

Klaus Neumann · Christoph Schwindt
Jürgen Zimmermann

Project Scheduling with Time Windows and Scarce Resources

Second Edition



Springer

Project Scheduling With Time Windows

**Klaus Neumann, Christoph
Schwindt, Jürgen Zimmermann**



Project Scheduling With Time Windows:

Project Scheduling with Time Windows Ulrich Dorndorf, 2002-08-06 Project Scheduling is concerned with the allocation of scarce resources over time. The rich optimisation models with time windows that are treated in this book cover a multitude of practical decision problems arising in diverse application areas such as construction engineering or make to order production planning. The book shows how Constraint Propagation techniques from Artificial Intelligence can be successfully combined with Operations Research methods for developing powerful exact and heuristic solution algorithms for a very general class of scheduling problems. Example applications demonstrate the effectiveness of the approach. **Project**

Scheduling with Time Windows Ulrich Dorndorf, 2012-12-06 Project Scheduling is concerned with the allocation of scarce resources over time. The rich optimisation models with time windows that are treated in this book cover a multitude of practical decision problems arising in diverse application areas such as construction engineering or make to order production planning. The book shows how Constraint Propagation techniques from Artificial Intelligence can be successfully combined with Operations Research methods for developing powerful exact and heuristic solution algorithms for a very general class of scheduling problems. Example applications demonstrate the effectiveness of the approach. Project

Scheduling with Time Windows and Scarce Resources Klaus Neumann, Christoph Schwindt, Jürgen Zimmermann, 2012-12-06 A survey of the state of the art of deterministic resource constrained project scheduling with time windows. General temporal constraints and several different types of limited resources are considered. A large variety of time based financial and resource based objectives important in practice are studied. A thorough structural analysis of the feasible region of project scheduling problems and a classification and detailed investigation of objective functions are performed which can be exploited for developing efficient exact and heuristic solution methods. New interesting applications of project scheduling to production and operations management as well as investment projects are discussed in the second edition. **Project**

Scheduling with Time Windows and Scarce Resources Klaus Neumann, Christoph Schwindt, Jürgen Zimmermann, 2013-06-29 A project is a unique undertaking or endeavor to be accomplished that can be divided into individual subtasks or activities each of which requires time and scarce resources for its completion. Also there is a desired objective to be attained for example minimization of project duration or of variation of resource utilization or maximization of net present value of the project. Moreover there are given precedence relationships among activities prescribing the order in which activities must be carried out. Project scheduling in its basic form consists of finding start times for all activities such that prescribed resource and precedence constraints are satisfied and an objective function is optimized. Since the concept of a project can be interpreted quite broadly project scheduling problems arise in a great variety of practical situations. These include construction work, the development and introduction of new products, service systems or software packages, strategic long term planning in manufacturing and the service sector, emergency planning and even the conducting of political

campaigns Recently project scheduling has been successfully applied to production and operations management e.g. make to order production in manufacturing and batch production in process industries Since the late 1950s network based planning methods for project scheduling problems have been developed cf Elmaghraby 1977 and Moder et al *Evolutionary Computation in Combinatorial Optimization* Carlos Cotta, 2007-03-30 This book constitutes the refereed proceedings of the 7th European Conference on Evolutionary Computation in Combinatorial Optimization EvoCOP 2007 held in Valencia Spain in April 2007 The 21 revised full papers presented were carefully reviewed and selected from 81 submissions The papers cover evolutionary algorithms as well as various other metaheuristics like scatter search tabu search memetic algorithms variable neighborhood search greedy randomized adaptive search procedures ant colony optimization and particle swarm optimization algorithms The papers are specifically dedicated to *Resource-constrained Project Scheduling with Time Windows* Klaus Neumann, Christoph Schwindt, Jürgen Zimmermann, 2005 **Project scheduling with time windows and scarce resources** Klaus Neumann, 2000 **Perspectives in Modern Project Scheduling** Joanna Jozefowska, Jan Weglarz, 2006-12-11 Operations Research began with the mathematical scheduling of a massive project logistically supplying Europe with military equipment and goods during the WWII Today project scheduling research continues growing in a variety of its theoretical models in its magnitude and application As the world becomes more interrelated and complex the wider its research is applied to an increasing number of project scheduling problems Project Scheduling Surveying the State of the Art surveys the current state of the art in operations research with chapters written by the respective leading experts on each topic It covers the range of the key models in the field including deterministic probabilistic single and multi mode single and multi objective and a general model on discrete continuous resources Recent solution algorithms are systematically examined The book summarizes the current developments and theoretical achievements in the field including project uncertainty and grid resource management [Handbook on Project Management and Scheduling Vol.1](#) Christoph Schwindt, Jürgen Zimmermann, 2015-01-13 Due to the increasing importance of product differentiation and collapsing product life cycles a growing number of value adding activities in the industry and service sector are organized in projects Projects come in many forms often taking considerable time and consuming a large amount of resources The management and scheduling of projects represents a challenging task and project performance may have a considerable impact on an organization's competitiveness This handbook presents state of the art approaches to project management and scheduling More than sixty contributions written by leading experts in the field provide an authoritative survey of recent developments The book serves as a comprehensive reference both for researchers and project management professionals The handbook consists of two volumes Volume 1 is devoted to single modal and multi modal project scheduling Volume 2 presents multi project problems project scheduling under uncertainty and vagueness managerial approaches and a separate part on applications case studies and information systems [Project Scheduling](#) Erik Leuven Demeulemeester, Willy S.

