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Knowledge Management and Digital Transformation through Industrial Engineering and Civil Engineering Perspectives

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Abstract

Knowledge management constitutes one of trends in digital economy era. The mentioned digital economy era is characterized by sophistication of human interaction, computing and content to provide interactive information highway. The objective of this paper is to ensure strategic implementation of knowledge management (KM) and digital transformation (DT) through theoretical perspectives of Industrial Engineering (IE) and Civil Engineering (CE). The strategic implementation in this paper is applicable within empirical perspective in PT. Wijaya Karya (Persero) Tbk, known as one of State Own Enterprises (SOE) in Indonesia, namely WIKA. Result of this paper refers to the bibliometric analysis of KM; and its vital role in DT through IE and CE perspectives. Subsequently, the mentioned result is implemented strategically in WIKA through its value of Agility (Change, Focus, Fast), Caring (Accountable, Respect, Safety Oriented) and Excellence (Commitment, Innovation, Professional). Discussion of this paper refers to strategic perspective to ensure implementation of KM and DT through theoretical perspectives of IE and CE. Meanwhile, the research methodology in this paper elaborates the quantitative approach through research model. This model involves variables of Perceived Usefulness (PU), and Perceived Ease of Use (PEOU) that influences Attitude Toward Using (ATU) that ultimately influences Actual System Usage (ASU).
Keywords: *WIKA, State Own Enterprise (SOE), Civil Engineering, Industrial Engineering, Badan Usaha Milik Negara (BUMN), Digital Economy Era*

1.Introduction

Knowledge Management (KM) is defined as the systematic coordination within an organization. The aforementioned KM coordinates human resources, technology, process and organizational structures toward the value added through innovation. Knowledge management constitutes one of trends in digital economy era. The mentioned digital economy era is characterized by sophistication of human interaction, computing and content to provide interactive information highway. Within Industrial Engineering Perspectives; Knowledge Management (KM) and Digital Transformation (DT) are orchestrated through the creation, sharing and knowledge implementation by using experiences and actions that have been conducted by company toward the sustainable organizational learning [1].

Meanwhile, within Civil Engineering; KM and DT relate to the construction projects as its centre stage. The aforementioned construction projects' time management relates to project duration with certain start and finish dates perspectives. Meanwhile, those projects are conducted with more traditional ways compared to the other industries. The demanding of clients' awareness comprises the quality of the projects, the projects' complexities. Those complexities are in terms of the cost, size, technologies that enable the construction industry to use the appropriate knowledge management system [2]. Furthermore, within the Civil Engineering; A process of creating, securing, capturing, coordinating, combining, retrieving, and distributing knowledge is called knowledge management [3]. The construction industry is a very competitive industry due to the following reasons: the products are considered as non-standards and having their own complexity with a very tight construction schedule and low profit margins. Those reasons make the knowledge management system is crucial for construction industry. The generation of processes and new technologies will be facilitated by the

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effective knowledge management. It will bring the industry improvement in productivity, competitiveness and profitability [4,5].

In some perspectives, the Civil Engineering is embedding the value engineering. In this paper, Value engineering as one of the management tool is functioned to get the product with lowest cost. But value engineering in construction industry most likely depends on the capability and the experience of team members. Knowledge management system in value engineering can improve the efficiency of the project. The inventive problem solving theory can be applied in value engineering knowledge management system. The ideas and solutions from historical value engineering studies that stored in database will reduce redundant work. Value engineering knowledge management can reduce 5-10% of the construction cost [6]. Innovation takes the important part in the digital sector. Digital transformation allows the real time project progress monitoring. It is very useful to get more information so the right decision can be made. Digital transformation in civil engineering such as the using of drones will make easier to get more real-time detailed control over the project [7].

2. Materials

This paper's objective is to ensure strategic implementation of knowledge management (KM) and digital transformation (DT) through theoretical perspectives of Industrial Engineering (IE) and Civil Engineering (CE). The strategic implementation in this paper is applicable within empirical perspective in PT. Wijaya Karya (Persero) Tbk, known as one of State Own Enterprises (SOE) in Indonesia, namely WIKA.

