Strategies for workers' skills development and engagement: the AGILEHAND project solutions' developers point of view

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Abstract
AGILEHAND is a Horizon Europe project that aims at developing advanced technologies for grading, handling and packaging autonomously soft and deformable products, as a strategic instrument to improve flexibility, agility and reconfigurability of production and logistic systems of the European manufacturing companies. In this project Artificial Intelligence and Robotic solutions will be developed. As AI automation progresses, there's a risk of creating significant skill gaps where displaced workers may not have the necessary skills to transition to new roles, leading to long-term unemployment and economic disparities.
In this context, some questionnaires have been developed in order to understand the workers' skills and engagement strategies necessary for using the AGILEHAND solutions. These questionnaires have been filled out by AGILEHAND solutions' developers in order to collect the designers point of view.
In conclusion this study has an important role in describing the current AGILEHAND scenario, providing interesting information for both researchers and designers since it defines the main enabling factors for successful AGILEHAND implementation and the main problems that designers and practitioners could face.

Keywords
Workers Skills, Workers Engagement, Artificial Intelligence, Robotic Solutions, AGILEHAND project

1. Introduction

AGILEHAND is a Research and Innovation Action project funded under the Horizon Europe calls HORIZON-CL4-2022-TWIN-TRANSITION-01-04 (Intelligent work piece handling in a full production line) that aims at developing innovative solutions for three key aspects of a workpiece handling system:

The "grading" aspect, i.e. knowledge of the workpiece's characteristics and condition. In particular, the project focuses on a self-calibrating sensing solution for producing a mesh of integrated and overlapping sensors that will improve production-line traceability, agility and reconfigurability. The main gains will be a cost effective, accurate and fast solution to finely grade the quality of delicate and perishable products.

- The "handling" aspect of soft and deformable products during the Sorting, Handling and Packaging stages. The AGILEHAND project addresses the problems of robotic manipulation, not in the factory setting, but in a more human-oriented environment, where objects are diverse, deformable, and delicate.

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- Aspects of agility, flexibility and reconfigurability in production lines. To build a set of solutions for Agile Production Line Reconfiguration in a mixed-model production system. These Artificial Intelligence (AI) based solutions, will allow for monitoring, adaptive control and synchronisation of production and logistics flows in a factory, even when faced with a variability of products, production mix or fresh market, guaranteeing high performance in customer response time, and an efficient use of resources.

In the AGILEHAND project context several tools and solutions based on AI and Robotic systems will be developed.

The rapid advancement of artificial intelligence (AI) and robotic systems has brought about significant transformations in the global workforce landscape [1]. As traditional job roles evolve and new ones emerge [2], there is an urgent need for workers to acquire and develop relevant skills to thrive in this AI-driven economy [3]. This paper comprehensively explores strategies for workers' skills development in the field of AI and robotics, aiming to provide insights for individuals, organizations, and policymakers. It begins by examining the current state of AI and robotic technologies, followed by an analysis of key skills required by workers. Subsequently, it delves into various strategies for skills development, including lifelong learning initiatives, upskilling/reskilling programs, collaboration platforms, and cross-disciplinary training opportunities. Furthermore, the paper addresses challenges and barriers in the implementation of these strategies and presents policy recommendations to foster an inclusive and resilient workforce in the era of AI and robotics.

The main aim of this work is to investigate from designers point of view which workers' skills and engagement strategies have an impact on successful AGILEHAND implementation.

This paper endeavors to elucidate the intricate strategies for workers' skills development and engagement in artificial intelligence and robotic systems, underscoring the imperative of continuous learning and adaptability in the face of technological evolution. Through an extensive exploration of requisite skills, challenges, and policy recommendations, this paper aims to empower individuals, project partners, and policymakers to navigate the dynamic landscape of the future world of work effectively.

