



D8.8 AI REGIO Skills Catalogue and Jobs Certification program

Author:	POLIMI
Work Package:	WP8
Delivery date:	31.03.2022
Due date:	31.03.2022
Classification:	PU /Report

The AI REGIO Project owns the copyright of this document (in accordance with the terms described in the Consortium Agreement), which is supplied confidentially and must not be used for any purpose other than that for which it is supplied. It must not be reproduced either wholly or partially, copied or transmitted to any person without the authorization of the Consortium.



H2020 Innovation Action - This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement N. 952003



Status of deliverable

Action/role	Name	Date (dd.mm.yyyy)
Submitted by	Sergio Gusmeroli (POLIMI)	30.03.2022
Responsible (WP leader)	Sergio Gusmeroli (POLIMI) Mahdi Mohammadian (POLIMI)	30.03.2022
Approved by (internal reviewer)	Mael Moguedet (S2P)	24.03.2022

Revision History

Date (dd.mm.yyyy)	Version	Author	Comments
15.11.2021	v0.1	POLIMI	ToC initial draft
20.01.2022	V0.2	POLIMI	Chapter 1,2,3
23.02.2022	V0.3	POLIMI	Chapter 4
29.02.2022	V0.4	POLIMI	Conclusion and summary
04.03.2022	V0.5	POLIMI	Figures and details
24.03.2022	V0.6	S2P	Internal review
30.03.2022	V1.0	POLIMI	Final version

Author(s) contact information

Name	Organisation	E-mail
Sergio Gusmeroli	POLIMI	Sergio.Gusmeroli@polimi.it
Mahdi Mohammadian	POLIMI	mohammadmahdi.mohammadianghovaghloo@polimi.it



Contents

Executive Summary6

1 Introduction.....7

 1.1 About this deliverable.....7

 1.2 Document structure.....7

2 Research background and related reports8

 2.1 An overview of digital transformation emerging skills8

 2.1.1 Labour market trends and needs for skills10

 2.1.2 Skills for the future of I4.0 and I5.011

 2.1.3 Changing roles and new roles.....12

 2.1.4 Challenges to digital skills development in SMEs13

 2.2 6Ps methodology in People dimension14

 2.3 Skills in Industry 4.015

 2.4 DR BEST – Services related to training actions.....16

3 New roles and professions17

 3.1 Data / AI new roles and Professions17

 3.2 Data / AI skills for enterprises I4.019

 3.3 Soft Skills21

4 Analysing approach22

 4.1 Voting and prioritizing skills - Survey22

 4.1.1 Result of first iteration23

 4.2 Possessed and Needed - Survey.....32

 4.2.1 Result of first iteration33

 4.3 Soft Skills43

 4.4 Training Activities45

 4.5 DR BEST - Services and customer journey46

 4.6 Plans for the next period49

5 Conclusions50

6 References51



Figures

Figure 1	A digital Europe need digital skills	9
Figure 2	Market and Technology trends	10
Figure 3	Reskilling needs in Advanced Manufacturing according to WEF 2020 report ⁸	11
Figure 4	World Economic Forum- Emerging Jobs and Top 10 Skills	12
Figure 5	Synthesis of Barriers for skills development in SMEs	13
Figure 6	6Ps Digital Transformation Tool	14
Figure 7	Skills in Industry 4.0 - Osservatorio Industria 4.0	15
Figure 8	General Overview of DR BEST	16
Figure 9	General overview of CJs	16
Figure 10	Voting and Prioritizing skills survey	22
Figure 11	Data Science Manager - result of Voting survey - 1 st Iteration	23
Figure 12	Data / AI Architect - result of Voting survey - 1 st Iteration	24
Figure 13	Data / AI Scientist - result of Voting survey - 1st Iteration	24
Figure 14	Visual Data Designer- result of Voting survey - 1st Iteration	25
Figure 15	Data / AI Specialist - result of Voting survey - 1st Iteration	26
Figure 16	AI Manager / Head of AI - result of Voting survey - 1st Iteration	27
Figure 17	Remote Worker - result of Voting survey - 1st Iteration.....	28
Figure 18	Strategy Manager I4.0 - result of Voting survey - 1st Iteration	28
Figure 19	I4.0 Professional - result of Voting survey - 1st Iteration	29
Figure 20	Digital Transformation Professional 4.0 - result of Voting survey - 1st Iteration.....	30
Figure 21	Plant Worker 4.0 - result of Voting survey - 1st Iteration	31
Figure 22	Technician 4.0 - result of Voting survey - 1st Iteration	31
Figure 23	Possessed and Needed – survey.....	32
Figure 24	Soft Skills - Management Level.....	44
Figure 25	Soft Skills - Professional Level	44
Figure 26	Soft Skills - Worker Level	45
Figure 27	Customer Journey – Managers Level (Strategy Manager I4.0).....	48
Figure 28	Customer Journey – Professionals Level (I4.0 Professional, and Digital Transformation Professional 4.0).....	48
Figure 29	Customer Journey – Workers Level (Plant Worker 4.0, and Technician 4.0).....	49

Tables

Table 1	Data Science Manager - Possessed and Needed – survey	33
Table 2	Data / AI Architect - Possessed and Needed – survey	34
Table 3	Data / AI Scientist - Possessed and Needed – survey	35
Table 4	Visual Data Designer- Possessed and Needed – survey	35
Table 5	Data / AI specialist - Possessed and Needed – survey	36
Table 6	AI Manager / Head of AI - Possessed and Needed – survey	37
Table 7	Remote Worker - Possessed and Needed – survey.....	38
Table 8	Strategy Manager I4.0 - Possessed and Needed – survey	39
Table 9	I4.0 Professional - Possessed and Needed – survey	40
Table 10	Digital Transformation Professional 4.0 - Possessed and Needed – survey.....	41
Table 11	Plant Worker 4.0 - Possessed and Needed – survey	42
Table 12	Technician 4.0 - Possessed and Needed – survey	42



Table 13 Soft Skills in Three different Levels43
 Table 14 Database of Training Activities46

Abbreviations and Acronyms:	
AI	Artificial Intelligence
AI Act	Artificial Intelligence Act (proposal)
AIDA	Special Committee on the Artificial Intelligence in the Digital Age
ALTAI	Assessment List for Trustworthy Artificial Intelligence
API	Application Programming Interface
B2B	Business to Business
CA	Competent Authority
CI	Collaborative Intelligence
DF	Didactic Factory
DIH	Digital Innovation Hub
DMA	Digital Market Act (proposal)
DMP	Data Management Plan
DOA	Description of Actions
DPO	Data Protection Officer
DR BEST	Data, Remote, Business, Ecosystem, Skills, Technology
DSA	Digital Service Act (proposal)
DT	Digital Twin
EC	European Commission
EDIH	European Digital Innovation Hub
EEG	Electroencephalogram
EFFRA	European Factories of the Future Research Association
ELS	Ethical, Legal and Societal
EP	European Parliament
ePD	e-Privacy Directive
ePR	e-Privacy Regulation (proposal)
ES	Ethical Strategy
EU	European
GDPR	General Data Protection Regulation (Regulation EU 2016/679)
HF	Human Factor(s)
HLEG	High Level Expert Group
HMI	Human-Machine Interaction
HRL	Human Rights Law
I4.0 I5.0	Industry 4.0 / Industry 5.0



IAs	Industry Agreements
ICT	Information and Communication Technologies
IDS	International Data Space
IEEE	Institute of Electrical and Electronics Engineers
IP	Intellectual Property
IPR	Intellectual Property Rights
KHC	Know-How-to-Cooperate
KPI	Key Performance Indicator
ML	Machine Learning
OEM	Original Equipment Manufacturer
MSD	Musculoskeletal Disorders
OSAI	Observatory on Society and Artificial Intelligence
PIA	Privacy Impact Assessment
R	Remotization
RED	Radio-Equipment Directive
SB	Standardisation Body
SME	Small Medium Enterprise
TEF	Testing and Experimentation Facility
TERESA	Technological and Regulatory Sandbox
UI	User Interface
VI	Vanguard Initiative
WP	Work Package



Executive Summary

The introduction of Industry 4.0, Data Management, digital platforms, and the use of modern technology such as Artificial intelligence, Machine learning, and others, creates a need for new skills within a company's workforce, which have historically not been appropriate. Aspects like lifelong learning and new paradigms in education are becoming more and more relevant.

This deliverable (D8.8), [Months: 1-18] "AI REGIO Skills Catalogue and Jobs Certification Program" is related to WP8, task T8.4 "Jobs Skills and Competences in AI for Manufacturing" and presents the following aspects:

Research background and related reports: Recent studies have been conducted in the field of skills and job profiles in industry 4.0; Artificial intelligence, Labour Market developments, Data management, etc. and an overview of relevant initiatives have been reviewed. Also, based on studies conducted in World Economic Forum, World Manufacturing Forum, and Osservatorio industria 4.0 of Politecnico di Milano, the job profiles and related skills required for industry 4.0 in the field of Data Science and AI management, how to move from industry 4.0 to industry 5.0, and the emerging job and related skills such as data science, Artificial intelligence, and others, have been discussed. In addition, there is also Introduction of 6Ps methodology - People dimension, which is the model, that examines six different aspects of experiments (Product-Process-Platform-People-Partnership Performance), that generally adopted by the University of Politecnico di Milano and has been implemented and analysed in previous European projects such as BOOST4.0, MIDIH, and CAPRI. The goal of this model is to assess manufacturing companies' current level of AI and digital maturity (AS-IS), quantify the desired level of AI and digital maturity that these companies want to achieve (TO-BE), and design a specific action plan to allow the transition needed to fill the gaps identified. Furthermore, a brief definition of the "Service Portfolio – DR BEST (Data, Remotization, Business, Ecosystem, Skills, and Technology)" model that is used to support Didactic Factory in service exchange and provisioning is also provided that in deliverable can play a supportive role for 6Ps model.

New roles and professions: As a first step of methodology, twelve jobs and related skills have been introduced. Seven out of twelve are related to "DATA/AI New Roles & Professions" which are new jobs that are introduced in line with the growth of technology in the field of data science and artificial intelligence, and five out of twelve are related to "DATA/AI Skills for Enterprise Industry 4.0 Roles", that many companies currently most probably have these roles but need to improve and develop skills in line with technology. In addition to the skills assigned to each job profile, which are mostly technical skills, a review of soft skills has been conducted at managers, professionals and worker levels.

Analysing approach: Two surveys (Voting, Needed and Possessed) and relevant interviews were conducted in relation to the introduced jobs and skills in order to prioritize skills dedicated to each job profiles and analyse the current situation of the experiments and identify the gaps in them. Then, as the second step of the methodology, in accordance with the skills and jobs introduced, relevant training activities have been defined and the model Service Portfolio – DR BEST and its related customer journeys are shown to support the 6Ps people dimension model.

Key Words: Artificial Intelligence, Industry 4.0, 6Ps People dimension, Data Science Management, Job Profiles, Skills



1 Introduction

1.1 About this deliverable

Industry 4.0 is focused on enterprise digital transformation, and the main challenges are related to the introduction of digital tools into industrial practices, such as artificial intelligence, advanced collaborative robots, big data and analytics, and others.

Managers, engineers, and blue-collar workers will require new lifelong learning programs to help them keep up with the pace of change. Rapid advancements in manufacturing technology and Information and Communication Technologies (ICT) have placed a high demand on manufacturing education for a continuous update of knowledge content and delivery methods. Understanding the technical essence and business potential of new knowledge/technology is critical for its successful adaptation and integration into industrial working practice.

Skills and job profiles are critical in companies' efforts to adopt new technologies and practices. Evolution occurs in all possible directions at the same time. Existing skills should be incorporated into job profiles. To properly address the new digitalization trends, new skills must be developed. New profiles should be created to better meet the needs of the businesses. This deliverable identifies emerging, new skills and job requirements aligned with Data Science Management and Artificial Intelligence, as well as new skills for current job profiles to improve employees' abilities at three different organizational levels (Manager, Professional, and Worker levels)

1.2 Document structure

The document is structured as follows:

- In chapter 2, an overview of market developments and technological trends is being presented. State of the art material as well as recent reports of WMF and WEF are used in order to give an overview of the need for digital skills in manufacturing. In addition, a brief explanation of the 6P People dimension methodology as well as the support method "Service Portfolio – DR BEST" is provided
- In chapter 3, twelve job profiles and related skills in the field of Data Science Management and Artificial intelligence are introduced, which are divided into two categories DATA/AI New Roles & Professions and DATA/AI Skills for Enterprise Industry 4.0 Roles.
- Chapters 4 and 5 Analysis of the AS-IS conditions of experiments in relation to the jobs introduced is stated. In addition, the database of training activities is defined. Finally, the conclusion of the first iteration of the method is expressed.



2 Research background and related reports

2.1 An overview of digital transformation emerging skills

The Industry 4.0 concept has emerged from an initiative supported by academics and the industry along with the support of the German Government. The initiative aims at strengthening the competitiveness of the manufacturing industry through the convergence between production processes and Information and Communication Technologies (ICT)¹. Industry 4.0 utilizes technologies such as the Artificial Intelligence (AI), Internet of Things (IoT) and services (IoS), Cyber Physical Systems (CPS), cybersecurity, smart robotics, augmented and virtual reality technologies, to improve the productivity of the industrial manufacturing systems. As a result of the increased use of digital technologies, the boundary between the real and the digital world is increasingly obscuring, leading to what is known as cyber-physical production systems. In addition to the technologies mentioned in the industry 4.0, Industry 5.0 is already being spoken about and involves robots and smart machines allowing humans to work better and smarter². Therefore, in order to realize the ideas of better communication between machine, robot and human, the main focus is on technologies that make this process easier and more accessible, such as Artificial Intelligence (AI), and machine learning (ML), because AI and ML refer to machines which utilize algorithms to process data and reach conclusions that were not programmed into them by human developers. These machines learn from data in order to generate increasingly accurate predictions³. Despite the considerable attention paid to the topic of I4.0, and I5.0 research on the changes in the jobs and skills required by I4.0, and I5.0 are still developing. Learning and training are fundamental key factors for achieving the I4.0, and I5.0 objectives as they will significantly transform the job and skills profiles of the blue and white-collar workers. New skills requirements are changing rapidly, and enterprises, especially SMEs, struggle to find the talent they need. On the other hand, due to the digitalization of many processes and the high speed of progress in this field it has created new needs in society as well as in the business environment.

According to research has been done in " Shaping Europe's digital future"⁴, in case of need for digital skills in society, as Figure 1 depicts, people divided into 3 categories:

- **Young people:** In this category almost 95%, who are between 16-24 years old are internet users so in this case education must adapt to the digital era. In addition, society need to raise the number of students in ICT because the number of ICT graduates has decreased 13% between 2016 to 2013.
- **Working aged people:** In this category, this issue can be mentioned that digital technologies create new jobs and opportunities, and it should be noted that each job in ICT creates 3 more jobs elsewhere in the economy. In addition, here also the whole workforce needs to be digitally trained.

1 H. Kagermann, J. Helbig, A. Hellinger, and W. Wahlster, Recommendations for implementing the strategic initiative INDUSTRIE 4.0: Securing the future of German manufacturing industry; final report of the Industrie 4.0 Working Group. Forschungsunion, 2013.

2 <https://www.twi-global.com/what-we-do/research-and-technology/technologies/industry-4-0>

3 <https://www.machinemetrics.com/blog/industry-4-0-technologies#artificial-intelligence-and-machine-learning>

4 <https://ec.europa.eu/digital-single-market/en/news/digital-europe-needs-digital-skills>



- **Older people:** In this category, society needs to raise awareness of the benefits of going digital, for instance by providing supports to older people to get online and develop digital skills.

