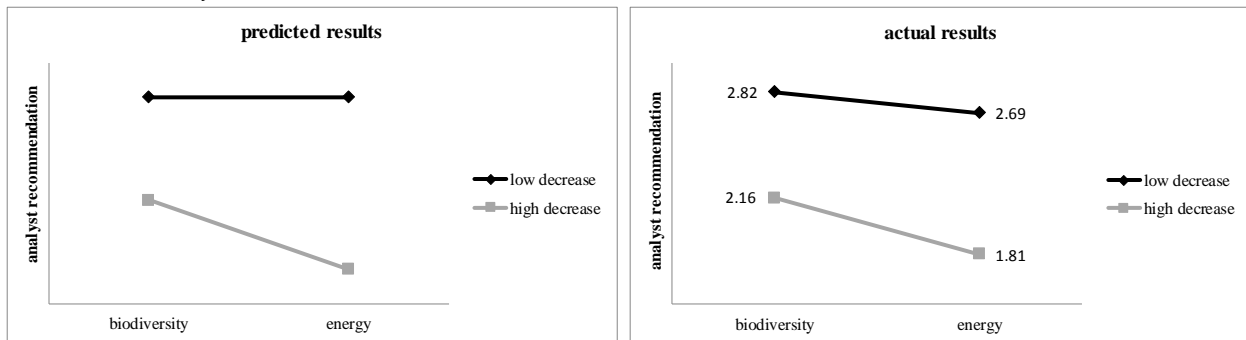
Panel B: *Investment attractiveness*
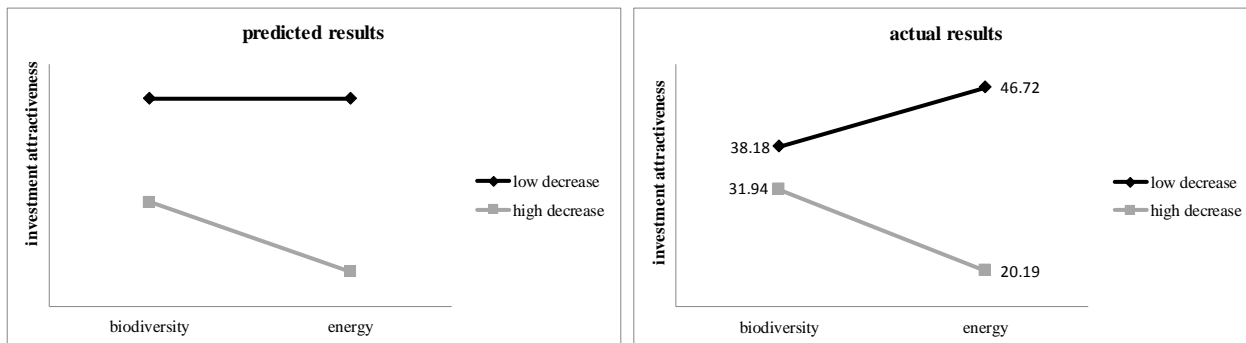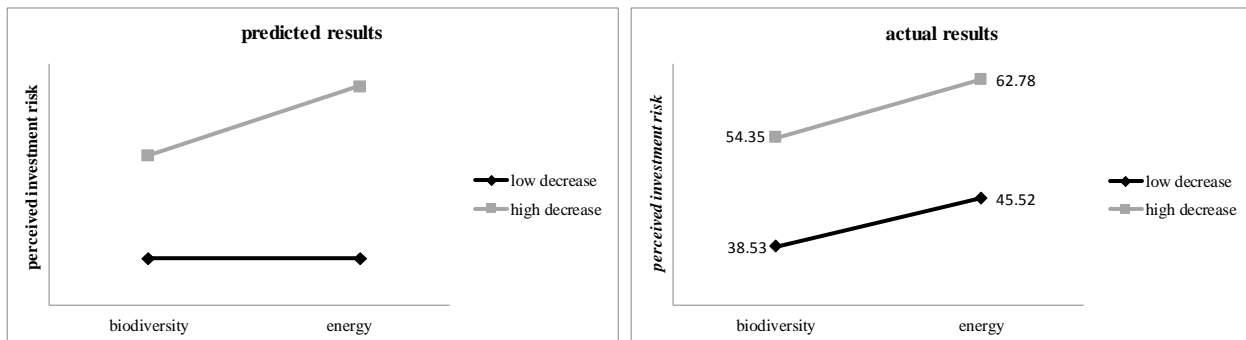

