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Book Review

100 Pioneers in Efficient Resource Management: Best practice cases from producing companies, Book Review of: "100 Pioneers in Efficient Resource Management: Best Practice Cases from Producing Companies" M. Schmidt, H. Spieth, C. Haubach, C. Kühne Springer (2018). 530 pp ISBN: 978-3-662-56744-9 (hardcover); ISBN: 978-3-662-56745-6 (e-book)

1. About the authors

Dr Mario Schmidt is professor at Pforzheim University, Germany, and director of their Institute for Industrial Ecology. Dr. Christian Haubach is a research fellow at the same institute. Dr. Hannes Spieth is director of the State Agency for Environmental Technology and Resource Efficiency. Dr. Christian Kühne works at the Ministry of Environmental Affairs of Baden Württemberg state.

2. General reflections

Sustainable development (SD) of producing companies is a central and frequently discussed topic. Following past and many recent discussions of SD of producing companies, energy efficiency is the most frequently considered aspect. This perspective derives from a traditional approach to SD focused upon increased energy efficiency. The book "100 Pioneers in Efficient Resource Management: Best Practice Cases from Producing Companies" was co-authored by Mario Schmidt, Hannes Spieth, Christian Haubach and Christian Kuehne, follows a completely different path.

In their book, which represents the outcome of an empirical study among 100 producing companies located in Baden Wuerttemberg State, in the South West of Germany, the authors documented, that instead of *only focusing upon making improvements* in energy efficiency it is important to focus more holistically upon efficient use of material resources in the production processes. Comparing the costs of manufacturing industries, the costs of materials are twenty times higher than energy costs (DSTATIS, 2019). Even if the current energy prices are still too low and do not internalize all of the externalized costs, it is important to study production systems, more holistically.

The book and the research upon which it is based, are unique. The title already expresses that the impressing number of 100 case studies all refer to pioneers in efficient resource management. The authors well describe the 100 cases of companies, which represent different industrial branches and sizes, and how those companies dealt with the challenges of improving resource use efficiency, holistically. The main contributions can be seen in raising the topic of resource efficiency and prove its importance and potential from a statistical viewpoint and from a case based view. Particularly the diversity and concreteness of the case descriptions should be seen as a main contribution. It can be seen as one of rather view books that are able to facilitate a discourse between academics, practitioners and politicians.

3. Research context and logic

The context of this research is exceptional. To obtain insight into this book, its origins are important. The 100 companies are located in Baden Wuerttemberg state in Germany. The research therefore, represents a region which is characterized by high innovativeness with a focus on production. Approximately, 35% of the GDP of this German state is from producing industries. Traditionally, Baden Wuerttemberg state has been among the top innovation regions within Europe and compares with the top regions worldwide. It is the state of socially responsible entrepreneurship and well-known scientists and innovators. An analysis of this early form of corporate social responsibility in that region was performed by Max Weber in 1909. Well known scientists such as Albert Einstein, Robert Bosch, Carl Benz or Gottlieb Daimler were from this region. The diversity of this study is unique and represents the industrial structure of the region.

In Baden Wuerttemberg, there is still a strong emphasis on manufacturing and engineering, however in different fields and with a high degree of interplay among branches and suppliers. High technology is not only concentrated in urban areas but can be found throughout the state, even in small villages where small and medium size enterprises (SMEs), also known as "Mittelstand", are located.

The 100 Case examples stem from process industries, commodity producers, energy suppliers, parts or finished goods manufacturers and the recycling industry. They produce consumer goods as well as industrial ones. The industrial sectors represented among the cases include: chemical, pharmaceutical, automotive, metal, and electronics industry.

The selection of the companies to be involved in the research were based upon this logic: ***"Who can provide an example for contributing to efficient material management independent from type of industry and company size?"*** Using that as a key selection criterion, well-known multinationals such as Porsche, Daimler or Bosch were selected but also companies that were completely unknown SMEs are among the 100 highlighted in this book. This very broad perspective offers a huge variety of insights and thematic foci. The cases dramatically document the diversity of ways by which improvements in resource efficiency can be achieved.

