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## Using VR technology in the pre-onboarding of temporary employees in a Norwegian SME

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### Abstract

European industry is currently facing extensive transformations. The well-being of the employees is an essential element in this transition, which is part of what we now call Industry 5.0. A challenge is to find and maintain a balance between human-centered manufacturing and focus on innovation and the implementation of new technology. The purpose of this article is to show how a Norwegian manufacturing industry SME (small and medium-sized business) can use VR (virtual reality) technology to prepare and empower temporary workers, by letting them see and experience a 360-degree video in VR of the assembly tasks even before they show up for their first day at work. A pilot case based on this technology is used as a platform for an immersive experience of 360 video in a pre-onboarding situation in the manufacturing industry company, will be presented in detail. The research is based on a case-study methodology, combined with Interpretive Field Study Research approach. Individual interviews with company management and involved employees (both temporary workers and permanent employees) have been conducted and analyzed.

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### 1. Introduction

Today's industrial workforce is facing a complex and extensive transformation, as it shall adapt in both a digital and a sustainable sense. These transformations are key parts of a major shift known as Industry 5.0, which includes not only technological changes and a greater focus on sustainability in production but implies a high focus on employee well-being and building a resilient workforce. The temporary workforce is a central part of the modern labor market, marking a rising trend [1] in many sectors, including the manufacturing industry. Due to a demand for flexibility, innovation, and resilience on a company level, the need to put in place temporary labor workers

that fast and precisely adopt new tasks and adapt to the work environment is important.

This has fueled concern for the workers' well-being and the long-term effect on attitude and behavior [34] while the short-term perspective and blended workforce can lead to a limiting of coordination, learning, and shared values [29]. A direct consequence of the widespread use of temporary workforce could be a rise in the experience of stress and strain, due to a lowered experience of control and affiliation. With Industry 5.0's focus on the workforce's well-being, supporting temporary employees during the adaption process should be a prioritized task for companies.

Temporary labor may be characterized by a broad diversity in experience, preconceptions, training, and pre-understanding

of the tasks to be performed. Workers may come from different workplace cultures, having different views on everything from how to perform the job, to matters surrounding the job itself, and the differentiation in experience, knowledge, and prepossessions can represent a big challenge for the organization and the management [2]. Newcomers may need time to adapt to new work situations and maximize the efficiency of hiring temporary employees and ensure that the onboarding is thorough and comprehensive, structured training will play a crucial role [3]. Ideally, training of temporary employees should, as far as possible, take place before starting the actual job [4]. Some methods can be used to distribute knowledge and necessary material for training, such as digital solutions, group training, shadowing, etc. [5]. Solutions for knowledge transfer and skills training can be resource-intensive and must be assessed based on cost-benefit and time spent.

This paper argues for the use of 360-degree video and virtual reality technology (VR) in a pre-onboarding situation with examples from a Norwegian SME industrial company. These technologies facilitate experiences in digital environments which are recorded from real life situations. Research have shown that this can augment the learning potential of simulation training [21][22]

The paper attempts to outline some answers to the research question: How to digitalize skills training in a pre-onboarding context, for temporary employees in a manufacturing industrial SME?

The contribution of the paper is a practical description of a case, which can be adapted to other contexts, industries, and sectors to help them build an empowered and resilient workforce. The paper is organized as follows: First, we will briefly review some relevant literature on the topics Industry 5.0, pre-onboarding of temporary employees, and digital pre-onboarding; second, we describe the methods used; third, we discuss the findings from the case in question; and finally, we present some key learnings points for SME industrial companies.

## 2. Theoretical framework

Industry 4.0., was an initiative from Germany that is adopted by several European industries. Even if this classification has not yet permeated the entire industrial sector [6], the European Commission [7] has already announced its successor, Industry 5.0., characterized by the fusion of elements from technology-driven industry (4.0. revolution) with a new principle and terms, focusing on human-centricity, sustainability, and resilience. Industry 5.0 is putting people back in the heart of industrial production and focuses on the collaboration between humans and machines.