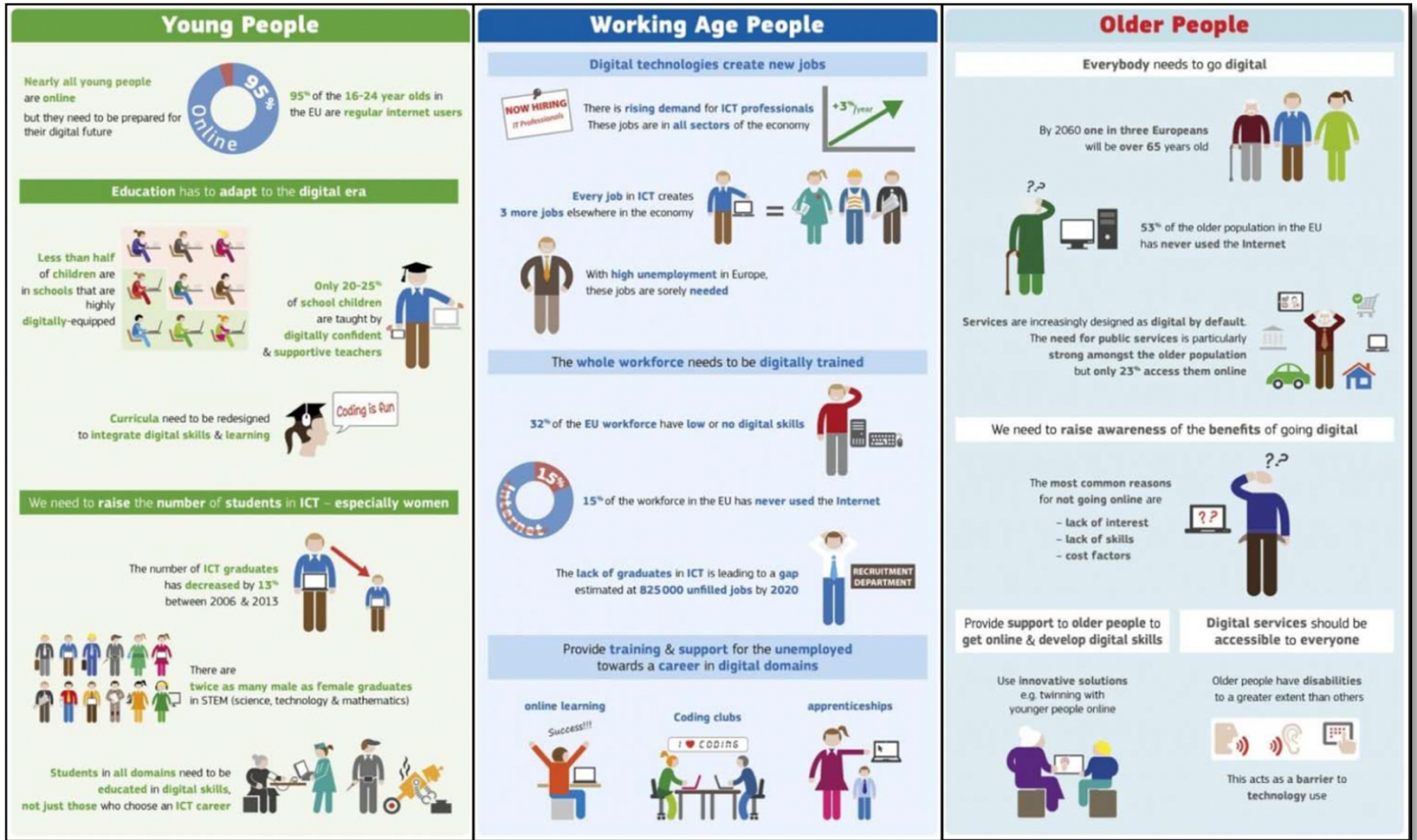


Figure 1 A digital Europe need digital skills

Furthermore, in order to investigate the impact of creating and adopting new jobs and skills according to the trend of emerging new technologies such as artificial intelligence on current organizations, a lot of research has been done, among which we can mention to the studies conducted by Mc Kinsey & company – "The Future of Work in Europe- 2020⁵" Based on questions about people's expectations regarding to see "skill gaps as market and technology trends alter organizations' talent needs" the following results (Figure 2) were obtained.

⁵ <https://www.mckinsey.com/featured-insights/future-of-work/the-future-of-work-in-europe#>



Figure 2 Market and Technology trends

Based on these results, it can be concluded that, 43% of respondents believe which currently they are experiencing skill gaps in their organizations, while 22% believe that they will face in next 2 years with this gap and the same percentage is also believe they will face in next 3-5 years and few percentages voted to more than 6 years. Analysing these responses shows that the technology and market is changing and developing very fast which many organizations are already facing these changes and many will touch it in the very near future in their business.

In addition, according to second analysis about " share of organizations' current roles at risk of being disrupted by market or technology trends in next 5 years" and based on respondents' expectation, it can be concluded that: 41% believe, between 11 to 25% of roles will disrupted in next 5 years and 22% believe this percentage is between 1 to 10 % and same percentage of participants believe 26 to 50% of roles will disappeared or replace by new roles in next 5 years. The analysis of these answers shows that the market and technology will change and grow a lot in the next 5 years, so that many of the existing roles will be affected by the new trend and as a result; will be removed, modified, or replaced.

2.1.1 Labour market trends and needs for skills

The development of novel technologies such as Artificial Intelligence, smart sensors, intelligent assistants, robots, and automation will continue to demand change in the types of skills as well as the labour landscape⁶. Global labour markets are undergoing major transformations, with changes to business needs and workforce profiles picking up an even more incredible pace in recent years. The human-centered paradigm shift will only be successful if work processes are reshaped, and new training approaches are introduced to support the continuous development of skills taking into account personal capabilities, skills and situational preferences of individual operators⁷. The Future

⁶ Ocident Bongomin , Gilbert Gilibrays Ocen, Eric Oyondi Nganyi, Alex Musinguzi, and Timothy Omara Exponential Disruptive Technologies and the Required Skills of Industry 4.0, 2020, <https://doi.org/10.1155/2020/4280156>

⁷ Ace factories, White paper on Human-centred factories from theory to industrial practice. Lessons learned and recommendations, 2019.

of Jobs Report 2020⁸ from World Economic Forum (WEF) maps the jobs and skills of the future. For 2020 the report suggests that “while technology-driven job creation is still expected to outpace job destruction over the next five years, the economic contraction is reducing the rate of growth in the jobs of tomorrow”. WEF reports estimate the needs in terms of reskilling needed according to the expected needs of the labour market. In Figure 3 below the infographics of the WEF report is presented that mentions that 73,2% of the employees will require a considerable amount of training (i.e., more than one month).



Figure 3 Reskilling needs in Advanced Manufacturing according to WEF 2020 report⁸

2.1.2 Skills for the future of I4.0 and I5.0

Towards a sustainable, human-centric, and resilient European industry report, Industry 4.0 and 5.0 recognizes the power of industry to achieve societal goals beyond jobs and growth to become a resilient provider of prosperity by making production respect the boundaries of our planet and placing the well-being of the industry worker at the centre of the production process⁹.

The skills for the future of manufacturing identified by the 2019 World Manufacturing Report are¹⁰:

- Digital literacy as a holistic skill to interact with, understand, enable, and even develop new digital manufacturing systems, technologies, applications, and tools.
- Inter-cultural and -disciplinary, inclusive, and diversity-oriented mindset to address new challenges arising from a more diverse manufacturing workforce
- Ability to use and design new AI and data analytics solutions while critically interpreting results

⁸ World Economic Forum, 2020, The Future of Jobs Report, October 2020.

⁹ Romero, D., Stahre, J., Wuest, T., Noran, O., Bernus, P., Fast-Berglund, Gorecky, D.: Towards an operator 4.0 typology: a human-centric perspective on the fourth industrial revolution technologies. In: Proceedings of the International Conference on Computers and Industrial Engineering, pp. 1–11 (2016).

¹⁰ World Manufacturing Forum's ten skills for the future of manufacturing - World Manufacturing Forum - <https://worldmanufacturing.org/>

- Cybersecurity, privacy, and data/information mindfulness to reflect the rapidly increasing digital footprint of the manufacturing value chain
- Creative problem-solving in times of abundant data and tasks technological opportunities in smart manufacturing systems
- Ability to handle the increasing complexity of multiple requirements and simultaneous tasks
- A strong entrepreneurial mindset including proactiveness and the ability to think outside the box
- Effective communication skills with humans, IT, and AI systems through different platforms and technologies
- Ability to work physically and psychologically safely and effectively with new technologies
- Open-mindedness towards constant change and transformation skills that constantly question the status quo and initiate knowledge transfer from other domains

2.1.3 Changing roles and new roles

The manufacturing transition with the implementation of AI has major effects on the positions and abilities of workers in the industry. It stressed the crucial role played by people to redefine the strategy of the organization. When the strategy is defined, the requisite steps for the transition are to be planned and assessed by other people. New functions and profiles are designed for the design, execution, operation, and maintenance of new AI applications during their life cycle. In a new organization of human and artificial intelligences, people can eventually interpret deeply changed positions. Such functions will be defined by the improvement of the conventional collection of competences, which both include improving foundational competences and core competences in the manufacturing sector and learning new data and AI skills. Figure 4 depicts ten Emerging jobs and top ten skills based on World Economic Forum report¹¹.

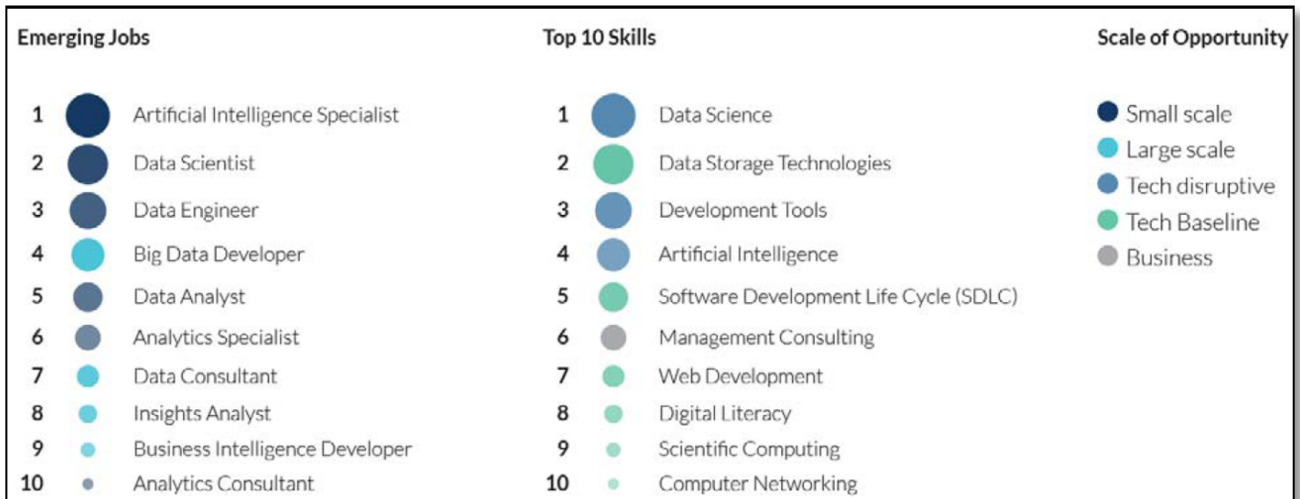


Figure 4 World Economic Forum - Emerging Jobs and Top 10 Skills

According to the Figure 4 Job profiles that have emerged can create opportunities in different scales, these scales depict the extent of influence and impact of these emerging jobs and skills in different sectors of the industry, which are classified as, Business, Tech Baseline, Tech disruptive, large and small scales. For instance: Data analyst and Analytics specialist in Tech disruptive scale, Analytics consultant in business scale, Artificial intelligence specialist, data science and data engineers in small and other job profiles in large scale. There are similar conditions for the top 10 skills, the most

¹¹ https://worldmanufacturing.org/wp-content/uploads/WorldManufacturingForum2020_Report.pdf

important ones which can mentioned are Management consulting in Business scale, Data science, Development tools and artificial Intelligence in Tech disruptive scale and Data storage Technologies, Software development Life cycle in Tech baseline scale, etc.

2.1.4 Challenges to digital skills development in SMEs

According to the European Commission's 2019¹² report Digital Skills New Professions, New Educational Methods, New Jobs, the most significant operational barrier to providing digital skills training to SME employees is a lack of time¹³. Further barriers relate to the availability of training programs, with cost, inflexible timetables, and distance cited as the main barriers to participation, as well as an inability to fully understand the training's content based on the limited information provided. Figure 5, from the 2019 Skills for SMEs¹⁴ report, depicts additional barriers.

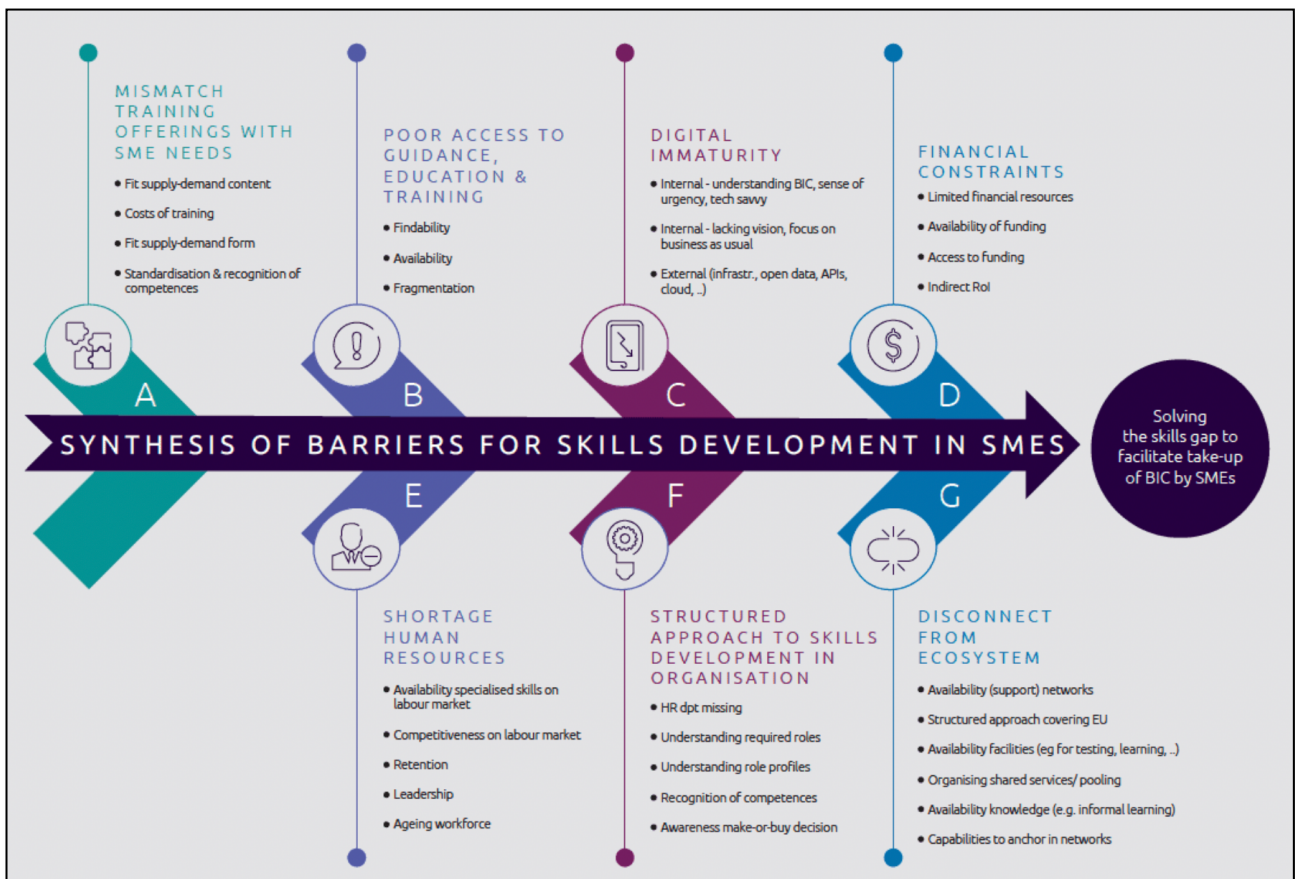


Figure 5 Synthesis of Barriers for skills development in SMEs

12 <https://digital-strategy.ec.europa.eu/en/library/digital-skills-training-blueprints-upskilling-sme-employees-and-unemployed-persons>

13 <https://www.digitalsme.eu/digital-skills-for-smes-challenges-and-opportunities/>

14 <https://op.europa.eu/en/publication-detail/-/publication/82aa7f66-67fd-11ea-b735-01aa75ed71a1/language-en>

2.2 6Ps methodology in People dimension

The 2020 WMF Report and the 2020 WEF Jobs of tomorrow (Mentioned in Section 1) suggest that the digitalization process and upgrading skills based on new technologies such as AI, does not refer to technologies and processes but must encompass also a proportionate empowering of digital skills at every level (from shop floor to top management) and eventually the creation of roles aligned to the digital advancement that industry is facing. In light of this, metrics aimed at measuring which skills are needed and how much developed must be at every level of an organization seems to be a fundamental element to transform the suggestions articulated into practice.

As the project utilizes AI technologies, the main scope in this chapter is to consider all the different dimensions affected by digitalization within the industrial environments, the Product, the Process, the Platform, the People, the Partnership, and the Performance. In this regard, the objective is to design and develop a structured methodology (6Ps) able to assess the current level AI and digital maturity of manufacturing companies (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. The main focus will be on the People dimension since a thorough analysis of current jobs and professions involved in this project context will be conducted in order to identify possible skills gaps derived by AI and digital adoption. In addition, this process will dedicate some of the efforts to organizing workshops and surveys to collect the needed feedback from the partners in the development stage of the project to ensure providing simple and easy-to-use AI tools. A structured approach – Survey-based (Industry 4.0) will be followed and skills needed/possessed analyzed and discussed as well as identification of the most suitable training programs to bridge such gaps. The first step of this methodology is primarily concerned with identifying new roles, professions, and relevant skills based on the project's content. In addition, related to these new roles and skills, two main questionnaires were asked of project partners and the first iteration of surveys implementation among project partners have already been completed. (The Summary result of this step is reported in Chapter 4.)

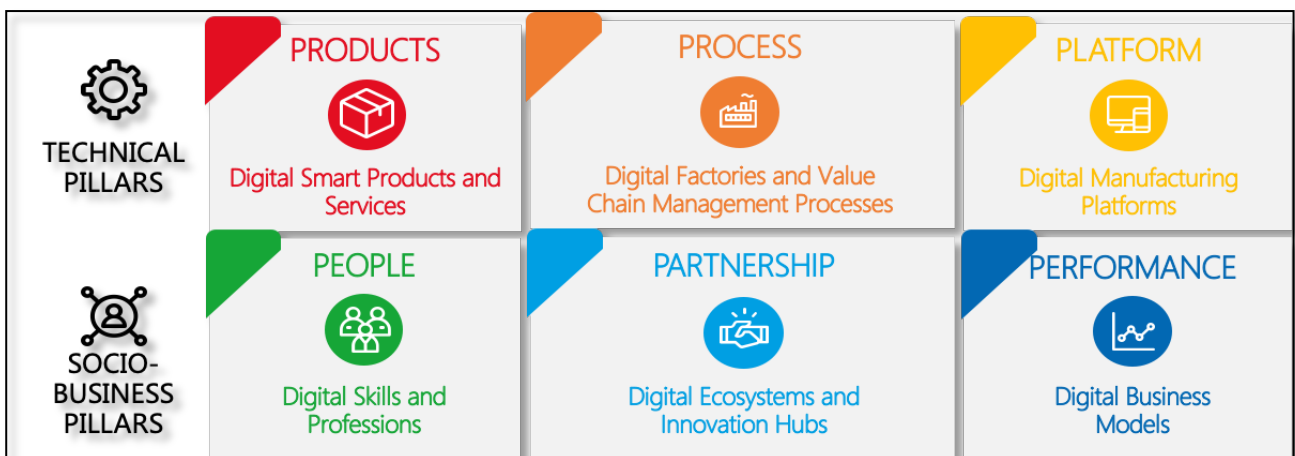


Figure 6 6Ps Digital Transformation Tool

Figure 6 depicts all six dimensions mentioned in the preceding paragraph which the main focus of this section is on the people dimension. According to the analyzes performed in the content of the project, two main groups were identified under the titles of “DATA/AI New Roles & Professions “, and “DATA/AI Skills for Enterprise Industry 4.0 Roles”.

