Scientific and Professional Curriculum Vitae
Marcello Colledani

Personal Data

Nationality	Italian
Place and date of birth	
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Education and Academic Career

- Marcello Colledani started the Mechanical Engineering studies in 1997 in Politecnico di Milano. During the academic year 2001-2002 he studied at Universidad Politecnica de Catalunia in Barcelona, financed by the Erasmus program.

- He **graduated in Mechanical Engineering in 2003**, presenting a work titled "An analytical method for evaluating the performance of multiproduct production systems" supervised by professor Tolio. This work originated a paper that was presented at the Fourth Aegean International Conference on Analysis of Manufacturing Systems, July 1-4 2003, Samos Island, Greece.

- In October 2003 he started the collaboration with the Mechanical Engineering Department at Politecnico di Milano.

- In February 2004 he classified first in the selection for the Phd position at Politecnico di Milano in Manufacturing Technology and Production Systems, XIX cycle, with a governmental grant.

- In May 2006 he classified first in the selection for a permanent position as **Assistant Professor** in the Mechanical Engineering Department.

- In May 2007 **he received his Phd cum laude** in Manufacturing Technology and Production Systems from Politecnico di Milano, presenting a thesis titled "Integrated Analysis of Production Logistics and Quality Performance in Manufacturing Systems".

- In 2008-2009 he spent 1 year as a **visiting professor** at the Laboratory for Manufacturing and Productivity LMP of the **Massachusetts Institute of Technology MIT** in US, carrying on a research activity in collaboration with Prof. Stanley Gershwin. The research activity was sponsored by a grant received from Rocca Foundation.

- Between 2009-2015 he regularly visited the Laboratory for Manufacturing and Productivity LMP at MIT for short term stays, carrying on collaborative research activities with Prof. Gershwin and Prof. Gutowski.

- Since 2012 he is Research Associate at ITIA CNR, Institute for Industrial Technologies and Automation, where his is responsible for the Recycling Technologies and Systems Cell within the "De-manufacturing" pilot plant.

- In November 2014 he classified first in the selection for a position as **Associate Professor** in the Mechanical Engineering Department.

- In November 2017 he received the National Habilitation for a **Full Professor** position.

Teaching Activity

He carried out teaching activities both at bachelor and master level. He collaborated in PhD level courses. The detailed list of activities follows:

Academic Year 2003-2004:

- Teaching assistant for the course "Reconfigurable Manufacturing Systems", 10CFU, dedicated to "Management Engineering" and "Mathematical Engineering" master level students at the Leonardo Campus of Polimi.

Academic Year 2004-2005:

- Teaching assistant for the course "Reconfigurable Manufacturing Systems", 10CFU, dedicated to "Management Engineering" and "Mathematical Engineering" master level students at the Leonardo Campus of Polimi.

Academic Year 2005-2006:

- Responsible for the course "Reconfigurable Manufacturing Systems", 10CFU, dedicated to "Management Engineering master level students at the Como Campus of Polimi. The course language was English (internationalization program).

Academic Year 2006-2007:

- Responsible for the course "Reconfigurable Manufacturing Systems", 10CFU, dedicated to "Management Engineering master level students at the Como Campus of Polimi. The course language was English (internationalization program).

- Responsible for the manufacturing related part of the integrated course "Manufacturing Technology and Metallurgy", 10CFU, dedicated to "Mechanical Engineering" bachelor level students at the Bovisa Campus of Polimi.

Academic Year 2007-2008:

- Responsible for the course "Reconfigurable Manufacturing Systems", 10CFU, dedicated to "Management Engineering master level students at the Como Campus of Polimi. The course language was English (internationalization program).

- Responsible for the manufacturing related part of the integrated course "Manufacturing Technology and Metallurgy", 10CFU, dedicated to "Mechanical Engineering" bachelor level students at the Bovisa Campus of Polimi.

Academic Year 2008-2009:

- Responsible for the course "Reconfigurable Manufacturing Systems", 10CFU, dedicated to "Management Engineering master level students at the Como Campus of Polimi. The course language was English (internationalization program).

- Teaching assistant for the course "Reconfigurable Manufacturing Systems", 10CFU, dedicated to "Management Engineering" and Mathematical Engineering" master level students at the Bovisa Campus of Polimi.

- Teaching assistant for the course "Manufacturing Technology I" 10CFU, dedicated to "Mechanical Engineering" bachelor level students at the Bovisa Campus of Polimi.

Academic Year 2009-2010:

- Responsible for the course "Reconfigurable Manufacturing Systems", 10CFU, dedicated to "Management Engineering master level students at the Como Campus of Polimi. The course language was English (internationalization program).

- Responsible for the course "Manufacturing Technology I" 10CFU, dedicated to "Mechanical Engineering" bachelor level students at the Bovisa Campus of Polimi.

Academic Year 2010-2011:

- Responsible for the course "Reconfigurable Manufacturing Systems", 10CFU, dedicated to "Management Engineering master level students at the Como Campus of Polimi. The course language was English (internationalization program).

- Responsible for the course "Manufacturing Technology I" 10CFU, dedicated to "Mechanical Engineering" bachelor level students at the Bovisa Campus of Polimi.

Academic Year 2011-2012:

- Responsible for the course "Reconfigurable Manufacturing Systems", 10CFU, dedicated to "Management Engineering master level students at the Como Campus of Polimi. The course language was English (internationalization program).

- Responsible for the course "Manufacturing Technology I" 10CFU, dedicated to "Mechanical Engineering" bachelor level students at the Bovisa Campus of Polimi.

Academic Year 2012-2013

- Responsible for the course "Reconfigurable Manufacturing Systems", 10CFU, dedicated to "Management Engineering master level students at the Como Campus of Polimi. The course language was English (internationalization program).

- Responsible for the course "Manufacturing Technology I" 10CFU, dedicated to "Mechanical Engineering" bachelor level students at the Bovisa Campus of Polimi.

Academic Year 2013-2014

- Responsible for the course "Reconfigurable Manufacturing Systems", 10CFU, dedicated to "Management Engineering master level students at the Como Campus of Polimi. The course language was English (internationalization program).

