



Organizational Learning, Knowledge Management, Dynamic Capability, Innovation Capability, Industry 4.0 Implementation and Firm Performance

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Abstract. Today, we stand on the brink of a technological revolution, also known as the Fourth Industrial Revolution, or Industry 4.0 (I4.0), which represents a comprehensive technological development within all industries. Industry 4.0 consists of key pillars, such as artificial intelligence, machine learning, cloud computing, big data analysis as well as augmented reality and virtual reality. Because of the impact that earlier industrial revolutions had on organizations, it can be said that I4.0 also will bring changes in organization with regards to work and tasks. The findings concluded that Industry 4.0 implementation in the manufacturing industry in Indonesia cannot be facilitated without organizational learning, knowledge management, and dynamic capability, as well as innovation capability. Dynamic capabilities ignite organizations to be aware of the changes within their surroundings with customers' preferences changing daily, companies need to be able to sense, seize, and manage their threats in order to remain competitive. Thus, this study aims to outline the impact of organizational learning, knowledge management, dynamic capability, innovation capability and firm performance in the implementation of industry 4.0 in the manufacturing industry.

Keywords: *Organizational learning; Knowledge Management; Dynamic Capability; Innovation Capability; Industry 4.0; Firm Performance.*

1 Introduction

The German scientist group Acatech in 2011 first introduced the word "Industry 4.0," which marks the beginning of the fourth industrial revolution during the Hanover fair in Germany in 2011. The fourth industrial revolution works with the use of new technology in the manufacturing sector, as well as the invention of machines and many more technological revolutions that have followed to replace Manpower with machine power, which have gained massive interest from within the global production industry [1]. Industry 4.0 has become a modern business paradigm; in addition to its advantages [2], this paradigm includes alterations to the organization's logic or philosophy of operation. According to [3], the extraordinary speed of Industry 4.0's arrival has no precedence, compared to the previous three industrial revolutions. Industry 4.0 is progressing exponentially rather than with linear speed [3]. Since 2011, Indonesia has been moving into Industrial Revolution 4.0 connectivity, as well as increasing knowledge transfer and sharing due to new innovations, which have also reduce barriers

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between places and individuals through technical and information innovation [4]. With around 20% of the nation's GDP being generated from the manufacturing sector, Indonesia's manufacturing and resource sectors will benefit from Industry 4.0 and in so doing will provide customers with modern products and services at an affordable price, as well as offering customers more advanced products and services to meet their demands which in turn creates the ability to reduce production costs and incidentally improve wages and living standards for Indonesia's population [5]. This study seeks to fill research gaps that have been identified previously, such as the increasing importance of Industry 4.0 for business organizations, inconsistencies in research results in regard to the relationships between organizational learning and knowledge management, and the roles of dynamic capability and innovation capability in influencing firm performance, as well as the limited availability of research on these topics.

2 Literature Review and Hypothesis Development

2.1. Literature Review

Organizational learning. Organizational theory conceptualizes organizational behaviour in terms of information creation and uncertainty reduction [6]. At the very least, organizational learning has been a part of our lexicon since [7] explored the subject more than 30 years ago. Although its popularity has increased substantially in recent years [8], little agreement or consensus on what the term means or its fundamental nature has arisen [9]. While a systematic paradigm for organizational learning remains elusive, a broad web of academic discourse has contributed to rich insights into the core questions of how and why people learn in organizational settings [10] because the notion of organizational learning is founded on the premise that organization develops from and through information. It is said that learning is intrinsically connected to the advancement of innovation process technology and, to a lesser extent, manufacturing performance. Additionally, it is believed that manufacturing has the ability to combine with internal and external learning to generate technical innovation [11].

Knowledge management. In today's knowledge economy, businesses refer to themselves as companies that are always learning and leveraging knowledge [12]. The corporate world has been undergoing a transition from an era of natural resources to an era of knowledge focused on research and development, skills development, and education [13]; moreover, the demand for knowledge management grew out of the awareness that rigid organizational structures are incapable of adapting to rapid changes that occur in today's marketplaces [14]. Knowledge management (KM) is the process of acquiring, managing, and sharing an organization's employees' knowledge capital; knowledge sharing within an organization improves current business processes, increasing efficient and effective business processes and eliminating redundancy [15].

