Circular Economy: The Next Level of Company Success

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Editors

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A Comprehensive Study on How to Create Value and Improve Operational Excellence Through Circularity

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Preface

Circular Economy (CE) is gaining significant momentum in businesses. Initially, this was motivated by environmental concerns, particularly those related to CO_2 emissions. Recently, there has been a noticeable shift in customer opinions towards environmentally responsible products. This will be a major differentiation factor for companies, further strengthened by evolving regulatory frameworks and requirements. In addition, the scope of CE initiatives has expanded to also include further effects such as resource scarcity and supply chain instability. Furthermore, it has been observed that CE initiatives can result in cost savings for companies and have great potential for innovation.

Contrasting sharply with the prevailing Linear Economy (LE) take–make–dispose approach, CE is shifting the aim towards the use and repeated use of resources in closed loops. This paradigm shift is prompting a fundamental rethinking of our approach to material usage.

We ask ourselves: What must companies do to align with this new way of thinking? Conversations within our group of colleagues and with students revealed that the topic CE needs a deep understanding of potential concepts, as well as a nuanced exploration of feasibility and implementation approaches.

Over the course of two years and more, 20 students and research assistants participated in our research at different stages. The dialogue with our fellow professors and experts at the Eastern Switzerland University of Applied Sciences (OST) further enriched our understanding, bringing diverse perspectives to the challenges of the different approaches.

On top of a comprehensive review of the literature, we collected insights from more than 500 companies on their view on CE and their current implementation status. Additional in-depth case studies provided detailed information on companies and their obstacles to implement CE specifically. We summarise our learning in the Rapperswil Circular Economy Model to guide companies on the path to circularity.

Our research clearly showed that integration of CE is a must for every company. Naturally, not all concepts are similarly relevant and the depth of implementation will vary greatly depending on the nature of the business and its value chain.

Our book not only intends for practice but also adds to the academic discussion of CE. It also helps to establish a solid foundation in our different lectures, where CE has become an integral part.

This book would not have been possible without the work and commitment of many people. We thank the students in the 2021 master class who started the journey of circular economy research in practice with us. They are listed alphabetically: Giuliano Bernard, Morena DiSilvestre, Samuel Folini, Patrick Looser, Sylvan Mächler, Fabio Marti, Odin Peter, Mladen Petraskovic, Mauro Ramirez, Mathilde Schäfer, Philipp Thomann and Raphael Welter. Not all of the above students decided to participate as authors in this book, but their first insights were valuable, and their investigations set the pace for this book.

What is science without colleagues who challenge ideas and provide support where necessary? Therefore, we want to thank our colleagues who were always eager to explore innovative concepts and who supported the students in their first research on CE, namely Prof. Dr. Daniel Keller, Prof. Dr. Daniel Politze, Prof. Dr. Felix Nyffenegger and Prof. Dr. Rainer Bunge.

The second year of master students, who engaged in the case studies, walked the extra mile to become the first authors in the chapters of Part II of this book. Their names can be found in the book, but we especially want to thank them for their commitment and enthusiasm: Nico Bleisch, Denis Hammer, Yannik Keller, Raphael Meyer, Roger Rinderer, Raffael Römer and Reto Weber.

We also express our gratitude to the dedicated team of scientific assistants of the Institute of Product Development and Design (IPEK) at OST who played a pivotal role in the realisation of this book. Their unwavering commitment to excellence, meticulous organisation of inputs, growing expertise with LaTeX and thorough proofreading significantly contributed to the quality and coherence of the final manuscript. A special thanks goes to the research assistant Nicolas Hofer, whose tireless efforts in gathering and organising data during his Master's Thesis, as well as his attention to detail, ensured the accuracy of the scientific content. His commitment to this book and to the topic of CE is truly exceptional.

Two more contributors spontaneously agreed to add their expertise to make our discoveries more useful in practice: Prof. Daniel Schwendemann from OST and Prof. Dr. Ramesh Subramoniam from the University of Texas at Dallas (UTD), who undoubtedly enhanced the overall depth and credibility of this work.

In addition to the professional support received, we are grateful to our friends and family for their patience and support during the writing and editing process. Their understanding and encouragement has played an invaluable role in the realisation of this book.

Rapperswil, Switzerland
December 2024

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Katharina Luban
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About This Book

Without any doubt, the current prevailing Linear Economy principle of take-make-dispose is inherently unsustainable: Raw materials are extracted, transformed into products, and discarded as waste after use. The resulting environmental and economic challenges brought together both practitioners and academics to develop more sustainable methods for production and consumption. Especially the concept of Circular Economy has received a lot of attention. But despite many technical solutions, a key question for practical implementation has remained unanswered until now: How can enterprises integrate Circular Economy into their business strategy to leverage success?

This book examines the topic of Circular Economy in an entrepreneurial context. It describes ten options for companies to retain value and identifies drivers and enablers for implementing Circular Economy in businesses.

A survey among more than 500 industry experts revealed the extent to which retention options were implemented in practice. For the first time, relevant drivers and enablers for each retention option were identified. On top of this, case studies of successful circular market offerings shed light on each retention option in detail.

The knowledge gained from research and the further shared experiences of experts that contributed to this book result in a 6-step management model. This model provides guidance on how to implement Circular Economy in organisations as an element of operational excellence and as a source of product, service, and business innovation. Now, every enterprise can start the journey!

