PLANET4

Practical Learning
of Artificial Intelligence
on the Edge for indusTry 4.0

R2.2 SOFT SKILLS FRAMEWORK AND METHODOLOGIES TO ADOPT FOR THE PLANET4 4.0I&CM TRAINING WORKSHOPS

Deliverable: D 2.2, WP2
Official title: R2.2: Soft skills framework and Methodologies to adopt for the PLANET4 4.0I&CM training workshops

Authors and Contributors:
Amadio Riccardo, UniPi Atzeni Daniele, UniPi Mazzei Daniele, UniPi

Statement of originality
This deliverable contains original unpublished work, except where clearly indicated otherwise. Acknowledgement of previously published material and of the work of others has been made through appropriate citation, quotation, or both.

Note
For anyone interested in having more information about the project, please contact us at:
info@planet4project.eu

TABLE OF CONTENTS

INTRODUCTION

This result presents a comprehensive collection of methods collected by the partners from HEI and companies related to the topics of our research and the related framework of soft skills to develop in learners. Based on these practices UniPi will define the PLANET4 4.0 Innovation and Change Management Method to be tested first with partner companies and then with other companies and to be taught to students and workers during the training course.

Result responsible: UniPi (IE&M Dep.)
Due date M7 (June)
Dissemination level: Public (to be published on the website repo)

RELATED TASKS

T2.1: Desk research on methods for the PLANET4 soft skills frameworkfor 4.0 Innovation and change management.

In this first step, UniPi will define the standard procedures for conducting desk research about existing methods for 4.0I&CM, intentionally having a full view of all the possible interesting methodologies at state of the art. The aim of this desk research is to gather and analyze methodologies implemented by educational institutions or companies that can help in managing changes introduced by industry 4.0 innovations. To have a comprehensive view of such a new and growing topic, the team of UniPi will take advantage of their expertise in text mining processes. After a manual systematic literature review, automatic analysis of the recent scientific literature about change management will be carried out using the Scopus (www.scopus.com) API. Thanks to the techniques of Topic Modelling, it would be possible to have a preliminary map of the problems and the solution at the state of the art relevant to the problem to be addressed. This mapwill be of great advantage for defining optimal change management methodologies in the context of industry 4.0 and will validate the results of the manual systematic literature review. Furthermore,the map will give a first draft of the content of the courses to be designed.

Duration: 4 months (M1 – M4) Linked Results: R2.1, R2.2

T2.2: Formalization of the PLANET4 soft skills framework for 4.0 Innovation and Change Management (UniPi IE&M; all)

After having conducted the desk research, UniPi will analyze and synthesize the information to define an actionable methodology for supporting experts in the 4.0 change management. This methodology will bring together the more recent approaches for managing digital innovation in companies but will also incorporate typical methods and practices of change management focusing not only on the technical competence of experts but also on her/his soft skills. These skills (such as communication, problem-solving or emotional intelligence) have been proved to be great tools to reach the goal of introducing a new (and potentially disruptive) innovation in companies.

Duration: 3 months (M5 – M7) Linked Result: R2.3 (ML3)

PLANET 4 SOFT SKILLS FRAMEWORK FOR 4.0 INNOVATION AND CHANGE MANAGEMENT

We did a desk research of soft skills for Industry 4.0 using a topic modeling approach on academic papers from Scopus. For making the research on Scopus we created a set of queries using a combination of keywords and their synonyms. We analyzed the results and we created a rank of the most cited papers, rank of the most popular journals or conferences, rank of the most prolific authors, and a trend graph showing the number of publications in the previous years.

Keyword set: Change Management, Soft Skills, IoT, Industry 4.0, wireless sensor network, Internet of Things, smart factory.

Query set :

- Change management AND soft skills AND (IoT OR Industry 4.0 OR wireless sensor network OR internet of things OR smart factory)
- Change management OR soft skills AND (IoT OR Industry 4.0 OR wireless sensor network OR internet of things OR smart factory)

The table below shows the results of the first query.

