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EDUCATION ADAPTING TO THE FUTURE: MEETING THE SKILL NEEDS IN MANUFACTURING SECTOR

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ABSTRACT

The "Manufacturing Academy 2.0" project, co-funded by the European Social Fund Plus, addresses the challenge of an aging workforce and declining birth rates in Finland's manufacturing industry. It focuses on developing training modules to preserve and transfer tacit knowledge from retiring experts to new employees in manufacturing industry. The education institutions involved in this project represent both higher education (Tampere University of Applied Sciences, Finland) and vocational secondary education (SASKY, Finland). This partnership ensures that the training programs are not only grounded in theoretical knowledge but are also directly relevant to the current and future needs of the manufacturing industry at various levels. Through structured interviews at the "Konepajamessut" Manufacturing Expo, the project gathered data to tailor training topics to industry needs. Results indicate a significant recognition of importance of tacit knowledge and a varied readiness to collaborate on training development. The responses also highlighted an overall positive disposition towards continuing education initiatives. This indicates a growing recognition of the value of life-long learning and upskilling opportunities, particularly through university and vocational school courses or training facilitated by them, to maintain a competitive and proficient workforce.

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1 INTRODUCTION

In recent years, Europe has been experiencing a consistent decrease in birth rates, leading to an increasingly aging workforce. Lower birth rates mean a gradual decline in the young, working-age population that is the backbone of labour market. Therefore, there are fewer entrants into the workforce, which can lead to a shortage of labour. Manufacturing companies across Europe are responding to these challenges in various ways, including automation, to reduce dependency on human labour, and enhancing training programs to transfer knowledge from retiring experts to the newer workforce. There is also a growing trend towards encouraging later retirement to retain older workers' expertise and experience within the industry. As the workforce in manufacturing industries ages, there is a risk that not enough new skilled workers will be attracted to the field to compensate for the shortfall, and companies are responding to this by moving their production abroad. When older workers retire, they take with them tacit knowledge, which is often quite significant for performing certain work phases or procedures.

Tacit knowledge refers to the knowledge that a person possesses but which is difficult to convey to others through words or writing. It can include personal experiences, intuitive insights, implicit skills, and practices that have been acquired over a long period and in a certain context. One of the most famous definitions comes from the philosopher Michael Polanyi (Polanyi 1966), who emphasized that we know more than we can tell. This suggests that a large part of human knowledge is internal and subjective and cannot be easily or completely articulated. Tacit knowledge encompasses a wide spectrum of insights, from intuitive judgments and implicit skills to nuanced practices honed over years of hands-on experience. The complexity of defining and encapsulating this knowledge has led to a variety of interpretations across academic and practical fields, underscoring the rich diversity yet elusive nature of tacit understanding.

Within the manufacturing sector, the transfer of tacit knowledge is a significant factor. Experienced workers possess an invaluable ability to detect subtle cues—be it minor alterations in machinery sounds or operational shifts—that pre-emptively signal potential issues. Their decision-making ability, refined through years of observation and engagement, often operates beneath the surface of formal recognition or documentation. Mohajan (Mohajan 2016) emphasizes that tacit knowledge is a crucial, yet often overlooked, component of an organization's knowledge base that plays a vital role in innovation and the successful implementation of knowledge management strategies. While tacit knowledge is inherently personal and context-specific, certain technologies can aid in its transfer. For instance, virtual reality (VR) and augmented reality (AR) can simulate real-world scenarios for training purposes, making it easier for workers to gain insights into tacit knowledge without the direct intervention of a human instructor. Also, AR/VR technologies can be used to capture and digitize the expertise of skilled workers (Sarhan et al. 2022).

