

Training and Education program – Politecnico di Milano

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6Ps Methodology “Digital transformation analysis tool”

The 6Ps methodology, named as such, is not a tangible resource but rather a set of instructions (including surveys and interviews) that can be used to determine a roadmap for digital transformation or assess the impact of a project in terms of digitization, specifically tailored for manufacturing companies. Therefore, it does not necessitate formal training to be utilized by end users (as it primarily involves conducting an evaluation). However, in order to expand the user base, our objective is to educate technology providers and Digital Innovation Hubs (DIHs) on effectively presenting the 6Ps assessment to businesses within their community.



General Overview of 6Ps Methodology

In the CAPRI project, our main emphasis for enhancing skills and training activities has primarily revolved around the **PEOPLE** dimension.

Process

The main objective that Polimi team is following by this methodology is to assess the current level of Data, AI and digital maturity of pilots (AS-IS), quantify the desired level of AI and digital maturity that these latter aim at achieving (TO-BE), and design a specific action plan to allow the transition needed to fill the gaps identified.

As mentioned earlier, the main focus in this task was on the People dimension since a thorough analysis of current jobs and professions involved in CAPRI project context conducted in order to identify possible skills gaps derived by Data, AI and digital adoption. A structured approach – Survey-based (Industry 4.0) followed and skills needed/possessed analyzed and discussed as well as identification of the most suitable training programs to bridge such gaps.

1. Identify new roles and skills

The first step of this methodology, has been primarily concerned with identifying new roles, professions, and relevant skills based on the project's content.

Data Science Manager

Data Science Managers propose, plan and manage functional and technical evolutions of the data science and AI operations within the relevant domain.

Skills:

- Knowledge about data and AI processes
- Knowledge about business processes
- Communication with domain experts
- Develop and execute the data and AI strategies
- Manage the data science team and resources
- Knowledge about performance indicators

Data/AI Architect

Data Science /AI Architects design and maintain the architecture of data science / AI applications and facilities.

Skills:

- Ability to integrate data universe
- Select software platforms for big data (Hadoop, Data Lake)
- Knowledge about big data architectural standards
- Select hardware platforms for big data (performances...)

Data/AI Scientist

Data/AI scientists find, interpret and merge data/AI sources, manage large amounts of data, ensure consistency of data and sets, and create visualizations to aid in understanding data/AI.

Skills:

- Identify and interpret relevant data sources
- Use a programming language (R, Python)
- Communicate with domain experts
- Mathematical and statistical models' knowledge
- Knowledge about domain-specific processes
- Use of AI technologies (ex. machine learning)
- Use of Bayes classifier, Deep Learning and optimization algorithms

Visual Data Designer

Visual Data Designers create custom visualizations from complex data sets in a compelling way.

Skills:

- Develop interface & interaction to increase user experience
- Develop vector graphics, scientific illustrations, and icons
- user experience analysis, design, and evaluation
- Understand complex information by integrating AI tools
- Visualize the huge and complex volume of data
- Develop insightful and engaging data analytics view
- create infographics (maps, charts, diagrams)

Data/AI specialist

Data /AI specialist build, manage and maintain data/AI pipelines.

Skills:

- Integrate data and AI technologies into existing systems

- Knowledge about data storage, query languages and use of machine learning
- Use and interact with collaborative robots, systems, and sensors
- Build AI models from scratch and help the different components of the organization
- Develop data models and workflows
- Maintain security, quality, integrity, safety, and availability of data
- Develop applications from big data /AI & provide operational tools for data and AI analytics
- Knowledge of OEE & hardware platforms for big data and Analysis related to AI
- Use cloud computing and AI in industrial control software and applications to monitor and control activities.

AI Manager / Head of AI

AI Managers manage and implement AI according to business objectives.

Skills:

- Adapt technological (new tech. such as AI, VR etc.) innovations to business and Supply Networks
- Build, implement and manage concurrent Digital/intelligence Supply Networks
- Understand and take advantage of IT-OT architectures, sensors, communication, data flow, cloud
- Develop and execute the data and AI strategies according to business objectives
- Knowledge about data and AI processes /User experience analysis, design, and evaluation
- Analyse and understand how the value chain is transformed by virtue of Industry 4.0 and new technologies related to AI
- Improving production process with the introduction of new technologies related to AI and I4.0

Remote Worker

Remote workers are employed in the company but work outside of a traditional plant environment.

