Edited by G.L.L. Reniers, K. Sörensen, K. Vrancken

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Management Principles of Sustainable Industrial Chemistry

Theories, Concepts and Industrial Examples for Achieving Sustainable Chemical Products and Processes from a Non-Technological Viewpoint

Table of Contents

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Preface

Chemical products make an irreplaceable contribution in every aspect of our modern day lives. Chemical processes and products play an essential role in industrial sectors as diverse as agriculture, automotive, clothing, communication, construction, food, health, leisure, mobility, plastics, space, transport, and so on. We can easily observe that our advanced society depends on the wealth-creating aspects of industrial chemistry.

Nonetheless, societal expectations and the depletion of natural resources are pushing toward chemical processes becoming cleaner, more efficient, less consuming, safer, and more secured. The ecological footprint of chemical products needs to be decreased.

Sustainable chemistry being concerned with the development of sustainable chemical products and processes and thereby integrating economic, environmental, and social performance, can provide an answer to these major challenges.

To achieve sustainable industrial chemical processes and products, companies, research centers, and academia tend to focus mainly on technological solutions such as cleantech, green technology, process intensification, new catalysts, new membranes, ecofining, and so on. However, nontechnological approaches are essential as well to succeed in adequate sustainable chemistry. Integrated management systems, cluster management, business models, measuring criteria and methods, sustainable supply chain management, chemical leasing, transition management, societal expectations, and so on are all important nontechnological aspects of sustainable chemistry. To date, most of the know-how and expertise on nontechnological issues is developed on individual company

or academia basis and in a fragmented way. An overview of management principles, theories, concepts, and so on from a nontechnological holistic (People, Planet, and Profit) perspective has, to the best of the Editors' knowledge, not yet been discussed in one book volume.

The objective of writing a book from a managerial viewpoint consists in leveraging the search for truly sustainable chemical products and processes, and to disseminate the available knowledge to captains of industry and to leaders of the public sector, as well as to company management (within all organizational levels and from all different departments, and disciplines). It is crucial for the vision of sustainable chemistry to be realized that not only novel technology is conceptualized and developed but also that innovative management models, intraorganization models, and interorganization models are elaborated, promoted, and implemented within the chemicals using industries.

We are convinced that a clear interdisciplinary approach within technological areas, supported by cross-cutting managerial actions, is required for truly successful tackling of these new chemistry challenges and paradigms.

