

Planning And Scheduling Of High Rise Building Using Primavera

In two volumes, *Planning Production and Inventories in the Extended Enterprise: A State of the Art Handbook* examines production planning across the extended enterprise against a backdrop of important gaps between theory and practice. The early chapters describe the multifaceted nature of production planning problems and reveal many of the core complexities. The middle chapters describe recent research on theoretical techniques to manage these complexities. Accounts of production planning systems currently in use in various industries are included in the later chapters. Throughout the two volumes there are suggestions on promising directions for future work focused on closing the gaps. Included in Volume 1 are papers on the Historical Foundations of Manufacturing Planning and Control; Advanced Planning and Scheduling Systems; Sustainable Product Development and Manufacturing; Uncertainty and Production Planning; Demand Forecasting; Production Capacity; Data in Production and Supply Chain Planning; Financial Uncertainty in SC Models; Field Based Research in Production Control; Collaborative SCM; Sequencing and Coordination in Outsourcing and Subcontracting Operations; Inventory Management; Pricing, Variety and Inventory Decisions for Substitutable Items; Perishable and Aging Inventories; Optimization Models of Production Planning Problems; Aggregate Modeling of Manufacturing Systems; Robust Stability Analysis of Decentralized Supply Chains; Simulation in Production Planning; and Simulation-Optimization in Support of Tactical and Strategic Enterprise Decisions. Included in Volume 2 are papers on Workload and Lead-Time Considerations under Uncertainty; Production Planning and Scheduling; Production Planning Effects on Dynamic Behavior of A Simple Supply Chain; Supply and Demand in Assemble-to-Order Supply Chains; Quantitative Risk Assessment in Supply Chains; A Practical Multi-Echelon Inventory Model with Semiconductor Application; Supplier Managed Inventory for Custom Items with Long Lead Times; Decentralized Supply Chain Formation; A Cooperative Game Approach to Procurement Network Formation; Flexible SC Contracts with Options; Build-to-Order Meets Global Sourcing for the Auto Industry; Practical Modeling in Automotive Production; Discrete Event Simulation Models; Diagnosing and Tuning a Statistical Forecasting System; Enterprise-Wide SC Planning in Semiconductor and Package Operations; Production Planning in Plastics; SC Execution Using Predictive Control; Production Scheduling in The Pharmaceutical Industry; Computerized Scheduling for Continuous Casting in Steelmaking; and Multi-Model Production Planning and Scheduling in an Industrial Environment.

This book concentrates on real-world production scheduling in factories and industrial settings. It includes industry case studies that use innovative techniques as well as academic research results that can be used to improve production scheduling. Its purpose is to present scheduling principles, advanced tools, and examples of innovative scheduling systems to persons who could use this information to improve their own production scheduling.

Towards Balanced Automation The concept. Manufacturing industries worldwide are facing tough challenges as a consequence of the globalization of economy and the openness of the markets. Progress of the economic blocks such as the European Union, NAFTA, and MERCOSUR, and the global agreements such as GATT, in addition to their obvious economic and social consequences, provoke strong paradigm shifts in the way that the manufacturing systems are conceived and operate. To increase profitability and reduce the manufacturing costs, there is a recent tendency towards establishing partnership links among the involved industries, usually between big industries and the networks of components' suppliers. To benefit from the advances in technology, similar agreements are being established between industries and universities and research institutes. Such an open *tete-cooperation* network may be identified as an extended enterprise or a virtual enterprise. In fact, the manufacturing process is no more carried out by a single enterprise, rather each enterprise is just a node that adds some value (a step in the manufacturing chain) to the cooperation network of enterprises. The new trends create new scenarios and technological challenges, especially to the Small and Medium size Enterprises (SMEs) that clearly comprise the overwhelming majority of manufacturing enterprises worldwide. Under the classical scenarios, these SMEs would have had big difficulties to access or benefit from the state of the art technology, due to their limited human, financial, and material resources.

