DIJDBM: Dinasti International Journal of Digital Business Management
E-ISSN: 2715-4203
P-ISSN: 2715-419X
https://dinastipub.org/DIJDBM dinasti.info@gmail.com +62 811 7404 455
DOI: https://doi.org/10.38035/dijdbm.v6i1.3319

Digital Transformation: Digital Maturity, Competitive Strategy, and Sustainable Business Model in Construction Industry. A Literature Review

Wildan Gilang[1], Orpha Jane[2]
[1]Universitas Katolik Parahyangan, Bandung, Indonesia, email. wildangilang@gmail.com.
[2]Universitas Katolik Parahyangan, Bandung, Indonesia, email. jane@unpar.ac.id.

Corresponding Author: wildangilang@gmail.com[1]

Abstract: In this digital era, the use of digital technologies is a must to implement in any industry, including construction industry. There are many technologies that have been implemented by construction companies in their digital transformation agenda like BIM, Artificial Intelligence, IoT, Big Data & Analytics, 3D printing, etc. Prior to implement those digital technologies, construction company should develop a comprehensive and holistic digital transformation strategy. The purpose of this research is intended to give recommendations in defining the dimension of digital maturity assessment and aspects to be well-thought-out in creating digital strategy. Literature review methodology is applied with reviewing books and journals that discussed the digital maturity assessment and strategy development. In conclusion, the digital transformation strategy development is required the maturity assessment first to understand the current digital transformation. The digital transformation strategy is recommended to consider the impact to the surrounding environment in order to give the value not only for the construction company itself.

Keyword: Digital Transformation, Digital Transformation Strategy, Construction 4.0, Sustainability Business Model.

INTRODUCTION

Nowadays, many organizations claim that they have implemented digital transformation. Digital transformation is the use of digital technology by a company or organization that change their business model, product, and business process to improve efficiency, reduce cost, and improve customer experience as well as innovation capability (Hongwei, et al., 2023). Digital transformation has changed significantly to conventional industry. As digital transformation is using digital technology, organizations are pushed to innovate their business model. Organizations that successfully innovate their business model will disrupt the conventional business.

In the last decade, Indonesia has experienced business disruption phenomena mainly caused by the adoption of technology. In the transportation sector, there were Gojek and Grab who disrupted the conventional business of ride hailing when they released their applications

on Android and IOS (detikcom, 2017). By using the application on mobile phone, people can easily ask for ride hailing for taxis, motorcycles, and other services that each platform provided. Like two side of a coin, Gojek and Grab provide benefits for people, but on the other hand they've been made significant disruption to the conventional business. When they hit the market, Bluebird and Express felt the changes (Tempo, 2015).

Digital Transformation is not only happening in the transportation sector, but also in other industries as construction. In construction industry, Construction 4.0 (4.0) becoming a new paradigm. C4.0 is a paradigm that change construction processes through the exploitation of technology including but not limited to AI, 3D Printing, BIM, Internet of Things, GIS, Extended Reality (VR/AR/MR), wearable technology, and other digital technologies. Construction industry needs to adopt a new way of working of doing business when it comes to implement new digital technologies by implement new standard operational procedure in order to maintain competitiveness (Leong, Manickam, Haque, Jumbulingam, & Md Noordin, 2024).

Considering the real-life examples of digital transformation, the Ministry of Industry of Indonesia released guidance and framework for assessing the readiness of Indonesian industry called Indonesia Industry 4.0 Readiness Index or INDI 4.0 (Kementerian Koordinator Bidang Perekonomian Republik Indonesia, 2018). The main objective of INDI 4.0 is to protect and uplift Indonesian industry competitiveness in industry 4.0 era and as a steppingstone to implement *Making Indonesia 4.0*. INDI 4.0 has five pillars or aspects in assessing the digital readiness transformation (Kementerian Perindustrian Republik Indonesia, 2018): (1) Organization and management; (2) People and culture; (3) Product and Service; (4) Technology; and (5) Factory operations.

Apart from INDI 4.0, there are numerous frameworks that can be using as reference to measure the digital transformation readiness in an organization. For example, Aarhus University has released framework that can be utilized in assessing the digital transformation readiness called Digital Maturity Assessment Tool (DMAT). DMAT is a tool that can help organization to measure the maturity level of an organization independently. There are six dimensions to measure the maturity level of digital transformation from DMAT of Aarhus University: (1) Strategy; (2) Culture; (3) Organization; (4) Process; (5) Technology; (6) Customer and Partner. From those two frameworks, they seem that the aspect or dimension to be assessed in digital transformation readiness have some similarities. INDI 4.0 and DMAT have similarities that they both mentioned strategy, organization, culture, and technology.