Furthermore, the book is an excellent example of ways research, technology transfer, industry and politics can fruitfully work together. This research was funded by the state government, which is currently a coalition of the green party and the conservatives and therefore, it combines the two perspectives of industry and environment in fostering enhanced corporate sustainability. It also provides insights into the origins of the co-authors and demonstrates their transdisciplinarity and underscores the high public interest of this project.

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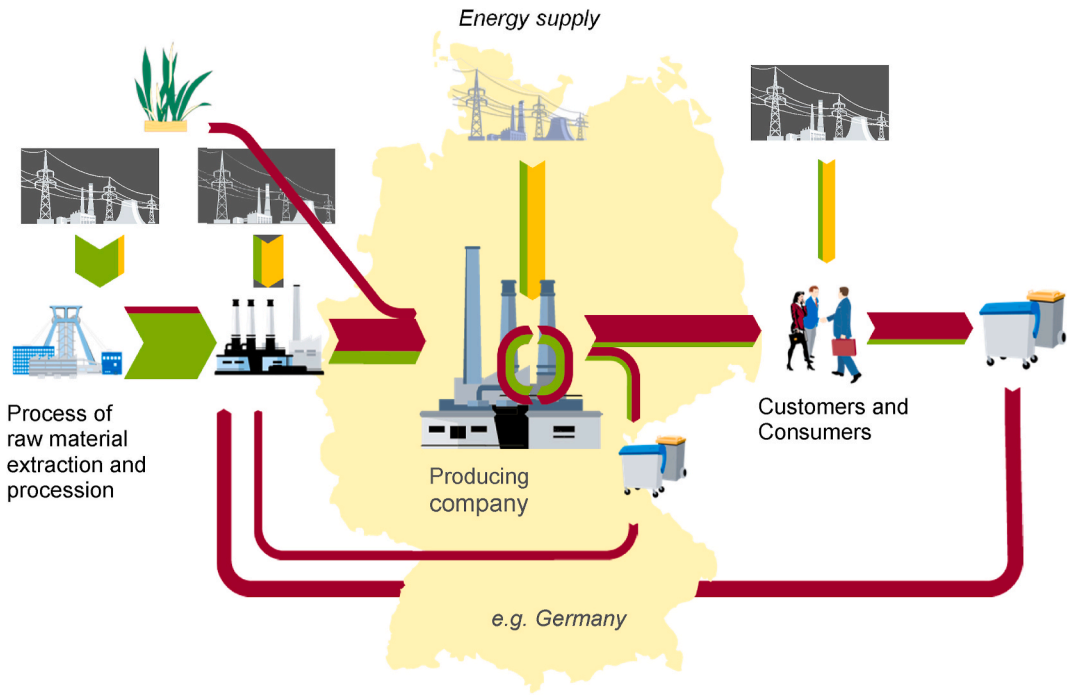

Fig. 1. Illustrating resource use in production supply chain (Schmidt et al., 2018, 31).

4. Structure and content

The book is divided into a theoretical and the case study part. Each part could be a book on its own. The value arises from the direct connection of the theoretic conceptual framework that was documented in the 100, real-world producing company cases. So, the meaning and consequence of theoretic models and figures becomes obvious through describing corporate realities. The 100 pages of part one, introduce the topic of resource efficiency in industrial society, including historical developments, definitions and political assumptions. In the subsequent 410 pages, the 100 company cases are described.

Part one provides an in-depth review about material resources from an economic, political and corporate level, built upon relevant statistical data, documents and investigative insights. The statistics used, document that improving resource efficiency, particularly for Europe, is not only an environmental issue, but is also a vital economic dimension, since Europe must import many important commodities, particularly, those needed for renewable energy and sustainable technologies (page 17).