- Responsible for the course "Manufacturing Technology I" 10CFU, dedicated to "Mechanical Engineering" bachelor level students at the Bovisa Campus of Polimi.

- Responsible for the lectures on "De-Manufacturing of Mechatronic Components" within the master post-lauream on "Mechatronics".

Academic Year 2014-2015

- Responsible for the course "Reconfigurable Manufacturing Systems", 10CFU, dedicated to "Management Engineering master level students at the Como Campus of Polimi. The course language was English (internationalization program).

- Responsible for the course "Manufacturing Technology I" 10CFU, dedicated to "Mechanical Engineering" bachelor level students at the Bovisa Campus of Polimi.

Academic Year 2015-2016

- Responsible for the course "Demanufacturing", 5CFU, dedicated to "Management Engineering master level students at the Bovisa Campus of Polimi. The course language was English.

- Responsible for the course "Production for Made in Italy", 10CFU, dedicated to "Management Engineering master level students at the Bovisa Campus of Polimi. The course language was English.

- Responsible for the course "Manufacturing Technology I" 10CFU, dedicated to "Mechanical Engineering" bachelor level students at the Bovisa Campus of Polimi.

Academic Year 2016-2017

- Responsible for the course "Demanufacturing", 5CFU, dedicated to "Management Engineering master level students at the Bovisa Campus of Polimi. The course language was English.

- Responsible for the course "Production for Made in Italy", 10CFU, dedicated to "Management Engineering master level students at the Bovisa Campus of Polimi. The course language was English.

- Responsible for the course "Manufacturing Technology I" 10CFU, dedicated to "Mechanical Engineering" bachelor level students at the Bovisa Campus of Polimi.

Academic Year 2017-2018

- Responsible for the course "Demanufacturing", 5CFU, dedicated to "Management Engineering master level students at the Bovisa Campus of Polimi. The course language was English.

- Responsible for the course "Manufacturing Technology I" 10CFU, dedicated to "Mechanical Engineering" bachelor level students at the Bovisa Campus of Polimi.

Academic Year 2018-2019

- Responsible for the course "Demanufacturing", 5CFU, dedicated to "Management Engineering master level students at the Bovisa Campus of Polimi. The course language was English.

- Responsible for the course "Manufacturing Technology I" 10CFU, dedicated to "Mechanical Engineering" bachelor level students at the Bovisa Campus of Polimi.

Academic Year 2019-2020

- Responsible for the course "Demanufacturing", 5CFU, dedicated to "Management Engineering master level students at the Bovisa Campus of Polimi. The course language was English.

- Responsible for the course "Manufacturing Technology and Quality" 10CFU, dedicated to "Management Engineering" bachelor level students at the Bovisa Campus of Polimi.

He has been supervisor of:

- 44 master level thesis works, 9 of which in co-supervision with foreign university (1 with MIT, 5 with KTH, Sweden, 1 with University of Bayreuth, Germany, 1 with University Linkoping, Sweden, 1 with University of Bristol, UK). The thesis he supervised titled "Flow Analysis and Optimization in Machining Lines - New Models Applied on a Real Industrial Case" by Polato A. and Moriggi P. was awarded with two prizes, one issued by AITEM "Italian Association of Manufacturing Technology" and one issued by UCIMU "Unione Costruttori Macchine Utensili".
- 5 PhD graduates:
    - Ramiz Assaf "Analysis of the Output Variability in Manufacturing Systems", January 2012, graduated with merit.
    - Anteneh Teferi, "Integrated analysis of manufacturing and supervisory systems", January 2013, graduated with merit.
    - Dariush Ebrahimi "Integrated quality and production logistic performance modeling for selective and adaptive assembly systems", January 2014, graduated with merit.
    - Ali Jadidi "A Methodology to Support the Modeling and Design of Material Separation Systems for Recycling", March 2015.
    - Nazanin Shabanpour, "Remanufacturing planning under uncertainty", 2017.

He currently supervises and coordinates a group composed of 3 PhD students, 1 Post-docs and 6 researchers. In 2012 he supervised a post-doc researcher (Dr. Malima Wolf) who took her PhD at the MIT - Massachusetts Institute of Technology MIT and was sponsored by Progetto Rocca for 1 year, and one undergraduate student (Patrick J. Callaghan) from the MIT.

He is responsible for the study plans in Mechanical Engineering at Politecnico di Milano and he has been the reference person for the track on Production Systems within the Mechanical Engineering course until 2019.

He is a member of the Mechanical Engineering PhD Board in the Department of Mechanical Engineering at Polimi.

Research Activity

Dr. Colledani carries on research activities in three main areas:

I - *Modelling, performance evaluation, design and reconfiguration of complex, evolving manufacturing systems.*
The uncertainty of the market and continuous evolution of technology is pushing manufacturing companies to design and operate systems that continuously change over time to work in the best possible operating conditions. In this highly dynamic context it is relevant for decision makers to be supported by advanced manufacturing models and tools to quickly and accurately predict in advance the impact of changes on the relevant system performance measures. The research activity in this area aims at modeling and analyzing the performance of production systems characterized by complex information and material flows, in highly stochastic contexts, by using approximate analytical methods and simulation. The main scientific contribution in this area has been:

- ✓ the development of a new "Two-level Decomposition" analytical approach to study manufacturing systems featuring multiple products, assembly/disassembly stations, non-linear split and merge flows and rework operations;
- ✓ the development of a new theory for estimating the production quantity variability in stochastic manufacturing systems and to derive management rules to reduce the impact of variability in the system, thus meeting a higher service level from the system;
- ✓ the development of a new method for optimally allocating buffers in multistage production systems to meet the required demand rate from the system, in the long term;
- ✓ the development of a new approach for analyzing systems with machines undergoing generally complex markovian models with a continuous flow analysis. This approach enables to study lines with parallel machines at system stages, lines with machines characterized by general distributed disruptions, lines with degrading machines and preventive maintenance.
- ✓ the application of the developed approximate analytical methods to the analysis of real-life systems in the automotive sector with relevant performance improvement results;

All these tools can be used for:
- system performance improvement;
- driving reconfigurations of changeable and evolvable production systems by forecasting the impact of changes on the system performance;

- bottleneck analysis, identification and system diagnosis;
- performance assessment and control;
- understanding the non-linear behavior of systems characterized by complex material flows.