2. Method

In order to develop an analysis which defines the AGILEHAND scenario of workers' skills and engagement two questionnaires were drawn up. The first questionnaire analyzes in detail if AGILEHAND solutions shall modify actual and future work processes and procedures, if AGILEHAND solution shall need new workers' skills for executing the roles and tasks associated with work process and activities, if AGILEHAND solution shall enhance new workers' skills for executing the roles and tasks associated with work process and activities and what new workers' skills will be needed. The second questionnaire will be focused on workers' engagement strategies.

The two questionnaires were developed on the basis of the extensive literature review carried out using the most important scientific papers repository (Scopus, Science Direct, Web of Knowledge).

A Likert scale was applied for each item from 1 point (totally disagree) to 5 points (Totally agree), indicating the level of consensus with the proposed sentences.

All AGILEHAND solutions developers have been involved in this survey. A total of 12 completed surveys were returned.

Data were collected from AGILEHAND partners via a combination of regular mail, e-mail and Internet-based survey methods, using a specially developed Internet-based questionnaire.

3. Results

Results obtained from the survey have been summarized in the next sections. In particular, section 3.1 is focused on AGILEHAND solutions impact on workers' skills while section 3.2 is focused on workers' engagement strategies.

3.1. AGILEHAND solutions impact on workers' skills

The first analysis carried out consist of the AGILEHAND solution developers opinion regarding the impact that their solution could have on workers' skills. Table 1 shows the average values and standard deviation.

Table 1: Descriptive statistic regarding AGILEHAND solutions impact on workers' skills

AGILEHAND solutions impact on workers' skills	Average	St. Dev.
Your AGILEHAND solution shall modify actual and future work processes and procedures	4,667	0,516
Your AGILEHAND solution shall need new workers' skills for executing the roles and tasks associated with work process and activities	3,5	1,048
Your AGILEHAND solution shall enhance new workers' skills for executing the roles and tasks associated with work process and activities	3,167	0,752

The following figure 1 graphically summarized the results shown in table 1.

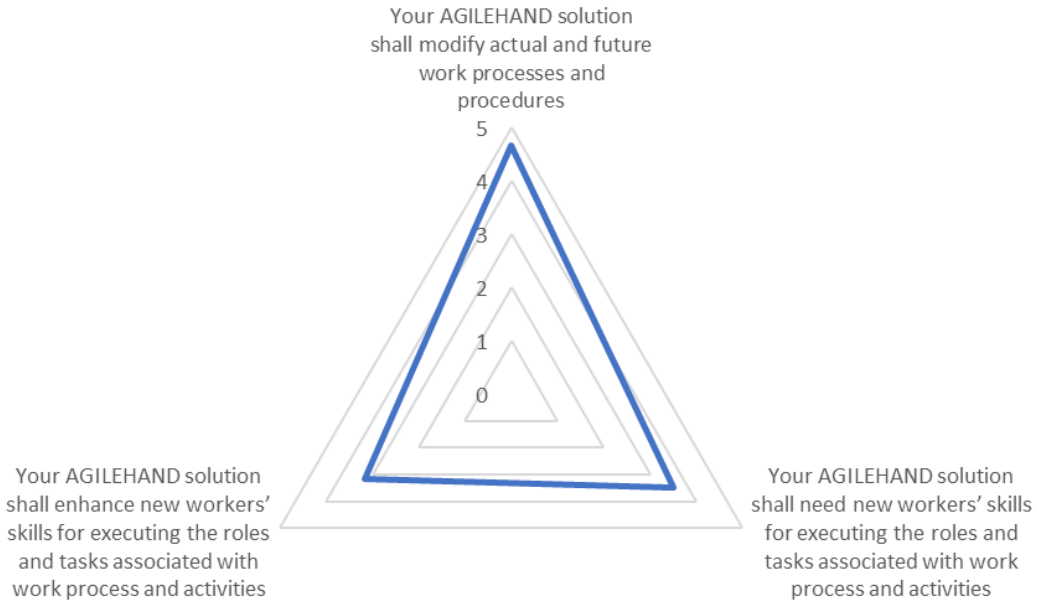

Figure 1: Radar diagram regarding the solution developers level of consensus with the sentences using a scale that goes from 1 (totally disagree) to 5 (Totally agree)

In order to analyze more in detail which skills will be needed to use AGILEHAND solutions, different skills have been proposed to solution developers. In particular the following classification has been proposed for skills: Core skills, Thinking skills, Self-management skills, Social and communication skills, Physical and manual skills.

