ASP WINTER School

The Fourth Industrial Revolution: promises and pitfalls in blending new and traditional approaches in manufacturing and service sectors

March 11th-15th, Loano (SV)

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With the Support of:

Premise

Digital technologies are improving the capability of organizations and individuals of accessing, storing and analyzing information (cloud computing, big data and artificial intelligence), of making things in a smarter, more efficient and safer way (augmented and virtual reality, additive manufacturing), and of connecting things (Internet of Things). The digital transformation triggered by the use of such technologies is a multifaceted phenomenon that changes the approaches and the skills of architects, designers and engineers in the way products, services, organizational and urban processes and systems are designed and implemented. There are certain dimensions in which digital technologies transform industries and processes in ways that replicate and extend transformations of the past. For example, IoT, big data and artificial intelligence offer new ways of implementing continuous improvement and lean thinking methods. The use of additive manufacturing and artificial intelligence applied to robotics promise to foster the flexibility paradigm introduced by robots and computers in manufacturing in the 1970s. The lessons learned in the past from such innovations are often overlooked and this brings many companies to digitalize their inefficiencies. However, there are other ways in which digital technologies transform industries that are fundamentally new (e.g. smart connected products and product-service systems), create new approaches to design and management, expose organizations to new sources of uncertainty, risk and competition, and require new approaches to decision-making, design and engineering. Both the "old" revisited approaches and the more radical transformations have in common the need of developing a tighter horizontal integration between the disciplinary fields of engineering, architecture and design. The School will be aimed at creating the shared vocabulary, the multidisciplinary attitude and the tools required to ASPers to work in this setting of tight cross-functional integration.

Main Goals

The course intends to explore the main challenges and perils produced by digital transformation and the way it requires to balance and integrate old and new approaches in architecture, design, and engineering. Specifically, the School aims to offer students comprehensive knowledge on the tools and skills needed for designing and engineering of products, services, organizational structures and manufacturing processes in a context of digital transformation.

The challenges of digital transformation will be discussed at three levels. At the macro level, the School provides an interpretation of the social and economic implications of digital transformation and it will offer a comparative analysis of its characteristics and effects across industries, within and outside the manufacturing world. Contextual factors will be considered. While digital transformation enables global innovations, economic regulations and institutions are still at a local level. This implies an understanding of the factors that can facilitate or hinder the success and the replicability of digital transformation initiatives across different industries.

At the meso level, digital transformation raises fundamental questions on the underlying processes, routines, capabilities and structures by which organizations innovate and build their organizational learning mechanisms, in processes like product and service development, manufacturing and customer relationship management. At the micro level, the simultaneous introduction of Artificial Intelligence, Big Data, algorithms and virtual reality challenges existing skills and capabilities into the organization. This raises several points for organizations related to how the new digital skills should be acquired and combined with "analog" legacy skills of an organization. Many of these issues involve ASPers since they require a tighter horizontal integration across the different engineering disciplines. In the same way, as industrial and consumer products are enriched of more complex software-based and connectivity functionalities, a tighter horizontal integration occurs between specialists in the different disciplines of engineering and design. Part of this need of a closer integration stems from the fact that technical and managerial decision-making processes in operations, strategy-making, and design are affected by the deluge of data and algorithms. In such a context, data-driven approaches must be combined with the "gut feeling" and the tacit experience of managers and technical specialists in ways that might vary significantly depending on the domain of decision-making. Such ways have been object of limited attention in the traditional curricula and courses offered in the "traditional" education paths of Architecture, Engineering and Design schools.

Learning outcome

At the end of the school, Aspers will have improved their understanding of the challenges, the skills and the design and managerial approaches that are needed for architects, designers and engineers in the increasing data-driven context of organizational processes and decision-making activities that are related to manufacturing and customer relationship management.

Project Work – structure and intended learning outcome

In the project work, the students will have to envisage how a mix of digital technologies including data analytics, augmented and virtual reality can be used to improve a manufacturing process and the related decision-making activities that are at the base of its continuous improvement and innovation. The project work will be focused on manual work, and the coordination and control mechanisms used in the process. In such a way, starting from what different technologies can do students will have to sketch-out a solution, understand its key features and assess the potential for its diffusion. The project work will be based on a gamification approach, with students organized in teams in assembling an IKEA furniture. This will represent the first step of the process and will be aimed at putting students on the same field ground that is needed to be able to understand how assembly processes work, what the key peculiarities, goals and complexity issues are concerning how things are done, supervision and coordination occur to sustain data-driven organizational learning. Students will be asked to understand how data analytics and data-driven decision-making can assist and enhance the learning capability of an organization, and how these approaches should be adapted to different industry and work contexts.

Each step of the project work is discussed in detail below, in the description of the program. It should be pointed out that the furniture assembled by the students will be donated to the Gaslini Children's Hospital in Genoa. Students will thus be involved in a useful initiative of social responsibility.

Program

The course is based on the combination of five modules, which can represent the specific themes of each day of the School. Most of the professors and speakers from the industrial world listed in the program have already confirmed their participation in the School. *****In the program the [C] symbol stands for "speaker confirmed"*****

March 11th, 2019.

Day 1. The technologies at the origin of Digital Disruption

- 11:00-11:45 P. Neirotti: introduction to the School
- 11:45-13:15. E. Baralis. Technologies and architectures for big data management
- 13:15-14:30. Lunch break
- 14:30-15:30. T. Cerquitelli. *AI for pattern recognition: some experience from industrial applications*
- 15:30-16:45. A. Bottino. Data visualization and new machine-man interfaces: Augmented Reality (AR) and Virtual Reality (VR)
- 16:45 – 17:05. Coffee Break
- 17:05-17:30. Introduction to the project work
- 17:30-19:00: Project work. Step 1.
- 19:00-19:30. Wrap-up of the Day

Project Work – Activity 1.

