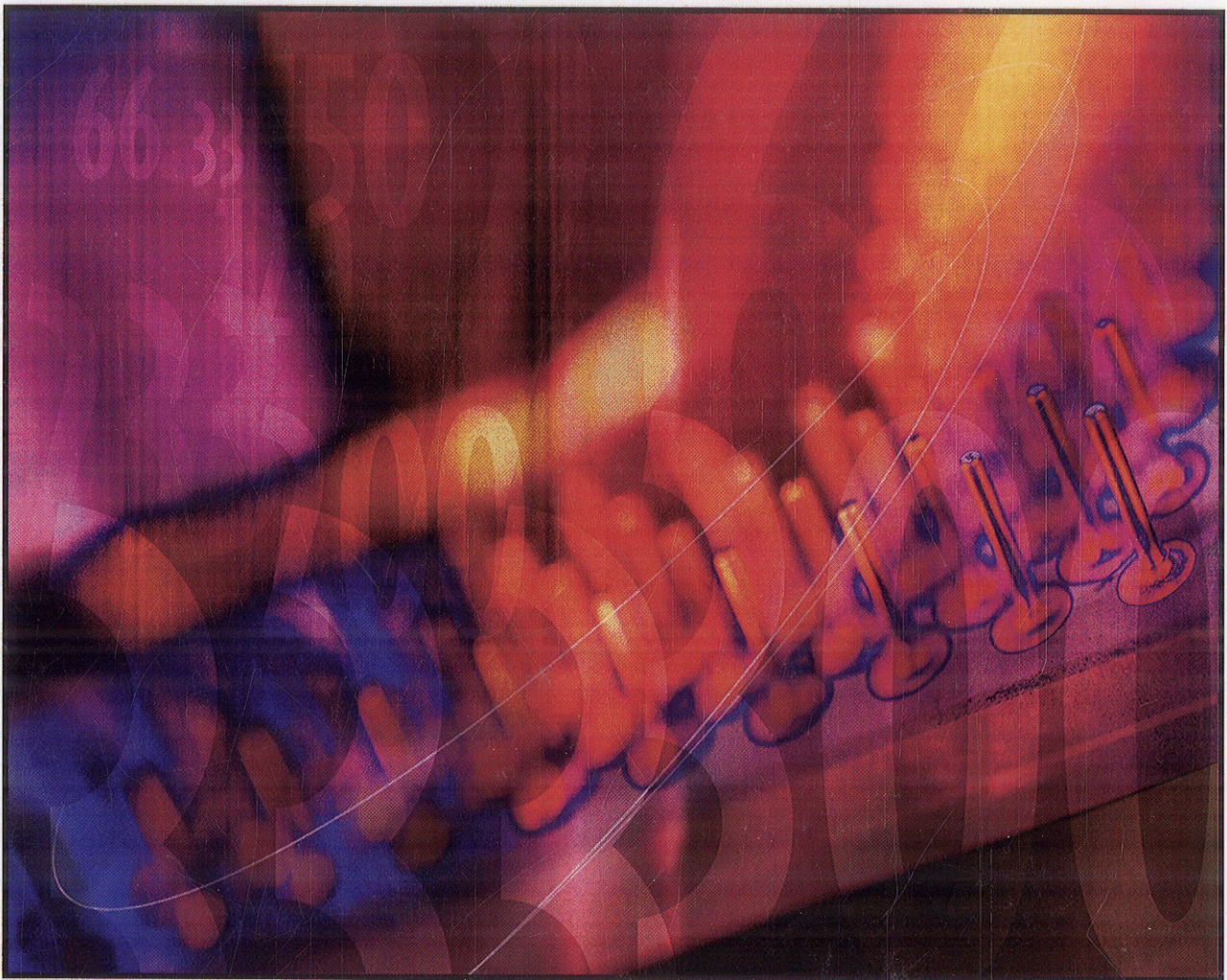


PREMIER REFERENCE SOURCE

INTELLIGENT SYSTEMS IN OPERATIONS

Methods, Models and Applications in the Supply Chain



BARIN NAG

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Employing Intelligent Decision Systems to Aid in Information Technology