2 MANUFACTURING ACADEMY 2.0 -PROJECT

Tampere University of Applied Sciences (TAMK) and SASKY education association, collaboratively initiated a "Manufacturing academy 2.0" project, which is co-funded by the European Social Fund Plus (ESF+). The aim of this MA 2.0 project is to find methods to identify, collect, and train tacit knowledge to bolster the manufacturing

sector in Pirkanmaa region in Finland. At the heart of MA 2.0 project's approach is the development of a pedagogical model or education concept that aligns with the needs of the manufacturing industry. The project also aims to modernize the training in the manufacturing industry so that tacit knowledge can be better transferred to new employees and that the training in general would better meet the demands of the modern age, which are related to the needs of the digital and green transition. The long-term goals of the MA 2.0 project are related to the establishment of the training model and increasing the attractiveness of the field, especially among young people. Additionally, the project offers opportunities for cooperation between different actors, both domestically and internationally, which strengthens networks and promotes the sharing of expertise.

A pivotal aspect of the MA 2.0 project is its collaborative framework, involving key stakeholders from both the education and industrial sectors. The education institutions involved in this project represent both higher education (TAMK) and vocational secondary education (SASKY). This partnership ensures that the training programs are not only grounded in theoretical knowledge but are also directly relevant to the current and future needs of the manufacturing industry at various levels. By fostering a strong link between education and industry, the project aims to ensure that the tacit knowledge transferred through its programs directly contributes to enhancing the competitiveness and innovation capacity of the manufacturing sector.

To be well aligned with the skill needs of the industry, companies were surveyed during “Konepajamessut”, a national Manufacturing Expo, that took place March 17-19, 2024, in Tampere, Finland. The expo spotlights advanced machinery, modern workshops, and smart investments. It's tailored for decision-makers in the metal industry, featuring machine tools, welding and joining tools, automation, robotics, maintenance, and industrial services. Alongside the Manufacturing Expo, also the Nordic Welding Expo and the 3D & New Materials Fair took place, making it a comprehensive event for industry professionals. The participating companies at the Manufacturing Expo span across various sectors of the manufacturing industry and other sectors, offering a diverse array of products and services. There were over 200 participating companies of which 78 were interviewed for this project. This manufacturing expo is one of the largest in Finland and companies all over the country participate. The companies interviewed range from medium-sized national to large international companies. Therefore, the results are expected to rather reflect rough average across companies operating in manufacturing sector in Finland, than only small regional companies.

3 SURVEYING COMPANIES THROUGH STRUCTURED INTERVIEWS

In the structured interviews aimed at manufacturing companies, the focus was on identifying the sector's near-future skill needs and whether companies have models for transferring tacit knowledge. The information obtained enables the project to direct its efforts so that training modules can be tailored to meet the skills the industry most urgently requires. The interviews also revealed which topics interest which companies, allowing for targeted training for different companies later on. The MA 2.0 project aimed to identify not only current but also future skill gaps, to proactively address labour market changes through education. The interviews

sought to find out which topics companies' current or future employees need concrete skills in and whether there are existing methods and models for transferring tacit knowledge to new employees. The questions and the response distributions are presented in the next chapter.

A key focus of the survey was to gauge the perceived magnitude of the problem posed by the loss of tacit knowledge. By employing a 6-point Likert scale, companies were queried on the extent to which they view this loss as a challenge, thereby quantifying the urgency and importance of devising effective transfer mechanisms. This quantitative assessment is complemented by inquiries into the existence of current practices or training models aimed at facilitating the inter-employee transfer of tacit knowledge, offering a snapshot of the industry's readiness to tackle this issue. In the beginning of the interview, the respondent was briefly informed about the survey and also about the tacit knowledge transfer and its' definition.

The survey further investigates the willingness of companies to participate in the development of tacit knowledge training programs in collaboration with Tampere University of Applied Sciences (TAMK). This partnership underscores the project's commitment to creating a synergistic relationship between academia and industry, ensuring that the developed educational models are not only theoretically sound but also practically relevant and directly applicable to the manufacturing context.