Many companies may use their digital maturity result as a baseline to define their strategy in executing digital transformation. To define strategy in specific to digital transformation is not an easy task. As mention in Strategic Management book, digital transformation is a collective process that would enable a company to integrate new digital technologies and improved with connectivity in every aspect (Orpha, 2022). Not only strategy, some studies say that digital transformation impacted to company's business model to be more sustainable (Broccardo, Zicari, Jabeen, & Bhatti, 2023).

Despite of having many frameworks or tools available to be adopted by many organizations in measuring the company's current stage of digital transformation, they are tending to question which framework or tool is the most suitable for them. On the other hand, the construction company would be questioning what would be the approach in defining digital transformation strategy and what would be sustainable business model look like in digital era. Considering the aforementioned, researchers determined the problem as follow: (1) What are aspects/dimensions to assess digital transformation readiness in construction industry? (2) Does digital transformation have impact to sustainable business model? (3) What would be the approach in defining digital transformation strategy?

METHOD

This research applied literature review approach that focusing on analyzing digital sustainable business model in digital era and its strategy to embrace the digital construction, especially in construction industry. The researchers studied and reviewed various studies that discuss digital transformation strategy that was collected from multiple electronic journal sources (Ayton, 2023).

RESULTS AND DISCUSSION

Results

1. Indonesia Construction Industry Overview

The construction industry is an industry that offers products and/or services to produce durable buildings and other works (Hillebrandt, 2000). Construction activities include new construction, repairs, and demolition of building and civil engineering works. Companies that carry out these activities are called construction companies that jointly form an industry. Not only companies, but all actors in this industry collectively form the construction industry consisting of limited liability companies, consultants, subcontractors, material factories, equipment suppliers, and labor. Generally, construction companies have the following main business processes (Jonas Construction Software, 2023):

a. Planning/design
   This phase is the initial phase in the main business process in a construction company. In this phase, the construction company will carry out activities such as *feasibility*, design schemes, and signing contracts with *the project owner*. This business process is important because, the construction company ascertains whether the project has business feasibility and is sufficient or not and gets an overview of the initial design and binding with *the project owner* through the signing of the contract.
b. Preconstruction
   After completion with the contract sign off in the planning/design business process, then the construction company will usually prepare the location of the construction project will take place such as but not limited to, soil pH testing, and soil structure checking.
c. Procurement
   Furthermore, construction companies procure materials needed in the implementation of the construction business process.
d. Construction
   This business process is a business process that is very commonly understood by everyone. In this business process, construction companies carry out their main activities to do the construction or construction supervision (depending on the type of project). This process is a crucial process for all construction companies, where the reputation of the construction company will be obtained from the final results of this business process.
e. Post-construction
   If the construction business process has been completed, then the post-construction business process is carried out. In this business process, the project owner will conduct a final check together with the construction company prior to handover.

The construction activities are classified into 3 (three) fields of work, namely (Badan Pusat Statistik, 2023):

a. Building construction
   Building construction includes general construction activities including the construction of new buildings, building repairs, building additions and building changes, erection of parts of prefabricated buildings/structures on site and also temporary construction. Building construction also includes the construction of all residences, office buildings,

shops, other public facilities and infrastructure, including agricultural buildings and others.

b. Civil building construction
   Civil building construction includes general construction activities of civil buildings, both new buildings, building repairs, building additions and building changes, erection of prefabricated building parts/structures on site and temporary construction.
c. Special construction
   Special construction includes construction activities that require special skills. Generally, expertise is meant to be one general aspect for different structures, which requires special equipment or skills and is more done on a sub-contract basis. This group also includes building completion activities, installation of various necessities that make the building function such as plumbing, heating, air conditioning (AC), alarm system and other electrical works, watering system, elevator and walking stairs.

Based on *Badan Pusat Statistik* (BPS) Indonesia, data collected in 2023 shows that the construction industry in Indonesia is in fifth place as an industry that contributes to Gross Domestic Product (GDP) of 9.92% (Badan Pusat Statistik, 2023). This seems that the construction industry in Indonesia is not only a complement, but also one of the main contributing industries to Indonesia's GDP. By looking at this data, the construction industry is also inseparable from the use of digital technology to always provide value for its service users.