The first group, "DATA/AI New Roles & Professions" includes jobs and skills that do not yet exist in the industrial environment but will be needed in the coming years due to technological trends. Of course, it's worth noting that some businesses may have already recognized the value of some of the skills associated with these jobs and have begun to implement them.

The second group "DATA/AI Skills for Enterprise Industry 4.0 Roles" is related to jobs that already exist in some form in companies, but due to the rapid growth of technology, especially artificial intelligence, and machine learning, they need to update their skills.

These jobs were examined at three levels "Managers, Professionals, and Workers Level" which will be introduced in section 3.

2.3 Skills in Industry 4.0

In addition to the references mentioned in section 2.1 and the two main groups mentioned in section 2.2; It should be noted that another main source "Osservatorio Industria 4.0 - Politecnico di Milano" were effective in introducing the job profiles and defining related skills. Osservatorio Industria 4.0 is a structured repository of 100+ technical and managerial skills 4.0 covering five areas¹⁵, necessary to define Industry 4.0 strategies, and design, manage and enable Industry 4.0 processes and business models which are:

- Smart product-service design management,
- Smart Hyperconnected Factories management,
- Smart Autonomous Factories management,
- IT-OT integration management,
- Data science and AI management (The main content of this Pentagon is introduced based on Data Science Management. In this project, due to the effect of artificial intelligence technology on many skills, job profiles were updated in accordance with the skills related to artificial intelligence and machine learning, and this change also was made in its original name of this pentagon – Figure 7.)

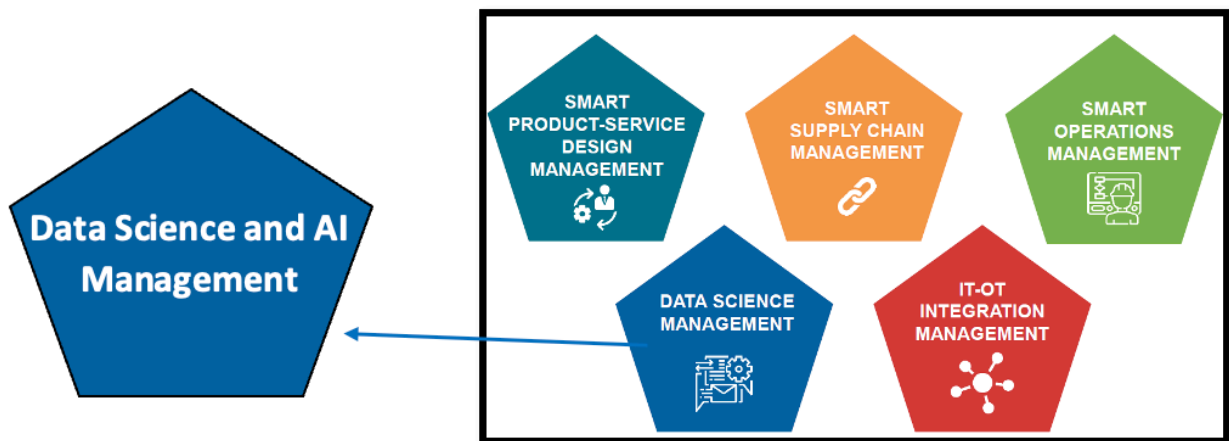


Figure 7 Skills in Industry 4.0 - Osservatorio Industria 4.0



2.4 DR BEST – Services related to training actions

In addition to 6ps methodology, which is explained in section 2.2, another tool that can be used to support 6Ps method to identify and updated companies by new jobs and related skills, as well as how to teach these skills and update them is “SERVICE PORTFOLIO – DR BEST “and especially Skills Block, which is related to Up skilling and reskilling employees. DR BEST is a Service portfolio (Figure 8) that covers six different areas (Data, Remotization, Business, Ecosystem, Skills, and Technology) and is used to support Didactic Factory in service exchange and provisioning.

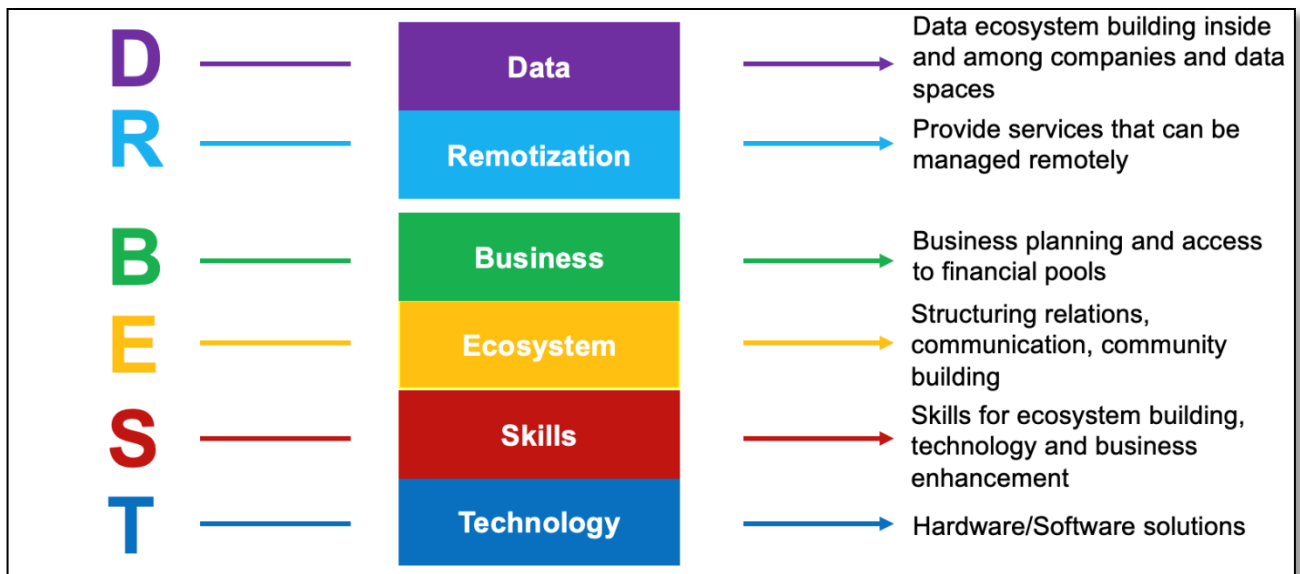


Figure 8 General Overview of DR BEST

Furthermore, in order to better understand the jobs and the steps taken to use these roles and skills in companies, customer journey (CJs) charts (Figure 9) are introduced, which in this deliverable, since the main purpose is to introduce jobs and improve skills, main focus will be on the skills block.

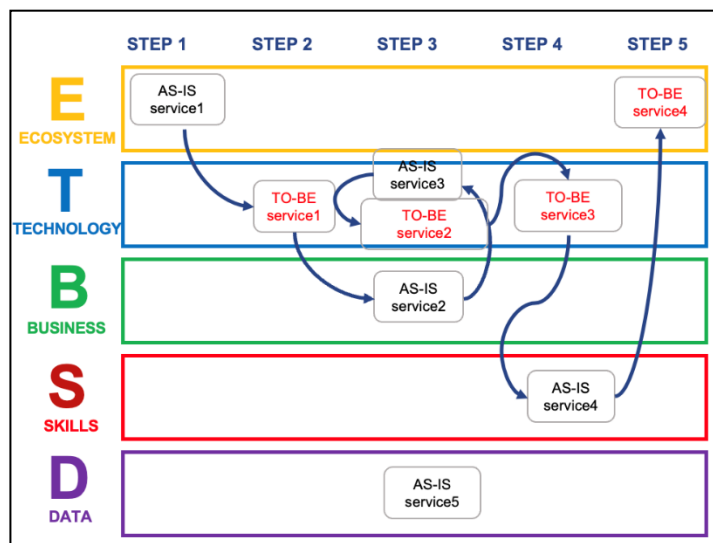


Figure 9 General overview of CJs



It should be mentioned that since this service and customer journeys relevant to this service are related to improving and updating skills, in this regard the second group of jobs, "DATA/AI Skills for Enterprise Industry 4.0 Roles" are covered. The first group of profiles "DATA/AI New Roles & Professions" can be introduced and explain to companies according to the training courses introduced in the section 4.3.

3 New roles and professions

3.1 Data / AI new roles and Professions

As mentioned in section 2.2, the first set of job profiles examined is about "DATA/AI New Roles & Professions." This category includes jobs and relevant skills that, while companies may not recognize the importance of their existence at the moment, but it will be felt in the coming years due to the growing technology in the fields of data science and artificial intelligence advances.

These are the jobs and related skills that are listed below:

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, OR 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 Manger, manages and implements 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,
- Analyze 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 worker is worker of a company but works 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,

3.2 Data / AI skills for enterprises I4.0

This section is about "DATA/AI Skills for Enterprise Industry 4.0 Roles," which is related to the second group of jobs. Several companies currently have these profiles or relevant job titles but based on the industry 4.0 and artificial intelligence technology trends, these need to be improved and upgraded. This section also examines jobs at three levels: managers, professionals, and workers, as listed below:

Strategy Manager I4.0

Strategy manager analyzes transformation of the value chain by adopting I4.0 tech, provides leadership for creation of an I4.0 strategy, creates relationship with various stakeholders.

Skills:

- Analyze 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 professional, uses common and enterprise systems, Analyzes, and interprets 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 analyze 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 Professional, evaluates pros and cons of different Software, protocols, Selects and implements new techs (AI).

Skills:

- Analyze 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 centered 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 worker supervises 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

Technician works 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,



3.3 Soft Skills

This section looks at soft skills in addition to the technical skills mentioned in previous sections. Soft skills are characteristics and personality traits that assist employees in interacting with others and succeeding in the workplace. The following is a list of all the soft skills associated with the various levels: "managers, professionals, and workers." Section 4.3 depicts an analysis of the responses received from project partners regarding soft skills.

List of Soft Skills:

- Emotional Judgment,
- Teamwork,
- Communication,
- Professional ethics,
- Problem solving,
- Critical thinking,
- Innovation,
- Ethical / Legal mindset ,
- speak second language,
- Time management Judgment,
- Interpersonal skills,
- Critical problem solving,
- Digital literacy problem solving,
- Self-management,
- Global perspective,,
- Digital skills,



4 Analysing approach

4.1 Voting and prioritizing skills - Survey

In order to examine the perspectives of project partners on the jobs and skills mentioned in the previous sections, surveys were set up to ask the experiments' opinions on the skills assigned to each job in the first place, and the skills were prioritized based on the answers received. This survey, which is named "Voting and Prioritizing skills" (Figure 10), was published in online mode¹⁶, which in section 4.1.1, the results of its first iteration is depicted.



Figure 10 Voting and Prioritizing skills survey

¹⁶ https://polimi.eu.qualtrics.com/jfe/form/SV_56H4kSHsnEESzAO

4.1.1 Result of first iteration

This survey was published in the project's M9 and M10, and its target group included all individuals and project partners. The results of this survey – First Iteration are as follows, based on the 23 votes received.

Data Science Manager

Based on the responses received for “Data Science Manager” – Figure 11; Skills can be divided into three categories; The most important skills are “Manage the data science team and resources - 24.24%”, and “Knowledge about data and AI processes- 21.21%”.

Then “Communication with domain experts – 16.67%” and “Develop and execute the data and AI strategies – 16.67%” in the second place.

Finally, “Knowledge about business processes – 10.61%” and “Knowledge about performance indicators – 10.61%” are less important than others

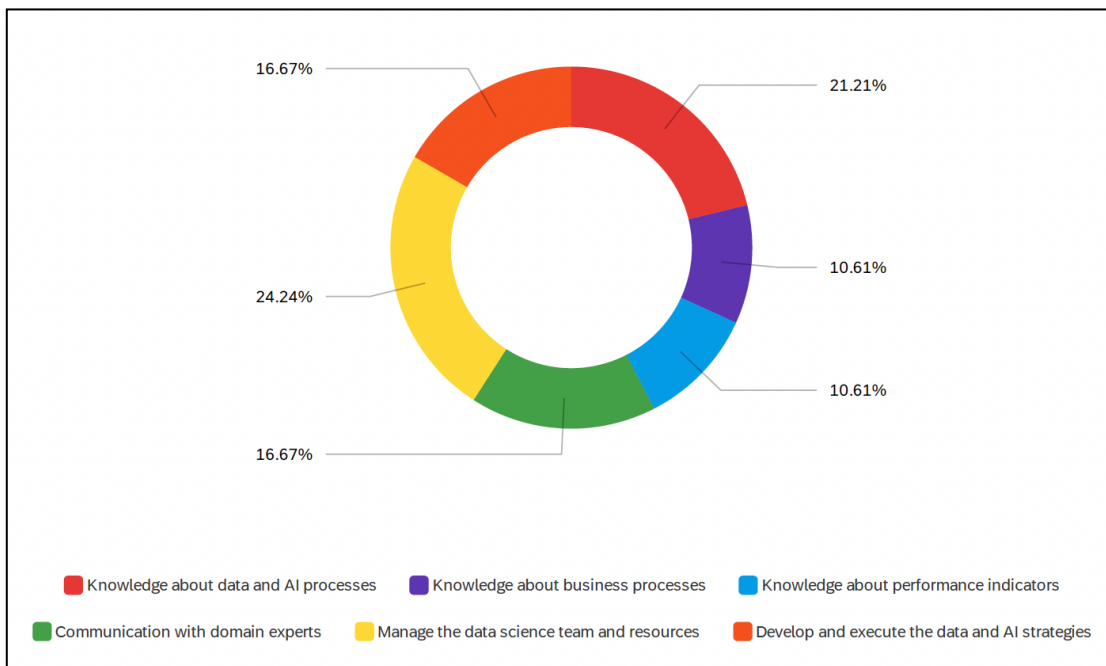


Figure 11 Data Science Manager - result of Voting survey - 1st Iteration

Data/AI Architect

In this job profile – Figure 12, all the identified skills are nearly equal in importance, but it should be noted that according to the project partners’ point of view “Knowledge about big data architectural standards – 27.78%” and “Select software platforms for big data (Hadoop, Data Lake) – 27.78%” are more significant than the other two skills.

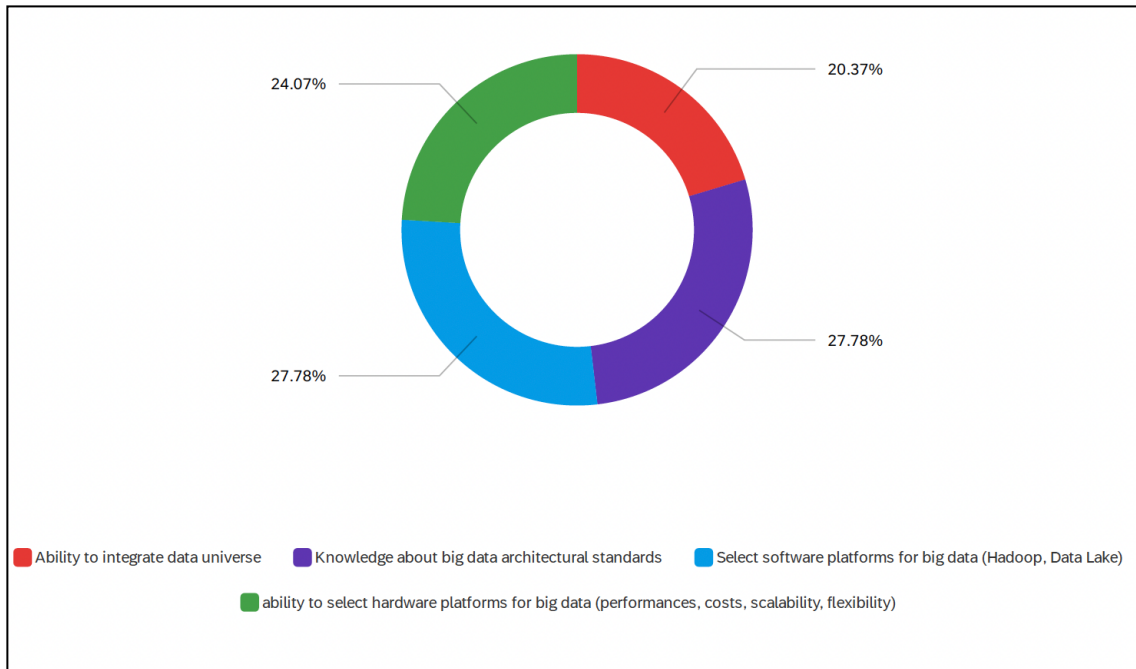


Figure 12 Data / AI Architect - result of Voting survey - 1st Iteration

Data/AI Scientist

Skills related to this job title – Figure 13, in terms of importance can be divided into high priority “Mathematical and statistical models' knowledge – 20%”, medium priority “Use of Bayes classifier, Deep Learning, OR, and optimization algorithms – 16.47%”, “Use of AI technologies (ex. machine learning) – 16.47%”, and “Use a programming language (R, Python) – 15.29%” as well as low priority that other skills which were not mentioned, are in low priority level.

