


Editor-in-Chief

Kai Rannenberg, Goethe University Frankfurt, Germany

Editorial Board Members

TC 1 – Foundations of Computer Science

Luis Soares Barbosa , University of Minho, Braga, Portugal

TC 2 – Software: Theory and Practice

Michael Goedicke, University of Duisburg-Essen, Germany

TC 3 – Education

Arthur Tatnall , Victoria University, Melbourne, Australia

TC 5 – Information Technology Applications

Erich J. Neuhold, University of Vienna, Austria

TC 6 – Communication Systems

Burkhard Stiller, University of Zurich, Zürich, Switzerland

TC 7 – System Modeling and Optimization

Fredi Tröltzsch, TU Berlin, Germany

TC 8 – Information Systems

Jan Pries-Heje, Roskilde University, Denmark


TC 9 – ICT and Society

David Kreps , University of Salford, Greater Manchester, UK


TC 10 – Computer Systems Technology

Ricardo Reis , Federal University of Rio Grande do Sul, Porto Alegre, Brazil


TC 11 – Security and Privacy Protection in Information Processing Systems

Steven Furnell , Plymouth University, UK

TC 12 – Artificial Intelligence

Eunika Mercier-Laurent , University of Reims Champagne-Ardenne, Reims, France

TC 13 – Human-Computer Interaction

Marco Winckler , University of Nice Sophia Antipolis, France

TC 14 – Entertainment Computing

Rainer Malaka, University of Bremen, Germany

IFIP – The International Federation for Information Processing

IFIP was founded in 1960 under the auspices of UNESCO, following the first World Computer Congress held in Paris the previous year. A federation for societies working in information processing, IFIP's aim is two-fold: to support information processing in the countries of its members and to encourage technology transfer to developing nations. As its mission statement clearly states:

IFIP is the global non-profit federation of societies of ICT professionals that aims at achieving a worldwide professional and socially responsible development and application of information and communication technologies.

IFIP is a non-profit-making organization, run almost solely by 2500 volunteers. It operates through a number of technical committees and working groups, which organize events and publications. IFIP's events range from large international open conferences to working conferences and local seminars.

The flagship event is the IFIP World Computer Congress, at which both invited and contributed papers are presented. Contributed papers are rigorously refereed and the rejection rate is high.

As with the Congress, participation in the open conferences is open to all and papers may be invited or submitted. Again, submitted papers are stringently refereed.

The working conferences are structured differently. They are usually run by a working group and attendance is generally smaller and occasionally by invitation only. Their purpose is to create an atmosphere conducive to innovation and development. Refereeing is also rigorous and papers are subjected to extensive group discussion.

Publications arising from IFIP events vary. The papers presented at the IFIP World Computer Congress and at open conferences are published as conference proceedings, while the results of the working conferences are often published as collections of selected and edited papers.

IFIP distinguishes three types of institutional membership: Country Representative Members, Members at Large, and Associate Members. The type of organization that can apply for membership is a wide variety and includes national or international societies of individual computer scientists/ICT professionals, associations or federations of such societies, government institutions/government related organizations, national or international research institutes or consortia, universities, academies of sciences, companies, national or international associations or federations of companies.


More information about this series at <http://www.springer.com/series/6102>


Luis M. Camarinha-Matos · Hamideh Afsarmanesh ·
Angel Ortiz (Eds.)

Boosting Collaborative Networks 4.0

21st IFIP WG 5.5 Working Conference
on Virtual Enterprises, PRO-VE 2020
Valencia, Spain, November 23–25, 2020
Proceedings

Editors

Luis M. Camarinha-Matos 
NOVA University of Lisbon
Monte Caparica, Portugal

Hamideh Afsarmanesh 
University of Amsterdam
Amsterdam, The Netherlands

Angel Ortiz 
Polytechnic University of Valencia
Valencia, Spain

ISSN 1868-4238 ISSN 1868-422X (electronic)
IFIP Advances in Information and Communication Technology
ISBN 978-3-030-62411-8 ISBN 978-3-030-62412-5 (eBook)
<https://doi.org/10.1007/978-3-030-62412-5>

© IFIP International Federation for Information Processing 2020, corrected publication 2021

This work is subject to copyright. All rights are reserved by the Publisher, whether the whole or part of the material is concerned, specifically the rights of translation, reprinting, reuse of illustrations, recitation, broadcasting, reproduction on microfilms or in any other physical way, and transmission or information storage and retrieval, electronic adaptation, computer software, or by similar or dissimilar methodology now known or hereafter developed.