2. Digital Transformation

The study of digital transformation has been in the forefront of the recent study. This can't be separated by many digital companies that have been emerged in the last decade. In Indonesia itself, as mentioned in the introduction there are Gojek and Grab who were pioneering the digital companies. Apart from that, in the last 5 years, the digital companies also landed in other industries. Seabank, Bank Jago, Bank Neo Commerce, Hibank, Blu, Bank Raya are some of digital banks that are currently existed in Indonesia in financial sector (Bisnis.com, 2024). In accordance with that, digital transformation is a must-do in every industry.

In a simple term, digital transformation is a change process by utilizing digital technology with aim to improve company's performance. Digital transformation will integrate new digital technologies and improved with connectivity everywhere to achieve sustainable superior performance and competitive advantage (Orpha, 2022). There are five areas that changed by digital transformation in a company as mentioned in Strategic Management + book:

Table 1. Areas Changed by Digital Transformation

Theme	From	To
Customers	• Customers as a mass market • Communication is distributed to customers (one-way) • The company is a key influencer • The marketing goal is to persuade them to buy • The flow of value is one-way • Economies of scale for enterprises	• Customers as dynamic networks • Two-way communication • Customers are key influencers • Marketing aims to inspire purchases, loyalty, and become ambassadors • Value flows are reciprocal • Economic value from a customer perspective
Competition	• Competition occurs in the same industry • The difference between partners and competitors is very clear • Competition is a win-lose • Key assets are within the Company	• Competition between industries is fluid • The difference between partners and competitors is not clear • Cooperation between competitors in key regions key assets outside the network

Theme	From	To
	• Product emphasis on unique benefits and features • Dominant competitors in each category are few	• Platforms with partners that exchange value • Winners can win all
Data	• Data generated within the Company is usually expensive • The challenge is managing and storing data • The company only uses structured data • Data is managed in separate units • Data is a tool for the optimization process	• Data is developed everywhere • The challenge is to turn data into information • Unstructured data increases its use and value • Valuable data is the result of units interacting with each other • Data is a key intangible asset for value creation
Innovation	• Decisions are made based on intuition and seniority • Idea testing is expensive, slow, and difficult • Experiments are rarely carried out and are usually by experts • The challenge of innovation is to find the right solution • Failure prevented by any means • Focus on the value of the end product	• Decisions are made based on testing and validation • Cheap, fast, and easy idea testing • Experiments conducted directly by anyone • The challenge of innovation is to solve the right problem • Failure is a learning process, fast and easy • Focus on viable maximum prototypes and iterations after launch
Value	• Value proposition determined by industry • Implementation of current value proportion • Optimize business models while possible • Judged based on how much impact the business is currently having • Success in the market can satisfy the company	• The proportion of value is determined by changes in customer needs • Seek out new opportunities for customer propositions • Development continues to be carried out in order to continue to lead • Judged based on how far the company can create business in the future • *Only the paranoid survive*

Source: (Orpha, 2022)

3. Sustainable Business model

Digital transformation consequently requires construction company to transform their business process legacy. Hence, not the technology adoption is very essential in digital transformation, but also the business model itself. A sustainable business model is a framework that enables businesses to create long-term value by balancing economic, environmental, and social considerations. It involves integrating sustainability principles into all aspects of a business, from value creation and delivery to value capture (Bocken, S.W. , Rana, & Evans, 2014).

When it comes to sustainable business model, there are 5 (five) key characteristics if a company has a sustainable business model:

a. Triple bottom line: Focuses on economic, environmental, and social performance (Hendricks, 2024).
b. Circular economy: Emphasizes resource efficiency, waste reduction, and product lifecycle extension (Comin, et al., 2020).
c. Stakeholder engagement: Involves collaboration with diverse stakeholders, including customers, employees, suppliers, and communities (Isystain, 2020).

d. Innovation: Promotes continuous innovation to develop sustainable solutions and products (Scheneider Electric, 2022).
e. Long-term perspective: Considers the long-term impacts of business decisions and seeks sustainable growth.

4. Construction 4.0

Since industrial revolution 4.0 started, the use of technology as a business model innovation has been widely used by companies in various industries, including the construction industry. As a result of the use of technology in the construction business process, there is the term *Construction 4.0* (C4.0). C4.0 is also called a new operating model based on the results of more effective and efficient construction implementation (Casini, 2022). To realize C4.0, there are 3 (three) factors that need to be considered:

a. The urgent need to increase productivity, reduce safety risks, and address the challenge of labor scarcity;
b. Urgent needs regarding trends such as sustainability, demographics, increased digital connectivity, and global health issues;
c. The latest digital technology developments such as *Building Information Modeling* (BIM), *Cloud and Edge Computing*, *Internet of Things* (IoT), 5G, *Artificial Intelligence* and *Machine Learning*, *Big Data* and *advanced analytics*, *Nanotechnology*, other technology trend fibers that are still developing today such as VR/AR/MR, GIS, and Others.