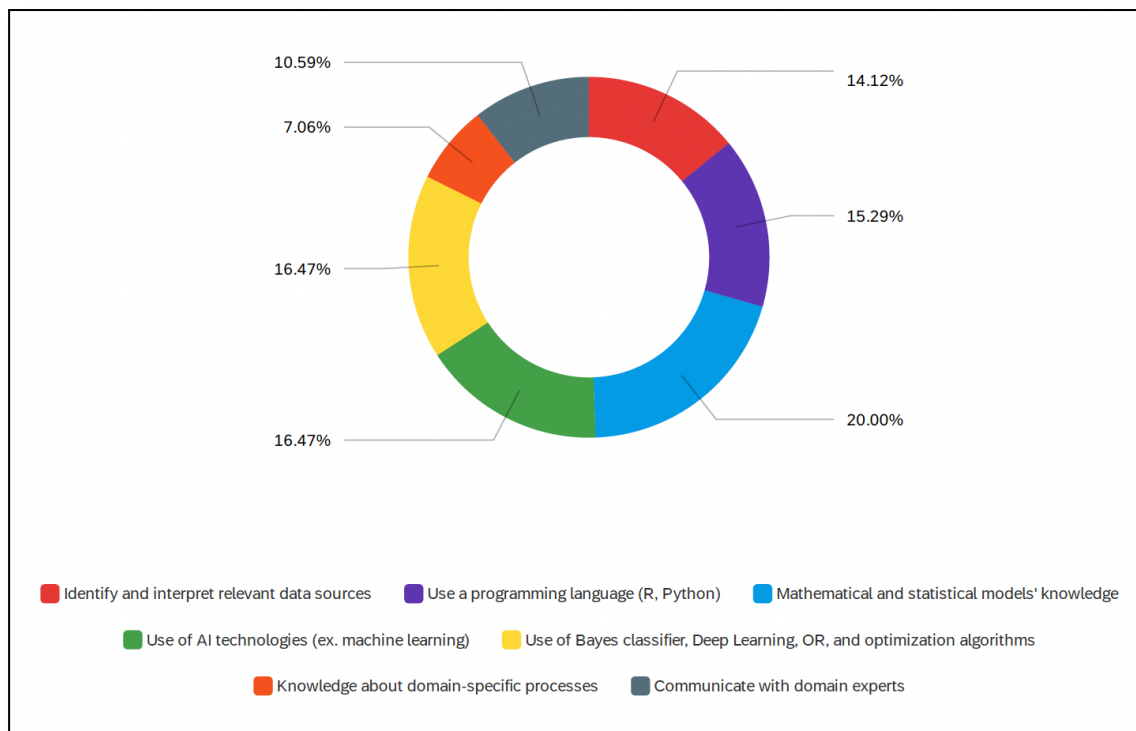


Figure 13 Data / AI Scientist - result of Voting survey - 1st Iteration

Visual Data Designer

As can be seen in the Figure 14, the most important skills of this job are “Develop insightful and engaging data analytics view – 22.22%” and “Develop interface & interaction to increase user experience – 20.63%”, which are related to better display data and create better communication with users, and the “Understand complex information by integrating AI tools – 4.76%” has low importance in this role.

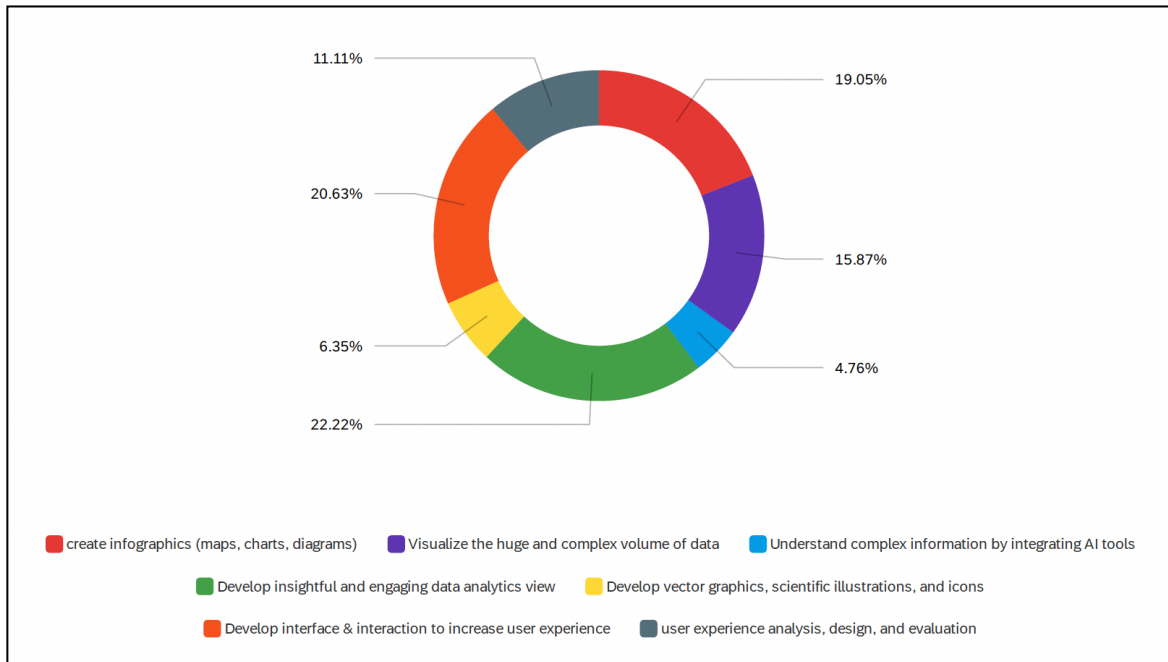


Figure 14 Visual Data Designer- result of Voting survey - 1st Iteration

Data/AI specialist

In this role – Figure 15, two main skills are “Integrate data and AI technologies into existing systems – 19.77%” and “Knowledge about data storage, query languages and use of machine learning – 17.44%”, which are related to information about new technologies such as artificial intelligence and machine learning and how to use them in existing systems and organizations. On the opposite side, skills related to monitoring and controlling activities as well as working with robots and sensors have a lower priority in this job profile.

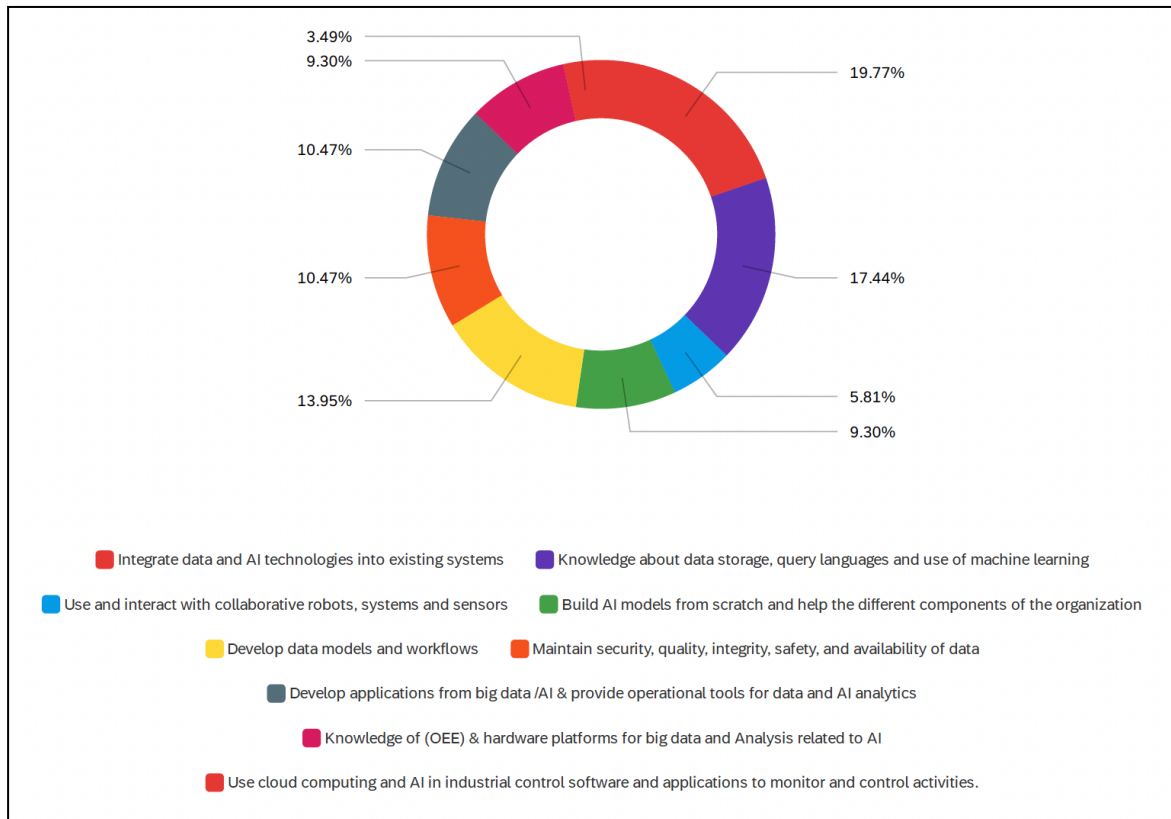


Figure 15 Data / AI Specialist - result of Voting survey - 1st Iteration

AI Manager / Head of AI

As shown in Figure 16, skills related to “Analyse and understand how the value chain is transformed by virtue of Industry 4.0, and AI – 21.05%”, is in the first priority of this role, while skills about “Develop and execute the data and AI strategies according to business objectives – 18.42%” and “Improving production process with the introduction of new technologies related to AI and I4.0 – 18.42%” can also be recognized as the main skills of this job. On the other side there is a skill about “Build, implement and manage concurrent Digital/intelligence Supply Networks – 5.26%” which according to the participants in the survey has a lower priority.

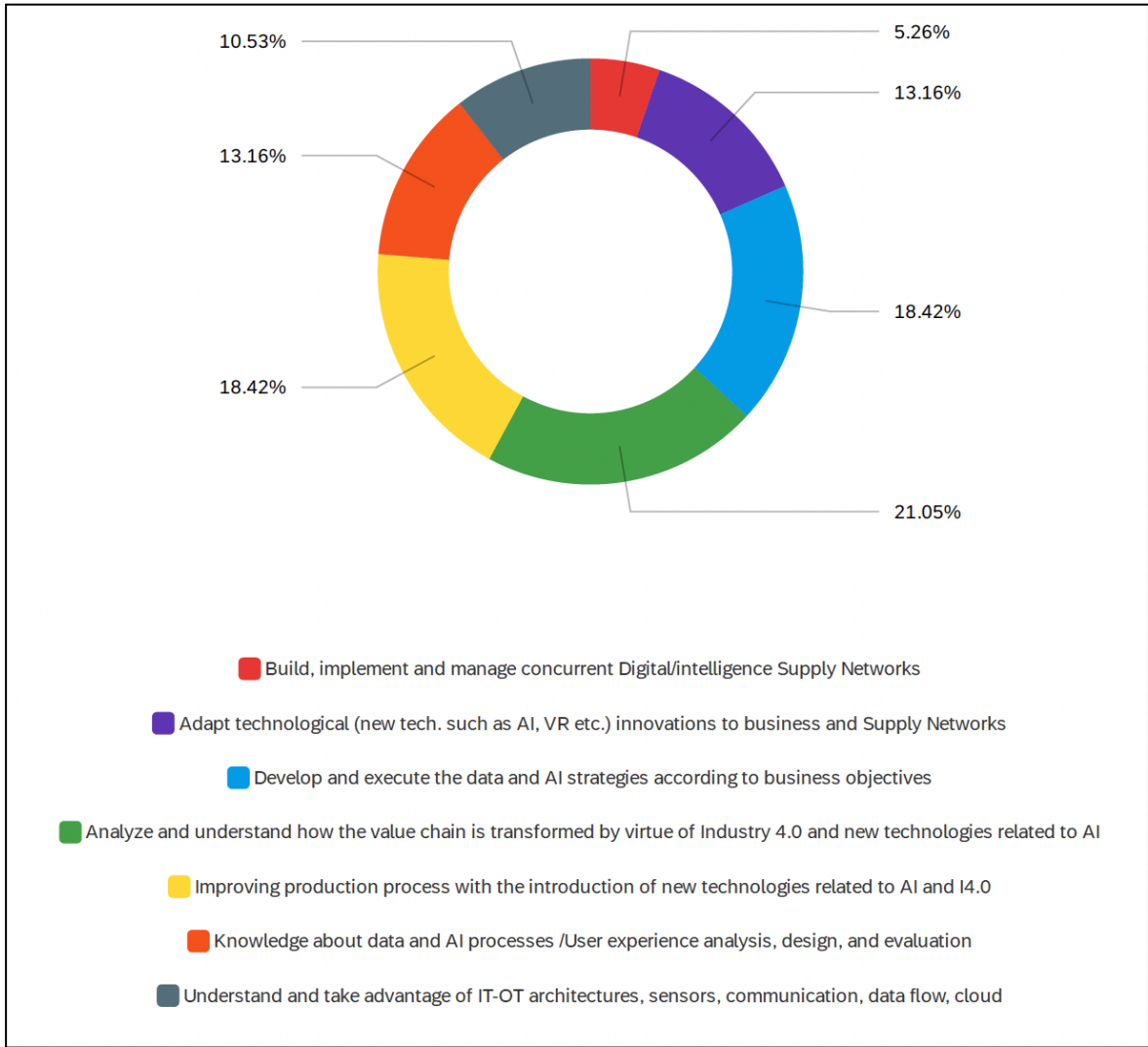


Figure 16 AI Manager / Head of AI - result of Voting survey - 1st Iteration

Remote Worker

Since people in this role work from outside the company environment, skills such as “Interpret quantitative data, graphs (KPIs), and 3D digital models”, and “Perform scenario analysis to evaluate and prepare for possible interventions” are crucial and according to the responses received from project partners “Understand and use additive manufacturing / AI technologies and mathematical models” is a skill with less importance compared to others. Figure 17

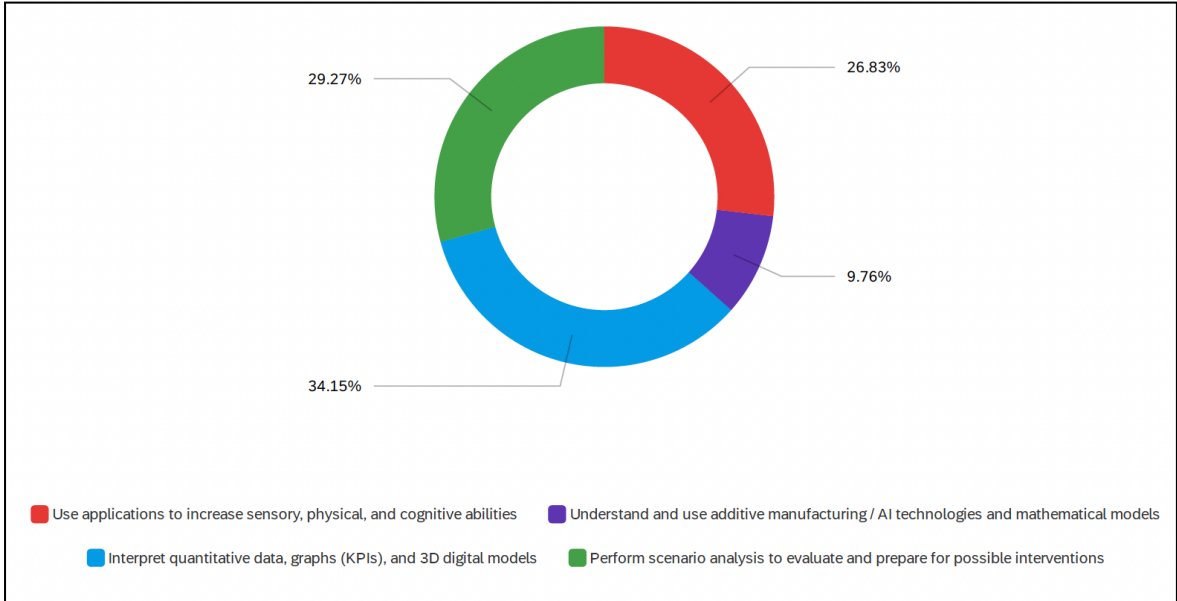


Figure 17 Remote Worker - result of Voting survey - 1st Iteration

Strategy Manager I4.0

This job, which has been analyzed at the management level, needs to improve some skills due to the growing trend of technology such as AI. The most important of which (Figure 18) are related to “define, implement, and manage a roadmap of technological evolution oriented to the generation of value – 20%” and “engage and dialogue with stakeholders and trade unions to better manage change related to the introduction of new technologies such as AI – 20%.”

