



Advances in Transdisciplinary  
Engineering series

volume 7



# *Transdisciplinary Engineering Methods for Social Innovation of Industry 4.0*



Proceedings of the 25th ISPE Inc. International  
Conference on Transdisciplinary Engineering,  
July 3 – 6, 2018



**EDITED BY**

Margherita Peruzzini

Marcello Pellicciari

Cees Bil

Josip Stjepandić

Nel Wognum



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# *Transdisciplinary Engineering Methods for Social Innovation of Industry 4.0*

The concept of concurrent engineering (CE) was first developed in the 1980s. Now often referred to as transdisciplinary engineering, it is based on the idea that different phases of a product life cycle should be conducted concurrently and initiated as early as possible within the Product Creation Process (PCP). The main goal of CE is to increase the efficiency and effectiveness of the PCP and reduce errors in later phases, as well as incorporating considerations – including environmental implications – for the full lifecycle of the product. It has become a substantive methodology in many industries, and has also been adopted in the development of new services and service support.

This book presents the proceedings of the 25th ISPE Inc. International Conference on Transdisciplinary Engineering, held in Modena, Italy, in July 2018. This international conference attracts researchers, industry experts, students, and government representatives interested in recent transdisciplinary engineering research, advancements and applications.

The book contains 120 peer-reviewed papers, selected from 259 submissions from all continents of the world, ranging from the theoretical and conceptual to papers addressing industrial best practice, and is divided into 11 sections reflecting the themes addressed in the conference program and addressing topics as diverse as industry 4.0 and smart manufacturing; human-centered design; modeling, simulation and virtual design; and knowledge and data management among others.

With an overview of the latest research results, product creation processes and related methodologies, this book will be of interest to researchers, design practitioners and educators alike.

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TRANSDISCIPLINARY ENGINEERING METHODS FOR  
SOCIAL INNOVATION OF INDUSTRY 4.0

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Edited by

**Margherita Peruzzini**

*University of Modena and Reggio Emilia, Italy*

**Marcello Pellicciari**

*University of Modena and Reggio Emilia, Italy*

**Cees Bil**

*RMIT University, Australia*

**Josip Stjepandić**

*PROSTEP AG, Germany*

and

**Nel Wognum**

*TU Delft, The Netherlands*

**IOS**  
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fax: +31 20 687 0019

e-mail: [order@iospress.nl](mailto:order@iospress.nl)

*For book sales in the USA and Canada:*

IOS Press, Inc.

6751 Tepper Drive

Clifton, VA 20124

USA

Tel.: +1 703 830 6300

Fax: +1 703 830 2300

[sales@iospress.com](mailto:sales@iospress.com)

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# Preface

This book of proceedings contains papers peer-reviewed and accepted for the 25th ISTE International Conference on Transdisciplinary Engineering, held at the UNIMORE University of Modena and Reggio Emilia, Modena, 3–6 July 2018, Italy. This is the seventh issue of the newly introduced series “Advances in Transdisciplinary Engineering”, which publishes the proceedings of the TE (formerly: CE) conference series and accompanied events. The TE/CE conference series is organized annually by the International Society of Transdisciplinary Engineering, in short ISTE, formerly called International Society of Productivity Enhancement (ISPE, Inc.) and constitutes an important forum for international scientific exchange on transdisciplinary engineering. These international conferences attract a significant number of researchers, industry experts and students, as well as government representatives, who are interested in the recent advances in transdisciplinary engineering research, advancements and applications.

Developed in the 80’s, the CE approach is based on the concept that different phases of a product life cycle should be conducted concurrently and initiated as early as possible within the Product Creation Process (PCP), including the implications of this approach within the extended enterprise and networks. The main goal of CE is to increase the efficiency and effectiveness of the PCP and to reduce errors in the later phases, as well as to incorporate considerations for the full lifecycle, through-life operations, and environmental issues. In the past decades, CE has become the substantive basic methodology in many industries (e.g., automotive, aerospace, machinery, shipbuilding, consumer goods, process industry, environmental engineering) and is also adopted in the development of new services and service support.

The initial basic CE concepts have matured and have become the foundations of many new ideas, methodologies, initiatives, approaches and tools. Generally, the current CE focus concentrates on collaboration within and between enterprises and its many different elements. Current research on CE is driven again by many factors like increased customer demands, globalization, (international) collaboration and environmental strategies. The successful application of CE in the past opens also the perspective for future applications like overcoming natural catastrophes, sustainable mobility concepts with electrical vehicles, and intensive, integrated, data processing. Due to the increasing importance of transdisciplinarity, the board of ISPE, Inc., now ISTE, decided to rename the conference series in “Transdisciplinary Engineering” in 2016.

