

An Overview of Knowledge Mapping in Digital Business Industry: A Systematic Literature Review

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Abstract— The increasing number of studies in the knowledge map shows attention from researchers in academic and professional areas. However, the knowledge map implementation has not effectively implemented in an organization whose business in the digital business industry, especially startup organization. The main reason is the lack of stakeholder's understanding of the knowledge map concept. Thus, this study gives a comprehensive understanding of knowledge map implementation in the digital business industry within the last five years period. The study will answer what problems knowledge map tackled, tools, and techniques used currently, the obstacles and benefits of using a knowledge map. The review was conducted through the structured systematic literature review procedure. It started with a review protocol declaration and ended with an analysis of the prior researches obtained from five credible sources. Only 25 of 775 studies remain after several filtering stages. It is found that a knowledge map is mostly used for decision-making purposes. Most studies adopted a visual knowledge map and concept map, even though it is difficult to align the knowledge depth. In the end, this study's result will help stakeholders to reflect on their existing knowledge relationship structure. This study also offers directions for future research and professional practices in digital business industry firms to perfect their existing organizational intellectual capital through a knowledge map.

Keywords— digital business, knowledge maps, knowledge management, startup, systematic literature review.

I. INTRODUCTION

Three million literature on KM (Knowledge Mapping) has been published online until the first quarter of 2020. Balaid, Rozan, Hikmi, and Memon [1] have found at least 132 articles addressing knowledge maps from 2000 to 2013. KM is viewed as an activity that can help organizations with their strategic planning, for knowledge transfer [1, 21], or critical knowledge mapping [2].

Contrary to that, there are still many organizations unfamiliar with the KM concept [1], especially startup as one of the organizations whose business in the digital business industry. Resources are assets and they visualize the development of the organization's internal capability [2, 3]. Earlier studies said that KM escalates the research subject's existing knowledge and adjust their commercial product knowledge [2, 3]. The fact that there are tons of literature on

KM, still not enough for the organization's stakeholders to grasp that KM is implementable. There are few unofficial assumptions amongst startups' stakeholders from previous interview about much of the efforts (time and money) needed to develop KM and led them not to prioritize KM.

So, to solve the stated problems, this study will conduct a systematic literature review [1], specifically in the context of KM in the digital business industry from 2015 to 2020. As earlier studies have not covered this knowledge yet. This study also targets KM implementation in startup organizations, but the main context is the digital business industry. The result differs from the prior study and more relevant to the latest issue. Therefore, the main goal of this study is to discover the recent implementation of knowledge mapping in the digital business industry through prior studies review or systematic literature review (SLR).

Kitchenham stated that SLR has some purpose which is: (i) to review the existing evidence of the research topic; (ii) to find gaps between evidence; (iii) to give recommendation; and (iv) to provide background for future research [4]. The four specific research questions as follow:

RQ 1. Why digital business industry implemented knowledge mapping?

RQ 2. What knowledge mapping tools and techniques are used in the digital business industry?

RQ 3. What are the obstacles to implement knowledge mapping in the digital business industry?

RQ 4. What are the benefits of adopting knowledge mapping in the digital business industry?

To deliver valid results, this systematic review follows well-defined methodological steps and three main phases (planning, conducting, reporting) [1, 4, 5]. Overall, this study will give the readers a comprehensive understanding of the fittest knowledge map implementation in the digital business industry. The rest of this study is structured as follows: theoretical foundation, research methodology, results and discussion, and conclusion.

II. THEORETICAL FOUNDATION

This section describes the theoretical foundation of knowledge map core definitions and their implementation.

A. Definition of Knowledge Map

KM is a method to visualize and display structured information. Davenport and Prusak [6] said that knowledge map might be an actual map, knowledge “yellow pages”, constructed database, but not a repository. Other authors, Wexler [7] also defined that KM used to capture and share explicit knowledge in the organization, or designed communication medium using text, models, numbers, or symbols between map makers and map users.

KM includes both explicit and tacit knowledge in the form of objects, which usually relate to documents and people [8]. Meanwhile, Leyer, Schneider, and Claus [9] perceived, KM does not require an explicit knowledge transformation. Instead, it simplifies the identification of knowledge owners in the business process [9]. In the context of the organization, the knowledge map may also form wherein organization, department, and project make decisions based on how relevant others act and likely to react to decisions [7]. Synthesizing from earlier definitions, KM is the established knowledge seen in a map and help the organization to discover available knowledge.

B. Knowledge Map Implementation in Digital Business Industry

Knowledge maps have been widely applied to define principal elements and actionable information in the organization. Effective knowledge maps help find intellectual capital and help predict unseen threats and/or opportunities [7]. Its implementation may also be used for research and development purposes [10, 11, 12], Li, Ge, and Den [13] used keyword map to help individual researchers strengthen their research on virtual communities. Lv, Zhao, and Yu [14] used ontology to develop planes and to avoid knowledge delivered more than it should be.

In the business environment, KM has been recognized on its ability to find, visualize, and store seas of business processes and employee knowledge [8, 9, 15, 16, 17, 18]. The advancement of technology has realized the combination of knowledge map theory and the recent technology implementation. Earlier studies used a concept map to solve the issue in natural language interpretation [19] or to customize the existing data science discipline [20]. Unfortunately, of all the prior studies which discuss KM implementation, there is no single study has e-commerce startup as their research subject.