In this perspective, technology-driven progress is only a part of the whole picture. This value-shifting attitude towards labor and human resources is trending among European industrial companies, partly thanks to the way the European Union is promoting Industry 5.0 as a central concept in human-centric manufacturing [10]. Since this is unprocessed and in the process of being implemented, there is a need for clarification in future research towards more conventional terms, such as Operator 4.0 [11], and Resilient Operator 5.0. [12].

Learning is a part of human-centric manufacturing, which requires all agents in the factory, including humans and machines to learn [14]. In the manufacturing context, it will be more important to deliver industrial learning and training which will build up “knowledge” workers for the factories of the future [15].

The industrial learning process addresses four parts: attitude, knowledge, skills, and competencies [15]. Different learning methods can help build these four building blocks, like discussions/debates, presentations, case studies, demonstrations, simulations, role plays, etc. [15,16]. Especially when it comes to workforce resilience through temporary employees, companies want well-skilled workers who can work immediately without extra learning. Still, this situation is hardly realistic. Each new employee needs some time to adapt to the new work situation. Due to the purpose of this article, we will briefly introduce skills training (on-the-job training) using demonstrations as learning methods in the pre-onboarding situation to increase temporary employees’ well-being.

“On-the-job training” is a part of the Human Resource Management. Training is typically provided at the workplace, the focus is on familiarization with the working environment, use of machinery, tools, equipment, etc. [17]. The effectiveness of this training is based on the use of existing working equipment and the knowledge of specialists at the workplace. Traditionally training takes place in a classroom, and job location. After the Covid-19 pandemic situation, which supported digital transformation, on-the-job training has moved to digital platforms e.g.: video, e-learning, VR, or other digital tools [18]. “On-the-job training” can be planned as regular training or training in onboarding situations.

Onboarding has several definitions in the literature that relates to how new employees are met and integrated with the organization [9]. Through well-designed onboarding programs, new employees can gain valuable insight into employers’ values, policies, processes, and practices [30]. Making employees psychologically empowered through meaning, feeling of competence, self-determination, and impact, build their intrinsic motivation [8]. This indicates that well-conducted onboarding may have a positive impact on employees’ performance and well-being. Still, research shows that there are shortcomings in the ways workplaces welcome their new employees [13, 9].

One of the lessons learned from the recent global pandemic is that organizations should start their onboarding process just after the contract is signed, to uphold the new employee’s motivation for the position [32]. Disregarding this special situation, digital technologies can play a significant role in pre-onboarding to prepare employees for the new workplace before they meet physically, and this seems extremely important for the temporary workers who will be a part of the organization just for a brief period. So far, most research in the onboarding field focuses on permanent employment[31]. Having in mind the trends for more temporary workers [1], this clearly shows the need to increase our knowledge of how companies can facilitate building empowerment at an early stage for this group to make them perform to the full extent of their capabilities and contribute to a resilient workforce in line with the goal for Industry 5.0.

At a general level, to attain knowledge utilization and learning on various levels in organizations and meet the demands for workforce flexibility within the context of Industry 5.0, there is a need for systems to capture, convey and facilitate the utilization of essential, tacit know-how. Systems using immersive and spatial technology (e.g., VR) could supplement conventional learning based on explicit sources like guidelines, books, and e-learning [21, 22]. Specific features like immersion and presence, make VR suitable for training on tasks and operations, providing features like real-time collaboration, distributed simulation models, and risk-free trial and error in digital environments [22, 24, 26].

This means that pre-onboarding can deliver high value for both individual workers and the company, with minimal use of resources, time, and effort. One can ask whether there are rational reasons for the use of 360 video in VR as a means of introduction to new workplaces and facilities. Why not use conventional 2D video on a computer screen or 360 video on a mobile phone? The technical questions are not crucial for the question of empowerment and well-being. First and foremost, the use of VR as a technology for watching 360 videos lies in the phenomena of "immersion" and "presence". This has to do with a feeling of "being there", due to the enclosed nature of the VR experience. The apparent lack of interaction is in this context not really a "lack", while the main purpose and the desired achievement lies in the experienced rendering and "get to know your surroundings and tasks" experience as a desired outcome.

