COMPUTATIONAL INTELLIGENCE FOR SUPPLY CHAIN MANAGEMENT AND DESIGN: ADVANCED METHODS

EDITED BOOK
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1. Synopsis

This edited volume will focus on the contribution of Computational Intelligence to Supply Chain Management. Computational Intelligence (CI) is a term corresponding to a new generation of algorithmic methodologies in artificial intelligence, which combines elements of learning, adaptation, evolution and approximate (fuzzy) reasoning to create programs that -in a way- can be considered intelligent. The proposed edited volume will present CI methods addressing topics in the entire spectrum of the supply chain i.e. from forecasting, planning for production and distribution to actual implementation, including production and inventory control, warehouse management, management of distribution channels, and transportation. Emphasis will be given to those CI methods and techniques that provide effective solutions to complex supply chain problems, exhibiting superior performance with respect to other methods of operations research. The edited volume will also include integrated case studies that describe the solution to actual problems of high complexity.

2. Supply Chain and Computational Intelligence

The supply chain of both manufacturing and commercial enterprises comprises a highly distributed environment, in which complex processes evolve in a network of companies. Such processes include materials procurement and storage, production of intermediate and final products, warehousing, sales, and distribution (see Fig. 1). The role of the supply chain in a company’s competitiveness is critical, since the supply chain affects directly customer service, inventory and distribution costs, and responsiveness to the ever changing markets. Furthermore, this role becomes more critical in today’s distributed manufacturing environment, in which companies focus on core competencies and outsource supportive tasks, thus creating large supply networks. Within this environment there are strong interactions of multiple entities, processes, and data. For each process in isolation, it is usually feasible to identify those decisions that are locally optimal, especially in a deterministic setting. However, decision making in supply chain systems should consider intrinsic uncertainties, while coordinating the interests and goals of the multitude of processes involved.

![Figure 1. The flow of decisions and information in the supply chain](image-url)
Most advances in the use of computational methods to support supply chain operations have focused on low level operational decisions, while little attention has been applied to more important areas of supply chain management like product forecasting and strategic support systems. In addition, many existing models focus on individual components of the overall system, and thus ignore the integrated approach. An integrated approach, however, is essential due to the inherent trade-offs involved in all stages of the supply chain operations.

Computational Intelligence has emerged as a rapid growing field in the past few years. Its variety of intelligent techniques emulate human intelligence and processes found in natural systems such as adaptation and learning, planning under large uncertainty, coping with large amounts of data, etc. Successful industrial applications of intelligent systems usually deal with several of these aspects and it is therefore natural to combine various technologies with different capabilities within an integrated decision support system. Most of the tasks required for effective management of logistics activities can be achieved using methodologies from several areas of computational intelligence.

For the purposes of this book computational intelligence methodologies are generally classified into three major areas, according to the nature of the methodology used to approach supply chain management problems:

1. **Standard** widely acknowledged and applied intelligent techniques, such as neural networks (NN), fuzzy systems (FS), genetic algorithms and genetic programming (GA/GP, and other machine learning algorithms (ML). These methods manage to successfully perform association, generalization, function approximation, rule induction, etc. in difficult multivariate domains of application. Methods belonging to this category could be further divided into automated-learning computational intelligence techniques, (NNs, GA/GP, other ML algorithms) and in intelligent modeling approaches (where fuzzy systems and rough sets could be included, as well as approaches related to fuzzy decision analysis, intelligent multi-criteria decision making, etc).

2. **Hybrid and Adaptive Intelligence** by which is meant any efficient combination of the above mentioned intelligent techniques, with other intelligent or conventional methodologies for handling complex problems. Usually one of the methods combined within a hybrid or adaptive scheme, is used either to filter or to fine tune special operations of another methodology, in an intelligent manner and in a way that the total scheme performs superior to simple standard or conventional approaches. Most popular hybrid methodologies are neuro-fuzzy systems, evolving-fuzzy systems, neuro-genetic approaches and genetic-fuzzy ones. There are also applications in literature combining wavelets with intelligent techniques, as well as standard intelligent techniques with nature-inspired ones.