The use of general descriptive names, registered names, trademarks, service marks, etc. in this publication does not imply, even in the absence of a specific statement, that such names are exempt from the relevant protective laws and regulations and therefore free for general use.

The publisher, the authors and the editors are safe to assume that the advice and information in this book are believed to be true and accurate at the date of publication. Neither the publisher nor the authors or the editors give a warranty, expressed or implied, with respect to the material contained herein or for any errors or omissions that may have been made. The publisher remains neutral with regard to jurisdictional claims in published maps and institutional affiliations.

This Springer imprint is published by the registered company Springer Nature Switzerland AG
The registered company address is: Gewerbestrasse 11, 6330 Cham, Switzerland

Preface

Collaborative Networks (CNs) play a key role in the ongoing process of digital transformation in industry and services. Although the CN area is relatively young, its history is longer than two decades, as is also reflected in the series of PRO-VE conferences. A number of major milestones can be identified through these decades in the CN's "revolution." The theme of the conference this year recognizes this fact and focuses on launching new ideas for its latest milestone.

As we look back in time, the first generation of the CN area was developed around the concept of extended enterprises and virtual enterprises. The focus of this first generation was to achieve the right design for these kinds of networks, to identify its constitutive elements, and to promote organized collaboration. The second generation of the CN area focused on better application of the ICT concepts and technologies to complement developments of its first generation. Furthermore, the idea of the breeding environment rose as the natural key concept to support different life cycle stages of the collaborative networks. The third generation of the CN area focused on supporting the inter- and trans-CN collaboration and networks co-creation. We can summarize these earlier milestones of the CN area as follows:

- Collaborative Networks 1.0 – primarily addressing the operation and management of goal-oriented networks, including the supply chains, extended enterprises, virtual enterprises, and virtual organizations.
- Collaborative Networks 2.0 – primarily addressing and supporting the complete life cycle of CN breeding environments, including the business and social ecosystems, industry clusters, industrial districts, and professional virtual communities.
- Collaborative Networks 3.0 – primarily addressing the interplay among multiple CNs, including those of the inter- and trans-value system networks, and co-creation networks.

However, the dynamic world of collaborative networks continue to evolve and need to be formalized in order to face new emerging aspects, e.g., to properly deal with the exponential increase in availability of both data and intelligence, the continuous increase in digitalization, and the better positioning of the role of humans in highly collaborative, dynamic, and resilient networks, among others. Research and development on CN is now beginning to address its fourth milestone, namely the Collaborative Networks 4.0, for which some of its main distinctive features include addressing: hybridization in CN structure, where network entities constitute organizations, people, intelligent systems, and machines; formation of distributed cognitive systems; collaborative decision making among humans and intelligent autonomous systems; managing big data; mass collaboration; and collaborative creativity. These raise a large number of new challenges for the CN area, specifically related to the rights and liabilities, monetization, accountability, ethics, trust, coping with risks and disruptions, as well as the need for the creation of new collaboration culture and business models for collaborative

value creation. These topics, among others, are challenges being tackled by the fourth generation of the CN area and constitute the contents of this proceedings book.

We would also like to further note, that this year, the PRO-VE conference took place under extraordinary circumstances. Although the conference was planned and organized to be held in its regular format, as in all previous editions, in Valencia, Spain, during September 2020, the world's dynamics changed from the beginning of the year, and the uncertainty increased dramatically throughout the year, due to the COVID-19 pandemic. Therefore, the conference could only be held in virtual format, while this proceedings book was prepared with the same quality requirements as in previous years.

