Digital Transformation Strategy in Construction Industry: A Case Study on PT. Konstruksi Membangun Negeri Tbk

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ABSTRACT: *The advancement of digital tools in construction has increased for the past decade and it brings a solution overcome the issues of low-level productivity and inefficiency. Digital transformation is one of the strategies to increase operational excellence and generate new competitive edges at the same time in the construction industry. PT. Konstruksi Membangun Negeri Tbk (KMNI), an Indonesian 50-year-old building contractor facing business issue as its revenue and profitability has been declining for the past 5 years. Mixed-methods explanatory were conducted to assess KMNI readiness and best fit-in strategy to conduct digital transformation. Using INDI 4.0 assessment, KMNI's readiness score is 2.03 or medium readiness with some areas for improvement. A house of KMNI digital transformation is proposed as guidance for KMNI to conduct digital transformation, encompassing (1) a roof as the direction, (2) a beam of goals, a pair of pillars (3) process that adopt lean construction 4.0 and (4) technology as the enabler, and (5) people as the foundation. To construct this house, a roadmap with five years of timeline and five phases to be executed in order to transform KMNI's operations and become a new way of delivering the product to its customers as a new competitive edge.*

KEYWORDS - *digital transformation, construction 4.0, digital maturity, roadmap, lean construction*

I. INTRODUCTION

The year 2020 was a challenging year for all the business industry when COVID-19 became a pandemic and disrupted the way of doing business. It had a significant impact on businesses, including the construction industry. However, the pandemic also accelerated the adoption of digital technologies in the construction industry, as companies had to find new ways to collaborate remotely and manage their projects. Move into 2021 and beyond, businesses in the construction industry will need to adapt and innovate to survive and thrive in the new normal. This may include leveraging new digital technologies, adopting more sustainable practices, and finding new ways to collaborate and communicate with stakeholders. Companies will also need to remain agile and responsive to changing market conditions and customer needs to stay competitive. Overall, the pandemic has highlighted the need for businesses to be resilient and adaptable in the face of unexpected challenges, and this will be an important lesson for companies in the construction industry moving forward.

PT. Konstruksi Membangun Negeri Tbk (KMNI) is a construction company that was founded in 1970 and go public 30 years later under the initial KMNI. Since the beginning of its establishment, KMNI has been focusing on high-rise buildings and targeting premium customers who are willing to pay premium prices to build a building with high-quality standards and services. To analyse KMNI's performance and to find the underlying issue, the following is the comparison of KMNI's financial report with nine construction company listed in the Indonesia Stock Exchange (IDX) from 2016 until 2022.
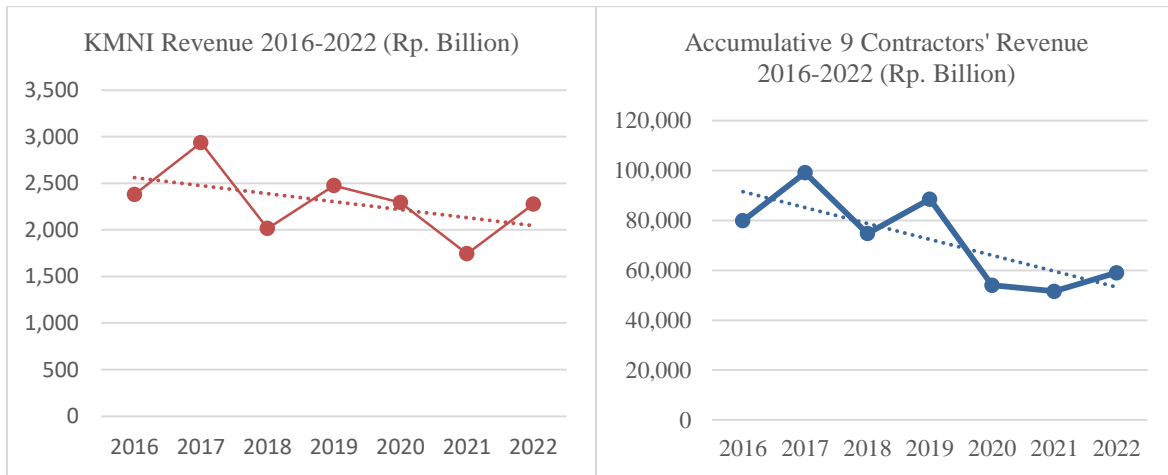
Figure 1.1 KMNI & accumulative 9 contractor's revenue 2016-2022

Based on Fig. I.1, both KMNI and all 9 contractors' financial reports fy 2016 until 2022 show a downward trend line. Especially during the year 2020, a contraction due to the Covid-19 pandemic reduced the overall revenue significantly by 39% compared to the previous year. This condition increases the competitiveness to get a market share. The low pricing strategy is the key to acquiring a new project, hence it becomes a red ocean strategy.
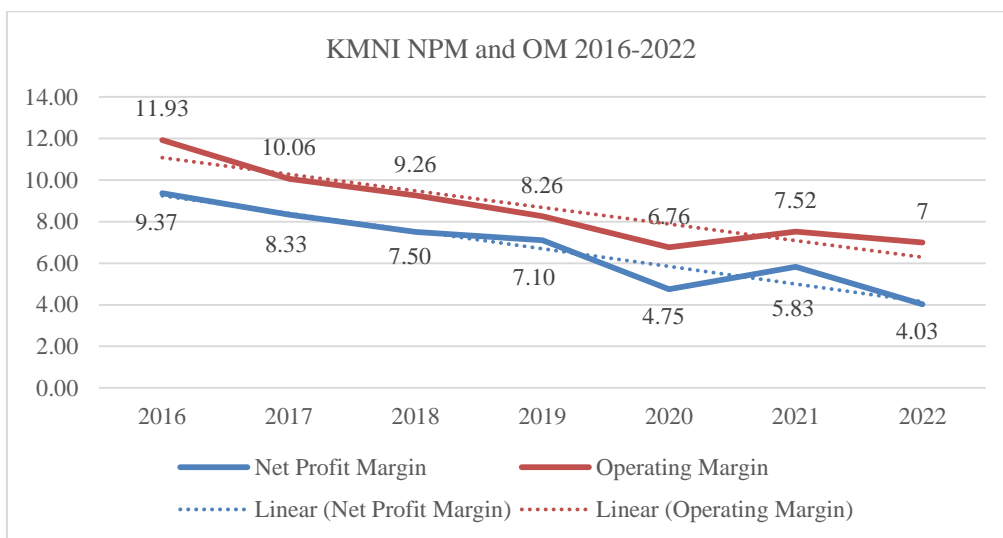