The former body of research has focused on how knowledge how knowledge transfer assumably can be enhanced by technological means, using VR in a combination with other, explicit sources of information and knowledge [21, 23, 25]. But the research is far from unambiguously positive about VR as a learning tool, and discussions about the purpose, utility, and usability of virtual reality are being raised at regular intervals. There is a general perception that we are now in the "second wave" of VR development and adoption [27]. Even if the technology has been around since the 1960s, it is only in recent years that the hardware has been sufficiently developed and affordable for use in a broad range of businesses and organizations. The gap between the extreme techno-optimists, including some who have already moved in into various forms of "metaverse", and the more sober techno-realists, must be said to never have been larger.

Due to the ambiguity of the research, this project chose a "low concept" approach, using a validated method for distributed simulation training, based on video captures of situations and scenarios with a 360-degree camera [28]. The videos are distributed through a mobile VR interface, using mobile phones and cardboards, and in this specific case, the company's proprietary communication app and YouTube as distribution platforms.

VR is in this context just the technological and viewing platform for the experience, which is provided through a 360 degrees video interface. These two technologies have been combined for soft skills training and simulation through a kind of since the first wave of VR in the 1980s and -90s [21, 27]. To clarify this further; the 360-degree video is the medium, and the VR is the watching device and software provider, just as a television or a computer would do in a more traditional e-learning context. VR and 360-degree video are not, competing,

or successive technologies, but a chosen "package" for the distribution and experience of video-captured simulations for skills training.

### 3. Case Company

The Case Company is an SME with about 40 employees situated at two different locations, approx. 5 km apart from each other. With a variation of products, this calls for a high degree of flexibility in the utilization of resources. With a high focus on the employee's well-being and need for variation, meaning, and mastery in everyday work, this company may be illustrative of Industry 5.0 in the Norwegian SME context.

The manufacturing of aluminum products constitutes the company's core business, e.g., undercarriages for adjustable desks for the office market, as well as the production of multiple socket rods and roller skis. Much of the production is automated and robotized, but still, when assembling the final products, the work is largely based on manpower, especially on the control functions. Their subdivision for roller skis produces for the Norwegian national ski team, for several professional skiers, and for the private market. This production is largely based on technologically advanced production machinery and the company's expertise in the production of other aluminum commodities.

The assembly of roller skis takes place a few kilometers away from the factory facilities, where most of the main parts (axles and frames) are being produced. The premises for inventory, assembly, packaging, and distribution are co-located with the administration and management. Due to the organizational structure, it is easy to communicate across levels and departments in the company. On the other hand, the physical distance between the different facilities has created a need for digital communication tools to strengthen the feeling of cohesion and community, facilitate the flow of information and two-way communication, and not least make quality work an integral part of the work processes. A couple of years ago, the company created its own, customized mobile application that soon replaced the company's conventional intranet. This proprietary application has been the primary channel for distribution of the virtual training material.

Each summer vacation, the company needs to supplement and temporarily replace the permanent employees assembling roller skis. The summer temps are often young people, preferably students, who can work a few weeks to make extra money. In the summer of 2022, three such summer temps were hired, who over 6 weeks would be responsible for the assembly, quality assurance, and packing of roller skis. All three had experience in elite sports and skiing at a high level, but no experience in the manufacturing industry.

The assembly process itself is a task that can be partially performed after reading instructions and procedures, divided into a series of subtasks where much of the knowledge needed is tacit. In this context, it may be crucial to distinguish between tacit and explicit knowledge. An essential question for the company and the management is how the assembly situation itself, with all that it entails of both explicit and tacit knowledge, can be conveyed to inexperienced temporary workers who are neither technicians nor engineers and who are

going to replace the permanent expert team and perform the tasks with the same high-quality measures and the same requirements for results and production efficiency as the ordinary workforce.