Skills:

- Use applications to increase sensory, remote, and cognitive abilities
- Interpret quantitative data, graphs (KPIs) and 3D digital models
- Understand and use additive manufacturing / AI technologies and mathematical models
- Perform scenario analysis to evaluate and prepare for possible interventions

Strategy Manager I4.0

Strategy managers analyse transformation of Value Chain by adopting I4.0 tech, provide leadership for creation of an I4.0 strategy, create relationship with various stakeholders.

Skills:

- Analyse and understand how the value chain is transformed by virtue of I4.0
- Define, implement, and manage a roadmap of technological evolution oriented to the generation of value (according to a lean approach)
- Lead structured problem solving (multi-objective, multi-actor) and provide real-time responses to changes in demand in the digital and intelligence supply network
- Ability to interface with complex knowledge management and reporting systems
- Redesign the production process end-to-end, improving it with the introduction of new technologies 4.0
- Engage and dialogue with stakeholders and trade unions to better manage change related to the introduction of new technologies such as AI
- Define the business model around the product-service and implement Digital Supply Networks

I4.0 Professional

I4.0 professionals use common and enterprise systems, analyse and interpret production data, improve performance through I4.0 tech.

Skills:

- Streamline production processes by digitalizing them and use computer-aided process planning (CAPP)
- Ability to perform scenario analysis to evaluate and prepare for possible interventions (simulations, classifiers, etc.)
- Ability to program & interact with collaborative robots and conduct testing simulations in a virtual environment
- Ability to design product data storage (big data database system) and Integrate sensors/actuators/ ports/ antennas/HMI into the product
- Independently analyse data related to demand and supply networks (e.g., R, Python, MATLAB)
- Knowledge of IoT platforms and sensors and use applications to monitor and control activities
- Use platforms for application development and execution

Digital Transformation Professional 4.0

DT Professionals evaluate pros and cons of different Software, protocols, select and implement new techs (AI).

Skills:

- Analyse the impact of emerging technologies on business (e.g., AI, big data)
- Evaluate pros and cons of platforms based on company's needs and select components (e.g., data and event processing, Tech. related to AI)
- Perform user/human centred analysis for the development of human-machine interfaces, mobile interfaces, augmented reality
- Knowledge and use of machine learning, Deep Learning techniques and develop applications from big data
- Realize communication networks (wireless, wired etc.) to connect robots, machines, products, systems, and people in real-time
- Ability to monitor, understand, contribute to the creation of new standards (e.g., IIoT, Cloud, AI and Data Technologies)

Plant Worker 4.0

Plant workers supervise the operation of an industrial plant.

Skills:

- Use of basic standard of HMI
- Use virtual and augmented reality goggles
- Use exoskeletons and other wearable devices
- Interact with collaborative robots.
- Interpret quantitative data and graphs and 3D digital models

Technician 4.0

Technicians work in a field of technology who is proficient in the relevant skill and technique, with a relatively practical understanding of the theoretical principles.

Skills:

- Use sensors/actuators/ ports/ antennas/HMI standards
- interact with smart warehouses equipped with automated picking systems and autonomous vehicles
- Analytical skills to Interpret data from operations
- Ability to use discrete event simulation
- Ability to use 3D printers

2. Surveys

The second step is related to the first iteration of surveys implementation

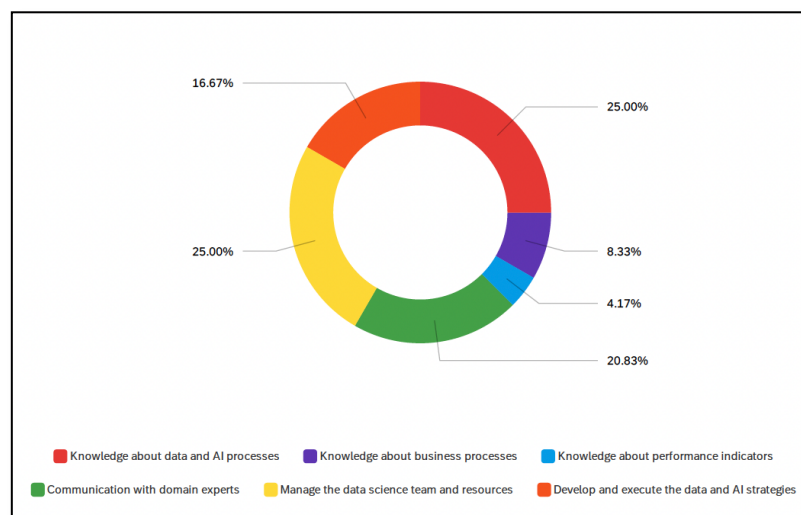
- **Voting and prioritizing skills - Survey**

To gather the viewpoints of project partners regarding the jobs and skills mentioned earlier, surveys were conducted. The purpose of these surveys was to inquire about the experimenters' opinions on the skills associated with each job, and based on the responses received, the skills were prioritized.