Panel C: *Perceived investment risk*

Figure 2: Predicted pattern and plotted results

H2 posits that investment-related judgments will differ between investors who receive non-financial information on a topic of low materiality (i.e., biodiversity) and those who receive information on a topic of high materiality (i.e., energy). Here, the mean *analyst recommendation* (2.27 versus 2.51, see Panel A, Table 1) and the mean *investment-attractiveness* (33.93 versus 35.20, see Panel A, Table 2) are lower for the energy compared to the biodiversity treatment groups while the *perceived investment risk* (53.84 versus 46.08, see Panel A, Table 3) is higher. These results are directionally consistent with H2. Furthermore, the ANOVA term for *topic* is statistically significant for *analyst recommendation* (Panel B in Table 1; $p < 0.05$) and *perceived investment risk* (Panel B in Table 3; $p < 0.1$). The ANOVA term is not significant for *investment-attractiveness* (Panel B in Table 2). Based on the plotted data (see Figure 2) and an additional series of post-hoc tests (i.e., Scheffé, Bonferroni, and Games-Howell),[5] H2 is mainly supported.

Finally, H3 posits that differences in investment-related judgments between investor groups who receive information indicating a strong or weak decrease in non-financial performance will be larger if the respective report covers a topic of high materiality (i.e., energy) compared with a topic of low materiality (i.e., biodiversity). The visual matching of the expected and actual patterns in Figure 2 supports this notion. The difference in *analyst recommendation* between the low and high decrease conditions increases from 0.66 in the biodiversity treatment groups (= 2.82 [bio-low] − 2.16 [bio-high]) to 0.88 (= 2.69 [energy-low] − 1.81 [energy-high]) in the energy treatment groups. These differences are statistically significant for the biodiversity ($F = 26.15$, $p < 0.01$) and the energy ($F = 25.94$, $p < 0.01$) treatments. We found a similar pattern for the *investment-attractiveness* and *perceived*

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[5] We conducted an additional series of post-hoc tests (i.e., Scheffé, Bonferroni, and Games-Howell). The tests indicated that the mean difference in *analyst recommendation*, and *perceived investment risk* is statistically significant ($p < 0.05$) for the energy (weak and strong decrease) versus biodiversity (weak and strong decrease) treatments. The mean difference in *investment-attractiveness*, however, is not statistically significant.

investment risk.[6] Furthermore, the ANOVA interaction term (*topic* x *performance*) is statistically significant for *investment-attractiveness* (Panel B in Table 2); the interaction term is not statistically significant for *analyst recommendation* (Panel B in Table 1) and *perceived investment risk* (Panel B in Table 3). However, H3 predicts an ordinal interaction, for which ANOVA is less powerful as a statistical tool (Buckless & Ravenscroft, 1990). Therefore, we further analyzed the functional form of the interaction using planned contrasts (Buckless & Ravenscroft, 1990; Lachmann et al., 2015), which increase the statistical power without increasing Type I error rates. For *analyst recommendation* and *investment-attractiveness*, we use contrast weights of –3 for the energy-high condition, –1 for the bio-high condition, and +2 for the bio-low and energy-low conditions.[7] Vice versa, for *perceived investment risk*, we use contrast weights of +3 for the energy-high condition, +1 for the bio-high condition, and –2 for the bio-low and energy-low conditions. This is consistent with our qualitative predictions (also see Figure 2) that a high decrease in non-financial performance is always associated with a lower perceived *analyst recommendation* and *investment-attractiveness*, and a higher *perceived investment risk* and that this effect is larger if the respective report covers the topic of energy as compared to biodiversity. The results of the planned contrast tests of interaction are reported in Panel C of Tables 1, 2, and 3. All three planned contrasts are statistically significant ($p < 0.01$); thus H3 is supported.

