



MEYER  
STIFTUNG

Monograph Series

**Tanja Schillinger**

**An accounting approach to create an  
environmentally sustainable company**

**Verlag Wissenschaft & Praxis**



An accounting approach to create an environmentally sustainable company

Monograph Series



Edited by  
Prof. Dr. Claus Meyer

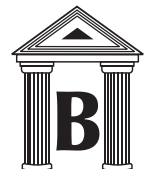
**Volume 18**

Tanja Schillinger

# **An accounting approach to create an environmentally sustainable company**

Selection and Definition of Environmental Indicators with special reference to Suppliers in Developing Countries

Verlag Wissenschaft & Praxis



**Bibliographic information published by the Deutsche Nationalbibliothek**

The Deutsche Nationalbibliothek lists this publication in the Deutsche Nationalbibliografie; detailed bibliographic data are available on the Internet at <http://dnb.dnb.de>.

ISBN 978-3-89673-722-9

© Verlag Wissenschaft & Praxis

Dr. Brauner GmbH 2016

Tel. +49 7045 93 00 93 Fax +49 7045 93 00 94

[verlagwp@t-online.de](mailto:verlagwp@t-online.de) [www.verlagwp.de](http://www.verlagwp.de)

All rights reserved

This work is copyrighted in its entirety. Any usage in violation of the narrow boundaries of copyright law without the prior approval of the publisher is prohibited and is punishable by law. This applies in particular to reproduction, translation, microfilming, or any other form of processing or transmission and to storage and processing in electronic systems.

Print and binding: Esser printSolutions GmbH, Bretten

## Foreword

The Claus und Brigitte Meyer-Stiftung awards the Thomas-Gulden-Preis for outstanding academic achievements in memory of the former student Thomas Gulden who died from an incurable disease at the age of 25.

The Thomas-Gulden-Preis was awarded for the first time in the summer semester 2005. In the winter semester 2015/16, the Meyer-Stiftung awarded Tanja Schillinger for her outstanding academic results in the programme Business Administration/ International Business and particularly for her excellent bachelor dissertation with the Thomas-Gulden-Preis. In particular worthy of emphasis is her long-term voluntary engagement in different fields, for instance her work as voluntary tutor at the Familienzentrum of the Pforzheimer Stadtmission, and her cooperation in different university institutions during her studies at Pforzheim University.

The Claus und Brigitte Meyer-Stiftung publishes the dissertations of the laureates in the MEYER STIFTUNG monograph series. The scientifically comprehensive and sound bachelor dissertation of Tanja Schillinger addresses the highly-complex issue „An accounting approach to create an environmentally sustainable company: Selection and Definition of Environmental Indicators with special reference to Suppliers in Developing Countries“. This scientifically challenging topic has been elaborated with great care and through an analysis of copious literature. The increasing importance of the environmental friendliness of companies as a part of the economy should be highlighted. Hence, this dissertation is particularly relevant and explores new scientific territory.

The Claus und Brigitte Meyer-Stiftung is pleased to publish this valuable contribution to business theory and practice as Volume 18 of the monograph series.

We would like to thank sincerely Ms. Neugebauer and Dr. Brauner at the publisher Wissenschaft & Praxis for their generous support in publishing the monograph series.

Stuttgart, April 2016

Prof. Dr. Claus Meyer



The Claus und Brigitte Meyer-Stiftung is a legally responsible and charitable foundation constituted under civil law based in Stuttgart, being approved as foundation by the administrative authority in Stuttgart on 21 April 2005. The purpose of the foundation is realized in promoting science and research, education and development as well as funding support of students in need at Pforzheim University, particularly by:

- Awarding the Thomas-Gulden-Preis for outstanding academic results and/or an excellent bachelor/master thesis in the area of Business, in particular Controlling, Finance and Accounting to one or several students.
- Awarding grants and similar support to students, particularly to those in need, to be able to continue and successfully accomplish their studies.

