Value assessment of cloud manufacturing for largescale manufacturing organizations

An exploratory study of the value, impact and barriers to implementation of cloud manufacturing

Simon Dalbom & Victor Willners

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Faculty of Engineering LTH
Lund University

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During the 21st century, the information technology (IT) industry has expanded rapidly and brought new digital solutions to manufacturing organizations, changing how they operate and conduct business (Faynberg et al., 2016). One exciting new solution is cloud manufacturing, a concept that connects cloud computing and the Industrial Internet of Things. Whether to implement these solutions and, if so, how to use them, are critical strategic decisions for many companies. The question is, therefore, what value does cloud manufacturing bring organizations, and what barriers to adoption currently exist for manufacturing companies?

Background

Digitalization has been an ever-increasing trend in companies, and investments in digital transformation are increasing (Lohr, 2023; Wang et al., 2022). Hot topics in recent years include Industry 4.0, and artificial intelligence (Lohr, 2023). Industry 4.0 technologies are highly relevant for companies today due to their potential impact on an organization, such as production processes and new product offers (Dalenogare et al., 2018).
One technology that falls under the Industry 4.0 umbrella is cloud manufacturing (CMfg), a concept that connects two technologies, cloud computing and Industrial Internet of Things. Cloud computing refers to the technologies used to handle data within the cloud. Industrial Internet of Things concerns the digitalization of machines used in the manufacturing industry by installing sensors and other devices to gather data, operate machines, and improve processes (Haghnegahdar et al., 2022). The Industrial Internet of Things connects the physical systems within the manufacturing process through smart devices, such as sensors, to a network from

which it can communicate with digital systems (Jeschke et al., 2017). When the physical system is digitalized through the Industrial Internet of Things and connected to the cloud, cloud manufacturing is born, and new avenues to improve various processes are opened.

The study

The purpose of this study is to assess the value the cloud manufacturing solutions can offer large-scale manufacturing organizations. The aim is to understand the motivations for implementing cloud manufacturing solutions, the barriers such implementations, and what manufacturers aim to achieve with digital solutions in the future. The thesis project is conducted by interviewing two manufacturing companies and contextualizing their cloud manufacturing experience through insights gathered from the interviews and literature.

Value of CMfg applications

Cloud manufacturing is overall found to provide benefits in terms of cost savings, improved data accessibility, increased efficiency, and higher resource utilization, as seen in Figure 1.

	Cloud Computing	IIoT			
		Environment Mapping	Process Optimization	Planning Optimization	Process Automation
Costs	X	-	X	X	-
Accessibility	X	X	-	-	-
Efficiency	-	X	X	X	X
Utilization	-	X	X	-	-

Figure 1. Benefits of CMfg (authors)

Although cloud computing and IIoT are separate technologies and not dependent on each other, synergies have been identified from integrating the two technologies. One example of this is that a cloud platform enables companies to have better access to their data, and the usage of IIoT, through sensors, enables companies to standardize what data is measured, thus increasing their ability to compare data between different factories.

Barriers to implementing CMfg

The key barriers that are identified from the analysis are network infrastructure, adequate skills, data management, investment requirements, and performance, as seen in Figure 2.

	Cloud Computing	IIoT			
		Environment Mapping	Process Optimization	Planning Optimization	Process Automation
Network Infrastructure	X	X	X	X	X
Uncertainty of Economic Benefits	-	-	-	X	-
Adequate Skills	X	X	-	X	-
Value-Chain Integration	-	-	-	X	-
Security	X	-	-	-	-
Data Management	-	X	X	X	-
Investment Requirements	-	X	X	X	X
Performance	X	-	X	-	X
Resistance to Change	-	-	-	X	X

Figure 2. Barriers to implementing CMfg (authors)

The barrier that affects most applications of CMfg is network infrastructure. Without the proper facilities and resources, it is difficult to implement and utilize any of the applications. Additionally, investment requirements are identified as a barrier. The cost in terms of both time and money will need to be reduced in order for these applications to be adopted. The real-time performance of implemented solutions is also a barrier to multiple applications. It is observed that latency issues have been a factor that has decreased the willingness to adopt CMfg. Such technical problems will

need to be solved to increase the adoption of CMfg.

Conclusion

The findings of the thesis project provide valuable knowledge to primarily three actors: academics, manufacturing companies, and suppliers of cloud computing and the IIoT solutions. To academics, the project combines previous research on CMfg with the experiences of two case companies which provides a real-life perspective on theory. Furthermore, the project highlights important aspects to consider for manufacturing companies, such as the trade-off between security and accessibility, and what impacts the cost benefits of cloud migration. Lastly, the barriers to implementation identified can provide suppliers with important insights into how to package and improve their services to meet demands and secure further success within the field.

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