II- *Integrated analysis of quality and production logistics performance of manufacturing systems.*
Quality and productivity are typically considered as two very separate research areas, concentrating on two different levels of analysis (resource and system level) and studied with very different methodologies and tools (e.g. SQC and queuing theory). However, the industrial practice shows that there are several decisions, drawn by quality and productivity needs, that are affected both by quality control and production control. This research activity aims at integrating these areas, providing highly integrated production models and analysis methods to identify improved system configurations that suitably exploit the quality/quantity trade-offs. The integrated quality and productivity approach at system level allows to set the control limits of quality control tools considering the specific impact of the different resources on the main system performance measures. Critical false alarm are avoided, while stops of non critical resources have lower priority. Moreover, the joint determination of quality and production control parameters has been proposed. It was shown that there is an impact of the production system architecture on the quality of produced parts which goes beyond the process capabilities of the single resources composing the system. This impact is mainly due to the delay in the transmission of the quality control feedback that is observed when the machine subject to out of controls is monitored remotely, e.g. at the end of the line. Moreover, the research shows that the presence of the quality control system has an impact of the productivity of the system. Indeed, the stops in the machine production due to quality checks reduce the operational time of the resources in the system. Therefore, configurations obtained without considering these relations are only sub-optimal. First pioneer works published in this new research area have shown great benefits for companies deriving from the use of the integrated quality-productivity theory at system level. Recently, preventive maintenance has also been included in this integrated framework. It was shown that preventive maintenance policies that are optimized at single resource level can be highly subperforming at system level. Indeed, the impact of the resource downtime induced by preventive maintenance on the overall system performance varies depending on the position of the bottleneck machine. Furthermore, it was shown that resource deterioration may cause part quality degradation. This phenomenon makes earlier maintenance actions more attractive at system level.

III - *Modelling and design of de-and remanufacturing technologies and systems.*
In recent years, interest in de-manufacturing has surged due to both fluctuating material prices and international laws introduced to improve the reuse, remanufacturing, recycling and recovery of end-of-life post-consumer products and industrial waste. High value multi-component wastes, such as WEEE (Waste Electric and Electronic Equipment), car scraps, and municipal wastes require processing by complex multi-step recycling systems to maximize output material value. The design of these systems is a critical task due to the high volatility of the price of recovered products, the variability in the input material composition and quantities and the increasing pressure towards efficiency of recycling plants. Moreover, the typically high investments involved and the long payback times call for efficient management of their evolution over time. However, in spite of the consistent research effort dedicated to the analysis of recycling technologies, the problem of designing multi-stage recycling systems has been rarely tackled from a systems engineering perspective. This research aims at proposing methods for designing multi-stage mechanical de-manufacturing systems to meet specified performance goals.
The system engineering perspective calls for an integraton among process level models and system level models. A multi-scale modeling architecture for these interacting layers has been proposed.
At system level, aggregated models of the material flow through the multiple stages of mechanical recycling systems have been developed. The developed approach investigates the robustness of the optimal configuration under variation of recovery/grade requirements and input material concentration. This enables the system designer to perform "what if analysis" and obtain indications on the degrees of freedom the system should have in order to be suitably managed along its life-cycle. Moreover, the developed design methods specifically look at enhancing energy efficiency of the recycling plant, while meeting recovery /grade goals. The developed methodology supports applications in the context of advanced modular recycling systems. Results can be used to generate maps of optimal system configurations for different grade / recovery requirements.
At process level, detailed models of the process physics are developed. In detail, advanced multi-body, multi-particle simulation models, able to capture the impacts between particles in the process, have been developed. At the current stage, Electrostatic and Eddy Current separation have been modeled.
The integration between these two levels has enabled, for example, to develope optimization algorithms to set the parameters of the shredding processes in order to guarantee a desired level of efficiency of the downstream separation processes, solving the trade-off existing beetween particle size and particle liberation degree.

Scientific and Technical Responsibility of Laboratories

Since 2013 Dr. Colledani is the scientific and technical leader of the Recycling Technology and Systems group at Polimi and ITIA-CNR. Overall, the group currently involves five researchers and one PhD student. Dr. Colledani is responsible

for the "Mechanical Recycling Cell" that is one of the three sections of the "**Mechatronics De-manufacturing Pilot Plant**" that was installed at ITIA-CNR in 2013. He is also the designer of the "Mechanical Recycling Cell" which includes two size-reduction machines, several mechanical separation technologies, a hybrid flexible mixture transportation system, including mechanical and pneumatic transportation modules, and hyperspectral imaging for in-line mixture characterization and quality control.

Since 2018 he has scientific responsibility of the Inter-departmental Laboratory "**CIRC-eV: Circular Factory for the Electrified Vehicles of the Future**" involving seven Departments at Politecnico di Milano and focused on new technological solutions for testing, disassembly, and re-assembly of Li-Ion batteries from electrified vehicles of the future, in view of second use applications. Located in the Mechanical Engineering department, the mission of the CIRC-eV Laboratory is to develop a new concept of Circular Factory to support the manufacturing industry in the recovery and reuse of functions and value from post-use Hybrid and Electric Vehicles, boosting the introduction of new circular economy models for sustainable e-mobility. Being LIBs the most critical component of EVs, they are particularly addressed in the lab. State-of-the-art technologies for the characterization, disassembly, reassembly and mechanical recycling of e-mobility LIBs are available in the laboratory.

International Associations

- Since 2005 he is member of the Italian Association for Manufacturing Technology (AITEM).

- Since 2006 he has been involved in scientific and organizational activity of the CIRP Working Group named SPECIES-Production Systems Evolution, launched and lead by Prof. Tolio. A CIRP Keynote Paper was published in 2010, which disseminates the results of the activities carried out in the SPECIES working group.

- Since 2006 he is active in the IFAC, International Federation of Automatic Control, as Affiliate.

- Since 2014 he is Associate Member of the CIRP - International Academy for Production Engineering.