Dynamic capability. Over recent years, the dynamic capacity (DC) concept gained a great deal of attention. With more than 200 publications since 2011, the DC construct

has been a widely discussed topic in the area of strategic management [16]. Firms' competitive advantage is thought to be founded on particular mechanisms that are produced by the role of assets in the firm and the evolution pathways that the firm has chosen or inherited [17]. In today's global economy, the environment of organizations becomes more volatile, and a firm's dynamic skills for expanding and renewing its resources and organizational capacities must be robust [18]. Thus, it is the ability of a company to "integrate, build, and reconfigure internal and external skills in response to rapidly changing environments" that is referred to as its "dynamic capabilities" [18]. In contemporary marketplaces, the dynamic abilities that enable firm managers to 'integrate, build, and reconfigure internal and external competences in order to deal with rapidly changing circumstances' are crucial in an environment where the competitive landscape is always changing [18]. In relation to that evolving landscape, developing new business models, products, and partnerships are all examples of operations that fall under the umbrella term "dynamic capabilities."

Innovation capability. Organizations must be innovative to maintain a competitive edge. This may be accomplished through the development of new goods, processes, novel marketing strategies, and organizational techniques. To be innovative, an organization's innovation capabilities must be developed and enhanced [19], which implies adjustments to current routines and configurations; these changes enable the business to discover novel methods of combining its resources, and to the degree that its new routines are difficult to replicate, it will take some time for a rival to replicate that combination [20]. Innovation is a primary engine of economic growth and a critical factor in both national and firm-level competitiveness [21]; therefore, innovation may be defined as an endeavour to reconcile the irreconcilable and is enabled by the capacity to connect thoughts, facts, or insights that no one else has before connected [22].

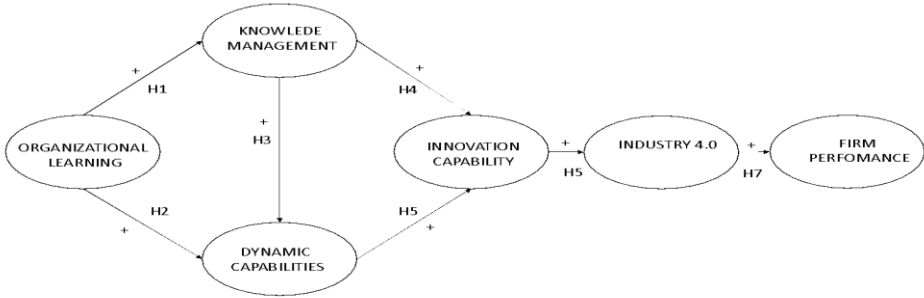
Industry 4.0 Despite the fact that the concept is not new and has been on the agenda of academic study for many years with many interpretations, the term "Industry 4.0" has only recently been introduced and is rapidly gaining acceptance not only in academic circles but also in industrial society [23]. Industry 4.0 or fourth industry revolution according to [1] is transforming the strategy, organization, business model, value, and supply networks, in addition to the processes, goods, skills and contacts between companies. Industry 4.0 has produced new possibilities to be controlled and managed so that both company and society may have a beneficial influence. The fourth industrial revolution involves the merging of the physical and virtual worlds within enterprises through the use of technologies such as artificial intelligence, analytics, cloud computing, and the internet of things (IoT) [24]. The term "fourth Industrial Revolution" was introduced in 1988 to describe the methods through which discoveries evolve into innovation as a result of scientists working on manufacturing teams, and, prior to 2012, this term was used more commonly in the development and use of nanotechnology [25].

Firm performance. The idea of firm performance must be differentiated from the wider structure of operational productivity [26] due to the primary objective of organization science being to ascertain the factors that influence corporate performance [27]. In today's business environment, when rivalry among firms has gotten

increasingly fierce, businesses must differentiate themselves from their competitors in order to retain customer relationships [28]; therefore, managers are increasingly being pressed to consider their organization's environmental and social performance in addition to profitability [29].

2.2. Hypothesis Development

Figure 1. Proposed Research Model



Organizational learning and knowledge management. According to previous research and ideas, organizational learning (OL) involves both cognitive processes and human actions that provide new knowledge to firms and enable managers to act on that knowledge. Individual learning has been associated with OL by certain theories [30]. This shows that the culture of learning can be developed by fostering knowledge practices inside the organization, which includes creating, sharing, and exploiting various forms of knowledge databases within the organization. Organizational learning is a collection of knowledge management procedures that allow the acquisition, development, storage, sharing, and application of information across all organizational levels. Hence, this study advances the following hypothesis.

Hypothesis 1: Organizational Learning has a positive relationship with Knowledge Management.

Organizational learning and dynamic capability. Organizational learning is essential for the development of capabilities. Instead of accumulating knowledge by static effort, organizations must focus on transmitting and creating new knowledge through dynamic efforts, according to [31]. Developing, adopting, and putting into action new ideas, processes, goods, and services is what dynamic capabilities are all about. The ability of a company to adapt to a complicated environment is made easier when the organization has a learning culture. Generally speaking, organizational learning begins with individuals recognizing an opportunity in their external environment [32]. Hence, this study advances the following hypothesis.

Hypothesis 2: Organizational Learning has a positive relationship with Dynamic Capability.