In fact, the situation created by this pandemic further reveals the timeliness of the conference motto, reaching its full sense worldwide. Today more than ever, everyone realizes the need to network and boost collaboration between varied partners, including governments, non-profit organizations, enterprises, professionals, and public citizens, across many sectors such as health, logistics, manufacturing, food, agriculture, and news media, while facilitating their work under tight restrictions and characteristics, such as speed, resilience, flexibility, quality, reliability, and trustworthiness.

Most approaches that have been applied so far, as well as the solutions which are adopted to mitigate the impact of the COVID-19 pandemic around the world, have already been addressed in the past PRO-VE conference series. Considering this crisis, we conclude that the performed research and developed applications in the CN area have been fundamental for facing these complicated times. Nevertheless, we also realize that there are many new challenges emerging and in need of innovative contributions.

PRO-VE 2020 addresses diverse viewpoints on timely CN 4.0 challenges. The conference provides a forum for sharing experiences, discussing trends, and identifying opportunities, thus introducing innovative solutions for the new generation of collaborative networks in the era of digital transformation. Understanding, modeling, and proposing solution approaches to these challenges require contributions from multiple and diverse areas and disciplines, including: computer science, manufacturing, industrial, electrical and computing engineering, social sciences, organization science, and technologies, among others, which are well tuned to both the interdisciplinary nature of the research and development on CN 4.0, as well as the spirit of the PRO-VE working conferences.

PRO-VE 2020 was the 21st event in this series of successful conferences, including: PRO-VE 1999 (Porto, Portugal), PRO-VE 2000 (Florianopolis, Brazil), PRO-VE 2002 (Sesimbra, Portugal), PRO-VE 2003 (Lugano, Switzerland), PRO-VE 2004 (Toulouse, France), PRO-VE 2005 (Valencia, Spain), PRO-VE 2006 (Helsinki, Finland), PRO-VE 2007 (Guimarães, Portugal), PRO-VE 2008 (Poznan, Poland), PRO-VE 2009 (Thessaloniki, Greece), PRO-VE 2010 (St. Etienne, France), PRO-VE 2011 (São Paulo, Brazil), PRO-VE 2012 (Bournemouth, UK), PRO-VE 2013 (Dresden, Germany), PRO-VE 2014 (Amsterdam, The Netherlands), PRO-VE 2015 (Albi, France), PRO-VE 2016 (Porto, Portugal), PRO-VE 2017 (Vicenza, Italy), PRO-VE 2018 (Cardiff, UK), and PRO-VE 2019 (Torino, Italy).

This proceedings book includes selected papers from the PRO-VE 2020 conference. It provides a comprehensive overview of major challenges that are being currently

addressed, and specifically recent advances in various domains related to the collaborative networks and their applications. There is therefore a strong focus on the following areas related to the selected main theme for the 2020 conference:

- Collaborative models, platforms, and systems for digital transformation
- Business ecosystems and collaboration in Industry 4.0
- Hybridization of collaboration – organizations, people, machines, and systems
- Big data analytics and intelligence
- Collaborative cyber-physical systems
- Distributed cognitive systems
- Risk, performance, and disruptions in collaborative networked systems
- Semantic data/service discovery, retrieval, and composition, in a collaborative networked world
- Ethics, trust, culture of collaboration, and sustainability in CNs
- Value creation, collaboration monetization, and social impact of collaborative networks
- Intelligent platforms supporting collaborative systems
- Collective intelligence and collaboration in advanced/emerging applications
- Collaborative manufacturing and factories of the future, e-health and care, food and agribusiness, and crisis/disaster management

We are thankful to all the authors from academia, research, and industry, for their contributions. We hope this collection of papers represents a valuable tool for those interested in research advances and emerging applications in collaborative networks, and in identifying future open challenges for research and development in this area. We very much appreciate the dedication, and the time and effort spent by the members of the PRO-VE International Program Committee who supported us with the selection of articles for this conference and provided valuable and constructive comments to help authors with improving the quality of their papers.