- Since 2012 he is funding member of the Technical Committee TC "Sustainable Production Automation" in the IEEE Robotics and Automation Society.

- He is member of the International Association "EMIRAcle, European Manufacturing and Innovation Research Association, a cluster leading excellence" (www.vrl-kcip.org).

- He is one of the founding members of the European Cluster "4ZDM - Zero Defect Manufacturing".

- He is part of the Roadmapping team of the Italian "Intelligent Factory" Cluster, CFI.

- He is member of the Technical Committee on "sustainable manufacturing" at the Italian "Intelligent Factory" Cluster, CFI.

- Since 2014 Prof. Colledani is the coordinator of the "De-and Remanufacturing for Circular Economy" working group within AFIL, involving Regional industrial stakeholders and RTOs in the field of circular economy at Lombardy Region level.

- Prof. Colledani is the coordinator of the Vanguard Initiative "De-and Remanufacturing" for Circular Economy demo-case, on behalf of Regione Lombardia and AFIL, involving more than 100 European stakeholders. The demo-case aims at creating a network of pilot plants, distributed in seven European Regions (Lombardy, Scotland, Saxony, Tampere, Basque Country, Norte, Flanders) designed to deliver services to industrial stakeholders by leveraging on multi- regional synergies and complementarities, with the goal of de-risking private investments in innovative and emerging Circular Economy businesses. This pilot network will act as innovation hub for circular economy, including a network of competence and technology centers and supporting future producer-driven replication at industrial scale. This ambitious project has been discussed with the EIB during a restricted meeting in Luxembourg in July 2016, aiming at assessing the bankability of the business model.

- He is a member of the working group on "Sustainable Manufacturing" within the Italian Cluster on Intelligent Factory.

- Since 2018 he is the Scientific Coordinator of the Manufuture Sub-platform on "Zero Defect Manufacturing".

- Since 2019 he is responsible for the Circular Economy Roadmapping group within the Lombardy Region.

- Since 2019 he is member of the Board of Directors of APRA-Europe, Automotive Part Remanufacturing Association.

- Since 2019, he is representing Politecnico di Milano as a member of the Ellen Mac Arthur Foundation Network.

Technical and Scientific Committees

- In 2009 he was member of the organizing committee of the SMMSO09 "International Conference on Stochastic Models of Manufacturing and Service Systems" held in Lecce, Italy.

- In 2010 he was member of the scientific committee of ETFA2010 "Emerging Technologies and Factory Automation" September 13-16, 2010, Bilbao, Spain, in Track 4 on "Automated Manufacturing Systems".

- In 2013 he was member of the scientific committee of the 46th "CIRP Conference on Manufacturing Systems (CIRP CMS 2013)" that was held in Setubal, Portugal, on May 29-31 2013.

- In 2013 he was member of the scientific committee of the VALUETOOLS 2013 - 7th International Conference on Performance Evaluation Methodologies and Tools that was held in Turin on December 10-12, 2013.

- In 2013 he was the co-organizer of the First Workshop on "Hyperspectral Imaging Applications and Opportunities for environment, sustainability and recycling" that was held in Milan on May 23rd, 2013.

- In 2014 he was member of the scientific committee of the CIRP DESIGN Conference 2014 that was held held in Milan on April 14-16, 2014.

- In 2014 he was member of the scientific committee of the VALUETOOLS 2014 - 8th International Conference on Performance Evaluation Methodologies and Tools.

- In 2015 he was member of the scientific committee of the CIRP DESIGN Conference 2015 that was held in Haifa.

- In 2015 he was member of the scientific committee of the MESIC Conference 2015 that was held in Barcelona, Spain.

- In 2016 he was member of the scientific committee of the CIRP DESIGN Conference 2016 that was held in Stockholm.

- In 2017 he was member of the scientific committee of the CIRP DESIGN Conference 2017 that was held in Cranfield.

- In 2017 he was member of the scientific committee of the International Conference on Sustainable Design and Manufacturing, SDM2017, held in Bologna in April 2017.

- In 2018 he was member of the scientific committee of the CIRP Design Conference, CIRP LCE Conference.

- In 2019 he was member of the scientific committee of the CIRP CMS Conference, CIRP LCE Conference.

- Since 2019 he is member of the Editorial Board of the International Journal of Computer Integrated Manufacturing, IJCIM.

- In 2020 he is a member of the scientific committee of the CIRP CMS Conference, of the CIRP Design Conference, CIRP LCE Conference.

- In 2020 he was the chairman of the "World Remanufacturing Summit", co-organized by Politecnico di Milano and the Lombardy Region, 2-3 March 2020, canceled due to the Covid-19.

Research Projects

He is involved in several research projects, both at National and International level.

Past Projects

- European Community 6th FP project. **Network of Excellence VRL KCiP** – Virtual research Lab for Knowledge Community in Production. The role of Dr. Colledani in this project has been both scientific and of coordination of the team at Politecnico di Milano.

- FIRB - Object Oriented Simulation Of Advanced Manufacturing Systems, Project funded by MIUR - Italian Ministry of University and Research. He had scientific role in this project.

- European Community 6th FP project PROMISE FP6-IST-IP-507100. He had scientific role in this project.

- National project PRIN 2005 "Methodologies and tools to plan production capacity with focused flexibility". He had scientific role in this project.

- **Industrial project with SCANIA AB**. Scientific and coordination role in this project. The Master Thesis work of Polato A. and Moriggi P. which was generated by this project and supervised by Dr. Colledani, Prof. Tolio and Dr.

Lundholm received two awards, one from the Italian Association of Machine Tool Builders (UCIMU) and one by Italian Association for Manufacturing Technology (AITEM).

- **Mechanical Engineering Department project – "**Model, Design and Control of Eddy Current Material Separation Systems (ECS) for car scraps recycling". <u>He was principal investigator and project coordinator</u>.

- **Roberto Rocca seed fund grant** "Interactions Among Quality and Productivity Performance Measures in Production Systems" in collaboration with Prof. Gershwin from the MIT Laboratory for Manufacturing and Productivity. He has scientific role in this project.

- **FP7 2010 European Project "Visionair – Vision, Advanced Infrastructure for Research".** He has scientific role in this project.

