

Profit or Loss?

Exploring the Decision-Making Value of Natural Capital Accounting
for Businesses

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Thesis for the fulfilment of the
Master of Science in Environmental Management and Policy
Lund, Sweden, September 2017

The perils and pains of life are mostly comforted by a good laugh in
a serious context. Wisdom alone is a dry affair.

—*Franz Knecht, personal communication, 2017*

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Published in 2017 by IIIIEE, Lund University, P.O. Box 196, S-221 00 LUND, Sweden,
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ISSN 1401-9191

Acknowledgements

...Writing your thesis over what the local weather agency calls the worst summer in 155 years can feel disheartening. Days pass by without seeing the sun, and thoughts are freezing under the veil of the ambiguity of the research area. A sudden and unexpected message hits harder than a thunderstorm: “*We cannot provide you with the data*”, reads the e-mail. It is June the 26th, and the looming deadline crawls ever so steadily, casting its shadow on an already cloudy day...

...It is now September the 4th, and the sun is forcing its way through the clouds. At the opposite end of the screen, the crooked lines of text are filling in the template. Looking back, it is the people that I shared this journey with to whom I owe the bits of sanity that I have left.

To my supervisors Tareq, for being a constant source of ideas and inspiration, and Peter, for every single comment on my drafts;

To all the interviewees, for showing their interest in my work and for alleviating my phone anxiety;

To the Sunshine Batch, for having been the greatest companions in this crazy ride;

To the staff of the Institute, for teaching us all about big fat pipes, mechanical cleaning, the subtle art of abbreviating and much more;

To my employer Titab Pac, for entrusting me with all your management systems over the summer and for making sure my procrastination was always productive;

To my flatmates, for all the shameless singing to misheard lyrics, rotten baby pumpkins and deeply disturbing conversations;

To the Swedish Institute, for granting me a scholarship to pursue a degree at IIIIEE;

To my mother, for beating the odds, and my grandmother, for the spirit of curiosity.

...Because pictures say more than words, even if they are technically full of words – and inside jokes...



Abstract

The aim of the study at hand was to explore the potential of Natural Capital Accounting (NCA) to integrate environment into business decision-making. In order to fulfill the aim, the research was split into three main parts.

First, the existing views on what constitutes NCA were reviewed through a literature analysis of grey literature, and the working definition established. The study found that the existing opinions differed in two aspects: (1) whether or not to monetise impacts and dependencies, and (2) the extent to which ecosystems are incorporated. NCA was then defined as a monetary evaluation of impacts and/or dependencies of businesses on natural capital and ecosystem services.

Second, building on the existing literature on similar environmental management concepts, several working claims were derived from the literature around the potential of NCA to contribute to the integration of sustainability, namely, its potential to (1) increase departmental collaboration, (2) enhance the value of Environmental Management System, (3) contribute to strategic decision-making and (4) build awareness on environmental risks and opportunities. Several contingent factors were identified that could influence the integrative value of NCA.

The claims were then tested through incorporating experiences of companies from various sectors. Unanimous evidence to support the first and the third claims were found, while results as related to the second and fourth claims were inconclusive. In general, the role of NCA in the integration of environment into corporate decision-making was found to be mostly indirect and related to building individual awareness of people within the company.

Recommendations for practitioners included communicating the added value of monetisation, increased dialogue between different initiatives and working on the social capital. Recommendations for businesses included establishing working groups consisting of various departments and building on the existing assessment tools to decrease the resource intensity. Finally, potential for future research was outlined, highlighting possible relevance of a process-tracing case study.

Keywords: natural capital accounting, corporate decision-making, integration, environmental information, monetary evaluation

Executive Summary

Background and Problem definition

Natural capital, defined as the world's stock of natural assets and the services they provide, is crucial to the functioning of our society (Natural Capital Forum, n.d.). Despite its fundamental importance, it is rarely incorporated into economic decisions and is subject to continuous mismanagement on both micro and macroeconomic levels (European Environment Agency, n.d., Lange, 2013), with more than half of the world's ecosystems currently experiencing deterioration of state (MEA, 2003). As a response to the threat, many policy developments are taking place at a national, regional and global level (Lange, 2013).

However, with a large portion of natural capital owned or used by companies, it is crucial that businesses participate in the process. Many initiatives are emerging trying to involve businesses in the process, including the Natural Capital Protocol, providing a framework for natural capital assessments, and the upcoming ISO standards on monetary environmental valuation. Private sector initiatives start to emerge, with large companies experimenting on the methodologies to value natural capital. This variety of practical developments leads to conflicting interpretations of the terms and the confusion that follows. Furthermore, while the decision-making relevance of the approach is stressed by practitioners, little is known about the actual potential of NCA to contribute to the integration of environment into companies' activities.

Research Objectives and Research Design

The purpose of the research was to investigate the potential of NCA to integrate environment into corporate decision-making. With this aim in mind, the following umbrella research questions were developed:

- RQ1: What can be understood as NCA for businesses?
- RQ2: How can NCA contribute to the integration of environment into business decision-making?

To answer these questions, a qualitative study employing literature analysis and interviews as the main methods was conducted. As the first step, the concept of NCA was defined to identify the traits of the approach and to synthesise the information obtained from literature. As the second step and based on the traits discovered, several environmental management approaches closely related to NCA were identified. Then, literature pertaining to various theories that assesses the potential of these approaches to affect internal decision-making processes was analysed. As the result of this step, a number of theoretically informed claims was derived around the potential of NCA to affect business decision-making. As the last step, these claims were tested, to the degree possible, through collecting primary data from companies engaging in NCA (*case companies*), and those opting for other forms of assessment (*other companies*).

Findings RQ1: What can be understood as NCA for businesses?

One main aspect in which the available frameworks and interpretations of NCA differed was whether or not to monetise the impacts and dependencies on natural capital, and, subsequently, the methods used for conducting the natural capital assessments and the scope of those. The second aspect was the degree of inclusion of ecosystems and the level of wholesomeness, as well as the degree of methodological precision.

The following definition of NCA was derived *for the purposes of the thesis*:

Natural Capital Accounting for Businesses – A monetary evaluation of impacts and/or dependencies of businesses on natural capital and ecosystem services.

Findings RQ2: What is the potential of NCA to integrate environment into business decision-making?

Four claims were developed, representing potential mechanisms whereby NCA could integrate environment into business decision-making. In addition, a limiting factor was identified.

Claim 1: NCA has potential to enhance collaboration between the departments and thereby facilitate the integration of environment into corporate decision-making.

Theory suggested that systematically collecting data for NCA can increase organisational awareness and interdepartmental collaboration. In practice, all the case companies pointed out that various departments participated in the development of NCA, and, a lesser extent, in the implementation of NCA. The participation of the Finance team was particularly stressed.

Claim 2: NCA can help to enhance the value of Environmental Management System (EMS) and thereby mainstream environment into decision-making.

Theoretical links between NCA and the integration effect of EMS were identified. In practice, the link was mentioned multiple times, particularly as related to the risk register and continuous improvement, but was not as strong as expected. Three potential reasons were identified: (1) the informational needs of EMS and NCA differ significantly, (2) EMS is seen as a compliance tool, and NCA as a sustainability leadership tool, and that (3) the transition to the new ISO 14001:2015, much more strategically oriented in nature, is still under way.

Claim 3: Information generated through NCA is of high relevance for strategic decisions and top management.

Given the characteristics of NCA as a type of information, namely, highly aggregated, long-term and future oriented, its high relevance for strategic decisions was identified. Almost all the *case companies* linked their strategies, either business or environmental, to NCAs. However, this value was found indirect: NCA was mostly used to set or confirm the general direction for environmental strategy, and did not, in itself, trigger the decision to implement this strategy.

Claim 4: NCA increases awareness about both environmental risks and opportunities facing the company, thus increasing the perceived importance of sustainability work.

All the interview participants unanimously confirmed the risk value of NCA. However, the potential of such information to form a basis for exploring new business opportunities or innovation was only mentioned indirectly. The claim was found inconclusive in practice.

Limitation: The potential of NCA to integrate environment into corporate decision-making will vary significantly across the organisation types and sectors.

Theoretical analysis proved that contingent factors can be expected to have direct consequences for both the rate of adoption of the approach and the effectiveness of NCA in affecting business decisions. The factors identified were *sector, size, organisational structure, business strategy*, all likely to be interlinked. Overall, NCA was found to be more relevant for big companies either under the increasing pressure from customers or subject to increasingly stringent sectoral or regional regulation.

Recommendations and Future Research Areas

Practitioners

- Enhance the dialogue between different initiatives
- Explore synergies between business and policy developments surrounding NCA
- Consider work on social capital in parallel
- Develop case studies with a detailed description of the business value
- Continue working on the underlying methods

Businesses:

- Involve different departments in performing the NCA (e.g. through a working group)
- Explore the synergies between NCA and EMS
- Consider NCA in identifying new business opportunities
- State the intended use of the results prior to the assessment, derive the scope and type of NCA thereof
- Build on the existing internal and external information in developing NCA to reduce costs
- Consider pilot-testing the approach on a project or a material area

Academia

- Research on the role of information in strategic decision-making and in building awareness within the organisation
- Explore the applicability of NCA to different sectors
- A more rigorous comparative study outlining the potential of monetary assessments vis-à-vis qualitative or quantitative assessments
- Investigation of the drivers and barriers for the implementation of NCA, with an accompanying overview of policy developments
- Case-based research involving process tracing could be valuable.

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Abbreviations

CBA – Cost-Benefit Analysis

CFO – Chief Financial Officer

CIO – Chief Investment Officer

CNCA – Corporate Natural Capital Accounting

CSO – Chief Sustainability Officer

CSR – Corporate Social Responsibility

CSV – Creation of Shared Value

DJSI – Dow Jones Sustainability Index

GDP – Gross Domestic Product

NCA – Natural Capital Accounting

NCC – Natural Capital Coalition

EA – Environmental Accounting

EIA – Environmental Impact Assessment

EMA – Environmental Management Accounting

EMS – Environmental Management System

EPD – Environmental Product Declaration

EP&L – Environmental Profit and Loss

EU – European Union

HR – Human Resources
IIIEE – International Institute for Industrial Environmental Economics
IFC – International Financial Corporation
ISO – International Organisation for Standardisation
KPI – Key Performance Indicator
LCA – Life Cycle Assessment
MCA – Multi Criteria Analysis
MEA – Millenium Ecosystem Assessment
NCC – Natural Capital Coalition
R&D – Research and Development
REACH – Registration, Evaluation, Authorisation and Restriction of Chemicals
RQ – Research Question
SEA – Strategic Environmental Assessment
SEEA - System of Environmental-Economic Accounting
SDGs – Sustainable Development Goals
SMEs – Small and Medium Enterprises
TEEB – The Economics of Ecosystems and Biodiversity
TEV – Total Economic Value
UK – the United Kingdom
UN DSD – United Nations Division for Sustainable Development
UNEP FI – United Nations Environmental Programme Finance Initiative
WBCSD – World Business Council for Sustainable Development

1 Introduction

Natural capital, defined as the world's stock of natural assets and the services they provide, is crucial to the functioning of our society (Natural Capital Forum, n.d., Costanza et al., 1998). It supports human and animal life on Earth, as well as contributes to wealth creation. According to the World Bank (n.d.), natural capital constitutes up to 36% of the total wealth of low-income countries. Globally, natural capital both contributes to the economy directly, by providing resources and jobs, and indirectly, through sustaining and underpinning other types of capital, namely, manufactured, human, social and financial (Voora & Venema, 2008). Various estimates show that the value of global natural capital either compares to or exceeds the global GDP (Costanza et al., 1998, World Bank, 2011, Agarwala et al., 2005, Costanza et al., 2014).

Despite its fundamental importance, natural capital is rarely incorporated into economic decisions and is subject to continuous mismanagement on both micro and macroeconomic levels (European Environment Agency, n.d., Lange, 2013). Some examples of such mismanagement include market prices of products that fail to reflect the environmental costs and benefits, or natural resources that are excluded from national wealth accounting systems (European Environment Agency, n.d.). Coupled with population growth and economic development, such lack of incorporation leads to an increasing pressure and degradation of natural capital and the services it provides, resulting in potential disruptions in economic activity. Leaving it unaccounted for creates a natural capital debt bubble that, once collapsed, has potential consequences far exceeding those of the latest financial crisis (UNEP Finance Initiative, GCP & FGV, 2012).

Results of the Millennium Ecosystem Assessment (MEA), the largest scale global effort in evaluating the state of the world ecosystems that involved around a thousand experts worldwide, showed that 60% of the world's ecosystems are currently experiencing the deterioration of state, including 70% of the provisioning and regulating services (MEA, 2003). The last half a century marked an unprecedented degree of ecosystem degradation, stemming from the growing demands of the global economy. The assessment also pointed out at the potential tipping points, which, once exceeded, may lead to abrupt and irreversible changes.

As a response to the situation, many policy developments are taking place at a national, regional and global level (Lange, 2013). The European legislation is becoming increasingly concerned with ecosystems and biodiversity, pointing at the need to “integrate the value of natural capital and ecosystem services into decision-making” (European Environment Agency, n.d.). One example is the recently adopted EU Biodiversity Strategy that recommends monetary valuation of ecosystem services on a member state level (European Commission, 2011). Another example is the incorporation of preservation and enhancement of natural capital as one of the objectives under the EU 7th Environment Action Programme (European Commission, 2014).

In an attempt to integrate environment into our economic systems, countries are attempting to incorporate ecosystem services into their economic systems through developing various economic and administrative instruments. Realising that the first step for a proper management of natural capital and ecosystems is understanding the current state, countries are starting to develop national natural capital accounts under the framework of the System of Environmental-Economic Accounting (SEEA), developed by the UN (United Nations Statistics Division, 2013). The framework suggests a common terminology and statistical methods to illustrate interactions between the economy and the environment. Under the umbrella of SEEA, Experimental Ecosystem Accounting has recently emerged, that addresses the flows of ecosystems specifically (United Nations Statistics Division, 2013). World Bank Group and The Economics of Ecosystems and Biodiversity (TEEB), an initiative hosted by UNEP, provided

an overview of the countries that started integrating natural capital into their national accounts (World Bank, n.d., TEEB, n.d.). During the Rio+20 Conference, a call was issued to strengthen the implementation of natural capital accounting approaches in countries (WAVES Partnership, 2012).

1.1 Problem Definition

However, with a large portion of natural capital owned or used by companies, it is crucial that businesses participate in the process. According to an assessment performed by Trucost in 2013, the total value of unpriced natural capital costs from primary production and primary processing globally amounts to \$7.3 trillion, which represents around 10% of the global GDP (Trucost, 2013). Businesses both impact the state of the world's ecosystems, contributing to the degradation, and benefit from them. Following the developments in the public sector, many of the ecosystems will increasingly become priced, drastically changing the cost structure of the primary industries, which, in turn, will transform into increased costs downstream, negatively affecting many, if not all, economic sectors (Trucost, 2013). The same study concludes that none of the sectors has the financial capacity to cover these increased costs, should they be fully internalised through regulation or other mechanisms. Interdependence of economic sectors coupled with the globalisation of supply chains puts simultaneous pressure on the environment and the economic system.

Realising the importance of business, many initiatives are trying to involve companies in the process. For example, the World Forum on Natural Capital is taking place annually in Scotland since 2014 (Natural Capital Forum, n.d.), bringing together representatives from various actors of the economy. On the measurement side, numerous attempts have been made by various institutions to create standardised frameworks for corporate natural capital assessments, including the UK Natural Capital Committee, acting as an advisor to the UK Government (Mayer, 2016) and the Natural Capital Protocol, developed by the World Business Council for Sustainable Development (WBCSD, n.d.). Parallel to these developments, private sector initiatives start to emerge, with large companies experimenting on the methodologies to value natural capital, including the global apparel group Kering that, already in 2011, developed an Environmental Profit and Loss (EP&L) account for Puma, one of its brands (Kering, n.d.). This was later named the pioneering work in Natural Capital Accounting (University of Cambridge Institute & CISL, 2016).

Central to all the views on what constitutes natural capital assessment is the notion that companies integrate their impacts and dependencies on natural capital into their business decisions. The decision-making relevance of the approach has been continuously emphasised by the practitioners¹ (see, e.g. A4S Network, 2014, Ernst and Young, 2014, Spurgeon, 2014, CIMA, 2014, Natural Capital Coalition, n.d.). The envisioned role of natural capital assessments is not reporting, but rather the integration of nature into business thinking, with the ultimate aim of reducing the negative impact private sector has on natural capital.

In the core of the natural capital accounting approaches lies the idea that companies start incorporating nature in their activities. However, the scope of it and its relation to other environmental assessment and management tools have been interpreted differently by different actors. Some closely related concepts have recently been gaining popularity among the practitioners, including natural capital assessment, ecosystem services valuation, corporate natural capital accounting, and natural capital accounting for businesses, among others (Hanson,

¹ The thesis defines practitioners as institutions involved in working with natural capital assessments for businesses, excluding the businesses themselves, i.e. consultants, coalitions, other institutions promoting the approach.

Ranganathan, Iceland, & Finisdore, 2012, Spurgeon, 2014, Maxwell, 2015, Natural Capital Committee, 2015). This variety of practical developments led to varying, often conflicting interpretations of the terms and the confusion that follows. For instance, Spurgeon (2014) in his overview of NCA states that the correct definition would require a monetisation of impacts, while his own definition is broader than this. Calls for conceptual consistency on what constitutes natural capital assessments have been issued by several prominent institutions, such as the European Commission, as well as companies themselves (Høst-Madsen et al., 2016, Hoejrup Schmidt & de Saxcé, 2016, Høst-Madsen et al., 2014).

In addition to these diverging interpretations, one more problem associated with the area is the unclear value of monetary assessment. Current NCA and similar frameworks available to businesses, including the most widely known Natural Capital Protocol suggest that companies decide by themselves which dimension of NCA is appropriate to their business, and focus more on the procedure itself, rather than the consequences.

The business world is constantly flooded with new sustainability-related concepts that often emerge through practice. Many of those concepts have not been properly researched and nonetheless are being promoted. Corporate sustainability is becoming a battlefield for competing institutions all having their visions of what should be prioritised. From a theoretical standpoint, many of these concepts build on already existing methods and approaches, and their effects on businesses are twofold – on the one hand, they revive corporate interest in sustainability through a renewed discourse, on the other hand, they may lead to an information overload and poorly researched results. Currently positioned as an effective mechanism to improve corporate decision-making, little is known about the limitations and the actual potential of NCA to contribute to the integration of environment into companies' activities. The limited number of case studies and other information available were developed by the institutions that have a direct interest in promoting the approach.

Thus, the question of how exactly NCA affects decision-making is being omitted in an attempt to promote the approach. This is where the scholarly work can contribute by bringing an informed discussion that draws on a variety of already existing and well-researched concepts within environmental management and the organisational theory. Learning the lessons from other tools and approaches can help concentrate practitioners' efforts where they are needed the most, and avoid unnecessary spending.

1.2 Aim and Research Objectives

The purpose of the research is to investigate the potential of NCA to integrate environment into corporate decision-making, drawing on the existing environmental management instruments due to the lack of research on NCA per se, and complementing the findings with empirical evidence from early adopters. With this aim in mind, the following umbrella Research Questions (RQ) and tasks, presented in Table 1-1, are guiding the study.

Table 1-1 – Research questions and tasks

RQ1: What can be understood as NCA for businesses?

- Identify differences in existing opinions on what constitutes NCA for businesses
- Identify the traits of NCA
- Establish a working definition
- Place NCA within the environmental management tools and approaches

RQ2: How can NCA contribute to the integration of environment into business decision-making?

- Identify environmental management concepts that are similar to NCA (proxy concepts)
 - Identify recurring claims in the literature about the potential of these proxy concepts to facilitate integration of the environment into corporate decision-making
 - Derive theoretical claims about NCA from these claims
 - Empirically test the claims
-

1.3 Limitations and Scope

The study intends to theoretically investigate the mechanisms through which NCA can deliver on the promises of practitioners to affect corporate decision-making. The scope of the study is purposefully broad and is justified by the exploratory research design, the theory development component and the requirements imposed by the collaboration institution. When dealing with a concept still under development and in conditions of virtually no academic literature available that deals with NCA directly, establishing a narrower focus would have been associated with difficulties in justifying it, as well as practical complications. Nonetheless, several elements within the area were left outside the scope of the study.