Core skills include working with numbers and measurements, using digital devices and apps, and comprehending, speaking, reading, and writing in one or more languages. They serve as the cornerstone for interpersonal interaction, personal growth, and education. Enhancing employees' multilingual comprehension, writing, speaking, and reading skills as well as their numerical and unit-of-measurement handling and device/application usage are essential while working with AI.

The term "thinking skills" describes the capacity to use mental processes for gathering, conceiving, analyzing, summarizing, and/or assessing data produced by observation, experience, introspection, reasoning, or communication. The utilization of diverse forms of information to organize work, accomplish objectives, resolve conflicts, and carry out intricate jobs in both conventional and innovative methods is indicative of this.

The ability to recognize and regulate one's own strengths and limitations and to apply this self-awareness to guide actions in a range of situations is referred to as self-management skills. This is

demonstrated by the capacity to act in a thoughtful, accountable, and disciplined way in line with ideals, to take criticism well, and to look for chances for both professional and personal growth.

The capacity to engage in constructive and good interactions with others is referred to as social and communication skills. Effective and compassionate communication of ideas, coordinating one's objectives and actions with those of others, seeking solutions to conflicts, establishing trust, and resolving them, as well as managing tasks, providing leadership, and showing concern for the well-being and advancement of others, are all examples of this.

The capacity to carry out tasks and activities requiring manual dexterity, agility, and/or physical strength is referred to as physical and manual skills. They can be carried out under challenging or hazardous conditions that call for strength or endurance. These chores and activities can be carried out manually, with the help of other direct physical interventions, or with the use of machines, ICT devices, hand tools, or musical instruments—among other tools and equipment—that call for strength, movement, or guidance.

The solution developers could select one, more than one or no skills for every class.

