

**University of Belgrade
Technical Faculty in Bor and
Mining and Metallurgy Institute Bor**



**49th International
October Conference
on Mining and Metallurgy**

PROCEEDINGS

Editors:

Nada Štrbac

Ivana Marković

Ljubiša Balanović

Bor Lake, Serbia

October 18-21, 2017

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International October
Conference

**PROCEEDINGS,
49th INTERNATIONAL OCTOBER CONFERENCE
on Mining and Metallurgy**

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PREFACE

On behalf of the Organizing Committee, it is a great honor and pleasure to wish all the participants a warm welcome to the 49th International October Conference on Mining and Metallurgy (IOC 2017) held at Bor Lake, Serbia, 18 – 21 October 2017.

The IOC 2017 has been organized by the University of Belgrade, Technical Faculty in Bor, in cooperation with Mining and Metallurgy Institute Bor. It is devoted to presenting recent research results and advances in the fields of geology, mining, metallurgy, materials science, technology, environmental protection, and related engineering topics. The primary goal of IOC is to bring together academics, researchers, and industry engineers to exchange their experiences, expertise and ideas, and also to consider possibilities for collaborative research.

This year's conference is dedicated to the memory of Professor Dragana Zivkovic who was one of our most loyal and active Committee members. The 4th International Student Conference on Technical Sciences (ISC 2017) will take place within the frame of IOC 2017. ISC provides a unique opportunity for the students from both the country and the region to promote scientific research and discuss future directions of research with the experts and specialists.

These proceedings include 153 papers from authors coming from universities, research institutes and industries in 30 countries: Austria, Bosnia and Herzegovina, Bulgaria, China, Croatia, Czech Republic, France, Germany, Hungary, India, Iran, Italy, Japan, Jordan, Kazakhstan, Libya, Macedonia, México, Montenegro, Norway, Poland, Romania, Russia, Slovakia, Slovenia, South Africa, Spain, Turkey, USA and Serbia.

Financial assistance provided by the Ministry of Education, Science and Technological Development of the Republic of Serbia is gratefully acknowledged. The support of the sponsors and their willingness and ability to cooperate has been of great importance for the success of IOC 2017. The Organizing Committee would like to extend their appreciation and gratitude to all the sponsors and friends of the Conference for their donations and support.

We would like to thank all the authors who have contributed to these proceedings, and also to the members of the scientific and organizing committees, reviewers, speakers, chairpersons and all the Conference participants for their support to IOC 2017. Sincere thanks to all the people who have contributed to the successful organization of IOC 2017.

We look forward to welcoming you to the 50th International October Conference on Mining and Metallurgy (IOC 2018), which will be held in October 2018.

On behalf of the 49th IOC Organizing Committee,
Assistant Professor Ivana Marković, PhD

IN MEMORIAM



Prof. dr Dragana Živković
(13th September 1965 – 26th November 2016)

Dragana Živković, a full professor and the dean at the Technical Faculty in Bor, University of Belgrade and a full member of the Academy of Engineering Sciences of Serbia, gave an immeasurable contribution to the development of science and education in the fields of thermodynamics, metallurgical engineering and materials science. She left a deep trace, unique in its nature, not only in Serbia, but also in the world.

Dragana Živković was one of the leading scientists in the field of Thermodynamics of multicomponent metallic systems, Advanced metallic materials, Metallurgy of iron and steel, Kinetics of metallurgical processes and Archaeometallurgy. She published over 200 scientific papers in international SCI journals, over 150 papers in national journals and more than 500 conference papers. Her papers have been cited more than 500 times.

She was involved in about 40 projects, about half of them being international, many of which were coordinated by Dragana herself. She was a member of numerous international and national scientific and professional organizations and associations, the editor-in-chief of Journal of Mining and Metallurgy, Section B: Metallurgy, a member of editorial boards of several international and national journals, the secretary of the Committee of thermodynamics and phase diagrams of Serbia, and the chairman and a member of the scientific and organizing committees of numerous national and international scientific conferences.

Through her continual participation at the International October Conference on Mining and Metallurgy, as an author, as a member of the organizing committee and the president of the scientific committee on several occasions, she managed to make this conference distinguishable in wider scientific circles, connecting people through successful collaboration and lasting friendships.

She was our dear friend, a valued and generous colleague and an inspiring teacher. She touched all of us with her positive attitude, dedication, generosity and friendship.

For all of us who had the privilege to know her, she will always be the part of our lives.