- **FP7 FoF.NMP.2011-5: "MuProD - Innovative proactive Quality Control system for in-process multi-stage defect reduction" funded by the European Commission Call FoF.NMP.2011-5 "Towards zero-defect manufacturing", 7th Framework Program.** From 1/11/2011 al 30/10/2014 [The total funded activity for Polimi amounts to 642'675.89 Euro]. <u>He had scientific responsibility and coordination role of the Polimi team in this project. He is workpackage leader in this project.</u>

  <u>He is also the scientific coordinator of the whole project consortium</u>.

  Marcello Colledani is the coordinator of WP5: "Development of new integrative solutions for proactive quality control in multi-stage systems" that sees the participation of the following partners: Tecnalia (ES), University of Stuttgart (GE), Bosch (GE), ENKI (IT), EPFL (CH), Trimek (ES), IBM (IS), Technion (IS), Marposs (IT), Gamesa Eolica (ES).

- **FP7-2011-NMP-ICT-FoF: "RLW Navigator - Remote Laser Welding System Navigator for Eco & Resilient Automotive Factories"** funded by the European Commission Call FoF-ICT-2011.7.4, "Digital factories: Manufacturing design and product lifecycle management", 7th Framework Program. From 1/1/2012 al 31/12/2014 [The total funded activity for Polimi amounts to 631331 Euro]. <u>He had scientific role and coordination role of the Polimi team in this project. He is workpackage leader in this project</u>.

  Marcello Colledani was the coordinator of WP1: "Production System Configuration" that sees the participation of the following partners: Jaguar-Land Rover (UK), Warwick University (UK), Comau (IT), Enginsoft (IT), EPFL (CH), Stadco (UK).

- **Italian Flagship Project – "Factory of the Future" 2012. "Integrated Technological Solutions for Zero Waste Recycling of Printed Circuit Boards (PCBs) - Zero Waste PCBs".** He had scientific role in this project. <u>He is leader of the workpackage 4 "Separation process modelling and simulation" and of the workpackage 11 on "Separation process control and validation" in this project</u>.

- **FP7 FoF.NMP.2013-9 "RobustPlaNet, Shock-robust Design of Plants and their Supply Chain Networks", GA 609087** funded by the European Commission Call FoF.NMP.2013-9, "Advanced concepts for technology-based business approaches addressing product-services and their manufacturing in globalised markets", 7th Framework Program. From 1/10/2013 al 31/9/2016 [The total funded activity for Polimi amounts to 446850 Euro]**.** <u>He has scientific responsibility and coordination role of the Polimi team in this project. He is workpackage leader in this project</u>.

  Marcello Colledani was the coordinator of WP2: "Technical solutions for shock-robust plants" that sees the participation of the following partners: Daimler (GE), KIT (GE), Festo (GE), MCM (IT), Marposs (IT), Stzaki (HU), Knorr Bremse (HU), ITC (HU).

- **2013 Italian project "FIDEAS– Intelligent Factory for the Advanced and Sustainable De-manufacturing".** He has scientific role in this project. <u>He was leader of workpackage 4 on "Advanced recycling Processes" in this project</u>.

- **Italian Flagship Project – "Factory of the Future" 2012. "WEEE Reflex "Highly Evolvable E-waste Recycling Technologies and Systems".** <u>He had scientific responsibility and coordination role of the Polimi team in this project. He is leader of workpackage 2 on "Design and Control of Modular and Evolving Recycling Systems" and of workpackage 3 on "Separation Process Optimization and Control" in this project</u>.

- **H2020 FoF-05-2014 Project "ProRegio, Customer-driven Design of Product-services and Production Networks to Adapt to Regional Market Requirements" GA 636966,** funded by the European Commission under the call FoF-05-2014: Innovative Product-Service design using manufacturing intelligence. From 1/1/2015 al 31/12/2017 [The total funded activity for Polimi amounts to 547750 Euro]**.** <u>He had scientific responsibility and coordination role of the Polimi team in this project. He is workpackage leader in this project</u>.

  Marcello Colledani was the coordinator of WP4: "Process and plant design for product-service innovation" that sees the participation of the following partners: KIT (Ge), Comau (IT), Enginsoft (IT), Ecole Centrale de Nantes (FR),

Audros (FR), Airbus (GE), Flexis (GE), TeXXmo (GE), Gizelis Robotics (GR), Arcelik (TK).

- **H2020 FoF-07-2014 Project "Focus – Factory of the Future Clusters" GA 637090.** Coordination and Support Actions (CSA), funded by the European Commission under the call FoF-07-2014. <u>Marcello Colledani was coordinating the expert group and the industrial advisory group.</u>

- **H2020 FoF-11-2015 Project "Recam, Rapid Reconfiguration of Flexible Production Systems through Capability-based Adaptation, Autoconfiguration and Integrated tools for Production Planning",** funded by the European Commission under the call FoF-11- Flexible production systems based on integrated tools for rapid reconfiguration of machinery and robots. From 1/11/2015 al 31/10/2018 [The total funded activity for Polimi amounts to 609375 Euro]. <u>He had scientific responsibility and coordination role of the Polimi team in this project. He is workpackage leader in this project.</u>

  Marcello Colledani was the coordinator of WP4: "Flexible Production System Engineering and Reconfiguration Management" that sees the participation of the following partners: Bosch (Ge), NxtControl (AT), CESA (SP), DGH (SP), Cosberg (IT), Enginsoft (IT), Tecnalia (SP), Tampere University of Technology (FI).

- **Italian Flagship Project – "Factory of the Future" 2015. "WEEE ReFlex CPS - Cyber-Physical System (CPS) for reconfigurable e-waste recycling processes".** <u>He had scientific role in this project.</u>

- **Italian Flagship Project – "Factory of the Future" 2015. "PCB-ID In-line automated device for the identification of components and the characterization of materials and value in waste PCBs".** <u>He had scientific role in this project.</u>

- **Italian Flagship Project – "Factory of the Future" 2015. "ShredIT - Self-Optimizing Shredding Station for Demanufacturing Plants".** <u>He had scientific role in this project.</u>

- **H2020 CIRC-03-2016 "Screen - Synergic Circular Economy across European Regions"** funded under the topic "Smart Specialisation for systemic eco-innovation/circular economy". The total project funding amounts to 1771865. It is a Coordinated and Support Action (CSA). Project duration: 2 years. <u>He had Scientific Role in the project and scientific responsibility</u> for the party AFIL - Associazione fabbrica Intelligente Lombardia, as linked third party of the Lombardy Region.