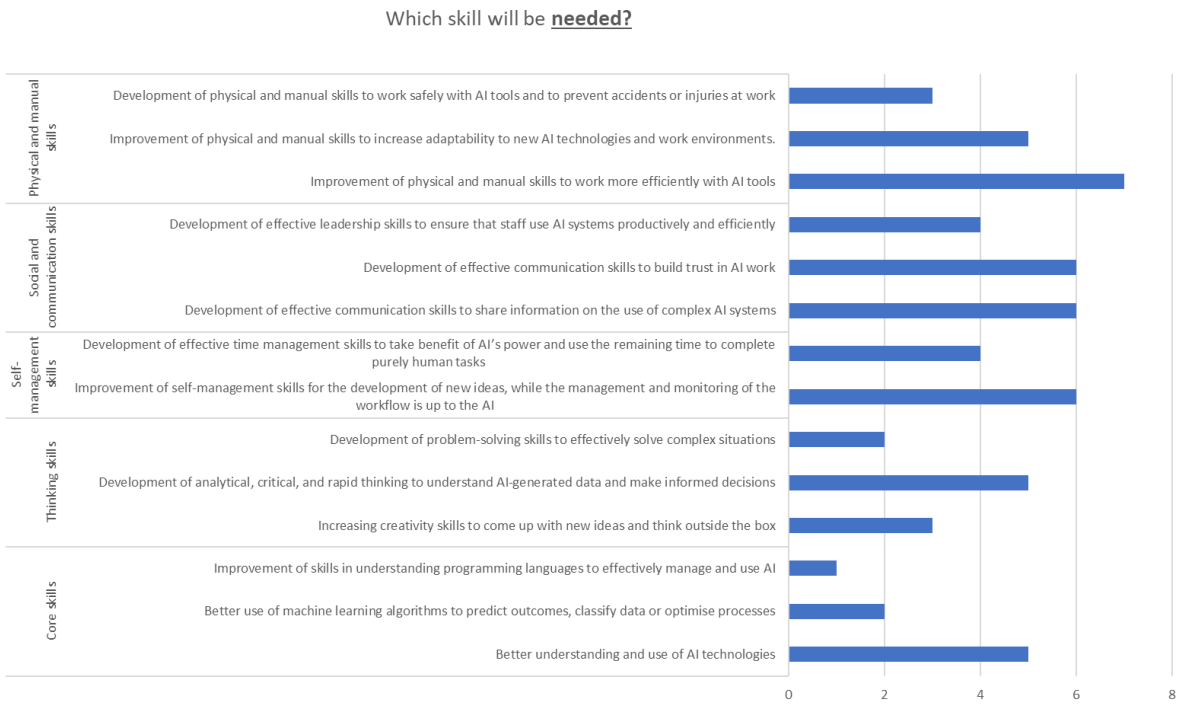

Figure 2: Workers' skill needed in AGILEHAND context

In next step we analysed which skills will be enhanced by AGILEHAND solutions. In this step we use the same classification already used for analysing the needed skills. In Figure 3 the results obtained.