Figure 1.2 KMNI Net Profit Margin (NPM) and Operating Margin (OM) year 2016 – 2022

Fig. I.2 reveals KMNI's net profit margin and operating have been starting to decline since 2016 and drop sharply during the COVID pandemic in 2020. KMNI tried to recover back in 2021 coming near to the pre-pandemic situation, yet it drops again the following year 2022. This declining trend indicates inefficiency in operations within KMNI to deliver the project hence the operational cost increase and the profit decrease.

KMNI should find a new strategy to increase efficiency as a solution to reduce costs and create a new value proposition to get a market share to overcome this situation at the same time. An analysis by Oesterreich and Teuteberg (2016)[1], followed by Bockshecker et al., (2018)[2] claimed that Digital Transformation (DT) gives some benefits such as cost and time savings, on-time and on-budget delivery, improving quality, increase the effectiveness of collaboration, communication, and connectivity, enhancing safety, and improving sustainability. In terms of numbers, McGraw Hill Construction Report (2012)[3] shows that DT reduces rework by 50% and 25% of cost overruns. According to BCG research (2020)[4], digital transformation could lead to 1.8

times higher earnings growth. Based on those various researchers, Digital Transformation significantly gives direct benefits to all the stakeholders.

This research's objective is to create a business strategy for a construction company by adopting digital transformation as a solution to deliver value both for the organization and customers, by answering the following questions:

a) What is the current digital maturity level of KMNI?
b) What are the challenges in implementing digital transformation faced by KMNI and how to overcome them?
c) What would be the Digital Transformation roadmap in KMNI that gives value to KMNI and its customers?

Within this research scope, Digital Transformation does not change KMNI's business model, rather than pursuing operational excellence that create new opportunity of competitive advantage as well. This research has a limitation of quantitative calculation on how much return on investment by implementing the digital tools is conducted based on assumption refers to secondary data acquired from the vendor's website.

II.   LITERATURE REVIEW AND CONCEPTUAL FRAMEWORK

II.1. Digital Maturity

This research will use INDI 4.0 as a tool to assess the digital maturity of the organization, developed by the Ministry of Industry Indonesia[5] to assess the digital readiness of the government and industry in Indonesia, to transform into industry 4.0.

Figure II.1 INDI 4.0 Digital Maturity Assessment (Ministry of Industry Indonesia, 2018)

INDI 4.0 assessment consists of 41 questions of multiple choice covering five pillars and seventeen areas. Once the assessment is completed, a range of scores of 0 to 4 is generated to assess the position of the company towards readiness to transform (Table II.1).

Table II.1 INDI 4.0 Score Level

Score Range	Level	Category
0,00 – 0,50	0	Not ready
0,51 – 1,50	1	Early stage
1,51 – 2,50	2	Medium readiness
2,51 – 3,50	3	Mature
3,51 – 4,00	4	Completed

II.2. Digital Leadership Assessment

Transforming the leadership style from traditional leadership into digital leadership using LEaD model (Dörr et al. 2018)[6]. Digital leadership style promotes teamwork, agile, room for improvement and innovation, and transparency & trust.

II.3. House Of Digital Transformation

The authors combine the Construct Map Digitalization, Digital Transformation, and Business Model Innovation (Tonder et al., 2009)[7]; and House of Lean Construction 4.0 (González et al., 2022)[8] to create a new model House of Digital Transformation (see Fig. II.2).
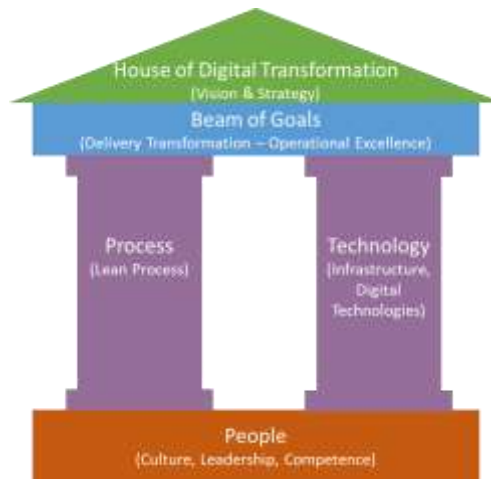

Figure II.2 House of Digital Transformation

Holistic House of Digital Transformation is built upon:

a. Roof – Vision and Strategy, gives direction towards the implementation efforts and initiatives of digital transformation programs. Tonder et al., (2009)[7] mentioned that a dedicated digital business strategy is needed to emphasize digital technologies remain the core focus, instead of traditional strategy.

b. Beam of goals – delivery transformation and operational. Digital transformation will transform how KMNI conducts the business to deliver the product and service to the customers, and how it creates benefits for KMNI at the same time, driving operational excellence in aspects of time, cost, and safety.

c. Pillar 1 – Process, adopting lean process tools and principles to eliminate waste, optimizing efficiency, streamlining the process, and continuously improving processes.

d. Pillar 2 – Technology, consists of infrastructure and digital technologies to enable people to perform the process effectively and efficiently.

e. Subgrade – People as foundation, three key focus areas: culture, leadership, and competence.

II.4 Conceptual Framework

Following is the conceptual framework to answer the research questions, starting with assessments of current conditions, continuing to business solutions, and implementation roadmap and plan.