Thomas Gulden was born on 15 March 1978. He studied Business/Controlling, Finance and Accounting at Pforzheim University and completed his studies with a “very good” overall grade. Due to a congenital and developing myopathy, Thomas Gulden was confined to a wheelchair since the age of ten. On 11 April 2003, he died from this disease of which course he was aware. Posthumously, Thomas Gulden was awarded with an advancement award for his excellent diploma thesis, graded with a mark of 1.0. According to his wish, humanitarian organizations were supported with this award and his entire fortune.

---

## **Claus und Brigitte Meyer-Stiftung**

### **Managing Director:**

Professor Dr. Claus Meyer

Bernsteinstr. 102

70619 Stuttgart

Phone: 0711/4411488

E-Mail: [claus.meyer@meyer-stiftung.de](mailto:claus.meyer@meyer-stiftung.de)

### **Commercial Management:**

Kathrin Zauner

Schulstr. 24

75385 Bad Teinach-Zavelstein

Phone: 07053/1432

E-Mail: [sekretariat@meyer-stiftung.de](mailto:sekretariat@meyer-stiftung.de)

### **Bank details:**

Sparkasse Pforzheim Calw

Account: 7670230

BLZ: 666 500 85

IBAN: DE 62 6665 0085 0007 6702 30

### **Website:**

[www.meyer-stiftung.de](http://www.meyer-stiftung.de)





## Preface

This present paper was written as bachelor dissertation to gain admission to Bachelor of Science degree in the programme Business Administration/International Business at Pforzheim University. The thesis was submitted 30 July 2015 and comprises the corresponding knowledge on the subject at that time.

I would like to thank my supervisor Professor Dr. Joachim Paul for his support and advice. Thanks also go to Professor Dr. Harald Strotmann as my second marker. Their feedback and stimulating questions helped me to continuously find ways to improve my work.

A very special word of thanks goes to Prof. Dr. Claus Meyer, his wife Brigitte Meyer and the MEYER STIFTUNG for supporting me and publishing my academic work.

I dedicate this work to my family, in particular to my parents, Monika and Hans Schillinger, which have supported and accompanied me through my whole life. I would also like to thank my friends Michael, Daniel, Katrin, Stefanie and Anja. Their support as well as their useful feedback made my work what it is today.

Munich, April 2016

Tanja Schillinger



# Table of Contents

<b>List of Abbreviations.....</b>	<b>15</b>
<b>List of Figures .....</b>	<b>17</b>
<b>List of Indicators .....</b>	<b>19</b>
<b>1 Introduction.....</b>	<b>25</b>
1.1 Problem Definition and Purpose .....	25
1.2 Delimitation and Research Approach.....	26
<b>2 Sustainability.....</b>	<b>29</b>
2.1 Definition and Differentiation .....	29
2.2 State of Corporate Sustainability.....	30
2.3 Shareholder Value vs Stakeholder Approach.....	32
2.4 Triple-Bottom-Line.....	32
2.5 Benefits .....	33
<b>3 Status quo in Developing Countries .....</b>	<b>35</b>
3.1 (Environmental) Sustainability Awareness.....	35
3.2 (Environmental) Sustainable Practices.....	36
3.3 Important Considerations for the Control of DC Suppliers.....	37
<b>4 Issues Caused by Unsustainable Behaviour and Unsustainable Business Practices .....</b>	<b>39</b>
4.1 Underlying Thoughts .....	39
4.2 Environmental Issues .....	40
4.3 Drivers and Economic Issues .....	41
4.4 Other Issues.....	43
<b>5 Introduction to Environmental Accounting and Indicators.....</b>	<b>45</b>
5.1 Conventional (Management) Accounting .....	45
5.1.1 Classification and Tasks.....	45
5.1.2 Indicators .....	46
5.1.2.1 Term and General Information.....	46

