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## THE LEAN 4.0 WORKSHOP: AN OVERVIEW

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### Abstract

In today's industrial landscape, companies must enhance operational efficiency, productivity, and sustainability while integrating traditional Lean manufacturing principles with Industry 4.0 technologies like IoT, AI, and data analytics. Despite the potential benefits, there is a significant gap in understanding and implementing Lean 4.0. The Lean 4.0 Workshop aims to provide a comprehensive and practical understanding of how Lean principles can be integrated with Industry 4.0 technologies to enhance industrial performance and sustainability. The event, held at Pusat Industri Digital (PID) 4.0, attracted representatives from many notable companies. This paper focuses on the benefits this event provides to the community. The workshop presentations disseminate ongoing research as well as theoretical and practical concepts in various areas of Lean 4.0. The exhibition of industrial tools and processes allows participants to become more familiar with advanced technologies and their practical applications. Considering the event's performance, the Lean 4.0 workshop was a success, with over 80 participants showing great interest and actively participating, along with effective and efficient knowledge sharing. Based on the satisfaction survey, 42.9% of respondents were very satisfied with the workshop, and 64.3% found it met their expectations, though not to the fullest extent.

**Keywords:** Lean 4.0, Workshop, Sustainability, Industrial Performance, Satisfaction Survey

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### INTRODUCTION

In today's swiftly changing industrial environment, companies are under significant pressure to improve operational efficiency, productivity, and sustainability. Lean is a manufacturing approach focused on minimizing waste and enhancing efficiency within the production process. Originating in the 1950s, Lean is a widely adopted management philosophy that revolves around "respect for people" and process improvement (Ohno, 2019). The primary objective of Lean is to reduce waste across all production areas, including overproduction, waiting times,

defects, unnecessary processing, excess inventory, unnecessary motion, and the underutilization of employees (Liker & Meier, 2007; Womack et al., 2007). By targeting waste elimination, Lean helps lower production costs, enhance product quality, and reduce lead times (Ciano et al., 2021).

Currently, Lean and Six Sigma are among the most widely adopted continuous improvement strategies in both the industrial and service sectors (Bhuiyan et al., 2006; Citybabu & Yamini, 2024). The integration of Lean and Six Sigma is essential because Lean alone cannot achieve statistical process control, while Six Sigma on its own cannot significantly enhance process speed or reduce

capital expenditure (Bhat & Jnanesh, 2014; Gleeson et al., 2019). Both methodologies share common principles and objectives, particularly in their commitment to customer satisfaction. Lean Six Sigma enhances customer value by minimizing defects and waste, thus optimizing the value stream and improving product delivery times (Vicente et al., 2024). By adopting Lean Six Sigma, organizations can refine their business strategies to develop a flexible and effective system, maintaining a competitive edge (Sony, 2019).

Since 2011, the manufacturing industry has experienced the rise of Industry 4.0, characterized by the integration of digital technologies into production processes. This technology-driven paradigm, introduced by the German government, aims to incorporate technological advancements into the manufacturing sector (Osterrieder et al., 2020). Industry 4.0 envisions the factory of the future, where various resources are interconnected in real-time, aware of their environment, and capable of adapting to changes in the process (Jerman et al., 2020). A key feature of Industry 4.0 is the Cyber-Physical System (CPS), which links the physical and virtual worlds and employs a distributed control system (Trappey et al., 2011). Today, Industry 4.0 is regarded as a new paradigm that connects people, machines, and processes within evolving operational frameworks and distributed management systems (Bartoloni et al., 2022).

The emergence of Industry 4.0 technologies, including IoT, AI, and data analytics, offers both opportunities and challenges in integrating these advancements with traditional Lean methodologies. While both Lean and Industry 4.0 aim to enhance productivity, their strategies differ. Lean emphasizes continuous improvement and leveraging human creativity to streamline processes and eliminate waste. It adheres to principles such as Just-In-Time (JIT), Kanban, and Pull production systems (Hossain, 2024). Implementing these systems requires harnessing human creativity to design efficient workflows, optimize resource use, and foster innovation throughout the organization (Lu, 2017; Mayr et al., 2018; Tortorella & Fettermann, 2018). Conversely, Industry 4.0 focuses on the strategic use of

advanced technologies to drive productivity gains (Cheng et al., 2016; Kamble et al., 2020; Sony, 2018). Buer et al., (2018) developed a conceptual model illustrating a supportive bidirectional relationship between Industry 4.0 and Lean, indicating that their combined application can enhance performance with a focus on environmental factors. However, this interaction was explained at a conceptual level and did not detail the interplay between the core principles of the two paradigms.

