Digital Work Instructions in Sheltered Workshops

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Abstract: This research-in-progress explores the impact of digital work instructions (DWI) in sheltered workshops, environments designed to provide employment opportunities for individuals with disabilities. The research commenced with a literature review on studies that compared digital to paper-based instructions. The review highlighted several potential benefits of DWI. Next, semi-structured interviews were conducted with C-level managers of sheltered workshops who are early adopters of DWI technologies. The interview findings provided real-world insights into the application of DWI in sheltered workshops, confirming several benefits identified in the literature. Notably, enhancements were observed in rapid interpretation of instructions, reduced training duration, increased employee autonomy, fewer execution errors, and a diminished need for prior knowledge. Future research steps include a second round of semi-structured interviews and a focus group to validate and synthesize the findings.

Keywords: Digital work instructions, Sheltered workshops, Disabled workers, Assembly processes

1. Introduction

Incorporating individuals with disabilities into meaningful and productive employment remains critical, yet challenging due to diverse impairments. Sheltered workshops play a pivotal role in facilitating this inclusion by customizing work processes tailored to individual needs and capabilities. Such setups help balance productivity with inclusivity, addressing the specific needs of disabled workers to foster their participation in the workforce (Bächler & Behrendt 2023).

In recent times, the complexity of assembly processes in manufacturing has escalated significantly due to the trend toward mass customization (Leder et al. 2023), a challenge that also extends to sheltered workshops. Therefore, the demand for context-aware assistance systems has surged. These systems are crucial in offering cognitive support and guiding workers through their tasks, improving workflow efficiency. Traditional paper-based instructions often create a complicated correlation between directions and actions. By adopting digital work instructions (DWI), these challenges can be significantly alleviated, simplifying processes and enhancing productivity (Pimminger, Neumayr, Panholzer, Augstein & Kurschl 2020).

This work-in-progress reports on the preliminary findings of a DWI project in Flanders, Belgium. The research investigates DWI in sheltered workshops and compares them to their paper-based counterparts. It concerns a comprehensive project that is funded by Flanders Innovation and Entrepreneurship, consisting of several work packages and objectives. The project focuses on a technology scan, DWI competencies for individuals with disabilities, experimental setups, and implementation strategies. The present paper discusses the implementation and implications at the organizational level. An in-depth discussion of the available technologies, effects at the individual level, and experimental results is out of scope.

This research project contributes to the exploration of the multifaceted impacts of digital innovation. More concretely, DWI can be analyzed within the framework of the Triple Bottom Line (TBL) (Elkington 1999), including economic, social, and environmental sustainability. Economically, the project investigates how DWI can streamline manufacturing processes, potentially reducing production times, decreasing costs, and enhancing output, thereby improving overall operational efficiency. Socially, the focus is on the implementation of these digital systems in sheltered workshops, examining their role in creating meaningful and economically beneficial employment opportunities for individuals with disabilities. Environmentally, the research extends beyond the mere reduction of paper use. It can uncover how DWI can lead to more

sustainable practices by pinpointing and diminishing inefficiencies in the consumption of energy, water, and raw materials, thereby fostering a smaller ecological footprint.

2. Methods

We aim to explore the employment of DWI within sheltered workshops. To the best of our knowledge, this area has received limited academic attention. To address this gap, we will employ a multi-faceted approach, beginning with a literature review. Because we are not aware of research on DWI in sheltered workshops, academic publications on DWI in mainstream industries will serve as a foundational framework. The rationale is that insights from experiments conducted within regular companies might offer valuable perspectives for the applications and benefits of DWI within sheltered workshops.

To further enrich our understanding of DWI implementation and its effects, we will proceed with semi-structured interviews. This first round of interviews targets early adopters which we define as sheltered workshops that currently have operational activities relying on DWI. As these sheltered workshops have experience with DWI, it will allow us to validate and corroborate the findings obtained from the literature review. Moreover, we might also capture insights and perspectives that extend beyond the scope of existing academic literature.

Next, we will proceed with a second round of semi-structured interviews targeting sheltered workplaces that are participating in the experiments within this research project. Distinguishing them from the first group, these workplaces have not yet commenced operational activities with DWI. Instead, their experience is solely based on their participation in experimental trials. Despite not having operational activities with DWI, we posit that their engagement in the experiments equips them with valuable insights and perspectives regarding the implementation and potential effects.

Finally, we will convene a focus group as the final step of our methodology. Building upon the insights gleaned from the literature review and the semi-structured interviews with two groups of sheltered workplaces (i.e., respectively operational experience and experimental experience), the focus group serves as a platform for comprehensive validation and synthesis of our research findings.

3. Preliminary Findings

This research-in-progress includes the literature review and the first round of semi-structured interviews. The second round of semi-structured interviews and the focus group were not completed yet.