Antwerp

Genserik L.L. Reniers, Kenneth Sörensen, and Karl Vrancken

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Part I

Introductory Section

1

Editorial Introduction

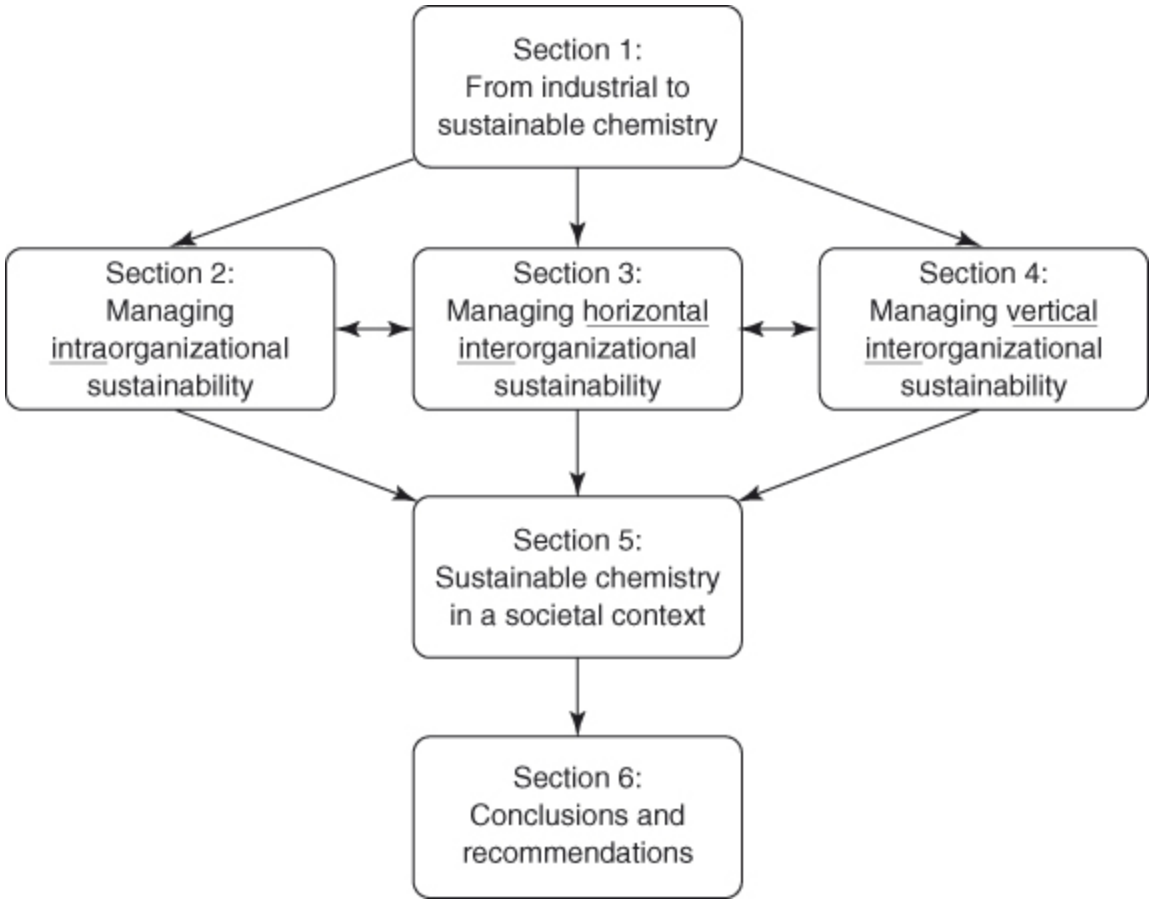
Genserik L.L. Reniers, Kenneth Sörensen, and Karl Vrancken

There has been an ever-growing worldwide interest in sustainability in all industrial sectors since the Rio declaration two decades ago (UN, 1992). Especially in industries using chemicals, topics related to sustainability are gaining importance by the year. Sustainability should be seen as an ideal. It is an objective of perfection that will never be completely achieved. It is a target of continuous improvement. It should be a business imperative. The interconnectedness of organizational actions and decisions should have an impact on the social, ecological, and economic sustainability of the community in which it operates. To achieve this ideal, and all its accompanying aims, technological as well as a nontechnological innovations and operations should be strived for and implemented. This book specifically deals with the nontechnological path that should be taken within the chemical industry to achieve sustainability in business needs.

However, these are rather vague concepts. All this wisdom about sustainability, the awareness, and information, does not suggest concrete actions and tactics needed to change an organization for the better. This book describes how to significantly enhance the sustainability of chemical plants from the management's perspective.

By taking into consideration the needs for nontechnological advancements toward sustainability, the present book, whose structure is illustrated in Figure 1.1, aims at covering all aspects and all principles leading to truly sustainable industrial chemistry from a managerial perspective. The first introductory section provides a description of the history and importance of sustainability in the chemical industry and of the evolution in managerial themes and models leading to a steady transition toward sustainability. The second section discusses the management system requirements and the needs to build corporate social responsibility within one plant, and provides tools and methods to measure sustainability within a chemical company or a part thereof. The third section investigates the managerial needs to improve cross-plant management and collaboration at the same level of the supply chain, for moving toward ever more sustainable chemical products and processes. The fourth section provides insights into some innovative managerial approaches with respect to collaboration and cooperation between organizations not situated on the same level of the supply chain, leading toward so-called vertical interorganizational sustainability. The fifth section presents and elaborates on the societal context of sustainable chemistry.

Figure 1.1 Structure of the book.



The following paragraphs offer an outlook of the 13 contributions that constitute the various sections of the book. In order to provide an introduction to the various chapters, a description of the main themes that are dealt with in each one is given.

1.1 From Industrial to Sustainable Chemistry, a Policy Perspective

This first, introductory, section contains three contributions. The first one, History and Drivers of Sustainability in the Chemical Industry, provides a brief description of the chemical industry's path toward sustainability. The

incentives and drivers for a step-by-step advancement, from the Responsible Care® program to the various corporate sustainability initiatives, are listed out and expounded.