As previously stated, digital transformation is very closely related to the use of digital technology in business processes in companies. Therefore, the following is a literature review of some of the technology trends in the construction industry (Casini, 2022).

a. Building Information Modelling (BIM)
   BIM is a comprehensive process for generating and managing asset information. Through a smart model supported by *a cloud* platform, BIM integrates structured and multi-disciplinary data to produce a digital representation of an asset in the construction life cycle, starting from planning, design, construction, and operation. There are levels of BIM technology ranging from 3D to 7D.
b. Artificial Intelligence & Machine Learning
   Artificial Intelligence (AI) is a computer science that focuses on the development of artificial intelligence inspired by human cognitive processes. AI is created using algorithms that are able to recognize patterns, illustrate relationships, and can help humans in decision-making. Machine Learning (ML) is crucial in the development of AI, where ML makes it possible to obtain data and interpret data. Specifically, ML uses mathematical models of data processing to help computers without instructions or intervention. Examples of AI capabilities that resemble human cognitive abilities are image recognition, writing text, speaking, or *self-driving*, flying airplanes or performing complex tasks, and even predicting the future based on the results of data analysis.
c. Cloud & Edge Computing
   According to one of the standards bodies in the United States, *the United States National Institute of Standards and Technology* (NIST), cloud computing is a model that allows convenient access to computing resources such as data storage, servers, databases, applications, and software that can be monitored and managed with minimal effort. Through the development of massive cloud computing technology, the construction world is also not spared from its reach which can provide advantages in every phase of the construction process, from design to construction, management, and maintenance. Cloud computing has 3 (three) models, namely: (1) Infrastructure as a Service (IaaS); (2) Platform as a Service (PaaS); (3) Software as a Service (SaaS).

d. Internet of Things (IoT)
A significant trend in today's digital revolution is that cyber and physical environments are becoming increasingly interconnected at different levels due to IoT implementation. IoT is a set of device and object infrastructures that are connected to the internet and can collect and transmit data at specific circumstances that can be used for monitoring, control, statistical analysis and decision support. IoT has been heavily immersed into various domains in the industry and is considered one of the key technologies that enable Industry 4.0.
The growth of IoT is also paving the way for the emergence of AI powered by Big Data. This is because IoT provides the detailed information needed to feed ML algorithms by analyzing the data collected by IoT in Big Data. IoT architecture makes it possible to equip all objects with identifying, sensing, networking, and processing capabilities that make it possible to exchange and share information and develop sophisticated services over the Internet.
IoT applications is by using sensors that can detect the surrounding environment and then analyze for the purpose of generating information in *real-time*. The information collected in real-time is intended for the purpose of monitoring, control, statistical analysis, and decision support that can be applied in the construction world both in the construction, operation, and maintenance phases.

e. Big Data & Advanced Analytics
The term *Big Data* refers to the exponential explosion in the amount of data generated and stored, while *Advanced Analytics* refers to the ability to automatically work with and generate insights from data processing (McKinsey Global Institute, 2011). Big Data It is also defined as an information asset that is characterized in the amount of data (volume), the need for data processing speed (velocity), and high data diversity (variety) and requires technology and analysis methods to transform it into value (De Mauro, Grimaldi, & Greco, 2014). Volume indicates a large amount of data, for example in terabits or petabits. Variety indicates diverse types of data such as data in text format, sensor results, sound, video, and images. Meanwhile, velocity indicates the speed of data processing needs such as data obtained through streaming.
Advanced analytics uses AI and ML to automate the analytics process, including collecting data from raw data sources, preparing and cleaning that data, building unbiased analytics models, and generating and communicating relevant insights.
When compared to other industries, the application of *Big Data & Analytics* in the construction industry is still lagging behind. The construction industry deals with data arising from diverse disciplines throughout the facility lifecycle. BIM is expected to capture CAD information systematically to support collaboration among stakeholders. With the advent of devices and sensors, facility management has even begun to generate data massively during the operation and maintenance stages of construction, ultimately leading to a richer source of Big BIM Data. As explained earlier, it is known that data in the construction industry is very numerous and diverse. These data include design, operations, financial, photo and video data, text, sensors, RFID, and BAS.