As an additional analysis, we also performed ANOVA for the variable *non-financial relevance* that directly captures the perceived materiality of the disclosed information. The mean *non-financial relevance* was 4.17 for participants who received information indicating a

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[6] The difference in *investment-attractiveness* between the low and high decrease conditions increases from 6.24 in the biodiversity treatment groups (= 38.18 [bio-low] – 31.94 [bio-high]) to 26.54 (= 46.72 [energy-low] – 20.19 [energy-high]) in the energy treatment groups. These differences are marginally statistically significant for the biodiversity treatments ($F = 2.44$, $p < 0.1$) and significant for the energy ($F = 46.70$, $p < 0.01$) treatments. The difference in *perceived investment risk* between the low and high decrease conditions increases from 15.83 in the biodiversity treatment groups (= 54.35 [bio-high] – 38.53 [bio-low]) to 17.26 (= 62.78 [energy-high] – 45.52 [energy-low]) in the energy treatment groups. These differences are statistically significant for the biodiversity ($F = 15.64$, $p < 0.01$) and the energy ($F = 18.93$, $p < 0.01$) treatments.

[7] These contrast weights are commonly applied to test the type of interaction that we predict in H3 (e.g., Elliott, Krische, & Peecher, 2010; Lachmann et al., 2015).

weak decrease in non-financial performance and 5.17 for those who received information on a strong decrease (see Panel A, Table 4). Furthermore, the *non-financial relevance* was higher for the energy compared to the biodiversity treatment groups (5.16 versus 4.22, see Panel A, Table 4). The ANOVA results further indicate that the effects of *topic* and *performance* on participants' judgments of *non-financial relevance* (Panel B in Table 4) were statistically significant ($p < 0.01$). An additional series of post-hoc tests (i.e., Scheffé, Bonferroni, and Games-Howell) revealed that all but one pairwise mean differences in *non-financial relevance* between the four experimental conditions were at least marginally statistically significant ($p < 0.1$). Only the bio-high (4.81) and the energy-low (4.76) conditions were statistically indistinguishable.

Table 4: Non-financial relevance

Panel A: Descriptive statistics (non-financial relevance[a]) (mean [SD])

		n	Non-financial topic Biodiversity	n	Energy	n	$\sum$
Non-financial performance	**Low decrease**	34	3.68 [1.25]	29	4.76 [1.24]	63	4.17 [1.35]
	High decrease	31	4.81 [1.10]	27	5.59 [1.08]	58	5.17 [1.16]
	$\sum$	65	4.22 [1.31]	56	5.16 [1.23]	121	4.65 [1.35]

Panel B: Results of ANOVA (non-financial relevance[a])

Source	df	Sum of squares	Mean square	F	p-value[d]	Partial eta squared
Corrected model	3	57.31	19.10	13.79	0.000	0.261
Topic[b]	1	26.21	26.21	18.91	0.000	0.139
Performance[c]	1	28.96	28.96	20.90	0.000	0.152
Topic x performance	1	0.66	0.66	0.475	0.492	0.004
Error	117	162.11	1.39			

[a] We asked participants to rate the relevance of non-financial information for their judgment and decision-making on a scale ranging from 0 (= not at all relevant) to 8 (= extremely relevant).
[b] Topic is 1 if participants received information on the topic energy and 0 otherwise.
[c] Performance is 1 if participants received information indicating a strong decrease in non-financial performance and 0 otherwise.
[d] p-values are two-tailed.

Finally, we also analyzed participants' assessments of the relevance of financial information for their judgment and decision-making. Here, the mean *financial relevance* (untabulated) was statistically indistinguishable between all experimental groups (bio-low: 7.56; bio-high: 8.00; energy-low: 7.90; energy-high: 7.89). Since we kept the financial information constant over all experimental groups and manipulated only the non-financial performance, these results further show that the experimental design was successful.

5   Discussion and conclusion

This study presents the results of an experimental analysis of the effects of different dimensions of non-financial materiality (i.e., qualitative and quantitative). We specifically tested three hypotheses. First, the results indicate that investment-related judgments by capital market participants who received information indicating a stronger decrease in non-financial performance were unfavorable compared with the judgments by capital market participants who received information indicating a weaker decrease (H1). This indicates that capital market participants react not only to non-financial information per se but also adjust their judgment during the actual performance. Although previous researchers found different reactions to good versus bad performance (Arnold et al., 2012; Cho et al., 2013), we show that there are different reactions even within one spectrum (i.e., bad performance). Consequently, it might be possible to operationalize the materiality of non-financial information alongside the performance-dimension, for example, by developing industry-specific threshold values.

