Preface

We study what we can see,
but what we see is not always what exists.
Paulo Coelho

The term "*supply chain management*" (SCM) was coined in the 1980–90s. Presently, SCM is considered as the most popular strategy for improving organizational competitiveness along the entire value chain in the twenty-first century.

A *supply chain* (SC) is a network of organizations, flows and processes wherein a number of various enterprises (suppliers, manufacturers, distributors and retailers) collaborate (cooperate and coordinate) along the entire value chain to acquire raw materials, to convert these raw materials into specified final products, and to deliver these final products to customers.

SCM studies human decisions in relation to cross-enterprise collaboration processes to transform and use the SC resources in the most rational way along the entire value chain, from raw material suppliers to customers, based on functional and structural integration, cooperation, and coordination throughout.

SCs influence the world economy and are influenced by it. The economic environment has changed significantly since the autumn of 2008. Hence, the necessity for new viewpoints on SCM has become even more obvious. The former paradigm of total and unlimited customer satisfaction has naturally failed because of the limited resources for this satisfaction.

In these settings, the duality of the main goals of SCM – maximizing the service level and minimizing costs – should be enhanced by the third component – maintaining SC stability. This triangle goal framework will build the *new SCM paradigm* that can be formulated as the maintenance of stability and the harmonization of value chains with possibly full customer satisfaction and cost-efficient resource consumption for ensuring the performance of production-ecological systems at the infinite time horizon. Therefore, new conceptual frameworks and mathematical tools for decision-making support are needed.

In taking the level of the engineering frameworks and mathematical models to the forefront of this study, the research logic includes the following main components (see Fig. 1). The SC design starts with the *system formation*. In this research stream, a wide variety of organizational issues are investigated in relation to the collaboration motivation, organizational structures, trust, etc. This level is out of the scope of this study. However, we will reflect the organizational issues in Chap. 2.

The first step in building an SC is *structural design*. Within the SC, a number of structures (organizational, functional, informational, technological and financial) are to be formed to ensure a backbone for the achievement of the system's goals.

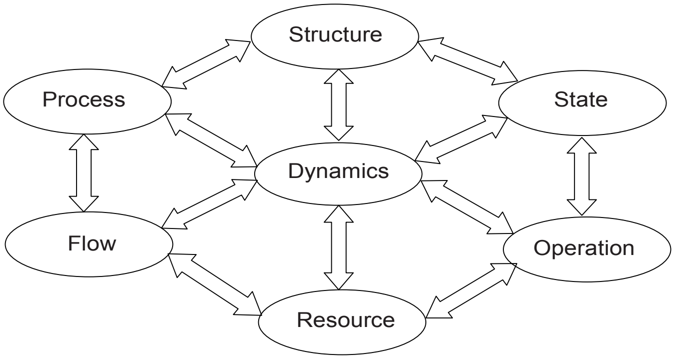

Fig. 1 Main components of system research on SCM

The *processes* and *flows* within the structures are implemented through the resource provision and consumption. These *resources* may be related to materials, time, information, people and finances. To utilize the resources, a number of *operations* is to be planned and executed. The execution happens not statically but dynamically, and is unwound over different time horizons. Through the structure and operations dynamics, SCs may appear in different *states*. The above-mentioned components are tightly interlinked.

The *primary objective* of this book is to reflect these conjunctions both at the conceptual and formal levels to contribute to the existing knowledge in the SCM domain in developing a framework, mathematical models and software prototypes for handling uncertainty and dynamics in SCs, taking into account high-dimensional and computational complex problems, the explicit interconnection of the planning and execution decisions, and decision-making by people to ensure SC adaptability, stability and crisis-resistance.

The *motivation for this contribution* consists of several topics that can be captured under the general problem of the handling of uncertainty and dynamism while planning and executing SCs.