Further, the current recycling reality of products made of substances such as rare earth elements is often below 1% despite those element's relative scarcity and the increasing demands for them (page 5). This global situation was addressed in light of political agendas and the political context in Germany and of the state of Baden Wuerttemberg. Due to its governor of the environmental party "the Greens" the political agenda moved considerably towards sustainability, which has been creating an enhanced level of awareness within its economics, public attitudes and the administration's commitment to making environmental, social and economic improvements.

The subsequent chapter illustrates the process flow in production in a visual way (Fig. 1). The process scheme was developed to clarify the material's usage, their origins, the potential recycling paths and the savings (page 27ff). In a more detailed illustration, each process step of an illustrative producing company was considered from the perspective of potential optimization measures. Particularly, this comprehensive view shows the potentials for savings within and around all dimensions of a company's production operations.

The planners and facilitators of this project developed and helped the 100 company teams to use standardized quantitative methods and instruments to monitor and to improve resource efficiency in their individual companies. That was particularly important due to the diversity of cases. The authors discussed potential indicators and relied on a combination of input-output measures of materials and energy, and a material flow cost accounting method (according to ISO 14051). Therefore, a transparent assessment standard was provided which was applied in all 100 cases.

The book's authors also reflected upon future trends in environmental technologies. It can be seen that recycling and resource efficiency will move towards far more complex fields of material reuse and replacement of currently used resources than is currently practiced. Additionally, digital technologies and new additive processes and shaping technologies provide new opportunities for improving material's, energy and time efficiency.

This generalized diagrammatic overview of company's different activities, provided the authors the framework to classify and report upon the 100 cases in a standardized, four-page format.

The reference to lean production in resource efficiency, which was done in Chapter 5, raises the question why a concept of the 1990's was referred to here. Lean production however, is a term which, was frequently used by the case companies. The authors argued that companies seek to avoid "muda" (waste), therefore, they are open to improving their resource efficiency; from their perspectives the logic of lean production and resource efficient production is the same.

The final theoretical concept referred to is the 'rebound effect.' The authors emphasized that efficiency related to resources must be clearly defined to avoid a single optimization at the expense of other resources or of a whole ecosystem. By discussing the 'rebound effect' in-depth, the authors emphasized that cost savings, particularly, through improved resource efficiency do not necessarily lead to increased consumption but for the industries, it provides them opportunities to invest in making additional improvements in their facilities operations.

The final section of part one is about the selection and evaluation of the case companies that were selected to participate in the Resource Efficiency Initiative. Companies had to apply to be included in the project. They could participate with a stand-alone measure or an overall engagement of the whole company. Either technical approaches or