3. Methods

Research Methods and Research Methodology in this paper are using validity test, reliability test, and classical assumption test including the hypothesis test using software of SPSS Version 23. The aforementioned both Methods and Methodology, refers to major part of Industrial Engineering, in addition the prior Civil Engineering Perspectives. The research methodology in this paper elaborates the quantitative approach through research model. This model involves variables of Perceived Usefulness (PU), and Perceived Ease of Use (PEOU) that influences Attitude Toward Using (ATU) that ultimately influences Actual System Usage (ASU) as depicted in Figure 1.

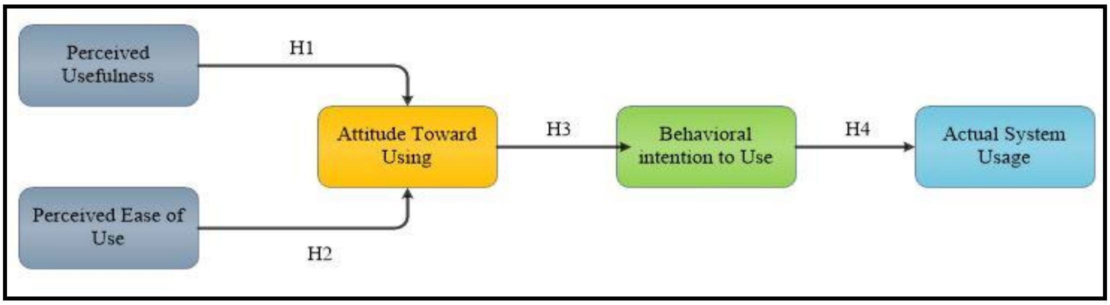

Figure 1 Research Model

4. Results and Discussion

Result of this paper refers to the bibliometric analysis of Knowledge Management (KM); and its vital role in Digital Transformation (DT), through Industrial Engineering (IE) and Civil Engineering (CE) perspectives. Initial bibliometric analysis of KM is depicted in Table 1 and Figure 2 [8].

Visualization of topography in terms of time was illustrated Figure 2, in which it convey the escalating trend in Knowledge Management and Sustainability. The source of bibliometric is originated from 3025 documents. Those documents comprise 51% conference papers, 38% journal articles, 4% journal reviews 4%, 2% conference reviews, book chapters and 1% books.

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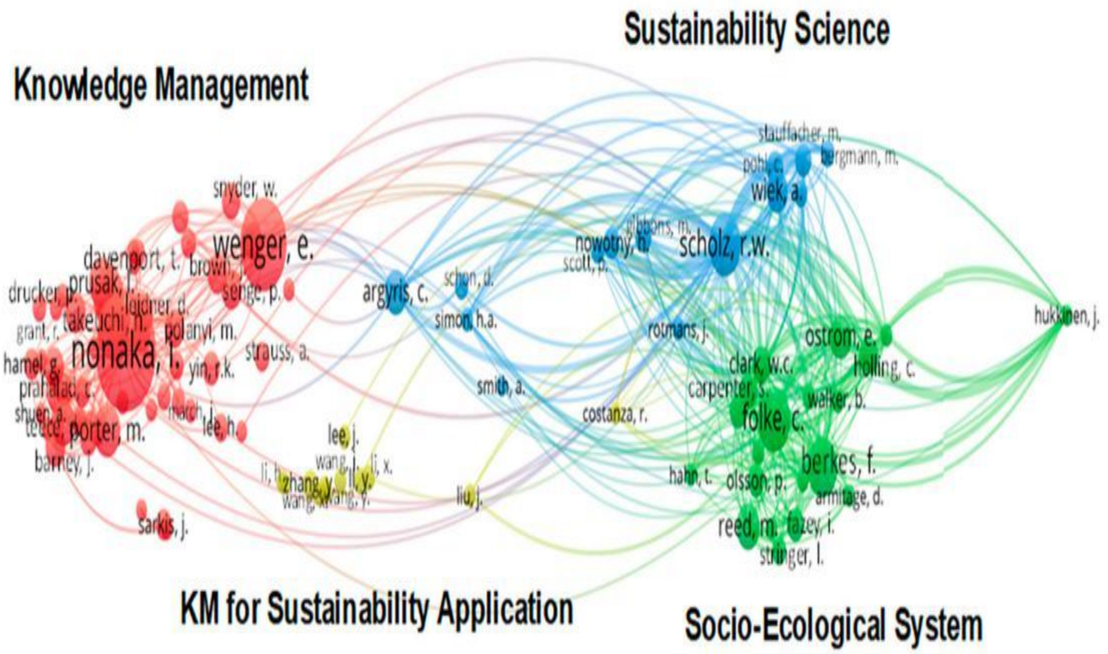

Figure 2 Scholar co-citation on Knowledge Management and Sustainability

The aforementioned bibliometric process was commenced in 1994 and subsequently continued in the year of 1990s and early 2000s. Interesting observations refer to the two folded publications numbers in the year 2004, as compared to its prior year in the year 2003. To some extent, Knowledge Management has been ubiquitously interested toward prior 25 years and beyond until current day. Subsequently, the mentioned result is implemented strategically in WIKA's value.