First, the study is only concerned with NCA as it relates to the business world. Parallel developments in the policy sector were only touched upon in the introduction, while building the context, and in the final discussion, as part of the general reflections on NCA. Second, the study does not discuss the limitations of the underlying methods: NCA is looked upon through the lens of organisational sustainability and theories of management, rather than environmental or ecological economics. Investigating the methodological element within NCA would undoubtedly require a separate, much more rigorous, study. Along the same line, the study is not discussing in detail the ethics of putting a price on nature and, thus, is not dealing with the notion of the intrinsic value of nature, apart from the final discussion.

In addition, the study only tests links between the presence of environmental information in the form of NCA and the potential to integrate sustainability into business decisions. The effect that integration of sustainability has on the environmental performance of companies is only covered as part of the literature review for the purposes of *Chapter 2* and as an area for future research in *Chapter 7*.

While the geographical scope of the study was not initially and explicitly defined, it naturally limited itself to companies with headquarters in Europe, where many of the developments within the area are taking place, both political and practical. In many instances, these companies had supply chains that extended beyond Europe. Even so, NCA application in the context of other geographical areas will most likely be associated with significant differences.

Establishing a working definition of NCA represented an important part of the scoping process. At the same time, the working definition derived limited the empirical part of the study to a small number of front runner companies. In addition, several limitations stem from the exploratory research design and the methods chosen. These are discussed in details in *Chapter 2*.

1.4 Ethical Considerations

Given that the research was part of a broader research project involving academic institutions, businesses and an organisation providing advice on NCA, an important consideration for the author was to ensure the impartiality of the research. During the initial scoping stage, it was agreed that the main outcome of the study would be an informed and critical discussion, rather than a one-sided view. Therefore, the participation of the institution that initiated the study was limited to defining the scope of the study, giving the initial directions and providing with

potential interview contacts for empirical analysis. In addition, the choice of the working definition was, to a certain degree, influenced by the cooperating institution, while also further justified from the academic standpoint.

From there, the author strived to be independent and unbiased, to the extent possible within the domain of social sciences. Nonetheless, a certain degree of evaluative judgement is to be expected throughout the thesis, particularly at a stage of choosing the applicable theories and in Chapters 6 and 7, explained by the exploratory nature of the research and the limited amount of peer-reviewed information available. Any instances where personal opinions are presented are explicitly marked for the audience through using appropriate wording.

Issues of confidentiality and privacy were agreed upon in advance with the interviewees. Document draft was sent to all the interviewees prior to the publication in order to receive their consent.

1.5 Audience

This thesis is written for the fulfillment of the Master of Science degree in Environmental Management and Policy at the International Institute for Industrial Environmental Economics (IIIEE), Lund University, Sweden.

The study's theoretical relevance is twofold: first, it summarises practical developments surrounding the concept and comes up with a working definition, second, through assessing the claims it builds the ground for future, more robust and representative, research. Practical relevance is though pinpointing areas that need further development within the concept, and areas or traits that have the most potential to achieve the ultimate goal behind the developments – to integrate environment into decision-making.

Thus, several audiences could benefit from the results of this work. Academia could derive value from a systematic summary of the current developments and use it as a basis for further research. Particularly, results of the study could be of relevance to academics from the following disciplines and research areas: corporate sustainability and environmental management, organisational decision-making. To facilitate this process, several future research areas, including brief methodological suggestions, where possible, were outlined in *Chapter 7*.

Practitioners involved in NCA implementation could benefit from using the recommendations and a discussion on how to improve the decision-making relevance of NCA and where the efforts should be focused.

Finally, companies that are thinking of adopting NCA could benefit from better understanding the value it provides, the limitations it comes with, and the mechanisms that could be in place to improve its effectiveness.

1.6 Disposition

Chapter 2 describes the research design and the logic behind the study, including a description of the main methods involved and their limitations. A special emphasis is placed on illustrating the degree to which research quality criteria were incorporated and justifying the choice of exploratory study design.

Chapter 3 presents a comprehensive overview of the concept of NCA, introduces a working definition and places the concept in the context of environmental management. It also identifies similar, “proxy” concepts. The chapter intends to answer the first research question.

Chapters 4 and 5 represent the findings of the study with regards to the second research question. *Chapter 4* contains findings from the literature analysis of the environmental management concepts similar to NCA and thereby derives theoretically informed claims about the potential of NCA to integrate environment into corporate decision-making. *Chapter 5* empirically tests these claims through employing interviews as the main method and literature analysis as a supporting method.

Chapter 6 analyses practical findings with regards to the theoretical findings and discusses the results of the study, particularly, the degree to which conclusions could be drawn from the analysis. In addition, it reflects on the consequences of the methodological choices, as well as on the concept and the value of monetisation.

Chapter 7 presents the recommendations for the main target audiences – practitioners, businesses and academia. For the latter group, the recommendations take form of highlighting potential future research areas. *Chapter 8* concludes the study.

2 Method

The main methodological challenge of the study lied within the concept of NCA for businesses itself. As a relatively new development, used by the practitioners but mostly overlooked by the academia, the concept posed many questions that had to be answered before proceeding to assess its potential to integrate environmental considerations into businesses. In addition, due to the novelty of the concept, limited academic literature was available that would investigate the links between NCA and corporate decision-making directly. With this challenge in mind, the following process, illustrated in Figure 2-1, was employed.

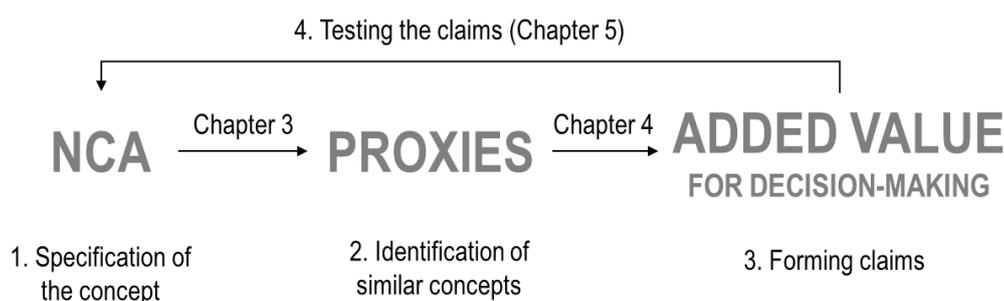


Figure 2-1 - Illustration of the analytical process behind the study

As the first step of the study, the concept of NCA was defined to identify the traits of the approach and to synthesise the scattered information obtained from reviewing grey literature. Several choices were made during this step. Given the conflicting interpretations, the author derived and justified own working definition of NCA. As the second step and based on the traits identified, several approaches and tools pertaining to environmental management and closely related to NCA were identified. Then, literature pertaining to various theories that assess the potential of these approaches to affect internal decision-making processes was analysed. As the result of this step, a number of theoretically informed claims was derived around the potential of NCA to affect business decision-making. As the last step, these claims were tested, to the degree possible, through collecting primary data from companies engaging in NCA (*case companies*), and, to a lesser extent, those opting for other forms of assessment (*other companies*).

Thus, the nature of the research is exploratory. The exploratory design defined the array of the methods involved and justified high dependency of the study on secondary data collection and analysis, and the extensive theoretical part (Yin, 2016). Overview of the data collection methods employed, split by research questions and tasks, is presented in Table 2-1.

Table 2-1 – The main data collection methods employed

Task	Data collection
Research question 1: What can be understood as NCA for businesses?	
1. Identify the existing opinions on what constitutes NCA for businesses	Literature Analysis, Interviews (Practitioners)
2. Identify the traits of NCA	Literature Analysis, Interviews (Practitioners)
3. Establish a working definition	Interviews (Practitioners)
4. Place NCA within other environmental management approaches	Literature Analysis, Interviews (Practitioners)

Research question 2: How can NCA contribute to the integration of environment into business decision-making?	
1. Identify environmental management approaches that are similar to NCA (proxy approaches)	Literature Analysis
2. Identify recurring themes in the literature about the potential of these proxy concepts to integrate environment into corporate decision-making	Literature Analysis
3. Derive working claims about NCA from these themes	Interviews (Businesses)
4. Empirically test the claims	Interviews (Businesses)

Case-oriented approach was employed in answering *RQ 2 Task 4*, justified by the goal of the study. Small-n is justified given the extreme (revelatory) nature of the cases (Yin, 2009). Companies that are implementing the approach can be considered front runners, therefore, the theoretical links identified can be deemed stronger and the awareness of the topic more present, both conducive towards the goals of the study. As a supporting evidence, interviews with companies that did not implement NCA were briefly incorporated as findings and for discussion.

Given the fact that several claims had to be tested, the case-oriented approach was preferred to the case-based approach. Some claims could be more relevant to companies of a particular size, or operating in particular sectors. Therefore, the case-based approach could have further reduced the generalisability of the findings. The variable-oriented research was deemed impossible to apply given the complexity of the issue dealt with, the importance of identifying causal links, and the limited empirical data available.

2.1 Similar Studies

Several exploratory studies that deal with newly emerging concepts were reviewed in order to develop the methodology presented above. Likewise, given that the study also dealt with a broad concept on the other end – corporate decision-making, existing studies were reviewed that investigate the potential of a certain approach to improve decision-making, to examine the methods used by the researchers.

Corporate decision-making and its relationship to sustainability or environment was frequently researched through assessing the integration effects on various initiatives on general decision-making processes within a company (see, e.g. Witjes, 2017, Engert and Rauter, 2016, Ballou, Casey, Grenier, & Heitger, 2012, Maas, Schaltegger, & Crutzen, 2016, Sroufe, 2017, Baumgartner & Rauter, 2017, Lozano, 2012).

Several main approaches in dealing with a potential of new or existing concepts to affect corporate decision-making were identified. First ones were concerned with identifying the drivers and barriers for the implementation of a specific initiative (see, e.g. Danciu, 2016 investigating Shared Value Creation), others dealt specifically with challenges arising from the implementation, yet others explored theoretical ways in which a concept could contribute. For instance, while investigating the potential of Environmental Management Accounting (EMA), Bartolomeo et al. (2000) start with placing the concept in the context of business accounting and followed by developing and empirically testing four working hypotheses related to the concept. However, the choice of the hypotheses was not described from a theoretical standpoint. A more theoretically grounded approach was undertaken by Amiruddin (2016). In figuring out the potential of EMA to affect business decisions, the author first places the concept in the existing theories of relevance. Wójcik (2016) compares an emerging concept of

shared value to an existing and relatively well-established Corporate Social Sustainability (CSR) and assesses its potential from there. Many of these studies followed an exploratory approach and were concerned with capturing the emerging themes (hypotheses or claims) without paying too much attention to whether all aspects are covered or not.

One study found to be very similar to the thesis at hand with regard to the research questions posed is the doctoral thesis of Krishna Manda (2014). The author looked at the potential of Life Cycle Assessment (LCA) to integrate environmental sustainability into business decisions. The study was systemic in so that it reviewed the main business functions that are using LCA results, as well as business decisions based on them. In addition, the study described the external context and drivers and culminated in identifying value creation opportunities. Overall, the study was concerned with the value creation approach based on LCA (Krishna Manda, 2014).

2.2 Literature Analysis

Literature analysis served as the primary method throughout the study, particularly in deriving the working definition of NCA (*RQ1*), and an important method for deriving theoretical claims about NCA (*RQ2 Tasks 2 and 3*). Several mechanisms were employed to make sure a wide range of topics and recurring themes and ideas were incorporated. The first mechanism was to actively employ meta studies and systematic reviews to identify relevant articles for each proxy concept. Second, the saturation principle was incorporated to the extent possible, which was particularly feasible for the *RQ1*, given that NCA is a new concept. Special attention was also paid to the key words. The author was well aware of the fact that some researchers and practitioners prefer terms other than natural capital. To build the conceptual framework, a list of all the similar concepts that the author could find was compiled, and several years of titles and key words in corporate sustainability journals were reviewed to adjust the terminology.

Several literature streams were reviewed in the course of this study. The first literature stream was concerned with the approach and the practical developments within the field. Apart from NCA itself, similar approaches, such as Natural Capital Assessments and Corporate Ecosystem Valuations, were investigated. A detailed overview of the different approaches is presented in *Chapter 3*. This literature stream consisted primarily of grey literature, with corporate, third-party and governmental reports serving as the main sources. Several meta-reports were also examined, such as the Guide to approaches for natural capital for businesses (Spurgeon, 2014). The extensive use of grey literature had its advantages, particularly in conveying the latest practical developments and keeping the research up to date (Pappas & Williams, 2011). However, the following disadvantages were identified and dealt with. First, in many instances, the results were contradicting each other and reflected opinions of a particular institution rather than well substantiated facts. Second, the terminology used was different from report to report. To decrease the negative effect of these and to introduce a more balanced overview, results from the review were complemented by the interviews with practitioners and developers of competing approaches (see *Chapter 2.3* for the description of the interview process).

The second literature stream was concerned the proxy concepts. In the identification of the proxy concepts, i.e. environmental management tools and approaches that share similar traits to NCA, various meta-studies were employed. To the best of the author's knowledge, no comprehensive and systematic overview of the field of corporate sustainability was performed that could have been relevant to the study at hand. Instead, classifications and frameworks for sustainability assessment, suggested by Ness et al. (2007), Sala, Ciuffo & Nijkamp (2015) and Povenda and Lipsett (2011), provided a comprehensive overview of the existing methods and tools used in sustainability assessment and were employed to make sure that the main approaches (proxies) relevant for the discussion are covered. In addition, the approach

undertaken by Lozano (2016) listed the most common voluntary sustainability initiatives, served as an inspiration.

Another stream of literature was concerned with reviewing the meta-studies of the field of corporate sustainability to see what theories are currently being employed in corporate sustainability and environmental management. Linnenluecke and Griffiths (2013) provided an overview of the last fifty years of the most important theories and thought streams applied in the field of corporate sustainability. They distinguish between the following main areas of research: the stakeholder theory, concerned with the drivers and barriers for sustainability, a debate on corporate environmental versus financial performance, and the radical greening debate on the need for a drastic change in what is perceived as corporate profit and corporate values and the developments that surround it, as well as reconsidering the business-society relationship. These studies were valuable in identifying the main theories and themes for answering *RQ2 Task 2*.

2.3 Interviews

The list of all people interviewed can be found in Appendix II. List of Interviewees. Two main groups of interviewees were contacted to fulfill the research objectives (Figure 2-2).



Figure 2-2 – The main interviewee groups and their relationship to the research objectives and the chapters

For answering the first research question, practitioners involved in developing NCA or similar approaches were contacted. The purpose of these interviews was to confirm or dismiss the findings obtained through grey literature analysis in *Chapter 3*. As part of this group, academia working with monetary environmental evaluations and issues related to the integration of sustainability were contacted to complement findings from the academic literature for the purposes of *Chapter 4*, developing the theoretical claims. For the purposes of *Chapter 5*, practical findings, and the following analysis and discussion, businesses that are working with NCA-like approaches were contacted. In addition and to account for the opposing viewpoints, companies that have opted for using other forms of environmental assessments, as opposed to NCA, were contacted.

2.3.1 Practitioners and Academia

Overall, the roles of the interviews with practitioners and academia were the following: to develop the author's understanding of the topic, to confirm or dismiss the findings with regards to *RQ1*, to give new insights and provide opposing views. Unstructured interviews (not to be confused with informal interviews) were, thus, employed, deemed relevant and appropriate

given the secondary role of these interviews in the research process, and the exploratory nature of the research (Patton, 2015). It was important for the researcher to stay open to any new inputs and ideas arising from these interviews, thus, while a general direction (agenda) of the conversation with each particular institution was pre-set, no pre-defined questions were employed. The questions varied depending on the interviewee and their particular area of expertise. In several instances and more as an exception, when the author had a very specific and straight-forward question/questions to a particular interviewee, that interview was conducted over the e-mail.

The main institutions to be interviewed were defined after all relevant parties dealing with the topic were identified in *Chapter 3*. In several instances, authors dealing with proxy concepts were contacted to develop the theory around NCA. No coding was deemed necessary due to the role of the interviews in the process.

2.3.2 Businesses

These interviews served as a primary method for answering *RQ2 Task 4*. The goal of the interviews with companies that implemented NCA was to find evidence to support or dismiss the claims derived in *Chapter 4*, and, in general, to capture the current state of development.

Case Companies

Two-step coding process was employed. First, the interviews were coded according to the research themes (claims), as presented below:

- Departmental Collaboration
- Environmental Management System
- Top Management Involvement and Strategic Relevance
- Risks and Opportunities
- Other: Drivers, Barriers/Challenges, Advantages of Monetary Assessment

As a second step, an interpretative coding of the opinions of the interviewees in relation to the claims was employed.

Pre-interview work was important for various reasons. Thus, the interview process consisted of the following steps:

1. Reviewing corporate annual report (integrated report, if necessary)
2. Reviewing publicly available information about the type of NCA work in the company
3. Checking the responsibility area of the interviewee
4. Filling in the company information sheet based on the findings from the previous stages
5. Reviewing and adapting the general questionnaire to the company at hand – changing the wording and/or adding additional questions
6. Conducting the interviews
7. Transcribing and coding the interviews

The interviews were semi-structured with much room for flexibility stemming from the fact that the approach implemented in each particular company was different. Nonetheless, the interview guide can be found in Appendix I. Interview Guide for Businesses.

Given that the area, and the conceptual framework, is still under development, the process of selection of companies represented a serious threat to the external validity and other quality dimensions of the study. The main issue during the selection process could be illustrated by the

following question: should the sample be limited to companies that specifically refer to the term NCA, or should it be expanded to include companies that are employing an approach that fits the definition adopted, but not referring explicitly to NCA? The author chose the second approach. To improve on the external validity aspect, several methods were employed. First, the approaches implemented in the case companies had to satisfy the definition of NCA adopted in this thesis, especially with regards to conducting the *monetary* type of assessment. The companies were selected from an initial list compiled by the author based on the NCA reports made by the third parties. While in general, the author tried to take several considerations in mind when selecting the cases, including sectoral diversity, varying sizes and scope of NCA implemented, in practice, the sample naturally limited itself.

Other Companies

Given that the interviews with companies that were not using NCA served primarily for the purposes of discussion, the interview process was more relaxed. Particularly, interview channels were more flexible – companies were provided with an online questionnaire alternative to a verbal interview. In addition, convenience sampling was employed. The interviews were shorter, and the questionnaire was significantly modified from the version available in Appendix I. Interview Guide for Businesses.

Alternative Methods

Alternative methods for qualitative research were briefly considered but dismissed shortly after. Surveys were not deemed as an appropriate method for several reasons. First of all, it was important for the author to be able to ask follow-up and open-ended, rather vague, questions to avoid hinting at certain answers. Second of all, the exploratory nature of the study implied the need to stay open for any new areas that might surge during the interview. The focus group method was dismissed due to both irrelevance, practical infeasibility and the threat of “group thinking”.

2.4 Research Quality Dimensions

Due to the exploratory nature of the study, limited consideration was given to the external validity of the collected primary data. The study at hand should be regarded as rather laying the ground for future research that can empirically test or dismiss the conclusions. Thus, an important result of the study is related to identifying the potential for future research. Nonetheless, the author strived to enhance the external validity where possible, including through heavily grounding the research in theory (particularly in *Chapter 4*), as well as during the interview stage.

Internal validity represented a major challenge throughout the research. The main mechanisms through which the simultaneous effect of multiple variables on the outcome was controlled was through employing various, including rival, theories in both developing the claims and designing the interview questions (Reynolds et al., 2011, Yin, 2016).

Construct validity was dealt with in several ways. An important concern was drawing inferences while hypothesising about NCA based on the proxy concepts. As a tool to strengthen the warrant, deconstruction of the working concept was employed. A set of traits of NCA were identified and then compared against the proxy concepts, which was followed by a comparison between the proxy and NCA in each instance prior to drawing a claim. In addition, the very choice of proxy concepts was based on the degree to which they could be compared to NCA.

3 Natural Capital Accounting for Business: An Overview

This chapter provides an overview of the existing approaches to assessing and valuing natural capital for businesses. Ultimately, the goal of the chapter is to summarise recent practical developments in the area in order to derive the working definition and a set of traits that comprise Natural Capital Accounting and to place it in the existing array of environmental management and corporate sustainability instruments. A special focus is placed on pinpointing conceptual controversies, whose presence led to the necessity of introducing this chapter in the first place.

3.1 Natural Capital Approach to Environment

Ultimately, it's all about conserving nature and environment and the planet that we all live in and rely on. [...] Natural capital is the term that, for some people, resonates better.