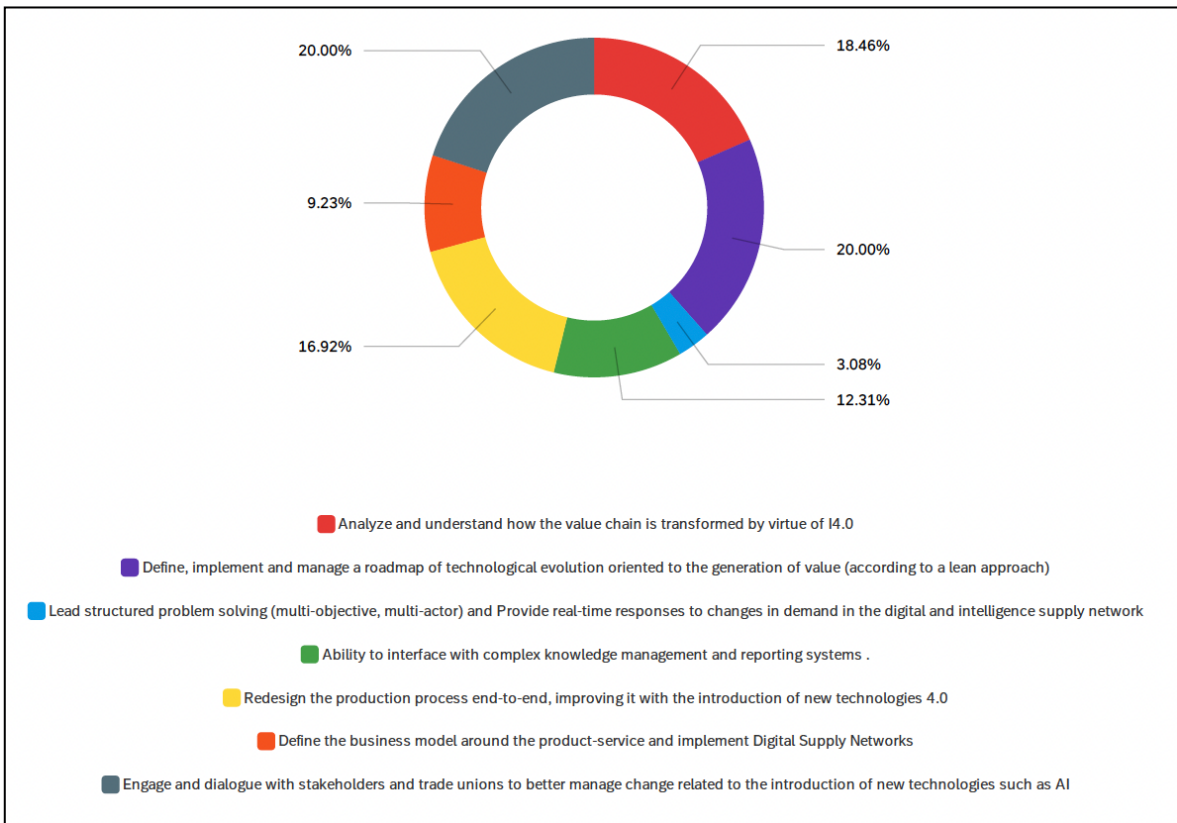


Figure 18 Strategy Manager I4.0 - result of Voting survey - 1st Iteration



I4.0 Professional

This job profile (Figure 19) has been analyzed in professional level. Its skills need to be improved in line with industry4.0 -related technologies, especially artificial intelligence, IoT. Therefore, the most important skill that has been considered by project partners is “Knowledge of IoT platforms and sensors and use applications to monitor and control activities – 24.62%.” This skill is mostly related to monitoring activities by using new technologies, including the Internet of Things.

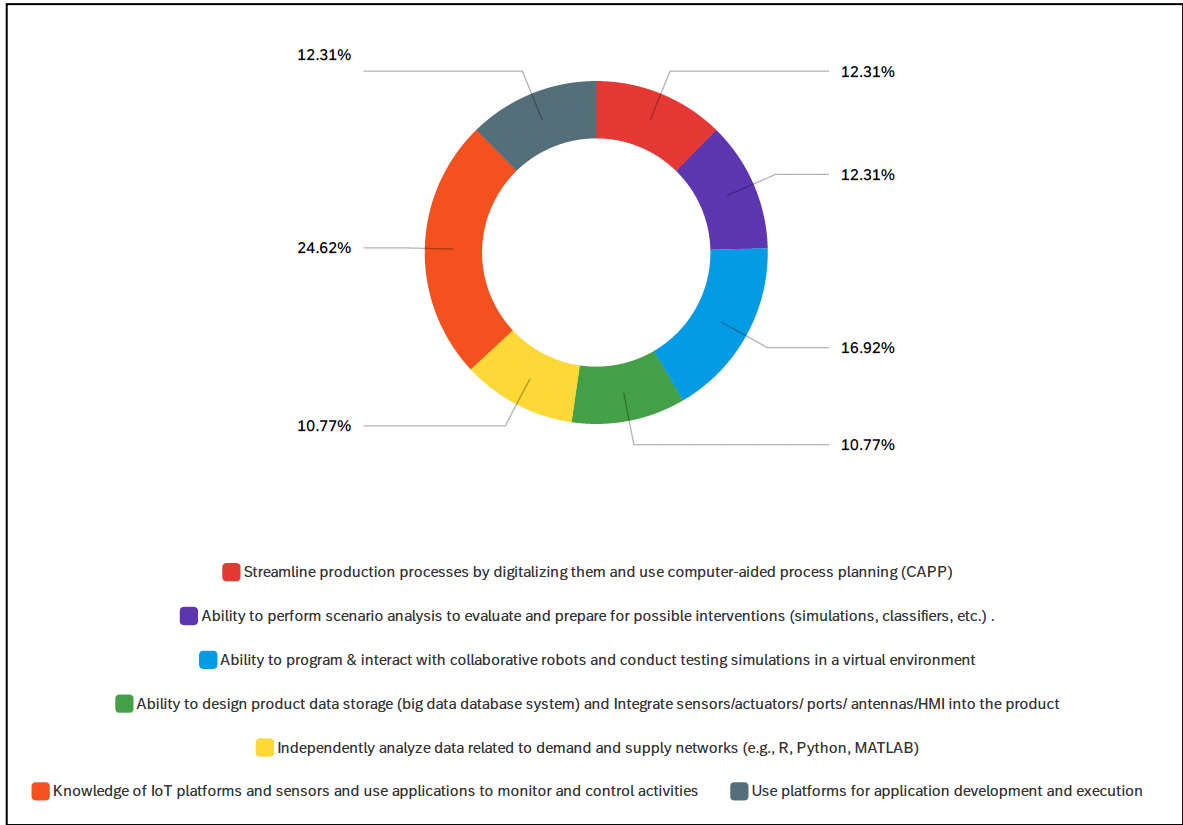


Figure 19 I4.0 Professional - result of Voting survey - 1st Iteration

Digital Transformation Professional 4.0

This job profile is another role that is analyzed at the professional level and as it is clearly shown in the Figure 20, “Analyze the impact of emerging technologies on business (e.g., AI, big data) – 33.96%” is in the main priority of this job. Also, “evaluate pros and cons of platforms based on company's needs and select components” is another important skill of this job, which is related to evaluating platforms according to the conditions of companies.

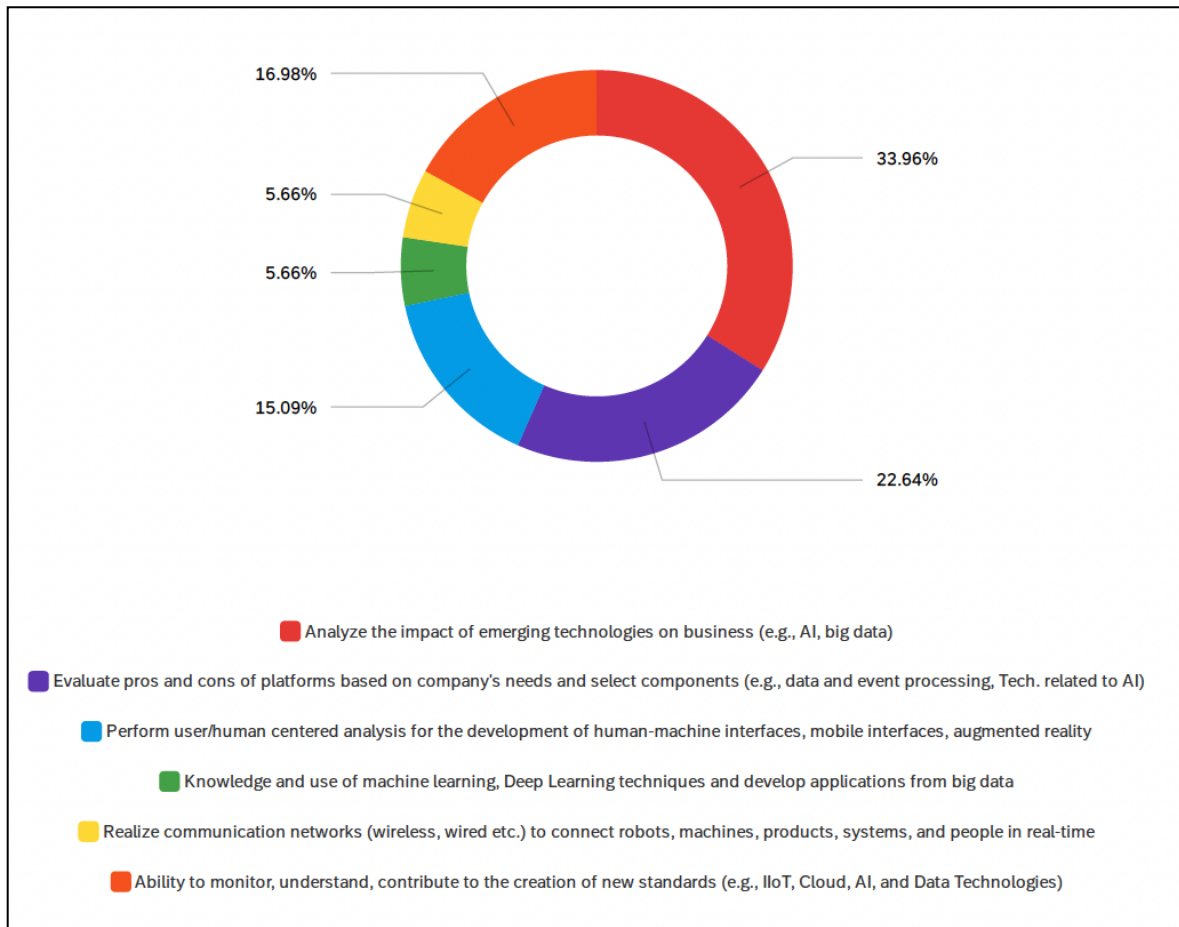


Figure 20 Digital Transformation Professional 4.0 - result of Voting survey - 1st Iteration

Plant Worker 4.0

In this job profile (Figure 21), which has been analyzed at the worker level, the skills of “Use of basic standard of HMI”, “use virtual and augmented reality goggles” and “Interact with collaborative robots” that are mainly related to workers' collaboration with new technologies such as VR and AR, have a higher priority than skills related to data analysis such as “Interpret quantitative data and graphs and 3D digital models.”

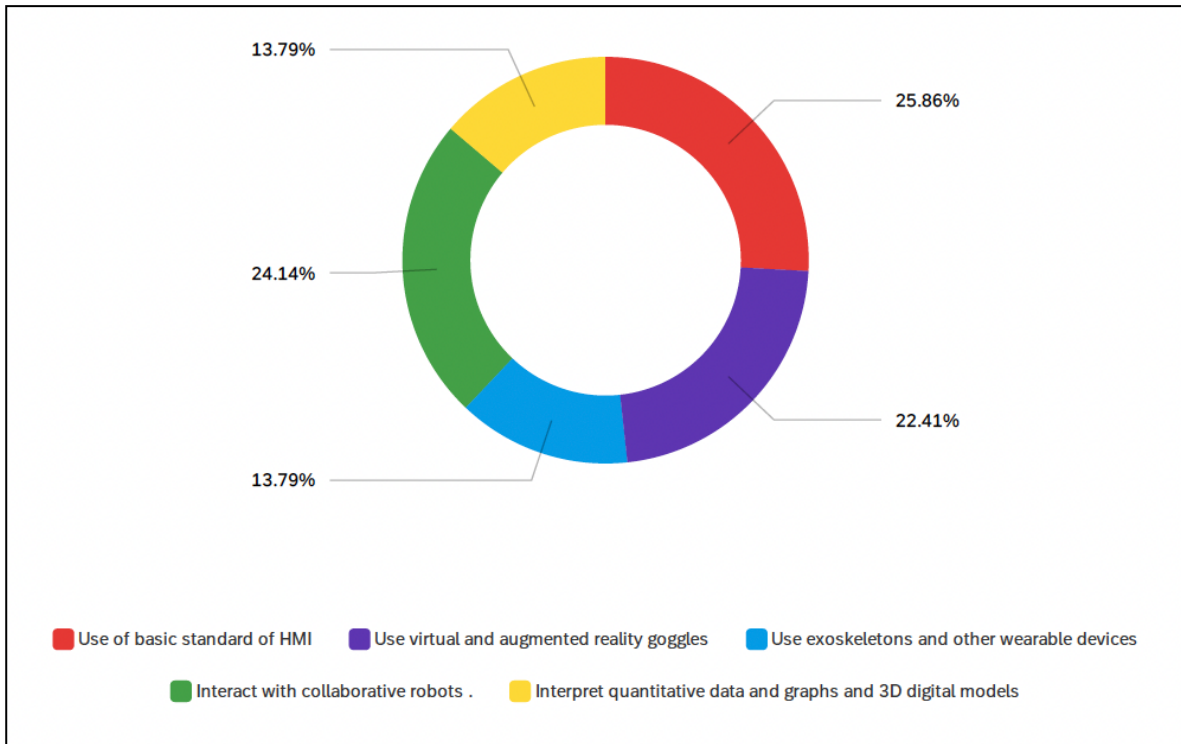


Figure 21 Plant Worker 4.0 - result of Voting survey - 1st Iteration

Technician 4.0

This job title (Figure 22) is another role that is analyzed at the worker level, and unlike the previous role, data analysis skills are prioritized “Analytical skills to Interpret data from operations”. Also, skills related to the use of sensors and interact with smart warehouses equipped with automated picking systems are other important skills of this job.

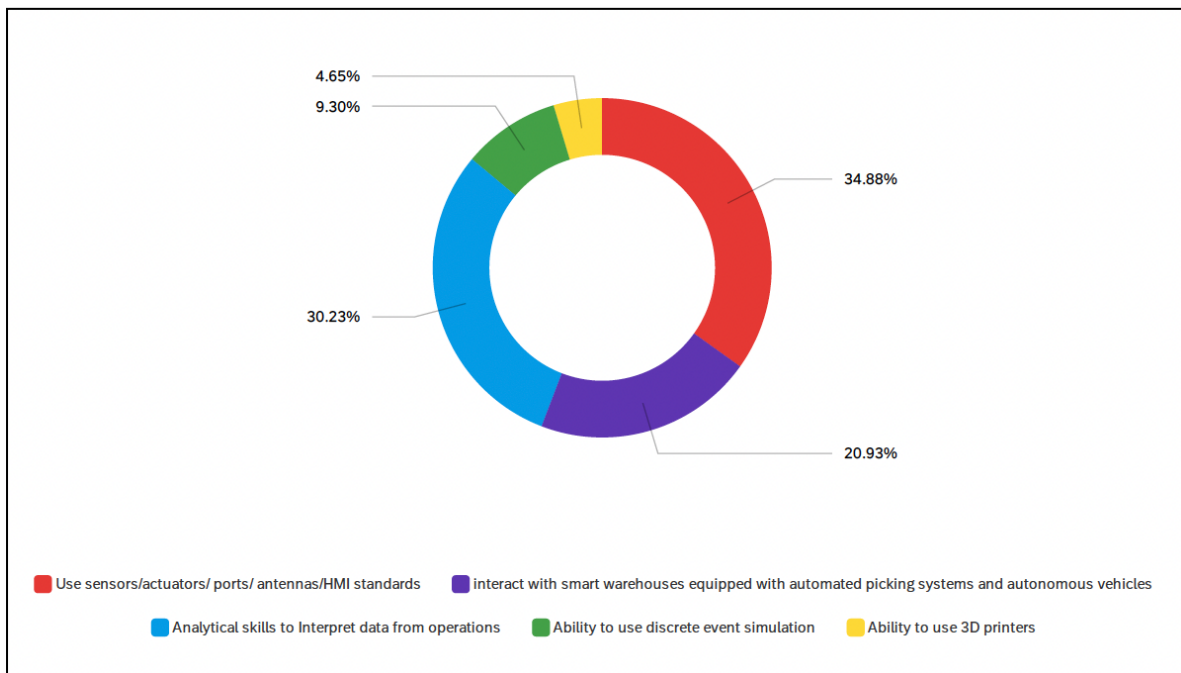


Figure 22 Technician 4.0 - result of Voting survey - 1st Iteration

4.2 Possessed and Needed - Survey

In order to assess the current situation of the project experiments and also their future expectations in relation to the jobs introduced in Section 3.1 and 3.2, the second survey entitled “Possessed and Needed” – Figure 23 was asked of them, in this survey experiments specify whether they need these skills in their company or were currently using them. To display this information, a numerical range between 1 and 5 has been used, in which 1 depicts "basic level required" and 5 shows "expert level required". The most important purpose of this survey is to compare the AS-IS Situation and their target conditions, finding the gap between them and the possible activities of the partners to bridge these gaps. This survey was published in online mode¹⁷ and in section 4.2.1, the results of its first iteration is depicted.



Figure 23 Possessed and Needed – survey

¹⁷ https://polimi.eu.qualtrics.com/jfe/form/SV_2n1like9xHW7cmQ6



4.2.1 Result of first iteration

This survey was published in the project's M9 and M10, and its target group included 16 experiments. The results of this survey – First Iteration are as follows, based on the 16 votes (one per each) received.