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When a firm initiates and invests into an information technology (IT) project, it is usually with the intention of realizing benefits in the informational, strategic, transactional, and infrastructure objective areas of its IT portfolio (Weill & Broadbent, 1998). From the project management perspective, it is critical to know how the project is performing from the viewpoint of scope, schedule, cost, and other constraints. Lewis (2008) reports that 70% of IT-related projects do not meet their objective. This work examines the use of a case-based reasoning decision support architecture that provides a collaborative intelligent agent system to aid in recommending the status of a project using color indicators (Red, Yellow, Green) derived from the progress and condition of the project-related constraints.

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SAT and Planning: An Overview	27
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This chapter firstly reviews the importance of the Satisfiability Problem (SAT) for a wide range of applications, including applications in Operation Management such as planning. A review of methods nowadays employed by modern SAT-solvers is then presented. We then use Classical Planning as an illustrative example of how a significant problem can be translated into SAT. We point out important results and studies concerning reductions of planning into SAT, and explain how to construct a SAT instance which is satisfiable if and only if an instance of a bounded version of the classic blocks-world problem is solvable.

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Integrated Multi-Agent Coordination	41
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Planning and scheduling have been a key topic in both Operations Research and Multi-Agent Systems. Most approaches are concentrated at an abstract system level on developing interaction protocols to be imposed on agents. There has been less concern about how the internal task structures of individual agents affect these higher-level coordination behaviors. Collaborative multi-agent planning addresses problems like uncertainty in plan outcomes, anticipating likely contingencies, and evaluating how agent actions achieve worth-oriented goals. This chapter presents extensions and restrictions, called extended hierarchical task networks (EHTN), to the traditional plan and schedule representations that allow the formal definition of an integrated multi-agent coordination problem. This chapter discusses open issues in multi-agent coordination (e.g. what to coordinate among agents, how much information to be exchanged, how to evaluate a planning approach) and proposes a general solution towards successful distributed goal achievement by analyzing the task structures of participating agents.

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Sensor-based decision support systems have to cope with a high volume of continuously generated sensor events. Conventional software architectures do not explicitly target the efficient processing of continuous event streams. Due to the high volume of events and their complex dependencies it is not possible to have a fixed or predefined process flow on the business level. Recently, Complex Event Processing (CEP) has been proposed as a general process model for event streams. Though CEP provides mechanisms for computing high volume of events, it doesn't define any methodologies, models and reference architectures, which would establish EDA as a mature software architecture. In this chapter the authors present a reference architecture for sensor-based decision support systems, which enables the analysis and processing of complex event streams in real-time. The proposed architecture provides a conceptual basis for development of flexible software frameworks that can be adapted to meet various applications needs. The authors' architectural approach is based on semantically rich event models providing the different stages of the decision process. They illustrate their approach in the domain of road traffic management for high-capacity road networks.

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With the growing complexity of information technology (IT) projects, the management of these projects is proving to be a daunting task. The magnitude of this problem is underscored by the assertion that approximately 70% of IT projects fail to meet their objectives (Lewis, 2007). Computational intelligence (CI) is an area of research focused on developing intelligent systems to help with complex problems. Specifically, CI seeks to integrate techniques and methodologies to assist in problem domains in which information, data and perhaps even the problem itself are vague, approximate, and uncertain. It would seem that research aimed at leveraging the power of CI against IT project management problems is critical if IT project success rates are to be improved. This work examines the core CI technologies – fuzzy logic, neural networks, and genetic algorithms – and looks at current and potential future applications of these techniques to assist IT project managers.

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This chapter studies a manufacturing process of pieces. These pieces are produced with molds which are mounted on machines. The authors describe this process as an optimization problem using an integer linear programming formulation which integrates the most important features of the system, and determines the quantities of pieces to produce, including the allocation of molds to machines. The objective function is to maximize the weighted production since they seek to minimize the non-fulfilled demand. First they show that the addressed problem belongs to the NP-hard class. After observing that solving the problem in an exact way is time consuming, they propose a solution methodology based on an Iterated Local Search Algorithm. Through computational experimentation we make conclusions about the difficulty of the decisions determined in this manufacturing planning.