5. Digital Maturity Assessment

In response to the digital transformation, many organizations are seeking to understand their current condition to implement the digital technologies that can change their business processes / business models (Remane, Hanelt, Wiesböck, & Kolbe, 2017). There are several aspects that need to be considered in assessing digital transformation readiness based on analysis result from previous study:

Table 2. Aspects in Assessing Digital Transformation

Title	Author	Dimension	Digital Maturity Level
Building a Digital Transformation Maturity Evaluation Model for Construction Enterprises Based on the Analytic Hierarchy Process and Decision-Making Trial and Evaluation Laboratory Method	Hongwei Zhu, Liang Wang, Chao Li, Simon P. Philbin, Hujun Li, Hui Ii, and Martin Skitmore	Digital strategy, data capability, digital technology capabilities, change management, digital organizational, digital business applications	• 0 to 0.8: integrating business systems for collaboration and information sharing, though data application remains low • 0.8 to 1.6: process operation focuses on integrating digital technology to enhance enterprise management, operations, and strategic planning • 1.6 to 2.4: intelligent construction, emphasizing quality, safety, and efficiency improvements through technology integration • 2.4 to 3.2: intelligent scenario application-level employs data analytics, BIM, and AI to optimize project management • 3.2 to 4.0: industrial ecological collaboration, wherein enterprises leverage their digital capabilities to build a digital engineering ecosystem, fostering efficient coordination across the industry chain and creating a comprehensive digital industry ecology
Development of a digital maturity model for Industry 4.0 based on the technology-organization-environment framework		• Technology (infrastructure, data technologies, advanced technologies, technology for smart products and services) • Organization (strategy, governance, culture, human resources, processes) • Environment (legal and regulatory, market perspective, interorganizational)	• Level 1 – Digitization • Level 2 – Communication • Level 3 – visibility • Level 4 – transparency • Level 5 – predictability • Level 6 – flexibility / adaptability
Digital Maturity: Conceptualization and Measurement Model	Alexander Rossman	• Strategic • Leadership • Market • Operational • People and expertise • Cultural • Governance • Technology	• Not defined

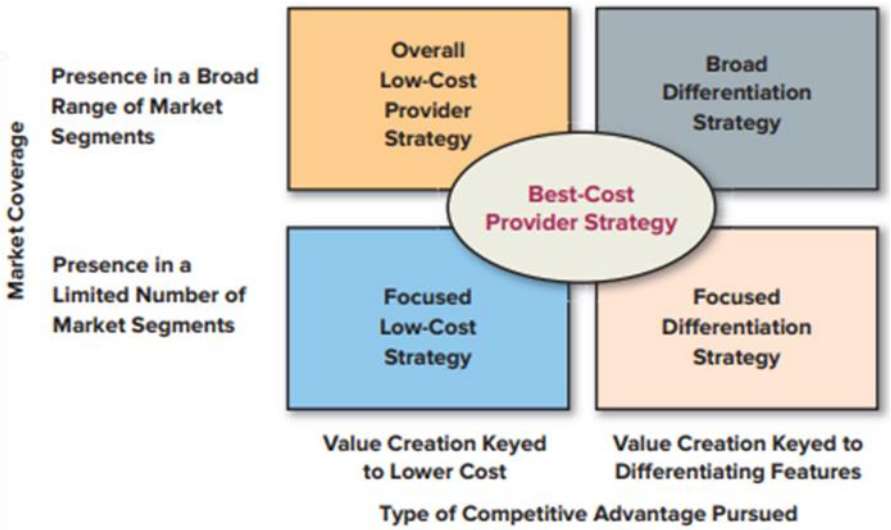
Justification of Construction 4.0 maturity model with a case study of a data driven façade company	Orsolya Heidenwolf, Ildiko Borbasne Szabo	• Technology Management & Business Strategy • Culture and People Management • Collaboration and Communication • Technology for Automation • Innovation • Change Management and Processes • Collaboration and communication	• Level 0 – Not importance to Level 5 – Most Importance
Digital Maturity: Definition and Model	Aslanova I.V, Kulichkina A.I	• Strategy • Organization • People • Technologies • Data	• Beginners • Catching-ups

Source: Research Data

6. Digital Transformation Strategy Development

Digital transformation is not the same as digitalization. Digital transformation not only changes the format of documents that were previously paper to digital, but also changes the business model and/or business processes in an organization/company (Hanelt, Bohnsack, Marz, & Marante, 2021). Therefore, a comprehensive strategy is needed in planning, implementing, and managing digital transformation. As Michael E. Porter explains, strategy is the creation of a unique and valuable corporate position (Porter, 1996). Digital transformation is considered one of the strategies in creating a unique and valuable company position, as well as becoming a competitive advantage. Hence, digital transformation is required a comprehensive stretegy in order to bring value to the companies that will a significant impact to lift up their performance as well as the company's value.