The annual ICAPS conference series was formed in 2003 through the merger of the International Conference on Artificial Intelligence Planning and Scheduling and the European Conference on Planning. ICAPS continues the traditional high standards of AIPS and ECP as an archival forum for new research in the field of automated planning and scheduling. The 64 papers included in this volume were selected from a record 187 submissions, including submissions to special tracks in Robotics and Novel Applications. To review the papers, three international program committees were formed -- one for the main conference track, and one for each of the special tracks -- ensuring reviewers had relevant experience and applied relevant criteria to the papers submitted. The result is a broad range of papers representing the latest advances in the field of automated planning and scheduling. This range of topics covered includes: search and constraint reasoning in planning and scheduling; probabilistic planning models and algorithms; integrated frameworks for planning, scheduling and execution; the use of learning methods; multiagent planning and scheduling; planning and scheduling for single and multi-robot scenarios; and others, including the application of planning techniques to novel real-world problems.

We live in a world where we try to solve similar problems in structurally the same way. But they simply are not optimally solved all the same. Supply Chain Optimization through Segmentation and Analytics addresses the issue of optimizing the planning and scheduling process and asks the question; "Is there a 'one size fits all' solution for planning and scheduling?" The answer is a resounding "No!" We migrated through EOQ, MRP, JIT, and TOC, each time hoping to find that one size fits all. Each of these systems looked at the facility as if it had one focused problem, either optimizing work schedules, materials movement, or machine utilization. But what if you have two, or possibly even all three of these problems? Then what system do you use? Or what if your critical resource is not labor, materials, or machinery? Then which planning and scheduling solution do you utilize? This book introduces the concept of segmentation as the planning and scheduling tool that facilitates the optimization of the supply chain. If you have one type of problem in a part of your supply chain, you use the solution that appropriately focuses on that problem. If you have a different problem in a different part of your supply chain, then you use a different and appropriate tool for that part of the supply chain, and so forth. Or, if your product is in different stages of its life cycle, it probably requires a different set of tools for each stage of that life cycle. In addition, the book discusses how to integrate planning and scheduling tools using a segmentation approach that results in a world-class supply chain environment. It clearly details the power of segmentation and offers a systematic plan for implementation in the supply chain. To facilitate this, the author covers the components of an integrated segmentation policy, including the analytics elements and the measures that define segmentation success. He helps you build a strategy and methodology for introducing segmentation principles that allow you to break free from "one size fits all" thinking.

This book focuses on planning and scheduling for construction projects and presents field-site-based best practices related to schedule management and Primavera P6, and offers strategies that utilize scheduling methodologies and tools. These strategies are based on the theory of schedule management and features of scheduling software packages, which can be applied in every field site no matter what the construction project type is. This book introduces examples and tips, as well as suggestions for developing efficient schedules and management methods that ensure immediate improvement in schedule controlling. This book is designed to be Primavera P6 user-friendly, so readers using P6 can understand P6-based schedule management with ease. This book covers all matters schedulers should know and understand regarding schedule management. It also includes the missing manuals of schedule management textbooks and Primavera P6 manuals.

Critical Path Method (CPM) and Performance Evaluation and Review Technique (PERT) are widely recognized as the most effective methods of keeping large, complex construction projects on schedule,

under budget, and up to professional standards. But these methods remain underused because they are poorly understood and, due to a host of unfamiliar terms and applications, may seem more complicated than they really are. This encyclopedia brings together, in one comprehensive volume, all terms, definitions, and applications related to the time and cost management of construction projects. While many of these terms refer to ancient and venerable building practices, others have evolved quite recently and refer specifically to modern construction and management techniques. Sources include hundreds of professional books, trade journals, and research publications, as well as planning and scheduling software vendor literature. The detailed glossary of all applicable terms includes a cross-referenced listing of examples that describe real-world applications for each term supplied. An extensive bibliography covers all applicable books, articles, and periodicals available on project planning, scheduling, and control using CPM and related subjects. This book is an important quick reference and desktop information resource for construction planners, schedulers, and controllers, as well as civil engineers and project managers. It is also the ultimate research tool for educators, students, or anyone who seeks to improve their understanding of the management of modern construction projects.

This book constitutes the refereed proceedings of the 17th IFIP/IEEE International Workshop on Distributed Systems, Operations and Management, DSOM 2006, held in Dublin, Ireland in October 2006 in the course of the 2nd International Week on Management of Networks and Services, Manweek 2006. The 21 revised full papers and four revised short papers presented were carefully reviewed and selected from 85 submissions.