Despite the potential benefits, there remains a considerable gap in understanding and implementing Lean 4.0, which combines traditional Lean manufacturing principles with Industry 4.0 technologies to optimize processes, reduce waste, and enhance overall efficiency. Lean 4.0 serves as an umbrella term for various digital Lean concepts such as JIT 4.0, TPM 4.0, Heijunka 4.0, Kanban 4.0, Poka-yoke 4.0, SMED 4.0, Andon 4.0, VSM 4.0, and visual management 4.0, among others (Anbessia & Singh, 2024). According to Küpper et al., (2017), manufacturers who successfully integrate Lean and Industry 4.0 can reduce conversion costs by up to 40% within five to ten years, significantly outperforming the reductions achieved through the independent deployment of either Lean or Industry 4.0. Figure 1 illustrates the Lean 4.0 concept.



Figure 1. Lean 4.0 concept (Javaid et al., 2022)

This paper explores the outcomes of the Lean 4.0 Workshop held at Pusat Industri Digital (PID) 4.0, focusing on how this event bridges the gap and benefits the community by promoting the integration of Lean principles with Industry 4.0. The workshop had several key objectives: to bust

the misconception about Industrial Engineering and Industry 4.0, to provide participants with knowledge about Lean 4.0 and its implementation for performance improvement, to raise awareness about the importance of utilizing Industry 4.0 technology for enhancing efficiency and productivity, and to highlight the versatile applications of Industry 4.0 technologies. Additionally, the workshop emphasized that digital competence is essential for Industry 4.0, which is attainable not just through IT disciplines but also from fields like Industrial Engineering. The workshop aimed to provide participants with a comprehensive understanding of Lean 4.0 and its practical applications, thereby fostering the adoption of innovative practices that improve industrial performance and sustainability. Figure 2 exhibits the building appearance of PIDI 4.0.



Figure 2. Building appearance of PIDI 4.0 (BDI, 2021)

## METHOD

The planning phase of the Lean 4.0 Workshop began with the creation of an informative and visually appealing e-flyer that highlighted the workshop's topics and agenda. This e-flyer, along with online registration forms, was distributed to all industrial partners of PIDI 4.0 and Swiss German University (SGU) to ensure broad participation. The workshop was promoted through various online channels such as social media, email campaigns, and WhatsApp messages to reach a wider audience. Interested participants were required to fill out the registration form, providing details about their professional background and expectations from the

workshop. Participants were selected based on their roles in their respective organizations and their potential to benefit from and contribute to the workshop. Figures 2 and 3 show the e-flyer and short invitation for the Lean 4.0 Workshop, respectively.

Table 1. Schedule timeline for Lean 4.0 Workshop

Activities	2024					
	01	02	03	04	05	06
Preparation of event	■	■				
Promotions and invitation to industry participants	■	■	■			
Execution			5 <sup>th</sup>			
Article development for press release			■	■		
After-event publicity through online media				■	■	
Reporting					■	■

The planning phase also included a detailed time schedule for the event, as shown in Table 1. This schedule comprised several stages: preparation of the event, promotion and invitation to industry participants, execution, article development for press release, after-event publicity through online media, and reporting.

During the workshop implementation, which took place on the 8th floor of Pusat Industri Digital Indonesia (PIDI) 4.0, on 5 March 2024, starting at 10:15 AM and concluding at 4:05 PM, lecturers from the Industrial Engineering Study Program (IE-SGU) delivered a series of presentations. These presentations disseminated ongoing research and covered both theoretical and practical concepts related to Lean 4.0. To engage participants and encourage active participation, the presentations included interactive elements such as Q&A sessions. Additionally, various advanced industrial tools and processes were exhibited by the industrial partner PT. AWASIN. This exhibition

provided participants with hands-on experience, allowing them to see practical applications of Industry 4.0 technologies firsthand.



Figure 3. E-flyer of the Lean 4.0 Workshop



Figure 4. Short invitation of Lean 4.0 Workshop

At the end of the workshop, online satisfaction surveys were distributed to gather participant feedback on various aspects of the event.

The survey addressed multiple factors, including the location of participants' workplaces, the modes of transportation they used to reach PIDI 4.0, and how they obtained information about the workshop. Participants were also asked about their reasons for joining the workshop, whether the workshop material met their expectations, and what aspects could be improved to enhance their satisfaction. Additionally, the survey inquired whether the speakers should have a better grasp of the material, if the number of speakers should be increased, if the duration of each speaker's presentation should be extended, if timeliness should be improved, if the teaching materials should be deepened, if the internet connection should be improved, and if more time should be allocated for trying out examples of calculations and programs. The collected data was meticulously analyzed to assess the workshop's effectiveness and identify areas for improvement. Figure 5 shows a snapshot of the satisfaction survey form.