5.1.2.2	Categories of Indicators .....	49
5.1.3	Indicator Systems .....	49
5.2	Environmental (Management) Accounting .....	50
5.3	Environmental Performance Evaluation – ISO 14031.....	52
5.4	Towards Environmental Indicators .....	54
5.4.1	General Information .....	54
5.4.2	Possible Challenges .....	55
5.4.3	Selection and Selection Criteria .....	56
<b>6</b>	<b>Definition of the Selected Environmental Indicators along the Whole Value Chain.....</b>	<b>59</b>
6.1	Environmental Supply Chain Management and Life Cycle Assessment .....	59
6.2	Porter’s Value Chain and its Adaptation.....	61
6.3	Structure and Categorization .....	63
6.4	Specific Divisional Environmental Indicators .....	64
6.4.1	Important Remarks .....	64
6.4.2	Inbound Logistics and Procurement with special reference to DC Suppliers.....	66
6.4.2.1	Supplier Management and Environmentally Conscious Purchasing.....	66
6.4.2.2	Conceptual Delimitation and Research Approach.....	68
6.4.2.3	Selecting and Monitoring Suppliers with the Help of Indicators.....	69
6.4.2.4	Procurement and Inbound Logistics .....	84
6.4.3	Technology Development: Product Design .....	85
6.4.4	Firm Infrastructure.....	87
6.4.5	Human Resource Management .....	90
6.4.6	Operations.....	92
6.4.7	Outbound Logistics .....	105
6.4.8	Marketing, Sales and Service .....	107
6.5	Corporate Environmental Indicators (KEIs) .....	110
6.6	Overall Environmental Indicator .....	117

---

<b>7</b>	<b>Integration of Indicators into an Exemplary Framework for Implementation and Application: The ‘Environmental Tree-Model’.....</b>	<b>121</b>
<b>8</b>	<b>Conclusion .....</b>	<b>125</b>
8.1	Critical Evaluation and Limitations .....	125
8.2	Opportunities and Outlook .....	128
	<b>Appendices .....</b>	<b>131</b>
Appendix 1:	Geographic Distribution of Sustainability Science Publications.....	131
Appendix 2:	Overall Increase in Publications on Corporate Sustainability .....	131
Appendix 3:	Value Creation with the Help of Sustainability .....	132
Appendix 4:	Four Approaches to Environmental Accounting .....	132
Appendix 5:	Different Categories of Environmental Accounting.....	133
Appendix 6:	The Value System.....	133
Appendix 7:	Porter’s Generic Value Chain.....	134
Appendix 8:	Overview of a Company’s Processes and Operations .....	134
Appendix 9:	Operations of an Organization.....	135
Appendix 10:	Inputs and Outputs of Manufacturing .....	135
Appendix 11:	Conversion Table .....	136
Appendix 12:	Conversion into Gigajoules .....	137
Appendix 13:	The 3 Emission Scopes .....	137
Appendix 14:	EcoMetrics of Interface .....	138
Appendix 15:	The Original ‘Environmental Tree-Model’ .....	142
	<b>References .....</b>	<b>143</b>
	<b>Alphabetical Index .....</b>	<b>181</b>



---

## List of Abbreviations

AHP	Analytical Hierarchy Process
BSC	Balanced Scorecard
BU	Business unit
CF	Carbon Footprint
CO <sub>2</sub>	Carbon dioxide
DC	Developing country
DEA	Data Envelopment Analysis
ECI	Environmental Condition Indicator
ECP	Environmentally conscious purchasing
EF	Ecological Footprint
EHS	Environment, Health, Safety
EMA	Environmental Management Accounting
EMI	Environmental Management Indicator
EMS	Environmental Management System
EPA	Environmental Protection Agency
EPE	Environmental Performance Evaluation
EPI	Environmental Performance Indicator
ESCM	Environmental Supply Chain Management
EU	European Union
EuP	Energy-using Products
FA	Financial Accounting
FTE	Full-time equivalent
GDP	Gross domestic product
GHG	Greenhouse Gas
GJ	Gigajoule
GRI	Global Reporting Initiative
GSC	Green Supply Chain
GSCM	Green Supply Chain Management
HAP	Hazardous air pollutants
HRM	Human Resource Management
i.a.	Inter alia
ICSB	International Corporate Sustainability Barometer
IFAC	International Federation of Accountants
Incl.	Including
ISO	International Organization for Standardization
KE(P)I	Key Environmental (Performance) Indicator
KPI	Key Performance Indicator
LCA	Life Cycle Assessment