Table 1 Most highly-cited scholar works on Knowledge Management and Sustainability

Author	**University A liation**	**Country**	**Documents**	**Citations**	**CPD** [1]	**H-Index**
D. Helbing	ETH Zurich	Switzerland	2	798	399	70
L. Bettencourt	U. of Chicago	USA [2]	1	782	782	32
C. Kühnert	Dresden U. of Technology	Germany	1	782	782	6
J. Lobo	Arizona State U.	USA	1	782	782	19
G. B. West	U. of Oxford	UK [3]	1	782	782	44
L. C. Stringer	U. of Leeds	UK	5	586	117	32
R. Phaal	U. of Cambridge	UK	3	580	193	26
M. S. Reed	Newcastle U.	UK	4	564	141	38
J. H. Dyer	Brigham Young U.	USA	1	555	555	20
N. W. Hatch	Brigham Young U.	USA	1	555	555	9
A. C. Evely	U. of St Andrews	UK	3	546	182	14
C. M. Raymond	Swedish U. of Agricultural Sciences	Sweden	3	485	162	26
I. Fazey	U. of St Andrews	UK	2	475	238	33
K. Yew Wong	U. Teknologi Malaysia	Malaysia	1	436	436	25
Y. Caloghirou	NTUA [4]	Greece	1	424	424	15
I. Kastelli	NTUA	Greece	1	424	424	3
A. Tsakanikas	NTUA	Greece	1	424	424	7
L. Van Kerkho	Australia National U.	Australia	3	388	129	16
P. Almeida	Georgetown U.	USA	1	385	385	13
A. Phene	U. of Utah	USA	1	385	385	10

Thomson was considered the most productive scholars with 11 documents and 58 citations. Subsequently, Thomson was followed by the following scholars in term of its documents and citations. Precisely, those scholars are Y. Zhang with 11 documents and 29 citations; J. Wang with 9 documents and 63 citations; Scholz with 8 documents and 371 citations; Liu with 8 documents and

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278 citations; Zhang with 8 documents and 4 citations; X. Zhang with 7 documents and 234 citations;, H. Li with 7 documents and 83 citations; and W. Wang with 7 documents and 29 citations; and H. Wang with 7 documents and 3 citations. On the perspective of citation analysis in Table 1 provides a segregated perspective on the literature of bibliometric analysis. The top 20 cited scholar works were extracted from Scopus citation analysis. The aforementioned list indicates that Helbing is in the first rank. He is deemed as the most frequently cited scholar on his articles domain of Knowledge Management and Sustainability. Through his two journals in the mentioned domain, he harvested 798 citations. The second rank was gained by Bettencourt, Kuhnert, Lobo and West. Those scholars have harvested 782 citations that is originated from merely one articles. In specific terminology, they harvested the highest Citation per Document (CPD).

Table 2 Frequently-cited records in Knowledge Management and Sustainability.