November 2020

Luis M. Camarinha-Matos
Hamideh Afsarmanesh
Angel Ortiz

Organization



PRO-VE 2020 – 21st IFIP Working Conference on VIRTUAL ENTERPRISES

Valencia, Spain, November 23–25, 2020

Conference Chair

Angel Ortiz

Polytechnic University of Valencia, Spain

Program Committee Chair

Luis M. Camarinha-Matos

NOVA University of Lisbon, Portugal

Program Committee Co-chair

Hamideh Afsarmanesh

University of Amsterdam, The Netherlands

Program Committee

Antonio Abreu, Portugal

Hamideh Afsarmanesh, The Netherlands

Cesar Analide, Portugal

Dario Antonelli, Italy

Américo Azevedo, Portugal

Thomas Beach, UK

Frédéric Bénaben, France

Peter Bernus, Australia

Xavier Boucher, France

Jeremy Bryans, UK

Luis M. Camarinha-Matos, Portugal

Wojciech Cellary, Poland

Rob Dekkers, UK

Filipa Ferrada, Portugal

Adriano Fiorese, Brazil

Adrian Florea, Romania

Rosanna Fornasiero, Italy

Gary Fragidis, Greece

Cesar Garita, Costa Rica

Ted Goranson, USA

Juanqiong Gou, China

Paul Grefen, The Netherlands

Dmitri Ivanov, Germany

Tomasz Janowski, Poland

Javad Jassbi, Portugal

Eleni Kaldoudi, Greece

Dimitris Karagiannis, Austria

Adamantios Koumpis, Germany

Matthieu Luras, France

Leandro Loss, Brazil

António Lucas Soares, Portugal

Laura Macchion, Italy

Patricia Macedo, Portugal

Kyrill Meyer, Germany

Istvan Mezgar, Hungary

Paulo Miyagi, Brazil

Arturo Molina, Mexico
Ovidiu Noran, Australia
Paulo Novais, Portugal
Adegboyega Ojo, Ireland
Ana Inês Oliveira, Portugal
Martin Ollus, Finland
Angel Ortiz, Spain
A. Luis Osório, Portugal
Hervé Panetto, France
Iraklis Paraskakis, Greece
Adam Pawlak, Poland
Jorge Pinho Sousa, Portugal
Raul Poler, Spain
Ricardo Rabelo, Brazil
João Rosas, Portugal

Hans Schaffers, The Netherlands
Jens Schütze, Germany
Volker Stich, Germany
Chrysostomos Stylios, Greece
Klaus-Dieter Thoben, Germany
Lorna Uden, UK
Paula Urze, Portugal
Katri Valkokari, Finland
Rolando Vallejos, Brazil
Agostino Villa, Italy
Antonio Volpentesta, Italy
Lai Xu, UK
Christian Zinke, Germany
Peter Weiß, Germany

Special Session Organizers

Special Session on Boosting Sustainability through Collaboration in Agri-Food 4.0

Mareva Alemany, Spain
Jorge Hernandez, UK
Hervé Panetto, France

Special Session on Digital Innovation Hubs for Digitalising European Industry

Francisco Blanes, Spain
José Ferreira, Portugal

Special Session on Collaborative Networks for Health and Wellness Data Management

Elena Pessot, Italy
Marco Sacco, Italy
Daniele Spoladore, Italy
Andrea Zangiacomi, Italy

Special Session on Skills for Organizations of the Future

Adrian Florea, Romania
Luis M. Camarinha-Matos, Portugal

Technical Sponsors



IFIP WG 5.5 COVE
Co-Operation infrastructure for Virtual
Enterprises and electronic business