m <sup>2</sup>	Square metre
m <sup>3</sup>	Cubic metre
MA	Management Accounting
MEMA	Monetary Environmental Management Accounting
MF	Material Footprint
MPI	Management Performance Indicator
mt	Metric ton
mt of CO <sub>2</sub> e	Metric tons of CO <sub>2</sub> equivalent
NGO	Non-governmental organization
ODS	Ozone-depleting substances
OECD	Organization for Economic Co-operation and Development
OPI	Operational Performance Indicator
PEMA	Physical Environmental Management Accounting
P&G	Procter & Gamble
PM	Particulate matter
POP	Persistent organic pollutants
QM	Quality Management
R&D	Research and development
RL	Reverse logistics
RoHS	Restriction of Hazardous Substances
ROI	Return on Investment
SC	Supply Chain
SCM	Supply Chain Management
SD	Sustainable development
SME	Small and medium-sized enterprise
TBL	Triple-Bottom-Line
tkm/ton-km	Ton-kilometre
UN	United Nations
VOC	Volatile organic compounds
WBCSD	World Business Council for Sustainable Development
WCED	World Commission on Environment and Development
WEEE	Waste of Electrical and Electronic Equipment
WF	Water Footprint
WRI	World Resources Institute

## List of Figures

Fig. 1: Modification of Porter's Value Chain .....	63
Fig. 2: Calculating the Supplier Environmental Sustainability Index (Step 1) .....	114
Fig. 3: Calculating the Supplier Environmental Sustainability Index (Step 2) .....	115
Fig. 4: An Example of a Hot Spot Analysis Matrix .....	121
Fig. 5: The 'Environmental Tree-Model' .....	123



## List of Indicators

This list shall give an overview of all selected indicators defined in chapter 6 by arranging them according to their respective value chain stage.

### **Inbound Logistics and Procurement (DC Suppliers) – Core Measures**

#### Energy

*(Electric) Energy Consumption and Intensity* ..... 70

*(Fuel) Energy Consumption and Intensity* ..... 71

#### Water

*(Input / Withdrawal) Water Usage and Intensity* ..... 72

*(Output / Discharge) Water Usage / Waste Water and Intensity* ..... 72

#### Material

*(Raw) Material Consumption and Intensity* ..... 73

#### Waste

*Hazardous Waste (Disposal) and Intensity* ..... 74

*Non-Hazardous Waste (Disposal) and Intensity* ..... 75

#### Emissions

*Direct Greenhouse Gas Emissions (Scope 1) and Intensity* ..... 76

*Electricity Indirect Greenhouse Gas Emissions (Scope 2) and Intensity* ..... 77

#### Costs

*Environmental Costs (Pollutant Effects)* ..... 78

*Environmental Costs (Improvement)* ..... 78

*Relative Environmental Spending* ..... 78

#### Optional Measures

*Renewable Energy (Total Consumption / Intensity / Relative Consumption)* ..... 80

*Recycling (Total Amount / Recycling Rate)* ..... 80

*Other Indirect GHG Emissions (Scope 3) and Intensity* ..... 80

*Transportation Fuel Efficiency* ..... 80

*Fines and Sanctions* ..... 80

Procurement and Inbound Logistics (others than supplier indicators)

*Material Shares* ..... 84

**Technology Development: Product Design**

Product Design

*Percent of Products Designed for Disassembly, Reuse or Recycling* ..... 86

Investment in Environmental Innovation

*Total R&D Costs for Environmental Innovation* ..... 86

*Percent of Investment in Environmental Innovation* ..... 86

**Firm Infrastructure**

Quality and General Management

*Total Number of Certificates* ..... 87

*Total Number of Eco-Labels* ..... 87

*Degree of Target Attainment* ..... 87

General Management and Finance

*Total Environmental Protection Investment and by Type* ..... 88

*Fines and Sanctions* ..... 88

*Total Amount of Savings through Environmental Practices* ..... 88

**Human Resource Management**

*Average Number of Hours of Environmental Training per Year* ..... 91

*Percent Trained Staff (Employees and Managers)* ..... 91

*Share of Environmental Trainings* ..... 91

*Total Number of Environmental Suggestions by Employees* ..... 91

*Employee Suggestion Rate* ..... 91

*Share of Environmental Suggestions* ..... 91

## Operations

### Energy

<i>Total Energy Consumption for Production</i> .....	94
<i>Source of Energy Rate</i> .....	94
<i>Renewable Energy Rate</i> .....	94
<i>Energy Intensity</i> .....	94