—Eva Zabey, WBCSD, personal communication, 2017

Arguably, the initial idea behind natural capital was to reconcile our economic system with the limits imposed on us by nature. While the term was first used in 1973 by Schumacher (1973), it was popularised and further developed in the nineties by the ecological economists Herman Daly and Robert Costanza (Missemer, 2018). The research around natural capital and the related terms has been there for a long time, and has been developed, somewhat in different directions, within both environmental and ecological economics², with many researchers and international institutions introducing their own working definitions. As can be seen from Figure 3-1, natural capital stock is comprised of ecosystem assets, abiotic assets and subsoil assets, which all provide certain services (benefits) to humans, which reflect the degree to which humans are dependent on the ecosystem services. At the same time, human activities impact the state of natural capital, which in turn affects their ability to provide the benefits (services).

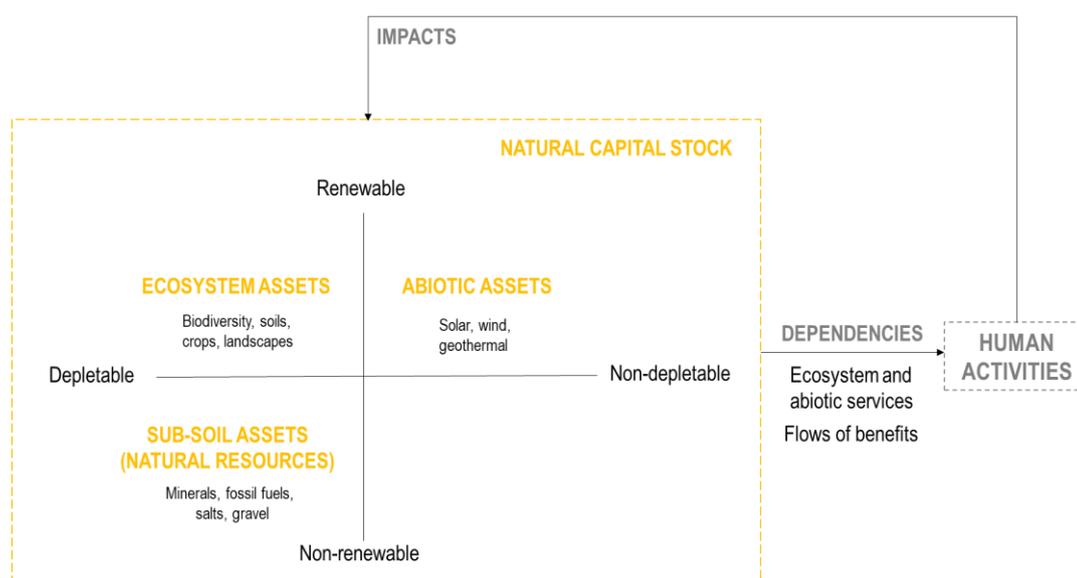


Figure 3-1 - Relationship between natural capital and ecosystems.
Source: Adapted from United Nations Statistics Division, 2013

² For a brief overview of the main differences between ecological and environmental economics, refer to Venkatachalam (2007)

Abiotic assets are of the least interest to economists due to their renewable and non-depletable nature, which in most cases eliminates the very need to value them. Subsoil assets are usually priced on the market to the extent they are extracted. Ecosystem assets, in turn, represent, arguably, the most diverse group of the three. According to the definition adopted by the European Commission et al. (2013), they represent spatial areas with a combination of components that jointly provide a flow of benefits (ecosystem services).

After publishing the Millennium Ecosystem Assessment (2005), it became clear that the total value of these assets has been neglected, which led to a deterioration in the state of the ecosystems. In addition, due to the latest developments in the political arena, briefly covered in the introduction, ecosystem assets, especially certain components of them, such as the overarching biodiversity, have gained an increased attention. The importance of natural capital was recognised through its inclusion in Sustainable Development Goals (SDGs), an initiative that sets general direction and the general policy framework for the world. For instance, natural capital elements are directly included as part of Goal 6 - Clean water and sanitation, 13 - Climate Action, 14 - Life below water and 15 - Life on land (Bann, 2016). Thus, even though the concept of natural capital is broader than the concept of ecosystem assets, the focus on ecosystems and their full value is justified given their vulnerable nature and the degree to which their value is neglected. For the purpose of this thesis, natural capital and ecosystem assets will be used interchangeably.

The value of the stock of ecosystem assets can be calculated through the value of the total flow of benefits it provides, a concept that is known as the Total Economic Value (TEV) (Bishop & Romano, 1998). This is where another research stream is unfolding, starting from the monetary valuation methods, that, although have been there for over forty years now, are still associated with a high degree of uncertainty, and are subject to questions regarding the very ethics of putting a price on nature – see, for instance, DesJardins (2013). Some are questioning the very use of the term capital in relation to nature, since it implies interchangeability of natural capital by other capital types and largely ignores the notion of the intrinsic value of nature, that is, the value beyond that associated with human existence (Attfield, 1998). Despite this, one can argue that both academics, businesses and politicians alike increasingly accept the underlying principles behind natural capital and ecosystem valuation. The idea of valuing nature, to some extent, is embedded in our fiscal system, with environmental taxes and economic instruments for environmental policies based on a certain degree of pricing the nature – for example through carbon pricing, ecosystem services payments, or through employing methods such as Cost-Benefit Analysis (CBA) (Randall, 1987). Therefore, following the assumption that the current developments will continue and no transformational systemic change is expected, the debate around the ethical side of valuing nature will largely be omitted. In a related comment, the discussion around the use of the term “natural capital” and the implications it has or might have on the corporate subconsciousness, as discussed, for instance, by Foster & Gough (2013), will also be left out.

Many of the existing environmental assessment methods only partially capture the value of ecosystem services. They account for ecosystems not through assessing the TEV of natural capital that the company benefits from and tracking the changes in the total value, but through capturing their value to the extent that they are impacted by companies, such as in the case of LCA, where ecosystem quality is one of the impact categories (Klöpffer & Grahl, 2014). They are designed to be impact-based and thus, generally, do not fully account for the dependencies on ecosystem services or the opportunities that they provide. Limited considerations towards the integration of the spatial and time dimension is given.

Latest attempts such as Eco-LCA (Brueel, Troussier, Guillaume, & Sirina, 2016), bioeconomic model (Brueel, Troussier, Guillaume, & Sirina, 2016) or ecosystem-based SEA (Partidario & Gomes, 2013) aim to bridge this gap. Eco-LCA is a tool that can be used for performing a non-monetary ecosystem valuation on a product level. Even though traditional LCAs have potential to capture certain ecosystem damage during the impact assessment stage, the intention behind eco-LCA was to take it to a comprehensive level and account for all types of ecosystem services by centring the assessment on them, approaching the TEV. Thus, the thinking behind is to visualise the most neglected ecosystem services in the assessment.

3.2 Existing Views on Natural Capital Assessments for Businesses

In its broadest sense, the idea behind natural capital assessments for businesses is to visualise the value of ecosystems and the degree to which the businesses are affected by their changing state, in order to prevent further deterioration. This is also where the general agreement ends, and diverging interpretations come into light.

The idea of integrating natural capital and ecosystem services considerations into business decisions has gained popularity in the last decade (Boehnert, 2016, Danley & Widmark, 2016). While the academic debate around natural capital accounting in policy-making is slowly gaining momentum (e.g. Jeantil, Virto, & Weber, 2016, Guerry et al., 2015), the field of natural capital accounting and natural capital assessments for businesses, defined in these terms, has almost exclusively been developing outside the academic community. Following the calls from policy makers, particularly within the European Union (European Commission - Environment, 2017), consultancies, research institutions, non-governmental organisations, as well as companies themselves, started developing their visions on how natural capital assessments for businesses might look.

Thus, a variety of closely related concepts have lately flooded the business world, including natural capital valuation, natural capital assessment, corporate natural capital accounting, corporate ecosystem valuation, environmental profit and loss, and so on. Many of these developments were promoted by either collaborating or competing institutions, arguably explaining the conceptual inconsistency. Various forms of assessments were developed, and different authors had to come up with their definitions. Table 3-1 provides an unsystematic summary of some of the latest developments in the field of natural capital assessments.

Table 3-1 – Latest developments surrounding natural capital assessments for businesses

Developer	Term used	Characteristics
Kering and Trucost (2011)	Natural Capital Accounting in the form of Environmental Profit & Loss Account	Monetised, mostly impacts, mostly based on market values and/or proxies, hard to capture non-use value
Hanson, Ranganathan, Iceland, & Finisdore (2012)	Corporate Ecosystem Services Review	Qualitative or quantitative, not monetised
James Spurgeon (2014)	Corporate Natural Capital Accounts Natural Capital Accounting for Business	Monetised, balance sheet form Qualitative or quantitative, monetised or not monetised
Maxwell (2015)	Valuing Natural Capital	Qualitative or quantitative, monetised or not monetised
Natural Capital Committee, the UK (2015)	Corporate Natural Capital Accounting	Monetised, balance sheet form

Natural Capital Coalition (2016)	Natural Capital Assessment / Natural Capital Accounting	Qualitative or quantitative, monetised or not monetised
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One main aspect in which the available frameworks and interpretations differ is whether or not to monetise the impacts and dependencies on natural capital, and, subsequently, the methods used for conducting natural capital assessments and the scope of those. Building on the risk theory and setting other variables aside, environmental assessments could be categorised into two main types – qualitative or quantitative (Rausand, 2011). Quantitative assessments, then, can be monetary and non-monetary. However, the boundaries between the three types of assessments are blurry. Monetary assessments are always based on physical units, while semi-quantitative assessment could be distinguished when results of quantitative or qualitative assessments are graded according to an established quantitative scale. Simplified examples of these types of assessments as it relates to impacts and dependencies are laid out in Table 3-2.

Table 3-2 - Types of environmental assessments with examples

Type of assessment	Ex.: Impact on forests	Ex.: Dependency on pollination
Monetary	Loss in the value of the forest in \$ due to company’s activities	Annual loss (increase in costs) in \$ if no pollination services
Quantitative	Net area of forest cut, ha	Reduction in productivity if no pollination, kg/acre
Semi-quantitative	7/10	3/5
Qualitative	High	Medium

Technically speaking, monetisation is still based on quantitative indicators and measurements, and monetised assessments are just a step further from a pure quantitative assessment.

The second aspect is the degree of inclusion of ecosystems and the level of wholesomeness. Whether only the impacts are considered, or the dependencies as well, represents a degree to which ecosystems are accounted for in each of the approaches. In addition, the degree of methodological precision varies. While some parties are treating NCA as an approach to taking nature into account rather than a method (e.g. Spurgeon, 2015), others develop strict methodologies for performing the assessments (e.g. Natural Capital Committee, 2015).

The interpretations of what constitutes natural capital and, thus, how to assess it, also differ. Some practitioners, such as the Natural Capital Committee (2015), undertake a strictly ecosystem-based approach, where the assessment starts with identifying the ecosystems relevant for businesses, and introducing the spatial dimension (e.g. by using land as a unit of analysis), in addition to the time dimension. This development, named by the authors as Corporate Natural Capital Accounting (CNCA), represents, perhaps, the strictest approach to performing natural capital assessments. As such, it introduces a set of accounts, or a register of natural capital for which the companies are responsible, visualises their total value and tracks changes in that value over time. Their approach also relies, to a large extent, on monetary assessment, however mindful of the importance of complementing monetary accounts with physical accounts (Natural Capital Committee, 2015).

At the opposite end of precision lies the approach embraced by the Natural Capital Protocol (Natural Capital Coalition, 2016). The developers of the framework are significantly more flexible in their interpretation of how businesses should account for natural capital. Broadly speaking, they are concerned with all impacts and dependencies of businesses on nature,

however stressing the importance of biodiversity. With such a degree of flexibility, the concept comes closer to an environmental assessment in its broadest sense, with a vast array of methods potentially applicable.

Natural Capital Coalition, the author of the Natural Capital Protocol, seems to have distanced itself from any definitions. While the Natural Capital Protocol does not introduce a formal definition, it briefly mentions “natural capital assessment” (Natural Capital Coalition, 2017). While understandable as an attempt to bring as many parties on board as possible, it is also associated with several disadvantages, such as limited comparability. Natural Capital Protocol’s practical relevance lies in guiding corporate transition towards the inclusion of environment into their decisions, but from a research point of view it remains a synthesis of the available approaches and a procedural guidance that builds on many environmental management tools already available. Even the procedure laid out in the Protocol largely follows the steps of the LCA. A representative from the WBCSD stated that such flexibility was deemed the first step in moving towards a mainstreamed assessment (Eva Zabey, personal communication, 2017). Given that the methods and tools are still under development, they decided to provide companies with the comfort of knowing that at least the procedure they are following is the same for everyone, even if the tools chosen differ.

EP&L, a methodology that is oftentimes referred to as a prime example of Natural Capital Accounting (e.g. by the Danish Environmental Agency, n.d., Scottish Forum on Natural Capital, n.d.), or is even equated to Natural Capital Accounting, is a monetary approach that uses a broad interpretation of the term natural capital and is largely focused on the impact side. The authors of the method track emissions and resource use throughout the supply chain to arrive at a number that represents a monetised environmental impact across the supply chain tiers. The goal of such an assessment is pinpointing the hotspots across the supply chain. Essentially, EP&L methodology is a form of a monetised LCA, extended to the whole product portfolio of the company, or, in other words, a monetised organisational environmental footprint (European Commission, 2012, Weidema, 2015, Weidema, personal communication, 2017).

Schematically, the differences in business approaches to natural capital assessments can be represented by Figure 3-2.



Figure 3-2 - Differences in approaches to natural capital assessments for businesses

As can be seen from Figure 3-2, NCA as a term is witnessed at the two opposite sides of the spectrum of approaches, creating the conceptual inconsistency. It is worth noting that the following division does not reflect all differences. For instance, the scopes of the assessment are

not reflected. For instance, while LCA assessments are product-based, Corporate Ecosystem Reviews usually extend to the whole supply chain. In addition, a division between methods and approaches is not introduced. For instance, while LCA represents a well-developed methodology, Natural Capital Accounting for business is more of an approach and encompasses LCA under the umbrella of methods. In addition, an overview of monetary evaluation methods for environmental impacts (quadrant 3) is provided by Tekie & Lindblad, (2013).

3.3 Deriving a Working Definition of Natural Capital Accounting

The study at hand adopts a perspective whereby NCA is treated as a term that represents a narrower approach than natural capital assessments (or environmental assessments in general). In coming up with a definition of Natural Capital Accounting, several trade-offs, or conceptual choices, were considered, including:

- The degree to which the approach is based on ecosystems
- Monetary/quantitative/qualitative assessment
- The degree of methodological precision
- Fixing the scope versus introducing various potential scopes

Whether to conduct monetisation or not was the first choice. As demonstrated earlier, both interpretations were found in the literature. Each type of the assessments (qualitative – quantitative – monetary) has their drawbacks. Monetary assessments are costly and time-consuming, data is often site-specific and imprecise, but it allows for an easy comparison. Qualitative assessments, in turn, make it difficult to compare the results between and within companies. Non-monetary assessments make it harder to compare values across ecosystems and natural capital types, unless a proxy is used, such as GHG emission. In addition, the uncertainty associated with the methods for capturing non-use values in monetary terms is the highest, while for qualitative assessments, the non-use values can be captured, however, with the uncertainty and flexibility inherent to all qualitative assessments³.

One could argue that, in many natural capital assessments, both qualitative and quantitative types are involved, with qualitative assessments used for the screening purposes to identify ecosystem elements whose value should be quantified, therefore, such division is not as straightforward.

Fixing the scope and introducing unified methodology are two interconnected trade-offs. Methodological precision and the balance sheet form that characterises CNCA (Mayer, 2016) is only applicable to the whole corporation, as the name suggests. At the same time, product/project/supply chain scopes open up for a variety of methodologies, and the outcomes of such assessments are different in many ways.

For the purposes of this thesis, the concept remains flexible as per the following aspects:

- Which tools and methods to use
- The degree to which the approach is reflecting opportunities, not just the impacts
- Which scope to choose

Given such flexibility, a question arises of what new it brings to companies, compared to other measurement approaches. From the practical developments described above, the following

³ A detailed elaboration on the advantages of monetary assessments is found in *Chapter 6.1.3*

recurring themes/traits were derived that could be considered, either alone or in their combination, as potentially advancing the field of corporate environmental management:

- Primarily used for internal decision-making
- An increased focus on dependencies rather than just the impacts
- Long-term and future-oriented assessment
- Strives to include ecosystems
- Monetised impacts and dependencies

Primarily used for internal decision-making

The ultimate premise of all the underlying developments, as stated in the previous chapters, is internal decision-making relevance. NCA is, thus, envisioned to support decisions within the company, rather than to report. However, the value of NCA for the purposes of communicating with stakeholders cannot be neglected. One can even go further and state, following Porter's Five Forces, that corporate work is driven by external environment (Porter, 2008). Therefore, the definition adopted will be mindful of the decision-making relevance of the approach, but will not explicitly state it.

Increased focus on dependencies rather than just the impacts

Many of the existing methods start with identifying the impacts and thus have limited capacity to capture the dependencies on natural capital, except those that are based on the notion of the total economic value. Therefore, fixing the double focus on impact and dependencies is associated with certain methodological difficulties. Some interviewees pointed out at the lack of methods for accounting for dependencies, as opposed to just impacts. This is why the author decided to leave room for flexibility in terms of the degree to which full value is reflected and ecosystems are considered.

Long-term and future-oriented assessment

TEV is a concept associated with long-term changes. Many of the existing methods are dealing with past information, for example, EP&L, while the TEV is inherently future-oriented in so that it assesses the changes in the state of ecosystems over time. While mindful of the importance of the long-term perspective, the definition adopted in this work will stay flexible.

Strives to include ecosystems

While a strict ecosystem-based approach, with a particular emphasis on biodiversity, could focus the effort on, arguably, the most neglected elements of natural capital, narrowing down the definition in such a way inevitably meets several barriers. Of the more definitive ones is the methodological gap in quantifying biodiversity, pointed out by one of the interviewees:

We got comments that there was not enough on biodiversity in the [Natural Capital] Protocol. But when you go to the experts, everyone has a different view on how you measure biodiversity. So if you're trying to think of giving guidance to business, the maturity of the field is one of the main challenges.

—Eva Zabey, personal communication, 2017

Monetised impacts and dependencies

An interpretation of NCA as associated exclusively with monetised impacts and dependencies was stipulated by practical developments. Puma's EP&L, self-proclaimed as the first NCA ever conducted, was a monetary assessment. Therefore, when looking for the definition of NCA, many institutions were stumbling upon this case and concluding that all NCAs are monetary assessments. A slight confusion was caused when Natural Capital Coalition (NCC, 2017) and Spurgeon (2015), among others, were referring to NCA as "taking nature into account", representing the opposite spectrum of opinions. Intuitively though, the term accounting in the corporate world is associated with money.

Following this logic and considering the traits described above, the working definition of Natural Capital Accounting *for the purposes of this study* is the following:

A monetary evaluation of impacts and/or dependencies of businesses on natural capital and ecosystem services.

The author is aware that such definition narrows the scope of the term significantly, particularly inasmuch as it is limited to the monetary form of assessment. Nonetheless, it is consistent with some of the opinions existing, and, arguably, represents the most novel of all the alternatives from the perspective of environmental management and corporate sustainability. As found later, this is also the definition consistent with what many companies understand when asked for their own interpretation.

3.4 NCA in the Context of Environmental Management

In order to assess the potential of NCA as an approach, it is crucial to place it in the array of existing environmental management approaches and approaches to corporate sustainability. This subchapter will identify those that could be relevant as proxies for assessing the potential of NCA to affect corporate decision-making in the chapters to follow.

Broadly speaking, NCA represents a type of environmental information to which the company becomes exposed. Following a classification suggested by Morioka et al. (2016), NCA is, thus, a *measurement* approach, which serves as a basis for *management* and *reporting*. Therefore, the role of NCA in mainstreaming environment into corporate decision-making will be limited by the potential of information, in general, to affect decisions, justifying the need to review a separate stream of literature concerned with the role of information in decision-making.