Society of Collaborative Networks



Project

Organizational Co-sponsors



UNIVERSITAT
POLITÈCNICA
DE VALÈNCIA



C I G I P
 Research Centre on Production
 Management and Engineering



Nova University of Lisbon



UNIVERSITY OF AMSTERDAM

Contents

Collaborative Business Ecosystems

- Evaluating and Influencing the Performance of a Collaborative Business Ecosystem – A Simulation Study 3
Paula Graça and Luís M. Camarinha-Matos
- Exploring the Barriers and Mitigation Strategies in Digital Business Ecosystem Development: A Case Study from Engineering Material Supply Service Provider 19
Qingyu Liang, Juanqiong Gou, Wenqiang Li, and Long Huang
- Developing Digital Business Ecosystems to Create Collaborative Value in Supply-Chain Finance 31
Xufan Zhao, Juanqiong Gou, and Wenchi Ying

Collaborative Business Models

- Deriving Collaborative Business Model Design Requirements from a Digital Platform Business Strategy 47
Frank Berkers, Oktay Turetken, Baris Ozkan, Anna Wilbik, Onat Ege Adali, Rick Gilsing, and Paul Grefen
- A Method to Guide the Concretization of Costs and Benefits in Service-Dominant Business Models 61
Rick Gilsing, Oktay Turetken, Baris Ozkan, Frans Slaats, Onat Ege Adali, Anna Wilbik, Frank Berkers, and Paul Grefen
- Green Virtual Enterprise Breeding Environment: A Proposal of Web Platform Model for a Circular Economy 71
Fernando Zatt Schardosin, Carlos R. De Rolt, Amanda M. L. Batista, Clerilei A. Bier, and Amanda A. Lentz

Collaboration Platforms

- For a Dynamic Web Services Discovery Model for Open Ecosystems of Software Providers 83
Ricardo J. Rabelo, Hernesto A. Ruiz, and Maiara H. Cancian
- Adoption of Digital Collaborative Networking Platforms in Companies: A Study of Twitter Usage in Finland. 98
Heli Hallikainen and Lili Aunimo

From Digital Platforms to Ecosystems: A Review of Horizon 2020
Platform Projects. 111
Henrique Diogo Silva and António Lucas Soares

Data and Knowledge Services

Towards a Reference Model for Knowledge Driven Data Provision
Processes 123
Wei Min Wang, Maurice Preidel, Bernd Fachbach, and Rainer Stark

A Semantic Data Model to Represent Building Material Data in AEC
Collaborative Workflows 133
*Prathap Valluru, Janakiram Karlapudi, Karsten Menzel,
Teemu Mätäsnieni, and Jari Shemeikka*

Towards a Framework for Federated Interoperability to Implement
an Automated Model Transformation. 143
*Mustapha Labreche, Aurélie Montarnal, Sébastien Truptil,
Xavier Lorca, Sébastien Weill, and Jean-Pierre Adi*

Blockchain and Knowledge Graphs

Design Principles for Blockchain-Enabled Point Exchange Systems:
An Action Design Research on a Polycentric Collaborative Network
for Loyalty Programs. 155
Jiaman Chen, Wenchi Ying, Yonggui Chen, and Zupeng Wang

Bitcoin Adoption as a New Technology for Payment Mechanism
in a Tourism Collaborative Network 167
Mehdi Daryaei, Javad Jassbi, Reza Radfar, and Abbas Khamseh

How to Effectively Make and Use Knowledge Graphs Through
Collaborative Activities: A Socio-Technical Perspective 177
Yanan Gao, Xiyan Lv, and Wenchi Ying

Maintenance, Compliance and Liability

Liability in Collaborative Maintenance of Critical System of Systems 191
*A. Luis Osório, Luis M. Camarinha-Matos, Hamideh Afsarmanesh,
and Adam Belloum*

Applying Predictive Maintenance in Flexible Manufacturing. 203
Go Muan Sang, Lai Xu, Paul de Vrieze, and Yuewei Bai

Verification and Compliance in Collaborative Processes. 213
Oyepeju Oyekola and Lai Xu