Second, we found that the investment-related judgments by capital market participants who receive non-financial information on a topic of high materiality for the respective company (in this case, energy) were unfavorable compared with the judgments from capital market participants who receive non-financial information on a topic of low materiality (in this case, biodiversity; H2). This result is consistent with Eccles et al. (2012) who argue that materiality has not only a quantitative, but also a qualitative element (i.e., the topic

dimension). We find, professional capital market participants consider the topic dimension, meaning the contextual content of the non-financial information provided, and translate the information into financial terms. Specific to this case, it is easier to identify direct or indirect costs and risks arising from excessive energy use than from a high impact on biodiversity, thus, the former was apparently regarded as a topic of high materiality by the study's participants. However, this is not necessarily related to materiality beyond financial considerations, yet. The GRI characterizes materiality as reflecting "the organization's significant economic, environmental and social impacts; or substantively influence the assessment and decisions of stakeholders." (GRI, 2013, p. 17) In the present experiment, the participants might have reduced the materiality of the energy topic to financial materiality interpretations. We focused on professional capital market participants, because they are familiar with analyzing companies and utilizing different types of information. Thereby, we do not take into account the wider stakeholder perspective (Edgley, Jones, Atkins, 2015), and, as a limitation of our study, we cannot rule out that other stakeholders would make different judgments based on the same information. Future studies could explicitly focus further stakeholder groups to investigate other materiality aspects (e.g., environmental or social impacts) of non-financial information.

Third, we expected and found that the differences in the investment-related judgments between capital market participants who receive information indicating a strong or weak decrease in non-financial performance were larger if the respective report covered the topic of high materiality compared to a topic of low materiality (H3). This result shows professional capital market participants consider the two dimensions of materiality, performance and topic, simultaneously for non-financial information. Based on this finding, developing quantitative thresholds for non-financial information (addressing the performance dimension) can be useful only when it is specific to the different topics. However, although the experimental setting allows for a strong interpretation of the impact of the two dimensions we manipulated,

it restricts the analysis to this specific setting. The study is specifically aimed at the two topics energy and biodiversity for chemical companies. This focus is necessary, because materiality is argued to be sector specific (Eccles et al., 2012), but the results are not necessarily transferable to other settings. Further studies of how sector-specific characteristics influence materiality could follow, in addition to investigations of how different topics and representations of non-financial information are associated with materiality.

In sum, this study contributes to the literature on the materiality of non-financial information. We tie the materiality discussion to the decision usefulness theory and show that professional capital market participants react to bad news of non-financial information in the expected way, meaning a lower evaluation of investment attractiveness and a higher evaluation of the riskiness of the investment. This finding can be a starting point for determining thresholds and topical guidance. This study also complements previous literature focusing on the materiality judgments of auditors for financial and non-financial information (Moroney & Trotman, 2016). We focused on a specific stakeholder group, professional capital market participants, to change the perspective from the assurer's point of view to the user's point of view. Our analysis complements empirical studies based on archival data that have high external validity, due to their reliance on large samples across several years and industries (Khan et al., 2016), while our empirical approach more appropriately addresses causality. Therefore, we show that the characteristics of sustainability information drive the valuation of professional capital market participants.

Furthermore, we establish that two dimensions must be considered when discussing the materiality of non-financial information: performance and topic. Thus, the results contribute to the research on the nature of disclosed items (Messier et al., 2005), especially regarding non-financial information (Iskandar & Iselin, 1999), and substantiate the arguments of Eccles et al. (2012) that the context of the information must be considered to determine what is material. In this regard, the findings that professional capital market participants

consider information about biodiversity to be of low materiality should be critically examined, because biodiversity has to be considered a pressing matter of sustainability (Milne & Gray, 2013), as indicated by recent natural scientific studies (Steffen et al., 2015).

Furthermore, we add to the call for sector-specific thresholds of Eccles et al. (2012) by showing that for non-financial disclosures thresholds should also be topic-specific. Finally, these results support the materiality assessment of chemical companies evidenced in their disclosed materiality assessments regarding the high relevance of the topic energy and the low/medium relevance of biodiversity. In this regard, this study provides an example of how assessments via questionnaires (as often carried out by companies to evaluate the materiality of different non-financial topics) can be substantiated with alternative research methods, such as experiments.

