INTEGRATED INVESTING

How to integrate environmental impacts in investment processes of companies

SIMON WEIHOFEN
Doctoral thesis

Integrated Investing

How to integrate environmental impacts in investment processes of companies.

Technische Universität Darmstadt (D17)
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Oh, Mother Earth,
With your fields of green
Once more laid down
by the hungry hand
How long can you
give and not receive
And feed this world
ruled by greed
And feed this world
ruled by greed.

Oh, ball of fire
In the summer sky
Your healing light,
your parade of days
Are they betrayed
by the men of power
Who hold this world
in their changing hands
They hold the world
in their changing hands.

Oh, freedom land
Can you let this go
Down to the streets
where the numbers grow
Respect Mother Earth
and her healing ways
Or trade away
our children's days
Or trade away
our children's days.

Respect Mother Earth
and her healing ways
Or trade away
our children's days.

Mother Earth (Natural Anthem)

Neil Young, 1990

The results, opinions and conclusions of this dissertation are not necessarily the same as the Volkswagen Group.
Abstract

Environmental management systems aim to ensure legal compliance on the one hand and continuous improvement of environmental performance on the other hand. Due to its cross-sectional character, environmental management systems affect all parts of the organisation. Another cross-sectional system is the management accounting system which intends to support ex-ante internal management decision-making processes. The overlapping part of both systems deals with environmental issues in business planning processes and is commonly referred to as environmental management accounting. However, the field of environmental management accounting is still young and corresponding methods are currently under development.

Besides financial goals, companies increasingly start formulating strategic environmental goals. However, the management and control of these goals remains a challenge. Thus, the formulation of strategic environmental goals in qualitative terms limits their management and control. On the other hand, the systematic integration of strategic environmental goals in management accounting processes, such as investment appraisals and decisions, represents a research gap. Therefore, this thesis aims to develop a method that is able to systematically integrate financial and environmental data in investment processes to support the achievement of strategic environmental and financial goals of companies. This new integrated investing method intends to provide a sufficient degree of scientific quality on the one hand and practical applicability on the other hand.

In context of this thesis, a deficit analysis assesses reasons why current methods of environmental management accounting have not established as common business practice so far. During the first part of the subsequent method development a set of seven requirements is composed. On basis of these requirements additional methods of environmental management and management accounting systems are evaluated resulting in a final set of three approaches representing the basis of developing the new integrated investing method. After developing and describing the new integrated investing method, the method is applied in seven case studies within the Volkswagen Group. This method application verifies the method’s practical applicability as well as its ability to manage and control strategic environmental and financial goals.

In conclusion, this dissertation contributes to the development and application of a new integrated investing method that aims to ensure a sufficient degree of scientific quality and practical applicability. With the help of this method, it is able to systematically integrate environmental impacts in investment processes of companies in order to manage and control the achievement of strategic environmental and financial goals.

The recommendations for future research address the limitation of the Ecological Scarcity Method, on which the integrated investing method is based, as well as the application of the new integrated investing method in contexts outside the Volkswagen Group.
Preface

This thesis evolved in context of my time as a doctoral candidate at the Volkswagen Group Research Environmental Affairs department, in which I had the pleasure to support the environmental management team. During the first few months, while I was searching for an appropriate topic for my dissertation, the team was faced with an increasing amount of enquiries. These enquiries requested a method for a decision-making process that balances financial and environmental aspects. While the financial costs and benefits of an investment could be identified and quantified, decision-makers were uncertain about the quantification of environmental impacts associated with the investment.

The more my colleagues and I immersed into this topic, the more controversial and complex were the associated discussions, which finally led us to the necessity for a sound academic but also pragmatic solution in form of my dissertation. Hence, this thesis addresses environmental management and management accounting professionals, who are faced with similar enquiries on the one hand and the scientific audience on the other hand, which is cordially invited to discuss my proposed method.

This thesis would have never been written without the support of my family, friends and colleagues. First of all, I am very grateful to Judith for her endless support and belief in me, not only during the time of my dissertation, but also for encouraging me in whatever I have done so far – be it studying and working abroad or all of my additional projects, which mostly take place far away from our shared home. In this context, I am especially pleased to count on my grandparents, parents and my sister, who constantly believe in the success of my projects, which always encourages and motivates me.