The 49th IOC Organizing Committee

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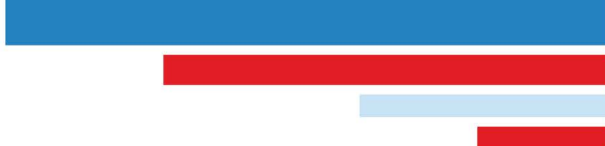
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ORDER FULFILLMENT PLANNING AT TIMKENSTEEL

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Abstract

A scope of a new order fulfillment planning methodology is provided including order promising, material allocation, production planning and scheduling. An experience of successful implementation of the planning methodology based on advanced planning and scheduling system of the new generation at American special steel maker -TimkenSteel is provided.

Keywords: *Order fulfillment planning, Supply Chain Management*

1. INTRODUCTION

Tough conditions of production companies' competition impose vital important requirements for improving customer service quality (due date performance, short production and logistic lead time, informational support of customers) and operational efficiency (assets utilization, inventory turnover, high yield). One of the key aspects for improving competitiveness in this case is development and implementation of new methodological approaches for order fulfilment planning in supply chain. Today Russian and foreign specialists, who are involved in supply chain planning, run into problems with underdevelopment of the methodology in the area of planning of contemporary supply chains of production companies. The necessity to solve these problems defines importance of investigation in this area.

2. EXPERIMENTAL

2.1 Scope of new order fulfilment planning methodology

The practical planning methodology which is program (algorithm), set of methods and approaches for achievement of some desired practical goal without missing the truth is investigated through the article. The quality (success, efficiency) of method is proved by practice, solving practical tasks – that is a search for the approaches to achieve the goal which could be implemented in complex of activities and circumstances [1-3]. Let's investigate the scope of the order fulfillment planning methodology for production companies using the following widely accepted structure: methodology basis, logical structure, specifics, timeframe.

Methodology basis

Methodological provisions of order fulfillment planning are based on fundamental and applied developments of Russian and foreign scientists in the area of economic, management, logistics, and supply chain management theories [5,6], mathematical modeling[4], business process modeling, system analysis, operational research and Delphi method.

Logical structure

Controlling object is functional departments responsible for order fulfillment planning in supply chain of a production company.

Subject matter is business processes in supply chain of a production company.

Scope is order fulfillment planning processes: order promising, material allocation, production planning, and scheduling.

Form is confirmed by controlling object key performance indicators of order fulfillment planning processes.

Tool is contemporary informational technologies.

Methods are defined by the base of methodology.

Results are realistic, goal targeted, and balanced order fulfillment plans in supply chain of a production company.

Specifics

The main specifics are the necessity to use a big hierarchy team of planners, combine push and pull methodology, take into account production technology rules and constraints.

Key principle is the following: maximization of customer service quality and support of maximal operational efficiency.

Main features are regular changes of internal and external conditions, constant increase in quality requirement for customer service, competitive pressure, decline of prices, and diversification in assortment.

Key normative is to follow the main principle.

Timeframe

Timeframe includes level of planning and scheduling. Planning and scheduling have the following horizon 1 month/1 week and period 1 day/1 minute.

The continuous order fulfillment planning is supported in order to adapt to changing internal and external conditions of supply chains of production companies.

The developed planning methodology was used at set of international production companies from aviation, machinery and metal industries. An example of successful implementation of the methodology at American metallurgical company – special steel maker is provided in this article.

2.2 Order fulfillment planning processes

Schematic view of order fulfillment processes is depicted on Figure 1.