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Appendix

Appendix 1: Alpha Company Report 2015 (Extract) – biodiversity score

Alpha Company Report 2015 (Extract)

Alpha Company is a multinational European chemical company, which manufactures plastics, chemicals, and agricultural products. It operates in more than 60 countries in Europe, Asia, Australia, America, and Africa. The company was founded in 1910, and it is currently listed on EURO STOXX 50.

FINANCIAL INFORMATION
STATEMENT OF INCOME
(IN MILLION €)

	2014	2015
SALES REVENUE	**23,692**	**23,621**
COST OF SALES	-17,799	-17,746
GROSS PROFIT ON SALES	**5,893**	**5,875**
SELLING EXPENSES	-2,388	-2,376
GENERAL ADMINISTRATIVE EXPENSES	-433	-436
RESEARCH EXPENSES	-601	-589
OTHER OPERATING INCOME	711	640
OTHER OPERATING EXPENSES	-838	-813
INCOME FROM COMPANIES ACCOUNTED FOR USING THE EQUITY METHOD	87	100
INCOME FROM OPERATIONS	**2,431**	**2,402**
FINANCIAL RESULT	**-135**	**-153**
INCOME BEFORE TAXES AND MINORITY INTERESTS	**2,296**	**2,249**
INCOME TAXES	-545	-518
INCOME BEFORE MINORITY INTERESTS	**1,751**	**1,731**
MINORITY INTERESTS	-107	-99
NET INCOME	**1,643**	**1,632**
EARNINGS PER SHARE (€)	**1.64**	**1.63**

STATEMENT OF CASH FLOWS
(IN MILLION €)

	2014	2015
CASH PROVIDED BY OPERATING ACTIVITIES	2,218	2,668
CASH USED IN INVESTING ACTIVITIES	-1,433	-1,777
CASH USED IN FINANCING ACTIVITIES	-882	-847
NET CHANGES IN CASH AND CASH EQUIVALENTS	-97	44
CASH AND CASH EQUIVALENTS AT THE BEGINNING OF THE YEAR	582	548
CASH AND CASH EQUIVALENTS AT THE END OF THE YEAR	548	509

NON-FINANCIAL INFORMATION
BIODIVERSITY SCORE

	2014	2015
OUR OVERALL SCORE*	62	60
INDUSTRY AVERAGE	65	65

* = the score can rank from "0" (very bad performance) to "100" (excellent performance)

Biodiversity is the foundation for numerous ecosystem services that are essential for human well-being. Therefore, biodiversity is an integral part of our strategy. We as a company are dependent on ecosystem services and have an impact on them. Both biodiversity and ecosystem services are under pressure from a rising world population, demand for higher living standards and increased industrial activity. We report an industry-score from an independent rating agency for the topic biodiversity which relies on two key performance indicators:

Renewable resources: Processes in the chemical industry are historically based on fossil resources. However, following our strategy we are advancing our research and development activities for products and production processes based on renewable raw materials.

Production site near protected areas: Internationally protected areas play a critical role in maintaining biodiversity around the world. This is why, in 2015, we once again investigated our production sites to discover which are located near internationally protected areas.

Appendix 2: Alpha Company Report 2015 (Extract) – energy score

Alpha Company Report 2015 (Extract)

Alpha Company is a multinational European chemical company, which manufactures plastics, chemicals, and agricultural products. It operates in more than 60 countries in Europe, Asia, Australia, America, and Africa. The company was founded in 1910, and it is currently listed on EURO STOXX 50.

FINANCIAL INFORMATION

STATEMENT OF INCOME
(IN MILLION €)

	2014	2015
SALES REVENUE	**23,692**	**23,621**
COST OF SALES	-17,799	-17,746
GROSS PROFIT ON SALES	**5,893**	**5,875**
SELLING EXPENSES	-2,388	-2,376
GENERAL ADMINISTRATIVE EXPENSES	-433	-436
RESEARCH EXPENSES	-601	-589
OTHER OPERATING INCOME	711	640
OTHER OPERATING EXPENSES	-838	-813
INCOME FROM COMPANIES ACCOUNTED FOR USING THE EQUITY METHOD	87	100
INCOME FROM OPERATIONS	**2,431**	**2,402**
FINANCIAL RESULT	**-135**	**-153**
INCOME BEFORE TAXES AND MINORITY INTERESTS	**2,296**	**2,249**
INCOME TAXES	-545	-518
INCOME BEFORE MINORITY INTERESTS	**1,751**	**1,731**
MINORITY INTERESTS	-107	-99
NET INCOME	**1,643**	**1,632**
EARNINGS PER SHARE (€)	**1.64**	**1.63**