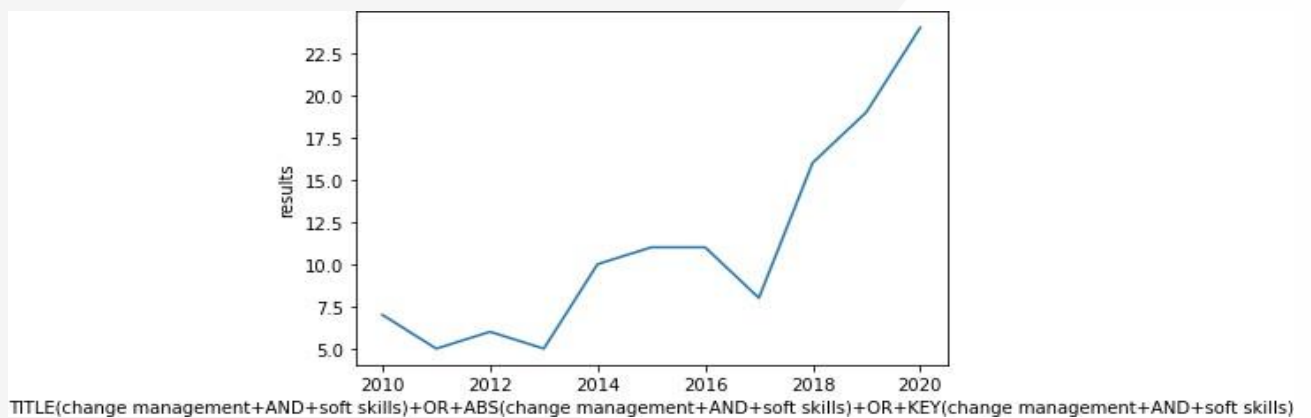| Article	Journal/Conference	Citations
Transformation towards smart factory system: Examining new job profiles and competencies	Systems Research and Behavioral Science Volume 37, Issue 2, 1 March 2020, Pages 388-402	15
Cooperative and application-oriented learning in engineering design – Systems design methodology educated on solutions for mousetrap-powered vehicles	Proceedings of the 21st International Conference on Engineering and Product Design Education: Towards a New Innovation Landscape, E and PDE 2019	0

Challenges for industry 4.0 in management area	Proceedings of the 30th International Business Information Management Association	0

The following table shows the results of the second query.

Article	Journal/Conference	Citations
Literature review of Industry 4.0 and related technologies	Journal of Intelligent Manufacturing volume	142
Energy efficient automated control of irrigation in agriculture by using wireless sensor networks	Computers and Electronics in Agriculture , Volume 113	94
Smart factory for industry 4.0: A review	Journal of Modern Manufacturing Systems and Technology	87
Perspective for smart factory in petrochemical industry	Computers & Chemical Engineering, Volume 91	47
The role of Internet of Things (IoT) in smart cities: Technology roadmap-oriented approaches	Sustainability Journal	30
Natural wind-driven ultra-compact and highly efficient hybridized nanogenerator for self-sustained wireless environmental monitoring system	Nano Energy, Volume 60	28
Internet-of-Things Enabled Real-time Monitoring of Energy Efficiency on Manufacturing Shop Floors	Procedia CIRP	20
Industry 4.0: a supply chain innovation perspective	International Journal of Production Research Volume 58, 2020 - Issue 5	20

Text mining of industry 4.0 job advertisements	International Journal of Information Management	19
The 'how' of benefits management for digital technology: From engineering to asset management	Automation in Construction Volume 107, November 2019, 102930	18

We analyzed the trend of academic papers during the last years in this research field to have another point of view on this topic.

TITLE(change management+AND+soft skills)+OR+ABS(change management+AND+soft skills)+OR+KEY(change management+AND+soft skills)

From the results of the queries on Scopus, we analyzed the most important Journals or Conferences active in this research field. The obtained results are reported in the following table.

Name	Type of Journal/Conference	Articles
Sensors (Switzerland)	Journal	93
Advances in Intelligent Systems and Computing	Book Series	70
IEEE Internet of Things Journal	Journal	57
Journal of Physics: Conference Series	Conference Proceeding	50
Sustainability (Switzerland)	Journal	42

IFIP Advances in Information and Communication Technology	Book Series	40
IOP Conference Series: Materials Science and Engineering	Conference Proceeding	36
CEUR Workshop Proceedings	Conference Proceeding	35
2020 61st International Scientific Conference on Information Technology and Management Science of Riga Technical University, ITMS 2020 - Proceedings	Conference Proceeding	30
International Journal of Information Management	Journal	30

The next table shows the most prolific authors in this research field resulting from the previously described queries.