Author/Year	Title	Scopus Citations	School of Thought
Bettencourt (2007)	Growth, innovation, scaling, and the pace of life in cities [9]	782	Social
Hatch (2004)	Human capital and learning as a source of sustainable competitive advantage [10]	555	Economic
Phaal (2004)	Technology road mapping—A planning framework for evolution and revolution [11]	519	Economic
Yew Wong (2005)	Critical success factors for implementing knowledge management in small and medium enterprises [12]	436	Economic
Caloghirou (2004)	Internal capabilities and external knowledge sources: Complements or substitutes for innovative [13]	424	Economic
Almeida (2004)	Subsidiaries and knowledge creation: The influence of the MNC and host country on innovation [14]	385	Economic
Raymond (2010)	Integrating local and scientific knowledge for environmental management [15]	367	Environ-mental
Schipper (2006)	Disaster risk, climate change and international development [16]	292	Environ-mental
Chandrase-garan (2013)	The evolution, challenges, and future of knowledge representation in product design systems [17]	285	Economic
Liu (2013)	Framing sustainability in a telecoupled world [18]	277	Integrated
Roux (2006)	Bridging the science-management divide: Moving from unidirectional knowledge transfer to [19]	275	Social
Van Kerkho (2006)	Linking knowledge and action for sustainable development [20]	274	Integrated
Olsen (2007)	The clean development mechanism's contribution to sustainable development: A review [21]	240	Environ-mental
Nambisan (1999)	Organizational mechanisms for enhancing user innovation in information technology [22]	238	Economic
Dao (2011)	From green to sustainability: Information Technology and an integrated sustainability framework [23]	229	Environ-mental
Chambers (2013)	The dynamic sustainability framework: Addressing the paradox of sustainment amid ongoing change [24]	226	Integrated
Viviroli (2011)	Climate change and mountain water resources: Overview and recommendations for research [25]	214	Environ
Shen (2011)	The application of urban sustainability indicators—A comparison between various practices [26]	205	Social
Fuhrer (2003)	Ecological issues related to ozone: Agricultural issues [27]	193	Environ-mental
Sharif (2006)	Emergence and development of the National Innovation Systems concept [28]	187	Economic

A record citation analysis was conducted at least toward 180 citations. Subsequently, this analysis generates the top 20 most highly-cited scholar works on Knowledge Management and Sustainability as depicted in Table 2. The first cited scholar work refers to "Growth, innovation, scaling, and the

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pace of life in cities" [9]. On its subsequent second cited scholar work refers to "Human capital and learning as a source of sustainable competitive" by Hatch and Dyer, and Phaal, Farrukh and Probert's "Technology road mapping—A planning framework for evolution and revolution" [10,11] Ultimately, those three winners are followed by several renown scholars in the domain of Knowledge Management [12, 13, 14,15,16,17, 18, 19, 20, 21, 22, 23, 24, 25,26,27, 28]. Discussion of this paper refers to strategic perspective to ensure implementation of Knowledge Management (KM) and Digital Transformation (DT) through theoretical perspectives of Industrial Engineering (IE) and Civil Engineering (CE). The implementation of the mentioned KM and DT are further translated into the analysis through the related software. The aforementioned analysis refers to the following but not limited to validity table, reliability table, regression model test and hypothesis test, as they are depicted in Table 3 until Table 7.

Table 3 Validity Table and Result

Variable	**Indicator**	**R calculated (*Corrected Item Correlation*)**	**>/<**	**R Tabel (α=0.05)**	**Result**
PEOU (X1)	X11	0.626	>	0.361	Valid
	X12	0.604	>	0.361	Valid
	X13	0.603	>	0.361	Valid
	X14	0.522	>	0.361	Valid
PU (X2)	X21	0.528	>	0.361	Valid
	X22	0.603	>	0.361	Valid
	X23	0.603	>	0.361	Valid
	X24	0.539	>	0.361	Valid
ATU (Y1)	Y11	0.392	>	0.361	Valid
	Y12	0.588	>	0.361	Valid
	Y13	0.49	>	0.361	Valid
	Y14	0.654	>	0.361	Valid
BITU(Y2)	Y21	0.382	>	0.361	Valid
	Y22	0.582	>	0.361	Valid
	Y23	0.522	>	0.361	Valid
	Y24	0.541	>	0.361	Valid
ASU (Y3)	Y31	0.668	>	0.361	Valid
	Y32	0.746	>	0.361	Valid
	Y33	0.674	>	0.361	Valid
	Y34	0.633	>	0.361	Valid

The above table indicates that all questionnaire variables are valid due to its complying criteria of Corrected Item Total Correlation, or R calculated > R table =0.361 (N=30, α=0.05)

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Table 4 Reliability Table and Result

Variable	**R calculated (Croncbach Alpha)**	>/<	**R Standard**	**Result**
PEOU (X1)	0.923	>	0.6	Reliable
PU(X2)	0.924	>	0.6	Reliable
ATU (Y1)	0.79	>	0.6	Reliable
BITU (Y2)	0.83	>	0.6	Reliable
ASU (Y3)	0.932	>	0.6	Reliable

The above table indicates that all Cronbach Alpha or r calculated for all 5 (five) variables are greater than 0.6 (R standard). Thus those variables are leading to the conclusion that the questionnaire test is reliable. The aforementioned variables refer to PEOU (X1), PU (X2), ATU (Y1), BITU (Y2) dan ASU (Y3). Meanwhile the above table 3 and 4 respectively about validity and reliability are supported by the following hypothesis test on Regression Equation 1, 2 and 3. The support refers to the further value of regression coefficient (beta), known as β. Furthermore, the support is intended to find the answer on the significant test toward hypothesis through "t" and "significant" column.