Knowledge management and dynamic capability. [33] have made one of the most comprehensive attempts to clearly integrate knowledge and dynamic capabilities to

date, and their work is widely regarded as ground-breaking in that it proposes a "knowledge evolution cycle" that characterizes the formation of dynamic capabilities and organisational routines; this cycle allows companies to alter their behaviour in pursuit of higher return. Individuals and groups come together and tackle problems in the old novel ways, using tacit and explicit methods to understand the changes in their surroundings. Hence, this study advances the following hypothesis.

Hypothesis 3: Knowledge Management has a positive relationship with Dynamic Capability.

Knowledge management and innovation capability. [34] sought to establish the relationship between knowledge management capabilities and innovation and competitiveness. It was discovered through this research that knowledge management capabilities are crucial for strategy development and also have an advantageous impact on innovation and competitiveness. Previous research has demonstrated that knowledge is a facilitator of innovation capability. According to another study [35], innovation capability involves a comprehensive knowledge exchange mechanism that allows the application of items, ideas, and procedures. Workers' knowledge-sharing abilities, on the other hand, are said to have a substantial impact on the ability of organizations to innovate. Hence, this study advances the following hypothesis.

Hypothesis 4: Knowledge Management has a positive relationship with Innovation Capability.

Dynamic capability and innovation capability. As defined by [36], organizational dynamic capabilities are defined as the ability of an organization to consciously build and actively generate its resource base, whereas innovative capabilities can be seen as potentially dynamic or non-dynamic, depending on the context [37]; based on [18] one may conclude that 'learning' is the very first characteristic that all of them share. Ideally one must constantly seek for, scan for, explore, and integrate new options both within and outside the firm, as well as environmental requirements, in order to continuously enhance innovation skills over time [38]. Hence, this study advances the following hypothesis.

Hypothesis 5: Dynamic Capability has a positive relationship with Innovation Capability.

Innovation capability and industry 4.0. Manufacturing companies' technological capabilities are based on a variety of characteristics called *capability for innovation* [39]. When Industry 4.0 is implemented, it raises the development of a company's innovation capabilities, which serves as the primary driver of a company's adaptation to the new world of digitalization in the manufacturing environment [40]. It is possible to connect the fact that an organization's ability to innovate will lead to the application of Industry 4.0 technology. This means that Industry 4.0 will have the largest impact on manufacturing if they have the greatest ability to innovate, which will serve as the most effective tool for measuring and evaluating firm performance [41]; on this ground the hypothesis was developed. Hence, this study advances the following hypothesis.

Hypothesis 6: Innovation Capability *has a positive relationship with* Industry 4.0.

Industry 4.0 and firm performance. A company may benefit from new digital technology breakthroughs in order to increase production [42]. Businesses that wish to fully use Industry 4.0, on the other hand, will be able to achieve greater levels of performance because they will be able to consistently create brand experiences that excite and inspire their customers. The product experience, which is concerned with the manufacturing process, is a component of the brand experience. While operations are certainly important, the brand experience involves much more than that, such as on-time delivery, responsiveness to customer demand, and creative business models that make life easier for the customer [43] Hence, this study advances the following hypothesis.

Hypothesis 7: Industry 4.0 has a positive relationship with Firm Performance.

3 Research Methodology

Sample and procedure. The target population of this study are employees of Indonesia's manufacturing industry. The administration of the survey was conducted via Google forms due to the Covid-19 pandemic. The administration of the surveys occurred over a period of six months, from March 2021 to August 2021. The resulting data sample comprises 259 valid respondents. Of those respondents, 71 percent were male, 38.2 percent were aged 30-39 years, 33.6 percent had bachelor degrees, 53 percent were lower-level staff, 45 percent worked in a company with more than 1000 employees. Measurement of OL was measured using 16 measurement items adopted from [44]; knowledge management was measured using 10 measurement items adopted from [45]; dynamic capability was measured using 9 measurements items from [46]; innovation capability was measured using 12 measurement items adopted from [47]; industry 4.0 was measured using 12 measurement items adopted from [48]; and firm performance was measured using 9 measurements items from [49]. All the variables were measured using 5-point Likert-type scales ranging from 1, strongly disagree, to 5, being strongly agree.

4 Results and Discussions

4.1. Results

Data analysis for this study was completed using SPSS for descriptive analysis and LISREL version 8.8 for hypothesis testing using Structural Equation Modelling (SEM). The Cronbach's Alphas of the constructs were all above 0.7, indicating good reliability. The Construct Reliability (CR) and Variance Extracted (VE) were also evaluated, where $CR \geq 0.50$ and $VE \geq 0.70$ indicates good reliability. The structural model fit was assessed by Goodness of Fit indices, as shown in Table 1. The result of the structural model fit showed an overall good fit model. The descriptive statistics are displayed in Table 2. Table 3 shows the correlation of the variables. The hypothesis testing results shown in Table 4 indicated that all hypotheses are supported.