Building on the traits of NCA described above, a similar concept to that of NCA is Environmental Management Accounting (EMA). Burritt (2012) suggests a classification of EMA types, according to which all EMA approaches can be classified into monetary and non-monetary, future and past-oriented, and short- and long-term. To date, this is the broadest interpretation of EMA, and it interprets EMA as a source of information about the environmental aspects of the company. Burritt (2002) also suggests two types of environmental impacts – impact of the environment on the company and impact of the company on the environment, which would be an equivalent of focus on impact and dependencies in NCA. It is acknowledged that, as opposed to Environmental Accounting (EA), EMA is intended primarily for internal use – a trait shared with NCA. Therefore, NCA, in a nutshell, is close to what is understood as a long-term future-oriented type of EMA.

Another closely related concept is Corporate Ecological Footprint, ecosystem-based Strategic Environmental Assessment (SEA) and eco-LCA, which cover the trait of NCA as ecosystem-based. CBA as a concept could also be relevant in order to investigate the monetisation aspect of NCA, as it is arguably the most widely used approach based on the notion of TEV. Multi-

Criteria Analysis (MCA), oftentimes portrayed as the alternative approach to CBA in so that it introduces multiple criteria as opposed to one aggregate number, could be considered for opposition (Sala et al., 2015). Environmental Impact Assessment (EIA) could also be worth looking into since it is concerned with integrating the environmental dimension in assessing project alternatives: it is performed before making the final decision and, thus, has potential to affect it (Espoo Convention, n.d.).

Table 3-3 presents a summary of the approaches that could be relevant for placing NCA in the current environmental management theories. They will serve as the basis for developing the claims in *Chapter 4*.

Table 3-3 - Environmental management approaches relevant for the research

Trait of NCA	Environmental Management Proxy	Measurement approach Environmental Information
Primarily used for internal decision-making	EMA, EIA, MCA	
An increased focus on dependencies rather than just the impacts	EMA (to some extent)	
Long-term and future-oriented assessment	EMA (some types), CBA	
Ecosystem-based approach	Eco-LCA, Corporate Ecological Footprint	
Monetisation	CBA, monetised LCA, Sustainability Accounting, EMA	

3.4.1 Typology of Uses of NCA

Despite the differences in defining the concept, many of the institutions involved in developing the concept emphasise the decision-making relevance of the approach, as already mentioned. However, reporting is still mentioned in many instances as one potential application, that should, according to many of the sources evaluated, be perceived as a co-benefit rather than the end goal.

Within the array of decision-making practices, identifying risks and opportunities related to natural capital was mentioned multiple times as an overarching purpose and the main use area (Natural Capital Coalition, 2016, Provins et al., 2015). Choosing between alternative options was mentioned as a potential use area (Natural Capital Coalition, 2016, Natural Capital Committee, 2014, Provins et al., 2015). Comparing options can relate to both projects, product, suppliers in the supply chain. A related category of investment decisions was also envisioned as an area where NCA could be applied (Natural Capital Coalition, 2016, Spurgeon, 2014, Spurgeon, 2016). A separate use category identified was related to justifying efforts to maintain and restore natural capital (Natural Capital Coalition, 2016). Last but not least, the potential of NCA to transform business models and coming up with innovative business ideas was suggested (CIMA, 2014).

These business uses can also be structured according to the ecosystem-centred generic applications, as defined by the WBCSD (2014). The first one is associated with calculating the change in the state of the ecosystem services, which could broadly be used to inform any decisions that require choosing between options, including project assessment, product development. The next one is estimating the total benefit of ecosystem services, which could be relevant for risk management and identifying business opportunities. Another category is dealing with assessing the distribution of ecosystem service costs and benefits, which could be used in external stakeholder management, as well as in supply chain management.

4 Theory

This chapter derives the claims about the potential of NCA to integrate environmental consideration into corporate decision-making. This is done by reviewing the existing literature that considers the proxy concepts in light of several theories, and then discussing what the conclusions and lessons learnt from these articles could mean for NCA.

4.1 Systems Theory and Stakeholder Theory

Systems theory views organisations as an established pattern of relationships among the parts of it (French, Kast, and Rosenzweig, 1985, p. 348). Departments or functional units within the organisation are an important analysis unit within this theory. Informational flows also represent a vital element of organisations as systems, since it is the main feedback mechanism for connecting the output with the input (Andrew, 2015, Meadows, 2008). The degree to which information is integrated into various elements of the system, then, defines its decision-making relevance. A highly functional system, then, is one where units (departments) are collaborating and exchanging the informational flows, which are, thus, penetrating the whole organisation.

Stakeholder theory, particularly its instrumental part, suggests a similar approach and justifies the very potential of environmental information to affect decision-making. Instrumental stakeholder theory suggests that more environmental information (negative or positive) leads to better managerial decision-making, which, in turn, leads to better performance (Grit, 2004, Hall, 2010). One study that tries to test this assumption empirically is that of Madein and Sholihin (2013). They assessed differences in an investment decision outcome in the presence or absence of environmental impact information (negative environmental information). Their study showed that, normalised by the economic outcome, the likelihood of a decision outcome change, given the environmental information is provided, increases. These findings prove that there is a value in environmental information as supporting data for decision-making. Ballou et al. (2012) empirically prove that insufficient measurement of sustainability initiatives is the most widely encountered challenge among the top managers of the companies that participated in the research.

Lozano (2012) investigates the links between the environmental tools available to companies and the elements of company's system (Porter's value chain) to improve their decision-making relevance. He comes to a conclusion that a combination of various tools should be used within the organisation to cover all functional areas and all dimensions of the sustainability. He adds that organisational processes and marketing were found to be two parts of the corporate system that are the least addressed by the existing tools and methods. On a higher level, one supposition the study is driven by is that to ensure integration of sustainability all functional units within the organisation have to be covered.

Andrew (2015) points out at the main barriers to integrating sustainability into strategic decisions, looking at organisations from an open systems perspective. He points out that the silo effect, i.e. segregation of issues throughout the departments significantly impedes the potential for integration. Yakhou (2004) supports these findings and stresses the importance of departmental integration. He names two key levels of integration of sustainability, namely, embedding environment into the corporate culture and ensuring collaboration between departments. The author argues that the environmental department plays a key role in facilitating such integration. Ballou et al. (2012), in turn, point out that the lack of collaboration between the accounting, the sustainability departments and the top management prevents strategic integration of sustainability. The findings are supported by Jasinski, Meredith and Kirwan (2015) who suggest, while exploring how full-cost accounting can contribute to integration, that a key is multi-disciplinary collaboration within the company. Amiruddin et al.

(2016), in turn, suggest that EMA can help bridging the gap between the accounting and the environmental departments, where eco-efficiency could serve as a bridge to obtain additional findings for environmental purposes. In investigating the potential of EMA to affect decision-making, United Nations Division for Sustainable Development (UN DSD) identified that, for any potential use area of the instrument, at least five departments were involved in developing, exchanging or using the information (UN DSD, 2001).

One conclusion from these articles is that collaboration between departments is crucial for environmental information to affect decision-making. Monetary type of NCA can increase such collaboration in two ways. First, it gives different departments a common language to speak. Second, performing an NCA requires informational input from various departments, like in the case of EMA and, arguably, to a greater extent. For instance, while environmental managers, or similar positions, might be tasked with implementing NCA, main data inputs will come from technicians, researchers and specialists within the organisation, with support from data obtained from the financial, legal, production departments. Presented in Table 4-1 is an overview of potential beneficiaries of NCA within the organisation split by their main role in the process:

Table 4-1 - Departments involved in the EMA process (conventional organisational structure)

Department	Initiator	Source	Developer	User
Top management	✓			✓
Environmental department	✓	✓	✓	✓
Legal and compliance departments				✓
Logistics and sourcing department		✓		✓
Accounting and finance department		✓	✓	✓
Research and Development (R&D) department				✓
Production management		✓		
Marketing and communications departments		✓	✓	✓

In addition, as opposed to EMA, where all data inputs come from within the organisation, NCA requires informational input from external sources, due to its ecosystem-based nature. Valuation results are obtained through specialised databases or software, such as inVEST, etc. Systematically collecting this data can potentially strengthen the feedback mechanism of information and increase organisational awareness and interdepartmental collaboration.

Claim 1: NCA has potential to enhance collaboration between the departments and thereby facilitate the integration of environment into corporate decision-making.

Systems theory also assumes that the information moves throughout the departments through various channels. In the context of environmental information, one of these enabling channels is Environmental Management Systems (EMS). Fryxell and Vryza (1999) argue that the role of all EMS in general is to overcome the inherent conflicts and tradeoffs within the company through facilitating the integration. They point out that EMS can contribute towards overcoming the differences between the departments through bridging the gaps between the values and the communication styles of different functional units. In turn, Yakhou (2004) links information to EMS and points out at the importance of the degree of alignment of Environmental Accounting as a type of environmental information with management tools within the company, particularly, EMS. The author argues that EMS as a bridge between the

environmental strategy and the overall business strategy within the company, and EA, as part of EMS, facilitates the integration. Witjes (2017) investigates the prerequisites for a successful integration of sustainability into Small and Medium Enterprises (SMEs) and empirically challenges the idea expressed by Yakhou (2004). The research shows that EMS is not perceived nor used by the companies as an integration tool.

EMS in itself, especially ISO 14001, has been moving towards better incorporation of the environment into the business. In the revised 2015 version of the standard, increased attention is paid to issues such as management commitment, the context of the organisation including risks and opportunities related to both business and the environment, as well as the alignment of the environmental strategy with the overall business strategy. In addition, a notion of incorporating the life cycle thinking and more emphasis on measurable environmental goals can be perceived as a move towards the increased significance of environmental information within the system.

EMS is a mechanism that was designed to take on a systematic perspective on the environment. While many of the elements of EMS are of mainly operational relevance, e.g. establishing routine procedures for consistent management of the environment, many of them have been moving towards the strategic dimension. Early EMS were concerned with operational efficiencies and compliance, while recent changes in some standards signify the move towards an expanded scope and going beyond the boundaries of the organisation. One of the main changes in the 2015 version of the ISO 14001 standard is the increased role of leadership in the process, and an increased emphasis on risks and opportunities (ISO/IEC 14001:2015) and the alignment of corporate strategy with environmental policy and the objective. Therefore, the idea behind the new version of the standard is to embed environment into corporate decision-making on all levels.

Thus, for NCA to be mainstreamed into the decision-making process, it could be embedded into the overall EMS of the company. There are many potential areas where NCA could enhance the value of EMS by providing a necessary informational input. Table 4-2 presents a description of the potential areas of interaction between EMS and NCA, using ISO 14001:2015 and its main clauses as examples. The use of ISO 14001 is justified given that it is the most widely used EMS (ISO, n.d.). The 2015 version is used because by 2018 all organisations that are certified according to ISO 14001 will have to transition to this version (ISO, n.d.).

Table 4-2 - Areas of interaction between EMS (ISO 14001:2015) and NCA

Clause of EMS	Element	Role of NCA
4. Context of the organisation	Understanding the context	Builds a stronger understanding of the relationship between the organisation and its environment
	Interested parties	Pinpointing the societal value
5. Leadership	Management commitment	Explains the value of ecosystems to leadership
6. Planning	Environmental aspects	Identifies positive environmental aspects, gives a fuller picture of environmental aspects
	Setting the objectives	Helps setting quantifiable objectives (recommended by ISO)
	Identifying risks and opportunities	Identifies ecosystem-related risks and opportunities
7. Support	Resources	Helps justify the specific amounts needed for environmental spending through monetising the value of ecosystem services

	Awareness	Builds awareness of the importance of ecosystems to the company (dependencies)
	Communication	Strengthens internal communication, potential for external communication value if results are reported
8. Operation	Value chain control	Helps to map and to compare the impact throughout the value chain
9. Performance evaluation	Compliance with legal and other requirements	Puts a number on the current compliance obligations, through risks identifies the scale of future compliance obligations
10. Improvements	Identifying the problem before it occurs	Through visualising risks, makes company more prepared to the changing environment

The table suggests that there are ways in which NCA and EMS could be interacting. Of the more significant ones is its role in gaining leadership commitment, as well as in identifying risks and opportunities, particularly, quantifying them through tracking changes in the state of the ecosystems relevant to the company.

ISO itself is recognising potential synergies with informational tools and approaches. A new generation of ISO standards, coming in the next two years, is concerned with the monetary developments in corporate, as well as governmental natural capital valuations. ISO 14008 aims at creating a framework with the fixed underlying methods and terms of monetary valuations of environmental impacts and related aspects. A related standard, ISO 14007, is concerned with determining environmental costs and benefits and aims specifically at private organisations. The potential of these standards to be integrated into the broader family of existing environmental management standards was highlighted by the developers (ISO, n.d., Franz Knecht, personal communication, 2017, Jimmy Yoler, personal communication, 2017). While not explicitly mentioning the term *natural capital* and opting for more neutral *natural resources* and *ecosystem assets*, the standards' definition is closely related to the definition of NCA as a subject of the study at hand. Thus, the following claim can be derived:

Claim 2: NCA can help to enhance the value of EMS and thereby mainstream environment into decision-making.

In finalising this subchapter, it is worth stating that the articles stated above make two important assumptions in taking up the departmental perspective. First, they assume that the actors fully comprehend the relationship between goals and information. In reality, some information, while objectively relevant, could not be perceived as such due to general lack of awareness. Second, the articles consider environmental information in isolation, ignoring the ways it interacts with other information received by the actors, thus neglecting potential conflicts and trade-offs. Third, so far, the discussion on how different properties of information affect decision-making was, for the most part, omitted. The next subchapter places environmental information in the context of all information received by the company and introduces various dimensions of informational properties.

4.2 Environmental Information in Corporate Decision-Making

The interaction of environmental information with economic information is a subject of many studies. An issue frequently raised in the literature related to corporate sustainability in general and sustainability assessments in particular is the potential of existing tools and assessment methods to deal with trade-offs, i.e. situations beyond eco-efficiency. Using the environmental information to only deal with eco-efficient situations significantly limits its potential to integrate sustainability into the company and leads to a weak form of sustainability. It is when

environmental and economic factors are treated as equal that the strong form of sustainability arises. The question of the potential and limitations of different assessment tools to deal with trade-offs is widely researched on two concepts: EMA and Creation of Shared Value (CSV).

In general, the literature on EMA has largely focused on win-win situations, where economic performance is directly correlated with the environmental performance (e.g. Jasch et al., 2010; Schaltegger et al., 2012; Staniskis and Stasiskiene, 2006) and environmental information just strengthens the economic arguments. These solutions are, for example, concerned with eco-efficiency, whereby environmental improvements generate direct financial benefits. The focus, therefore, has been on specifying precisely how much savings a certain reduction in environmental impact would generate, as opposed to dealing with a more difficult question of trade-offs. According to Hahn et al. (2010), the potential role of EMA while dealing with trade-offs, which is arguably where EMA is even more needed, has not been investigated enough.

According to Christ, Burritt and Varsei (2016), the way through which EMA can become a tool to also consider the trade-offs is through accounting for non-market values and thus visualising the whole spectrum of value. However, the researchers argue that, especially for companies that already perceive their activities as being environmentally detrimental, the EMA is not a straightforward solution. In this case, companies are probably afraid that having EMA in place will make the detrimental effects their activities have on environment evident and visualise a trade-off between financial gains and environmental conservation, ultimately undermining their legitimacy. Potentially, within the current economic system and following a neoclassical approach, the most effective way to overcome such a trade-off is to internalise the impacts through the external forces, such as regulation. In the absence of such, partial internalisation of the impacts can be undertaken through risk management.

In investigating the role of CSV, Corner and Pavlovich (2016) pointed that it was created as a way to deal with the seeming trade-offs between the social/environmental and the economic. However, according to the authors, resolving these tensions is often impeded by the automatic, based on habits, nature of sense making within the organisations. They mention the potential sources of capacities that are required to resolve tensions, including insight and disruptive information that challenges the habitual sense making. De los Reyes (2017), in turn, mentions that CSV has to be complemented by norm making and norm frameworks if it is to address win-lose situations.

Attempting to see how CSV works in situations beyond efficiency, Orr and Sarni (2015) apply it to water risk. According to the authors, effective CSV starts with an understanding of how external conditions define the risks facing businesses. Dembek et al. (2016) pointed out the limitations of win-win solutions in CSV and concluded by saying that shared value can only address some urgent societal issues and not long-term transformational change, so its potential is limited to just bridging the temporary gap.

Figge and Hahn (2012) point out that the green business case in general often focuses on win-win cases, and prioritises monetary over environmental. It, then, leads to a preference of a win-win case regardless of whether a lose-win case has a higher net gain from a societal perspective. However, Baumgartner and Rauter (2017) suggest that dealing with tradeoffs and win-lose situations is ultimately about considering both short-term and long-term goals. Therefore, organisations with well developed long-term strategies are better equipped for dealing with trade-offs. Battaglia et al. (2016) disagree. They conclude that, while sustainability control systems facilitated the integration of sustainability into the company, it did not remain stable over time in the face of trade-offs. They link the potential for stable integration the participatory

approach and internal stakeholder involvement, supporting the conclusions from the previous subchapter.

NCA gives a rather complete and holistic picture on ways in which the company depends on nature. If presented in the balance sheet form, it visualises the gap between the realised (financial) liabilities and all existing liabilities that the company can potentially be exposed to, between assets that are priced, and assets that the company is using for free. Visualising dependencies on natural capital rather than just impacts might bring an alignment of short and long-term goals, as suggested by Baumgartner and Rauter (2017). Therefore, the trade-offs that were previously seen as such become perceived as long-term win-wins following the implementation of NCA. However, the potential of the concept to radically change company's perception of the environment is questionable.

4.2.1 Properties of Environmental Information

Burritt et al. (2002), in investigating EMA, specifies what types of information are desired by different actors within the organisation, building up on the goals that each actor has within the system. One important difference as we move up the organisational level, according to Burritt et al. (2002), is the level of detail in the information provided, the level of monetisation and whether the information is long- or short term/ future or past-oriented. While top managers prefer highly aggregated information that is related to the long-term survival of the company, the environmental department operates in physical units, for example in order to report on compliance or to manage EMS. One of the main conclusions of the article is that different parts of the system require different types of information and, therefore, many types of information might be needed to satisfy the needs of different stakeholders within the organisation.

The role of information in strategic decision-making was also addressed by Citroen (2011). The author pointed out that several properties of information become relevant to affect strategic decision-making, namely, the reliability of the sources of information, its completeness, the potential to decrease the uncertainty supporting the decision, as well as robustness. According to the authors, informational overload did not represent an issue, as long as the information was relevant. Delmas et al. (2013) are of the opposite opinion. They express concern over the potential of environmental information to cause confusion and informational overload. Thus, they pinpoint the need for balance in introducing environmental information, with robustness and simplicity as conflicting ends. Of similar opinion are Herva and Roca (2013). They discussed the decision-making potential of multi-criteria analysis and pointed at the need to reduce the complexity of decision-making process, as well as avoiding double counting. Another article by Ny et al. (2006) is concerned with trade-offs facing LCA as a type of information provided. According to the authors, a similar conclusion is reached: the main trade-off that can be observed when dealing with LCA is between specificity and depth on the one hand, and applicability and comprehension, on the other hand.

Spencer, Adams and Yapa (2013) investigated several properties of environmental information – degree of aggregation, the degree of integration and degree of timeliness and robustness. They found out that only supply of aggregated environmental information can act as a mediator between management commitment to sustainability and environmental performance, while integrated, timely, or broad scope systems were found to have no effect.

Annema et al. (2015), in their investigation of cost-benefit analysis versus multi-criteria analysis in policy decision-making, come up with other informational properties that can be valuable for strategic decision-making. They argued that visualising trade-offs (e.g. through MCA) is more important than coming up with one final number (as in CBA) and that transparency of the

underlying methods should be clear. In addition, other potential criteria such as general preference towards information that leaves room for flexibility in its interpretation, are considered. Another take on CBA was performed by Asplund and Eliasson (2016). Using the case of CBA, they discussed the potential of monetary valuations vis-à-vis other assessment. They conclude that even the degree of uncertainty associated with the valuation methods did not affect the realised benefits and investment selection.

Rikhardsson and Holm (2008) investigate the effect of environmental information on investment allocation decisions. In contrast to previous theoretical findings, they empirically derived that qualitative information is effective in affecting short-term investment decisions, while quantitative information had limited influence. They explain that short-term investments are characterised by a higher degree of risk, so the value of each piece of information becomes higher, while for long-term decisions, financial performance becomes more relevant. The quantitative environmental information did not seem to affect the investment decisions in their study. The authors link it to difficulties with interpretation of such information. However, Herva and Roca (2013) are of a different opinion and state that qualitative assessments can lead to non-uniformity and, subsequently, skewed evaluation results.