Data Science Manager

Regarding this job profile, 13 out of 16 experiments stated that they possessed it now or will need it in the near future. According to the Table 1, the skills introduced for this job are needed in these 13 experiments at the intermediate and advanced level or they already possessed them in this level. According to the supplementary answer we received from these experiments, it can be understood that a large number (about 11 out of 13) have achieved the desired level so far by relying on the capabilities of the company itself or by holding training courses and hiring personnel with skills related to them. And two of these experiments stated that they feel the need for this job title and related skills soon, so they considered holding training courses as a suitable way to bridge this need.

On the other hand, some of them pointed out that having a distinct profession called “Data Science Manager” in the company may not be needed at the moment and only creating some skills in the current employees is a good solution.

Table 1 Data Science Manager - Possessed and Needed – survey

#	Field	N/A	1	2	3	4	5	Total
1	A: Knowledge about data and AI processes	0.00%	7.69%	15.38%	23.08%	23.08%	30.77%	13
2	B: Knowledge about business processes	0.00%	7.69%	23.08%	15.38%	38.46%	15.38%	13
3	C: Communication with domain experts	0.00%	0.00%	7.69%	30.77%	46.15%	15.38%	13
4	D: Develop and execute the data and AI strategies	0.00%	7.69%	7.69%	53.85%	7.69%	23.08%	13
5	E: Manage the data science team and resources	0.00%	0.00%	15.38%	23.08%	38.46%	23.08%	13
6	F: Knowledge about performance indicators	0.00%	0.00%	15.38%	30.77%	38.46%	15.38%	13



Data/AI Architect

In this role, nine out of 16 experiments stated that they possessed it now or will need it in the near future. According to the Table 2, the skills introduced for this job are needed in these nine experiments at the lower intermediate to expert level or they already possessed them in this level. Based on the interviews and comments we received from these experiments, it can be understood that seven out of nine have achieved the desired level so far by relying on the capabilities of the company itself or collaboration with internal and external partners. Also, two of these experiments stated that they feel the need for this job title and related skills soon, so they considered holding training courses and opening new collaborations with high-level centers as suitable ways to bridge these gaps.

Table 2 Data / AI Architect - Possessed and Needed – survey

#	Field	N/A	1	2	3	4	5	Total
1	A: Ability to integrate data universe	0.00%	0.00%	22.22%	33.33%	22.22%	22.22%	9
2	B: Select software platforms for big data (Hadoop, Data Lake)	0.00%	0.00%	22.22%	22.22%	33.33%	22.22%	9
3	C: Knowledge about big data architectural standards	0.00%	0.00%	33.33%	11.11%	33.33%	22.22%	9
4	D: Select hardware platforms for big data (performances...)	0.00%	11.11%	22.22%	0.00%	33.33%	33.33%	9

Data/AI Scientist

Regarding “Data / AI Scientist” role, as it is shown in Table 3, 11 out of 16 experiments stated that they possessed its skills now or will need it in the near future. According to the Table 3, the skills introduced for this job are needed in these 11 experiments at the intermediate to expert level or they already possessed them in this level. Based on the interviews and comments we received from these experiments, it can be understood that six out of 11 have achieved the desired level so far by relying on the capabilities of the company itself or collaboration with partners, but they still need to improve through training courses. Also, five of these experiments stated that they feel the need for this job title and related skills soon, so they considered holding training courses as a suitable way to bridge these gaps.

In addition, experiments believe that this profile is needed for a short time in the company, so either it should be used as a service from external sources, or it should include other skills related to data and AI Architect and AI Manager to make an opportunity to work in other departments of organization.



Table 3 Data / AI Scientist - Possessed and Needed – survey

#	Field	N/A	1	2	3	4	5	Total
1	A: Identify and interpret relevant data sources	0.00%	0.00%	0.00%	27.27%	27.27%	45.45%	11
2	B: Use a programming language (R, Python)	9.09%	0.00%	9.09%	18.18%	18.18%	45.45%	11
3	C: Communicate with domain experts	0.00%	0.00%	0.00%	36.36%	27.27%	36.36%	11
4	D: Mathematical and statistical models' knowledge	0.00%	9.09%	9.09%	27.27%	27.27%	27.27%	11
5	E: Knowledge about domain-specific processes	0.00%	0.00%	27.27%	45.45%	9.09%	18.18%	11
6	F: Use of AI technologies (ex. machine learning)	9.09%	9.09%	18.18%	9.09%	18.18%	36.36%	11
7	G: Use of Bayes classifier, Deep Learning, OR methods, and optimization algorithms	9.09%	9.09%	9.09%	9.09%	27.27%	36.36%	11

Visual Data Designer

In this Job profile, as it is shown in Table 4, 10 experiments out of 16 stated that they possessed its skills now or will need it in the near future. According to the votes received can be concluded that the level which experiments are currently at or need to reach for the skill about “Develop interface & interaction to increase user experience” is in the intermediate to expert level, but in relation to other skills due to low the number of votes received cannot be accurately estimated. On the other hand, according to the additional comments received by experiments, relying on the company's own capabilities and cooperation with internal partners, they have been able to reach this level, and in few cases also they want to bridge the existing gap by hiring new staff.

Table 4 Visual Data Designer- Possessed and Needed – survey

#	Field	N/A	1	2	3	4	5	Total
1	A: Develop interface & interaction to increase user experience	0.00%	0.00%	0.00%	50.00%	20.00%	30.00%	10
2	B: Develop vector graphics, scientific illustrations, and icons	50.00%	0.00%	0.00%	50.00%	0.00%	0.00%	2
3	C: user experience analysis, design, and evaluation	0.00%	0.00%	0.00%	0.00%	100.00%	0.00%	2
4	D: Understand complex information by integrating AI tools	0.00%	0.00%	0.00%	50.00%	0.00%	50.00%	2
5	E: Visualize the huge and complex volume of data	0.00%	0.00%	0.00%	0.00%	50.00%	50.00%	2
6	F: Develop insightful and engaging data analytics view	50.00%	0.00%	0.00%	0.00%	50.00%	0.00%	2
7	G: create infographics (maps, charts, diagrams)	50.00%	0.00%	0.00%	0.00%	0.00%	50.00%	2



Data/AI specialist

Regarding this profile, as it is shown in Table 5, nine out of 16 experiments stated that they possessed its skills now or will need it in the near future. According to the Table 5, the skills introduced for this job are needed in these nine experiments at all levels or they already possessed them in this level. Based on the interviews and comments we received from these experiments, it can be understood that six out of nine have achieved the desired level so far by relying on the capabilities of the company itself or collaboration with partners, but they still need to improve through training courses. Few partners, in addition to requesting the renaming of this position to AI Engineer stated that there is no need to have a fixed position with this name in the company and for bridging this gap can be hired new personnel for a short-term period or collaboration with other partners.

Table 5 Data / AI specialist - Possessed and Needed – survey

#	Field	N/A	1	2	3	4	5	Total
1	A: Integrate data and AI technologies into existing systems	0.00%	0.00%	22.22%	0.00%	66.67%	11.11%	9
2	B: Knowledge about data storage, query languages, and use of machine learning	0.00%	0.00%	11.11%	11.11%	55.56%	22.22%	9
3	C: Use and interact with collaborative robots, systems, and sensors	11.11%	11.11%	11.11%	22.22%	22.22%	22.22%	9
4	D: Build AI models from scratch and help the different components of the organization	0.00%	11.11%	22.22%	22.22%	22.22%	22.22%	9
5	E: Develop data models and workflows	0.00%	0.00%	33.33%	11.11%	44.44%	11.11%	9
6	F: Maintain security, quality, integrity, safety, and availability of data	0.00%	11.11%	11.11%	22.22%	44.44%	11.11%	9
7	G: Develop applications from big data /AI & provide operational tools for data and AI analytics	0.00%	22.22%	22.22%	11.11%	22.22%	22.22%	9
8	H: Knowledge of (OEE) & hardware platforms for big data and Analysis related to AI	0.00%	33.33%	11.11%	22.22%	22.22%	11.11%	9
9	I: Use cloud computing and AI in industrial control software and applications to monitor and	0.00%	0.00%	33.33%	11.11%	44.44%	11.11%	9

AI Manager / Head of AI

In this position, seven out of 16 experiments stated that they possessed its skills now or will need it in the near future. According to the Table 6, the skills introduced for this job are needed in these seven experiments mostly at intermediate level or they already possessed them in this level. Based on the interviews and comments we received from these experiments, it can be understood that four out of seven have achieved the desired level so far by relying on the capabilities of the company itself or collaboration with partners. In addition, few of experiments mentioned that in order to have



this job position, it is necessary to establish new collaboration with other companies, also, it is mentioned that they need to have a person in-house, who understands the value and opportunities of different digital technologies and wants to drive the company in that direction who has a position (manager) to do such decisions.

Table 6 AI Manager / Head of AI - Possessed and Needed – survey

#	Field	N/A	1	2	3	4	5	Total
1	A: Adapt technological (new tech. such as AI, VR, etc.) innovations to business and supply network	0.00%	0.00%	0.00%	57.14%	28.57%	14.29%	7
2	B: Build, implement and manage concurrent Digital/Intelligence Supply Networks	0.00%	14.29%	0.00%	42.86%	42.86%	0.00%	7
3	C: Understand and take advantage of IT-OT architectures, sensors, communication, data flow, cloud	0.00%	0.00%	14.29%	28.57%	42.86%	14.29%	7
4	D: Develop and execute the data and AI strategies according to business objectives	0.00%	14.29%	14.29%	14.29%	42.86%	14.29%	7
5	E: Analyze and understand how the value chain is transformed by virtue of Industry 4.0 and new technologies related to AI	0.00%	14.29%	14.29%	28.57%	28.57%	14.29%	7
6	F: Improving production process with the introduction of new technologies related to AI and I4.0	0.00%	0.00%	14.29%	28.57%	28.57%	28.57%	7
7	G: Knowledge about data and AI processes /User experience analysis, design, and evaluation	0.00%	14.29%	14.29%	14.29%	42.86%	14.29%	7



Remote Worker

For this role, Five out of 16 experiments stated that they possessed its skills now or will need it in the near future. According to the Table 7, the skills introduced for this job are needed in these five experiments mostly at upper-intermediate level or they already possessed them in this level. Based on the interviews and comments we received from these experiments, it can be understood that four of them have achieved the desired level so far by relying on the capabilities of the company itself, collaboration with partners, and training courses. Of course, they still need to improve and believe training course could be the most important method.

Table 7 Remote Worker - Possessed and Needed – survey

#	Field	N/A	1	2	3	4	5	Total
1	A: Use applications to increase sensory, physical, and cognitive abilities	0.00%	0.00%	0.00%	20.00%	60.00%	20.00%	5
2	B: Understand and use additive manufacturing / AI technologies and mathematical models	0.00%	0.00%	0.00%	20.00%	60.00%	20.00%	5
3	C: Interpret quantitative data, graphs (KPIs), and 3D digital models	0.00%	0.00%	0.00%	20.00%	60.00%	20.00%	5
4	D: Perform scenario analysis to evaluate and prepare for possible interventions	0.00%	0.00%	0.00%	20.00%	60.00%	20.00%	5

Strategy Manager I4.0

For this role, nine out of 16 experiments stated that they possessed its skills now or will need it in the near future. According to the Table 8, the skills introduced for this job are needed in these nine experiments mostly at intermediate level or they already possessed them in this level. Based on the interviews and comments we received from these experiments, it can be understood that five of them have achieved the desired level so far by relying on the capabilities of the company itself, and collaboration with partners. One of the interesting points here in this job is that; few partners stated that since their personnel carries R&D activities in this domain, some skills related to this job are not related to their company. And an experiment mentioned that they may need this job in the future and do not see the need to have it now.



Table 8 Strategy Manager I4.0 - Possessed and Needed – survey

#	Field	N/A	1	2	3	4	5	Total
1	A: Analyze and understand how the value chain is transformed by virtue of I4.0	11.11%	0.00%	11.11%	44.44%	22.22%	11.11%	9
2	B: Define, implement and manage a roadmap of technological evolution oriented to the generation of value (according to a lean approach)	11.11%	0.00%	0.00%	33.33%	33.33%	22.22%	9
3	C: Lead structured problem solving (multi-objective, multi-actor) and Provide real-time responses to changes in demand in the digital and intelligence supply network	11.11%	0.00%	11.11%	33.33%	33.33%	11.11%	9
4	D: Ability to interface with complex knowledge management and reporting systems.	11.11%	0.00%	22.22%	22.22%	22.22%	22.22%	9
5	E: Redesign the production process end-to-end, improving it with the introduction of new technologies 4.0	11.11%	11.11%	11.11%	22.22%	33.33%	11.11%	9
6	F: Engage and dialogue with stakeholders and trade unions to better manage change related to the introduction of new technologies such as AI	22.22%	11.11%	11.11%	11.11%	33.33%	11.11%	9
7	G: Define the business model around the product-service and implement Digital Supply Networks	11.11%	11.11%	33.33%	11.11%	11.11%	22.22%	9

I4.0 Professional

In this profile, eight out of 16 experiments stated that they possessed its skills now or will need it in the near future. According to the Table 9, the skills introduced for this job are needed in these eight experiments mostly at lower-intermediate and intermediate levels or they already possessed them in these levels. Based on the interviews and comments we received from these experiments, it can be understood that four of them have achieved the desired level so far by relying on the capabilities of the company itself, collaboration with partners and training courses. In addition, some experiments also need to improve their level through training courses and hiring new personnel. One of the interesting opinions of the partners was related to the size of the companies, which in small size companies can gather the skills of many positions like; I4.0 professional, AI manager, AI scientist and Digital Transformation Professional 4.0 in one person instead of hiring different employees for short-term periods.



Table 9 14.0 Professional - Possessed and Needed – survey

#	Field	N/A	1	2	3	4	5	Total
1	A: Streamline production processes by digitalizing them and use computer-aided process planning (CAPP)	12.50%	0.00%	0.00%	12.50%	37.50%	37.50%	8
2	B: Ability to perform scenario analysis to evaluate and prepare for possible interventions (simulations, classifiers, etc.)	0.00%	12.50%	25.00%	12.50%	25.00%	25.00%	8
3	C: Ability to program & interact with collaborative robots and conduct testing simulations in a virtual environment	25.00%	12.50%	12.50%	12.50%	25.00%	12.50%	8
4	D: Ability to design product data storage (big data database system) and Integrate sensors/actuators/ ports/ antennas/HMI into the product	25.00%	0.00%	12.50%	12.50%	37.50%	12.50%	8
5	E: Independently analyze data related to demand and supply networks (e.g., R, Python, MATLAB)	25.00%	0.00%	12.50%	25.00%	25.00%	12.50%	8
6	F: Knowledge of IoT platforms and sensors and use applications to monitor and control activities	0.00%	0.00%	12.50%	37.50%	37.50%	12.50%	8
7	G: Use platforms for application development and execution	0.00%	0.00%	37.50%	12.50%	37.50%	12.50%	8

Digital Transformation Professional 4.0

In this role, seven out of 16 experiments stated that they possessed its skills now or will need it in the near future. According to the Table 10, the skills introduced for this job are required in these seven experiments mostly at lower-intermediate and intermediate levels or they already possessed them in these levels. Based on the interviews and comments we received from these experiments, it can be understood that five of them have achieved the desired level so far by relying on the capabilities of the company itself, collaboration with partners and training courses. In addition, some experiments also need to improve their level through training courses and re-up-skilling. In addition, an experiment mentioned that they may need this job in the future and do not see the need to have it now.



Table 10 Digital Transformation Professional 4.0 - Possessed and Needed – survey

#	Field	N/A	1	2	3	4	5	Total
1	A: Analyze the impact of emerging technologies on business (e.g., AI, big data)	0.00%	0.00%	14.29%	28.57%	28.57%	28.57%	7
2	B: Evaluate pros and cons of platforms based on the company's needs and select components (e.g., data and event processing, Tech. related to AI)	0.00%	0.00%	14.29%	28.57%	57.14%	0.00%	7
3	C: Perform user/human-centered analysis for the development of human-machine interfaces, mobile interfaces, augmented reality	0.00%	14.29%	14.29%	42.86%	14.29%	14.29%	7
4	D: Knowledge and use of machine learning, Deep Learning techniques and develop applications from big data	0.00%	0.00%	42.86%	42.86%	0.00%	14.29%	7
5	E: Realize communication networks (wireless, wired, etc.) to connect robots, machines, products, systems, and people in real-time	14.29%	14.29%	28.57%	0.00%	28.57%	14.29%	7
6	F: Ability to monitor, understand, contribute to the creation of new standards (e.g., IIoT, Cloud, AI and Data Technologies)	14.29%	0.00%	14.29%	28.57%	14.29%	28.57%	7

Plant Worker 4.0

Regarding to this position, 10 out of 16 experiments stated that they possessed its skills now or will need it in the near future. According to the Table 11, the skills introduced for this job are needed in these ten experiments at all levels or they already possessed them. Based on the interviews and comments we received from these experiments, it can be understood that five of them have achieved the desired level so far by relying on the capabilities of the company itself, collaboration with partners and training courses. In addition, some partners stated that in the future they can consider a position for this role in their company by hiring new personnel. Another interesting case is the percentages assigned to N/A in Table 11, which indicates that some skills in this role are not currently applicable for some experiments.