Figure II.3 Conceptual Framework on Digital Transformation at KMNI

III. RESEARCH METHODOLOGY

This research is conducted with a mixed-methods explanatory approach, a quantitative followed by a qualitative to give more explanation towards the results and interpretation. INDI 4.0[5] and LeaD Digital Leadership[6] are used as a quantitative basis to assess the digital readiness of the organization and its leadership style. Using an online survey, the INDI 4.0 assessment was participated by 271 respondents, exceeding the target minimum of 255 respondents which represent KMNI's 750 employees. LEaD assessment would generate a score of 1 to 4 which represents traditional leadership and digital leadership to each extreme. This assessment was participated by 54 respondents, representing 61 senior and middle managers.

Later, 5 FGDs as qualitative research were conducted to get clarification of the quantitative results. The first group was conducted with top-level management to acknowledge the direction toward digital transformation and its goals. The second and third group was conducted with IT department and Engineering department, to get more in-depth information on the problems faced so far in implementing technologies such as Enterprise Resource Planning (ERP) and Building Information Modelling (BIM). The fourth and fifth groups are 2 projects representing the user of digital technology, which suffered or benefited the most from current digital technologies. Finally, all the gathered data will be interpreted using House of Digital Transformation. House of Digital Transformation.

Table III.1 Respondent Profile

	INDI 4.0 Digital Maturity Assessment	LEaD Digital Leadership Assessment	Focus Group Discussion
Senior Manager	12	11	10
Middle Manager	32	43	4
Junior Manager	97	-	9
Staff	130	-	-
Total	271	54	23

IV. RESULTS AND DISCUSSION

IV.1. Digital Maturity Assessment
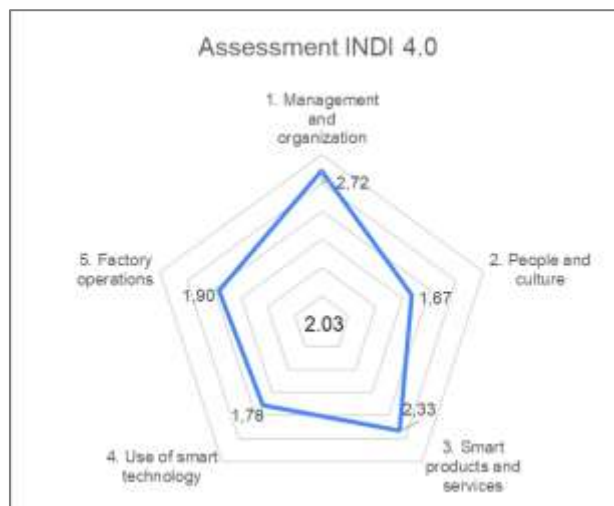Based on INDI 4.0 assessment, KMNI's digital maturity level is on medium readiness with a score of 2.03.

Figure IV.1 KMNI Assessment INDI 4.0 Digital Maturity

Following is the detail result of INDI 4.0 assessment, consist of 17 area grouped by 5 pillars:
1. Management and organization - 2,72 (mature)
   The company has a mature level of management and organization with strong commitment from the senior manager. The area that needs further attention is the formulation of top-down strategy as there is a misperception of the strategy at senior manager level and staff level which then is clarified during the interview. The company has initiated the digital transformation strategy which translated into yearly

corporate strategy. However, it lacks comprehensiveness and measurement of success towards business impact. The other area that needs attention is the commitment to invest more in digital technology, which is currently at 1 percent of revenue. Any investment in digital technology needs to be calculated for its impact on business.

Table IV.1 INDI 4.0 Assessment Results: Pillar Management and Organization

Area	Assessment	Analysis
Strategy & Leadership	2,66	DT strategy has been initiated, yet impact analysis has not been conducted.
Investment	2,99	Business impact of the investment has not been conducted. Investment in Digital Tools needs to be added, as now approximately 1% of revenue.
Policy & Innovation	2,63	Implementation of digital tools doesn't have a clear and measurable KPI.

2. People and culture - 1,67 (medium readiness)
This pillar has the lowest score compared to the other four pillars; the people are not well equipped with digital competency to adopt the technology advancement. KMNI has not developed any digital competency or human capital roadmap that synchronized with digital transformation strategy. The assessment also indicates that KMNI has minimum culture to accelerate and nurture digital transformation such as continuous improvement, adaptive to change, and innovation culture.

Table IV.2 INDI 4.0 Assessment Results: People and Culture

Area	Assessment	Analysis
Culture	1,95	Digital culture is still low, especially at staff level.
Openness to Change	2,61	Some employees are still resistant to using digital technology as it becomes double task, coupled with manual system.
Competency Development	1,91	Digital competency has not yet been defined, despite some digital skills training has been conducted.

3. Smart products and services - 2,33 (medium readiness)
The company is on a medium readiness level to provide customized services to adapt to customers' needs, as each project has its own characteristics. However, data analytics is still indicated in the early stage, especially on senior and middle managers, where data is processed manually as a decision support system. The delivery of the services to customers is still conducted in a conventional way.

Table IV.3 INDI 4.0 Assessment Results: Smart Products and Services

Area	Assessment	Analysis
Product Customization	3,26	Services could be customized based on project's characteristics.
Data-Oriented Services	1,95	Data is scattered in the system and local files. Data analysis is conducted manually.
Smart Products	2,19	The BIM application to support construction has been implemented, although it has not been used effectively by external stakeholders such as consultants and owners.

4. Use of smart technology - 1,78 (medium readiness)
KMNI has started adopting digital technology as a tool to support the operations and drive efficiency. Areas that need to be concerned are the low adoption of smart machines to increase operational efficiency. KMNI has implemented basic cyber security such as firewall, VPN, and other cyber security mechanisms. However, the effectiveness of protecting KMNI from cyber-attack has not been assessed by a third party. This should be a concern as incremental digital adoption brings higher risk toward cyber security threats.