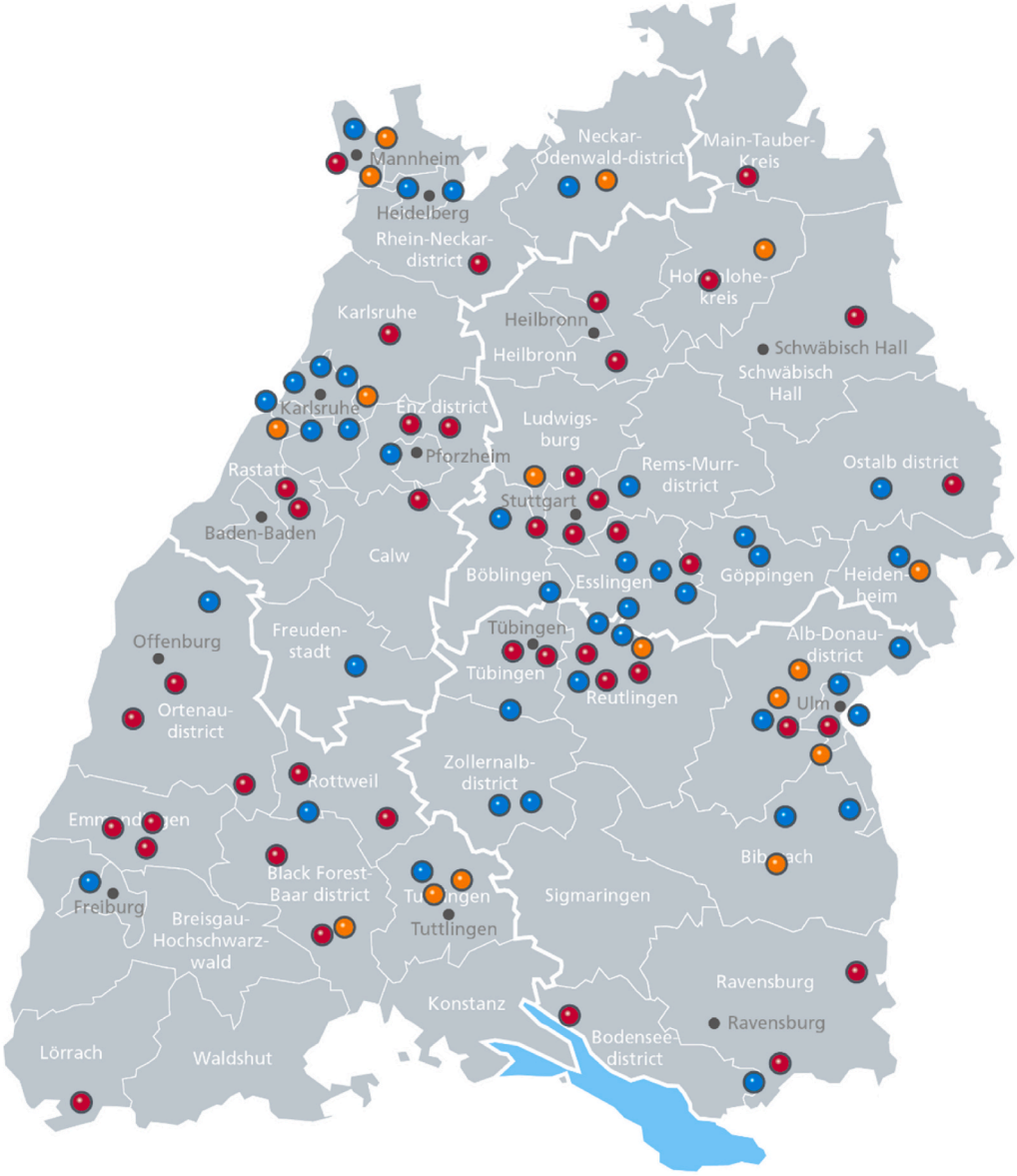

Fig. 2. Distribution of the 100 case companies within the Baden Württemberg state (Schmidt et al., 2018, 87).

structural organizational dimensions could have been applied. The companies had to prove savings such as material savings in tons or energy savings in kilowatts. The objective of the project was to create public awareness about the efforts of manufacturing companies on making improvements in resource efficiency. An interdisciplinary jury selected the 100 applicants that were officially invited to take part in the project.

In an accompanying research process, the cases were evaluated statistically and described as individual case studies. This combination of the statistical view and the in-depth case description provided a very important contribution of this study as individual company effects were evaluated in relation to the whole economic system. The selected companies represented a wide variety of industrial sectors within the state, including mining, food, textile, wood and paper, oil processing, chemical, pharmaceutical, plastics, glass and ceramics, metal processing, metal manufacturing, electronics and optics, machine, automotive, furniture, energy supply and the recycling industry (See page 85).

The comprehensiveness and diversity of this study was on the one hand its great value, but, on the other hand it was also its biggest challenge to standardize and to compare the results in terms of improved resource efficiency. 52 large and bigger companies (over 250 employees) participated, 48 small to medium size enterprises (SME). This was important because SMEs make substantial contributions to employment and innovation, which are the backbone of the manufacturing industry in Baden Württemberg state. Although, the core industrial regions of the state were well represented, also many companies from the more rural areas participated. Fig. 2 shows the local distribution of project participants and also the fields they covered: orange dots refer to improvements in energy efficiency; the blue dots highlight material's savings; the red dots reflect upon savings of both energy and materials.