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In this chapter, the authors present an intelligent simulation system for supply chain event management for the purpose of designing and re-engineering the supply chain. The simulation framework mainly composes of component layer, process layer, intelligent execution layer, and output layer. The functional design of the layers is discussed with comments on the contribution of the simulation. Implementation issues are further addressed and an illustrative case study is reported.

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The present chapter discusses the application of intelligent decision-support systems – mathematical programming-based in particular – to operations management within the mining industry. The underlying production and distribution planning and scheduling problems have often been addressed individually, in disregard of upstream and downstream operations. A supply chain approach to mining operations, however, requires an integrated perspective which takes into account mine, railway and port operations, as well as domestic and international supply stations served by appropriate logistics channels. Three main topics are discussed here: recent operations research developments in the mining industry; integrated approaches towards the development of decision-support systems to address a global mining supply chain; and possible solution approaches to the integrated problems. The main thread is oriented to mathematical programming approaches, but relevant applications of simulation and artificial intelligence techniques are also discussed.

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<i>Paolo Renna, University of Basilicata, Italy</i>	

The development of Information and Communication Technologies (ICT) allowed the enterprises to adopt an e-marketplace approach to Business to Business (B2B) applications. In particular, these kind of applications are demonstrating their capacity to provide real added value to manufacturing industries by allowing their global performance to increase. The implementation of the e-marketplace by firms is not considered an easy job because of the lack of automation: the human participation is still in all stages of the B2B process. The chapter proposes a three value added services: workflow design, Multi Agent System and negotiation approach. In particular, two negotiation, an auction and single round approaches with three customer behaviors are proposed. A simulation environment is developed in order to test the proposed approaches. The simulations have been conducted in several scenarios in order to highlight what is the best approach to perform.

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<i>Valentina Colla, Scuola Superiore Sant'Anna, Italy</i>	
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Computer vision is nowadays a key factor in many manufacturing processes. Among all possible applications like quality control, assembly verification and component tracking, the robot guidance for pick and place operations can assume an important role in increasing the automation level of production lines. While 3D vision systems are now emerging as valid solutions in bin-picking applications, where objects are randomly placed inside a box, 2D vision systems are widely and successfully adopted when objects are placed on a conveyor belt and the robot manipulator can grasp the object by exploiting only the 2D information. On the other hand, there are many real-world applications where the 3rd dimension is required by the picking system. For example, the objects can differ in their height or they can be manually placed in front of the camera without any constraint on the distance between the object and the camera itself. Although a 3D vision system could represent a possible solution, 3D systems are more

complex, more expensive and less compact than 2D vision systems. This chapter describes a monocular system useful for picking applications. It can estimate the 3D position of a single marker attached to the target object assuming that the orientation of the object is approximately known.

Chapter 11

Developing a Collaborative Supply Chain Management Platform:
A Service-Oriented Approach 209
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Jean-Charles Lange, University Catholique de Louvain, Belgium
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Service-oriented computing is becoming increasingly popular. It allows designing flexible and adaptable software systems that can be easily adopted on demand by software customers. Those benefits are from primary importance in the context of supply chain management; that is why this paper proposes to apply ProDAOSS, a process for developing adaptable and open service systems to an industrial case study in outbound logistics. ProDAOSS is conceived as a plug-in for I-Tropos - a broader development methodology - so that it covers the whole software development life cycle. At analysis level, flexible business processes are generically modelled with different complementary views. First of all, an aggregate services view of the whole applicative package is offered; then services are split using an agent ontology - through the i* framework - to represent it as an organization of agents. A dynamic view completes the documentation by offering the service realization paths. At design stage, the service center architecture proposes a reference architectural pattern for services realization in an adaptable and open manner. The chapter finally presents the implemented platform for a particular service – manage transport – so that the reader can realize how the developments have been achieved.