Author	Articles
Jerman A.	41
Luna A.M.	30
Aboltins U.	30
Antzoulatos G.	24
Sodhro A.H.	24
Rastegar S.H.	21
Brous P.	21
Grenda D.	21
Ayoub W.	18
Nawaz A.	18

After the desk research of the literature, a deeper analysis of the three papers found by the first

query has been made. Unfortunately, there is not any available version of "Challenges for industry 4.0 in management area".

In [2], they analyze the concept of smart factory system and its implementation in the automotive industry, focusing on the future jobs perspective by answering specific research questions. They describe the new hard-skilled professions required by I4.0, but they also highlight the need for soft skills for these profiles, like continuous learning, flexibility, creativity, problem-solving, critical, and analytical thinking.

Regarding [1], they describe two university courses: one is held during the bachelor degree, the other is aimed at master students. The first one is more theoretical and focuses on modeling concepts. The second one is more domain-specific and develops project management skills, allowing students to face product planning, task clarification, and prototypical realization in a public contest.

The previous analysis suggests the need to find the right questions and look for their answers. As also reported in R2.1, the soft skills for 4.0 Innovation and Change management desk research has been organized in order to answer a series of research questions:

1. **What are the most important soft skills in the Industry 4.0 context?**

2. **What are the working methods more used for the learning and upskilling in the Industry 4.0?**

3. **How are soft skills and change management courses typically organized?**

Due to the scarcity of results obtained from the proposed queries, in order to be able to answer these questions, it was necessary to extend the search not only to other academic papers but also to blog posts and other sources. In the following, the results of this extensive search are reported.

RESEARCH QUESTIONS

What are the most important soft skills in the Industry 4.0 context?

It is now well established that Industry 4.0 requires professions having both solid technical knowledge as well as more versatile soft skills. Regarding the latter, in order to understand which ones are considered most important, a further research has been carried out. The following table shows the obtained results.

Soft Skill	Citations
Ability to work in a team	[1] [2] [13] [12] [11]
Critical thinking	[1] [2] [13] [11] [12]
Problem-Solving	[1] [2] [13] [11] [12]
Leadership	[2] [1] [13] [12]
Flexibility	[1] [2] [11] [13]
Creativity	[1] [2] [13]
Entrepreneurial spirit	[2] [1] [13]
Analytical Thinking	[1] [2] [13]
Multidisciplinary approach	[1][2][13]
Decision Making	[2] [1] [13]
Communication	[2] [1]
Research Skills	[2] [13]
Emotional Intelligence	[2][13]
Work on stressful situations	[2] [1]
Continuous Learning	[2]
Language Skills	[2]

The table shows the increasing interest in teamwork-related soft skills, e.g., leadership and the ability to work in a team, and skills related to rational thinking, like problem-solving and critical thinking.

What are the working methods more used for addressing Industry 4.0 problems?

To understand which working methodology should be strengthened during the workshop, we conduct a study on the current methods adopted to address I4.0 problems.

Methodology	Citations
Agile Technologies Development	[14], [21], [22]
Readiness and Maturity Models	[18], [20]
Cooperative and Application-Oriented Learning method using IPPE Framework.	[1]
Scrum approach for the Digital Transformation on IoT factory in China	[16]
Adoption of Design Thinking in Industry 4.0 Project Management	[17]
Six Sigma: Define, Measure, Analyze, Improve, Control	[15]
Lean Thinking for Industry 4.0	[19]

The result shows the importance of Agile methodologies, which allow continuous product updates by keeping up constant communication with the clients and focusing on communication between team members.

How are soft-skills and change management courses typically organized?

Assuming the importance of the soft skills described in the first research question, the Planet4 Soft Skills Framework for 4.0 Innovation and Change Management Workshop must set the goal of teaching and developing these soft skills. In order to better design this work, a search for papers describing how this goal has been tackled in the past has been carried out. The results of this research are shown in the following table.