Optimization problems in practice are diverse and evolve over time, giving rise to requirements both for ready-to-use optimization software packages and for optimization software libraries, which provide more or less adaptable building blocks for application-specific software systems. In order to apply optimization methods to a new type of problem, corresponding models and algorithms have to be "coded" so that they are accessible to a computer. One way to achieve this step is the use of a modeling language. Such modeling systems provide an excellent interface between models and solvers, but only for a limited range of model types (in some cases, for example, linear) due, in part, to limitations imposed by the solvers. Furthermore, while modeling systems especially for heuristic search are an active research topic, it is still an open question as to whether such an approach may be generally successful. Modeling languages treat the solvers as a "black box" with numerous controls. Due to variations, for example, with respect to the pursued objective or specific problem properties, addressing real-world problems often requires special purpose methods. Thus, we are faced with the difficulty of efficiently adapting and applying appropriate methods to these problems. Optimization software libraries are intended to make it relatively easy and cost effective to incorporate advanced planning methods in application-specific software systems. A general classification provides a distinction between callable packages, numerical libraries, and component libraries.

Master scheduling is an essential planning tool that helps manufacturers synchronize their production cycle with actual market demand. The third edition of this easy-to-follow handbook helps you understand the basic and more advanced concepts of master scheduling, from implementation to capacity planning to final assembly techniques. Packed with handy checklists and examples, Master Scheduling, Third Edition delivers guidelines and techniques for a world-class master schedule.

Introduction Vision, Mission and Strategy Maintenance Basics Planning and Scheduling Parts, Materials and Tools Management Reliability Operational Reliability M&R Tools Performance Measure - Metrics Human Side of M&R Best Practices/Benchmarking Maintenance Excellence Appendices

Abstract: "Execution of tasks in dynamic batch units provides additional operating freedom via transient control profiles. When considered at the design and scheduling stage, this freedom can stretch the limits of profitability under strict market, facility and time constraints. The work in this paper incorporates dynamic processing conditions for products in a multi-product batch plant, as opposed to fixing the process by recipes, in the broader context of equipment design, production planning, scheduling and inventory considerations. The objective is a general function of fixed design costs, operating costs, production revenues etc. Decisions include stage processing times for products, transient stage operating policies, continuous design parameters, production capacity and production schedules. The infinite dimensional optimal control problem for each operation is solved using collocation over finite time elements ([6], [7]). Scheduling, with its combinatorial complexity, is addressed in the scope of flowshop plants for specific transfer policies using the Aggregated Scheduling model in [3] and [4]. Two examples are solved via sequential and simultaneous solution approaches. The smaller first example allows transient control at the reaction stage for problems with relevant objectives in planning and scheduling. The second example allows transient control at the reaction and high purity separation stage for a general objective function. Considerable savings achieved in most situations are reported, along with moderate computational requirements for solving the examples."

Become an Expert on the Work Breakdown Structure! The basic concept and use of the work breakdown structure (WBS) are fundamental in project management. In Work Breakdown Structures for Projects, Programs, and Enterprises, author Gregory T. Haugan, originator of the widely accepted 100 percent rule, offers an expanded understanding of the WBS concept, illustrating its principles and applications for planning programs as well as its use as an organizing framework at the enterprise level. Through specific examples, this book will help you understand how the WBS aids in the planning and management of all functional areas of project management. With this valuable resource you will be able to:

- Tailor WBSs to your organization's unique requirements using provided checklists and principles
- Develop and use several types of WBS
- Use WBS software to gain a competitive edge
- Apply the 100 percent rule when developing a WBS for a project or program
- Establish a WBS for a major construction project using included templates
- Understand portfolio management and establish an enterprise-standard WBS

This is the first book to focus on emerging technologies for distributed intelligent decision-making in process planning and dynamic scheduling. It has two sections: a review of several key areas of research, and an in-depth treatment of particular techniques. Each chapter addresses a specific problem domain and offers practical solutions to solve it. The book provides a better understanding of the present state and future trends of research in this area.