Ongoing projects

- **2013 Italian Cluster Intelligent Factory – "Project 1: Sustainable Manufacturing".** <u>He is the scientific coordinator of the "Target Objective" on "De-manufacturing" within this project. He has scientific responsibility and coordination role of the Polimi team in this project.</u>

- **H2020 FoF-03-2016 Project "ForZDM, Integrated Zero Defect Manufacturing Solution for High Value Adding Multi-stage Manufacturing systems",** funded by the European Commission under the call FoF-03-2016: Zero-defect strategies at system level for multi-stage manufacturing in production lines. From 1/10/2016 al 30/9/2020 [The total funded activity for Polimi amounts to 617000 Euro]. <u>He has scientific responsibility and coordination role of the Polimi team in this project. He is workpackage leader in this project.</u>

  <u>He is also the scientific coordinator of the whole project consortium.</u>

  Marcello Colledani is the coordinator of WP5: "System-level zero defect manufacturing solution" that sees the participation of the following partners: NxtControl (AT), Enginsoft (IT), Masmec (IT), Tecnalia (SP), Ideko (SP), University of Stuttgart (GE).

- **H2020 CIRC-01-2016 Project "FiberEUse Large scale demonstration of the techno-economical benefits of new circular economy value-chains based on the reuse of end-of-life fiber reinforced composites",** funded by the European Commission under the call CIRC-01-2016. From 1/6/2017 to 31/5/2021 [The total funded activity for Polimi amounts to 1100000 Euro]. The project involves 21 partners over 7 European Countries with a total funding of €9,800,000 Euro and has a duration of 4 years. The project aims at developing eight innovative demonstration products re-using recovered glass and carbon reinforced plastics to be introduced in the market, where the economic viability is supported by a circular economy oriented, cross-sectorial value-chain approach. <u>He is the Project Coordinator.</u>

- **H2020 ECSEL Joint Undertaking Project "Productive 4.0: A European co-funded innovation and lighthouse project on Digital Industry",** funded by the European Commission. From 1/5/2017 to 30/4/2020 [The total funded activity for Polimi amounts to 500000 Euro]. <u>He has scientific responsibility and coordination role of the Polimi team in this project.</u>

- **"CyberSort– In-line identification and automatic sorting for high-efficiency circular economy solutions"** funded by the Lombardy Region funded project and coordinated by ITIA-CNR. <u>Marcello Colledani has scientific role in this project.</u> He is leader of activity 1.1 on "Analysis and identification of waste matrices and their variability",

of activity 1.2 "Waste material characterization by multi-sensor hyperspectral imaging solutions", and of activity 3.1 "In line control of size-reduction processes" in this project and actively involved in the demonstration activities. The total funding amounts to €1,037,000.

- **H2020-NMBP-FOF-2018, "Iqonic - Innovative strategies, sensing and process Chains for increased Quality, re- configurability, and recyclability of Manufacturing Optolectronics"** funded by the European Commission under the call DT-FOF-03-2018. From 1/10/2018 al 31/3/2022 [The total funded activity for Polimi amounts to 511250 Euro]. He has scientific responsibility and coordination role of the Polimi team in this project. He is workpackage leader in this project.

- **H2020-MSCA-ITN-2018, "Digiman: MANufacturing Technologies for Zero-defect Industry 4.0 Production",** funded by the European Commission under the call H2020-MSCA-ITN-2018. From 1/01/2019 al 31/12/2022 [The total funded activity for Polimi amounts to 784000 Euro]. He has scientific responsibility and coordination role of the Polimi team in this project. He is workpackage leader in this project.

- **DT-ICT-07-2019, EU H2020 project DigiPrime "Digital Platform for Circular Economy in Cross-sectorial Sustainable Value Networks- DigiPrime",** GA 873111. From 1/01/2020 al 31/12/2024 [The total funded activity for Polimi amounts to 1031000 Euro]. The project involves 36 partners over 11 European Countries with a total funding of €15,963,173 Euro and has a duration of 4 years. The objective is to develop a new concept of Circular Economy digital platform overcoming current information asymmetry among value-chain stakeholders, in order to unlock new circular business models based on the data-enhanced recovery and re-use of functions and materials from high value-added post-use products with a cross-sectorial approach. He is the Project Coordinator.

- **H2020-NMBP-TR-IND-2020, EU H2020 project DAT4-ZERO "Data Reliability and Digitally-enhanced Quality Management for Zero Defect Manufacturing in Smart Factories and Ecosystems",** From 1/8/2020 to 31/7/2024 [The total funded activity for Polimi amounts to 575625 Euro]. He has scientific responsibility and coordination role of the Polimi team in this project. He is workpackage leader in this project.

  He is also the scientific coordinator of the whole project consortium.

  Marcello Colledani is the coordinator of WP5: "Modelling and simulation for rapid line qualification and reconfiguration" that sees the participation of the following partners: Sintef (No), Ideko (SP), KIT (GE), TTS (IT), ENKI (IT), HOLONIX (IT), Robert Bosch (GE), Danobat (SP), Fersa (SP).

- **H2020-LCCI-2020 project Trick "Product Data Traceability Information Management by Blockchains Interoperability and Open Circular Service Marketplace",** From 1/3/2021 to 28/2/2024 [The total funded activity for Polimi amounts to 327000 Euro]. He has scientific responsibility and coordination role of the Polimi team in this project. He is also the scientific coordinator and quality manager of the whole project consortium.

Titles, Awards and Acknowledgments

- In 2006 he received the **Best Young Author Prize** by the 12th IFAC Symposium on Information Control Problems in Manufacturing, INCOM 2006.

- In 2008 his paper was awarded honorable mention as one of the five finalists of the **Young Author Prize** at the 17th IFAC World Congress in Seoul, Korea.