As the survey and the cases show: Circular Economy is a promising way to the next level of company success. The book at hand will help organisations to develop their own individual approach that matches their business model. In short, you will find:

- First comprehensive analysis of 10 retention options, their drivers, and enablers.
- Survey of more than 500 companies and in-depth case studies for each retention option.
- Practical research-based implementation model for companies.

Contents

About the Editors

Prof. André Podleisek is a specialist in Sustainability and Quality in Industry. His enthusiasm for environmental protection and Circular Economy began when he studied 20 years ago. Since then, he has been employed by global industrial companies as a Sustainability Officer, where he has changed their way of doing business to incorporate Circular Economy. Recently, he joined the university to pass on his practical sustainability knowledge to the next generation of industrial engineers.

Prof. Dr. Katharina Luban is a distinguished expert in the field of Supply Chain Management. She dedicates her professional endeavours to pioneering modern, technology-driven solutions that enhance logistics operations, procurement activities and product cost. A focal point of her research, teaching and consulting efforts lies in embracing Circular Economy principles, which play a pivotal role in fortifying supply chains for long-term resilience in the ever-evolving landscape of the future.

Prof. Dr. Roman Hänggi is an expert in Production Management, having accrued 25 years of experience in the industry at all levels of hierarchy. His passion for the ongoing development of lean in the digital age continues to motivate him today. He assisted numerous industrial companies in their journey to become operational champions through the combination of lean and digitalisation. His expertise has enabled him to incorporate Circular Economy into the operational excellence path in both practice and research.

Acronyms

AHP	Analytic Hierarchy Process
AI	Artificial Intelligence
ANSI	American National Standards Institute
AR	Augmented Reality
B2B	Business-to-Business
B2C	Business-to-Consumer
BIM	Building Information Modelling
BPA	Bisphenol-A
BPF	Business Performance Factors
C2C	Consumer-to-Consumer
CCU	Carbon Capture Utilisation
CE	Circular Economy
CEBM	Circular Economy Business Models
CHF	Swiss Francs
CLSC	Closed-Loop Supply Chains
cobot	Collaborative Robots
CSR	Corporate Social Responsibility
EEE	Electrical and Electronic Equipment
EIP	Environmental Impact Points
EOL	End-of-Life
EPA	Environmental Protection Agency
EPR	Extended Producer Responsibility
ERP	Enterprise Resource Planning
ESG	Environment, Social and Governance
EU	European Union
EUR	Euro
GBP	Great Britain Pound
GDP	Gross Domestic Product
GWP	Global Warming Potential
I4.0	Industry 4.0
IAM	Independent Aftermarket

IoMT	Internet of Manufacturing Things
IoT	Internet of Things
IPEK	Institute of Product Development, Industrial Engineering and Product Lifecycle Management
IWK	Institute for Materials Science and Plastics Processing
KPI	Key Performance Indicators
LCA	Life Cycle Assessment
LE	Linear Economy
LED	Light-Emitting Diode
LIB	Lithium-Ion Battery
LO	Lista Office
MCP	Manufacturers of Convenience Products
MDP	Manufacturers of Durable Products
MNP	Manufacturers of Non-durable Products
MPC	Manufacturers of Parts and Components
NFC	Near-Field Communication
OE	Original Equipment
OE-CE	Operational Excellence Circularity
OEM	Original Equipment Manufacturer
OES	Original Equipment Service
OST	Eastern Switzerland University of Applied Sciences
PA	Impact Assessment
PaaS	Product as a Service
PAH	Polycyclic Aromatic Hydrocarbons
PBT	Polybutylene Terephthalate
PE	Polyethylene
PET	Polyethylene Terephthalate
PLA	Polylactic acid
PLC	Product Lifecycle
PLM	Product Lifecycle Management
PM-CE	Product/Service/Business Model Innovation Circularity
POM	Poly-Oxy-Methylene
PP	Polypropylene
PRV	Pressure Regulating Valve
PSS	Product Service System
PVC	Polyvinylchloride
R	Retention Option
R0	Refuse
R1	Reduce
R2	Reuse
R3	Repair
R4	Refurbish
R5	Remanufacture
R6	Repurpose
R7	Recycle

R8	Recover
R9	Remine
RA	Reclaimed Asphalt
RAP	Recycled Asphalt Pavements
RFID	Radio Frequency Identification
RIC	Remanufacturing Industries Council
RIME	Repair and Installation of Machinery and Equipment
RL	Reverse Logistics
ROI	Return on Investment
RQ	Research Question
rTPU	Recycled Thermoplastic polyurethane
RW	Retail and Wholesale
SBB	Swiss Federal Railways
SDG	Sustainable Development Goal
SME	Small and Medium-sized Enterprises
SPLM	Smart Product Lifecycle Management
SVC	Service Industry
TA	Time Assessment
TCO	Total Cost of Ownership
TPE	Thermoplastic elastomer
TRA	Theory of Reasoned Action
UNEP	United Nations Environmental Programme
USD	US Dollar
UTD	University of Texas at Dallas
VR	Virtual Reality
WEEE	Waste from Electrical and Electronic Equipment
WERZ	Institut für Wissen, Energie und Rohstoffe Zug
WTB	Wind Turbine Blade
WWF	World Wide Fund for Nature

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