Herroelen,2006-04-11 Our objectives in writing Project Scheduling A Research Handbook are threefold 1 Provide a unified scheme for classifying the numerous project scheduling problems occurring in practice and studied in the literature 2 Provide a unified and up to date treatment of the state of the art procedures developed for their solution 3 Alert the reader to various important problems that are still in need of considerable research effort Project Scheduling A Research Handbook has been divided into four parts Part I consists of three chapters on the scope and relevance of project scheduling on the nature of project scheduling and finally on the introduction of a unified scheme that will be used in subsequent chapters for the identification and classification of the project scheduling problems studied in this book Part II focuses on the time analysis of project networks Part III carries the discussion further into the crucial topic of scheduling under scarce resources Part IV deals with robust scheduling and stochastic scheduling issues Numerous tables and figures are used throughout the book to enhance the clarity and effectiveness of the discussions For the interested and motivated reader the problems at the end of each chapter should be considered as an integral part of the presentation **Project Scheduling** Jan

Weglarz,2012-12-06 Project scheduling problems are generally speaking the problems of allocating scarce resources over time to perform a given set of activities The resources are nothing other than the arbitrary means which activities complete for Also the activities can have a variety of interpretations Thus project scheduling problems appear in a large spectrum of real world situations and in consequence they have been intensively studied for almost forty years Almost a decade has passed since the multi author monograph R Slowinski 1 W glarz eds Advances in Project Scheduling Elsevier 1989 summarizing the state of the art across project scheduling problems was published Since then considerable progress has been made in all directions of modelling and finding solutions to these problems Thus the proposal by Professor Frederick S Hillier to edit a handbook which reports on the recent advances in the field came at an exceptionally good time and motivated me to accept the challenge Fortunately almost all leading experts in the field have accepted my invitation and presented their completely new advances often combined with expository surveys Thanks to them the handbook stands a good chance of becoming a key reference point on the current state of the art in project scheduling as well as on new directions in the area The contents are divided into four parts The first one dealing with classical models exact algorithms is preceded by a proposition of the classification scheme for scheduling problems Resource-Constrained Project Scheduling

Christian Artigues,Sophie Demassey,Emmanuel Néron,2013-03-01 This title presents a large variety of models and algorithms dedicated to the resource constrained project scheduling problem RCPSP which aims at scheduling at minimal duration a set of activities subject to precedence constraints and limited resource availabilities In the first part the standard variant of RCPSP is presented and analyzed as a combinatorial optimization problem Constraint programming and integer linear programming formulations are given Relaxations based on these formulations and also on related scheduling problems are presented Exact methods and heuristics are surveyed Computational experiments aiming at providing an empirical

insight on the difficulty of the problem are provided The second part of the book focuses on several other variants of the RCPSP and on their solution methods Each variant takes account of real life characteristics which are not considered in the standard version such as possible interruptions of activities production and consumption of resources cost based approaches and uncertainty considerations The last part presents industrial case studies where the RCPSP plays a central part Applications are presented in various domains such as assembly shop and rolling ingots production scheduling project management in information technology companies and instruction scheduling for VLIW processor architectures

Resource Allocation in Project Management Christoph Schwindt, 2005-06-13 The book is devoted to structural issues algorithms and applications of resource allocation problems in project management Special emphasis is given to a unifying framework within which a large variety of project scheduling problems can be treated Those problems involve general temporal constraints among project activities different types of scarce resources and a broad class of regular and nonregular objective functions ranging from time based and financial to resource levelling functions The diversity of the models proposed allows for covering many features arising in scheduling applications beyond the field of project management such as short term production planning in the manufacturing or process industries

