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*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.

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Osiris Canciglieri Junior ·  
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# Product Lifecycle Management

Green and Blue Technologies to Support  
Smart and Sustainable Organizations


18th IFIP WG 5.1 International Conference, PLM 2021  
Curitiba, Brazil, July 11–14, 2021  
Revised Selected Papers, Part I

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# Preface

The year 2021 was marked by the worsening of the COVID-19 crisis restricting our social lives and freedom of movement, especially in the city of Curitiba, Brazil, where the 18th edition of the IFIP International Conference on Product Lifecycle Management (PLM 2021) was held. The industry has continued to be hard hit, with companies closing down, reduction of working hours, and restriction of borders altering the world's traditional activities. On the other hand, this crisis has provoked conceptual changes in the search for innovative solutions, making society adapt to the new work model that has been mostly performed in a virtual way.

However, it was not by chance that this was possible. On the contrary, it was the result of continuous research and development during the last decade and, in part, of efforts to contribute to state-of-the-art research questions involving issues of green and blue technologies to support smart and sustainable organizations in the digital age. Since 2003, the IFIP WG 5.1 International Conference on Product Lifecycle Management (PLM) has brought together researchers, developers, and users of PLM. This event has always aimed to integrate business approaches to the creation, management, sustainability, and dissemination of product and process data in companies that create, manufacture, and operate engineered products and systems. In this context, approaches such as digital and virtual product development, digital twins, smart manufacturing, or artificial intelligence in a sustainability context were discussed and developed further. While these sustainability concepts seemed vague and visionary at first, the contributions from this year's edition clearly showed that these innovative concepts have maturity and are being addressed and implemented with relative success in industry. Virtual collaboration, agile and green supply chains, intelligent manufacturing, and interoperability of work are becoming of paramount importance for worldwide technological development. PLM systems based on cloud and web service technologies, oriented to the purposes of sustainable development and combined with Internet of Things (IoT) platforms, seem to be actors promoting smart or intelligent solutions for products, processes, and decisions.

PLM 2021 was organized by the Industrial and Systems Engineering Graduate Program of the Pontifical Catholic University of Paraná, Brazil. So, this edition was concerned with responses to environmental and energy crises involving and considering green and blue issues. The health crisis has been added to these issues, demonstrating the need to change industry practices at the heart of PLM's concerns.

Due to the continuing global impact of COVID-19, the conference was held for the second time in its history in a virtual edition (like the PLM 2020 conference in Rapperswil, Switzerland).

PLM 2021 was attended by 97 researchers from 22 nations across three special sessions (PLM Maturity, PLM Implementation and Adoption within Industry 4.0; Sustainability, Sustainable Development and Circular Economy; and Blockchain Integration with Enterprise Applications) and 22 parallel sessions with a total of 100

online presentations. PLM 2021 also included the following academic keynotes, industrial keynotes and open webinars:

i) Academic Keynotes

- Andreia Malucelli – Pontifical Catholic University of Paraná, Brazil;
- Luiz Marcio Spinosa – Fundação Araucária, Brazil;
- Robert Young – Loughborough University, UK;
- Rodrigo Lozano – University of Gävle, Sweden;
- Cecilia M. V. B. Almeida – Universidade Paulista and the Journal of Cleaner Production and Cleaner and Responsible Consumption, Brazil;
- Ubiratã Tortato – Pontifical Catholic University of Paraná, Brazil;
- Elias Hans Dener Ribeiro da Silva – University of Southern Denmark, Denmark;
- Marcelo Távora Mira – Pontifical Catholic University of Paraná, Brazil.

ii) Industrial Keynotes

- Domingo Ureña Raso – Mecanizados Y Montajes Aeronáuticos, Spain;
- Regis Ataides – Siemens Digital Twins, Brazil.

iii) Open Webinars

- David Berquelange – Renault, France;
- Renato Grottoli – Robert Bosch, Brazil;
- Alex Rogério Figueiredo – Volvo, Brazil.

The pre-conference program featured a virtual PhD workshop dedicated to young researchers. The main program was structured so that on each day of the conference we had at least one academic keynote, industrial keynote, and open industry webinar, freely accessible to all, followed by intense discussions with researchers and industry participants.

All submitted papers were reviewed in a blind review process by at least two reviewers (2.4 reviewers per paper, on average). In total, 133 full papers were submitted, of which 107 were accepted to be presented at the conference. The accepted papers are grouped into 25 thematic sections in this book, which is part of the IFIP Advances in Information and Communication Technology (AICT) series that publishes state-of-the-art results in the sciences and technologies of information and communication. In addition to this conference proceedings, the International Journal of Product Lifecycle Management (IJPLM) is the official journal of the IFIP WG 5.1. Selected papers from PLM 2021 might be published as extended versions in IJPLM.

We would like to thank everyone who directly or indirectly contributed to making the PLM 2021 conference a success, particularly under the difficult circumstances of the worsening COVID-19 pandemic.



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