One component of the survey centers on identifying the specific areas of manufacturing where companies foresee imminent workforce needs, attributable to retirement or other factors. By soliciting input on the significance of new workforce competencies across various domains, the survey aims to tailor the educational concept to address these emerging requirements effectively. Additionally, companies' preferences for the modality of training delivery—ranging from VR and AR simulations to online and in-person formats and workshops—are explored to design programs that align with organizational needs and learning cultures.

4 RESULTS

Figure 1 shows the answer distribution to the question of the importance of tacit knowledge loss in the company. The companies were also asked if they had methods or training models for transferring tacit knowledge from one employee to another and if they were willing to co-develop the transfer methods together with the education institution (TAMK). The answers are shown with different colours for different responses as indicated in the figure. Majority of the respondents (45 companies, 58 %) considered this to be a problem for them (scores 3-5). Altogether 18 companies expressed their interest to participate in developing tacit knowledge transfer methods. This is a very good starting point for planning the next actions and workshops in the MA 2.0 project.

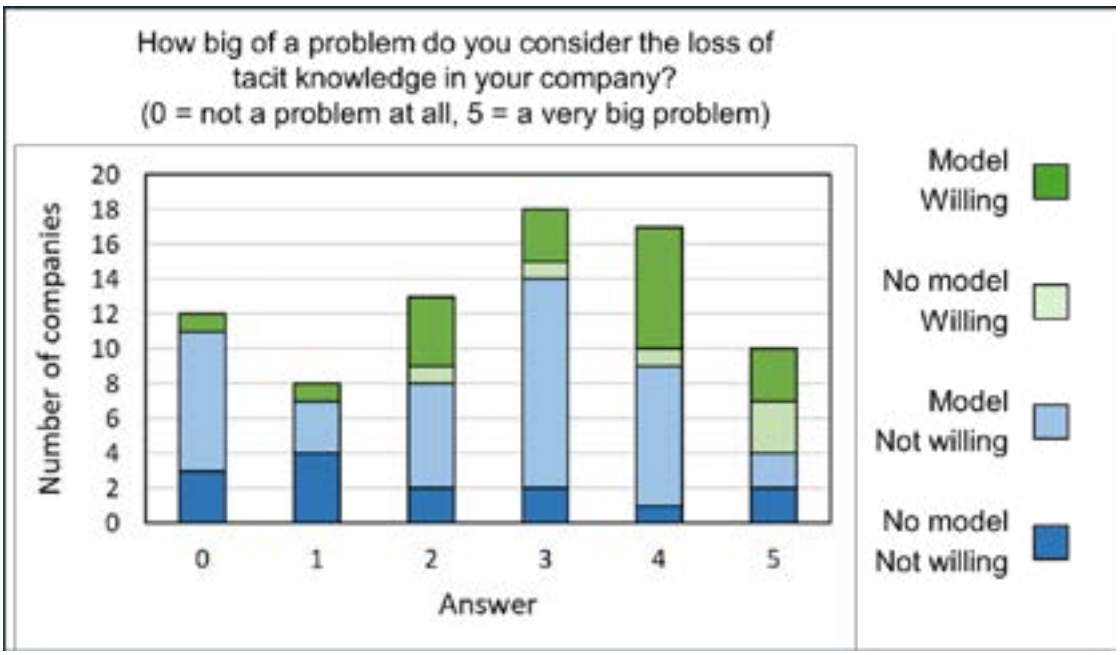

Fig. 1. The answer distribution to the question of the importance of tacit knowledge loss in the company. The companies were asked if they had a model for transferring tacit knowledge and if they were willing to co-develop it with TAMK. N = 78.

The survey results in Fig 1. indicate a substantial recognition among companies of the importance of transferring tacit knowledge, with a significant majority affirming the existence of practices or training models dedicated to this end (58 companies, 74%). This demonstrates a widespread acknowledgment of the risks associated with the loss of tacit knowledge, especially as a skilled workforce approaches retirement. However, it also highlights that a notable proportion of companies have yet to implement systematic approaches to address this issue.