Teaching Methodology	Citations
Practical Training / Workplace Problems / Case Studies	[1]. [3], [6], [10]
Theoretical Courses on soft skills held by experts	[1], [3], [5]
Educational Games	[4], [8], [9]
Extra-Curricular Activities / Informal Activities, i.e., seminars, conferences, debates	[3]
Volunteering	[7]

The table shows the importance of combining both theoretical lessons and practical exercises/case studies. Case studies should be faced in groups, intending to develop the most important soft skills found while answering the first research question.

CONCLUSIONS

The obtained results suggest that the Planet4 Soft Skills Framework for 4.0 Innovation and Change Management Workshop should focus on the growth of professional figures able to work ina team and to develop a continuously evolving project. We suggest adopting an **online flipped class** framework, which alternates theoretical lessons, possibly using slides, and practical activities to be delivered as synchronous training. The latest should be done in groups, in order to enhance teamwork abilities, and should follow agile methodologies, with continuous project updates.

NEXT STEPS

1. **T2.3 Design and development of the PLANET4 4.0I&CM training workshops for internal testing.**

   The partners, led by UniPi, should design a training course for students of at least 10 hours, to be delivered internally at UniPi.

2. T2.4 Internal testing of the PLANET4 4.0I&CM training workshopswith students and companies.

We propose to test the training (in full or at least in parts) in all the countries, involving both students and workers from the partners and non-partners companies, for whose research all partners should contribute. At the end of the sessions, the training materials will be evaluated by the participants through an easy online tool. Feedback will be collected and strengths, weaknesses, and proposals of improvement will be identified and reported by a previously determined partner. At the end of this process, the authors of the training materials, led by UniPi, will deliver the updated version of the PLANET4 4.0I&CM workshops.

Target n. of participants: 12 (both students and workers)

October 2021 - January 2022

3. T2.5 Improvements of the PLANET4 4.0I&CM training workshopsand release of the workshop final version.

The feedback collected from the learners will allow the authors to define the ultimate version of the methodology and training materials to be included in the PLANET4 course (WP5). The final version of the training materials will be presented to the partners by UniPi on a dedicated event and a dedicated training session will be organized.

February 2022 - April 2022

REFERENCES

[1] "Cooperative and Application - Oriented Learning in Engineering Design – Systems DesignMethodology Educated on Solutions for Mousetrap - Powered Vehicles"

[2] "Transformation towards smart factory system: Examining new job profiles and competencies"

[3] "Soft skills at the Malaysian institutes of higher learning"

[4] "Integrating Soft Skills Through Active Learning In The Management Classroom"

[5] "LEARNING SOFT SKILLS AT WORK: An Interview With Annalee Luhman"

[6] "Project-based Learning (PjBL): Inculcating Soft Skills in 21st Century Workplace"

[7] "How volunteering helps students to develop soft skills"

[8] "Using a stakeholder developed case study to develop soft skills"

[9] "Educational Games for Soft-Skills Training in Digital Environments: New Perspectives"

[10] "Using different learning methodologies and tools to exploit the educational impact of aUniversity Art Collection: a pilot phase at Roma Tre University (IT)."

[11] "Industry 4.0: a supply chain innovation perspective"

[12] "Perspective for smart factory in petrochemical industry"

[13] "Text mining of industry 4.0 job advertisements"

[14] "Agile Requirement Engineering Maturity Framework for Industry 4.0"

[15] "Supply chain management six sigma: a management innovation methodology at theSamsung Group"

[16] "Scrum – an Agile Approach to Digital Transformation"

[17] "Adoption of Design Thinking in Industry 4.0 Project Management"

[18] "A maturity model for assessing Industry 4.0 readiness and maturity of manufacturing enterprises "

[19] "Lean Thinking contributions for Industry 4.0: a Systematic Literature Review"

[20] "A measurement framework for assessing the maturity of requirements engineering process"

[21] "A Maturity Model for Scaling Agile Development"

[22] "Agile Factory - An Example of an Industry 4.0 Manufacturing Process"

Lead Partner:

UNIVERSITÀ DI PISA

Partners:

POLITECHNIKA RZESZOWSKA
im. IGNACEGO ŁUKASIEWICZA

laSalle
UNIVERSIDAD RAMON LLULL

UNIVERSITY OF IOANNINA

ValueDo

Kaunas Science and Technology Park

Zerynth®
Enabling IoT

BOBST

elecnor infraestructuras

OHS
ENGINEERING GMBH

Exquisite
packaging industry