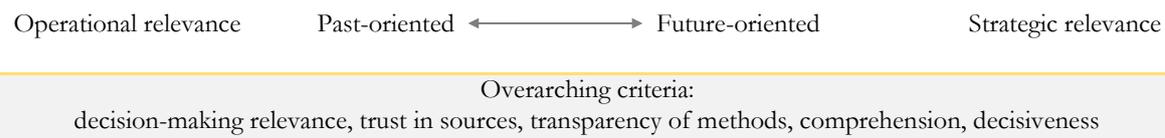
Pagell and Shevchenko (2014) identify issues associated with measurement within the sustainable supply chain measurement practices. They stress out that the current measurement techniques were imperfect in so that they only covered a limited number of stakeholders and outcomes. In addition, another drawback was that they were artificially limited to the amount of harm, thus not providing the users with the whole picture. They also underscored that the past-oriented nature of information systems for supply chain management represents part of the problem.

A separate group of research is concerned with the effects of incomplete environmental information. Starik (2005) looks at the issue of measuring sustainability from such a perspective and concludes that unmeasurable aspects of sustainability are more important than the measurable ones, therefore, only taking the measurable aspects into account will lead to skewing and the ultimate goal of decreased environmental performance will not be reached.

The main informational properties and how they affect decision-making, based on the literature reviewed, are summarised in Table 4-3.

Table 4-3 - Properties of environmental information and inherent trade-offs

Pros/Cons	Characteristics of information		Pros/Cons
Difficult to interpret Operational relevance	Nonmonetary	↔ Monetary	Common language Methodologically complex Strategic relevance
Easy to interpret Subjective	Qualitative	↔ Quantitative	Difficult to interpret
Risk for bias, skewing Easier/cheaper	Selective (materiality)	↔ Complete (robust)	Risk for overload Hard to operationalise Addresses the needs of different stakeholders
Hard to comprehend Visualises trade-offs Operational relevance	Detailed	↔ Aggregate	Easy to comprehend, decisive Strategic relevance



Overall, the main differences that are observed are related to the properties of information depending on types of decisions facing the company. Figure 4-1 presents a potential relevance of NCA with regards to the different types of decisions.

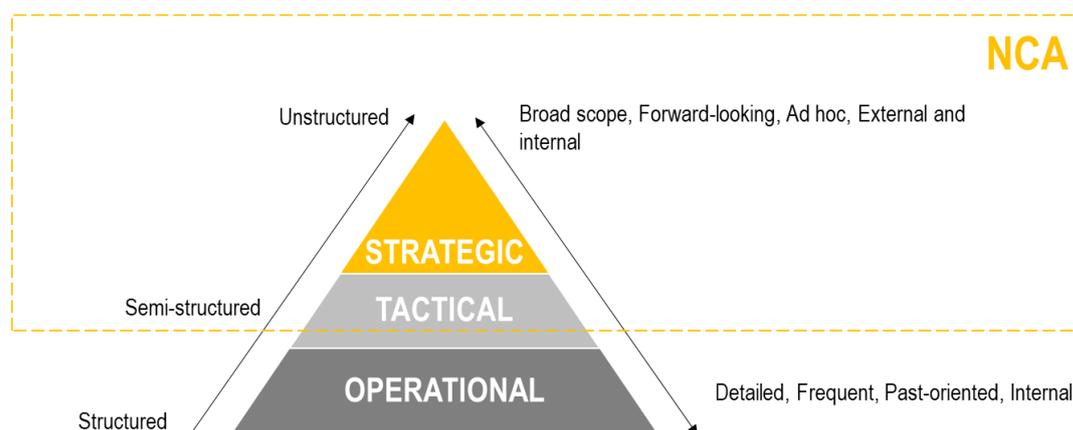


Figure 4-1 - NCA and the types of decisions in the company.
Source: Adapted from Eckerson (2010) and Bagchi (2010)

According to the classification suggested above, NCA can be characterised as a highly aggregated, long-term and future oriented type of information. Merging this characteristic with the decision level perspective, one can derive that NCA might have higher relevance for the top management of the company and strategic rather than operational decisions.

Claim 3: Information generated through NCA is of high relevance for strategic decisions and top management.

4.3 Risk Management Perspective

Although there are currently several frameworks that describe corporate risk management process, broadly speaking it usually includes identification of risk, its assessment and the actual management (treatment) (Merna & Al-Thani, 2008). Risk management, especially when conflicting interests are involved, is an important mechanism to link environmental impact to business costs and translate environmental dependencies into opportunities. Risks comprise of two main components – the probability of occurrence and the scale of the consequences if the risk is realised (Merna & Al-Thani, 2008). Therefore, environmental risk management is an important mechanism through which partial (limited by the probabilistic nature of the assessment) internalisation of externalities can be achieved.

Identifying opportunities is a flip side of risk (Olsson, 2007). Opportunities in a corporate setting can be defined as a type of risk with a positive nature of the impact. It follows similar stages to that of risk management – identification of business opportunities, assessment, for instance, through a creation of a business plan with certain well-grounded assumptions as per future revenues or market share, and implementation.

Natural capital and ecosystem services, as part of the company’s external environment, have direct relationship to many types of corporate risks. Table 4-4 presents some examples of realised natural capital-related risks split by the type of effect and the inward or outward nature of the relationship to the environment (impact versus dependency).

Table 4-4 - Relationship between natural capital and business risks types

Risk type	Natural capital dimension	
	Impact	Dependency
Strategic	Losing the license to operate	Losing competitive advantage
Compliance	Non-compliance due to tougher emission regulation	x
Operational	x	Disruptions in supply of raw materials due to a change in the state of the ecosystem
Financial	Increased interest rate due to lowered environmental rating (responsible investment) Toxic assets	Share value drop due to volatility in the market
Reputational	Accusations of non-ethical behaviour	x

Risk management can be broadly regarded as a mechanism to improve corporate decision-making, since the chance of decision failure directly correlates to the amount of uncertainty associated with a certain decision (Lu, Jain, & Zhang, 2012). The main role of information, thus, is to reduce the organisational uncertainty through bridging the informational gaps. Through creating new knowledge about the environment, new risks are identified that were not previously comprehended by the management. The role of quantified information in corporate risk governance was investigated by Franks et al. (2014). They concluded that a better understanding of costs in stakeholder-related risk management might lead to a change in corporate behaviour and business decision outcome.

Bebbington and Thompson (2007) are concerned with whether the presence of the practices of EA has potential to enhance corporate risk governance. They argue that the primary role of accounting and accountants is to visualise risks facing the companies, while their contribution to the actual management of those risks remains limited. Perhaps more importantly, they point out that accounting empowers the external stakeholders to hold the companies accountable for their actions. Bui and De Villiers (2017) go one step further and conclude that the use and the adoption of environmental management accounting practices (case of carbon management accounting) are determined by the type of risk management strategy adopted by the company, which, in turn, is dependent on the level of regulatory uncertainty. They identify several risk management strategies, including creative, proactive and reactive, depending on the degree of change and innovation involved, and describe which role carbon management accounting plays under each strategy and what type of accounting practices are adopted. They conclude that monetarised, future-oriented, routinely collected EMA has higher relevance under the proactive or creative risk strategy. In addition, the role of EMA under creative risk management strategy is related to increased awareness and organisational learning, while the main role under the proactive strategy is associated with supporting decision-making.

NCA has many of the elements to contribute to corporate risk management successfully. As a forward-looking and long-term type of assessment, it matches the inherently future-oriented proactive risk management process. Risk management also requires a certain degree of precision in measuring the scale of the consequences. This is where the monetary type of NCA can

contribute through a better incorporation of risk assessment results. However, it also has limitations. Due to the aggregated nature of NCA, it is poorly equipped to deal with operational risks.

Claim 4: NCA increases awareness about both environmental risks and opportunities facing the company, thus increasing the perceived importance of sustainability work.

4.3.1 Financial Sector as a Driver for Integration

A lot of risk management associated activities are driven and enhanced by developments external to the companies. For instance, an important driver for risk governance is financial institutions (Weber, Fenchel & Scholz, 2006). Natural capital-related risks are becoming an increasingly important assessment criteria that translate to the cost of capital attracted by companies. Several parallel developments are taking place in this area. Financial lenders are starting to introduce no net biodiversity loss as one of the requirements for securing financing (Spurgeon, 2014). One of the first formal requirements was introduced by International Financial Corporation (IFC, 2012), which set a no net loss principle on a project level, although for big scale projects only. A framework that emerged based on IFC standards is that of Equator Principles. The framework, currently adopted by 91 financial institutions and covering around 70% of project finance debt in emerging economies, aims to identify environmental and social risks in projects (Equator Principles, n.d.).

The Equator Principles (EP) set minimum environmental and social performance requirements for the projects financed by the participating institutions. It incorporates many existing environmental management initiatives in order to perform the assessment. The potential interlinks between the Equator Principles and monetary environmental evaluations were pointed at by one of the interviewees participating in the study (Franz Knecht, personal communication, 2017). Table 4-5 presents an elaboration of potential of NCA to satisfy the Equator Principles.

Table 4-5 – Comparative potential of project-based NCA to enhance the value of the Equator Principles

Equator Principle	EM approach	NCA potential
2: Environmental and social assessment	EIA	Potential to incorporate environmental performance into project results
4: Environmental and Social Management System and EP Action Plan	EMS	None, since the principles require just the presence of EMS
5: Stakeholder Engagement	EIA (public participation requirement)	-
10: Reporting and Transparency	GHG Protocol, GRI reporting	-

Thus, the EP requirements are rather too broad for NCA to be successfully applied in synergy. The only potential area of interaction identified lies within the methodology of environmental assessment.

These efforts, however important, mark an incipient stage in sectoral transformation. So far, natural capital is included exclusively as part of the risk assessment, whereas the business potential of incorporating natural capital is frequently overlooked (NewForesight, 2015). However, new funding opportunities and financial products are starting to emerge for companies with a strong environmental consciousness (Nakayashiki, Zang & Kumagai, 2017).

Thus, the need to consider the opportunities that lie within the natural capital, needs to be emphasised.

To bridge this gap, United Nations Environmental Programme Finance Initiative (UNEP FI) established the Natural Capital Finance Alliance to look specifically at how natural capital considerations could be incorporated into financial products (Natural Capital Finance Alliance, n.d.). In a parallel development, the Natural Capital Coalition is currently in the process of preparing a Finance Sector Supplement to its Natural Capital Protocol (NCC, n.d.). One of the main differences between this initiative and that of the EP is an increased focus on opportunities rather than just risks. So far, the natural capital was mostly included as part of the risk assessment, whereas the business potential of incorporating natural capital is frequently overlooked (NewForesight, 2015).

The project is currently undergoing the public consultation process, in which the author of this thesis participated, and covers three main sectors within the financial sector: banking, investment and insurance, reflecting an increased emphasis on opportunities. The main added value of this Supplement, according to the authors, lies within the four following areas:

1. Focus on dependencies and not just impacts
2. Broader scope of issues
3. Reflecting the connectivity of the issues
4. Value chain focus
5. Aggregation

This development, if broadly accepted by the companies, can facilitate the integration of natural capital consideration into the business world.

So far differences between the organisational types and other characteristics in assessing the decision-making potential of NCA were not considered. However, the extent to which NCA can facilitate the integration of environment into the decision-making may be expected to vary between companies, sectors and, not least, countries. The next subchapter is dealing with these differences.

4.4 Contingency Theory

Contingency theory claims that there is no universal best way to manage, due to the presence of a variety of external and internal factors (Donaldson, 2001). As applied to the topic at hand, the theory could suggest a set of contingent factors that define the potential of NCA to affect decision-making, as well as the decision to adopt NCA in the first place. Within the umbrella of sustainability assessment tools, the theory was most frequently applied to EMA, however, with mixed results.

For instance, Christ et al. (2013) undertook a contingency theory approach in order to test whether certain variables affect the adoption of EMA as an approach of choice. The authors concluded that the presence of environmental strategy, the industry in which a company operates and the organisational size are the variables that affect the adoption of EMA the most. Particularly, it was found that big companies with a comprehensive environmental strategy and those operating in environmentally sensitive areas are at the forefront of the area, while the approach fails to engage with the vast majority. A similar conclusion was reached by Peters and Romi (2014). In addition, Bartolomeo et al. (2000), Bennett and James, (1999) and Lee (2011) derived from case studies that successful EMA adoption, that is, maximised decision-making relevance, is contingent upon the organisational structure and the degree to which it supports

inter-functional cooperation, as well as communication between different departments. Both studies, however, were highly contextual and contradicted each other.

An article by Ferreira and Moulang (2008) applied contingency theory to test the links between EMA use and innovation within companies. They concluded that EMA use is not related to the organisational size, but underlined that three sectors: chemical, mining and smelting industries, are more likely to engage in EMA activities. However, external validity issues were raised by the authors themselves and explained by the exploratory nature of their study. Mokhtar et al. (2016) reject the findings above and find no evidence of contingency theory in EMA implementation in Malaysian companies.

Therefore, taken in their entirety, these studies do not allow for the derivation of a set of contingent variables, due to their varying findings. Nonetheless, a recurring theme in all of them was that high sensitivity of the industries on the ecosystem services could mean higher adoption rate and better incorporation of NCA into business decisions.

However, this might just be explained by the prevalence of win-win situations in industries that experience a direct dependency on ecosystems (see *Chapter 4.2*). When ecosystem services provide a substantial input to the production process, eco-efficiency approach is in direct correlation with business profits. Along the same line, these companies are also better aware of the relationship between corporate risks and natural capital (see *Chapter 4.3*). Therefore, a NCA-like assessment becomes part of the integrated corporate risk management system.

At the same time, companies that are directly and strongly dependent on certain, e.g. provisioning, ecosystem services also might fall into the trap of neglecting other, less evident services the same ecosystem provides. The role of a comprehensive, whole encompassing NCA becomes crucial.

The degree to which industries depend on ecosystem services and natural capital depends on the type of industry (Figure 4-2). Logically, primary and secondary sectors (especially primary processing) are expected to derive the most value from natural capital and have the most direct links to the natural environment, while also causing the most palpable impact. At the same time, tertiary sectors' impacts on natural capital is expected to be found upstream (through consuming the produce of the primary and secondary industries, or downstream at the customer end, e.g. for sectors that derive value from the cultural services, e.g. tourism, or the financial sector, whose impacts are indirectly created by the customers).

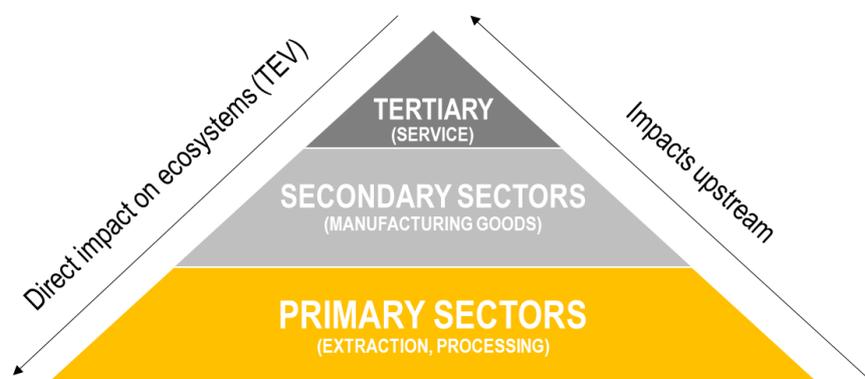


Figure 4-2 - Industry types and natural capital impacts.

Source: Own elaboration

This has important consequences for the choice of the scope of the assessment. For extractive and primary processing industries, the effective and relevant scope of NCA is different than for manufacturing (secondary) and service sectors. The relevance of upstream supply management is higher for tertiary and secondary sectors, while project scale and corporate scale have to be prioritised for primary sectors. However, the relevance of the financial sector should not be underestimated. Through indirect natural capital aspects, it acts as an important enabler. Question of demand and supply.

While neither ISO nor NCC limit their scope to any sector, and while natural capital is important for all the sectors given high dependencies on our economy on the environment, several interviewees expressed their opinions on the sectors that could benefit more from performing an NCA.

Franz Knecht, working closely on ISO 14007 and 14008 development, pointed on two potential groups of the beneficiaries of NCA-like assessments. The first one is companies that face a complex situation of several environmental aspects that are interlinked, whereby NCA can provide a clear picture of these interlinkages and set priorities for action. The second group was companies that have one critical impact, either due to the nature of their operations (the interviewee referenced Novo Nordisk in this regard), or due to the fact that they are operating in a country where there is a general societal pressure related to that aspect, whereby NCA can provide an added value by going beyond compliance, and demonstrate the positive value from working on this impact.

In turn, Eva Zabey from the WBCSD mentioned several sectors which were quite active in their work on NCA and expressing their interest, particularly, the apparel industry, extractive, e.g. cement, the chemical sector, forestry and agriculture. Natural Capital Protocol, developed by WBCSD, currently prepared their sector guides for food and beverage and apparel sectors, with a guide for the Financial and Forestry sector coming up soon.

Lynne Donald from Maersk Drilling pointed that the traditional NCA sectors were pharmaceutical and apparel, perhaps reflective to some extent of the industrial perception on NCA. Lizzie Rendell from Skanska UK noticed the increased interest from the utility sector, particularly, water utilities. Bo Weidema, a practitioner, pointed at the relevance of size as a factor. Companies will need to have the academic personnel in place to understand the importance of such an assessment (Bo Weidema, personal communication, 2017).

Therefore, there are likely to be differences in the value that NCA brings to the company and the way it influences business decisions depending on certain contingent factors, such as sector or the level of environmental performance and environmental awareness in the company.

4.5 Summary

Theoretical analysis presented in the current chapter identified several ways in which NCA could foster the integration of environment into corporate decision-making. Table 4-6 features a summary of the findings with regards to the main topical areas reviewed.

Table 4-6 - Theoretically derived claims about the integrative effects of NCA

Potential	Theoretical Basis / Topical Area
Claim 1: NCA has potential to enhance collaboration between the departments and thereby facilitate the integration of environment into corporate decision-making.	Systems and Stakeholder Theory
Claim 2: NCA can help to enhance the value of EMS and thereby mainstream environment into decision-making.	Environmental Management, Systems Theory
Claim 3: Information generated through NCA is of high relevance for strategic decisions and top management.	Environmental Information in Corporate Decision-Making
Claim 4: NCA increases awareness about both environmental risks and opportunities facing the company, thus increasing the perceived importance of sustainability work.	Risk Management
Limitation: The potential of NCA to integrate environment into corporate decision-making will vary significantly across the organisation types and sectors.	Contingency Theory

As a concluding remark to this chapter, NCA could affect corporate decision-making in several ways (Figure 4-3).



Figure 4-3 – Mechanisms through which NCA contributes to the integration of the environment into corporate decision-making

Source: Own elaboration

The next milestone in investigating the integration potential of NCA is testing these claims, to the extent possible, in the corporate world.

5 Practice

This chapter marks the *first* step in testing the theoretically derived claims developed in the previous chapter. It presents a narrative description of four cases of companies that engaged in a NCA-type monetary environmental assessment, which is then followed by *Chapter 6*, representing cases comparison and an analysis of the findings with regards to the claims introduced. Furthermore, in a brief attempt to see whether the claims would still hold if only a non-monetary (quantitative) assessment is involved, the author contacted two companies, one of them not doing NCA as defined in this thesis and opting for other forms of assessment, and another one just in the beginning of their journey and thus, willing to share their doubts and reservations.

5.1 Corporate Cases

Four companies engaged in NCA-like assessments were contacted. Each case starts with a general overview of the companies, followed by a brief description of the sustainability work within the company, and the main body, consisting of the description of company's work on NCA.

5.1.1 Cases Introduction

Table 5-1 – Cases description features general comparison of the companies and serves as an introduction to the cases.

Table 5-1 – Cases description

Name	Sector	Profit, billion EUR (2016) ⁴	Revenue, billion EUR (2016)	Notes
Arla Foods	Dairy / Food and Beverages	0,356	9,6	Cooperative ownership
Crown Estate	Real estate	0,357	13	Semi-independent, incorporated public body
Maersk Drilling	Oilfield services / Oil and gas	-0,581	1,9	Part of the Maersk Group (29,7 billion EUR in revenue)
Skanska UK	Construction	0,038 (operating profit)	1,75	Part of Skanska Group (14,8 billion EUR in revenue)

Source: Own elaboration based on Maersk (2017), Arla Foods (2017), The Crown Estate (2017), Skanska (2017), Skanska UK, (n.d.).