- In 2007 he was **invited speaker at the DMMS** (Design and Management of Manufacturing Systems) **Conference**, presenting the results of a successful research project in collaboration with Scania, a Swedish truck manufacturer.

- In 2011 his paper was awarded honorable mention as one of the five finalists of the **Young Author Prize** at the 18th IFAC World Congress in Milan, Italy.

- In 2013 his paper was awarded honorable mention as one of the four finalists of the **Young Author Prize** at the 11th AITEM Conference in Italy.

- In 2013 he was invited speaker at the VALUETOOLS 2013 - 7th International Conference on Performance Evaluation Methodologies and Tools that was held in Turin on December 10-12, 2013. The talk was titled "Analytical methods to support the configuration and reconfiguration of manufacturing and assembly systems".

- In 2013 he was invited participant to the Manufuture 2013 Conference in Vilnius on October 6-8, 2013.

- In 2013 he was invited participant to the Workshop "e-skills in European manufacturing: A view to the future" to be held in Athens on 14-15 May, 2012.

- In 2014 he was invited speaker at the "Panel discussion: Maximising Impact & Successful Innovation Strategy" within the 2013 EU Factory of the Future Impact Workshop, March 2013.

- In 2014 he organized and chaired the Special Session on "Zero Defect Manufacturing" within the CIRP Design Conference 2014, that was held in Milan, Italy.

- In 2014 he was Invited Speaker at the Conference on Italian-Serbian Collaboration Platform In Advanced Manufacturing Technology – ISC 2014 held in Belgrad the 29th of April, with a speech titled "INTELLIGENT FACTORY - Current Stage, Perspectives and Italian Ongoing Initiatives".

- In 2015 he was Invited Speaker at the CESMA meeting on "Parting out of Aeronautics Components" in Rome, representing the Italian Cluster on Intelligent Factory - CFI.

- In 2015, the paper "M. Colledani, F. Franchini, F. Micchetti, A. Ratti, A. Taurisano *A software platform for the multi-objective early-stage design of automotive assembly lines,* IFAC-PapersOnLine, Volume 48, Issue 3, 2015, Pages 2287-2292" has been awarded the **Best Application Paper Award winner** at the INCOM 2015, Information Control Problems in Manufacturing.

- In 2016, he submitted a keynote paper at the 3rd International Conference on Ramp-Up Management (CIRP sponsored) from June 22nd until 24th, 2016, in Aachen.

- In 2017, he was invited speaker at the Italian Cluster Intelligent Factory general assembly on "Technologies 4.0: an engine for the intelligent factory".

- In 2017, he was invited speaker at the CRIT – Center for Technology and Innovation Transfer in Modena.

- In 2017, he was invited by the EC DG-REGIO as a panel member at the Smart Regions 2.0 event in Helsinki, Sweden, presenting the main outcomes of the Vanguard Initiative "De-and Remanufacturing" pilot network aiming at supporting industrial uptake and exploitation of innovative solutions for circular economy with a cross-regional approach.

- In 2017, he was invited speaker at the EFFRA – European Factories of the Future Research Association meeting on Zero-defect manufacturing cluster in Brussels.

- In 2018, he was Invited Speaker at the Digital Innovation Hub Conference in Warsaw, organized by EC DG CNECT.

- In 2019 he was Invited Speaker at the Seminar "Interregional Innovation Investments: Strengthening innovation opportunities for firms in the EU", organized by the Czech Ministry of Regional Development in cooperation with the European Commission, Prague, March 11th, 2019.

- In 2019, he was the organizer of a session on the FiberEUse project focused on the recovery and re-use of composite materials within the Ellen Mac Arthur Fundation CE100 in Catalunya, Spain.

- In 2020, he was invited speaker at the European Cluster Conference 2020 organized by the European Cluster Collaboration Platform ECCP, www.clustercollaboration.eu.

Additional Information

He speaks fluent English and Spanish.

Complete List of Publications

Reviews
He is reviewer of the following scientific journals: IIE Transactions, International Journal of Production Economics, IEEE Transactions on Automation Science and Engineering, Annals of OR, SME Journal of Manufacturing Systems, International Journal of Production Research, International Journal of Computer Integrated Manufacturing, Stochastic Models.

Performance Indicators from the Scopus Database:
N° of citations: 1410.
Average N° of citations per year: 88
H index: 21

Book Chapters (7):

Colledani M., Matta A., Tolio T., "*Performance evaluation of production lines with finite buffer capacity producing two different products*", in G. Liberopoulos, C.T. Papadopoulos, B. Tan, J. Macgregor Smith, S.B. Gershwin Editors, "Stochastic Modelling of Manufacturing Systems - Advanced in design, performance evaluation and control issues", Ed. Springer 2006, pp. 77-97. ISBN 3-540-26579-1

Colledani M., Tolio T. "*Performance Evaluation of Production Systems Monitored by Statistical Process Control and Offline Inspections*", Information Control Problems in Manufacturing 2006, Edited by Alexandre Dolgui, Gerard Morel and Carlos Pereira, Ed. Elsevier 2006, pp. 317-322. ISBN 0-08-044654-X.

M. Colledani, F. Iovane, T. Tolio, M. Urgo "*Design of sustainable product life cycles*" editors Jorg Niemann, Serge Tichkiewitch, Engelbert Westkamper, 2009, Springer-verlag, ISBN: 9783540790815.

Colledani M., Terkaj W, Tomasella M. and Tolio T. "*Development of a Conceptual Framework to Manage Manufacturing Knowlegde Related to Products, Processes and Production Systems,* Knowledge Management Book, VRL KCiP, Springer ed. 2008, pp. 259-284, ISBN 978-3-540-78430-2.

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Colledani M., Tolio T., "*Impact of Quality Control on Production Systems Performance*", Annals of the CIRP Vol. 55/1/2006, pp. 453-456.

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Colledani M., Tolio T. "*Performance Evaluation of Production Systems Monitored by Statistical Process Control and Offline Inspections*", 2009, International Journal of Production Economics, Volume 120, Issue 2, August 2009, Pages 348-367.