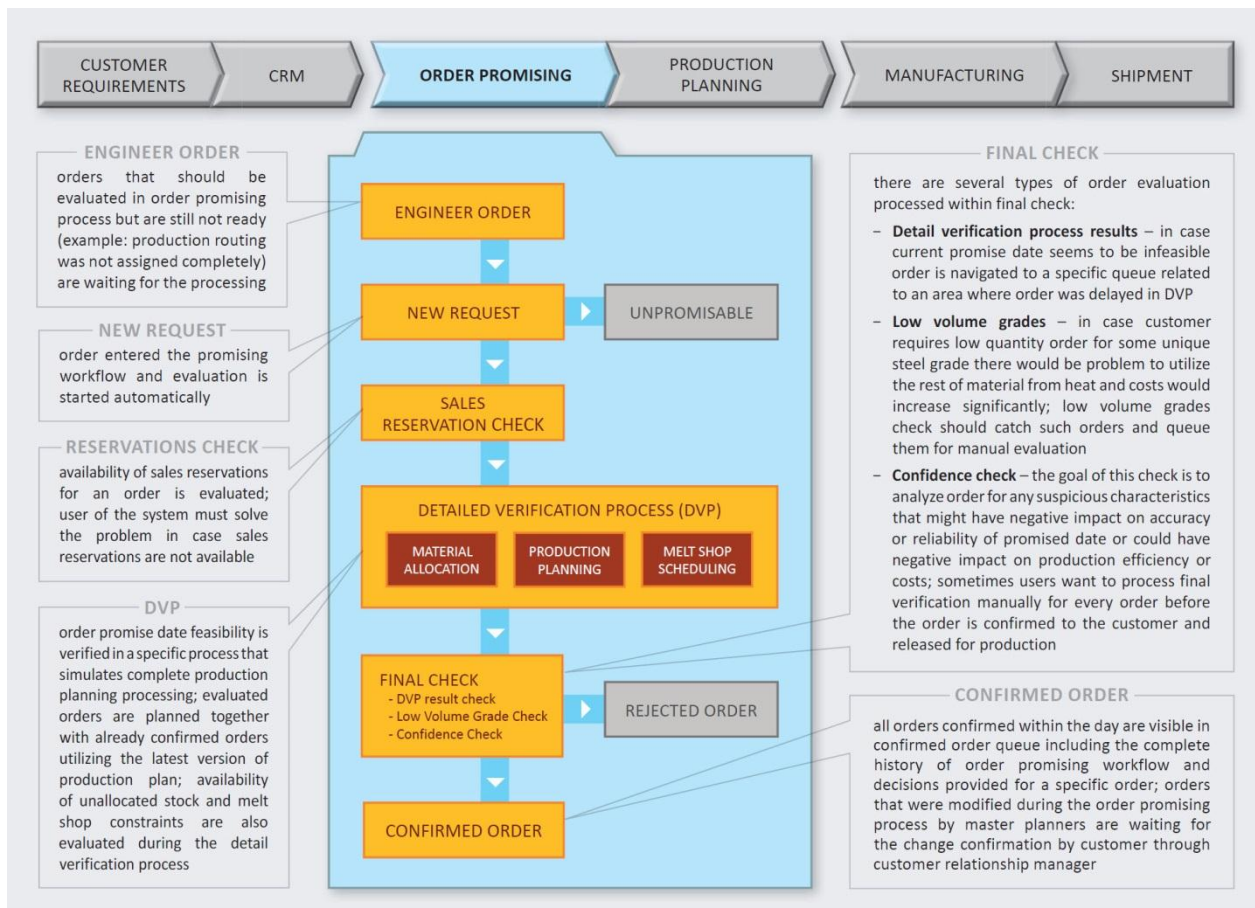


Figure 1 – Order fulfillment process

A client order passes two stages during its lifecycle. At first it is a requirement to company’s sales department from client’s purchasing department. If the requirement could be produced and confirmed it becomes an order. The order enters the planning system and reserves production capacities. Planners monitor order status and make necessary changes during daily planning.

3. RESULTS AND DISCUSSION

3.1 About special steel maker – TimkenSteel

American metallurgical company TimkenSteel produces custom alloy steels that are recognized among the highest quality, highest performing air-melted products in the form of specialty bar, seamless tubing, value-add components, billets and bottom-poured ingots. Company’s products could be found in bearing races and rolling elements, heavyweight drill pipe, drill bits and collars, stator tubes, wind energy gears and shafts, axles, crankshafts and connecting rods and much more.

The new order fulfillment planning process was deployed at TimkenSteel using advanced planning and scheduling system of the new generation.

The following key changes were done during new planning methodology implementation:

- horizon widening, rolling daily planning, plan update frequency increase (several times per day);
- motivation scheme modernization, new KPIs system implementation;
- seamless integration of order promising with production planning and scheduling;
- modeling specific constraint and rules of steelmaking production;
- organization of real team planning in demanding planning environment.

The key results of the implementation of the planning system are:

- significant rise in speed of calculation;
- complex planning environment with support of team planning and management;
- improving plan quality thanks to detail modeling of steel making rules and constraints.

The main results of the implementation of the new order fulfillment planning methodology based on advanced planning and scheduling system of the new generation are:

- increase of due date performance from 50% to above 90%;
- optimization of inventory level;
- improving asset utilization;
- improving quality of client information service.

4. CONCLUSION

The order fulfillment planning methodology was tested at a set of international production companies, proved its efficiency and is recommended for implementation at similar companies (complex technological specifics, demanding planning environment, necessity to manage production online).

Implementation of order fulfillment planning methodology often requires changes in organizational structure of a company, changes in motivation, and implementation of new KPIs.

The crucial condition for successful methodology implementation is usage of an appropriate planning tool. This tool has to support team planning and management, model technological specifics, have high performance.

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