The survey was administered to all individuals and project partners, comprising the target group. Below are examples of the analysis conducted during the initial iteration.

EX1: Data Science Manager

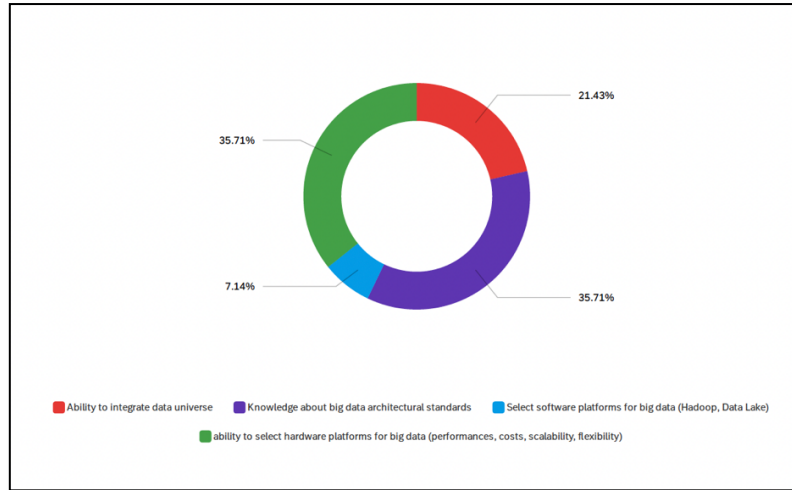
The findings from the responses concerning the "Data Science Manager" role indicate that the skills considered most crucial are as follows: "Manage the data science team and resources" at 25%, and "Knowledge about data and AI processes" at 25%. On the other hand, skills related to "Knowledge about business processes" hold lesser importance at 8.33%, while skills pertaining to "Knowledge about performance indicators" are of even lower significance at 4.17% compared to other skills.



Data Science Manager - result of Voting survey - 1st Iteration

EX2: Data/AI Architect

According to the perspective of project partners in this job profile, two skills stand out as particularly important. "Knowledge about big data architectural standards" and "ability to select hardware platforms for big data (considering performance, cost, etc.)" are both regarded as highly significant, each receiving a rating of 35.71%. In comparison, the remaining two skills hold less significance in the partners' assessment.



Data / AI Architect - result of Voting survey - 1st Iteration

- **Possessed and Needed Skills - Survey**

The compilation of this survey was undertaken by three project pilots who represented the Asphalt, Pharma, and Steel sectors. To ensure a clearer understanding of their responses and opinions in the questionnaire, interviews were carried out with pilots from the Asphalt and Steel industries. Presented below are a few instances of the analysis conducted during the initial iteration.

Based on the received responses and interviews with partners in the Asphalt industry, it becomes apparent that certain roles mentioned earlier are necessary and vary in their level of importance. These roles include the Data/AI Architect (intermediate level), Data/AI Scientist (upper intermediate level), Visual Data Designer (intermediate level), and Plant Worker 4.0 (basic level). Industry experts state that other positions are not currently required, although a platform for their growth may be established in the future.

The Asphalt industry has access to cutting-edge technologies such as artificial intelligence and machine learning. However, several obstacles hinder their implementation. One challenge is the quality of information dissemination across different parts of the organization. Additionally, the industry faces difficulties in effectively processing vast amounts of data. There are also challenges in establishing coordination and synchronization between new technologies and existing departments. The high cost and uncertain return on investment further impede the adoption of these technologies.

The type of product and the size of the company can pose additional obstacles. Large companies are better positioned to acquire and utilize these technologies in their products, as well as promptly integrate the relevant job roles into their organization. In contrast, small and medium-sized companies may encounter delays in adopting such technologies.