Table IV.4 INDI 4.0 Assessment Results: Use of Smart Technology

Area	Assessment	Analysis
Cyber Security	1,63	Cyber security measure has been placed, yet it has not been assessed by a third party.
Connectivity	2,42	Interconnectivity between ERP and BIM has not been well established.
Smart Machines	1,06	There has been no evaluation of the business impact of each intelligent system/machine used.
Digitalization	2,28	Need to improve digital infrastructure in accordance with the conditions of the project.

5. Factory operations - 1,90 (medium readiness)
    Data is already centralized on the ERP system and cloud-based storage which is accessible for anyone across the company based on permission. The area that needs further improvement is the utilization of technology to leverage the supply chain process. Despite the procurement module is already available in the ERP system, the data has not been analyzed and gives feedback as predictive tools.

Table IV.5 INDI 4.0 Assessment Results: Factory Operations

Area	Assessment	Analysis
Data Repository & Sharing	2,63	Company data has been stored in a private cloud and local centralized file server with adequate data authorization management.
Smart Supply Chain & Logistics	1,38	Current supply chain system is limited to internal used.
Autonomous Process	1,95	About 50% of automation is still focused on office/ administrative task.
Smart Maintenance System	1,80	Maintenance still conducted based on corrective action.

IV.2. Digital Leadership Assessment

LEaD Digital Leadership assessment was participated in by 54 respondents consisting of top management, project managers, and head of departments. This assessment contains five scales representing five Lead competencies. Each extreme side indicates traditional leadership and digital leadership.
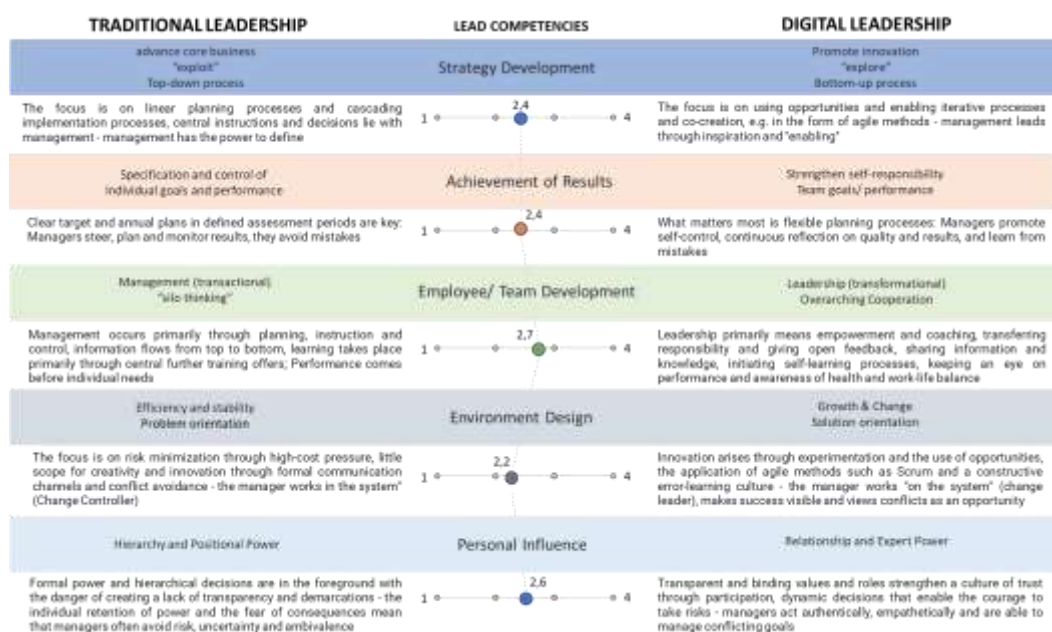

Figure IV.2 KMNI LEaD Assessment

The LEaD digital leadership assessment shows five lead competencies scored between 2.2 and 2.7, meaning the digital leadership style of KMNI leaders has started moving from traditional leadership to digital leadership.

IV.3. Summary Analysis

Based on the digital maturity assessment, digital leadership assessment, and focus group discussions, the author summarized the analysis from the perspective of the house digital transformation.

1. Vision & Strategy

   KMNI has initiated the digital transformation strategy such as implementation of BIM and ERP for the past 5 years, although it lacks comprehensiveness and measurement of success towards business impact. Despite the unclear direction, these initiatives give a signal to the whole organization that top management is concerned and committed on digital transformation.

2. Beam of Goals

   As of now, the goals of implementing digital technologies are not clearly defined. Digital transformation should be focused on internal issues: cost overrun and time delay. Time is a critical factor as a delay of time would have a direct impact on incremental overhead and equipment cost. At the same time, the use of technology should increase productivity to reduce the overheads. As of now, the availability of a report may take up to days as it need to be processed manually.

3. Process

   KMNI develops its own ERP system based on conventional processes that have been established for decades which are not integrated and have redundant information. When these processes are translated into a system, it would cause inefficiency in data input and data processing, hence tends to become additional administrative tasks. Current technology adoption is seen as an additional workload that requires additional manpower which contradicts with company's purpose – to increase productivity and reduce overhead.

4. Technology

   The IT department has the capability to develop its own ERP system, but it lacks interoperability resulting in complaints from users that redundant input, which becomes an administrative burden. During the implementation of the ERP system on the project site, unreliable network connection and lack of implementing team become critical issues. Despite having been implemented for six years, the benefit of the ERP system is not significantly obtained by senior management and project's team to make decisions. As for digital security, KMNI has implemented a firewall system that protects the servers from risk of hacking or interference, yet it has not been tested by a third party. KMNI has implemented BIM technology on project sites, but it is not fully utilized as the implementation is focused on the engineering division. The full potential could be reached if all the stakeholders such as commercial team, site execution team, subcontractors, consultants, and project owners involved in the BIM ecosystem to collaborate and communicate.

5. People

   KMNI has not defined any digital competency hence its leader and staff lack digital competency. This deficiency hinders the company from accelerating technology implementation. Training in technical aspect alone is insufficient to ensure the staff can maximize the utilization of technology. It should be followed with non-technical aspects such as problem-solving, data literacy, etc.