Digital Transformation

- Strategic Target System to Select Digitalization Measures in Manufacturing Companies 227
Günther Schuh, Jan Hicking, Felix Jordan, Max-Ferdinand Stroh, and Stephan-Andrés Saß
- Fostering Digital Growth in SMEs: Organizational Competence for Digital Transformation 237
José M. González-Varona, Fernando Acebes, David Poza, and Adolfo López-Paredes
- Digital Transformation of Virtual Enterprises for Providing Collaborative Services in Smart Cities 249
Bokolo Anthony Jr., Sobah Abbas Petersen, and Markus Helfert

Skills for Organizations of the Future

- Towards Agile Operation for Small Teams in Knowledge Intensive Organizations: A Collaboration Framework 263
Qinghua Liu, Juanqiong Gou, and Luis M. Camarinha-Matos
- OMiLAB: A Smart Innovation Environment for Digital Engineers 273
Dimitris Karagiannis, Robert Andrei Buchmann, Xavier Boucher, Sergio Cavalieri, Adrian Florea, Dimitris Kiritisis, and Moonkun Lee
- Improving the Training Methods for Designers of Flexible Production Cells in Factories of the Future 283
Ion Mironescu, Daniel-Cristian Crăciunean, Adrian Florea, and Ioan Bondrea
- Immersive Systems in Human-Centered Manufacturing: The Informational Dimension 297
Filipa Rente Ramalho, António Lucas Soares, and António Henrique Almeida

Collaboration in Open Innovation

- Collaborative Networking to Enable Innovation and Entrepreneurship Through Open Innovation Hubs: The Entrepreneurship Learning Centre of Mexico City 311
Jhonattan Miranda, José Bernardo Rosas-Fernández, and Arturo Molina
- A Model to Support OI Collaborative Risks Applying Social Network Analysis 324
Marco Nunes and António Abreu

A Framework Based on Fuzzy Logic to Manage Risk in an Open Innovation Context 336
Ricardo Santos, Antonio Abreu, J. M. F. Calado, José Miguel Soares, and José Duarte Moleiro Martins

Collaboration in Supply Chain

Reshaping Supply Chain Collaboration - The Role of Digital Leadership in a Networked Organization 353
Marzena Frankowska and Andrzej Rzeczycki

Artificial Intelligence in Supply Chain Operations Planning: Collaboration and Digital Perspectives 365
María Ángeles Rodríguez, M. M. E. Alemany, Andrés Boza, Llanos Cuenca, and Ángel Ortiz

Toward Physical Internet-Enabled Supply Chain and Logistics Networks in Developing Countries 379
Sam Ban, Matthieu Laurus, and Sarot Srang

Simulation and Analysis in Collaborative Systems

A Collaborative Approach to Demand Side Energy Management 393
Kankam O. Adu-Kankam and Luis M. Camarinha-Matos

Analysis of Productivity and Profitability of a SME Through Collaborative Networks Using Discrete Event Simulation Tool: An Automotive Case Study 406
Emigdio Martínez, Daniel Cortés, José Ramírez, María Guadalupe Obregón, and Arturo Molina

A Physics-Based Approach for Managing Supply Chain Risks and Opportunities Within Its Performance Framework 418
Thibaut Cerabona, Matthieu Laurus, Louis Faugère, Jean-Philippe Gitto, Benoit Montreuil, and Frederick Benaben

Product and Service Systems

Value Proposition in Smart PSS Engineering: Case Study in the Residential Heating Appliance Industry 431
Camilo Murillo Coba, Xavier Boucher, François Vuillaume, Alexandre Gay, and Jesus Gonzalez-Feliu

Collaborative Product and Service Customization in Fashion Companies 440
Elena Pessot, Laura Macchion, Irene Marchiori, Rosanna Fornasiero, Pedro Senna, and Andrea Vinelli

The Digital Twin as a Knowledge-Based Engineering Enabler for Product Development	450
<i>Miguel Azevedo, Sérgio Tavares, and António Lucas Soares</i>	