I have also not forgotten the inspiration of Tim Kaske, who encouraged me to even think about the option of writing a dissertation. At that point of time, writing a dissertation seemed to me as an unreachable goal. Without his inspiration, I would have never applied for the job offer as doctoral candidate at the Volkswagen Group.

During my time as doctoral candidate, I had the pleasure to work together with lots of bright colleagues, who took the time to listen to my thoughts and who did not hesitate to provide valuable and constructive feedback. In this context, I am especially thankful for the constant help of Steffen Wellge in form of time, guidance, motivation, trust, creativity, open and honest feedback. Without Steffen's support, I would simply not have been able to finish my dissertation in three years' time and working on my dissertation would not have been that much fun.

Furthermore, I was supported by my supervisors, Günther Damme, Dr. Liendel Chang and Gerhard Mogg, who enabled me to present my dissertation to broad audiences within the Volkswagen Group Research but also in context of external scientific conferences.

I am additionally thankful for various colleagues who supported me in conducting the case studies: Kai Schweingruber, Kai Jaekel, Christian Pressel, Marius Rode, Markus Meyer, Dr. Stefan Brinkmann, Dr. Jens Asche, Marcin Grochowski, Stefan Rose, Erhan Icten, Malte Gebler, Volker Hillers, Ralf Steffen, Carsten Weinz, Hans-Joachim Blunck, Arnd Müller, Reinhard Marowsky, Martin Müller, Markus Lange, Johannes Meichsner, Stefanie Hofmann, Florian Müller, Yvonne Thoben, Robert Schmidt, Micha Bruchmüller, Cynthie Gadiel, Vitali Hartfelder, Thomas Kitzmann, Thomas Kröschle, Thomas Belger, Dr. Klaus Matalla and Silke HärTEL. Thanks also to Astrid Kuwert-Behrenz, Britta Mostert and Beate Hainke who helped me with the professional layout of my dissertation and to Katharina Storm who invested a tremendous effort for eliminating all the typos in this dissertation.
Last but not least, I am very grateful for the support of my doctoral supervisor Prof. Dr. Liselotte Schebek and my second supervisor Prof. Dr. Edeltraud Günther, who not only agreed to supervise my thesis, but also took their time to provide constructive and valuable feedback, which helped me to keep focused and to solve all emerging issues.

If you have comments or if any questions remain unanswered at the end, please do not hesitate to send me an e-mail:

simon@integrated-investing.com

Simon Weihofen
Wolfsburg, Germany
September 2015
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<tr>
<td>ARR</td>
<td>Accounting Rate of Return</td>
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<tr>
<td>BAFU</td>
<td>See FOEN</td>
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<tr>
<td>BAT</td>
<td>Best available technology</td>
</tr>
<tr>
<td>Capex</td>
<td>Capital expenditure</td>
</tr>
<tr>
<td>CHP</td>
<td>Combined Heat and Power Station</td>
</tr>
<tr>
<td>CML</td>
<td>Centrum voor Milieukunde Leiden</td>
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<td>CPI</td>
<td>Corruption Perception Index</td>
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<tr>
<td>CV</td>
<td>Compound Value</td>
</tr>
<tr>
<td>CVM</td>
<td>Contingent Valuation Method</td>
</tr>
<tr>
<td>EF</td>
<td>Ecological Footprint</td>
</tr>
<tr>
<td>EFANRW</td>
<td>Efficiency Agency of North Rhine Westphalia</td>
</tr>
<tr>
<td>ELU</td>
<td>Environmental Load Unit</td>
</tr>
<tr>
<td>EMA</td>
<td>Environmental Management Accounting</td>
</tr>
<tr>
<td>EMAS</td>
<td>European Eco-Management and Audit Scheme</td>
</tr>
<tr>
<td>ENPV</td>
<td>Ecological Net Present Value</td>
</tr>
<tr>
<td>EP</td>
<td>Eco-Point</td>
</tr>
<tr>
<td>eP&amp;L</td>
<td>Environmental Profit &amp; Loss Account</td>
</tr>
<tr>
<td>EPM</td>
<td>Eco-rational Path Method</td>
</tr>
<tr>
<td>EPP</td>
<td>Ecological Payback Period</td>
</tr>
<tr>
<td>EPS</td>
<td>Environmental Priority Strategies</td>
</tr>
<tr>
<td>EROI</td>
<td>Ecological Return on Investment</td>
</tr>
<tr>
<td>ESM</td>
<td>Ecological Scarcity Method</td>
</tr>
<tr>
<td>EU ETS</td>
<td>European Union Emissions Trading Scheme</td>
</tr>
<tr>
<td>EURIBOR</td>
<td>Euro Interbank Offered Rate</td>
</tr>
<tr>
<td>EVIL</td>
<td>Environmental Impact Load</td>
</tr>
<tr>
<td>FEM</td>
<td>German Federal Environment Ministry</td>
</tr>
<tr>
<td>FOEN</td>
<td>Swiss Federal Office for the Environment</td>
</tr>
<tr>
<td>ICV</td>
<td>Internationaler Controller Verein</td>
</tr>
<tr>
<td>IFAC</td>
<td>International Federation of Accountants</td>
</tr>
<tr>
<td>IPCC</td>
<td>Intergovernmental Panel on Climate Change</td>
</tr>
<tr>
<td>IRR</td>
<td>Internal Rate of Return</td>
</tr>
<tr>
<td>ISO</td>
<td>International Organization for Standardization</td>
</tr>
<tr>
<td>JIT</td>
<td>Just-in-Time</td>
</tr>
<tr>
<td>KEA</td>
<td>Cumulated Energy Demand</td>
</tr>
<tr>
<td>KPI</td>
<td>Key Performance Indicator</td>
</tr>
<tr>
<td>LCA</td>
<td>Life-cycle assessment</td>
</tr>
<tr>
<td>LCC</td>
<td>Life Cycle Costs</td>
</tr>
<tr>
<td>LIBOR</td>
<td>London Interbank Offered Rate</td>
</tr>
<tr>
<td>MADM</td>
<td>Multiple Attribute Decision-Making</td>
</tr>
<tr>
<td>MCS</td>
<td>Management Control System</td>
</tr>
<tr>
<td>MEJ</td>
<td>Ministry of the Environment Japan</td>
</tr>
<tr>
<td>MIPS</td>
<td>Material Intensity per Service Unit</td>
</tr>
<tr>
<td>MJ</td>
<td>Mega joule</td>
</tr>
<tr>
<td>N₂O</td>
<td>Nitrous oxide</td>
</tr>
<tr>
<td>NGO</td>
<td>Non-Governmental Organisation</td>
</tr>
<tr>
<td>Nm³</td>
<td>Norm cubic metre</td>
</tr>
<tr>
<td>NPV</td>
<td>Net Present Value</td>
</tr>
<tr>
<td>Abbreviation</td>
<td>Full Form</td>
</tr>
<tr>
<td>--------------</td>
<td>-----------------------------------------------</td>
</tr>
<tr>
<td>OEM</td>
<td>Original Equipment Manufacturer</td>
</tr>
<tr>
<td>Opex</td>
<td>Operational expenditure</td>
</tr>
<tr>
<td>PBP</td>
<td>Payback period</td>
</tr>
<tr>
<td>PDCA</td>
<td>Plan-Do-Check-Act</td>
</tr>
<tr>
<td>PFC</td>
<td>Perfluorocarbon</td>
</tr>
<tr>
<td>ROI</td>
<td>Return on Investment</td>
</tr>
<tr>
<td>SAR</td>
<td>Second Assessment Report</td>
</tr>
<tr>
<td>SPI</td>
<td>Sustainable Process Index</td>
</tr>
<tr>
<td>TCO</td>
<td>Total Cost of Ownership</td>
</tr>
<tr>
<td>TEEB</td>
<td>The Economics of Ecosystems and Biodiversity</td>
</tr>
<tr>
<td>UBA</td>
<td>German Environmental Protection Agency</td>
</tr>
<tr>
<td>UBS</td>
<td>Underbody sealant</td>
</tr>
<tr>
<td>UK</td>
<td>United Kingdom</td>
</tr>
<tr>
<td>USEPA</td>
<td>US Environmental Protection Agency</td>
</tr>
<tr>
<td>UVA</td>
<td>Utility Value Analysis</td>
</tr>
<tr>
<td>VDI</td>
<td>Association of German Engineers</td>
</tr>
<tr>
<td>VOC</td>
<td>Volatile Organic Compound</td>
</tr>
</tbody>
</table>
1. Introduction

Environmental management systems have experienced increased importance within companies to address public and legal environmental concerns. The aim of environmental management systems is to ensure legal compliance on the one hand and continuous improvement of environmental performance on the other hand (Förtsch and Meinholz, 2014). Due to its cross-sectional character, environmental management affects all parts of the organization. Besides managing environmental performance of existing business operations, environmental management systems also focus on business planning processes (Burschel, 2004).