Colledani M., Ekvall M., Lundholm T., Moriggi P., Polato A., Tolio T. "*Analytical methods to support continuous improvements at Scania*" 2010, International Journal of Production Research, Vol. 48, No. 7, 1 April 2010, pages 1913–1945.

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Colledani M., Tolio T. "*Performance Evaluation of Transfer Lines with General Repair Times and Multiple Failure Modes*" 2011, Annals of Operations Research, Volume 182, Number 1, pages 31-65, DOI: 10.1007/s10479-009-0595-3.

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Colledani M., Matta A., Tolio T., "*Performance evaluation of continuous production lines with deterministic processing times, multiple failure modes and multiple part types*" 4° CIRP International Seminar on Intelligent Computation in Manufacturing Engineering CIRP ICME '04. 30 June-2 July, Sorrento, Italy. pp. 29-34.

Colledani M, Grasso M. Matta A. Tolio T., "*A new Analytical Method for Buffer Space Allocation in Production Lines*", 37° CIRP International Seminar on Manufacturing Systems. May 19-21, Budapest, Hungary. pp. 231-237.

Colledani M., Matta A., Tolio T., "*Performance evaluation of multi-product two-machines lines*", 18th International Conference on Production Research, 2005.

Colledani M., Tolio T., "*Impact of statistical process control (SPC) on the performance production systems - Part One (small systems)*", 5° International Conference on Analysis of Manufacturing Systems- Production Management. May 20-25, Zakynthos Island, Greece, 2005, pp. 76-84.

Colledani M., Tolio T., "*Impact of statistical process control (SPC) on the performance production systems - Part Two (large systems)*", 5° International Conference onAnalysis of Manufacturing Systems- Production Management. May 20-25, Zakynthos Island, Greece, 2005, pp. 85-92.

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Colledani M., Tolio T. "*Performance Evaluation of Production Systems Monitored by Statistical Process Control and Offline Inspections*", Proceedings of the INCOM 12th IFAC Symposium on Information Control Problems in Manufacturing, Saint Etienne, France, May 2006, pp. 329-334. Received the Best Young Authors Paper Award.

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Colledani M. and Tolio T. "P*erformance Evaluation of Long Production Lines with General Repair Times and Multiple Failure Modes*", Proceedings of Analysis of Manufacturing System Conference, Luntheren, The Netherlands, 11-16 May 2007, pp. 57-63.

M. Colledani, T. Lundholm, P. Moriggi, A. Polato, T. Tolio "*A Decomposition Method to Support Evaluation and Continuous Improvement of Reconfigurable Manufacturing System Performance*" Proceedings of the 40° CIRP Conference on Manufacturing Systems, 30 May-1 June 2007, Liverpool, UK.

Colledani M. "*Integrated Analysis of Quality and Production Logistics Performance in Asynchronous Manufacturing Lines*", 17th IFAC World Congress 2008, July 6-11 2008, Seoul, Korea. Awarded honorable mention - Young Author Prize.

Colledani M., Matta A. Tolio T. "*Analysis of the production variability in manufacturing lines with multiple failure modes machines*" ASME ESDA Conference, July 7-9 2008, Haifa, Israel.

Colledani M., Gershwin S.-B. "*Modeling and Analysis of Two-Stage Systems with Parallel Machines and Limited Repair Capacity*" 13th IFAC Symposium on Information Control Problems in Manufacturing, June 3 - 5, 2009, Moscow, Russia.

Colledani M., Gershwin S.-B. "*A Decomposition Method for Approximate Evaluation of Continuous Flow Multi-Stage Lines with General Markovian Machines*", 7th Conference on Stochastic Models of Manufacturing And Service Operations, 7-12 June, 2009, Ostuni, Italy, pp. 73-80.

Borgh D., Colledani M., Tolio T. "*An analytical method for the optimal design of buffers in asynchronous transfer lines*" 7th Conference on Stochastic Models of Manufacturing And Service Operations, 7-12 June, 2009, Ostuni, Italy, pp. 225-232.

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Colledani M., Matta A., Moriggi P., Simone F. "*Analysis of two-machine lines with operation-dependent and time-dependent failure modes*, MITIP Conference, 15-16 October 2009, Bergamo - Italy.

Assaf R., Colledani M., Matta A. "*Analysis of the Output Variance in Production Lines: Methodology and Applications*". MITIP Conference, 15-16 October 2009, Bergamo - Italy.

M. Colledani, Wolf, M.I., S.B. Gershwin, and T.G. Gutowski, "*Modeling and Design of Multi-Step Separation Systems,*" IEEE/International Symposium on Sustainable Systems and Technology, Washington D.C., May 16-19, 2010.

Colledani, M., S.B. Gershwin, T. Gutowski and M.I. Wolf "*A methodology to support the design of multi-stage material separation systems for recycling,*" 43rd CIRP International Conference on Manufacturing Systems, Vienna, Austria, May 2010, pp 651-658.

Colledani, M., Tolio T., "*A method for the Joint Design of Quality and Production Control in Manufacturing Systems,*" 43rd CIRP International Conference on Manufacturing Systems, Vienna, Austria, May 2010, pp. 335-342.

Colledani, M. Teferi A., "*Integrated Quality and Production Logistics Analysis of Closed Loop Manufacturing Systems*", Proceedings of the EFTA 2010 Conference on Emerging Technology and Flexible Automation, Bilbao, Spain, September 13-16, 2010.

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Angius A., Colledani M, Horvath, A., "*Moments of Cumulated Output and Completion Time of Unreliable General Markovian Machines*", Proceedings of the 18th IFAC World Congress, 2011, Milan, Italy, Aug 28 - Sep 2, 2011, ISBN: 978-3-902661-93-7.

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Assaf R., Colledani M., "*A Decomposition Approach for the Approximate Evaluation of the Output Variability in Multi-Stage Production Lines*" in Proceedings of the 12th INCOM Information Control Problems in Manufacturing, May 23-25 2012, Bucarest, Romania.

F. Braghin, M. Colledani, S. Negrini, A. Tasora, "*A multi-body, multi-particle simulation model of Eddy Current Separation (ECS) process for recycling*" in SUM2012 Symposium on Urban Mining, May 21-23 2012, Bergamo, Italy.

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