   KMNI leaders have started to adopt the digital leadership style which is the key to influencing the staff to become risk-taking and maximizing the opportunity provided by technological advancement.

IV.4. Business Solutions

Based on the analysis, KMNI needs a set of strategy to address the challenges faced by the company and achieve the potential benefit of digital transformation as leverage for its business goals. House of KMNI Digital Transformation as a guide for the implementation of the strategy.
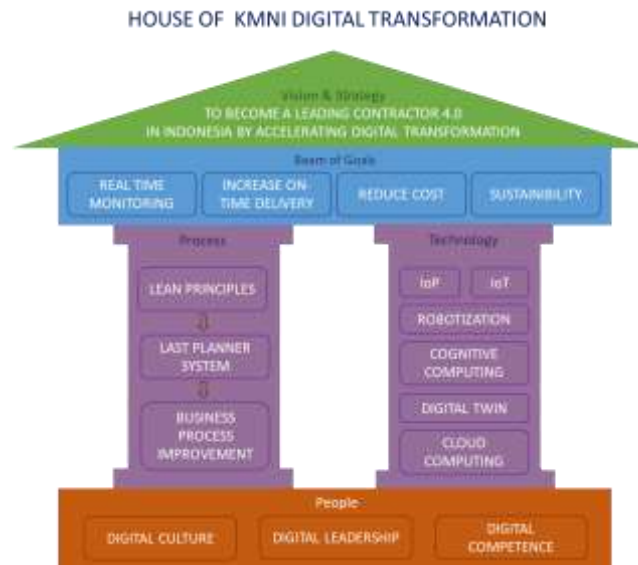
Figure IV.3 House of KMNI Digital Transformation

1. Vision & Strategy

   In order to have a successful digital transformation, KMNI should set a clear direction toward digital adoption as a new strategy. Based on the discussion with the senior management, KMNI's vision and strategy are "To become a leading contractor 4.0 in Indonesia by accelerating digital transformation". KMNI will be known as the leading contractor company in Indonesia that is at the forefront of using digital technology to streamline the construction processes, enhance communication and collaboration, and be sustainable. This vision and strategy should be communicated to all stakeholders, especially KMNI's staff, hence everybody will go to the same direction.

2. Beam of Goals

   Digital transformation at KMNI should be value-driven, hence adopting digital technologies would give benefit to all the stakeholders: top management, staff, subcontractors, suppliers, and ultimately its customers.

   Four benefits that would be pursued by KMNI as beam of goals are:

   a. Real-Time Monitoring

      Digital transformation provides real-time data monitoring as decision-making tools. Data analytics would help top management and project team to have an early warning regarding time, cost, and safety issues, and find a solution to prevent it to happen or to minimize the impact. Real-time monitoring will lead to better project outcomes and customer satisfaction.

   b. Increase On-Time Delivery

      Time is a crucial factor in project, as delay can result in increased costs, reduced quality, reduced safety, and decreased customer satisfaction. Digital technologies would enable better project management, coordination and communication between stakeholders, and reduce the likelihood of errors and reworks that contribute to project delay.

   c. Reduce Cost

      The use of technology can have an impact on reducing costs either directly or indirectly as an effect of optimization of processes. To this extent, digital transformation will be focused on reducing preliminary costs which is fully under KMNI control. Overhead costs and equipment costs dominate the preliminary costs, hence digital technology should optimize the utilization of overhead and equipment.

   d. Sustainability

      Digital technologies adoption helps KMNI to promote sustainability by reducing waste in the process and waste in materials as the number of reworks due to miss coordination has significantly reduced. IoT sensors contribute to energy savings by automatically adjusting energy consumption based on site activity. This goal could resonate with customers who have the same concern to produce green buildings with green construction.

3. Process

Process is one of the pillars that support the vision and one of mechanism to achieve the goals. KMNI's processes need to be designed as effectively and efficiently as possible in order to be executed with the help of technologies to achieve digital transformation goals. Following are initiatives to create a process that support the goals:

a. Lean Construction Principle

Fundamental of lean construction principle is to reduce non-value-adding activities or waste (Koskella, 1992)[9]. KMNI should implement lean construction principles across the whole project process to eliminate waste as a measure to increase time delivery and reduce cost. Koskela (1992)[9] defines 11 heuristic principles of lean construction to reduce non-value-adding activities and increase efficiency of value-adding activities. Supported by BIM technology, the synergy would enhance 5 out of 11 lean principles (González et al., 2022)[8]: reduce the share of non-value-adding activities, reduce variability, reduce the cycle time, increase process transparency, and increase output flexibility.

b. Last Planner System (LPS)

The Last Planner System (LPS) is a concept by Ballard that divide project planning into long-term and short-term planning stages (Ballard, 2000)[10]. LPS will be adopted to the existing KMNI's project business processes. By implementing LPS into project planning and execution process, KMNI will gain the on-time delivery goal. One of the key metrics being used is Percent Plan Complete (PPC), which measures percentage of daily progress against the target weekly work plan, ideally, it should be 100% for each day.

LPS will help to coordinate all stakeholders and reduce the gap between planning and realization as daily huddles would detect any progress delay or deviation in PPC. When there is a deviation, project team will have a discussion with all stakeholders to find the constraints and do a root cause analysis, which later finds a solution to catch up and prevent it to happen again. By collaborating with subcontractors in creating a look-ahead plan and hurdle meeting, it will enhance the capabilities of the subcontractor's project management as well.

c. Business Process Improvement

Translating existing processes into ERP has proven to be ineffective to improve project team performance, as it creates more non-value-adding administration activities that the team complained about. Therefore, KMNI should conduct business process improvement by adopting the 11 lean construction principles, and removing the non-value-adding processes before adopting new technology.