First, the composite objective of maximizing both the *SC stability and economic performance* can be considered as a timely and crucial topic in modern SCM. The profit losses through non-purposeful (e.g., demand fluctuations) and purposeful (e.g., terrorism or thefts) perturbation impacts can amount to 30% of the annual turnover. The current economic decline and its impacts on SCs confirm the necessity for rethinking the SC optimization vision of an unlimited profitability growth. Striving for maximal profitability in the hope of an unperturbed environment and unlimited economic growth led to tremendous collapses and losses in SCs. The crisis provides the ultimate evidence that one of the main tasks of SCM is to balance profitability and stability to remain competitive in the perturbed economic environment. Besides, the stability indicator meets the SCM nature to a greater extent. Increases in sales and cost reductions may be related to operational logistics improvements at local knots of SC. But the stability of the whole SC is even the direct performance indicator of SCM.

Second, within SCs, there are lots of problems that have been conventionally treated in isolation from each other but which are indeed tightly *interlinked*. In our opinion, these explicit interconnections may potentially provide new quality of decision-making support for SCM. For example, planning and scheduling are an integrated management function. SCs consist of different structures. The planning and execution of SCs are based on the same decision-making procedures that do, however, differ in their decision-making speed. Hence, the planning and execution stages of SCM can be considered within an adaptation framework. In following these assumptions, we will consider dynamics in SCs at the structural–operational level with concrete processes and parameters rather than at the strategic level, which usually suffers from a lack of links to concrete processes and a high abstraction degree. We will consider SCs as multi-structural systems and propose an SC structure–operations dynamics approach to establish adaptive feedback loops at the tactical and operational decision-making levels.

Third, we assume that SCs as complex systems are described by *different models*. In modelling SC structure and operations dynamics, a number of *particular features of the SCM domain* should be taken into account. The processes of SC execution are non-stationary and non-linear. It is difficult to formalize various aspects of SC functioning. Besides, the SC models have high dimensionality. There are no strict criteria of decision-making for SCM and no *a priori* information about many SC parameters. The SC execution is always accompanied by negative perturbation impacts. These negative perturbation impacts initiate the SC structure dynamics and predetermine a sequence of positive control compensating for the perturbations. Unlike the automatic systems, adjustment control decisions in SCs are taken by managers and not by automatics. This results in individual interests, risk perceptions and time delays (from minutes to months) between disruption identification and taking adjustment measures.

To answer these challenges, the research approach in this study is based on the *combined application* of modern optimal control theory, operations research (OR), systems analysis and artificial intelligence. In particular, recent advancements in applying different OR approaches in the SCM domain as well as advancements in modern control theory and applied mathematics, namely the theory of structure dynamics control (SDC) and multi-model complexes will be considered.

Fourth, another particular feature of this book is the developing of *generic model constructions* and guidelines for near real-world problem identification and the application of a problem-specific solution method (or a combination of methods) rather than dealing with clear identifiable problems and specific problem cases with a known desirable outcome in a known environment. Such problem localizations may lead to unrealistic simplifications where the connection of the model to reality fails. Real problems are different and involve multiple decision makers and different interests and value sets (e.g., individual risk perception). Of course, the continuous improvements in the solution of partial SCM problems are very important. There is a wealth of literature on these problems and the optimization potential. However, this literature indicates even more case-study applications but as yet almost no new methodical approaches.

In this research, we will not concentrate on the solutions to partial benchmarking problems of SCM that are known and localized in the literature. We will put the emphasis on the fact that these partial problems and specific cases are tightly interlinked with each other with regard to different SCM levels, different SC structures, and in SC dynamics. Even these links will be at the forefront of our considerations to develop a *problem semantic* for the SCM domain. In the situation when the further optimization of known referenced problems can hardly provide a significant increase in SC performance, even the investigation into the links between different problems may lead to a new breakthrough in SCM research.

In this book, we will consider the modelling level at a higher degree of abstraction and develop generic methodical constructs that can be localized in concrete environments with the help of certain methodical guidelines. Finally, the proposed approach will reflect the fact that SCs evolve as a result of subjective decisions taken by people on the basis of compromised iterative decision making procedures within an information environment.

http://www.springer.com/978-1-84882-951-0

Adaptive Supply Chain Management
Ivanov, D.; Sokolov, B.
2010, XXXII, 269 p., Hardcover
ISBN: 978-1-84882-951-0