3. **Nature Inspired Intelligence** (NII) in which are included methodologies such as swarm intelligence, ant colony optimization, bee-algorithms, artificial immune systems etc., applied in logistics and supply chain optimization problems. Usually these methodologies represent simultaneous exploration and exploitation of the search space in a smart manner (i.e. local and global search), analogously to the way natural systems or societies perform similar tasks (e.g. swarm flying or swimming, food search and identification, etc.)
This edited volume will present CI methods addressing topics in the entire spectrum of the supply chain i.e. from forecasting, planning for production and distribution to actual implementation, including production and inventory control, warehouse management, management of sales and distribution channels, and transportation. Emphasis will be given to those CI methods and techniques that provide effective solutions to complex supply chain problems, exhibiting superior performance with respect to other methods of operations research. The edited volume will also include integrated case studies that describe the solution to actual problems of high complexity.

It is our aim to include at least one intelligent methodology of each of the above mentioned categories, applied to each of the five (5) parts to which the book contents are divided. Furthermore, we especially welcome contributions that address and discuss important issues related to the application of computational intelligence to supply chain and logistics, such as:

- Why computational intelligence is suitable for supply chain optimization problems and in which cases?
- Which of the CI methodologies seems to be the method of choice for what kind of supply chain problem?
- Which are the main advantages of the most popular CI approaches in logistics domains and why?
- What are the best tasks to perform using CI when handling optimization problems in supply chain (e.g. classification, clustering, modelling, etc.)?

3. Draft contents of book

The proposed edited volume will comprise 5 parts. The first 4 parts will include chapters that focus on computational intelligence applications to different functions of the supply chain. The fifth chapter will focus on supply chain integration; i.e. it will include chapters that present the use of computational intelligence in real-life applications and case studies. A tentative table of contents is presented below.

PART I: Procurement and Inventory management

Potential topics include CI contributions in:
- Supplier selection
- Procurement
- Cost management
- Just-in-time procurement
- Inventory management
- The balance of customer service vs. cost in purchased goods
- Supplier collaboration
- Spend analysis
- Other topics in procurement and inventory management

PART II: Production Planning and Scheduling

Potential topics include CI contributions in:
- Hierarchical production planning
- Aggregate production planning
- Materials requirement planning
- Just in time productivity
Lean production  
Production scheduling  
Order management  
Shop floor control  
Factory dynamics  
Other topics in production planning and scheduling

PART III: Warehousing, Transportation and Distribution management

Potential topics include CI contributions in:
- Storage and handling decisions,
- Picking
- Stock control in view of competing orders
- Vehicle routing (planning, dynamic routing)
- Fleet management systems
- Distribution management
- Other topics in warehousing, transportation and distribution management

PART IV: Forecasting, Sales and Customer Service

Potential topics include CI contributions in:
- Demand forecasting
- Defining optimum service levels and inventory costs
- Sales management
- Distribution channel management
- Other topics in forecasting, sales and customer service

PART V: Integration of Supply Chain

Includes integrated methods, novel system concepts and applications of computational intelligence in improving a significant part of supply chain activities.

4. Deadlines and Important Dates

The work schedule for the book is as follows:
- Extended abstracts of contributions (max 750 words): **May 31, 2008**
- Editorial responses to abstracts: **June 30, 2008**
- First drafts of chapters (max 6.000 words): **October 30, 2008**
- Reviews due by: **February 15, 2009**
- Second draft of chapters: **March 31, 2009**
- Camera ready chapters: **July 15, 2009**
- Book published: **September 2009**

All draft chapters will be subject to a double-blind review by three reviewers (not including the editorial review by the book editors).

**Extended abstracts and chapters should be sent to Dr. V. Zeimpekis**
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