Collaboration Impacts

Building Business Impacts of an Industry 4.0 Ecosystem Through Collaborative Network Settings Between IT and Forest Companies	463
<i>Katri Valkokari, Pasi Valkokari, Helena Kortelainen, and Jutta Nyblom</i>	

The Role of Collaboration for Sustainable and Efficient Urban Logistics	475
<i>Leandro Carvalho, Jorge Freire de Sousa, and Jorge Pinho de Sousa</i>	

A Balanced Sociotechnical Framework for Collaborative Networks 4.0	485
<i>Paula Urze, A. Luis Osório, Hamideh Afsarmanesh, and Luis M. Camarinha-Matos</i>	

Boosting Sustainability Through Collaboration in Agri-food 4.0

Assessing and Selecting Sustainable and Resilient Suppliers in Agri-Food Supply Chains Using Artificial Intelligence: A Short Review	501
<i>Antonio Zavala-Alcívar, María-José Verdecho, and Juan-José Alfaro-Saiz</i>	

Assessing the Impact of Pumpkins Plantation, Harvest and Storage Decisions on a Collaborative Supply Chain with Data Analysis Tools	511
<i>David Pérez, Maria de los Ángeles Rodríguez, Ángel Ortiz, and Cécile Guyon</i>	

Impact Analysis of Industrial Standards on Blockchains for Food Supply Chains	524
<i>Themo Voswinckel, Dino Hardjosuwito, Torben Gehring, Ralph Siruet, and Andreas Fuessler</i>	

A Decision Support Tool for the Selection of Promoting Actions to Encourage Collaboration in Projects for the Agriculture Sector	534
<i>M. M. E. Alemany, F. Alarcón, D. Pérez, and C. Guyon</i>	

Optimization Models to Improve First Quality Agricultural Production Through a Collaboration Program in Different Scenarios	546
<i>Ana Esteso, M. M. E. Alemany, Ángel Ortiz, and Pascale Zaraté</i>	

Resilient Strategies and Sustainability in Agri-Food Supply Chains in the Face of High-Risk Events	560
<i>Antonio Zavala-Alcívar, María-José Verdecho, and Juan-José Alfaro-Saiz</i>	

Digital Innovation Hubs for Digitalising European Industry

Cobotic Assembly Line Design Problem with Ergonomics 573
Mohammed-Amine Abdous, Xavier Delorme, and Daria Battini

Analysis of Manufacturing Platforms in the Context of Zero-Defect Process
Establishment 583
*Artem A. Nazarenko, Joao Sarraipa, Luis M. Camarinha-Matos,
Marc Dorchain, and Ricardo Jardim-Goncalves*

Towards a Reference Model for Configuring Services Portfolio of Digital
Innovation Hubs: The ETBSD Model 597
*Claudio Sassanelli, Hervé Panetto, Wided Guedria, Sergio Terzi,
and Guy Doumeingts*

Developing Digital Capabilities for SMEs: SMART4ALL’s Cross-Border
Experiments for Emerging Technology Development and Adoption. 608
Anna K. Lopez-Hernandez and J. Francisco Blanes Noguera

Collaborative Networks for Health and Wellness Data Management

A Framework for the Collaborative Evaluation of Service Outsourcing
Contracts in Pharmaceutical Logistics 623
Elena Pessot and Gianni De Togni

Towards a Collaborative Ontology-Based Decision Support System
to Foster Healthy and Tailored Diets 634
Daniele Spoladore and Marco Sacco

Leveraging on Enterprise Building Information Models in Health Care
Services: The Case of St. Olav University Hospital 644
*Sobah Abbas Petersen, Tor Åsmund Evjen, Seyed Reza Hosseini Raviz,
and John Krogstie*

Correction to: Boosting Collaborative Networks 4.0 C1
Luis M. Camarinha-Matos, Hamideh Afsarmanesh, and Angel Ortiz

Author Index 655