Responses regarding the interest in collaborating on the development of tacit knowledge training with Tampere University of Applied Sciences (TAMK) showcased a divide. While some companies expressed interest (25 companies 32 %), a larger portion appeared reluctant. This hesitancy could be attributed to various factors such as resource constraints, satisfaction with existing training mechanisms, or possible uncertainty about the efficacy of new educational initiatives.

Figure 2 presents a bar graph illustrating the perceived significance of different skill areas for the new workforce. Almost identical results were obtained for the question about the training needs within a company for the near future (1-3 years). Due to the similarity of the results, only this first one is presented here.

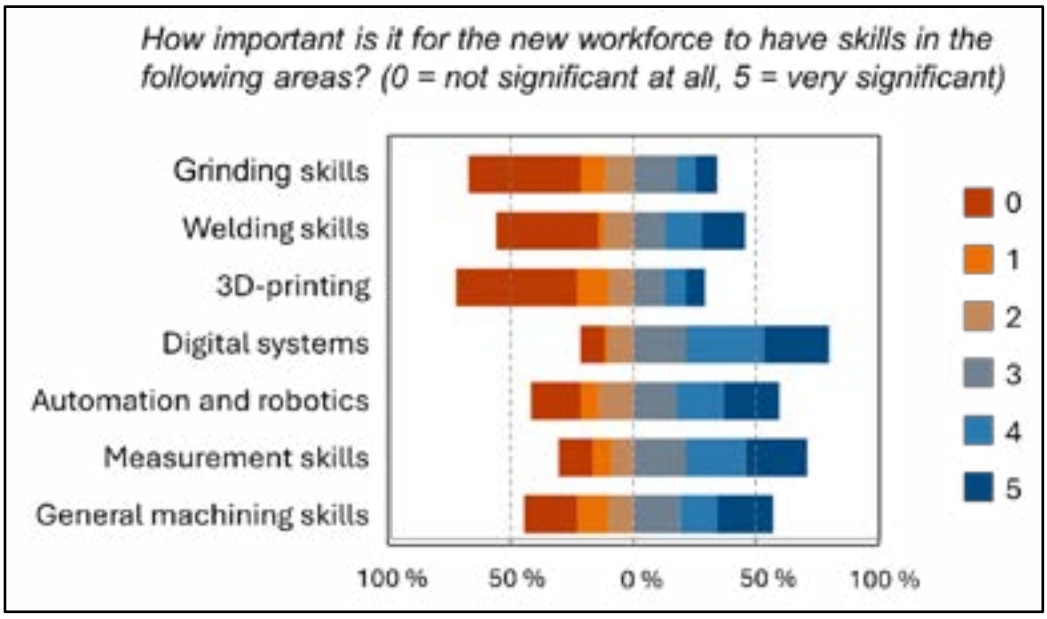

Fig. 2. The answer distribution of the importance of different skills that the new workforce should have. Similar results were obtained also for in-company training needs. N = 78.

Each topic was rated on a 6-point Likert scale from 0 (not significant at all) to 5 (very significant). The data points to a recognition that there is a varying need for training across different technical skills. All topics received answers ranging from 0 to 5. This was to be expected, as the sectors in which the companies operate varied, and thus the needs for skills also varied between companies. On average, companies rated skills such as digital systems and measurement skills as significant for their staff and for new employees, to mention a few. The results help the MA 2.0 project to contact right companies with certain training topics but also tell about which aspects to take into consideration in formal higher education programmes in general.

The companies were also asked about which training delivery methods would suit them. The answers are shown in the figure 3. This horizontal bar graph shows the number of responses for different types of training preferences. The respondents were encouraged to choose all possibly suitable training methods. According to the results in figure 3, online courses are the most preferred training type among the respondents, with supported self-learning as the second. The preference for online courses and supported self-learning among companies likely reflects a broader trend towards flexible and accessible forms of professional development. Online courses offer the convenience of anytime, anywhere learning, which aligns with the busy schedules of working professionals. Supported self-learning, being the second preference, indicates a desire for autonomy in learning, yet with a structure that provides guidance and support when needed. These preferences suggest companies value both the adaptability of online learning environments and the effectiveness of personalized learning pathways in meeting their workforce's ongoing skill development needs.