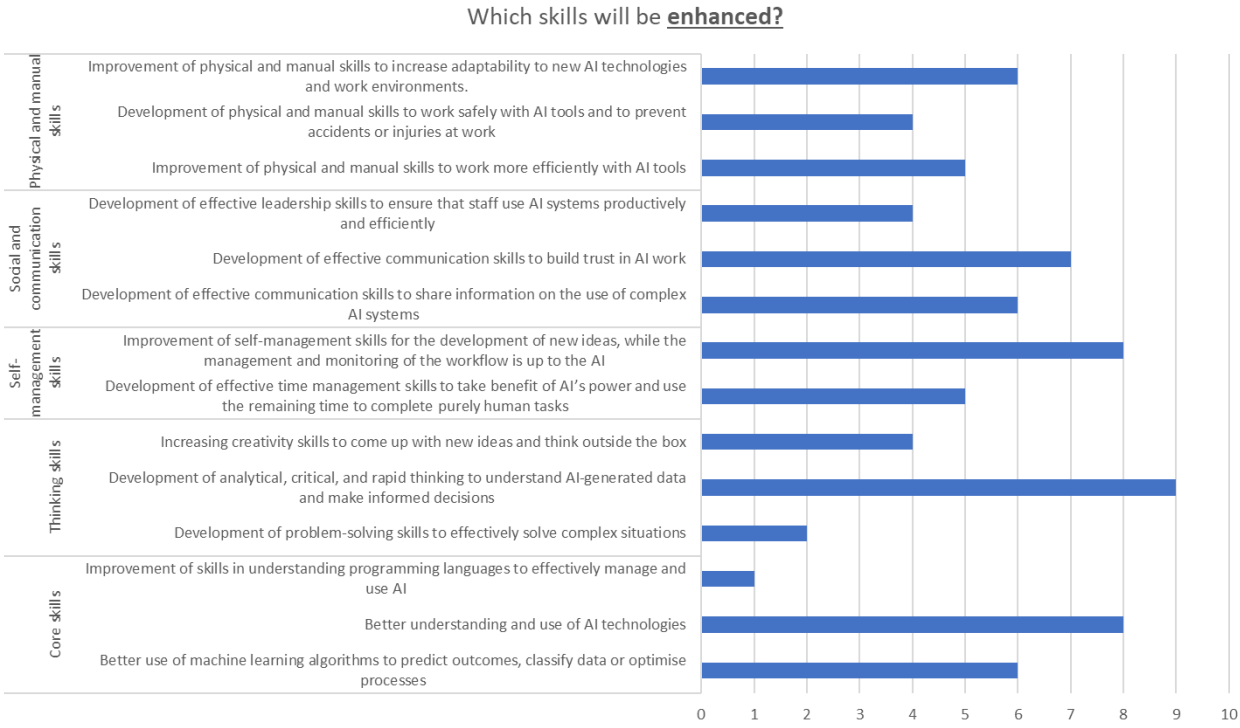

Figure 3: Workers' skill enhanced in AGILEHAND context

3.2. Workers' engagement strategies

The last step of this study concerned the workers' engagement strategies for AGILEHAND solutions.

In particular, different aspects have been analyzed, such as:

- Surveillance and Privacy Concerns: The implementation of AI-driven monitoring systems in workplaces can raise concerns about privacy violations and intrusive surveillance, potentially leading to increased stress and decreased morale among workers.
- Job Quality Reduction: AI may lead to the creation of more monotonous, low-skilled jobs, reducing overall job satisfaction and fulfillment.
- Worker Surveillance and Control: Employers may misuse AI for excessive monitoring and control of workers, eroding trust and autonomy in the workplace.
- Disruption of Traditional Work Models: AI-driven automation can disrupt traditional employment models, leading to job insecurity and a lack of benefits for workers.
- Psychological Stress: Constant exposure to AI-driven performance evaluations and competition with automated systems can lead to stress and burnout among workers.
- Loss of Human Connection: Increased automation may reduce opportunities for human interaction in the workplace, leading to feelings of isolation and disconnection.
- Loss of Professional Identity: Workers whose roles are automated by AI may experience a loss of professional identity and self-worth, leading to psychological distress.

Table 2 and Figure 4 show the results in terms of average and standard deviation values.

Table 2: Descriptive statistic regarding AGILEHAND engagement strategies

AGILEHAND engagement strategies	Average	St. Dev.
Your AGILEHAND solution shall avoid Surveillance and Privacy Concerns	4,333	1,211
Your AGILEHAND solution shall avoid Job Quality Reduction	4,167	1,169

Your AGILEHAND solution shall avoid Worker Surveillance and Control	3,833	1,169
Your AGILEHAND solution shall avoid Disruption of Traditional Work Models	3,333	0,516
Your AGILEHAND solution shall avoid Psychological Stress	3,833	0,983
Your AGILEHAND solution shall avoid Loss of Human Connection	4,167	0,752
Your AGILEHAND solution shall avoid Loss of Professional Identity	3,667	1,366