The second contribution of this section, From Industrial to Sustainable Chemistry, a Policy Perspective, clarifies the policy developments that could be observed over the past decades in relation to chemistry on an industrial scale. The contribution clearly demonstrates that there has been a shift in focus over the last two decades from strict rule-driven regulations and authorities toward performance-based and stakeholder-based governance. This shift has initiated and empowered a shift of industry – such as the chemical industry – toward new managerial and governance approaches.

The third contribution of this introductory section, Sustainable Industrial Chemistry from a Nontechnological Viewpoint, briefly discusses what is understood in this book by “sustainable chemistry” and what constitutes a “nontechnological viewpoint.” The foundations are laid for the further chapters by elaborating on the different managerial topics for achieving sustainable chemistry in a simple, nontechnological manner.

1.2 Managing Intraorganizational Sustainability

The second section of the book is composed of four chapters. The first one, *Building Corporate Social Responsibility* – Developing a Sustainability Management System Framework, deals with the creation of a conceptual sustainability management system, mainly on the basis of

the umbrella guideline ISO 26000. The proposed coherent and systematic framework contains five inherent and consecutive features of sustainability. The current overload of standards makes organizations uncertain how to translate the idea of sustainability optimally into a management system, and this section provides an answer to this organizational need.

The second chapter of this section, Sustainability Assessment Methods and Tools, discusses a sustainability assessment framework and impact indicators and assessment approaches from both a uni- and a multidimensional perspectives. The chapter argues that harmonization and standardization of knowledge in three dimensions (environment, economic, and social) should be pursued for the chemical industry.

The third contribution of this section, Integrated Business- and SHESE Management Systems, takes a closer look at the added value of integrated management systems and the required steps to successfully implement an integrated management system approach. The chapter provides arguments for treating sustainability as a holistic, organization-wide objective, to be achieved by an integrative generic framework that leaves space for specificities wherever and whenever needed.

The last contribution is concerned with the identification of relevant impact categories and suitable KPIs for sustainability performance. How the KPIs should be interpreted and aggregated is explained, amongst others. The method elaborated in this contribution helps decision makers in the design for sustainability within chemical process plants.

1.3 Managing Horizontal Interorganizational Sustainability

The third section of the book is contains two chapters. The first chapter, Industrial Symbiosis and the Chemical Industry: between Exploration and Exploitation, explains industrial symbiosis and compares different chemical clusters from the Netherlands in this regard. The advantages and hurdles of realizing cross-plant collaboration initiatives to advance environmental symbiotic linkages are discussed.

The second contribution in this section, Cluster Management for Improving Safety and Security in Chemical Industrial Areas, proposes a framework and an approach for chemical plants situated within the same chemical cluster, to transfer knowledge, know-how, and best practices, and a more intensive collaboration on safety and security topics.

1.4 Managing Vertical Interorganizational Sustainability

The fourth part of this book has three contributions. The first contribution, Sustainable Chemical Logistics, investigates the status of sustainability in chemical logistics, and argues that organizational aspects have an important role to play in this area. Furthermore, different ways to improve sustainability of chemical logistics are discussed: optimization in logistics, coordinated supply chain

management, horizontal collaboration, and intermodal transportation.

The second contribution, Implementing Service-Based Chemical Supply Relationship – Chemical leasing® – Potential in EU?, explains “chemical leasing” as a new business model that aligns economic incentives in the chemical supplier–user relationship toward reduced material use on the one hand and waste prevention on the other. The contribution clarifies this novel business concept and shows its innovative nature and possible role in “servicizing” the chemical supply chain. Furthermore, the synergy that exists between chemical leasing and several relevant legal frameworks, such as REACH, is addressed.

The third contribution deals with the needs as regards sustainable warehousing. It is evident that adequate risk management policies and -procedures and risk treatment strategies need to be in place in warehouses. The different factors important in this regard, are given and clarified. The chapter further discusses sustainable inventory management and vendor management inventory, and their importance.

1.5 Sustainable Chemistry in a Societal Context

The fifth section of the book is based on three contributions. The first one, A Transition Perspective on Sustainable Chemistry: the Need for Smart Governance, offers an exploratory transition perspective on challenges and changes going hand in hand with sustainable chemistry. The author argues and explains that a transition toward sustainable industrial chemistry is not so much a