As digital transformation is also aiming the competitive advantage, company can consider the 5 (five) generic competitive strategies (Thompson, Jr., Peteraf, & Gamble, 2017):



Source: (Thompson, Jr., Peteraf, & Gamble, 2017)

Figure 1. 5 (Five) Generic Competitive Strategies

a. A low-cost provider strategy—striving to achieve lower overall costs than rivals and appealing to a broad spectrum of customers, usually by underpricing rivals.
b. A broad differentiation strategy—seeking to differentiate the company's product or service from rivals' in ways that will appeal to a broad spectrum of buyers.
c. A focused low-cost strategy—concentrating on a narrow buyer segment (or market niche) and outcompeting rivals by having lower costs than rivals and thus being able to serve niche members at a lower price.
d. A focused differentiation strategy—concentrating on a narrow buyer segment (or market niche) and outcompeting rivals by offering niche members customized attributes that meet their tastes and requirements better than rivals' products.
e. A best-cost provider strategy—giving customers more value for the money by satisfying buyers' expectations on key quality/features/performance/service attributes while beating their price expectations. This option is a hybrid strategy that blends elements of low-cost provider and differentiation strategies; the aim is to have the lowest (best) costs and prices among sellers offering products with comparable differentiating attributes.

On the other hand, company should also consider that their strategy of digital transformation will have positive impact for their environement. To ensure that the company will have the posistive impact to their environment, Net Positive can be used as an approach. Net Positive refers to a business approach that aims to have a positive impact on the environment and society, going beyond just minimizing harm. It involves creating a net benefit for the environment, communities, and other stakeholders. This approach focuses on not only reducing negative impacts but also actively contributing to social and environmental well-being. Net Positive companies strive to make a positive contribution to the world, often by implementing sustainable practices, supporting local communities, and promoting environmental conservation. The concept emphasizes the idea that businesses should be a force for good, actively working to improve the world around them (Polman & Winston, 2021).

There are five core principles that separate the net positive companies from the merely well-run and well-meaning business:

a. Ownership of all impacts and consequences, intended or not
b. Operating for the long-term benefit of business and society
c. Creating positive returns for all stakeholders
d. Driving shareholder value as a result, not a goal
e. Partnering to drive systemic change

Discussion

The following section is intended to discuss the result of this research which answering the questions mentioned.

Q1: What are aspects/dimensions to assess digital transformation readiness in construction industry?

As part of the digital transformation implementation readiness, a construction company should consider to assess some aspects within its own field. Based on the literature review, there are 5 (five) dimensions in assessing the digital transformation maturity as mentioned below:

1. Technology

   This dimension is intended to understand current technology implementation that the construction company has been implemented and in progress. BIM, AI, Machine Learning, Big Data & Analytics, IoT are some digital technologies that commonly accepted as digital transformation in construction company. Apart from the technology implementation itself, the construction companies would also to consider on how do they manage their technology from planning, developing, testing, to releasing the technology.

2. Strategy & Organization
   The responsibility of digital transformation implementation is not only given to the IT function / organization in the construction company. All stakeholders should be considered as impacted parties that will have contribution to define the business cases, technology options, and investment cases. This dimension is required a comprehensive and holistic strategy that applies as enterprise-wide strategy for digital transformation. Digital transformation would be successful if there is no definitive organization (functional or structural) which responsible to oversee the overall strategy execution of digital transformation.
3. People & Culture
   Change is an aspect that construction company should face in digital transformation. Hence, this aspect is very crucial to determine the objective of digital transformation is clearly communicated to all stakeholders, identify the impact to each stakeholder from digital transformation implementation, define the right approach to improve the capability of human resources to use the digital technology, define the communication strategy for each stakeholder, and measure the improvement of each business function of digital transformation implementation (compare expected result in planning stage and the value delivered when the digital technologies have been implemented).
4. Data
   Digital technologies will become the data source for the construction company and data will be the new oil and be treated as valuable asset. Data management should be assessed to understand the current state on how the construction company treat their data. This includes the processes to manage data, the technology to acquire, store, and process / analyze the data, and the data protection.
5. Innovation
   Digital technologies are enabler for the digital transformation implementation. Considering that the digital technologies are always growing, construction company should assess the level of innovation within the company. This is intended to encourage the construction companies to be more flexible, innovative, and find the right purpose of the digital technologies' implementation. This dimension is also seeking on how the construction companies manage the innovation from incubation to piloting the ideas.

Q2: Does digital transformation have impact to sustainable business model?