Table 5 Coefficient of Regression Equation 1

Model	Standardized Coefficients	t	Significant	Collinearity Statistics	
	Beta			Tolerance	VIF
1 (Constant)		5.320	0		
PEOU	0.507	3.49	0.002	0.786	1.272
PU	0.356	2.45	0.021	0.786	1.272

Based upon the above table, therefore, the coefficient regression (Beta) are the following $\beta 1= 0.507$, $\beta 2 = 0.356$. Subsequently, the obtained regression equation 1 is $Y1 = \beta 1\ X1 + \beta 2\ X2 + e1$. Ultimately, the obtained complete equation is $Y1 = 0.507X1 + 0.356X2 + e\ 1$

Table 6 Coefficient of Regression Equation 2

Model	Standardized Coefficients	t	Significant	Collinearity Statistics	
	Beta			Tolerance	VIF
1 (Constant)		0.612	0.545		
ATU	0.715	5.407	0	1	1

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Based upon the above table, therefore, the coefficient regression (Beta) are the following β3= 0.715 Subsequently, the obtained regression equation 2 is Y2 = β3 Y1 + e2. Ultimately, the obtained complete equation is Y2 = 0.715Y1 + e2

Table 7 Coefficient of Regression Equation 3

Model	Standardized Coefficients	t	Significant	Collinearity Statistics	
	Beta			Tolerance	VIF
1 (Constant)		-860	0.397		
BITU	0.581	3.779	0.001	1	1

Based upon the above table, therefore, the coefficient regression (Beta) are the following β4= 0.581. Subsequently, the obtained regression equation 3 is Y3 = β4 Y2 + e3. Ultimately, the obtained complete equation is Y3 = 0.581Y2 + e3

5. Conclusion

The centre stage's conclusion of this paper refers to the hypothesis test result. Precisely, the first test indicates that calculated t for PEOU(X1) 3.49 > t table 2.04 and significant level 0.002 < 0.05 as significant. Thus, PEOU (X1) positively significant influences ATU (Y1). Ultimately, Hypothesis (H1) is accepted. Furthermore, the second test indicates that calculated t for PU (X2) 2.45 > t table 2.04 and significant level 0.021 < 0.05 as significant. Thus, PU (X2) positively significant influences ATU (Y1). Ultimately, Hypothesis (H2) is accepted. The third test indicates that calculated t for ATU (Y1) 5.407 > t table 2.04 and significant level 0.000 < 0.05 as significant. Thus, ATU (Y1) positively significant influences BITU (Y2). Ultimately, Hypothesis (H3) is accepted. Furthermore, the fourth test indicates that calculated t for BITU (Y2) 3.779 > t table 2.04 and significant level 0.001 < 0.05 as significant. Thus, BITU (Y2) positively significant influences ASU (Y3). Ultimately, Hypothesis (H4) is accepted.

In other lenses, this paper conveys its conclusion that the results and discussion have satisfied its objective. The aforementioned objective of this paper is to ensure strategic implementation of knowledge management (KM) and digital transformation (DT) through theoretical perspectives of Industrial Engineering (IE) and Civil Engineering (CE).

The strategic implementation in this paper is applicable within empirical perspective in PT. Wijaya Karya (Persero) Tbk, known as one of State Own Enterprises (SOE) in Indonesia, namely WIKA. Result of this paper refers to the bibliometric analysis of KM; and its vital role in DT through IE and CE perspectives. As ultimate conclusion, the mentioned result is implemented strategically in WIKA through its value of Agility (Change, Focus, Fast), Caring (Accountable, Respect, Safety Oriented) and Excellence (Commitment, Innovation, Professional). Discussion of this paper refers to strategic perspective to ensure implementation of KM and DT through theoretical perspectives of IE and CE. As future research is it deemed indispensable to explore further the relevancies of Knowledge Management toward the Sustainability, as one of competitive advantages factor for corporate success. The aforementioned future research and exploration is highlighted due to the increasing trends of digital era within digital transformation.

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