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## **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. An umbrella organization for societies working in information processing, IFIP's aim is two-fold: to support information processing within its member countries and to encourage technology transfer to developing nations. As its mission statement clearly states,

IFIP's mission is to be the leading, truly international, apolitical organization which encourages and assists in the development, exploitation and application of information technology for the benefit of all people.

IFIP is a non-profitmaking organization, run almost solely by 2500 volunteers. It operates through a number of technical committees, which organize events and publications. IFIP's events range from an international congress to local seminars, but the most important are:

- The IFIP World Computer Congress, held every second year;
- Open conferences;
- Working conferences.

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 small and 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.

Any national society whose primary activity is about information processing may apply to become a full member of IFIP, although full membership is restricted to one society per country. Full members are entitled to vote at the annual General Assembly, National societies preferring a less committed involvement may apply for associate or corresponding membership. Associate members enjoy the same benefits as full members, but without voting rights. Corresponding members are not represented in IFIP bodies. Affiliated membership is open to non-national societies, and individual and honorary membership schemes are also offered.

Vittal Prabhu Marco Taisch  
Dimitris Kiritsis (Eds.)

# Advances in Production Management Systems

Sustainable Production  
and Service Supply Chains

IFIP WG 5.7 International Conference, APMS 2013  
State College, PA, USA, September 9-12, 2013  
Proceedings, Part II



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# Preface

For the last several years, APMS has been a major event and the official conference of the IFIP Working Group 5.7 on Advances in Production Management Systems, bringing together leading experts from academia, research, and industry. Starting with the first conference in Helsinki in 1990, the conference has become a successful annual event that has been hosted in various parts of the world including Washington (USA, 2005), Wroclaw (Poland, 2006), Linköping (Sweden, 2007), Espoo (Finland, 2008), Bordeaux (France, 2009), Cernobbio (Italy, 2010), Stavanger (Norway, 2011), and Rhodos (Greece, 2012). By returning to the Americas after eight years, we hope to widen the global reach of the Working Group and the APMS conference.

Through an open call for special sessions and papers, APMS 2013 sought contributions in cutting-edge research, as well as insightful advances in industrial practice in key areas of sustainable production and service supply chains, including green manufacturing, sustainability of additive manufacturing processes, advanced control systems, enterprise information systems and integration, sustainable logistics and transportation. The intent of special sessions is to raise visibility on topics of focused interest in a particular scientific or applications area. This year we have planned 15 special sessions which are focused around the theme of the conference. Over 135 papers have been accepted based on blind peer-review. The main review criteria were the paper's contributions to science and industrial practice. Accepted papers of registered participants are included in this volume. This is the first time for APMS conference that full papers have been submitted and reviewed from the outset thereby eliminating the extended abstract stage and allowing for the final proceedings to be available at the time of the conference.

Following the tradition of past APMS conferences, the 6th APMS Doctoral Workshop is planned offering Ph.D. students the opportunity to present, discuss, receive feedback and exchange comments and views on their doctoral research in an inspiring academic community of fellow Ph.D. students, experienced researchers, and professors of the IFIP WG 5.7 community. The Doctoral Workshop will be chaired by Sergio Cavalieri (University of Bergamo).

Two types of awards have been planned for APMS 2013 participants:

- Burbidge Awards for best paper and best presentation
- Doctoral Workshop Award

Approximately 150 participants from across academia, research labs, and industry from 23 countries are expected to attend the APMS 2013 conference. The Scientific Committee consisting of 77 researchers, many of whom are active members of the IFIP WG 5.7, have played key roles in reviewing the papers in a timely manner and providing constructive feedback to authors in revising their

manuscripts for the final draft. Papers in this volume are grouped thematically as follows:

- **Part I Sustainable Production:** Enablers for Smart Manufacturing, Social Sustainability in Manufacturing, Intelligent Production Systems and Planning Solutions for Sustainability, Design, Planning and Operation of Manufacturing Networks for Mass Customization and Personalization, Energy Efficient Manufacturing
- **Part II Sustainable Supply Chains:** Sustainability Characterization for Product Assembly and Supply Chain, Interoperability in the Manufacturing and Supply Chain Services, Sustainable Manufacturing and Supply Chain Management for Renewable Energy, Closed Loop Design, Supply Chain Management
- **Part III Sustainable Services:** Service Manufacturing Systems, Art of Balancing Innovation and Efficiency in Service Systems, Simulation Based Training in Production and Operations Management, Modelling of Business and Operational Processes, Servicization,
- **Part IV ICT and Emerging Technologies:** ICT-Enabled Integrated Operations, Sustainable Initiatives in Developing Countries, LCA Methods and Tools, ICT for Manufacturing and Supply Chain Management, Product Design for Sustainable Supply Chains

We hope that the present volume will be of interest to a wide range of researchers and practitioners.

August 2013

Vittal Prabhu  
Marco Taisch  
Dimitris Kiritsis

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