4. Technology

Technology is the second pillar to support the goals and vision of digital transformation at KMNI. Technology helps KMNI to streamline the processes, as an enabler to achieve the goals of real-time monitoring, on-time delivery, reduce costs, and sustainability. Emerging technology provides a wide range of options that could be adopted. Following are six technological bases to connect the cyber-physical system that brings those benefits (Klinc & Tur, 2019 & McKinsey, 2020)[11][12]:

a. Internet of People (IoP) – BIM, ERP, and Client's Portal

The Internet become the hub for connecting stakeholders where communication and coordination are conducted via cloud. BIM and ERP interconnected with Client's portal is the perfect technology to accommodate this purpose. Through this portal, customers could respond to all transmittal documents and track progress without waiting for monthly reports prepared by the contractor.

BIM technology bridges the coordination problem that was previously done manually in the physical world by superimposing multiple drawings paper. While ERP and client's portal bridge the data transactional and communication which was previously conducted in paper-based which required sending back-and-forth using mail delivery. As it is moved to the cloud-based, communication would be done simultaneously and instantly.

Figure IV.4 KMNI Technologies Interoperability

Fig. IV.4 describes the interoperability between technologies implemented at KMNI to connect all the stakeholders. ERP and BIM are the major technology to achieve the beam of goals, has the cability to be integrated with other technology.

b. Internet of Things (IoT) – Smart sensors

The main idea of IoT is to create a seamless connection between the physical world and cyber world through the internet using smart sensors. These sensors would detect what is happening around it and send the data to the server in real-time. IoT sensors could be attached to machines, materials, and workers to track the mobility and predictive analysis. With the help of machine learning, data that has been collected could suggest preventive action such as maintenance schedule, materials stock, and warning on unsafe action.

c. Robotization – smart factory, 3D printing

Robotization is an emerging technology that might help to reduce the dependency on the workforce which reduce risk exposure towards safety and quality non-conformances. The controlled environment where robot translates digital information into the design of the material world would speed up the construction time. For example, 3D printing translates the design into a machine pouring the concrete that would become a physical product. Despite the limitations, this technology might be growing rapidly in the following years.

d. Digital Twin – BIM, AR & VR

Digital twin is a digital replica of its physical object. The use of BIM, combined with AR and VR technology helps to visualize the digital object to the real world. This implementation might help to demonstrate and visualize during coordination in the project site, hence reducing the risk of miscoordination and rework. In addition, this could become a marketing tool for engaging new customers to have a live demo experience of visiting the actual building design. Customers could make better decisions during material approval due to the visualization of the actual installed product.

e. Cognitive Computing – Big Data, Data Analytics, Machine Learning, Artificial Intelligence.

Cognitive Computing is a term for a stack of technologies that try to simulate human thought processes in the computer model (Klinc & Turk, 2019)[11]. Various data collected from the BIM, ERP, and other 3rd party software are processed through big data, data analytics, machine learning, and artificial intelligence to provide insight for stakeholders to make a better decisions. As the data continues to grow at an exponential number, the cognitive model would be improved and its accuracy would be improved as well.

f. Cloud Computing – ICT Infrastructure, Cyber Security

Cloud computing is one of the alternatives to reduce the investment of hardware servers to run all the technologies dan data storage of KMNI. The pay-as-you-use concept provides convenience and speed when an increase in server capacity is needed due to an increase of the number of users. Vice versa, when the number of users decreases when a project is completed, reducing servers will save IT operational costs. Most of cloud computing providers have met certain standards which ensure service level agreement at 99.9 percent and also cyber security protection from cyberattack, hence reliability and security are assured.

5. People
    KMNI people as the foundation of digital transformation is the critical factor to have a successful and sustainable digital transformation.
    a. Digital Culture
        According to Buvat et al (2017)[13], there are 7 attributes of digital culture, in which KMNI has shown these 5 attributes such as customer centricity, innovation, open culture, agility and flexibility, anc collaboration. Following are two additional digital cultures that need to be developed:
        •   Data-driven decision making
            The projects team should get used to using dashboards or data analytics to convey a report. Continued by the leaders to challenge based on the data, and make a decision based on the data.
        •   Digital-first mindset
            As digital technologies are provided, KMNI staff should have a mindset to do everything digitally or online. For example, shop drawings should be accessed via mobile devices; finding a non-conformity should be input into the system, not via messaging apps or phone calls.
    b. Digital Leadership
        KMNI leaders has shown a transition from traditional leadership to digital leadership, despite it is still in the early stage. KMNI leaders need to keep practicing by implementing the key principle of digital leadership such as risk-taking, involving team to make a plan and decision, embracing mistakes as learning opportunities, coaching, and transfer of trust and responsibility.
    c. Digital Competence
        KMNI has to define digital competence and embedded it in each job position and define requirement proficiency level according to the job position. Following are four digital competencies which comprise four levels of proficiency level (DigComp 2.2, 2022)[14].

Table IV.5 KMNI Digital Competence Adopting DigiComp 2.2

Competence	Proficiency Level	Job Position
1. Information and Data Literacy	**Foundation:** • Identify information needs and find credible data or information through simple search in digital environments.	Administrator
	Intermediate: • Explain information needs; organize data and information in digital environments. • Perform the analysis, comparison, and evaluation of data and information.	Manager
	Advance: • Respond and assess information needs; show and explain how to access the most appropriate data and information. • Critically assess data and its reliability by using different data.	Head of Department, Project Manager
	Highly specialized: • Create a solution to complex problems with limitation of data. • Integrate knowledge and guide others in the analysis and evaluation.	Director, General Manager
2. Communication and Collaboration	**Foundation:** • Identify appropriate simple communication means for a given context • Recognize simple appropriate digital technologies to share data and information. • Choose simple digital tools and technologies for collaborative processes.	Administrator