Companies from four sectors participated in the study. All the companies have their headquarters in the EU, are characterised by a medium to large size, and either have business units in various countries or represent a part of a multinational corporation. These characteristics also mean that they might have had more resources for implementing the initiatives, or more understanding than the majority of corporations.

In addition to these general observations, types of the assessments performed are presented in Table 5-2. It is worth stating again at this point that, while some companies do not explicitly state NCA as a term, their work, nonetheless, fits the definition developed in *Chapter 3.3*.

⁴ Converted to EUR from GBP, USD on the 7th of September 2017 using XE currency convertor

Table 5-2 - Assessment types in case companies

	Term used	Scope
Arla Foods	EP&L	Supply chain
Crown Estate	Total Contribution	Supply chain
Maersk Drilling	EP&L	Project
Skanska UK	NCA, SCA	Operations

Arla Foods and Maersk Drilling opted for EP&L, while Skanska UK and Crown Estate's work extends beyond an environmental evaluation and incorporates, among others, social capital considerations.

5.1.2 Arla Foods, Denmark

We need to know the facts, so we can say whether we are going in the right direction regarding the improvements. Even if the focus [of environmental work] will differ slightly from year to year, we need to have a long-term perspective.

—Jan Dalsgård Johannesen, *Director Sustainability, Global QEHS, Arla Foods, personal communication, 2017*

Arla Foods is the largest dairy product producer in Scandinavia (fourth largest in the world) with headquarters in Denmark (Arla Foods, 2017). It is cooperatively owned by more than 12 000 farmers and currently sells its products to more than 100 countries, with Europe representing the biggest market. It has plans to grow in six geographic regions, laid out in the Good Growth 2020 Strategy alongside a strong emphasis on innovation and plans for significant cost reductions (Arla Foods, 2017).

Sustainability work within the company goes a long way back. As part of its sustainability work, Arla Foods had long been using other forms of environmental assessments, particularly, LCAs, and performing an NCA was deemed a next logical step. The method chosen was EP&L (Hoejrup Schmidt & de Saxcé, 2016). The motivation behind using a monetary assessment was two-fold. First, it provided the necessary level of aggregation of data, and second, it was perceived to be more science-based and thus, credible. In addition, the long-term and comprehensive nature of the assessment was deemed more appropriate for strategic purposes than the LCAs. NCA assessment was conducted in 2014 in collaboration with the Danish Environmental Protection Agency. Globally, the company was the first one in the food sector to engage in such assessment.

From the company's side, several departments collaborated in the project. The Sustainability team led the work, important inputs from the Finance team were provided. While the working group was small, the work on NCA was broadly communicated internally. A deep interest from the top management in using the results was expressed. The scope was set to encompass all countries of operations and the whole supply chain.

One of the main challenges associated with the development of NCA was convincing people within the company to disclose the negative impacts. Given the nature of the industry, the size of the company and the broad scope of the assessment, it was clear that the resulting impacts revealed will be significant.

The results of the NCA pointed out the areas the company has to focus on, several surprising material impacts were identified. These results were used as the basis for the development of the upcoming sustainability strategy of the Group. According to Jan Dalsgård Johannesen (personal communication, 2017), it is the long-term and comprehensive nature of the assessment, along with the comparatively solid scientific basis, which allowed its use in strategic decision-making.

However, several drawbacks of the approach were pointed out. First of all, the interviewee mentioned that more focus on positive impacts would have benefited them. In addition, a huge variety of methodologies led to somewhat of confusion. Furthermore, the company expressed interest in incorporating social capital considerations, deemed to be an area much less developed.

Plans and thoughts for the future include performing a follow-up assessment in several decades in order to track changes, and to do it without help from external consultancies, potentially having a team that is in charge of performing the assessment.

The role of NCA in measuring environment-related risks was stressed, while links to the EMS were not acknowledged. The interviewee stated that the nature of Key Performance Indicators (KPIs) used within the company's EMS (each production unit is certified according to ISO 14001) is inherently more detailed and straightforward/simple, and the results of NCA are, perhaps, too complicated to be used as part of EMS.

5.1.3 The Crown Estate, the UK

Putting a number on it [...] causes you to examine the figure. [...] It is a catalyst that pushes you to investigate if you don't like what you are seeing.

—Jane Baptist, Deputy Head of Sustainability, The Crown Estate,
personal communication, 2017

The Crown Estate is an independent, commercial property business with a statutory duty to manage the estate forming part of the hereditary possessions of the Sovereign in right of the Crown. In other words, it manages lands owned by the Crown corporately. It is one of the largest property managers in the UK, with three-quarters of all assets (in value) being of urban type (The Crown Estate, 2017).

Embedding sustainability into business processes is seen within the company as one of the three ways to achieve the stated vision of “becoming a truly modern commercial business” and becoming a resilient company (The Crown Estate, 2017). The main methodological and informational basis for ensuring integration is the company's work on Total Contribution, an assessment, broader in scope than NCA, which strives to visualize, in monetary terms, all types of capital that the company is drawing on, including natural, physical, social and financial, as well as the value of networks and corporate know-how (The Crown Estate, 2017).

The Crown Estate's work on Total Contribution began in 2013 and was initially driven by the perceived need to understand and visualise the value of the company to the community and to change public perception of their work (Jane Baptist, personal communication, 2017).

The scope chosen for the assessment was the whole supply chain. The decision was driven by the fact that the direct impact of the company is rather small, and the main impacts occur upstream and downstream.

The first report was compiled based on the KPIs already established within the company, and was performed in physical units. The task consisted in compiling the scattered data and complementing it by the missing data. However, the need to come up with a common denominator was quickly understood by the steering group, which led to a final choice of a monetary assessment. According to the interviewee, the main value of monetary information lay in the comparison of things that are otherwise hard to compare, and in pinpointing the areas that need developments.

Some of the challenges along the way were associated with the concept itself, which was deemed rather hard to grasp for departments that were not directly dealing with sustainability. The biggest challenge, however, remained to get consistent data across the whole supply chain.

Several departments participated in the development of the report, including finance, Human Resources (HR), and investment teams. Generally, the company tried to involve all the co-functions. Interestingly, the steering group that is working on the report is currently led by the Chief Financial Officer of the company, working closely with the Head of Sustainability. In addition, Chief Investment Officer expressed their interest in the results of the assessment. Thus, top management of the company is actively involved in the work.

Although the method was initially tailored for reporting, the company quickly realised that there is also a decision-making value in the information provided by the report and is currently at the beginning of their journey to understand how to best apply it to internal decision-making. According to the interviewee, the decisions that are, or potentially could be, affected by the information presented, are manifold, particularly, with regards to the choice of suppliers. The interviewee confirmed that the company is considering both the relationship of the approach to risk management, particularly in putting the value on environmental risks, and the links to company's EMS (ISO 14001).

Plans for the future include further exploring the internal decisions applications of the approach, as well as performing the assessment without help from the external parties.

5.1.4 Maersk Drilling with Dong Energy, Denmark

Being able to try and apply dollar value to the impacts can help to convince people that are more of a finance or business focus.

—*Lynne Donald, HSSE Strategy Manager, Maersk Drilling, personal communication, 2017*

Maersk Drilling is part of the Maersk Group, a Danish conglomerate operating within transport and logistics, and energy sectors, the areas that, since 2016, represent two separate divisions of the group (Maersk, 2017). Maersk Drilling is a drilling rig operator that owns more than twenty rigs, catering to the oil companies around the world (Maersk Drilling, 2017).

Sustainability within Maersk Drilling has several focus areas, including a strong emphasis on safety and climate impact. The company run a pilot project on NCA with DONG Energy, the largest energy company in Denmark, and COWI, a consultancy working on the approach. The pilot NCA was conducted at the project level, on the project of drilling of a well in the Danish part of the North Sea. It was performed applying the EP&L methodology and looked at the whole life cycle of the well.

The pilot aimed to test the feasibility of applying the methodology to the offshore drilling activities. Several challenges were highlighted by the interviewee, including data gaps, the need

to rely on external databases, the element of uncertainty, non-uniformity and the many underlying assumptions.

The departments that participated in performing the assessment were the Environmental team, the Engineering function, which provided technical input, and Communication and Stakeholder Relations team. In addition, Finance team was involved in helping to figure out how to present some of the data so that it is consistent with how financial reporting looks like. The team was found overall interested in the initiative. However, the interviewee also stated that all the aforementioned teams collaborated on a frequent basis even before performing an NCA. Top management had a general oversight in the project.

The interviewee stressed that the perceived value of such an approach was in demonstrating that the company is looking for the emerging techniques and going beyond what is required by law or other binding obligations. The commercial value was also stressed.

The interviewee highlighted the relationship of NCA with EMS. Particularly, they stressed the value in supplementing the data found in the environmental risk register and demonstrating to the external auditors that a more thorough approach to understanding and quantifying environmental risks is undertaken. In this regard, the interviewee pointed at the connection to the continuous improvement requirement of ISO 14001.

5.1.5 Skanska UK, the UK

We can make better decisions as a company by raising awareness of individuals within the company about the environment and the case for supporting it.

—*Lizzie Rendell, Lead for Natural Capital and Biodiversity, Skanska UK, personal communication, 2017*

Skanska UK is part of Skanska Group, the fifth largest construction company in the world with headquarters in Sweden (Skanska UK, 2017). The four business streams of the group include construction, residential development, commercial property development and infrastructure development.

Company's sustainability work focuses on five main areas – ethics, health and safety, environment, community investment and diversity and inclusion (Skanska UK, 2017). Environmental work, an area labelled by the company as “green”, dates back to 1996, when the company was first certified according to ISO 14001, just one year before the company's first sustainability report became public. It positions itself as an industry leader in environmental management work and engages in various initiatives to promote sustainability in the building sector (Skanska UK, 2017).

Skanska UK's work on NCA started around 2014. It was driven by the desire to be a sectoral leader in sustainability, particularly in the green dimension of it, and to demonstrate it to their customers. The company was looking for emerging initiatives that could help them to maintain that leadership position. Customer interest played a crucial role in the adoption of NCA. According to the interviewee, natural capital is an area that a number of their customers were interested in, so the company was keen to understand how to support their customers in this area in the future. Interestingly, the company's work was inspired by the Crown Estate's⁵ Total

⁵ The Crown Estate is Skanska UK's client

Contribution methodology and the other similar developments around that time, particularly, Kering's EP&L.

The company is using their data on carbon emissions, water and waste to transform it into the natural capital perspective. Air pollution is increasingly being considered. In addition, the company is currently looking into including biodiversity into their assessments.

The NCA within Skanska UK is complemented by the social and economic dimensions, both monetised. Social capital work is led by a separate working group, who are currently engaged in calculating social return on investments.

The natural capital working group is co-chaired by representatives from both the Financial and the Environment teams. The company stressed that the collaboration between Finance and Environment teams increased drastically following NCA implementation, and go so far as to call it one of the biggest NCA-related successes. They stress that the natural capital working group is a joint initiative where both Finance and Environment teams have equal responsibilities, rather than being an initiative controlled and promoted by the Environment team alone. According to the interviewee, the Finance team brings the necessary expertise in order to look at the environment from the natural capital perspective, as well as their extensive expertise in auditing. For instance, the Finance team was auditing the process of calculating the NCA. Besides, the parallel social capital working group is bringing in the expertise from HR and Health and Safety teams.

The main perceived value of monetary assessment was associated with communication – both external and internal. It was considered a tool to embed sustainability into business processes, as well as to make sure that environmental impact and its magnitude are understood within the company, so that it could be used in higher level planning.

However, the company's representative stated that, given the level of development of the methodology and the area of NCA, particularly, the methodological uncertainty and data reliability issues, using these as the sole basis for any decisions is currently not feasible. Instead, NCA is one of the many factors company is considering when taking higher level decisions. The NCA work forms a basis for the company's 2020 business plan, which represents a joint environmental and finance strategy. The interviewee stated that they "built their strategy around [NCA] and around the people" (Lizzy Rendell, personal communication, 2017).

Skanska UK's work on EMS and NCA is quite separate at the moment, particularly due to the fact that ISO 14001 is more on the compliance side, while NCA is all about sustainability leadership, as noted by the interviewee. Thus, they represented two ends of the spectrum, one end being the risk side, and another one - the opportunity side. However, theoretical potential to embed the two was stated by the interviewee.

5.2 Additional Information

A representative from Danfoss, a Danish company operating in fluid control equipment, pump, seal and valve manufacturing sectors, stated that they have been considering NCA since 2014, and are currently starting the assessment. However, they also name several challenges that they are facing, including the recent organisational changes, but, perhaps more importantly, the resources that performing such an assessment would require, given the broad product portfolio, and the lack of drivers, particularly, low demand from customers' side on such information. Danfoss stated that their work is mainly carried out by the Sustainability department, which had recently been merged with the Communications department. They also pointed at an overall

improving understanding of the value of sustainability work within the company, particularly after the merge.

In turn, an anonymous representative from another Danish company, operating in the building materials sectors (*Company A*), stated that the reason why their company is not considering doing NCA is mainly because they do not see the added value this approach brings compared to, for instance, LCA. The company has been using LCA for quite some time now, for the purposes of filling in Environmental Product Declarations (EPDs), calculating carbon footprint and, broadly speaking, in communication. Company A stated that in their work the Sustainability team collaborates actively with the Public Affairs team, as well as Sustainability teams from other countries where the company is present. Work on LCA and on ISO 14001 in Company A seemed to be rather structurally split.

6 Analysis and Discussion

The chapter presents a critical look at the results of the study. First, it intends to reflect upon the extent to which theoretical findings around the value of NCA (*Chapter 4*) are substantiated by practical evidence (*Chapter 5*), including a brief comparison and discussion on the differences between the case companies. Furthermore, the degree to which practical developments (*Chapter 5*) reflected the idea behind the approach (*Chapter 3*) are discussed. Then, general reflections on the NCA as an approach and the emerging trends are introduced, as an elaboration on *Chapter 3*. As the final step, methodological choices are discussed and the degree to which the research fulfills the objectives are evaluated.

6.1 Decision-Making Value of NCA

The mechanisms through which NCA facilitates integration of environment into corporate decisions within a particular company (RQ2) were investigated in the previous chapters both through theoretical lens and through practical perspective. This subchapter compares the cases to note differences in the application of NCA, as well as goes through each theoretical claim in light of the new knowledge created through cases. The goal of such comparison is not to pick winners or state which company was more advanced in NCA application – this would have been impossible given the differences between companies and in the scales/types of the assessment performed – but rather to capture the diversity of potential ways in which NCA can affect decisions.

6.1.1 Summary of the Cases

This part features a comparison of the case companies with regards to both their profile, their application of the approach, and the perceived value from implementation, and should be regarded as a background for the further discussion of the cases. First of all, differences and similarities were found with regards to the type of assessment performed (Table 6-1).

Table 6-1 - Assessment characteristics in case companies

	Term used	Scope	Use	Benefits of \$	Drivers	Challenges
Arla Foods	EP&L	Supply chain	Pinpoint areas to focus on, Basis for sustainability strategy	Science grounded, long-term		Convincing people within the company
The Crown Estate	Total Contribution	Supply chain	Pinpoint areas to focus on, Basis for informing decision-making	Comparison	To inform decision-making	Data gaps, Concept hard to grasp by other departments
Maersk Drilling	EP&L	Project	Choose alternative designs within the project, Commercial value	Convincing other departments, Comparison	To show that they are doing more than required by law	Data gaps
Skanska UK	NCA, SCA	Operations	Basis for business strategy, Commercial value	Understanding, innovative approach	To be a sustainability leader, Customer interest	Data reliability, Methodological Uncertainty

The scopes of the assessments varied across the companies. In deciding to implement NCA, companies were driven by different factors, although some of the drivers were shared, particularly, the desire to demonstrate that they are trying innovative approaches, reaffirming their position as sustainability leaders, or changing public perceptions on their work. Overall, many drivers mentioned were external to the companies.

Likewise, many of the challenges faced by the companies were shared between all the participants. Particularly, methodological uncertainties and extensive data collection were named as the main issues. Some also noted some resistance from within the company. Many companies implemented NCA as part of a larger effort on a joint natural and social capital assessment, in attempt to reflect the full value and the full impacts.

6.1.2 Theory and Practice: Revisiting the Claims

An important objective of the thesis was to understand how NCA can improve corporate decision-making and facilitate the integration of the environment into business practices. The mechanisms through which NCA can integrate sustainability into corporate decision-making, suggested as a result of literature analysis, were only partially confirmed by practical evidence and are revisited herein. Table 6-2 **Ошибка! Источник ссылки не найден.** presents a summary of the findings from the participating organisations.

Table 6-2 – Mechanisms through which NCA adds value in case companies

	Claim 1 ⁶	Claim 2	Claim 3	Claim 4	
Contingent factors	Arla Foods	During the development and, to some extent, implementation	Different informational needs for EMS and NCA	Basis for the environmental strategy	Indirectly
	Crown Estate	During the development and the implementation	Considering for the future	Core of the business strategy	Directly related to risks
	Maersk Drilling	During the development	Continuous improvement, External Audit, Risk register	Operational value	Directly related to risks
	Skanska UK	During the development and implementation	Only in theory, EMS = compliance, NCA = leadership	Basis for the joint finance and environment strategy (business plan)	Opportunity side is stressed

Claim 1: NCA has potential to enhance collaboration between the departments and thereby facilitate the integration of environment into corporate decision-making.

All the case companies stressed that various departments participated in the development of NCA. Notably, the participation of the Finance team was mentioned by every company, either during the development stage or, to a slightly lesser extent, following the implementation - through expressing their interest in the approach. The use of NCA, however, remained largely tied to the Environmental or Sustainability department, be it developing an environmental strategy, choosing the suppliers or any other application.

⁶ Claim 1 – enhancing departmental collaboration, Claim 2 – Enhancing the value of EMS, Claim 3 – Relevance for strategic decisions and top management, Claim 4 – Awareness of risks and opportunities

Some companies established interdepartmental working groups for overseeing the work on NCA. The departmental collaboration was even stronger when the social assessment was involved. The primary motivation of involving other teams in the development of NCA was associated with bringing the additional expertise.

A theme picked up by many companies was the initial resistance from other teams within the company and the top management, linked to the fact that these were not fully comprehending the value it brings to the organisation. Therefore, the mere act of convincing people within the organisation in performing the assessment, in most cases costly and resource-consuming, could already be a step in advancing sustainability within the organisation. Likewise, some companies stated that the Finance team was looking into potential applications of the approach in their work.

However, some companies stated that collaboration between departments was of frequent occurrence within the organisation even before deciding to work on NCA. One could argue that NCA is only feasible for organisations with highly integrated sustainability agenda and that the strategic relevance of the approach has a direct relationship with the degree to which departmental collaboration is involved: when sustainability is part of the business strategy, it is easier to bring many people on board.

NCA is an ad hoc endeavor and one might argue that it is, therefore, a one-off collaboration project with limited effects on communication between departments *in the long run*.

However, experiences from the companies proved that it is quite an extensive assessment that requires continuous work, which was reflected in the presence of working groups in many cases. Therefore, an indirect effect of NCA on decision-making could be expected, associated with interdepartmental collaboration and realised through influencing people and slowly building awareness within the company.

Indeed, comparing the results of case companies with companies who opted for qualitative assessments, or have not yet initiated their work on NCA, the most easily palpable difference lied in the lesser degree of collaboration between the departments in the latter case, particularly as it relates to the collaboration with the Finance team.

As a conclusion, it could be argued that NCA does, indeed, entail a degree of interdepartmental collaboration, however, at the development stage more so than at the use stage. Actually using the data by other teams, particularly the Finance team, *for their own purposes* is likely prevented by poor understanding of the concept and of the value that it may bring to organisations.

Claim 2: NCA can help to enhance the value of EMS and thereby mainstream environment into decision-making.

In general, the link between the EMS and NCA, as described in the claim, was mentioned multiple times, particularly when it comes to creating environmental risk register. However, the link was not as strong as expected. In part, this could be due to the fact that almost all of the companies that took part in the study are currently using ISO 14001:2004 version that, as noted in *Chapter 4.1*, is largely focused on operations and risks, and are still transitioning towards the more strategically-oriented 2015 version of the standard. Along the same line, such results could be explained by the structural fragmentation of EMS work and strategic environmental work within the organisations.