Computational Collective Intelligence. Technologies and Applications Jeng-Shyang Pan, Shyi-Ming Chen, Ngoc-Thanh Nguyen, 2010-11-06 This volume composes the proceedings of the Second International Conference on Computational Collective Intelligence Technologies and Applications ICCCI 2010 which was hosted by National Kaohsiung University of Applied Sciences and Wroclaw University of Technology and was held in Kaohsiung City on November 10 12 2010 ICCCI 2010 was technically co sponsored by Shenzhen Graduate School of Harbin Institute of Technology the Tainan Chapter of the IEEE Signal Processing Society the Taiwan Association for Web Intelligence Consortium and the Taiwanese Association for Consumer Electronics It aimed to bring together researchers engineers and policymakers to discuss the related techniques to exchange research ideas and to make friends ICCCI 2010 focused on the following themes Agent Theory and Application Cognitive Modeling of Agent Systems Computational Collective Intelligence Computer Vision Computational Intelligence Hybrid Systems Intelligent Image Processing Information Hiding Machine Learning Social Networks Web Intelligence and Interaction

Mathematics - Key Technology for the Future Willi Jäger, Hans-Joachim Krebs, 2011-06-28 Efficient transfer between science and society is crucial for their future development The rapid progress of information technology and computer systems offers a large potential and new perspectives for solving complex problems Mathematical modelling and simulation have become important tools not only in scientific investigations but also in analysing planning and controlling technological and economic processes Mathematics imbedded in an interdisciplinary concept has become a key technology The book covers the results of a variety of major projects in industrial mathematics following an initiative of the German Federal Ministry of Education and Research All projects are collaborations of industrial companies and university based researchers and range from automotive industry

to computer technology and medical visualisation In general the projects presented in this volume prove that new mathematical ideas and methods can be decisive for the solution of industrial and economic problems **Operations Research Proceedings 2006** Karl-Heinz Waldmann,Ulrike M. Stocker,2007-05-07 This volume contains a selection of papers referring to lectures presented at the symposium Operations Research 2006 held at the University of Karlsruhe The symposium presented the state of the art in Operations Research and related areas in Economics Mathematics and Computer Science and demonstrated the broad applicability of its core themes placing particular emphasis on Basel II one of the most topical challenges of Operations Research **Project Scheduling under Limited Resources** Sönke Hartmann,2012-12-06 Approaches to project scheduling under resource constraints are discussed in this book After an overview of different models it deals with exact and heuristic scheduling algorithms The focus is on the development of new algorithms Computational experiments demonstrate the efficiency of the new heuristics Finally it is shown how the models and methods discussed here can be applied to projects in research and development as well as market research [An Introduction to Project Modeling and Planning](#) Gündüz Ulusoy,Öncü Hazır,2021-04-05 This textbook teaches the basic concepts and methods of project management but also explains how to convert them to useful results in practice Project management offers a promising working area for theoretical and practical applications and developing software and decision support systems DSS This book specifically focuses on project planning and control with an emphasis on mathematical modeling Models and algorithms establish a good starting point for students to study the relevant literature and support pursuing academic work in related fields The book provides an introduction to theoretical concepts and it also provides detailed explanations application examples and case studies that deal with real life problems The chapter topics include questions that underlie critical thinking interpretation analytics and making comparisons Learning outcomes are defined and the content of the book is structured following these goals Chapter 1 begins by introducing the basic concepts methods and processes of project management This Chapter constitutes the base for defining and modeling project management problems Chapter 2 explores the fundamentals of organizing and managing projects from an organization s perspective Issues related to project team formation the role of project managers and organization types are discussed Chapter 3 is devoted to project planning and network modeling of projects covering fundamental concepts such as project scope Work Breakdown Structure WBS Organizational Breakdown Structure OBS Cost Breakdown Structure CBS project network modeling activity duration and cost estimating activity based costing ABC data and knowledge management Chapter 4 introduces deterministic scheduling models which can be used in constructing the time schedules Models employing time based and finance based objectives are introduced The CPM is covered The unconstrained version of maximizing Net Present Value NPV is also treated here together with the case of time dependent cash flows Chapter 5 focuses on the time cost trade off problem explaining how to reduce the duration of some of the activities and therefore reduce the project duration at the expense of additional costs This