Another cross-sectional system is the management accounting system. In contrast to financial accounting, which is concerned with external reporting of ex-post financial performance, management accounting intends to support ex-ante internal management decision-making processes. These decision-making processes comprise amongst others cost-benefit analyses, budgeting processes, cost allocation processes or investment appraisals. Hence, the management accounting system is also referred to as the internal accounting system. (Zimmermann, 2011)

The overlapping part of both systems deals with environmental issues in business planning processes. When building a new plant or replacing equipment, costs and benefits need to be forecasted to support the upcoming investment decision. In addition, these decisions have an impact on the environmental performance as well. This overlap of environmental information in form of physical flows with monetary information is referred to as environmental management accounting (IFAC, 2005).

However, the field of environmental management accounting is still young and environmental management accounting methods are currently under development (Faßbender-Wynands et al., 2009), leading to the subsequent problem situation of this thesis.

1.1. Problem situation

The strategic goals of a company are typically expressed in quantitative financial values (Hungenberg, 2012). Hence, target values in form of financial ratios or figures are formulated on company level and broken down to its organisational units. For instance, the targeted percentage of return on investment (ROI) is determined at ten percent as strategic goal. In this case, this strategic goal is broken down to the business units of a company. Therefore, the expected returns of competing investment objects are calculated and investment objects with a ROI below the targeted ten percent are excluded from further consideration. With this procedure, management accounting professionals ensure that investment decisions support achieving the targeted strategic financial goal.

Besides financial goals, companies increasingly start formulating strategic environmental goals (Burschel, 2004). Nonetheless, challenge remains regarding the achievement of these environmental goals (Liesen et al., 2013). This challenge originates from two sources, which is on the one hand the formulation of the environmental goals and on the other hand the management accounting system missing to support the achievement of these environmental goals.

Environmental goals are regularly expressed in a qualitative way. Nevertheless, to enable monitoring the achievement of strategic environmental objectives, the associated accounting ratios need to reflect the values of the strategic goals (Gladen, 2011). Hence, environmental goals need to be expressed in quantitative values.
Due to the qualitative expression of environmental goals, possible conflicts with quantitative financial goals remain intangible. This conflict mainly comprises the incomparability between qualitative and quantitative strategic goals. With the establishment of quantitative environmental goals, this subtle conflict turns tangible especially with environmental management measures that do not provide any profitability (Dyckhoff and Souren, 2008). As a consequence, the decision-maker becomes aware of the environmental impacts besides the already-known financial impacts in order to come to a comprehensive investment decision.

In addition, companies need a systematic integration of indicators or ratios in the decision-making processes that is analogous to achieving financial goals. Therefore, it is necessary to link physical environmental information with the underlying monetary information of investment decisions. This physical environmental information is tracked by the environmental management system. Hence, the environmental accounting system as overlapping system intends to provide such a comprehensive data base.

However, the systematic integration of environmental management information in management accounting processes such as investment appraisals remains a research gap (Herzig and Schaltegger, 2009). While academic literature discusses possible integrated environmental investment appraisal methods, none of these methods has established as accepted standard so far.

1.2. Research objective

Basing on the identified research gap in the previous subchapter, the first step of this thesis intends to assess methods dealing with the integration of environmental impacts in investment processes. This step further aims to perform a deficit analysis to identify reasons which have prevented these methods to establish as accepted standard in business. The concluding step reveals the development of a method based on the insights of the deficit analysis.

Hence, the research objective of this thesis is to develop a method to systematically integrate environmental impacts in investment decisions within companies (integrated investing method) and to verify its practical applicability. With the help of such an integrated investment decision, companies should be able to execute environmental management accounting to consequently achieve strategic environmental and financial goals. Therefore, the main research question is formulated as follows:

**Main research question:**

*How to integrate financial and environmental data in investment processes to achieve strategic environmental and financial goals of companies?*
1.3. Methodology

The methodology describes the way to solve the problem situation by achieving the research objective. However, to answer this research question, it is necessary to develop an integrated method that offers a sufficient degree of scientific quality on the one hand and is able to be applied in business practice on the other hand. Hence, the integrated investing method needs to meet requirements corresponding to theory and practice.