However, it could also be, as noted by both Arla Foods and Skanska UK, that the informational needs for EMS and NCA differ significantly: EMS, as a compliance-based mechanism, requires clear and operational data, while NCA operates in aggregated and hard to grasp terms. In general, while EMS work is considered to be a must-have, NCA is deemed too innovative and progressive to have any relationship to EMS. This is worth briefly revisiting a theme picked up in *Chapter 4.2*, namely, tradeoffs in informational properties. Since NCA is quite robust, its value in operational environmental management could be deemed marginal, as opposed to the added value for *strategic* environmental management, which brings us to the next claim. Likewise, as the opportunity value of NCA increases, its relevance with regards to EMS, still seen as primarily compliance instrument, rather fades.

Claim 3: Information generated through NCA is of high relevance for strategic decisions and top management.

The strategic value of NCA was, indeed, confirmed by practical developments. Almost all companies linked their strategies, either business or environmental, to NCAs. Logically, for Maersk Drilling, which implemented the assessment as a pilot project and on the project basis, this claim was irrelevant.

However, the value to strategic decisions was rather indirect – NCA was used to set the general direction for environmental strategy in one of the case companies, and did not, in itself, trigger the decision to implement this strategy, to the best of the author's knowledge. As pointed out by the interviewee from Skanska UK, for NCA to drive decisions around business strategy, the quality of the data and assessment methods within NCA are paramount. Until the quality of the data is understood, companies may rightfully remain wary of using NCA for strategic decision-making (Lizzie Rendell, personal communication, 2017). A representative from Egetæpper⁷, one of Europe's biggest carpet producers, stated that one value of NCA was in confirming the strategic directions of the company. Even through the information generated did not confirm anything drastically new, it gave company reassurance in that the direction chosen is correct. One might speculate that NCA gives the company further stimulus for action. To relate it back to theory, NCA has clearer links to the single-loop organisational learning, as introduced by Argyris and Schön (1978), while its role in changing the underlying assumptions on the environment (double-loop learning) remains a topic for a separate discussion. One could, once again, argue that there needs to be a certain level of awareness and maturity already present within the organisation in order to unleash the decision-making value of NCA.

To convince top management of the necessity of such an assessment, likely to draw in substantial human and financial resources, requires sustainability to be placed high up both structurally, and in the corporate agenda. All the companies investigated could be considered rather advanced in their sustainability work even before deciding to implement the NCA. To provide a snapshot of the state of sustainability work in the companies, the author briefly reviewed their sustainability (integrated) reports at the time preceding the NCA. Both Maersk Drilling and Arla Foods signed up to the Global Compact and had a sustainability strategy in place in 2014. Skanska UK formalised its ambition to be a sustainability leader in the business plan and was involved in the groundbreaking construction supply chain greening work jointly with the UN. The Crown Estate had sustainability structurally embedded through the presence of the Chief Sustainability Officer, had integrated reporting and was paying attention to the sustainability metrics. According to a rating of CSRHub (n.d.), conducted annually on a sample of more than 17 thousands companies worldwide, both Arla Foods, Maersk Group and Skanska

⁷ Egetæpper was not one of the case companies due to time constraints, but their input was also considered important.

AB are better than 50% of companies when it comes to environmental sustainability. Skanska Group was listed on Dow Jones Sustainability Index (DJSI) for several consecutive years.

Claim 4: NCA increases awareness about both environmental risks and opportunities facing the company, thus increasing the perceived importance of sustainability work.

All the interview participants unanimously confirmed the risk value of NCA. However, the potential of such information to form a basis for exploring new business opportunities or innovation was only mentioned briefly. Perhaps the way it manifests itself is rather indirect, through sustainability strategy. The mechanisms through which NCA affects corporate risk management were not fully unleashed. This could be due to the lack of direct external pressures.

The author noticed a general lack of acknowledgement of the potential relevance of such data for innovation processes and business model changes. It is most likely related to the methodological gaps when trying to assess the “dependencies” component and the opportunities component.

Contingent Factors

Limitation: The potential of NCA to integrate environment into corporate decision-making will vary significantly across the organisation types and sectors.

Many differences between companies were spotted during primary data collection through interviews. However, the ability of the researcher to attribute these differences to certain aspects was limited due to the fact that virtually all elements of both NCA performed (scope, method) and organisational characteristics (sector, size, economic conditions) were different. Nonetheless, contingent factors can be expected to have direct consequences for both the rate of adoption of the approach and the effectiveness of NCA in affecting business decisions. Table 6-3 presents an elaboration on the potential application of the contingency theory as it relates to the claims discussed above.

Table 6-3 - Potential contingent factors in decision-effectiveness of NCA and their relationship to the claims

Value	Contingent factors
Claim 1: NCA has potential to enhance collaboration between the departments and thereby facilitate the integration of environment into corporate decision-making.	Organisational structure, size
Claim 2: NCA can help to enhance the value of EMS and thereby mainstream environment into decision-making.	Sector, size
Claim 3: Information generated through NCA is of high relevance for strategic decisions and top management.	Business strategy, sector, size
Claim 4: NCA increases awareness about both environmental risks and opportunities facing the company, thus increasing the perceived importance of sustainability work.	Sector, size
Contingent factors: Sector, size, organisational structure, business strategy	

For instance, organisational size can have a limiting or reinforcing effects on all the claims and the degree to which NCA affects decision-making processes. While bigger organisations can also be more structurally divided, limiting the realisation of the first claim, the strategic value of the environment is likely to be better understood in big companies due to external pressures. Generally, the resource-intensiveness of NCA and high data demands mean that it is generally relevant for bigger companies, potentially with operations in different countries, an observation

confirmed in practice. The degree to which environment is embedded in the general business strategy is another contingent factor that can contribute.

In addition, it is a general impression of the author is that NCA, as defined in the thesis, is more relevant for companies that are either under the increasing pressure from customers or subject to increasingly stringent sectoral or regional regulation. All the companies participating in the study, and many of those reviewed at the selection stage, had their headquarters in Europe and operations extending to other countries or even continents. Likewise, the scope and use area of the assessment could be expected to be based, to some extent, on the sector.

Crown Estate and Maersk Drilling were driven, to some extent, by external pressures – either public perception or external stakeholders’ management. Likewise, textile and pharmaceutical sectors were described in *Chapter 4.4* as two sectors where NCA is expected to thrive – after all, EP&L was developed by a holding within the textile sector. Both pharmaceutical and textile sector companies are currently under external pressure coming from both society and the governments. The former is experiencing stiffening regulations and increased attention to the concept of chemical footprint, reflected, among other things, in the increased relevance of the chemical regulation (e.g. REACH) and the increased emphasis towards chemical inventories. The latter is constantly ranked as one of the most polluting industries (EcoWatch, 2015). Same stands for oil and gas sectors, with the current climate negotiations, volatile oil prices and various divestment movements.

On the other hand, dairy sector and construction sector, while not under the direct pressure, are still realising the value of the assessment. High participation from the construction sector was also noted while selecting the case companies and going through reports on corporate ecosystem valuations and NCAs. This could be driven by a higher understanding of concepts of natural capital and ecosystems in the sector, due to the conservation and restoration work and the associated societal value (“license to operate”) – on a more positive side than what is experienced by the sectors described above. Dairy sector, on the other hand, is experiencing a shift in the geographical markets. Milk consumption is stagnating in Europe, and decreased since 1995 (EEA, 2017), perhaps explaining Arla’s plans to go to the new markets, while there is also an increased awareness of the animal grazing industry and its relationship to climate change, which could help explaining why health benefits are emphasised by milk producers, and why Arla would be interested in performing a social impact assessment, as opposed to just natural capital assessment.

An important observation related to the previous one was that, even though the approach is positioned as aimed at internal decision-making, the reporting value cannot be neglected. External stakeholder communication on natural capital impacts and dependencies seems to remain a prime driver for introducing such an assessment in the first place in many instances. Companies seem to engage in a learning journey that starts with preparing the assessment for reporting and ends at unleashing the internal decision-making value. The decision-making relevance or the value proposition of the approach remains, perhaps, too vague and poorly communicated to companies to serve as a sole driver.

6.1.3 Added Value of Monetisation

So far, we have examined the potential of NCA *in its entirety* to integrate environment into corporate decision-making: it has not always been clear whether some of the mechanisms through which NCA facilitates integration can be attributed to its monetary nature or other traits. However, throughout the research, one of the things that the author kept pondering upon was the *comparative* added value of a monetary assessment and the benefits it entails to the company, as well as a related question of whether NCA brings anything new to corporate

environmental management (relative to other forms of assessment). Figure 6-1 outlines the main themes that were identified by the interviewees, both practitioners and businesses, as the main advantages of a monetary assessment, compared to quantitative and qualitative types.

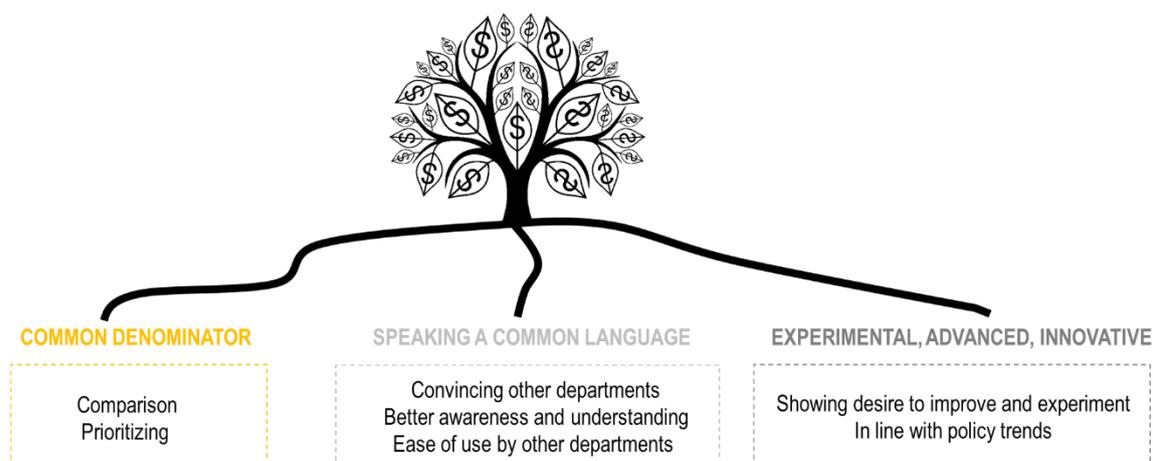


Figure 6-1 –Perceived advantages of a monetary environmental assessment

Source: Own elaboration

The first value proposition was related to having a common denominator that paved the way to a comparison that would have not been possible otherwise. However, several quantitative tools and approaches, such as LCA or organisational ecological footprint, have a similar trait, the difference being the proxy chosen – money in the former case and impact categories, in the latter. This was a value proposition most questioned by Company A which was performing LCA instead. The value becomes more tangible when both social and natural impacts are taken into consideration. However, one must bear in mind the question of whether this leads to shifting the focus towards areas where data is more easily available, and ignores natural capital elements that are more vulnerable, and hard to quantify or monetise.

Another recurring theme was related to speaking a common language between the departments. Environmental work can be hard to communicate internally, in all its complexity, so, potentially, money is an appropriate language that is understandable for all departments. On a related note, Egetapper, who built their NCA based on the information contained in the EPDs, stated that the very driver of performing the assessment was to make the information contained in EPDs understandable for people within the company, and to make it more appropriate for strategic work (Henrik Schmidt Hansen, personal communication, 2017).

However, this value proposition was questioned by Klas Hallberg, a representative from AkzoNobel⁸, who stated that this proposition had a downside (Hallén Jorquera, & Lindblad, 2016). According to Hallberg, presenting environmental impacts in monetary terms can lead to a wrong perception, particularly from the Finance team, that these are the actual costs to be borne by the company in the future (author's note: perhaps not too far away from the truth if the current policy developments continue).

Another value proposition, either directly or indirectly mentioned several times, lied in the perceived novelty of the approach, linked by many interviewees to the monetary nature of the assessment. First of all, NCA was considered a way to demonstrate to external stakeholders that the company is willing to experiment and innovate when it comes to dealing with the

⁸ Not interviewed by the author of this thesis

environment. In addition, there was a potential for companies to get on board of a general policy trend towards monetisation, stated, among others, by Steen and Weidema (personal communication, 2017). Instead, companies that were doing other assessments pointed at the lack of drivers and demand for such information from their upstream and downstream partners.

Furthermore, the representative from Arla Foods and Bo Weidema, an LCA and EP&L practitioner, pointed that one of the main perceived advantages of NCA lies in the “ability to make science-based trade-offs” (Bo Weidema, personal communication, 2017). However, other companies pointed at the opposite, stating that they feel uncomfortable in basing their decisions on NCA due to the incipient stage of development of the approach. However, with further development of the underlying methods, the importance of this advantage might become higher.

During the theoretical analysis in *Chapter 4*, it was an impression of the author that the main mechanism through which a monetary assessment would add value was regarding investment decisions and risk management. These value areas were not explicitly stated but indirectly confirmed by Maersk Drilling, which used the results of the assessment to choose between the investment alternatives.

6.2 General Reflections on NCA

Where we are now is that there is no consensus on one particular or prescriptive methodology to measure or value natural capital.

—Eva Zabey, WBCSD, *personal communication*, 2017

The author found it hard to find companies that fully satisfied the definition of NCA, developed in *Chapter 3*, or the idea behind the approach, introduced by various institutions. Many of the practical developments were leaning towards just focusing on the impacts and not dependencies. In addition, most of the assessments performed by companies were impact-based, rather than ecosystem register based. This could partially be explained by the fact that such approach is more consistent with the current data structures and indicators present within the companies, and thus does not require “starting from scratch”. In addition, this could be a sign of methodological variety and gaps, worth investigating outside the scope of this thesis. In practice, the definition of NCA narrowed down to a monetary environmental assessment, which explain the high emphasis on the added value of monetisation as opposed to the other traits of NCA, such as its long-term and forward-looking nature.

A related challenge within the study was to identify companies that are working with the concept: practically every company examined was calling their approach differently, while the essence was largely the same, with some methodological deviations. In part, this is due to the fact that many parallel developments are taking place in the business sector surrounding NCA.

The organisations working with NCA have slightly different approaches to the trend of valuing natural capital. One way, adopted by the ISO, is starting from standardising and fixing the terms and the underlying methods, which would then supposedly lead to increasing acceptance and spreading of the approach, eliminating the confusion and inconsistencies. Another way, undertaken by the Natural Capital Coalition (NCC), is to move from flexibility to unification, through first getting as many companies on board as possible, to then unifying the methodologies. These are by no means contradictory. ISO can fix the underlying TEV methods, while NCC can focus on the tools that are using these methods and on engaging the business.

Many methods are being developed simultaneously by companies and research institutes. While potentially a sign of a new trend in environmental management, such diversity can be confusing and counterproductive: it pushes companies to compete on the methodology, and not on the results and the actual environmental performance, a thought introduced by one of the interviewees:

By having a generally accepted, prescriptive, methodology... we can move from comparable process to comparable results, and then companies will compete on performance and not on methodology, which is what happens today.

—Eva Zabey, personal communication, 2017

At the same time, companies seem to be willing to share their methodologies (e.g. both Total Contribution Methodology and EP&L were available at respective companies' websites). Unifying terminology and methodology could bring several important benefits, including a potential for a better comparison between companies and thus, increased reporting value, and, arguably, decreased cost of the assessment for companies – they can then focus on gathering relevant data and deciding on the scope of application. The question is whether the field is mature enough for this. WBCSD doubts that. Their idea is, over time, to get statistics on the tools that get used the most, in order to see what could potentially become a prescriptive tool (Eva Zabey, personal communication, 2017). However, unification is also connected to certain challenges – it is hard, if not impossible, to develop an approach that is relevant for companies of all sectors. Figure 6-2 presents a brief elaboration on trade-offs in having a diverse approach in place versus introducing unification.

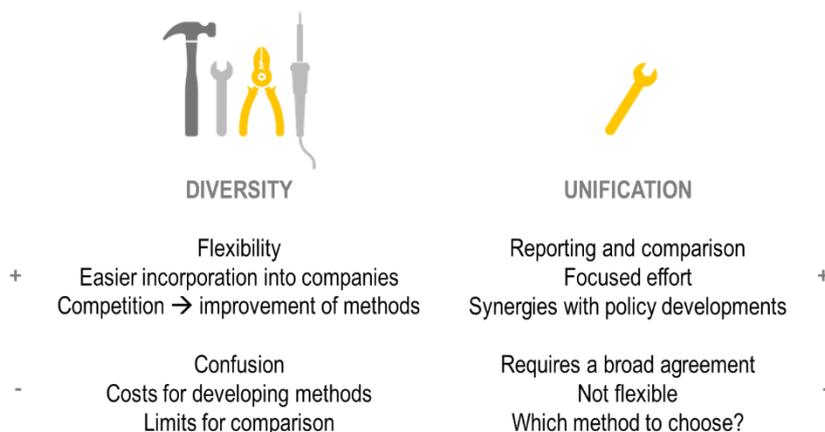


Figure 6-2 – Potential advantages and disadvantages of diversity of tools, methods and terms surrounding NCA versus their unification

Source: Own elaboration

Another potential emerging trend identified in the corporate world is a combined social and natural capital evaluation, striving to reflect the full value and the total impact. Indications of this are the Social Capital Protocol and the corporate interest witnessed among the participants of the study. This trend can also present both negative and positive consequences. While potentially providing a more comprehensive picture of the total value the company brings, one might argue it could lead to some companies trying to “offset” their negative impact on nature by the positive social impact, or vice versa, going against the notion of the triple bottom line.

Regardless of these issues, it is the author’s impression that the importance of a monetary assessment will increase over time. Bengt Steen, who has been working with monetary assessments since the 1990s, is of a similar opinion:

Considering that the driving force comes from government organisations and that government organisations control more than half of our economy, transitions to a sustainable economy will happen and will need monetary values of the natural capital. Forecasting the timing of this process is, however, difficult as other interests in society compete on the available economic space.

—Bengt Steen, *personal communication*, 2017

Presented in Table 6-4 – Potential drivers and barriers for the application of NCA in companies is a synthesis of potential facilitating and limiting factors for the implementation of NCA assessment, both external and internal.

Table 6-4 – Potential drivers and barriers for the application of NCA in companies

	Facilitating factors	Limiting factors
Internal	Leadership values	Human resources and qualification
	Business and sustainability strategy	Cost of the assessment
	Innovation and business model opportunities	Time required to perform the assessment
	EMS enhancement	Extensive data requirements (internal data gaps)
External	Policy trends and future disclosure requirements	Methodological uncertainty
	Access for external finance (subject to financial sector developments)	Many alternatives to choose from
	Commercial value	Risks associated with disclosing negative impacts (if reported)
	Competitors (mimetic pressure)	

6.3 Methodological Choices

With regards to the first research question, the objective was largely fulfilled. The main developments within the area were outlined, the differences between the existing approaches underscored, and the working definition derived. Interviews with institutions working with the approach either confirmed or supplemented the findings from the literature analysis. The results confirmed the presence of the divergent interpretations stated in the introduction.

With regards to the second research question, the objective was partially fulfilled. While several theoretical claims were derived with regards to the potential of NCA to facilitate integration of the environment, the list is by no means exhaustive. In addition, theoretical claims were only partially tested and confirmed by practical developments.

As predicted during the research design phase, the broad scope of the study and the exploratory nature inevitably imposed several limitations on the author. Of the more significant ones are the rather broad scope of literature analysis to answer the second research question. Many important points have likely been missed along the way.

Many of the limitations of this study are related to the incipient stage of the development of the area under investigation, as noticed multiple times. First, it reduced the number of companies to be interviewed, which, in turn, had broad implications for the level of conclusiveness and generalisability. However, it is the author’s personal conviction that, although it is hard to generalise from such a small sample, the theoretical relevance of these findings is not to be

neglected. Particularly in case of a concept under development, limiting oneself to a theoretical framework and disregarding practical developments that extend beyond the boundaries of the framework can be questioned.

As a second limitation, much time was spent trying to understand the concept boundaries and building the conceptual framework. In addition, the study was dealing with two very broad concepts at both ends: NCA and business decision-making, interlinked through an integration dimension. It, thus, started from the assumption that integration of environmental considerations into business decisions has a positive influence on the ultimate variable – environmental performance or corporate sustainability, which was not properly substantiated.