		Intermediate: • Select and perform well-defined and routing interactions with digital technologies • Select well-defined and routine appropriate digital technologies to share data and information; and for collaborative process.	Manager
		Advance: • Use a variety of digital technologies to interact and adapt to the most appropriate communication means. • Use a variety of appropriate digital technologies to share data and information. • Propose different digital tools and technologies for collaborative processes.	Head of Department, Project Manager
		Highly specialized: • Create solutions to complex problems with many interacting factors interacting through digital technologies and digital communication means. • Choose the most appropriate digital tools for co-constructing and co-creating data, resources, and knowledge.	Director, General Manager
3.	Safety	Foundation: • Identify simple ways to protect own devices, data, and privacy in digital environments. • Differentiate simple ways to avoid health risk and threats to physical and psychological well-being while using digital technologies.	Administrator
		Intermediate: • Organise ways to protect own devices and data in digital environment. • explain ways to avoid health risk and threats to physical and psychological well-being while using digital technologies.	Manager
		Advance: • Apply different or choose the most appropriate protection for devices and data. • Show different ways to avoid health risk and threats to physical and psychological well-being while using digital technologies.	Head of Department, Project Manager
		Highly specialized: • Create solution related to protecting devices and data; managing risks and threats.	Director, General Manager
4.	Problem Solving	Foundation: • Identify simple technical problem and simple solution to solve them.	Administrator
		Intermediate: • Differentiate technical problems and select solutions to solve.	Manager

Advance: • Assess technical problems and apply different solutions to solve. • Assess needs and choose the most appropriate digital tools to solve.	Head of Department, Project Manager
Highly specialized: • Create solution to complex technical problems.	Director, General Manager

IV.5. Digital Transformation Roadmap

Digital transformation roadmap is a guidance timeline for KMNI to implement Digital Transformation initiatives referred to the KMNI House of Digital Transformation. This roadmap has a timespan of five years with 5 phases or milestones that organize aspects of process, technology, and people.

1. Phase I: Preparation (Year 1)
   In the first year, KMNI needs to setup DT governance to carry on the Digital Transformation initiatives come to live. During this stage, the focus is on improving business processes by adopting lean tools and principles. To leverage maximum benefit and capacity of BIM, KMNI should have a strong BIM foundation. BIM 3D coordination is the basic requirement that should be well possessed so that KMNI can proceed to the next stage. All the digital technologies could run properly if the infrastructures such as cloud server, cyber security, and devices are well established. Leaders and staff of KMNI should be prepared as well starting with transformation of the leadership style and defining the detail of digital competence for each position.

2. Phase II: Building Internal Capabilities (Year 2)
   The focus on this stage is preparing internal capabilities in terms of digital tools readiness as well as KMNI people to be digital talent that able to adapt and strive using digital tools. After a set of new lean standard procedures has been developed, then it will be absorbed into the ERP enhancements. It is recommended if the agile concept is implemented in the development of new ERP system.
   As BIM has reached the maturity of 3D coordination, it will be continued integration with lean and the fourth dimension – time. Digital culture initiatives need to start developing as soon as possible, as it takes multi-years to become a culture. Finally, internal capabilities are all about KMNI people whose competencies are well-developed.

3. Phase III: Influencing External Stakeholders (Year 3)
   When KMNI internally has no technical issues regarding technological and people aspects, DT will start involving external stakeholders such as consultants, suppliers, subcontractors, and owners. KMNI needs to influence those external stakeholders to actively participate using digital tools under KMNI DT ecosystem as the full potential benefit of DT could only be achieved if all stakeholders take part.

4. Phase IV: Integrating Physical and Digital (Year 4)
   In this phase, digital design is brought into reality with the help of advanced technology such as Augmented Reality, Virtual Reality, 3D printing, and smart factory. The prerequisites for this are BIM design has reached minimum maturity of 4D cost. This emphasis that previous milestones are required for Digital Transformation program could go forward to the next milestone.

5. Phase V: Mature (Year 5)
   Mature milestone does not indicate the end of the digital transformation. It imposes that KMNI is ready to implement the most advanced technology available during this research is conducted such as machine learning and artificial intelligent. It is inevitable the advancement of new technology has increased rapidly in recent times. Whatever the coming new technology, KMNI is prepared to become an early adopter as KMNI has become an agile organization.

IV.6 Implementation Plan & Justification

To execute the Digital Transformation roadmap, KMNI should consider the barriers described by Olanipekun & Sutrisna (2021)[15] as it will hinder the execution. Following are the implementation plans in accordance with the Digital Transformation Roadmap timeline.

• The most important thing is to have a clear set of rules, procedures, and monitoring mechanisms to ensure all the programs are executed according to the timeline. Hence, a Digital Transformation governance should be drawn up and led by a Director of Digital transformation. The main task of DT Director is overseeing the digital transformation team and ensuring DT strategy is aligned with the overall corporate strategy as other business units might have another agenda or strategy that might misalign with DT strategy. The objectives and measurements should be translated into a Balance Score Cards, then monitored regularly (Ariono et al., 2021)[16].

- KMNI should increase the budget for digital transformation to 1.68% as it is the average of the construction industry researched by Delloitte (2020)[17]. Calculating using KMNI's yearly revenue 2 trillion, then the best practice investment would be around 33 billion in total for the year 2024 to 2027. Based on the simulation conducted by the author, the investment needed for Digital Transformation is around 29.4 million or 1.47% of revenue. From business perspective, an investment should be calculated the benefit out of it using financial metrics such as ROI, ROA, etc.
- Create a change management program as the KMNI has initiated a digital transformation initiative that is not running well. Based on the Kübler Ross change curve model, current condition might be at frustration or depression stage. DT Team should consider adding a new digital tool without any significant benefit or purpose that might drive to prolonged depression. One of the expectations that are stated by the respondent is a dedicated team to guide them during the implementation. This approach gives a sense of ease when a problem occurs and commitment from the company to help them through this journey of transformation.

V. CONCLUSION

Digital transformation is a form to transform KMNI to operate superior to the competitors and brings value to all stakeholders. Later it would become a competitive edge and drive the company to become leaner, more innovative, and agile at the same time. Digital transformation could be seen as a strategy to solve KMNI's current business conditions as the revenue and profit margin have been declining for the past five years.