Table 11 Plant Worker 4.0 - Possessed and Needed – survey

#	Field	N/A	1	2	3	4	5	Total
1	A: Use of basic standard of HMI	0.00%	0.00%	20.00%	20.00%	30.00%	30.00%	10
2	B: Use virtual and augmented reality goggles	30.00%	20.00%	0.00%	10.00%	20.00%	20.00%	10
3	C: Use exoskeletons and other wearable devices	40.00%	0.00%	20.00%	10.00%	20.00%	10.00%	10
4	D: Interact with collaborative robots.	20.00%	30.00%	10.00%	0.00%	20.00%	20.00%	10
5	E: Interpret quantitative data and graphs and 3D digital models	10.00%	30.00%	0.00%	20.00%	10.00%	30.00%	10

Technician 4.0

In this role, 11 out of 16 experiments stated that they possessed its skills now or will need it in the near future. According to the Table 12, the skills introduced for this job are needed in these 11 experiments mostly at lower-intermediate to upper-intermediate levels or they already possessed them in these levels. Based on the interviews and comments we received from these experiments, it can be understood that six of them have achieved the desired level so far by relying on the capabilities of the company itself, collaboration with partners and training courses. In addition, some experiments stated that by conducting training courses, and re-up- skilling can improve skills of current workers and align them with skills identified for this position

Table 12 Technician 4.0 - Possessed and Needed – survey

#	Field	N/A	1	2	3	4	5	Total
1	A: Use sensors/actuators/ ports/ antennas/HMI standards	0.00%	9.09%	0.00%	36.36%	27.27%	27.27%	11
2	B: interact with smart warehouses equipped with automated picking systems and autonomous vehicles	27.27%	9.09%	27.27%	18.18%	9.09%	9.09%	11
3	C: Analytical skills to Interpret data from operations	9.09%	9.09%	9.09%	18.18%	45.45%	9.09%	11
4	D: Ability to use discrete event simulation	27.27%	18.18%	9.09%	9.09%	36.36%	0.00%	11
5	E: Ability to use 3D printers	36.36%	0.00%	0.00%	27.27%	27.27%	9.09%	11

As can be seen in the above analyzes, there are various approaches to achieve new job profiles and improve skills, which were mentioned by experiments, among which the creation of cooperation with project partners for up-re skilling as well as the use of training courses were much more highlighted.



4.3 Soft Skills

As mentioned in the section 3.3 In addition to technical skills, we also analyzed soft skills at three different levels: Management, Professional, and Worker levels, which in the Table 13 you can see the results of the survey of project partners.

Table 13 Soft Skills in Three different Levels

Soft Skills	Manager	Professional	Worker
Teamwork	7.23%	8.30%	15.87%
Communication	8.03%	5.68%	6.35%
Professional ethics	6.83%	5.68%	8.73%
Problem solving	4.02%	8.73%	10.32%
Critical thinking	7.63%	6.99%	3.97%
Innovation	6.83%	8.30%	3.17%
Emotional Judgment	4.02%	1.75%	3.97%
speak second language	7.23%	6.55%	1.59%
Time management	6.43%	5.68%	4.76%
Interpersonal skills	6.43%	5.24%	8.73%
Critical problem solving	6.43%	8.30%	6.35%
Digital literacy problem solving	2.81%	6.11%	0.79%
Self-management	5.62%	6.11%	7.94%
Digital skills	4.82%	9.17%	11.90%
Ethical / Legal mindset	8.03%	4.80%	3.97%
Global perspective	7.63%	2.62%	1.59%
Total Votes	249	229	126

According to the answers received from the project partners, it can be concluded that skills related to “Teamwork, Internal and external organizational Communication, Critical thinking in different financial and political situation, ability to speak second language to make a stronger relationship with partners, customers and other companies, Ethical and legal mindset, and Global Perspective” are the most important skills at the management level. Figure 24 shows these skills in three different levels.

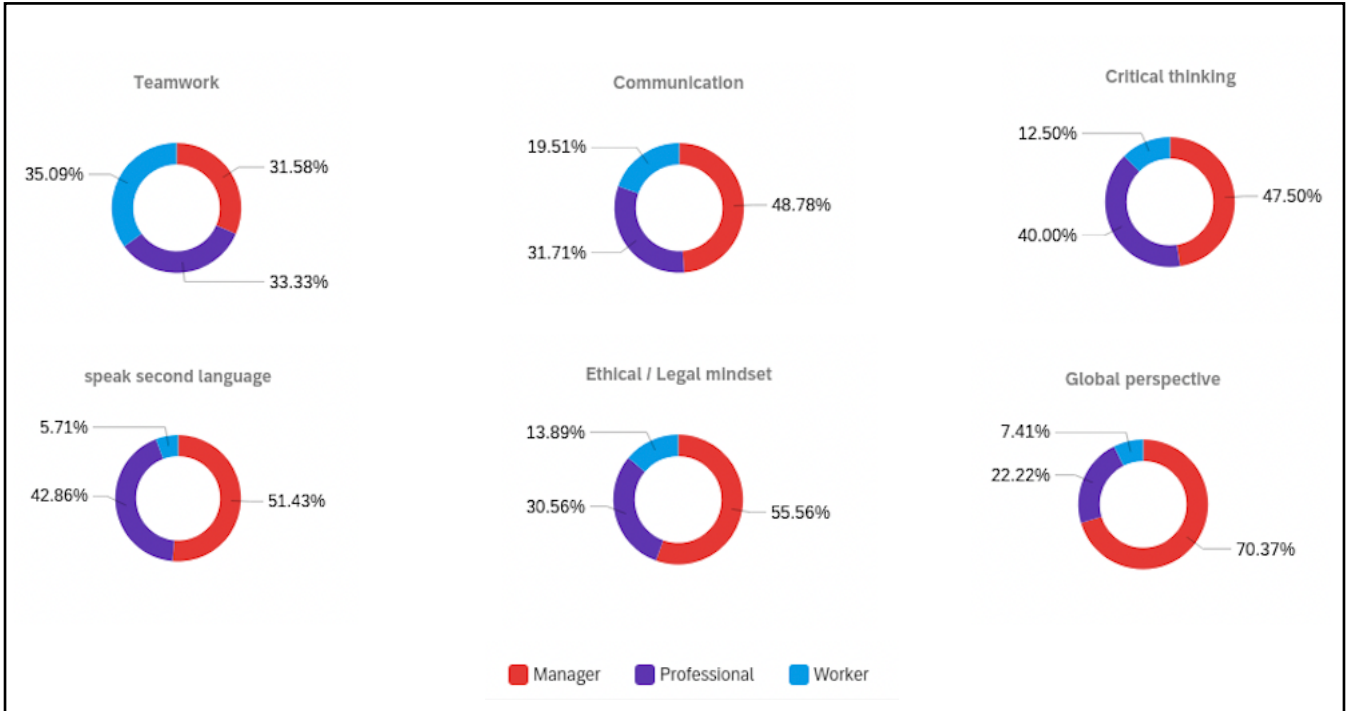


Figure 24 Soft Skills - Management Level

Skills about “Teamwork, ability to solve technical problems, Innovation in making new product, services or solutions to solve problems, Critical problem solving and digital skills and being up-to-date according to the technology conditions of the time” are the crucial skills at the professional level - Figure 25 shows these skills in three different levels.

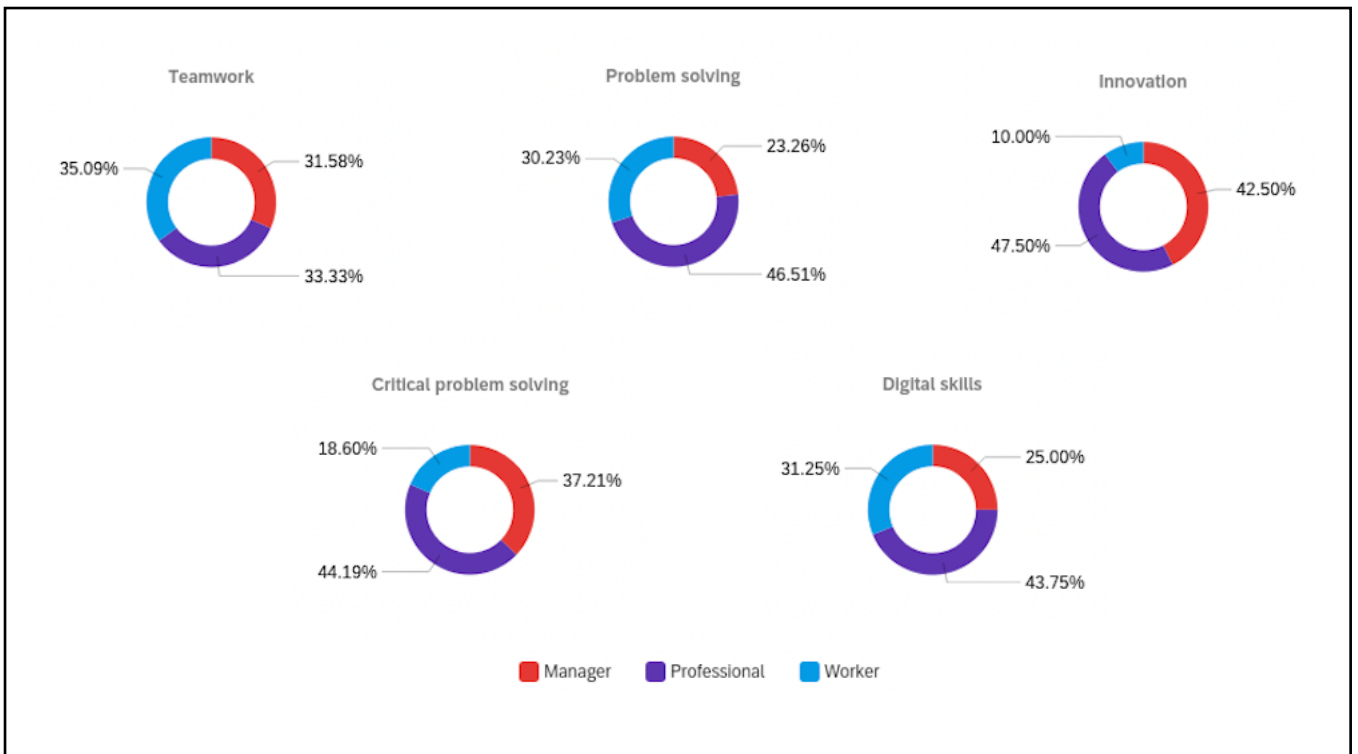


Figure 25 Soft Skills - Professional Level

In addition, “Teamwork, Professional ethics in working environment, solving basic problems of machines or different services, interpersonal skills, and basic to intermediate digital skills to understand and working better with new technologies” at the labor level are more important than others – Figure 26 shows these skills in three different levels.

Furthermore, as can be seen. Teamwork is a common skill for all three levels, as well as problem-solving and digital skills at professional and worker levels, which indicates the importance of these skills in the workplace.

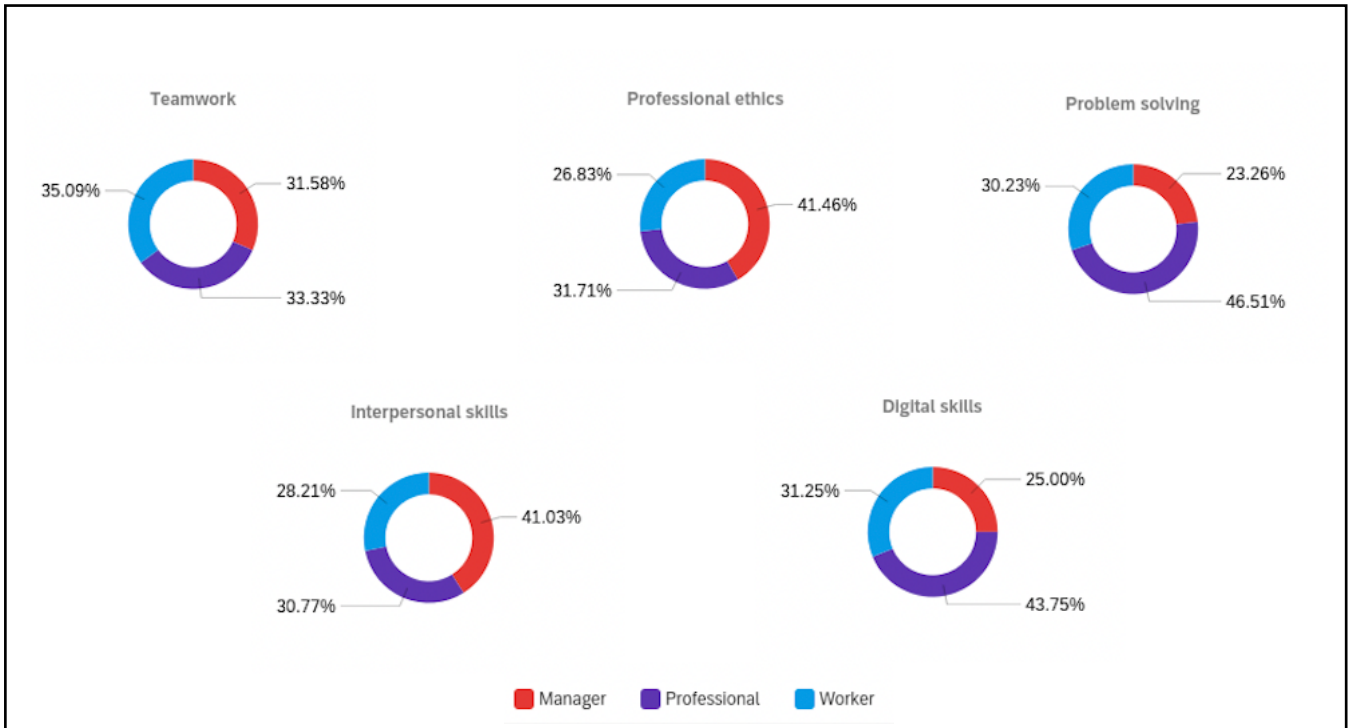


Figure 26 Soft Skills - Worker Level

4.4 Training Activities

In this section, we go to the second step of the method introduced in section 2.2. After introducing the related jobs and skills in the first step and implementing & analyzing the surveys that were explained in the sections 4.1.1 and 4.2.1 and finding the gaps among the project experiments, we will now introduce training activities that can help partners to strengthen their required skills in the introduced job profiles.

In this step, first of all, three levels “Awareness”, “Foundations”, and “Extended Know-How” were considered which Awareness refers to general knowledge and information to get familiar to the subject, Foundation refers to basic useful information, and Extended Know-How refers to a range of information that can help audience to increase their level of knowledge and understand of how to use the technology. Then, each of the training courses that were introduced in “I4MS Catalogue of Trainings¹⁸” and “Polimi open knowledge¹⁹” in relation to the topics of data science and artificial intelligence were analyzed and the correlation between jobs and related skills and these courses at three levels were defined. Table 14

¹⁸ <https://i4ms.eu/trainings/>
¹⁹ <https://www.pok.polimi.it/>



Table 14 Database of Training Activities

Matrix: relation between courses and Roles 1 - Awareness 2 - Foundations 3 - Extended Know-How		Provider	I4MS	PoK- Politecnico di Milano	PoK- Politecnico di Milano
		Course name	AI Opportunities for SMEs	Artificial Intelligence - An Overview	Artificial Intelligence and legal issues
DATA/AI New Roles & Professions	Data Science Manager				
	Knowledge about data and AI processes		1	1	
	Knowledge about business processes		2		1
	Communication with domain experts				
	Manage the data science team and resources			1	
	Knowledge about performance indicators				1
	Develop and execute the data and AI strategies		1	1	1
	Data/AI Architect				
	Ability to integrate data universe			1	
	Select software platforms for big data (Hadoop, Data Lake)			1	
	Knowledge about big data architectural standards				1
	Select hardware platforms for big data (performances...)			3	
Data/AI Scientist					
Identify and interpret relevant data sources			1		
Use a programming language (R, Python)					
Communicate with domain experts					
Mathematical and statistical models' knowledge			3		
Knowledge about domain-specific processes			1		
Use of AI technologies (ex. machine learning)		3			
Use of Bayes classifier, Deep Learning, OR and optimization algorithms		1	1		
Visual Data Designer					
Develop interface & interaction to increase user experience				2	
Develop vector graphics, scientific illustrations, and icons					
Visualize the huge and complex volume of data					
Develop insightful and engaging data analytics view					
create infographics (maps, charts, diagrams)					
user experience analysis, design, and evaluation					
Understand complex information by integrating AI tools		1	1		

In this database, all 12 jobs that were introduced in the previous sections and their related skills are covered and the Table 14 is just a part of this database to show how it works. For example, in the first column of the courses, we have the “AI Opportunities for SMEs” which is presented by “I4MS Catalogue of Trainings”. This course is held in the context of Artificial intelligence and in connection with the “Data / AI new roles and Professions” provides explanations in awareness level for “Knowledge about data and AI processes” and “Develop and execute the data and AI strategies” skills, Knowledge in Foundation level for “Knowledge about business processes” skill. Also, its main focus is on “Use of AI technologies (ex. machine learning)” skill which provides in information Extended Know-How Level. It should be noted that this database is open source, which means that if the partners were able to improve their required skills using other training activities, they can add to this file so that other partners can get acquainted with it.

4.5 DR BEST - Services and customer journey

As mentioned in section 2.4, to support the methodology mentioned in the previous sections, “Service Portfolio – DR BEST “can be used, especially in the skills block to show how to implement this method for different levels of organization. In the main skills block of “service portfolio - DR BEST” we have three main types of skills services: Process & Organizational Maturity, Human Capabilities Maturity and Skills Improvement and Development.

S1. Process & organizational maturity

- Maturity Assessment: assessment of company readiness for Industry 4.0 (tech, organizational, and ecosystem readiness).
- Maturity Strategy Development: definition of a roadmap starting from the characteristics of the single enterprise or part of it.