According to the sources that discussed in this paper, the digital technologies that implemented as part of digital transformation initiative have an impact to the business model. When it comes to the sustainability, construction companies should also consider the impact to the environment as digital technologies require resources like computing power. Hence, the construction companies should seek the technology provider that has an alignment to the environmental perspective. Apart from that, the use case digital technologies implementation should also consider the impact to the environment. For example, the construction company will assess the environment impact like carbon emission of UAV usage for layout mapping compared against if the construction companies are used carbon emitted vehicle. In addition, the construction companies can consider the net positive principle in every digital technology initiative.

Q3: What would be the approach in defining digital transformation strategy?

Considering the digital maturity assessment dimensions (technology, strategy & organization, people & culture, data, and innovation), construction companies should also consider the area that change by digital transformation:

1. Customers
   Some questions to be answered when formulating digital transformation strategy:

a. Does the digital technology can change the company offering?
b. Will the digital technology increase the customer engagement to the company?

2. Competition
   Some questions to be answered when formulating digital transformation strategy:
   a. Have the competitors implemented the digital technologies?
   b. How can we differentiate ourselves with the competitors if we implement the same digital technologies?
   c. What would be the market response that we expect for our digital transformation initiative?
   d. Will the digital technologies that we will implement make ourselves as the winner?
3. Data
   Some questions to be answered when formulating digital transformation strategy:
   a. Do we have the right capabilities to manage our data (structured and unstructured data?
   b. Do we need to implement other technological tools in supporting the data management?
   c. Can we analyze the data to become valuable insight to the company?
4. Innovation
   Some questions to be answered when formulating digital transformation strategy:
   a. What is our current process in initiating, testing, and validating the innovation proposal?
   b. Do we solve the right problem of our innovation proposal?
   c. Do we have the sufficient capital resource to do the innovation?
5. Value
   Some questions to be answered when formulating digital transformation strategy:
   a. Do we address the customer needs as the basis for digital technologies implementation?
   b. Do we change our customer propositions as the expected result of digital transformation?
   c. Do we create new business model or line of business from digital transformation?

CONCLUSION

Digital transformation strategy is a must have in this digital era. But, the execution itself requires a comprehensive and holistic strategy that treated as a company-wide strategy. The responsibility of developing the digital transformation strategy is not given to the specific function in an organization, but requires involvement from the all functions in an organization. Prior to crafting the digital transformation strategy, a construction company is recommended to conduct the assessment that aims to understand the current digital transformation that they already had.

Once the digital maturity assessment level is known, the construction company is recommended to conduct the hypothesis impact of the digital transformation that will change their ways of working. This activity would be leveraged to also define the impact to the environment to get the maximum value (net positive) to the company. It is also important for the construction company to assess their external environment to enrich the digital transformation strategy.

REFERENCE

Ayton, D. (2023). *Chapter 5: Qualitative descriptive research*. Retrieved from Open Educational Resources Collective: https://oercollective.caul.edu.au/qualitative-research/chapter/ unknown -5/#:~:text=A%20qualitative%20descriptive%20study%20is%20an%20effective%20des

ign%20for%20research,analysis%20to%20be%20relatively%20simple.

Ayton, D. (2023). *Chapter 5: Qualitative descriptive research*. Retrieved from Open Educational Resources Collective: https://oercollective.caul.edu.au/qualitative-research/chapter/__unknown__-5/#:~:text=A%20qualitative%20descriptive%20study%20is%20an%20effective%20design%20for%20research,analysis%20to%20be%20relatively%20simple.

Badan Pusat Statistik. (2023). *Indikator Konstruksi.* Badan Pusat Statistik.

Badan Pusat Statistik. (2023). *Konstruksi dalam Angka 2023.* Badan Pusat Statistik.

Bisnis.com. (2024, May 25). *Top 7 Bank Digital di Indonesia Kuartal I/2024: Seabank Teratas, Hibank Melesat*. Retrieved from bisnis.com: https://finansial.bisnis.com/read/20240525/90/1768141/top-7-bank-digital-di-indonesia-kuartal-i2024-seabank-teratas-hibank-melesat

Bocken, N., S.W. , S., Rana, P., & Evans, S. (2014). A literature and practice review to develop sustainable business model archetypes. *Journal of Cleaner Production*, 42-56.

Broccardo, L., Zicari, A., Jabeen, F., & Bhatti, Z. A. (2023). How digitalization supports a sustainable business model: a literature review. *Technological Forecasting and Social Change*.

Casini, M. (2022). *Construction 4.0: Advanced Technology, Tools and Materials for the Digital Transformation of the Construction Industry.* Duxford: Elsevier.