Based on the assessment, KMNI is at a moderate level of readiness with some challenges on the clear direction, measurement of success toward business impact, and absence of digital competence. These challenges hinder KMNI from adopting digital tools that aim to reduce costs by increasing productivity. To overcome it, a house of KMNI digital transformations adopted from lean construction 4.0 become the guiding principle for KMNI to conduct a transformation on the people, process, and technology aspect with the purpose to increase on-time delivery, reducing costs, and promoting sustainability. DT multidisciplinary team should be formed to carry on the 5 years roadmap within DT governance. Collaborating with community, government, academia, and industry might bring new opportunities such as partnership, expert opinion, and speed up the digital transformation (Ariono et.al., 2022) [18].

To respond to future challenges, KMNI should become an ambidextrous and agile organization, not only focusing on digital transformation for operational excellence but at the same time creating innovation and competence that become the new competitive advantage.

VI. REFERENCES

[1] Oesterreich, Thuy & Teuteberg, Frank. (2016). *Understanding the implications of digitisation and automation in the context of Industry 4.0: A triangulation approach and elements of a research agenda for the construction industry*. Computers in Industry. 83. 10.1016/j.compind.2016.09.006.

[2] Bockshecker, Alina; Hackstein, Sarah; and Baumöl, Ulrike, "*Systematization of the term digital transformation and its phenomena from a socio-technical perspective – A literature review*" (2018). *Research Papers*. 43.https://aisel.aisnet.org/ecis2018_rp/43

[3] McGraw Hill Construction Report (2012). *The Business Value of BIM in North America*. Smart Market Report, McGraw Hill Construction. ISBN: 1-800-591-4462

[4] Forth, P., Reichert,, T., Laubier, R., Chakraborty, S., *Flipping the Odds of Digital Transformation Success* (2020, October 29). From https://www.bcg.com/publications/2020/increasing-odds-of-success-in-digital-transformation#factor1 (last accessed on May 24, 2023)

[5] Ministry of industry of the republic of Indonesia. *Industry 4.0 Readiness Index*. https://sindi4.kemenperin.go.id/assets/content/INDI4.0_Full_v1.pdf

[6] Dörr, Stefan L., Schmidt-Huber, Marion., Maier, Günter W. (2021). *The LEaD competency model – effective leadership in the context of digital transformation*. Gr Interakt Org (2021) 52:325–339. https://doi.org/10.1007/s11612-021-00582-w

[7] van Tonder, C., Schachtebeck, C., Nieuwenhuizen, C., & Bossink, B. (2020). *A Framework for Digital Transformation and Business Model Innovation*. [Teorijski Okvir Digitalne Transformacije I Inovacije Poslovnih Modela] Management: Journal of Contemporary Management Issues, 25(2), 111-132. doi:https://doi.org/10.30924/mjcmi.25.2.6

[8] González, V., Hamzeh, F., & Alarcón, L. F. (2022). *Lean Construction 4.0 (*1st ed.). CRC Press.

[9] Koskela, L. (1992). Application of the New Production Philosophy to Construction, Center for Integrated Facility Engineering Technical Report No. 72, Stanford University

[10] Ballard, G. (2000). *The Last Planner System of Production Control (Doctoral Dissertation, University of Birmingham)*. Available at https://etheses.bham.ac.uk/id/eprint/4789/1/Ballard00PhD.pdf (last accessed on April 24, 2023)

[11] Klinc, R., & Turk, Ž. (2019). *Construction 4.0—digital transformation of one of the oldest industries*. Economic & Business Review, 21(3), 393–410. https://doi.org/10.15458/ebr.92

[12] Bartlett, K., Blanco, J.L., Jhonson J., Fitzgerald, B., Mullin, A., Ribeirinho, M.J., *Rise of the platform era: The next chapter in construction technology* (2020, October 30) McKinsey. from https://www.mckinsey.com/industries/private-equity-and-principal-investors/our-insights/rise-of-the-platform-era-the-next-chapter-in-construction-technology (last accessed on May 14, 2023)

[13] Buvat, J., Crummernel, C., Kar, K. et al. 2017. *The digital culture challenge: closing the employee leadership gap. Capgemini Digital Transformation Institute Survey*. Paris: Capgemini Digital Transformation Institute.

[14] Vuorikari, R., Kluzer, S. and Punie, Y., *DigComp 2.2: The Digital Competence Framework for Citizens - With new examples of knowledge, skills and attitudes*, EUR 31006 EN, Publications Office of the European Union, Luxembourg, 2022, ISBN 978-92-76-48882-8, doi:10.2760/115376, JRC128415.

[15] Olanipekun, A.O., Sutrisna, M., (2021). *Facilitating Digital Transformation in Construction—A Systematic Review of the Current State of the Art*. Front. Built Environ. 7:660758. doi: 10.3389/fbuil.2021.660758

[16] Ariono, B., Wasesa, M., Dellyana, D., Dhewanto, W. (2022). *A Comparative Case Study on Performance Management System in Architecture, Engineering, and Construction Start-up Enterprises in Indonesia*. The Asian Journal of Technology Management (AJTM), [S.l.], v. 14, n. 3, p. 216-229, dec. 2021. ISSN 2089-791X. Doi:10.12695/ajtm.2021.14.3.2.

[17] Gurumurthy, R., Schatsky, D., & Camhi, J. (2020, May 26). *Uncovering the connection between digital maturity and financial performance*. Retrieved May 1, 2023, from https://www2.deloitte.com/us/en/insights/topics/digital-transformation/digital-transformation-survey.html

[18] Ariono B, Wasesa M, Dhewanto W. (2022). *The Drivers, Barriers, and Enablers of Building Information Modeling (BIM) Innovation in Developing Countries: Insights from Systematic Literature Review and Comparative Analysis. Buildings*. 2022; 12(11):1912. https://doi.org/10.3390/buildings12111912

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