S2. Human capabilities maturity

- Human skills maturity: support in capabilities screening through on-site visit(s), interviews, etc. and definition of the actual level of skills maturity in Industry 4.0.
- Skills strategy development: gap analysis between the AS-IS and the desired level of AI skills, action plan definition and support to implementation.

S3. Skills improvement and development

- Human up-skilling, re-skilling training: life-long training on technical and soft skills focused on AI at corporate level, operational and technology specific level
- Educational Programs: attracting and forming next generation talents, forming Industry 4.0 employees and workers.
- Scouting and Brokerage: support in identifying channels, structure contacts and collaborations intended to knowledge-transfer, etc.

In order to integrate and make an alignment among the method presented in the previous sections and this service portfolio, The commonalities between the two methods were identified as follows.

Human skills maturity (level of current situation) is related to identifying the current (AS-IS) situation of experiments that is align with the phases of Introducing and Identifying new professions and related skills, asking surveys to prioritize skills and identify AS-IS situation of experiments, interviewing with experiments to clarify their current condition and future expectation.

Skills strategy development (Gap Analysis) is related to identifying the gaps in relation to the jobs and skills introduced that are consistent with the phases of analyzing answers received by surveys and interviews in the previous sections.

Human up-skilling, re-skilling training and Educational Programs (Actioning) is related to the actions that can be done to bridge the gaps that are consistent with the phase of training activities in aforementioned methodology.

In order to better display, how to implement the methodology and support it with “Service Portfolio – DR BEST”, we use customer Journey (CJ) which was different types of CJ previously introduced in D3.4. In this section, “Technology Users Customer Journeys’ terminologies” will be used and we will examine 3 CJs in Managers, Professionals, and Workers levels (These 3 levels are mainly related to the jobs related to “Data / AI skills for enterprises I4.0” which were introduced in section 3.2)

Customer Journey – Managers Level (Strategy Manager I4.0)

In this customer journey – Figure 27, the managers who are at the top of the organizations in the “Observation” phase can get acquainted with the growth and changes in the field of new skills through the Technology Dissemination (virtual training) and Educational Programs. Then in the “Awareness” phase, they can be informed about the skills implementation process by participating in webinars and also visiting training courses in their partner companies. In phase of “Experience” by implementing the method mentioned in the previous sections, can identify their current level (AS-IS) and the gaps in their organization. In the “Experiment” phase, they can perform activities such as up-re skilling programs and training activities, also evaluate the growth-related indicators about skills. In addition, they have possibility to benefit from the help of their project partners to develop skills. Finally, in the “Adoption” phase they can check the future status of their company (TO – BE) and compare it with the current condition (AS -IS) to be informed of their growth rate.

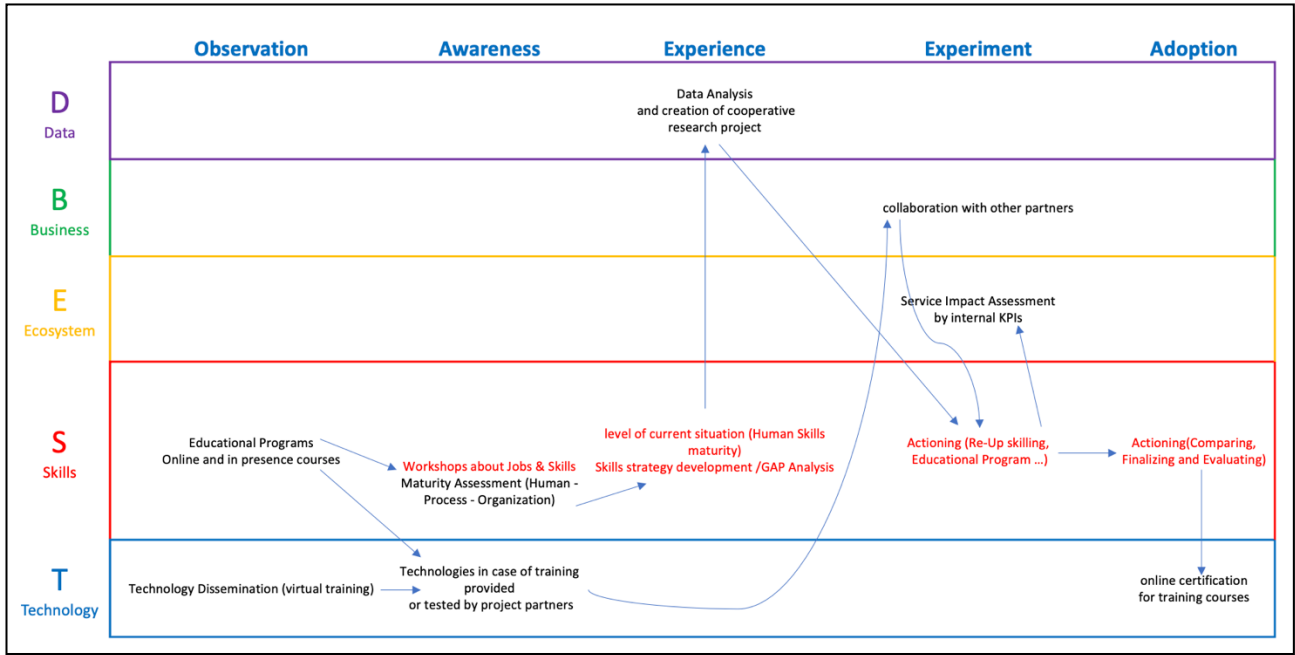


Figure 27 Customer Journey – Managers Level (Strategy Manager 14.0)

Customer Journey – Professionals Level (14.0 Professional, and Digital Transformation Professional 4.0)

In this customer journey – Figure 28, same as the managers' level, Professionals can also get acquainted with new jobs and skills through the Technology Dissemination (virtual training) and Educational Programs. Then by participating in workshops related to the introduction of new jobs and learning up to date skills, and performing the method presented in this deliverable, can be informed of the gap in their skills. Finally, professionals can try to cover their gaps by performing training activities and cooperating with project partners.

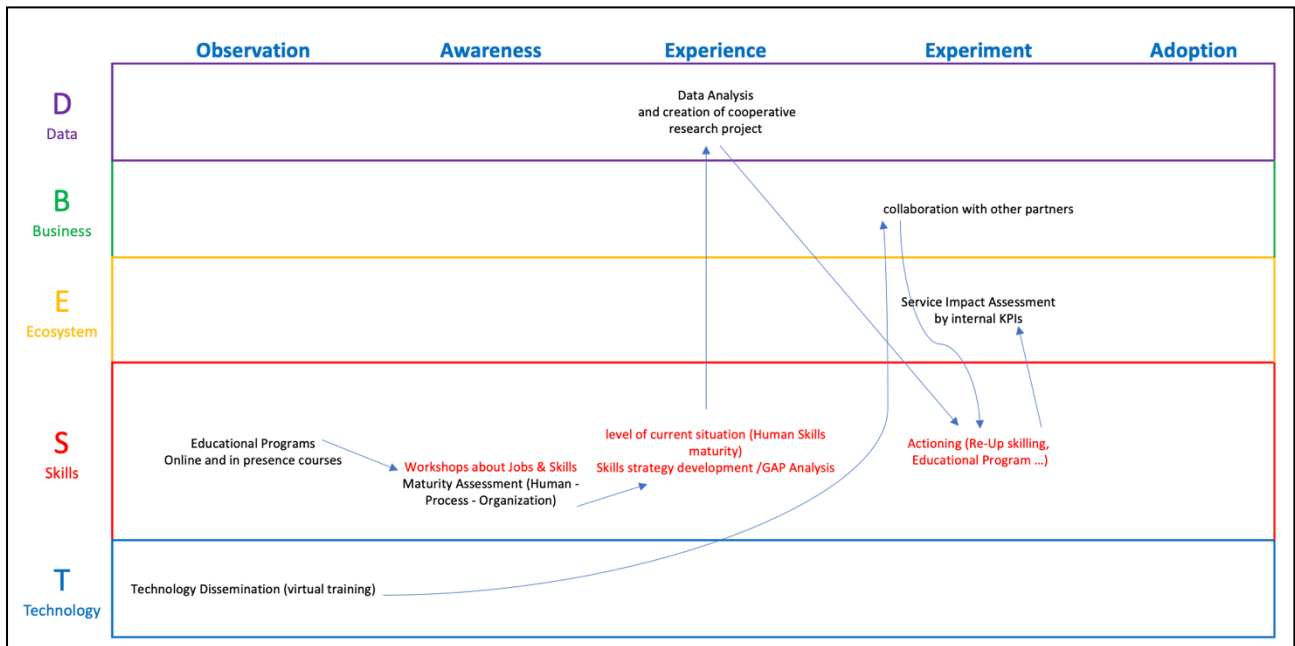


Figure 28 Customer Journey – Professionals Level (14.0 Professional, and Digital Transformation Professional 4.0)

Customer Journey – Workers Level (Plant Worker 4.0, and Technician 4.0)

In this customer journey – Figure 29, people who are working at the Worker level can get acquainted with new skills through the Educational Programs and increase their level of awareness by participating in workshops, then by performing analyzes such as those mentioned in the aforementioned method. (Questionnaire, interview, etc.) can find a gap in their skills and try to cover it by doing training activities and adapt themselves to new skills.

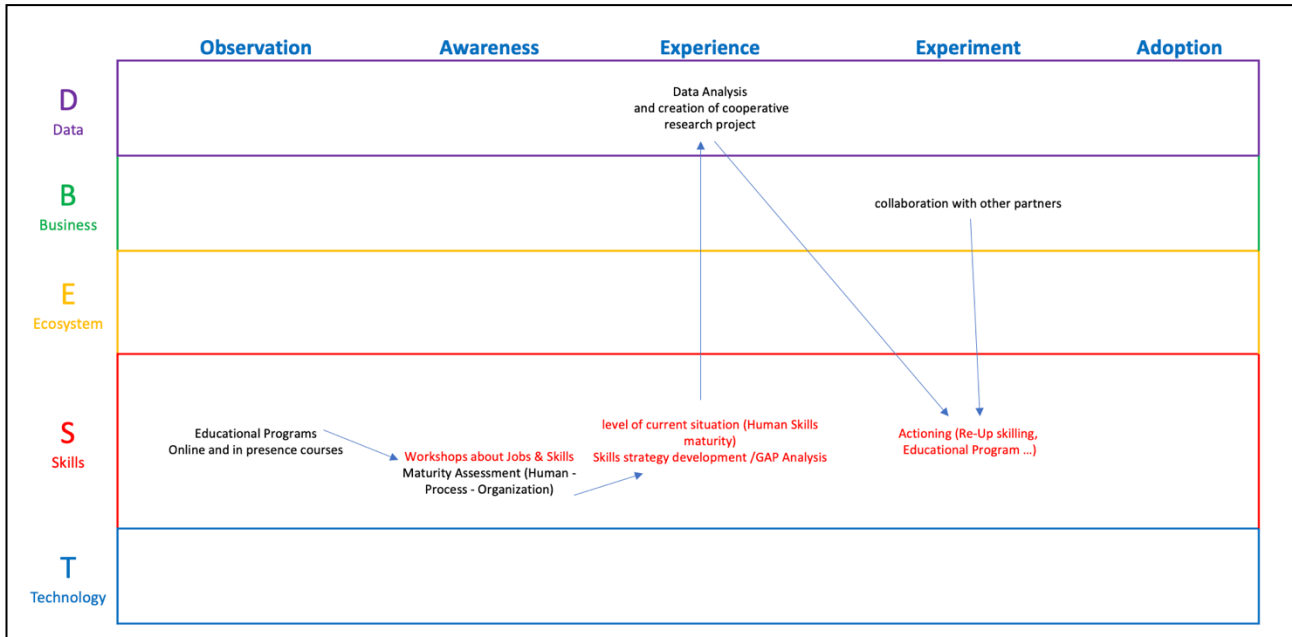


Figure 29 Customer Journey – Workers Level (Plant Worker 4.0, and Technician 4.0)

4.6 Plans for the next period

Some of the plans that should be considered in the future in order to complete the process related to “Skills Catalogue and Jobs Certification program” are as follow:

- Implement the second iteration of the method to analyze the TO-BE conditions and compare it with the AS-IS situations of experiments.
- Complete databases of training activities by gathering information from project partners.
- Complete customer journeys by introducing other approaches to bridge the gaps and also make an DIH oriented customer journeys.
- Focus on details of 13 DIHs and Give a DIH orientation to aforementioned approach and methodology.
- Comparing Individual and group training for SMEs.
- Analyzing success stories and approaches that DIHs do to improve their digital transformation.



5 Conclusions

This deliverable presents the list of emerging new skills and job requirements and, eventually, a prioritization for critical ones, as well as their need and availability in project experiments, regarding the digital transformation and technology growth.

In this regard, after reviewing previous studies conducted in the field of digital transformation, AI, market developments, technological trends, and introducing the 6Ps, People dimension model (aimed at supporting manufacturing companies in defining its current level of digital maturity), twelve job profiles about data science management and Artificial Intelligence in 2 categories: DATA/AI New Roles & Professions and DATA/AI Skills for Enterprise Industry 4.0 Roles were defined. In addition, two surveys related to prioritizing skills dedicated to each profile according to experiments' conditions and analyzing experiments' current situation and their expectation for the future regarding identified job profiles and skills were implemented.

The 'voting' survey, which was conducted online to examine the opinions of project partners regarding the skills assigned to each job profile and their prioritization, received 23 votes; based on these votes, the skills for each profile were prioritized in order of importance for project partners. In addition, another crucial goal of this survey was to identify skills that were not completely relevant to the jobs introduced, "based on partners' points of view"; however, an interesting result of the feedback was that; the skills assigned to each job were correctly identified and no needed to be eliminated for next steps (second iteration).

The 'needed and possessed' survey, which was asked of the experiments to examine their current situation in relation to the jobs and skills introduced, received 17 votes (it should be noted that the target group of this survey was 17 project experiments, all of whom participated in this survey). After reviewing and analyzing the received responses, the existing gaps related to the skills became apparent. The important result obtained from the analysis of the responses is this: almost all of these experiments believed that the most important solutions to cover the existing gaps in relation to the jobs and skills are creation of cooperation with project partners for up-re skilling as well as the use of training courses to get acquainted with new jobs and skills and improving current level of skills.

Since use of training courses was one of the important strategies to cover the job and skill gaps in experiments, as the second step in the first iteration, list of training activities (from I4MS catalogue of training, and Polimi open knowledge website), field of training, level of information they provide to the audience (awareness, foundation, and extended know/how) were also offered to experiments, so that they have the possibility to use these training courses to improve their skills in the field of introduced jobs. Furthermore, customer journeys were drawn in three organizational levels (managers, professionals, and workers) to support experiments in terms of implementation of the method.

The second iteration of these surveys will be conducted in the last months of the project, where the content of the surveys will change slightly, and the main questions will take DIH orientation. In addition, another point of focus will be on examining the future conditions and the result of using the proposed approaches to cover the gaps.

As a general conclusion, we can affirm that the purpose of task T8.4 "Jobs Skills and Competences in AI for Manufacturing" is well covered in this deliverable.



6 References

1. H. Kagermann, J. Helbig, A. Hellinger, and W. Wahlster, Recommendations for implementing the strategic initiative INDUSTRIE 4.0: Securing the future of German manufacturing industry; final report of the Industrie 4.0 Working Group. Forschungsunion, 2013.
2. <https://www.twi-global.com/what-we-do/research-and-technology/technologies/industry-4-0>
3. <https://www.machinemetrics.com/blog/industry-4-0-technologies#artificial-intelligence-and-machine-learning>
4. <https://ec.europa.eu/digital-single-market/en/news/digital-europe-needs-digital-skills>
5. <https://www.mckinsey.com/featured-insights/future-of-work/the-future-of-work-in-europe#>
6. Ocident Bongomin, Gilbert Gilibrays Ocen, Eric Oyondi Nganyi, Alex Musinguzi, and Timothy Omara Exponential Disruptive Technologies and the Required Skills of Industry 4.0, 2020, <https://doi.org/10.1155/2020/4280156>
7. Ace factories, White paper on Human-centred factories from theory to industrial practice. Lessons learned and recommendations, 2019.
8. World Economic Forum, 2020, The Future of Jobs Report, October 2020.
9. Romero, D., Stahre, J., Wuest, T., Noran, O., Bernus, P., Fast-Berglund, Gorecky, D.: Towards an operator 4.0 typology: a human-centric perspective on the fourth industrial revolution technologies. In: Proceedings of the International Conference on Computers and Industrial Engineering, pp. 1–11 (2016).
10. World Manufacturing Forum's ten skills for the future of manufacturing World Manufacturing Forum - <https://worldmanufacturing.org/>
11. https://worldmanufacturing.org/wp-content/uploads/WorldManufacturingForum2020_Report.pdf
12. <https://digital-strategy.ec.europa.eu/en/library/digital-skills-training-blueprints-upskilling-sme-employees-and-unemployed-persons>
13. <https://www.digitalsme.eu/digital-skills-for-smes-challenges-and-opportunities/>
14. <https://op.europa.eu/en/publication-detail/-/publication/82aa7f66-67fd-11ea-b735-01aa75ed71a1/language-en>
15. Osservatorio Industria 4.0 - Politecnico di Milano
16. https://polimi.eu.qualtrics.com/jfe/form/SV_56H4kSHsnEESzAO
17. https://polimi.eu.qualtrics.com/jfe/form/SV_2n1ike9xHW7cmQ6
18. <https://i4ms.eu/trainings/>
19. <https://www.pok.polimi.it/>