Table 1. Result of Structural Model Fit Indices

χ^2/df	RMSEA	GFI	SRMR	CFI	NFI	NNFI	IFI	
1.57	0.047	0.90	0.02	1.00	0.99	0.99	1.00	

Table 2. Descriptive Statistics Result

ITEM	Result						
Construct	Mean	SD	Min	Max	CR	VE	Cronbach Alpha
OL	3.61	0.915	1.00	5.00	0.96	0.59	0.916
KM	3.74	0.876	1.00	5.00	0.95	0.63	0.908
DC	3.76	0.828	1.00	5.00	0.94	0.65	0.897
IC	3.76	0.864	1.00	5.00	0.95	0.63	0.902
I4.0	3.68	0.867	1.00	5.00	0.96	0.65	0.904
FP	3.69	0.927	1.00	5.00	0.95	0.66	0.909

Table 3. Correlation Test Result

	Variable	Mean	SD	1	2	3	4	5	6
1	OL	3.61	0.91	1					
2	KM	3.73	0.87	0.585**	1				
3	DC	3.75	0.82	0.556**	0.658**	1			
4	IC	3.76	0.86	0.516**	0.628**	0.723**	1		
5	I4.0	3.6	0.86	0.526**	0.545**	0.657**	0.675**	1	
6	FP	3.6	0.92	0.514**	0.471**	0.594**	0.635**	0.677**	1
**Correlation is significant at the 0.01 level (2-tailed).									

Table 4. Result of Hypotheses Testing

Code	Hypothesis	Structural Coefficient	T-value	Hypothesis Test Result
H1	Organizational learning has a positive relationship towards knowledge management	0.83	14.96	Supported
H2	Organizational learning has a positive relationship towards dynamic capability	0.22	3.04	Supported
H3	Knowledge management has a positive relationship towards dynamic capability	0.65	8.36	Supported
H4	Knowledge management has a positive relationship towards innovation capability	0.31	7.95	Supported
H5	Dynamic capability has a positive relationship towards innovation capability	0.71	9.78	Supported
H6	Innovation capability has a positive relationship towards Industry 4.0	1.05	15.67	Supported
H7	Industry 4.0 has a positive relationship towards Firm Performance	0.97	18.78	Supported

4.2. Discussions

The findings from the study shows that organizational learning has more impact on dynamic than knowledge management despite the fact organizational learning and knowledge management theatrically seen more closer since learning and knowledge walk in hand, but the responds shows dynamic capability which happens to deal with rapidly changing environments, this confirms the studies [50], dynamic capabilities, which are developed via the mediation of organizational learning processes, become the most important source of competitive advantage in this dynamic environment.

The study also shows that industry 4.0 will become a key driver to high firm performance like it is said if a company is able to make progress in the field of technology into an opportunity and take advantage of new value streams, it can gain superior performance than competitors [51].

5 Conclusion

It can be concluded that Industry 4.0 implementation in the manufacturing industry in Indonesia cannot be facilitated without organizational learning, knowledge management, and dynamic capability as well as innovation capability. Dynamic capabilities ignite organizations to be aware of the changes within their surroundings with customers' preferences changing daily, companies need to be able to sense, seize, and manage their threats in order to remain competitive. This study has several limitations; first, the context of this research is the manufacturing sector in Indonesia; second, with a population of over 40,000,000, the sample size of only 259 respondents does not provide a detailed research on the implementation of industry 4.0., including many aspects of industry 4.0 like artificial intelligence, robotics and so on, which were not covered in this research. Thus, future research should incorporate additional factors that may have an impact on the deployment of Industry 4.0, such as top-level management support, environmental unpredictability, absorptive capacity, and sustainability competence. Theoretically, as previously demonstrated and discussed, this study adds to the body of information regarding Industry 4.0, as well as technology, learning, knowledge, dynamic, and innovative capabilities in relation to firm performance. By demonstrating the actual position of Industry 4.0 implementation research and sharing empirical findings from Indonesia's manufacturing sector, the primary background for Industry 4.0. has been outlined. To begin, this study presents a research model that incorporates critical elements that influence Industry 4.0 implementation. Apart from theoretical implications, the study at hand has numerous managerial implications. As has been shown, that organizational learning, knowledge management, dynamic capability, and innovation capability play an important role for the implementation of industry 4.0. In particular, implementation requires that organizations embrace changes in the era of industry 4.0. Hence, managers should be aware of the importance of the various constructs in the implementation, especially dynamic capability which has a high impact on creating better competitive advantages that leads to high firm performance.

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