3.1 Literature Review

A literature review was conducted to assess the impact of DWI as compared to traditional paper-based methods. Utilizing the SCOPUS database, a targeted search was performed using the term "digital work instructions", yielding 36 scientific studies. Conforming the research objective, only those studies that explicitly compared digital and paper-based work instructions were included. This refinement process led to the exclusion of 28 studies, resulting in a core set of eight academic contributions. Notably, all identified studies were conducted within the regular economy; none were carried out in sheltered workshops. The technologies deployed in these studies varied, including AR headsets, AR projections, touchscreens, and monitors. They focused predominantly on assembly tasks across diverse industries such as machinery, automotive, and aerospace. Each study was examined to extract the potential effects of DWI. The findings are synthesized in Table 1, which lists the effects identified from each article. For each study, the observed effects are indicated with an “X”. The absence of an "X" does not necessarily imply the contrary; it could simply indicate that the potential effect was beyond the scope of the study.

Table 1: Effects of DWI compared to paper-based instructions identified in academic literature

	(Gors et al. 2021)	(Leder et al. 2023)	(Li et al. 2018)	(Lotsaris et al. 2021)	(Papetti et al. 2023)	(Pimminger et al. 2020)	(Yang et al. 2023)	(Zogopoulos et al. 2022)
Accelerated creation of instructions	X							
Enhanced adherence to instructions						X		
Accelerated execution				X	X	X	X	
Improved user experience				X	X			
Accelerated interpretation							X	
Improved retention							X	
Accelerated training processes		X				X		
More objective training		X				X		
Facilitated management of diverse production			X					
Reduced perceived workload			X					
Increased employee autonomy	X							X
Reduction in execution errors	X			X	X			X
Enhanced employee confidence				X				
Reduced requirement for prior knowledge	X							X

3.2 Semi-Structured Interviews (Round 1)

Following the literature review, a series of semi-structured interviews were conducted to investigate the applicability of DWI effects observed in the regular economy to sheltered workshops. For the initial round, C-level managers of sheltered workshops in Flanders recognized as early adopters of DWI were targeted. These individuals were identified through a LinkedIn search, resulting in 24 potential candidates. Of these, invitations were sent, and eight interviews were successfully conducted. The interview protocol was designed to ensure comprehensive data collection, including items such as the introduction of the study's purpose, background questions to establish the context of each sheltered workshop, specific questions about the use and impacts of DWI, and open-ended questions allowing respondents to elaborate on their experiences. Rather than systematically reviewing the list of DWI effects identified in the literature, participants were asked to discuss the effects they had observed within their own operations. Conducted in Dutch, these interviews were recorded and transcribed using Microsoft Teams, and the transcripts were subsequently analyzed using Nvivo to compare against the DWI effects outlined in the literature review. The findings from this analysis are presented in Table 2. For each interviewee, the observed effects are indicated with an “X”. The absence of an "X" does not necessarily imply the contrary.

Table 2: Effects of DWI compared to paper-based instructions identified in sheltered workshops

	Interviewee 1	Interviewee 2	Interviewee 3	Interviewee 4	Interviewee 5	Interviewee 6	Interviewee 7	Interviewee 8
Accelerated creation of instructions								
Enhanced adherence to instructions								
Accelerated execution	X		X	X	X	X	X	
Improved user experience								

	Interviewee 1	Interviewee 2	Interviewee 3	Interviewee 4	Interviewee 5	Interviewee 6	Interviewee 7	Interviewee 8
Accelerated interpretation	X	X	X			X	X	X
Improved retention								
Accelerated training processes	X	X		X	X		X	X
More objective training								
Facilitated management of diverse production								
Reduced perceived workload								
Increased employee autonomy	X	X	X	X		X	X	X
Reduction in execution errors	X		X	X	X	X	X	X
Enhanced employee confidence								
Reduced requirement for prior knowledge	X	X		X	X	X	X	

4. Preliminary Discussion

The C-level managers observed several key effects of DWI that align with the academic literature, albeit within the unique context of sheltered workplaces. Firstly, accelerated interpretation and execution was highlighted, with managers noting a marked decrease in the time required for employees to understand and carry out the instructions. Secondly, the accelerated training processes effect was evident, as managers observed that DWI significantly shortened the training period, enhancing the speed of skill acquisition among new employees. This is particularly beneficial in sheltered workshops where varying capabilities may necessitate more dynamic training approaches. Additionally, an increase in employee autonomy was noted, suggesting that DWI empowers employees by providing them with the tools to manage their tasks more independently. This empowerment is linked to the reduction in execution errors, another effect managers observed. This underscores the precision and reliability that DWI brings to task execution. Finally, the managers recognized a reduced requirement for prior knowledge, indicating that DWI allows employees to perform tasks with less dependence on pre-existing knowledge. This is an important finding as it might broaden the scope of tasks the employees can undertake.

It is important to acknowledge that some effects highlighted in the literature did not surface in discussions with C-level managers. This discrepancy may arise because certain effects are less apparent in real-world settings as opposed to controlled experimental environments. Effects such as "improved retention," "reduced perceived workload," and "enhanced employee confidence" exemplify this possibility. Additional research is necessary to further explore and clarify these observations.

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