### Water

<i>Total Water Withdrawal for Production</i> .....	96
<i>Total Water Discharge / Waste Water from Production</i> .....	96
<i>Volume Fraction of Water Type</i> .....	96
<i>Reused and Recycled Water Fraction</i> .....	96
<i>Water Intensity</i> .....	96
<i>Waste Water Intensity</i> .....	96

### Material

<i>Total Materials Used</i> .....	98
<i>Total Packaging Mass</i> .....	98
<i>Mass Fraction of Material Type</i> .....	98
<i>Material Intensity</i> .....	98
<i>Mass Fraction of Products from different Material Types (Optional)</i> .....	98
<i>Packaging Mass Fraction of Products (Optional)</i> .....	98
<i>Mass Fraction of Reusable Packaging (Optional)</i> .....	98

### Waste

<i>Total Weight of Residuals</i> .....	101
<i>Total Weight of Hazardous Waste and Non-Hazardous Waste</i> .....	101
<i>Total Weight of Waste for Recycling and Disposal</i> .....	101
<i>Waste Intensity</i> .....	101
<i>Recycling Rate</i> .....	101

### Emissions

<i>Total Amount of Emissions</i> .....	103
<i>Emissions Intensity</i> .....	103

**Biodiversity: Land - Optional**

*Total Surface of Facilities in or close to Protected and High Biodiversity Areas*..... 104

*Natural Cover*..... 104

**Outbound Logistics****Transportation**

*Traffic Volume per Transport Mode* ..... 106

*Share of Transport Mode* ..... 106

*Transport Intensity* ..... 106

*Total Energy Consumption of Vehicles*..... 106

*Share of Environmentally Friendly Vehicles*..... 106

*Total Emissions* ..... 106

**Marketing, Sales and Service****Marketing & Sales**

*Total Number of Press Reports on Firm's Environmental Performance*..... 108

*Share of Positive Reports* ..... 108

*Share of Green Customers* ..... 108

**Reverse Logistics - Service**

*Share of Products with Take-back Policies*..... 109

*Share of Reclaimed Products and Packaging Materials*..... 109

**Corporate Environmental Indicators (KEIs)**

<i>Energy Consumption</i> .....	111
<i>Water Withdrawal</i> .....	111
<i>Water Discharge</i> .....	111
<i>Material Consumption</i> .....	112
<i>Waste Production</i> .....	112
<i>GHG Emissions</i> .....	112
<i>Environmental Costs and Fines</i> .....	113
<i>Total Savings</i> .....	113
<i>Share of Trained Staff</i> .....	113
<i>Share of Green Customers</i> .....	113
<i>Supply Chain Traffic Volume</i> .....	113
<i>Supplier Environmental Sustainability Index</i> .....	114
<i>Degree of Target Attainment</i> .....	116





---

# 1 Introduction

## 1.1 Problem Definition and Purpose

*“As we watch the sun go down, evening after evening, through the smog across the poisoned waters of our native Earth, we must ask ourselves seriously whether we really wish some future universal historian on another planet to say about us: ‘With all their genius and with all their skill, they ran out of foresight and air and food and water and ideas’”* – U Thant<sup>1</sup>

Environmental issues have become ubiquitous, and so has the term sustainability.<sup>2</sup> A plethora of policies, companies, customers, investors, NGOs, and societies discuss sustainability; but talking and acting are two entirely different realms. The corporate sector, as one of the main polluters, bears a special responsibility to behave and act sustainably.<sup>3</sup> Many firms state that they care about sustainability.<sup>4</sup> However, sustainability is often not actually implemented into the company’s culture and actions, but may represent a tool for looking good to the outside. In order to truly ingrain sustainability, there is a need to have specific internal instruments that track the firm’s environmental performance.<sup>5</sup> This is where indicators come into the picture – more precisely environmental indicators. These are useful tools which may be applied by the accounting function in a firm in order to track its environmental performance and to support the decision-making of the management. However, in order to be useful they first have to be accepted and implemented, and unfortunately up until now, environmental accounting still seems to be rather an unpopular outsider in accounting.