This book is a guide to modern production planning methods based on new scientific achievements and various practical planning rules of thumb. Several numerical examples illustrate most of the calculation methods, while the text includes a set of programs for calculating production schedules and an example of a cloud-based enterprise resource planning (ERP) system. Despite the relatively large number of books dedicated to this topic, Advanced Planning and Scheduling is the first book of its kind to feature such a wide

range of information in a single work, a fact that inspired the author to write this book and publish an English translation. This work consists of two parts, with the first part addressing the design of reference and mathematical models, bottleneck models and multi-criteria models and presenting various sample models. It describes demand-forecasting methods and also includes considerations for aggregating forecasts. Lastly, it provides reference information on methods for data stocking and sorting. The second part of the book analyzes various stock planning models and the rules of safety stock calculation, while also considering the stock traffic dynamics in supply chains. Various batch computation methods are described in detail, while production planning is considered on several levels, including supply planning for customers, master planning, and production scheduling. This book can be used as a reference and manual for current planning methods. It is aimed at production planning department managers, company information system specialists, as well as scientists and PhD students conducting research in production planning. It will also be a valuable resource for students at universities of applied sciences.

Understanding how to make the best of human skills and knowledge is essential in the design of technology and jobs, particularly where these involve decision-making and uncertainty. Recent developments have been made in naturalistic decision-making, distributed cognition and situational awareness, particularly with respect to aviation, transport and strategic planning, the nuclear industry and other high-risk industries. Despite the integration of computer-based support systems in production scheduling in recent years, the reality is that most enterprises consist of reactive re-scheduling, involving a high degree of human involvement. It is often with the insight, knowledge and skills of people that scheduling skills can function with any degree of success. Human Performance in Planning and Scheduling covers many industries, including clothing, steel, machine tools, paper/board, and the automobile industry. Using international case studies from various manufacturing industries, they highlight the fact that the human scheduler is a pivotal element in the scheduling process. Each section of the book includes an introduction with an overview of the material to follow, clearly identifying themes, discussion points and highlights inter-connections between the authors' work.

This book constitutes the thoroughly refereed post-proceedings of the Joint ERCIM/Compulog-Net Workshop on New Trends in Constraints held in Paphos, Cyprus, Greece in October 1999. The 12 revised full research papers presented together with four surveys by leading researchers were carefully reviewed. The book is divided in topical sections on constraint propagation and manipulation, constraint programming, and rule-based constraint programming.

Lists citations with abstracts for aerospace related reports obtained from world wide sources and announces documents that have recently been entered into the NASA Scientific and Technical Information Database.

This proceedings book brings together the leading innovations and achievements by leading professionals. It acts as a forum for engineers, scientists, researchers, managers and students from academia and industry to present and discuss progress being made in research and application of computer-aided process engineering.

This new edition of the well established text Scheduling - Theory, Algorithms, and Systems provides an up-to-date coverage of important theoretical models in the scheduling literature as well as significant scheduling problems that occur in the real world. It again includes supplementary material in the form of slide-shows from industry and movies that show implementations of scheduling systems. The main structure of the book as per previous edition consists of three parts. The first part focuses on deterministic scheduling and the related combinatorial problems. The second part covers probabilistic scheduling models; in this part it is assumed that processing times and other problem data are random and not known in advance. The third part deals with scheduling in practice; it covers heuristics that are popular with practitioners and discusses system design and implementation issues. All three parts of this new edition have been revamped and streamlined. The references have been made completely up-to-date. Theoreticians and practitioners alike will find this book of interest. Graduate students in operations management, operations research, industrial engineering, and computer science will find the book an accessible and invaluable resource. Scheduling - Theory, Algorithms, and Systems will serve as an essential reference for professionals working on scheduling problems in manufacturing, services, and other environments. Reviews of third edition: This well-established text covers both the theory and practice of scheduling. The book begins with motivating examples and the penultimate chapter discusses some commercial scheduling systems and examples of their implementations." (Mathematical Reviews, 2009)

The International Symposium on Distributed Computing and Artificial Intelligence is an annual forum that brings together ideas, projects, lessons, etc. associated with distributed computing, artificial intelligence and its applications in different themes. This meeting has been held at the University of Salamanca from the 22th to the 24th of October 2008. This symposium has been organized by the Biomedicine, Intelligent System and Educational Technology Research Group (<http://bisite.usal.es/>) of the University of Salamanca. The technology transfer in this field is still a challenge and for that reason this type of contributions has been specially considered in this edition. This conference is the forum in which to present application of innovative techniques to complex problems. The artificial intelligence is changing our society. Its application in distributed environments, such as the Internet, electronic commerce, mobile communications, wireless devices, distributed computing, and so on is increasing and is becoming an element of high added value and economic potential, both industrial and research. These technologies are changing constantly as a result of the large research and technical effort being undertaken in both universities and businesses. The exchange of ideas between scientists and technicians from both academic and business areas is essential to facilitate the development of systems that meet the demands of today's society.