*Students get familiar to the main principles and software-based tools for data analytics. ***TO BE COMPLETED****

March 12th, 2019.

Day 2. When Digital met Manufacturing: inside the Industry 4.0 transformation

Curated by Politecnico di Milano, Manufacturing Group and DEIB

- 9:00-10:45. M. Taisch (Politecnico di Milano). Manufacturing and its digital twins
- *10:45-11:15. Coffee break*
- 11:15-13:00 P. Rocco (Politecnico di Milano). Robots, vision, and data: how industrial automation is changing the production processes
- 14:15-15:30: L. Massone (FCA) on digital factories
- 15:30-16:00. Introduction to the Project work – Step 2.
- 16:00-18:30. Project work – Step 2.
- 18:30-19:00. Wrap-up of the Day

Project work – Activity 2:

2.A The students - in a role playing modality, and mimicking blue and white collar workers in a lean factory - will be asked to:

- assemble an IKEA furniture

- document the costs and assembly times and the main issues encountered in: i) process and product quality, ii) health and safety conditions of the work,

- document the organization of the team and task allocation (distinguishing between manual, supervision and technical activities). (Expected time required: 1.5 hours)

2.B With reference to the main inefficiencies that characterized their assembly process, the students will:

- identify and document the root causes of the main inefficiency/quality problems distinguishing between items due to product, process and workplace design,

- formalize and document the lessons learnt.

(Expected time required: 45 minutes)

2.C Based on the ouput of activities 2.A and 2.B, The students will structure the database required to control the process, as if their assembly activity were a repetitive and standardized process of "mass production" (45 minutes)

Students will be split in 20 teams made by six students each.

March 13th, 2019.

Day 3. Digital Transformation and Lean Thinking: what's new, if any?

- 9:00-11:00 H. Boer (Aalborg University): on continuous improvement: historic perspective until smart product-service systems
- *10:30-11:00. Coffee Break*
- 11:30-13:00 P. Neirotti: on the transformation of work
- 13:10-14:10. Lunch Break
- 14:10-15:10. G. Amoroso. Enel and the digital transformation in electrical utilities
- 15:10-16:00. S. Musso Illogic on Augmented and Virtual Reality
- 16:00-19:00: Project work - Step 3.
- 19:00-19:30. Wrap-up of the Day

Project work – Activity 3 (Continuous Incremental Improvement):

3.A Each team will freeze the database structure for the control of the assembly process run the day before. Then, for each team a representative will be involved in a committee accountable of defining the structure of a unified database for the 20 teams involved in the project work. A cloud-based database will be created [1 hour]

3.B. Once the unified database is structured, the students will enter the data collected the day before.

3.C Using the tools for data analytics learnt on day 1, the students will start analyzing the data to extract applicable knowledge for continuous improvement.

March 14th, 2019.

Day 4. Digital transformation outside manufacturing

- 9:00-10:30. A. Mantelero (Politecnico di Torino): AI, big data and the legal regulatory framework
- 10:30-11:00. Coffee Break
- 11:00- 12:00. A. Osello (Politecnico di Torino). Virtual Reality in healthcare and assisted living. SAM4.0Care: Smart Advanced Modeling for Care.
- 12:00-13:00. F. Tosoni. (IKEA Italy) IKEA and its digital transformation
- 14:00-15:00. V. Gasparotti (Google Arts & Culture). Digitalization of cultural heritage
- 15:00-15:30. D. Pesce (Politecnico di Torino). Best practices in the Digital Transformation of cultural heritage: The case of the Van Gogh Museum
- 15:30-18:30. Project Work – Step 4.
- 18:30-18:45. Wrap-up of the Day

Project Work - Activity 4: the "Radical Innovation" Day

Role playing. The students will keep on role playing as if they were blue and white collar workers in a factory. The students, with reference to the assembly process carried out the day before, will envisage how Augmented and Virtual Reality, virtual assistant methods, wearables, and other technologies can be used to support and/or train the operators to avoid the main inefficiencies in costs, product quality, health, safety, workers' cognitive load. The implications of the innovation proposed for work organization will be discussed. The students will also sketch-out the database architecture needed to run the process once it is supported by the new digital technologies. An attempt will be made to understand which type of data can be hardly codified in the AR system and which part of the control should be intentionally left driven by experience, tacit knowledge, intuition and a "gut-feeling".

Then, based on their own experience in assembling a furniture and propose innovation in the way this process is run, the students will analyze how the use of AR, VR and data analytics approaches can be extended to support specialists in product design, and the whole process of assisting a customer in sales and after sales. Implications for the design of retail stores will be drawn.

The students will also finish running the data analytics on the main problems encountered, costs and times of assembly, on the main lessons learnt. Findings should be communicated in a clear and meaningful visual form.

March 15th, 2018.

Day 5. A look at the legal and cognitive implications of a data-driven world

- 9:00 – 10:30 G. Zotteri (Politecnico di Torino): The data deluge and how our brain works
- 10:30 – 10:30 Coffee Break
- 10:30- 12:30. M. Robiglio, A. Vetrò, (Politecnico di Torino and Future Urban Legacy Lab). Digital Open Urban Twins
- 12:30-13:30. Project Work Presentation
- 13:30-14:30. Lunch Break
- 14:30-15:30. Project Work Presentation and Closing Remarks

Project Work - Activity 5:

The best proposals (for what regard the "radical innovation" ideas) and the best documented use of data analytics for continuous improvement will be presented and discussed.