The concept of transdisciplinarity transcends inter- and multi-disciplinary ways of working. Though it is also aimed at aligning different types of knowledge, the context in which research and processes are performed is key. Transdisciplinary processes are aimed at solving complex ill-defined problems or problems for which the solution is not obvious from the beginning. It is important that people from practice collaborate with people from scientific communities. Moreover, for the respective problems, single disciplines cannot bring sufficient knowledge for solving those problems. Disciplines should be open to other disciplines to be able to share and exchange the knowledge necessary for problem solving. In particular, technical and social science disciplines need to collaborate to use the best of different worlds.

The conference is entitled: “Transdisciplinary Engineering Methods for Social Innovation of Industry 4.0”. The TE2018 Organizing Committee has identified 23 thematic areas within TE and launched a Call For Papers accordingly. In total 259 papers have been submitted from all continents of the world. The submissions as well as invited talks have been collated into 11 streams led by outstanding researchers and practitioners.

The Proceedings contains 120 peer-reviewed papers by authors from 23 countries. These papers range from the theoretical, conceptual to strongly pragmatic addressing industrial best practice. The involvement of more than 22 companies from many industries in the presented papers gives additional importance to this conference.

This book on ‘Transdisciplinary Engineering Methods for Social Innovation of Industry 4.0’ is directed at three constituencies: researchers, design practitioners, and educators. Researchers will benefit from the latest research results and knowledge of product creation processes and related methodologies. Engineering professionals and practitioners will learn from the current state of the art in concurrent engineering practice, new approaches, methods, tools and their applications. The educators in the CE community gather the latest advances and methodologies for dissemination in engineering curricula, while the community also encourages young educators to bring new ideas into the field.

The proceedings are subdivided into several parts, reflecting the themes addressed in the conference programme:

Part 1 is entitled Industry 4.0 and smart manufacturing and contains papers on a wide range of issues concerning the adoption and use of an Industry 4.0 approach ranging from SMEs to large manufacturing companies.

Part 2 outlines the importance of additive manufacturing. It contains papers addressing various aspects of the transition to additive manufacturing in different application domains.

Part 3, human-centered design, addresses a variety of approaches for, amongst others, human-robot collaboration, vehicle motions, user interface design, and other highly important applications involving or impacting on people.

Part 4 contains papers in the theme innovation and product development and Management addressing e.g., integrated design issues, cost estimation, and corporate knowledge.

Part 5 focuses on cost modeling with an emphasis on cost modeling in a lifecycle process and inventory management.

Part 6 contains contributions on decision support with various methodologies for decision support in particular domains.

Part 7 illustrates some approaches to modeling, simulation and virtual design. Papers included in this part address simulation methods for products as well as processes with the goal to reduce costs and errors.

Part 8 deals with the transdisciplinary engineering. This part contains reflections on a TE approach as well as knowledge and information sharing in social and cultural contexts.

Part 9 contains contributions on production technology, robotics and maintenance addressing various methodologies in design, production, and maintenance, with an emphasis on efficiency enhancement and operational issues.

Part 10, Knowledge and data management, contains papers on information and knowledge management as well as knowledge extraction in various domains.



Part 11 addresses the theme sustainability, risk management and supply chain with papers on sustainability and environmental issues in various environments including the supply chain and alliances. Other approaches are also contained in this part, like risk estimation for alliance formation.

We acknowledge the high quality contributions of all authors to this book and the work of the members of the International Program Committee who assisted with the blind peer-review of the original papers submitted and presented at the conference. Readers are sincerely invited to consider all of the contributions made by this year's participants through the presentation of TE2018 papers collated into this book of proceedings. We hope that they will be further inspired in their work for disseminating their ideas for new approaches for sustainable, integrated, product development in a multi-disciplinary environment within the ISTE community.

Margherita Peruzzini, Conference Chair  
University of Modena and Reggio Emilia, Italy

Marcello Pellicciari, Conference Chair  
University of Modena and Reggio Emilia, Italy

Cees Bil, Co-Program Chair  
RMIT University, Australia

Josip Stjepandić, Co-Program Chair  
PROSTEP AG, Germany

Nel Wognum, Co-Program Chair  
TU Delft, The Netherlands