Regarding the theoretical development of the integrated investing method, the requirements originate from the outcome of the deficit analysis of existing methods. Additional requirements emerging from method development, as discussed in current academic literature, aim to ensure a sufficient degree of scientific quality. In conclusion, the first sub-research question is formulated as follows:

Sub-research question 1:
Which requirements does the integrated investing method need to meet in order to ensure a sufficient degree of scientific quality?

Besides requirements ensuring scientific quality, the other aim is to ensure successful practical application of the integrated investing method. In this context, current academic literature on method development reveals a set of additional requirements which the method needs to meet. Therefore, the second sub-research question is formulated as follows:

Sub-research question 2:
Which requirements does the integrated investing method need to meet in order to ensure its practical applicability?

After conducting the deficit analysis of currently existing methods and composing a set of requirements ensuring sufficient scientific quality and practical applicability, the concluding step comprises the method development. As already indicated in the introductory passage, the integrated method can be categorised in the field of environmental management accounting, which overlaps with management accounting and environmental management systems. Both systems provide methods that have already established as common accepted standard. Therefore, it is necessary to assess methods that might be able to serve as a basis of the concluding method development. To provide a suitable framework for this assessment, the previously developed set of requirements provides the basis of this method screening and evaluation. Hence, the third sub-research question is formulated as follows:

Sub-research question 3:
How well do additional methods from environmental management and management accounting systems meet the requirements to qualify as a basis for the development of the integrated investing method?

Besides the compliance with requirements ensuring scientific quality, the integrated investing method also needs to be applied in a real-life business context to verify its successful applicability in practice. Furthermore, the method application intends to verify whether the integrated investing method is able to support the strategic environmental goals of an existing company. Hence, the fourth sub-research question is formulated as follows:

Sub-research question 4:
Does the method application verify the practical applicability of the developed method and the ability to manage and control strategic environmental goals of an existing company?
Structure of this dissertation

To describe the current state of academic knowledge and business practice, it is necessary to deal with the main object of this thesis which is the investment process. Hence, the second chapter comprises an introduction into the investment process within companies as well as the most common conventional investment appraisal methods. The second part of this chapter discusses current methods aiming to integrate environmental impacts in investment decisions. The discussion intends to identify reasons for their immaturity in practical application with the help of a deficit analysis.

Based on the results of the deficit analysis and current academic literature on method development, a set of requirements, ensuring sufficient scientific quality on the one hand and practical applicability on the other hand, is intended to be developed in the third chapter. Thus, the first two sub-research questions are answered within the first part of the third chapter. Moreover, the third chapter aims to identify and evaluate additional methods which might serve as a basis for the development of the new integrated investing method. The result of the evaluation of the identified methods according to the requirements provides the answer to the third sub-research question. The final part of the third chapter intends to comprise the development of the new integrated investing method.

The result of the method development process is described in the fourth chapter containing the description of the new integrated investing method. This method description is structured along the previously identified main object of this dissertation in form of the investment process in companies.

After having developed the new integrated investing method, the fifth chapter intends to apply the method in real life business context in order to provide an answer to sub-research question four. Moreover, this method application chapter intends to verify the method’s practical applicability on the one hand and its ability to manage and control environmental goals of an existing company on the other hand.

Finally, the validity and reliability of the results are discussed in chapter six to finally provide the conclusion and recommendations for further research within the subsequent chapter. Within this last chapter, the main research question of this thesis is going to be answered as well.

The methodological structure of this dissertation is also illustrated in Figure 1.
Figure 1: Methodological structure of this dissertation

1. Introduction

1.1. Problem situation
1.2. Research objective
1.3. Methodology

2. State of current academic knowledge

2.1. Investment decisions in companies
2.2. Conventional investment appraisal methods
2.3. Modifications of conventional investment appraisal methods
2.4. Environmental impact assessment in companies
2.5. Deficit analysis

3. Method development

3.1. Determination of requirements
3.2. Method screening and evaluation
3.3. Method derivation
3.4. Summary and discussion

4. Method description

4.1. Defining a strategic environmental goal
4.2. Problem situation
4.3. Search for investment objects
4.4. Investment appraisal
4.5. Investment decision
4.6. Investment realisation
4.7. Investment controlling
4.8. Summary and discussion

5. Method application

5.1. Case study research design
5.2. Introduction to the Volkswagen Group and its investment process
5.3. Case study reports
5.4. Cross-case synthesis
5.5. Summary and discussion

6. Validity and reliability of results

7. Conclusions and recommendations

Source: Own illustration