#### 4. Methodology

To better understand both the group of permanent employees to be replaced and the temporary workers to replace them for the summer, the research used a case study methodology, combined with an interpretive field study approach. “In short, the use of case studies allows one to examine the knowledge utilization process, and ultimately to recommend and design appropriate policy interventions” [19]. In this case, knowledge utilization is a multiple-step process, as the knowledge being expressed essentially through practice must be captured on video, conveyed, received, adapted, and translated back into practice.

This paper has a three-step research design: (1) preparation of a 360-degree VR video, (2) distribution of the 360-degree video and the VR cardboard to temporary employees, (3) interviews with the company management and involved employees, both temporary and permanent.

The purpose of step (1) was the production of a 360-degree video, introducing the company and a central assembly operation consisting of a series of tasks (the assembly of roller skis). The case describes a situation where the tasks are to be taken care of by temporary workers during the permanent workers' vacation. The video is appr. 15 minutes long, the first 4 minutes introducing the company, and the second part introducing the assembly operation. The video was recorded in the company's facilities, accommodating storage space, assembly premises, and management. Each step was made in collaboration with the director of business development, who is also introducing the company in the video's first part. The purpose of the video was to prepare the temporary employees for what awaits them, which tasks make up the daily work, and convey insights that can be difficult to formulate with explicit means, like written guidelines. This will be elaborated further in subsequent papers, as this kind of conveying practice through an immersive visual interface, may reveal and convey hidden aspects of practice and tacit knowledge. Production time: May 2022; Two days of planning and preparation, one full day of filming and production, and three days of postproduction. Technical tasks were managed by the external health trust partner, within the frames of the R&D project FAbL (Faster Assembly by Learning). Equipment: Insta 360 pro for the recording of the video, camcorder tripod, iPad with software for remote control of the recording, and post-production software.

Step (2) was the distribution of the 360-degree video to the temporary employees. The video was distributed through a dedicated YouTube channel and relayed through the company's proprietary app for internal communication. To make the introduction friendly and inviting, the business manager prepared three boxes, each with a pair of cardboard headsets for use with a mobile phone, a letter of invitation, information about downloading and registering on the internal communication app, and a small chocolate gift. In the letter, the

temporary employees were encouraged to watch the video in VR before the first day of work. Time: June 2022, delivered 3 days before the first workday.

The last step (3) was observations and interviews. One of the authors of this paper has been involved in step (1) as an observer and has also performed interviews with the involved participants. The interviews were conducted in August 2022, when the temporary employees had a few days of practice. Notes have since been transcribed and analyzed. Time: Primo/medio August 2022.

#### 5. Results and discussion

Due to the company's participation in project FAbL, the employees were familiar with VR technology. Representatives from the management and the workforce had also been participating in several workshops to map the needs for learning and skills training, formulate ideas and concepts, and outline possible pilots for the use of VR for specific training contexts in the participating companies. Due to this preparatory effort, and thanks to great interest among the participating managers for such innovative solutions, there was already established a basic interest in the development and practical use of new technology in the pre-onboarding situation for temporary workers. The manager for business and innovation is a proactive person, putting a lot of effort into the development of new and resilient solutions to adapt the business to the ever-changing world of technology and novelties. The final pilot production was a 360-degree video showing both a working environment with a series of tasks and a presentation of the company performed by the business manager, to be watched and experienced through a VR interface. The video was produced by technicians employed at the health trust partner in project FAbL participating through all phases of the pilot production, from the idea and concept stage to a fully developed pilot draft, filming, and post-production. All costs have been covered by the publicly funded FAbL project. Some minor additional costs, such as the purchase of 3 cardboard VR headsets, were covered by the company.