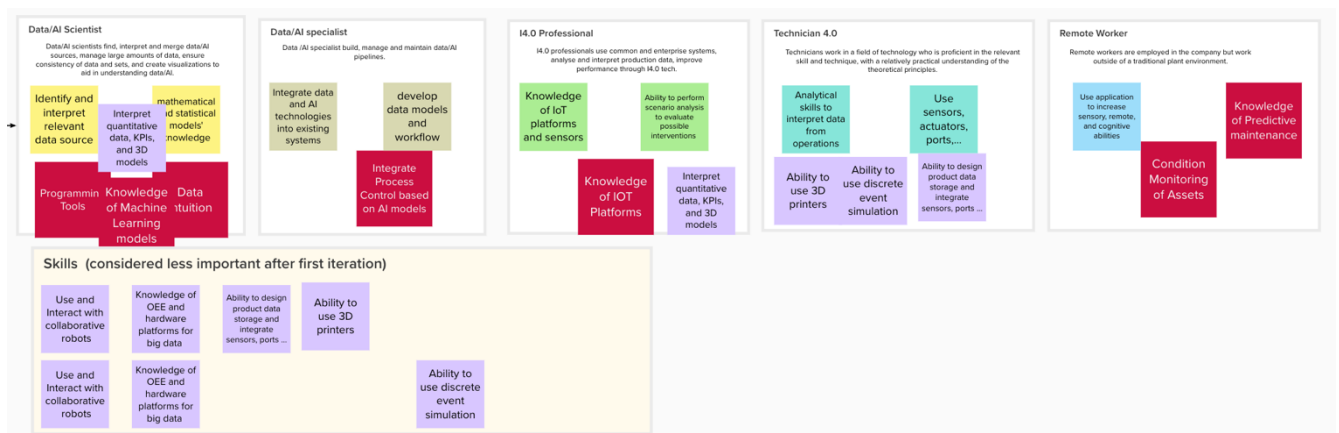
Additionally, based on the responses gathered from the survey and interviews conducted with experts in the Steel industry, it becomes apparent that certain roles mentioned earlier are essential and carry varying degrees of significance. These roles include the Data/AI specialist (at an expert level), Remote Worker (at an upper intermediate or expert level), I4.0 Professional (ranging from intermediate to upper intermediate level), Digital Transformation Professional 4.0 (at an intermediate level), and Technician 4.0 (at an expert level).

In both the Steel and Asphalt industries, there exists an opportunity to establish a platform for the development of these introduced jobs. Some of the skills required for these roles are already present in the IT director position; however, further practice and improvement are necessary

for upskilling and reskilling. Moreover, there are certain barriers to overcome, such as establishing connections between geographically distant parts of the organization, managing software and facilitating communication between departments, addressing the high cost and market maturity disparities among different countries, and hiring specialized employees proficient in data and artificial intelligence.

WORKSHOP

To finalize and authenticate the information and responses obtained from the initial iteration of the 6Ps (People Dimension) methodology, a workshop was conducted on May 31st, 2023. The workshop featured an interactive segment towards the end, where the main objective was to collect information from internal partners regarding job statuses, skills, relevant tasks, and past achievements. The purpose of this exercise was to enhance existing skills and introduce new ones based on the gathered insights and success stories.



Mural session of workshop

Training courses

Following the introduction of the relevant jobs and skills, conducting surveys, performing validation workshops, and identifying gaps in the project experiments, we have now progressed to the stage of suggesting training activities aimed at strengthening the required skills for the introduced job profiles.

In this phase, three levels of training have been established: "Awareness," "Foundations," and "Extended Know-How." The "Awareness" level focuses on providing general knowledge and information to familiarize individuals with the subject matter. The "Foundations" level encompasses essential and practical knowledge, while the "Extended Know-How" level offers a comprehensive range of information to enhance the audience's understanding and ability to utilize the technology effectively.

To fulfill these training requirements, various courses from sources such as the "I4MS Catalogue of Trainings," "Polimi open knowledge," "Coursera," "Udemy," "Google courses," and others, specifically related to data science and artificial intelligence topics, have been analyzed. The correlation between the jobs, related skills, and these courses at the three defined levels has been determined.

Next steps

Among the activities to be considered for the future, one important step is to implement the second iteration of surveys. This will allow for the analysis of the "TO-BE" condition of partners, evaluating how the methodology has been effective in the project. By conducting these surveys, we can gather valuable data on the progress and impact of the implemented changes.

Another significant aspect is to expand the number of training courses available and enhance the existing database of training activities. This will provide partners with a wider range of options to strengthen their skills and acquire new knowledge. Improving the database will ensure that it remains up-to-date and comprehensive, catering to the evolving needs and requirements of the project.

These activities will contribute to the continuous improvement and refinement of the project, enabling partners to continually enhance their skills and adapt to the changing landscape of data science and artificial intelligence.