Comin, L. C., Aguiar, C. C., Sehnem, S., Yusliza, M.-Y., Cazella, C. F., & Julkovski, D. J. (2020). Sustainable business models: a literature review. *Benchmarking: An International Journal*, 2028-2047.

De Mauro, A., Grimaldi, M., & Greco, M. (2014). What is Big Data? A Consensual Definition and a Review of Key Research Topics. *4th International Conference on Integrated Information.*

detikcom. (2017, Agustus 22). *Awal Mula Transportasi Online Menjamur di Indonesia*. Retrieved from detikcom: https://inet.detik.com/cyberlife/d-3609781/awal-mula-transportasi-online-menjamur-di-indonesia

Hanelt, A., Bohnsack, R., Marz, D., & Marante, C. A. (2021). A Systematic Review of the Literature on Digital Transformation: Insights and Implications for Strategy and Organizational Change. *Journal of Management Studies*, 1160-1197.

Hendricks, D. (2024, April 25). *How to Create a Sustainable Business Model*. Retrieved from business.com: https://www.business.com/articles/how-to-create-a-sustainable-business-model/

Hillebrandt, P. M. (2000). *Economic Theory and the Construction Industry.* London: MACMILLAN PRESS LTD.

Hongwei, Z., Liang, W., Chao, L., Simon, P. P., Hujun Li, Hui, L., & Martin, S. (2023). Building a Digital Transformation Maturity Evaluation Model for Construction Enterprises Based on the Analytic Hierarchy Process and Decision-Making Trial and Evaluation Laboratory Method. *MDPI-Buildings*, 1-20.

Isystain. (2020, May 19). *Why stakeholder management is essential to sustainable business*. Retrieved from isystain.com: https://www.isystain.com/blog/2020/5/18/stakeholder#:~:text=For%20a%20company%2C%20this%20typically,suppliers%2C%20customers%20and%20employees.%E2%80%9D

Jonas Construction Software. (2023, Juli 17). *The 5 Phases of Construction Project Management & How Software Can Help*. Retrieved from jonasconstruction.com: https://www.jonasconstruction.com/blog/phases-of-construction-project-management/#:~:text=This%20process%20can%20be%20broken,construction%2C%20and%20post%2Dconstruction.

Kementerian Koordinator Bidang Perekonomian Republik Indonesia. (2018, April 4). *Pemerintah Luncurkan Making Indonesia 4.0*. Retrieved from ekon.go.id: https://ekon.go.id/publikasi/detail/1443/pemerintah-luncurkan-making-indonesia-40

Kementerian Perindustrian Republik Indonesia. (2018). *Indonesia Industry 4.0 Readiness Index (Indeks Kesiapan Industri di Indonesia untuk Bertransformasi Menuju Industri 4.0)*. Jakarta: Kementerian Perindustrian Republik Indonesia.

Leong, L. K., Manickam, L., Haque, R., Jumbulingam, K., & Md Noordin, N. B. (2024). Embracing Digital Transformation for Sustainable Business in the Construction Industry. *Pakistan Journal of Life and Social Sciences*, 1621-1640.

McKinsey Global Institute. (2011). *Big Data: The next frontier for innovation, competition, and productivity*. McKinsey Global Institute.

Orpha, J. (2022). *Strategic Management +*. Bandung: Refika Aditama.

Polman, P., & Winston, A. (2021). *Net Positive. How Courageous Companies Thrive by Giving More Than They Take.* Boston: Harvard Business Review.

Porter, M. E. (1996). What is strategy? *Harvard Business Review*, 37-55.

Remane, G., Hanelt, A., Wiesböck, F., & Kolbe, L. (2017). DIGITAL MATURITY IN TRADITIONAL INDUSTRIES – AN EXPLORATORY ANALYSIS. *Twenty-Fifth European Conference on Information Systems (ECIS)*.

Scheneider Electric. (2022, May 16). *Sustainable business model innovation: A brief overview*. Retrieved from Scheneider Electric: https://blog.se.com/sustainability/2022/05/16/sustainable-business-model-innovation-a-brief-overview/#:~:text=Assuring%20resource%20efficiency%2C%20ethical%20business,a%20successful%20sustainable%20business%20model.

Tempo. (2015, Oktober 26). *Ojek Pangkalan Geruduk Kantor Gojek di Bandung* . Retrieved from tempo.co: https://nasional.tempo.co/read/713181/ojek-pangkalan-geruduk-kantor-gojek-di-bandung

Thompson, Jr., A. A., Peteraf, M. A., & Gamble, J. E. (2017). *Essentials of Strategic Management. The Quest for Competitive Advantage.* New York: Mc Graw Hill Education.