This low-cost and low-concept use of VR technology based on 360-degree video and the most affordable gear possible – cheap cardboard VR, YouTube, and the employees' own mobile phones – illustrates that low-hanging and technologically inexpensive solutions may be sufficient for the preparation and pre-onboarding of temporary employees, helping them to understand the basic environment, the context, and tasks simply through looking at situations in an enclosed virtual space. While 360 video is still just 2D, it encapsules the user in a spatial environment, immersing them in a spatial, learning environment. This may indicate, but more research is needed here, that far more advanced, and expensive VR simulation solutions can be a waste of time and money in similar contexts. This combination of technologies also has a solid foothold in a variety of fields where VR has been used in simulation training for decades: "As well, the growing popularity of panoramic 360-degree cameras and photogrammetry has provided an affordable means to create photorealistic content for VR applications. Although expectations of computer graphics have also increased steadily, especially with a younger generation that has grown up with

computer and console games and may be put off by low-quality graphics, perceptually convincing VR scenarios are now more the norm than the exception in current VR development." [35]

The temporary employees could watch the video from the workplace three days in advance of their first day at work. This means they got the opportunity to see, experience, mentally prepare and make up their mind about the company and the tasks. Their responses indicate that the temporary workers saw a clear benefit in the intervention, but this requires further data collection to determine whether this is significant for the quality and effectiveness of work performed: "*Seeing the work situation before entering the job was an advantage. We were able to prepare ourselves differently than if we had only received a welcome letter and written descriptions*". Responses like this could signal that such interventions can be interpreted as a significant element in human-centric manufacturing and well-being.

The permanent employees participating in the preparatory work on the production of the 360-degree video were challenged to show clearly and unambiguous how they are performing the assembly and the other tasks assigned to them. They are mostly used to working with their hands, and it could be a bit challenging to describe and present what they do, and how they perform their practice: "*The summer interns have to do this according to procedures, but mostly, we do this on autopilot and based on incorporated skills. It can certainly be useful for the new ones to see how we do it before they start assembling and packing the roller skis*", they said about their visual knowledge sharing with new coming workers.

The company has placed great emphasis on ensuring that new employees are prepared for work. This is based on management's desire not only to perform the job safely, precisely, and efficiently, but also on values based on Industry 5.0, such as empowerment, well-being, and resilience. This is reflected in the commitment to the pre-onboarding situation, showing a deep interest in the temporary workers, that they should feel a sense of mastery and experience that they have a real value for the company and the production: "*In the management, we have been positively surprised of how these young and unexperienced employees managed the series of tasks. We are sure they will perform at a high level, but this video and the VR stunt could make them more prepared, while they will get a more realistic understanding of the tasks and what is expected from them. The management has no prior experience with this kind of virtual pre-onboarding, and we will surely try again*", says the business developer in the company.

It is important to note that this pilot project was aiming at a very narrow target, that is, to demonstrate how VR and 360 video can be used to empower temporary workers in a pre-onboarding context. While the employees' and the manager's responses were positive and promising, there is also research showing that the significant lack of physicality, haptic solutions, tactility, and sensory stimuli like real-world sounds, noises, smells, etc., could mean that VR training may be far less effective than many certain promoters, especially VR equipment manufacturers and their front-runners in the consulting industry have claimed.

## 6. Conclusion

Recent literature on the use of digital tools in onboarding situations tends to focus on quality management and basic knowledge about the companies or organizations to be studied. There is a far less frequent focus on the use of digital technology in pre-onboarding situations, and in "on-the-job training" in industrial SMEs. According to our experience, the following variables are supporting this case: The participation in the research project FABL, and the management's interest and engagement in the development and use of the innovative application. Another takeaway from this case is that these variables should not limit other industrial SMEs to try this kind of "on-the-job training". We see a value in letting temporary employees undergo a virtual preparation for the actual job situation, showing specific operations and tasks. This can help SMEs to meet the demands for well-being, resilience, and empowerment for employees within the frame of Industry 5.0., defining a human-centric manufacturing concept where employees are more an investment than a cost. Further research should pay attention to how different digital tools can be helpful to enhance empowerment and skills for temporary workers through well-designed pre-onboarding.

Regarding certain technological characteristics, we have scarce knowledge: "Very few papers have been found that contain useful information relating to such basic issues as the appropriateness of 2D versus 2.5D versus 3D [...] for complex and dynamic visualization applications." [33] There is a need for more research on issues spanning from technology and human interaction, to learning outcomes and knowledge transfer in the use of VR and 360 video on pre-onboarding and skills instruction to ensure resilience in the workforce.

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