This is a hands-on reference guide for the maintenance or reliability engineer and plant manager. As the third volume in the "Life Cycle Engineering series, this book takes the guiding

principles of Lean Manufacturing and Maintenance and applies these concepts to everyday planning and scheduling tasks allowing engineers to keep their equipment running smoothly, while decreasing downtime. The authors offer invaluable advice on the effective use of work orders and schedules and how they fit into the overall maintenance plan. There are not many books out there on planning and scheduling, that go beyond the theory and show the engineer, in a hands-on way, how to use planning and scheduling techniques to improve performance, cut costs, and extend the life of their plant machinery. * The only book that takes a direct look at streamlining planning and scheduling for a Lean Manufacturing Environment * This book shows the engineer how to create and stick to effective schedules * Gives examples and templates in the back of the book for use in day-to-day scheduling and calculations

Bringing artificial intelligence planning and scheduling applications into the real world is a hard task that is receiving more attention every day by researchers and practitioners from many fields. In many cases, it requires the integration of several underlying techniques like planning, scheduling, constraint satisfaction, mixed-initiative planning and scheduling, temporal reasoning, knowledge representation, formal models and languages, and technological issues. Most papers included in this book are clear examples on how to integrate several of these techniques.

Furthermore, the book also covers many interesting approaches in application areas ranging from industrial job shop to electronic tourism, environmental problems, virtual teaching or space missions. This book also provides powerful techniques that allow to build fully deployable applications to solve real problems and an updated review of many of the most interesting areas of application of these technologies, showing how powerful these technologies are to overcome the expressiveness and efficiency problems of real world problems.

Using many illustrations, this book takes time to describe a strategy for enhancing organizational trust and productive communication and to demonstrate how these can be used to plan and organize, both in maintaining the school organization and in adapting it for change.

Primavera P6 is one of the project management super tools that can have high potential for improving project success. There are many project management software tools in the market today. Unfortunately, many people who know the software have no idea how to use it. It is important to understand basic concepts of project management using a software tool like Primavera P6 that enables users to plan, schedule and control a large number of projects in a single software platform. This book was developed to accomplish two purposes. First, to provide a practical guide to using Primavera P6 to schedule and manage projects. Second, to introduce the required knowledge and skills to aid professionals wishing to achieve PMI-Scheduling Professional certification in Planning & Scheduling and Oracle Certification in Primavera P6 Enterprise Project Portfolio Manager to do so with ease. Oracle Primavera P6 Project Management module is comprehensive, scalable, multiproject planning and control software, built on Oracle or Microsoft SQL databases for organization-wide project management. It consists of role-specific tools to satisfy each team member's needs, responsibilities, and skills.

Is living becoming irksome? Are relationships turning sour/unsustainable? Are you at a crossroads, confused, in a Catch-22 situation, in need of counsel and advice? Do you find others unbearable? You aren't lost/ebbed/withered/a spent force. You are laying your hands on the panacea. Receiving, imbibing, assimilating and implementing all that is contained herein would usher in the transformation. Relevant, situation-centric, situation-specific, contextual, and with value-addition, you will stand strengthened and empowered after going through this book. It does not matter whether you are an upstart or a virtuoso in your chosen area, or if you are confined to working at/from home or are on a globe-trotting spree. You are bound to be caught in circumstances that could be dicey. Who isn't in need of a helping hand? You would benefit substantially from the doses of motivation, solace, analogies and anecdotes contained herein. Go through the contents and face the vicissitudes with courage. Finally, 'Bang 'em on' after you 'Bring 'em on'!