Considering the statistical analyses of the results of the '100 companies' project, the many savings were also documented in reduction of energy usage and exhaust gas emissions. However, the largest total savings were due to reductions of materials' usage. The means applied included a broad variety from energy efficiency improvement approaches to product and process innovations, process controls, recycling, insulation or green supply chain management. A key finding was that the companies in the project documented reduction of 350,000 tons CO_2 emission/yr. through reductions in materials and energy

inefficiencies.

Part two provides a description of the 100 cases. The case studies are presented with the same template in a clear and rigorous way. This helps the reader to effectively obtain an overview and to compare among companies' initiatives. Each case provides information about the company and its location and its type of industry. Each study was divided into background and objectives, challenge, idea, implementation, savings, learning objective and company description. The cases were illustrated with several pictures that enhance the understanding of their context and type of production. At the end of each case study, the address and web-page are included. The case descriptions are presented in a standard four-page format. Therefore, the reader obtains a well-structured, beautifully illustrated overview of each case. The case studies were organized in sectors following the order introduced in part one (page 85).

Cases examples to illustrate the character and diversity of the empirical study.

(1) An office chair producer (Interstuhl), a family business with 850 employees, which is located in a small village, optimized their shaping injection molding process through the use of finite element analysis. The goal was to minimize material usage and to reduce the production process time. The project idea was to find new ways of redesigning office chairs by determining minimum material input, e.g. through reducing the wall thickness, while maintaining the same level of strength and quality of the product. The company applied the finite element method for stability calculations of chair components. The challenge was to achieve the combination of strength with design and ergonomics, and in the reproducibility of the results. During the project, the company gained significant knowledge in optimized product design and achieved a 15% weight reduction per production unit. This resulted in savings of nearly 130 tons of material, mainly polyamide, and a cost reduction of 100.000 Euros/yr. The lesson for the company was an unexpected degree of savings through a more scientific approach to product development and production.

(2) The ELM recycling company is a relatively young SME, which produces substitute fuels, at four locations. The case was focused upon the cement industry where sintering is an energy intensive process that is usually supplied by fossil fuels. ELM has supplied alternative fuels for the sintering process. The project idea was to produce the fuel on-site within the cement plant to fulfil their special technological requirements and to avoid additional logistical costs. This was achieved through recycling materials which were processed in a specific cleaning and separation process. This was done through a multi-step shredder and infrared material selection. Through this process, a 90% substitution rate of fossil fuel in the sintering process was achieved. The use of high caloric waste, not usually recycled, provides the same energy efficiency as coal. The CO2 savings were around 66.000 tons/yr., coal dust emission could be reduced by 80.000 tons/yr. Such effects were only possible through the proximity to and close communication with the customer.

(3) The manufacturing of interior components for railway cars, aircrafts and ships is the business of GETA, a 120 employee SME in the countryside. They are specialized in wood and plastics processing. The company was challenged by a switch from solid wood towards natural fiber materials due to requirements for weight reduction and different material properties. They implemented a three-way strategy. To replace wood by flax fiber, to reduce cutting waste and to reorganize the interplay between product development and production. Through the new composite material, 50% of material weight was saved in combination with new areas of application. Through reorganization of their production processes, 1,5 million Euros/yr. were saved and approximately 45t/yr. of waste were prevented. The lessons for the company were for them to continuously monitor their in-house processes and to systematically search for innovations.

The three examples provide an appetizer of the contents of this book. The diversity of companies and businesses shown provide a large array of ways and means by which companies from all sectors and sizes can effectively improve their efficiency, product quality and contribute, thereby to helping society to make progress toward sustainable development.