To support the development towards the implementation of environmental aspects into accounting, this paper seeks to provide practical advice for German companies by selecting and defining a set of environmental indicators. The aim is to provide applicable and well-defined environmental indicators that address the most important global environmental issues, and that are assigned to the different value chain stages of a firm and beyond. This will be achieved, by also assigning indicators to the firm’s suppliers, especially those suppliers from developing countries, as well as offering corporate environmental indicators.

---

<sup>1</sup> The U Thant Institute (URL).

<sup>2</sup> See chapter 4 and 2, incl. following sentence.

<sup>3</sup> See Hawken (1996), p. 37; Herva (2011), p. 1687; Azapagic (2000), p. 243.

<sup>4</sup> See section 2.2, incl. following sentence.

<sup>5</sup> See chapter 5, incl. following sentences.

## 1.2 Delimitation and Research Approach

Great effort has been made to find measures, indicators and approaches towards sustainability.<sup>6</sup> It has started with the discussion, research and implementation of such means on a global, national and local sphere.<sup>7</sup> Yet, it has been recognized that it is impossible to go this journey towards sustainability without involving one of the main obstacles towards a sustainable world – the corporations.<sup>8</sup>

This present paper will therefore concentrate on the environmental aspect of sustainability from a corporate perspective; by providing generic environmental indicators<sup>9</sup>, suitable for all kinds and sizes of companies in Germany. A special focus will lie on their developing country suppliers as they have become increasingly important to the supply chain and the paper seeks to encourage environmental sustainability in the entire chain. To be able to understand sustainability, and consequently the environmental indicators' true usefulness, application and relevance, the paper will first try to give a comprehensive overview of all three relevant thematic aspects: (environmental) sustainability, accounting and environmental accounting.

Therefore, the second chapter will present theoretical foundations concerning sustainability and related issues. As developing countries should be understood well before implementing corresponding indicators, their current awareness and practices of sustainability will be described in chapter 3. In order to understand the urgent need for change, chapter 4 will present current issues caused by unsustainable behaviour and actions with focus on businesses. Chapter 5 will finally present the last important theoretical basis for this paper by explaining important aspects of conventional and environmental accounting with special reference to indicators in the context of Germany.

In allusion to this, chapter 6 will clarify the significance of a holistic view concerning the creation of an environmentally sustainable company, and refer to Porter's value chain, which provides the basis for the selection and definition of the environmental indicators along this value chain with special reference to suppliers in developing countries. The selection approach is based on a comprehensive literature review, looking for the indicators most prevalent in theory and practice, that cover all important global issues, as well as on specific selection criteria. This chapter will

---

<sup>6</sup> See Kates (2015), p. 802; chapter 5 and 6.

<sup>7</sup> See Hahn (2006), p. 2; Hallay (1992), p. 17; Gallopín (1997), p. 13; Liverman (1988), p. 133; Atkinson (2000), p. 235; UNDP (2012), p. 7; for environmental indicators for the macro level see i.a. Wiedmann (2010); Bell (2008), pp. 29-40, 45ff; Wilson (2007); Hoekstra (2006); Wiedmann (2013).

<sup>8</sup> See Hawken (1996), p. 37; Wolters (2002), p. 231; Azapagic (2000), p. 244.

<sup>9</sup> Some indicators which deal for example with environmental costs, fines, investments and savings will also be provided. Some may perceive them as economic indicators, others as environmental indicators. In this paper they will be considered as environmental indicators (EMIs); see subsection 5.4.1; section 6.3.

conclude by offering not only specific divisional environmental indicators for each value chain stage but also presenting possible corporate environmental indicators most relevant for the management. Finally, it will give a brief introduction into the topic of an overall environmental indicator by demonstrating present issues associated with such measures, some opportunities and methodologies to derive a suitable indicator. Chapter 7 serves, on the one hand, as a summary of all selected indicators, and on the other hand, will deal with different models and frameworks to facilitate the implementation of the indicators. The 'Environmental Tree-Model' being proposed by the author. The last chapter closes with a critical evaluation and limitations concerning this work, as well as with opportunities and future prospects.