Selected Readings

Chapter 12

Applying Dynamic Causal Mining in Health Service Management 233
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This article describes an application that illustrates the role of data mining technology in identifying hidden causal knowledge from health and medical data repositories. Across the health care and medical enterprises, a wide variety of data is being generated at a rapid rate. Current information technologies tends to focus on a more statical side of causal knowledge and do not address the dynamic causal knowledge. This article shows that the dynamic causal relation data can be captured for treatment, payment, operations purposes and administrative directed insights. Accessing this currently unrealized knowledge potential would enable the delivery of actionable knowledge to medical practitioners, healthcare system managers, policy planners and even patients to make a significant difference in overall healthcare.

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Using Simulation Systems for Decision Support..... 253
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This chapter describes the use of simulation systems for decision support in support of real operations, which is the most challenging application domain in the discipline of modeling and simulation. To this end, the systems must be integrated as services into the operational infrastructure. To support discovery, selection, and composition of services, they need to be annotated regarding technical, syntactic, semantic, pragmatic, dynamic, and conceptual categories. The systems themselves must be complete and validated. The data must be obtainable, preferably via common protocols shared with the operational infrastructure. Agents and automated forces must produce situation adequate behavior. If these requirements for simulation systems and their annotations are fulfilled, decision support simulation can contribute significantly to the situational awareness up to cognitive levels of the decision maker

Chapter 14

Genetic Algorithm to Solve Multi-Period, Multi-Product,Bi-EchelonSupply Chain
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In many multi-stage manufacturing supply chains, transportation related costs are a significant portion of final product costs. It is often crucial for successful decision making approaches in multi-stage manufacturing supply chains to explicitly account for non-linear transportation costs. In this article, we have explored this problem by considering a Two-Stage Production-Transportation (TSPT). A two-stage supply chain that faces a deterministic stream of external demands for a single product is considered. A finite supply of raw materials, and finite production at stage one has been assumed. Items are manufactured at stage one and transported to stage two, where the storage capacity of the warehouses is limited. Packaging is completed at stage two (that is, value is added to each item, but no new items are created), and the finished goods inventories are stored which is used to meet the final demand of customers. During each period, the optimized production levels in stage one, as well as transportation levels between stage one and stage two and routing structure from the production plant to warehouses and then to customers, must be determined. The authors consider “different cost structures,” for both manufacturing and transportation. This TSPT model with capacity constraint at both stages is optimized using Genetic Algorithms (GA) and the results obtained are compared with the results of other optimization techniques of complete enumeration, LINDO, and CPLEX.

Chapter 15

Data Mining in Decision Support for Bioenergy Production 290
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Yuji Naka, Tokyo Institute of Technology, Japan

Deliberate exploitation of natural resources and excessive use of environmentally abhorrent materials have resulted in environmental disruptions threatening the life support systems. A human centric approach of development has already damaged nature to a large extent. This has attracted the attention of environmental specialists and policy makers. It has also led to discussions at various national and international conventions. The objective of protecting natural resources cannot be achieved without the involvement of professionals from multidisciplinary areas. This chapter recommends a model for the creation of knowledge-based systems for natural resources management. Further, it describes making use of unique capabilities of remote sensing satellites for conserving natural resources and managing natural disasters. It is exclusively for the people who are not familiar with the technology and who are given the task of framing policies.

Chapter 16

Towards a Semiotic Metrics Suite for Product Ontology Evaluation 309

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In recent years, product ontology has been proposed for solving integration problems in product-related information systems such as e-commerce and supply chain management applications. A product ontology provides consensual definitions of concepts and inter-relationships being relevant in a product domain of interest. Adopting such an ontology requires means for assessing their suitability and selecting the “right” product ontology. In this article, the authors (1) propose a metrics suite for product ontology evaluation based on semiotic theory, and (2) demonstrate the feasibility and usefulness of the metrics suite using a supply chain model. The contribution of our research is the comprehensive metrics suite that takes into account the various quality dimensions of product ontology.

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