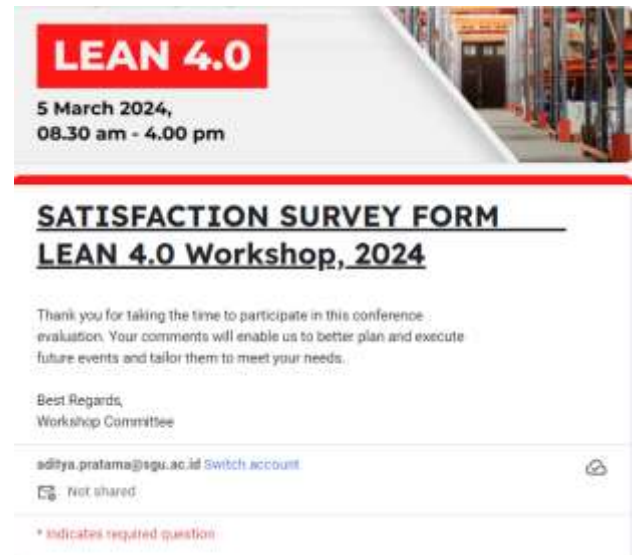


Figure 5. Snapshot of online satisfaction survey form for Lean 4.0 Workshop

## RESULT AND DISCUSSION

The Lean 4.0 Workshop was a significant success, attracting over 90 participants from various

notable companies, with a majority hailing from the apparel industry. The participants showed great interest and actively engaged in the workshop activities. The workshop covered a range of topics, including an Introduction to Lean 4.0, Economic Analysis for New Technology Investment, Quality and Reliability Management, Data Analytics for Optimization, and an Equipment Demo for supporting Lean 4.0. Figure 6 shows the documentation of the event.

Participants gained a comprehensive understanding of how Lean principles can be integrated with Industry 4.0 technologies to improve industrial performance and sustainability. The exhibition of advanced industrial tools and processes allowed participants to see practical applications of Industry 4.0 technologies, effectively bridging the gap between theory and practice. According to the satisfaction survey, most of the participants came from the Serang, Banten area, representing 57.1%, with 42.9% of respondents using their own vehicles to reach the venue at PIDI 4.0. In addition, the primary reason for attending the event was assignments from their companies (64.3%).

Regarding workshop content, 64.3% of participants expressed a desire for more in-depth material, indicating that while the content was valuable, there is room for deeper exploration of the topics covered. Furthermore, 50% of respondents mentioned the need for better internet connectivity, suggesting that enhancing this aspect could significantly improve the overall experience for future workshops. Despite these areas for improvement, 42.9% of respondents were very satisfied with the workshop, and 64.3% felt the workshop met their expectations, though not to the fullest extent. These insights will be crucial for planning and refining future events to better meet participant needs and expectations.

The feedback from the event highlighted several areas for improvement. Participants noted that the material was too theoretical and suggested it should be tailored to better suit practitioners. They recommended providing examples for the implementation of Lean 4.0 and preparing materials specific to different factory sectors to make the content more relevant.



Figure 6. Documentation of the event

Additionally, there were issues with the visibility of the projector screen and the audibility of the presentations in the back of the room; adding monitors and speakers at the back was suggested. Lastly, participants expressed a desire for more

booths with prototypes and demos to enhance visual understanding. This feedback highlights the workshop's effectiveness in knowledge dissemination and participant engagement.

The Lean 4.0 Workshop, hosted by the Industrial Engineering Department of Swiss German University at Pusat Industri Digital Indonesia (PIDI) 4.0, received significant media coverage, demonstrating the event's impact and outreach. Articles highlighting the workshop were published on several prominent platforms. The Swiss German University website detailed the workshop's success in attracting participants from various renowned manufacturers (SGU, 2024). Additionally, the PIDI 4.0 website featured a report on the workshop's launch, training activities, and the signing of a Memorandum of Understanding (MoU) between BPSDMI and Industries (PIDI4.0, 2024). National media outlets such as Tribun News, Medcom, and Warta Kota also covered the event, emphasizing its role in promoting productivity in the manufacturing industry and supporting the implementation of Lean 4.0 in Indonesia (medcom.id, 2024; Sabran, 2024; Triajmojo, 2024). This widespread publicity underscores the workshop's significance in advancing digital competencies and industrial performance.

## CONCLUSION

The Lean 4.0 Workshop successfully addressed the gap in understanding and implementing Lean 4.0 by providing participants with both theoretical knowledge and practical exposure to advanced Industry 4.0 technologies. The positive feedback and active participation underscore the workshop's impact on enhancing operational efficiency, productivity, and sustainability in the industrial sector. Continued efforts to conduct such workshops will be crucial in promoting the widespread adoption of Lean 4.0 principles, ultimately leading to more competitive and resilient industrial operations.

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