Chapters 4 and 5 outlined the existence of the relationships between NCA and certain decision-making value aspect. However, the question of whether NCA is a symptom of an organisation that is already mature regarding sustainability or an approach that moves this organisation closer to a sustainable business was impossible to answer with a high degree of certainty, largely due to the methodological choices. For answering this higher level question, a case based research enhanced by process tracing would have been beneficial. Deeper investigation of the processes occurring within the organisation before, during and after NCA implementation would have potentially provided a higher level of depth. At the same time, such design was deemed unfeasible given time and resource limitations of the author.

Interviews proved to be an effective data collection method for the study. However, the interview channel could have been reconsidered for the first research question – due to the questions being rather straightforward, a simple e-mail questionnaire would have sufficed, and possibly could have had a positive influence on the response rate. On the other hand, more in-depth interviews with businesses, potentially with several representatives from each case company and with a larger number of *other* companies, would have enriched the results. It would have been interesting to select *other* companies from the same sectors as the *case* companies to control for at least some of the factors.

A more systematic literature analysis, although largely unfeasible due to time limitations, would have added weight to the theoretical conclusions (*Chapter 4*). Perhaps a more structured and systematic review of the existing opinions, potentially involving context analysis, would have added value and presented a more holistic picture.

Content analysis of corporate reports could have provided valuable insights in terms of pinpointing statistically relevant correlations. However, the potential of employing this method was limited due to the early stage of development of NCA.

Conclusions drawn from *Chapter 5 Practice* should be taken with caution due to the small sample and the presence of the contingent factors. However, in some instances a degree of uniformity was noticed in interview responses across the participating companies, reflecting similarities across businesses and sectors.

Reflections on the Framework

Overall, the general impression of the author after testing the framework with the case companies is that it does reflect the reality, to some extent. However, some claims were definitely more prevailing in practice. Particularly, enhancing interdepartmental collaboration and the strategic relevance of NCA were found to be the two claims that the companies put more emphasis on.

After undergoing this journey, the claims were found either interconnected, or, in some instances, reinforcing each other, or, contradicting. In addition, the ultimate variable that all of them revolved around was individual awareness within the organisation. Figure 6-3 presents a critical look on the relationship between the claims.



Figure 6-3 - Potential relationships between the claims introduced

Source: Own elaboration

Claim 1 and 4 were found to be largely interlinked: both were concerned with the understanding of the value of the environmental work within the company and, ultimately, awareness. Claim 2 and 3 resulted somewhat contradictory, given that one introduces NCA as a predominantly strategic tool and the other hints at its operational significance. This contradiction was suspected already at the stage of building the framework, but became clear during the interview process. Claims 3 and 4 were found to be interlinked given that the strategic relevance of environment is largely based on the understanding of the risks and opportunities that it provides. Claim 4 in itself was found to be too broad to derive any significant conclusions from applying it, while Claim 2 was found to be of marginal relevance, when tested in practice. In addition, all claims emphasized the importance of awareness of people within the organisation in integrating environmental considerations into business decision-making.

The framework could have benefited from various improvements. For instance, mentioning the potential internal uses of NCA could have added value. However, this was hard given the difficulties in coming up with an exhaustive list of all decisions that NCA can affect. In addition, the work could have been furthered by applying more of a process approach to introducing the claims. It could have been transformed into a scheme that reflects the step by step mechanism whereby NCA facilitates the integration. However, two limitations come into mind with regards to the process approach – first, methodological, discussed further on, and second, contingent associated with difficulties in coming up with a single process relevant to all companies.

However, despite these potential issues, the framework does reflect potential mechanisms through which NCA can affect corporate decision-making. This became particularly evident after the interviews with both case companies and companies that did not implement the approach: the differences were easily palpable, with some companies introducing the claims themselves without the author alluding to them in the first place. Nonetheless, implementing NCA does by no means imply that all these claims will hold true (which is why contingent factors are mentioned). Several mechanisms to enhance the decision-making value of NCA are discussed in *Chapter 7* (when talking about recommendations).

7 Recommendations and Future Research

Rather than a definitive guide, the recommendations presented below should be regarded as a collection of ideas and reflections inspired by the analysis performed in the previous chapters. Likewise, future research areas are selected based on the unsatisfied informational needs witnessed by the author and the gap between the desired and the intended outcome of the study. The list presented is thus, by no means, exhaustive.

7.1 Practitioners

First of all, aligning the terminology across various institutions and different initiatives could be conducive towards the general understanding of the approach. That being said, differences in views on terminology and methodology that should be applied should not prevent collaboration between various initiatives. Enhanced dialogue between different initiatives is strongly encouraged, ultimately because they are working for the same goal, i.e. incorporating natural capital into business thinking. In this regard, the World Business Forum on Natural Capital could serve as one platform for collaboration.

Policy efforts and business efforts should not go their separate ways. The author of this thesis is convinced there are significant synergies to be derived from combining the two initiatives in one way or another. For instance, businesses could use the results of countries' SEEA accounts in developing their private accounts. Business accounts, in turn, could be used as a basis for subsidies. This could increase the uptake of the approach through providing a policy stimulus. Naturally, these would have to be preceded by a certain degree of methodological unification and a plentitude of other preconditions.

In developing NCAs for companies, an increased attention could be given to the potential of NCA to assess opportunities/dependencies on natural capital and the associated business values. The value of NCA, particularly in relation to other assessment approaches, needs to be communicated very clearly. In addition, work on social capital assessment could be considered in parallel to NCA, given that businesses show interest in such a combined assessment.

The approach could be positioned differently for different sectors. Likewise, the appropriate scope and relevance of the sector-specific guidance could be stressed. Several sectors that could benefit from the approach were highlighted in the thesis.

To enhance the integrative effects of NCA, continuous development of case studies and more detailed description of the business value could be considered. Particularly, the strategic value of NCA could be communicated and illustrated with cases. Special attention could be put to illustrating how this information can be used in the everyday work of other teams within companies. In developing NCA, consulting companies could actively involve representatives from various departments within the client company.

7.2 Businesses

Recommendations for businesses are split into two main areas – recommended actions to enhance the decision-making relevance of the approach and recommendations for performing the NCA.

7.2.1 Increasing the Decision-Making Relevance

Top management involvement and commitment to the initiative is of great importance. Thus, convincing top management that it is a worthwhile initiative becomes crucial. This can be done through emphasising the risk management value of the approach, particularly in dealing with

supply and regulatory risks, as well as demonstrating current policy trends and other developments that demonstrate long-term benefits of being proactive. In addition, reporting and commercial value as one of the side benefits of the approach could be stressed. Communicative value of NCA, namely, its potential to make both internal (interdepartmental) and external (auditors, financial institutions, customers, suppliers) communication more effective, can also be stressed.

Likewise, different departments could benefit from using the results of the NCA. Involving different departments in performing the NCA, including consulting with them, could spark interest in using the results of the evaluation. A working group consisting of representatives from different departments could be formed, should NCA be conducted by the company itself without external help.

NCA could be regarded as a useful addition and enhancement to the existing environmental management system within the company. As such, information obtained through NCA, particularly if performed at a corporate scope, could be embedded in the EMS documented information, for making sure that it is used within the company.

Companies could consider unleashing the value of NCA in identifying business opportunities. For this, dependencies on natural capital should be underscored. NCA could provide important inputs for organisations in the process of transformation, opening up to the new markets or launching a new product range. Then, it can be part of the business plan for the initiative.

To avoid lack of operationalisation, the intended use of the results of the NCA should be clearly stated prior to performing the assessment, and the scope and type of it derived thereof. While results of the study show that monetised approach could add value, the importance of qualitative and quantitative assessment, particularly for the purposes of materiality analysis, should not be underestimated. In choosing the type of the assessment, several factors could be considered, including the intended users of information within the company.

7.2.2 Performing NCA

Developing an NCA requires resources, both financial and human. However, there is a significant potential in reducing the costs associated with the assessment. One way to lower the bill is to through an information gap analysis. Such analysis could help identify information that is already available within the company, as well as pinpoint further informational needs.

Various sources of information could be used as a basis for NCA. These include corporate reports, environmental KPIs, in general, information contained within the environmental management system, particularly in the risk register, environmental aspects and impacts register, quantified environmental objectives. Figure 7-1 presents some potential sources of information for performing an NCA within the company. Naturally, applicability will largely depend on the scope and type of assessment chosen and will vary across companies.

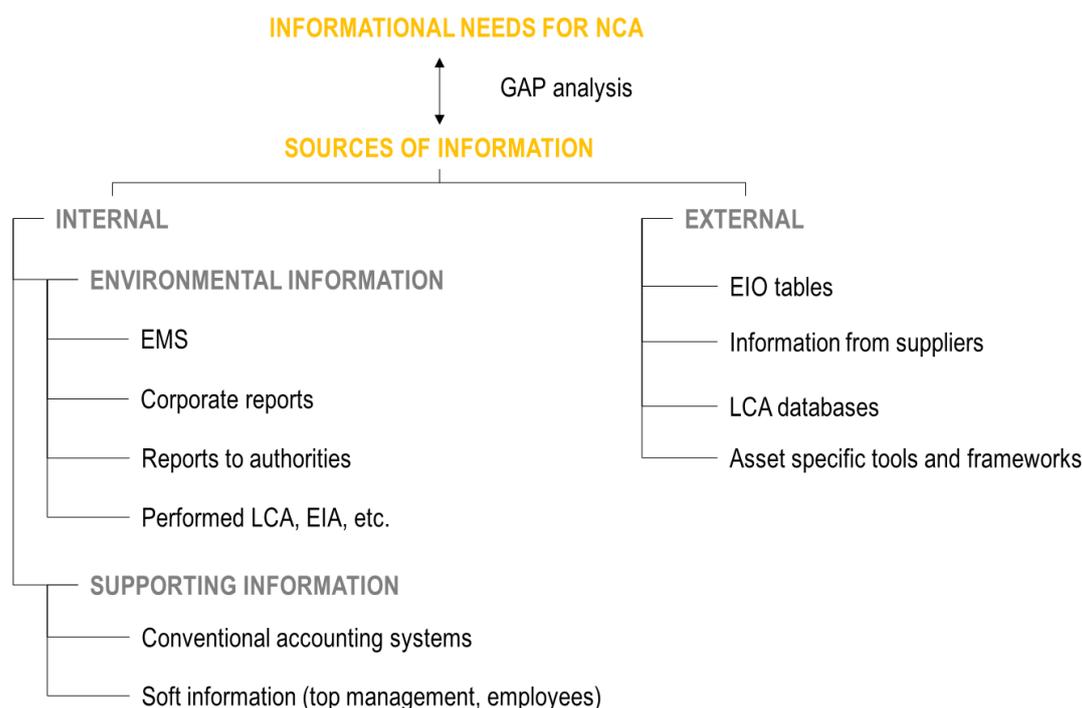


Figure 7-1 - Potential sources of information for NCA

Source: Own elaboration

One important remark to the figure is that the informational sources outlined are interacting with each other. For instance, integrated corporate reports are based on data obtained from EMS and performed assessments. Nonetheless, all of them are worth mentioning since the presence of one or another informational source will differ across companies.

Another way to reduce the cost of the assessment is to consider various scopes and pilot-testing the approach and its applicability, a tactic probed by Maersk Drilling. The scope chosen should be tailored for the intended use, which, in turn, should also be made very clear. Performing a form of materiality analysis before the monetary evaluation could narrow down the scope to a particular environmental aspect or environmental impact/dependency. Monetising the whole supply chain, in turn, can be associated with several difficulties, including low operational value, complicated presentation and timely and costly execution. Particularly for companies that are strongly depending on one natural capital element significantly more than the rest, this would help avoid nitpicking and the associated costs.

7.3 Academia – Future Research

In general, a more extensive research related to investigating the role of information, particularly environmental information, in corporate decision-making would have benefited the study at hand. Management and change management could be used for grounding the research, while behavioural theory could provide an interesting angle linking processes and people within the organisation. Economics, finance and conventional accounting could bring their expertise. Of particular interest are areas such as the limitations of information, the role of information in fostering transformational change, the role of informational properties in evoking change, rebound effects from increased awareness or a supply of incomplete/skewed information.

A parallel research stream is ecological economics, which could further develop the underlying methods behind monetary evaluations.

Within the area of NCA, several important research streams could be outlined. However, a certain maturity of the field has to be reached first in order to be able to conduct such research, due to, for instance, sample size barriers.

With regards to the theoretical claims introduced, of particular importance could be the research on the role of information in strategic decision-making, as well as in building awareness within the organisation.

Contingent factors were mentioned in the thesis at hand, but only partially tested due to a small sample. One interesting area of research could be to look at the applicability of NCA to sectors that are strongly dependent on the environment but do not cause much impact directly or upstream. The number of these sectors is expected to increase and their realisation of the importance of natural capital - to rise due to, for instance, climate change and the increasing consequences that companies are facing. One such sector could be tourism.

The study at hand dealt predominantly with the monetary type of environmental information. A more rigorous comparative study outlining the potential of monetary assessments vis-à-vis qualitative or quantitative assessments could provide valuable inputs. A case-oriented research design could be used, with several companies in the same sector and of similar size.

The study at hand used case-oriented design to test the theoretically derived claims. A more long-term and thorough case-based research involving, potentially, process tracing of the incorporation of NCA within the organisation, could point out the causal links.

In addition, drivers and barriers for the implementation of NCA could be researched in detail, with a particular emphasis on an overview of policy developments. An appropriate research design could be variable-oriented. A special consideration could be paid to contingent variables for implementation.

Trade-offs in informational properties of NCA, particularly between robustness and simplicity, were outlined in theoretical findings but deemed unfeasible to test in practice. Therefore, research that investigates how various properties of NCA affect its decision-making relevance or, one step further, the environmental performance of a company, could be of use.

8 Conclusions

Natural Capital Accounting is an emerging area within corporate sustainability that has recently gained an increased attention from companies and other institutions. As a new concept that evolved through practical developments, diverging interpretations of what it entails exist. Regardless of the definition, the emphasis on the decision-making relevance of NCA was frequently emphasised. However, the questions of how and if it actually leads to better incorporation of environment into corporate decision-making remained largely unanswered.

The study at hand intended to bridge this gap through investigating the ways in which NCA can facilitate the integration of sustainability into corporate decision-making. The journey was guided by the following umbrella questions:

RQ1: What can be understood as NCA for businesses?

RQ2: How can NCA contribute to the integration of environment into business decision-making?

The first step in fulfilling the objective was to build the theory around the integration potential of NCA, starting with the very definition of the concept, and ending with theoretical claims around the mechanisms through which NCA can help embed environment into corporate decision-making. As the next step, experiences from frontrunner companies were examined with regards to the claims introduced.

The role of NCA in augmenting the collaboration between departments, more so than other forms of non-monetary environmental assessments, was witnessed both in theory and in practice. Of particular relevance was the collaboration between the Finance and Environment teams, perhaps indicative of a changing perception on the environment within the adopting company. The relationship between EMS and NCA, and an idea that NCA can enhance the value of the system, remained rather unsubstantiated by practical developments. This connection was found rather indirect and blurry, due to the fact that EMS was still seen as merely a compliance mechanism, and NCA - driven by a desire to experiment, innovate, and strengthen the sustainability leadership position. The two instruments were found to be at the opposite ends of the corporate sustainability innovation curve: while EMS was pushing the laggards further, NCA was a weapon of choice for a small number of sustainability leaders. While this can be expected to change as the majority of the companies move ahead towards sustainability and ISO standards become increasingly stricter, a development already being witnessed, the claim could not be confirmed as of yet. This brings us to a related conclusion, namely, that NCA could, indeed, be highly relevant for strategic purposes, particularly inasmuch as setting the direction of the strategy and reaffirming and justifying corporate action on sustainability are concerned. The relationship of the approach to risk management and opportunities identification, stated through theory, found indirect confirmation in practice.

In another conclusion, contingent factors were found to play an important role in the adoption of the approach, as well as in the degree to which the approach affects corporate decision-making, once adopted. The contingent factors identified could be reflective of various degrees of the sense of urgency and understanding of the need for action on the environment and indicative of different levels of individual awareness already present within the companies.

Thus, the study contributed with an input for a continuing research concerned with the role of information in corporate decision-making, as well as a more thorough investigation of changes in corporate processes following the development and the implementation of NCA.

However, the research also left a big room for discussion. With regards to all the dimensions of integration investigated, the role of NCA remained rather indirect: either supporting and reassuring, or educational. It either manifested itself in giving confidence and supporting arguments for individuals to promote the case for environmental action, or led to increased awareness on the issue.

One cannot expect that information alone lead to a drastic shift in organisational behavior with regards to environment. If information were enough, companies would have already experienced a large transformation, given that environmental assessment methods have been there for a long time. If that information were perfect, companies would have felt more comfortable basing their decisions on it. If the associated policy developments were moving at a faster pace, companies would sense the urgency. It will undoubtedly take more than NCA to transform companies, and ultimately our economic systems. NCA itself is far from perfect, the very idea behind it might be repugnant to some. But, while methods are being perfected and the policy agenda being set, why not let companies innovate and experiment with ways to measure their contribution to the society.

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Appendix I. Interview Guide for Businesses

- Thank for agreeing to be interviewed
- Talk briefly about the study
- Ask permission for recording, agree on the privacy settings
- Ask if they have any questions

Questions⁹:

1. What is your role within the organisation and with regards to the NCA developed?
 2. What type of NCA was developed within the organisation?¹⁰ [*Check for: scope, methodology, impacts/dependencies, risk/opportunities*]
 3. What were the drivers for performing an NCA?
 4. Who was the initiator of the process within the company?
 5. What do you see as the main benefits for conducting a monetary assessment? [*as opposed to qualitative or quantitative*]
 6. What were the main challenges in performing the assessment?
 7. Which departments participated in the development and use of the NCA? [*Check for collaboration before work on NCA but try not to be leading*]
 8. How would you describe the degree of involvement of the top management in the NCA process? [*in both use and development of the NCA*]
 9. What would you describe as the main uses of the information generated through NCA?
 10. What main changes have NCA results caused within the company?
 11. Do you see any links between corporate strategy (environmental or business) and NCA?
 12. What is the relationship between the NCA work within the company and the EMS work, if any? [*check whether the same department is responsible for the two*]
 13. Is NCA considered to be part of the business risk management within the company? If so, please elaborate [*an opening question for a discussion on risks and opportunities*]
 14. Any further comments or ideas?
- Thank for the interview
 - Ask for a possibility to ask follow-up questions

Theme	Question
Opening questions	1, 2, 3
Claim 1 – Enhancing departmental collaboration	4, 7, 9, 10
Claim 2 – Enhancing the value of EMS	12
Claim 3 – Relevance for strategic decisions and top management	4, 8, 11
Claim 4 – Awareness of risks and opportunities	2, 3, 13
Closing question	14
Other themes	Drivers and barriers – 3, 6, Advantages of monetary - 5

⁹ A modified questionnaire was used for supporting interviews with companies (Group II in Appendix II. List of Interviewees)

¹⁰ This question was asked if no information was available online.

Appendix II. List of Interviewees

Name	Position	Organisation	Country	Channel
<i>Group 1.1: Case companies</i>				
Jane Baptist	Deputy Head of Sustainability	The Crown Estate	The UK	Phone
Lynne Donald	HSSE Strategy Manager	Maersk Drilling	Denmark	Phone
Jan Dalsgård Johannesen	Director Sustainability, Global QEHS	Arla Foods	Denmark	Phone
Lizzie Rendell	Environmental Advisor, Lead for Natural Capital and Biodiversity	Skanska UK	The UK	Phone
<i>Group 1.2: Other companies</i>				
Flemming Lynge Nielsen	Sustainability Director	Danfoss	Denmark	Phone
Henrik Schmidt Hansen	CSR Manager	Egetapper	Denmark	E-mail
Anonymous	Sustainability Expert	Sector: Building materials	Denmark	Phone
<i>Group 2: Practitioners and academia</i>				
Eva Zabey	Director, Natural Capital and Ecosystems	WBCSD	Switzerland	Skype
Franz Knecht	Founder and lead partner (1)	Connexis AG (1), SNV (ISO)	Switzerland	Phone
Jimmy Yoler	Project Manager	Swedish Standards Institute (ISO)	Sweden	Skype
Bo Weidema	Founder	LCA Consultants 2.0	Denmark	E-mail
Bengt Steen	Professor Emeritus (1)	Chalmers University (1), ISO	Sweden	E-mail
Jesper Karup Pedersen	Chief Market and Project Manager, Water & environment	COWI	Denmark	Skype