topic is addressed for both continuous and discrete cases Chapter 6 discusses models and methods of scheduling under uncertain activity durations PERT is introduced for minimizing the expected project duration and extended to the PERT Costing method for minimizing the expected project cost Simulation is presented as another approach for dealing with the uncertainty in activity durations and costs To demonstrate the use of the PERT a case study on constructing an earthquake resistant residential house is presented Classifications of resource and schedule types are given in Chapter 7 and exact and heuristic solution procedures for the single and multi mode resource constrained project scheduling problem RCPSP are presented The objective of maximizing NPV under resource constraints is addressed and the capital constrained project scheduling model is introduced In Chapter 8 resource leveling and further resource management problems are introduced Total adjustment cost and resource availability cost problems are introduced Various exact models are investigated A heuristic solution procedure for the resource leveling problem is presented in detail Also resource portfolio management policies and the resource portfolio management problem are discussed A case study on resource leveling dealing with the annual audit project of a major corporation is presented Project contract types and payment schedules constitute the topics of Chapter 9 Contracts are legal documents reflecting the results of some form of client contractor negotiations and sometimes of a bidding process which deserve closer attention Identification and allocation of risk in contracts project control issues disputes and resolution management are further topics covered in this Chapter A bidding model is presented to investigate client contractor negotiations and the bidding process from different aspects Chapter 10 focuses on processes and methods for project monitoring and control Earned Value Management is studied to measure the project performance throughout the life of a project and to estimate the expected project time and cost based on the current status of the project How to incorporate inflation into the analysis is presented In Chapter 11 qualitative and quantitative techniques including decision trees simulation and software applications are introduced Risk phases are defined and building a risk register is addressed An example risk breakdown structure is presented The design of risk management processes is introduced and risk response planning strategies are discussed At the end of the Chapter the quantitative risk analysis is demonstrated at the hand of a team discussion case study Chapter 12 covers several models and approaches dealing with various stochastic aspects of the decision environment Stochastic models generation of robust schedules use of reactive and fuzzy approaches are presented Sensitivity and scenario analysis are introduced Also simulation analysis which is widely used to analyze the impacts of uncertainty on project goals is presented Chapter 13 addresses repetitive projects that involve the production or construction of similar units in batches such as railway cars or residential houses Particularly in the construction industry repetitive projects represent a large portion of the work accomplished in this sector of the economy A case study on the 50 km section of a motorway project is used for demonstrating the handling of repetitive project management How best to select one or more of a set of candidate projects to maintain a project portfolio is an important problem for project based

organizations with limited resources The project selection problem is inherently a multi objective problem and is treated as such in Chapter 14 Several models and solution techniques are introduced A multi objective multi period project selection and scheduling model is presented A case study that addresses a project portfolio selection and scheduling problem for the construction of a set of dams in a region is presented Finally Chapter 15 discusses three promising research areas in project management in detail i Sustainability and Project Management ii Project Management in the Era of Big Data and iii the Fourth Industrial Revolution and the New Age Project Management We elaborate on the importance of sustainability in project management practices discuss how developments in data analytics might impact project life cycle management and speculate how the infinite possibilities of the Fourth Industrial Revolution and the new technologies will transform project management practices

Application of Mathematics and Optimization in Construction Project Management Hêriş Golpîra, 2021-12-12 This book provides a broad overview of project and project management principles processes and success failure factors It also provides a state of the art of applications of the project management concepts especially in the field of construction projects based on the Project Management Body of Knowledge PMBOK The slate of geographically and professionally diverse authors illustrates project management as a multidisciplinary undertaking that integrates renewable and non renewable resources in a systematic process to achieve project goals The book describes assessment based on technical and operational goals and meeting schedules and budgets

Project Management with Dynamic Scheduling Mario Vanhoucke, 2013-11-29 The topic of this book is known as dynamic scheduling and is used to refer to three dimensions of project management and scheduling the construction of a baseline schedule and the analysis of a project schedule s risk as preparation of the project control phase during project progress This dynamic scheduling point of view implicitly assumes that the usability of a project s baseline schedule is rather limited and only acts as a point of reference in the project life cycle Consequently a project schedule should especially be considered as nothing more than a predictive model that can be used for resource efficiency calculations time and cost risk analyses project tracking and performance measurement and so on In this book the three dimensions of dynamic scheduling are highlighted in detail and are based on and inspired by a combination of academic research studies at Ghent University www.ugent.be in company trainings at Vlerick Business School www.vlerick.com and consultancy projects at OR AS www.or-as.be First the construction of a project baseline schedule is a central theme throughout the various chapters of the book and is discussed from a complexity point of view with and without the presence of project resources Second the creation of an awareness of the weak parts in a baseline schedule is discussed at the end of the two baseline scheduling parts as schedule risk analysis techniques that can be applied on top of the baseline schedule Third the baseline schedule and its risk analyses can be used as guidelines during the project control step where actual deviations can be corrected within the margins of the project s time and cost reserves The second edition of this book has seen corrections additions and amendments in detail throughout the book Moreover Chapter 15 on Dynamic Scheduling

with ProTrack has been completely rewritten and extended with a section on ProTrack as a research tool

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