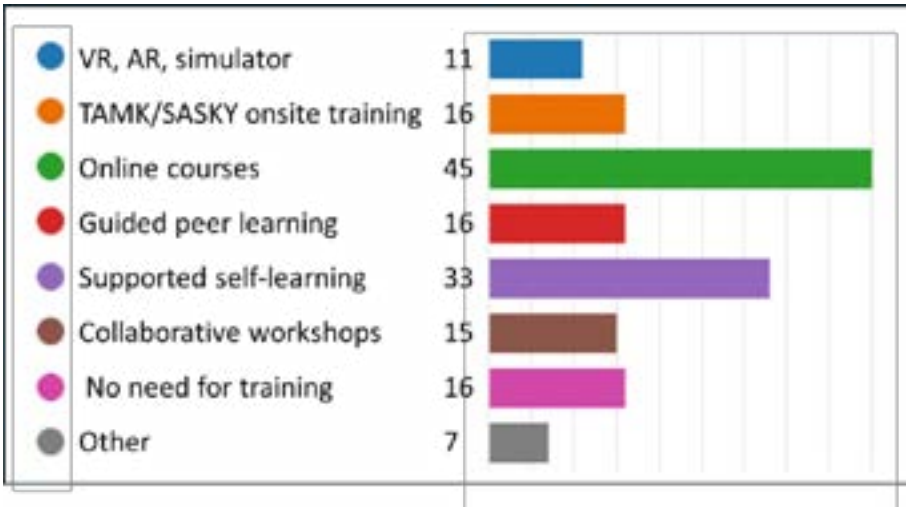

Fig. 3. The preferred training methods.

The traditional training delivery methods, like onsite training (TAMK/SASKY), guided peer learning and collaborative workshops received roughly similar response rates, but they were not as popular as the self-spaced learning options. VR, AR, and simulator trainings, on the other hand, are not considered as so good options. These are of course the state-of-the-art training methods and the reluctance to use them is a bit surprising. The hesitance towards VR, AR, and simulator training might stem from several factors, including the initial high costs and resource requirements for setup and implementation. Additionally, there could be a lack of familiarity or comfort with these advanced technologies within the company's current training ecosystem. This reluctance may also reflect a perceived complexity in integrating such state-of-the-art methods into existing training programs or uncertainty about their effectiveness and return on investment compared to more traditional, less technologically advanced training methods.

5 CONCLUSION

While the readiness to engage with TAMK in developing tacit knowledge training programs varied, the responses highlighted an overall positive disposition towards continuing education initiatives. This indicates a growing recognition of the value of life-long learning and upskilling opportunities, particularly through university and vocational school courses, to maintain a competitive and proficient workforce.

Survey results highlight the importance of retaining valuable tacit knowledge within the industry as technology evolves. The findings indicate varying needs for skills and training across different areas. Self-directed and flexible study methods, such as online learning and guided self-study, seem to best suit the industry's needs. However, there's hesitation in adopting new technologies like VR and AR. The project emphasizes the importance of collaboration between the education and industrial sectors to adapt to labor market changes. More dialogue and cooperation between educational institutions and the industry are needed. As the manufacturing sector progresses, these insights will inform the development of training models that aim to meet both current and future skill needs.

Although these findings were gathered in Finland, the issues of aging and retirement are widespread across the European manufacturing workforce. Consequently, there

is a need for upskilling and reskilling initiatives to preserve critical knowledge and maintain industry competitiveness beyond Finland. By customizing training modules to local industry needs, this approach can be adapted to various contexts, promoting tacit knowledge retention and enhancing competitiveness in companies across Europe.

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