In Germany's producing industry, around 43% of the production cost are material related costs (Schmidt et al., 2018, 16). Related to this fact, the 100 case studies document that relatively small investments in time and changes in product design, production processes, changes in raw materials and other changes, can provide countable annual benefits for the companies (figures are provided for each case) and the economy as a whole. Although, each company had specific needs and used different approaches to improve their efficiency and quality, all cases have in common, a creative and innovative approach towards sustainable development. It was encouraging for the reviewers of this book to see the efficiency improvements achieved by all of the companies. This provides positive environmental and economic impacts. Hence the effects are twofold, environmental savings that contribute to societal sustainable development and increased economic efficiency of the firms and communities in which they operate. For sustainable development, the second effect was important as companies primarily focused upon cost savings. The case studies revealed that prior to their involvement in this project, the company personnel were not aware of the potential contributions that their optimizations can contribute to their profitability and to the region's sustainable development.

5. Discussion and conclusions

From the book reviewers view, the book, "100 Pioneers in Efficient Resource Management" should be seen as an outstanding, timely and tangible contribution to the sustainability discourse. The value of this book lies in the number and diversity of cases and the richness of the case descriptions. They represent a geographical region, which is one of the main innovation driver regions in Europe. The case descriptions were systematically standardized. Therefore, diverse cases can be compared and understood easily by the reader. This was facilitated by the four-page template used for the description of each case study's findings. Each case study provides concise information about the company, its products and production processes and how they improved their material's and energy efficiency. All provided insights into the lessons learned by the people of each company. The data of the companies are transparent and concrete and provide the opportunity for the readers to obtain additional information through webs-sources.

The book author's systematic approaches provide the connection between concrete cases and statistical analyses that summarized the findings of the 100 case companies. This connection and conceptual reflection of the case outcomes made it clear that each case contributed to overall improvements in regional sustainable development. The integration of parts one and two goes beyond traditional case books and thereby, greatly enhances its scientific value. It should therefore, be seen as a platform for further discourse, particularly in transdisciplinary contexts, particularly in the co-engagement of practitioners, politicians and scientists. With the case companies and the Institute of Industrial Ecology at Pforzheim University, the book provides the foundation for future research.

Despite the excellent value and comprehensiveness of this book, the reviewers make the following observations: First the understanding of "resource" could have been more fully elaborated. It is not only material or energy but according to a resource-based view, also human potential and knowledge plays a decisive role in "resource efficiency". Implicitly this fact can be seen when reflecting on the cases and how the solutions

of efficient resource management where brought about. Apart from a few examples, the case companies were considered as stand-alone entities. However, the materials originated somewhere and the products are distributed to customers. Hence, this value chain, which goes beyond firms' boundaries, should be part of the consideration of improving resource efficiency: What are the effects of changes in one link on the whole value chain? This coherence and correlation of cases should be researched further. Finally, even though the changes had radical impacts on 100 companies, the overall picture of the innovation was of incremental improvements. Based on the suggestion of considering whole value-added chains, it would be valuable to systematically address questions such as, is it sufficient to improve individual businesses or do we need to make more radical changes in the attitudes, values and visions for our societies, whereby, some types of companies and their supply chains should be replaced or eliminated?

Also, with regard to "Industry 4.0," the consequences of digitalization and the transforming of manufacturing towards adding of value through knowledge, there are topics that require more in-depth research. The 100 cases can be an excellent basis for this type of research on how to actively facilitate the process of change for transitioning to societal sustainable development in the digital age.

The book review authors think that this book can be used for multiple purposes. Firstly, it is an excellent text- and casebook for teaching, not only for sustainability, but also for strategy and innovation, as it documents the natural connections among management, strategy, innovation, economy, ecology and sustainable development.

The authors of this book review have used the book in teaching in China during the summer of 2019, in an on-line course with students in 22 countries and in innovation classes of an executive MBA and an international master's program. The students were positive and learned much from the case studies and from the broader concepts covered so effectively in this fine book.

Further, the book is useful for practitioners, to provide examples and inspirations for their own journey toward more sustainable production of products and provision of services. Finally, the book is a valuable contribution to research, particularly with its comprehensiveness of cases and related considerations.

Declaration of competing interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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