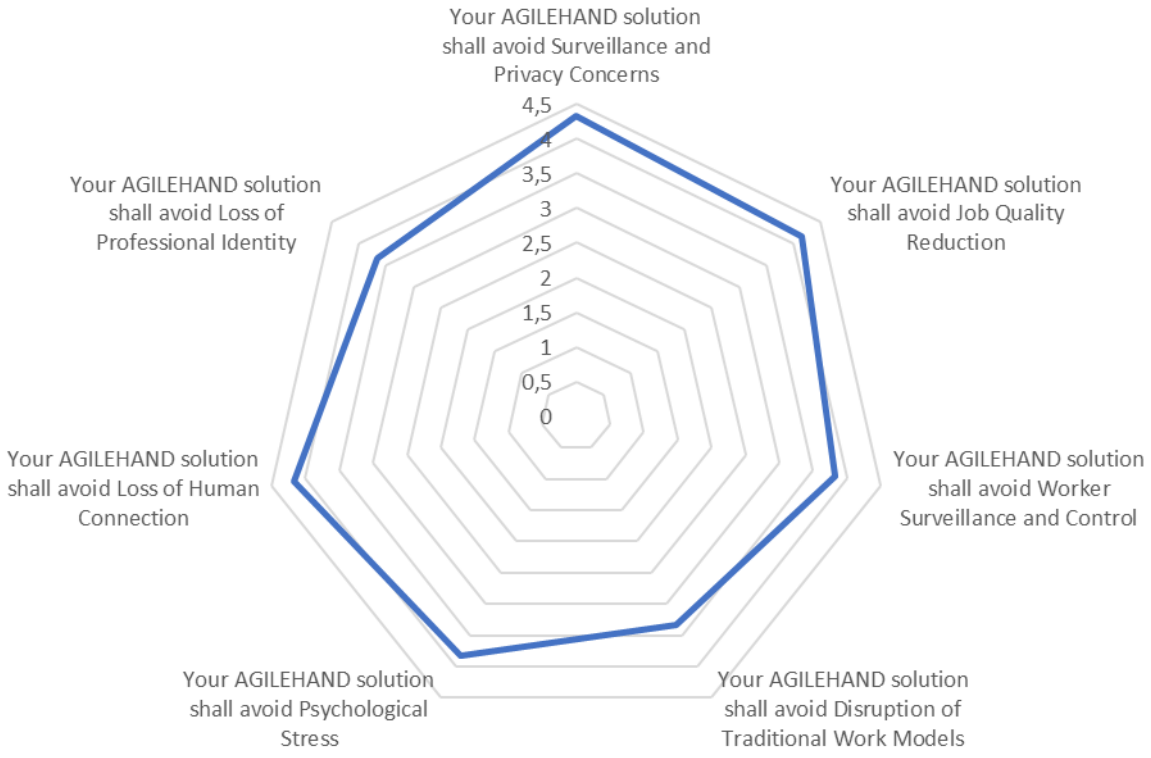

Figure 4: Workers' engagement strategy in AGILEHAND context

4. Conclusions

In this paper, we explore the strategies for workers' skills development in the dynamic fields of artificial intelligence and robotics. By understanding the key skills required, implementing effective development strategies, overcoming challenges, and considering policy recommendations, we can empower the workforce to thrive in an AI-driven world [4]. The ascent of artificial intelligence (AI) and robotics marks a watershed moment in human history, reshaping the landscape of work and industry. As automation becomes increasingly prevalent, the demand for skilled workers proficient in AI and robotics grows exponentially [5]. This paper presents a comprehensive exploration of strategies aimed at fostering the development of workers' skills in AGILEHAND project. It delineates the requisite technical and soft skills, surveys existing challenges, and offers actionable strategies for individuals, organizations, and policymakers. By elucidating the multifaceted nature of skills development in this domain, this paper aims to empower stakeholders to navigate the evolving AGILEHAND solutions.

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Declaration on Generative AI

The author(s) have not employed any Generative AI tools.

References

[1] Paciarotti Claudia, Bertozzi Gabriele, Sillaots Martin. "A new approach to Gamification in engineering education: the Learner-Designer Approach to Serious Games". European Journal of Engineering Education, (2021), 46(6), pp. 1092–1116.

[2] Paciarotti Claudia, Cesaroni Angela. "Spontaneous volunteerism in disasters, managerial inputs and policy implications from Italian case studies". Safety Science (2020), Vol. 122, 104521

[3] Paciarotti Claudia, Valiakhmetova Inna. "Evaluating Disaster Operations Management: An Outcome-Process Integrated Approach". Production and Operations Management (2021), 30(2), pp. 543–562

[4] Fani Virginia, Antomarioni Sara, Bandinelli Romeo, Bevilacqua Maurizio. "Data-driven decision support tool for production planning: a framework combining association rules and simulation". Computers in Industry (2023), 144, 103800

[5] Antomarioni Sara, Bevilacqua Maurizio, Ciarapica Filippo Emanuele, De Sanctis Ilaria, Ordieres-Meré Joaquin. "Lean projects' evaluation: the perceived level of success and barriers". Total Quality Management and Business Excellence (2021), 32(13-14), pp. 1441–1465