Traditional manufacturing systems rely upon centralized, hierarchical systems that are not responsive enough to the increasing demand for mass customization. Decentralized, or heterarchical, management systems using autonomous agents promise to nullify the limitations of previous solutions. Agent-Based Manufacturing and Control Systems: New

This dissertation is composed of three major parts, each studying a problem related to semiconductor manufacturing. The first part of the dissertation proposes a high-level scheduling model that serves as an intermediate stage between planning and detailed scheduling in the usual planning hierarchy. The high-level scheduling model explicitly controls the WIP over time in the system and provides a more specific guide to detailed scheduling. WIP control is used to balance the WIP (Work In Process) level and to keep the bottleneck station busy to maintain a high throughput rate. A mini-fab simulation model is used to evaluate the benefits of different approaches to implementing such a high-level scheduling model, and to compare different WIP control policies. Extensive numerical studies show that the proposed approaches can achieve much shorter cycle times than the traditional planning-scheduling approach, with only a small increase in inventory and backorder costs. With increasing worldwide competition, high technology product manufacturing companies have to pay great attention to lower their production costs and guarantee high quality at the same time. Advanced process control (APC) is widely used in semiconductor manufacturing to adjust machine parameters so as to achieve satisfactory product quality. The interaction between scheduling and APC motivates the second part of this dissertation. First, a single-machine makespan problem with APC constraints is proved to be NPcomplete. For some special cases, an optimal solution is obtained analytically. In more general cases, the structure of optimal solutions is explored. An efficient heuristic algorithm based on these structural results is proposed and compared to an integer programming approach. Another important issue in manufacturing system is maintenance, which affects cycle time and yield management. Although there is extensive literature regarding maintenance policies, the analysis in most papers is restricted to conventional preventive maintenance (PM) policies, i.e., calendar-based or jobbased PM policies. With the rapid development of new technology, predictive maintenance has become more feasible, and has attracted more and more attention from semiconductor manufacturing companies in recent years. Thus, the third problem considered in this dissertation is predictive maintenance in an M/G/1 queueing environment. One-recipe and two-recipe problems are studied through semi-Markov decision processes (SMDP), and structural properties are obtained. Discounted SMDP problems are solved by linear programming and expected machine availabilities are calculated to evaluate different PM policies. The optimal policy can maintain a high machine availability with low long-run cost. The structures of the optimal PM policies show that it is necessary to consider multiple recipes explicitly in predictive maintenance models.

Project Management, Planning & Scheduling with Primavera P6A Practical Guide Independently Published

Human and organizational factors have a substantial impact on the performance of planning and scheduling processes. Despite widespread and advanced decision support systems, human

decision makers are still crucial to improve the operational performance in manufacturing industries. In this text, the state of the art in this area is discussed by experts from a wide variety of engineering and social science disciplines. Moreover, recent results from collaborative studies and a number of field cases are presented. The text is targeted at researchers and graduate students, but is also particularly useful for managers, consultants, and system developers to better understand how human performance can be advanced.

This book thoroughly covers the topic of the need and use of project planning, scheduling, and control in the construction industry. It approaches the subject—and its related terminology and techniques—from a conceptual viewpoint that reinforces learning with increasingly difficult levels of analytical problems. KEY TOPICS Chapter topics cover the development of work breakdown structures, precedence grids, precedence network node diagrams, analytical methods for network solutions, resource scheduling, leveling and allocation, and project-scheduling simulation with PERT application. For use in construction management and technology, and civil engineering.

This research presents an integrated model for the planning, scheduling and control of high-rise building construction. The model has three main modules: planning, scheduling and progress reporting. The developed model is flexible, providing an open architecture that allows for user interaction. The proposed model is designed using object-oriented modeling and builds on earlier developments made by El-Rayes (1997) and Moselhi. It also captures the experience gained from an actual case study of a recently constructed institutional high-rise building. The case study assisted in the model developments in establishing the job logic vis-a-vis the relationships among the project activities and progress reporting, supporting exception reporting and the generation of different types of reports. The case is of a 17 floor institutional high-rise building constructed for Concordia University in downtown Montreal. The planning module of the developed model was designed using knowledge extracted from the literature and the experience gained from the case study. It has the ability to assign both the contractor's own work force and subcontractors simultaneously to reflect the status of current practice. The scheduling module uses resource driven scheduling techniques for repetitive construction and considers the impact of the learning curve and crew work continuity. An optimization algorithm designed using dynamic programming is embedded in the model to enable the optimization of the project schedule considering the following priorities: (1) cost; (2) time; and (3) their combined effect; in a manner similar to what is known as A + B bidding in highway construction. The model was coded using Microsoft Visual C++ Version 6.0 and Microsoft Visual C++ NET. The tracking and control model uses the Earned Value technique and is capable of providing various efficient reports, to suite the needs of different levels of management. Numerical examples are presented to illustrate the essential features of the developed model.

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