STATEMENT OF CASH FLOWS
(IN MILLION €)

	2014	2015
CASH PROVIDED BY OPERATING ACTIVITIES	2,218	2,668
CASH USED IN INVESTING ACTIVITIES	-1,433	−1,777
CASH USED IN FINANCING ACTIVITIES	-882	-847
NET CHANGES IN CASH AND CASH EQUIVALENTS	-97	44
CASH AND CASH EQUIVALENTS AT THE BEGINNING OF THE YEAR	582	548
CASH AND CASH EQUIVALENTS AT THE END OF THE YEAR	548	509

NON-FINANCIAL INFORMATION
ENERGY SCORE

	2014	2015
OUR OVERALL SCORE*	62	42
INDUSTRY AVERAGE	65	65

* = the score can rank from "0" (very bad performance) to "100" (excellent performance)

The chemical industry in which we operate is energy-intensive. Therefore, we commit to energy efficiency and global climate protection. We contribute through our efforts to continue reducing emissions along the whole value chain and by our climate product solutions. We report an industry-score from an independent rating agency for the topic energy which relies on two key performance indicators:

Carbon emissions: Our climate protection activities are based on emissions controlling. We consider the whole value chain and determine the level of emissions produced by which activity, from the supply via production and the use of the end products we produce. The analysis adheres to the Greenhouse Gas Protocol standards and the standard for the chemical industry.

Energy-efficiency: Energy is one of the main cost drivers of production. Therefore, an efficient energy generation and use of energy is very essential. We utilize energy-efficient production processes and efficient technologies to generate steam and electricity and have implemented an energy management program.

Selbstdeklaration bei kumulativen Promotionen

Konzeption / Planung: Formulierung des grundlegenden wissenschaftlichen Problems, basierend auf bisher unbeantworteten theoretischen Fragestellungen inklusive der Zusammenfassung der generellen Fragen, die anhand von Analysen oder Experimenten/Untersuchungen beantwortbar sind. Planung der Experimente/Analysen und Formulierung der methodischen Vorgehensweise, inklusive Wahl der Methode und unabhängige methodologische Entwicklung.

Durchführung: Grad der Einbindung in die konkreten Untersuchungen bzw. Analysen.

Manuskripterstellung: Präsentation, Interpretation und Diskussion der erzielten Ergebnisse in Form eines wissenschaftlichen Artikels.

Die Einschätzung des geleisteten Anteils erfolgt mittels Punkteinschätzung von 1 – 100 %

Für mindestens einen der vorliegenden Artikel liegt die Eigenleistung bei 100 %.

Für einen zweiten Artikel liegt die Eigenleistung für
das Konzept / die Planung bei   100 %
die Durchführung bei   100 %
die Manuskripterstellung bei   100 %

Für einen dritten Artikel liegt die Eigenleistung für
das Konzept / die Planung bei   33 %
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die Manuskripterstellung bei   25 %

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Erklärung

Hiermit erkläre ich, Eric Schmiedchen, dass ich keine kommerzielle Promotionsberatung in Anspruch genommen habe. Die Arbeit wurde nicht schon einmal in einem früheren Promotionsverfahren angenommen oder als ungenügend beurteilt.

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Ort/Datum   Unterschrift Doktorand/in

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Eidesstattliche Versicherung

Ich, Eric Schmiedchen, versichere an Eides statt, dass ich die Dissertation mit dem Titel:

„The materiality of non-financial information – evidence from the interaction of firms

and capital market participants with a special focus on the chemical sector"

selbst und bei einer Zusammenarbeit mit anderen Wissenschaftlerinnen oder Wissenschaftlern gemäß den beigefügten Darlegungen nach § 6 Abs. 3 der Promotionsordnung der Fakultät Wirtschafts- und Sozialwissenschaften vom 24. August 2010 verfasst habe. Andere als die angegebenen Hilfsmittel habe ich nicht benutzt.

_____   _____

Ort/Datum   Unterschrift Doktorand/in

_____

Unterschrift Verwaltung