III. RESEARCH METHODOLOGY

This study follows a systematic literature review, that summarizes the existing evidence of a topic area and analyzes the gaps for further investigation [4, 5]. Following are review procedures proposed by Kitchenham,

A. Review Protocol

The review protocol specifies the methods that will be used to undertake a systematic review, including background, research questions, study selection criteria, to project timetable [5]. However, this section will only include

the study selection criteria derived from results to research questions. Population, intervention, comparison, outcome, and context (PICOC) criteria were chosen as the selection criteria rule and depicted in Table I. The population as the main area of study. Meanwhile, the intervention as a context to be studied. The context is the niche of the problem to be analyzed and tend to be general. Though, as mentioned in the first section, this study target particularly on startup organization, because there are future needs that subjectively related to the e-commerce startup. The reasons why the context and the keyword mention startup and e-commerce.

TABLE I. PICOC CRITERIA

Population	Knowledge mapping, knowledge map
Intervention	Problem, advantage, tool, mechanism, technique, challenge, barrier, obstacle
Comparison	-
Outcome	Knowledge mapping implementation overview of problems, techniques, barriers, and benefits in the digital business industry
Context	Business, digital business, startup, e-commerce

B. Search Strategy

Continuing the part of review protocol components, the search strategy means to include the relevant prior studies from the five sources: Scopus, Science Direct, ACM Digital Library, ProQuest, and IEEE (Institute of Electrical and Electronics Engineers) Xplore. The boolean search used for each source can be seen in Table II.

TABLE II. BOOLEAN SEARCH

Source	Keyword
Scopus	TITLE-ABS-KEY ((“knowledge mapping” OR “knowledge map” OR “mapping knowledge”) AND (“problem” OR “advantage” OR “tool” OR “mechanism” OR “technique” OR “challenge” OR “barrier”) AND (“business” OR “digital business” OR “startup” OR “e-commerce”))
Science Direct	Title, abstract or author-specified keywords: ((“knowledge mapping” OR “knowledge map”) AND (“problem” OR “advantage” OR “tool” OR “technique” OR “challenge” OR “barrier”) AND (“business” OR “digital business” OR “startup” OR “e-commerce”))
ACM, IEEE Xplore, ProQuest	(“knowledge mapping” OR “knowledge map” OR “mapping knowledge”) AND (“problem” OR “advantage” OR “tool” OR “mechanism” OR “technique” OR “challenge” OR “barrier”) AND (“business” OR “digital business” OR “startup” OR “e-commerce”)

C. Inclusion and Exclusion Criteria

The next procedure is to screen the article gradually: initiation, title, and abstract choice, full-text choice. The details criteria are written in Table III.

D. Quality Assessment

Kitchenham stated that the purpose of quality assessment (QA) in SLR is to decide regards the overall quality of the selected studies [5]. Several quality criteria were used to guide prior studies analysis, as follow:

QA1. Does the article describe the clear purpose of the research?

QA2. Are the context of the research, literature review, and background described in the research?

QA3. Does the article display related work from earlier research to show the main contribution of the research?

QA4. Is the method of research clearly explained in the research?

QA5. Does the article describe the application of knowledge mapping clearly?

QA6. Does the article display conclusions that are relevant to the objectives/research questions?

QA7. Does the article recommend future work or improvements for future research?

QA8. Scopus indexed (Q1 / Q2 / Q3 / Q4 / unindexed)

After 30 studies selected in stage 3 (full text), the studies were assessed using the eight QA (Quality Assessment) criteria presented above and scored each criterion on a five-point scale: "not at all" (0), "very little" (0.25), "a little" (0.5), "yes, but not the most relevant" (0.75), and "the most relevant" (1). The possible total score is 0 – 8. Out of 30 studies, 25 were finally selected: 9 from ProQuest, 6 from IEEE Xplore, 6 from ACM Digital Library, 2 from ScienceDirect, and 2 from Scopus. Many studies got an assessment score higher than 6, and 7 studies got a perfect score showing its high-quality study. The duplicate studies were detected automatically by Mendeley.

TABLE III. INCLUSION AND EXCLUSION CRITERIA

Inclusion Criteria	Exclusion Criteria
I. Initiation	
Should be: <ul style="list-style-type: none"> Relevant to the research topic and search keywords Included in these articles type: journal, conference paper, proceeding journal, book, or chapter and written in English Published between 2015 and 2020 	Articles that: <ul style="list-style-type: none"> Have no relevance to research topic a search keyword Are not included in require article type and not written in English Published before 2015
II. Title and abstract selection	
Should be: <ul style="list-style-type: none"> Discuss KM In the context of digital business industry 	Articles that: <ul style="list-style-type: none"> Discuss other than KM Out of the digital business industry Duplicate paper
III. Full-text selection	
Should be: <ul style="list-style-type: none"> Discuss reasons, benefits, techniques, and obstacles implementing knowledge map Unrestricted access content 	Articles that: <ul style="list-style-type: none"> Are not discuss reasons, benefits, techniques, and obstacles implementing knowledge map Restricted access content

E. Data Extraction

Extraction of selected prior studies was executed by skimming read each of the 25 studies, using MS Excel and Mendeley. The following columns were considered in this review: ID, reasons, tools and techniques, obstacles, and benefits implementing KM. As for showing the eligibility and novelty of the researches, such columns are also included: source and publication year. Full-text screening of each primary study results done, to understand knowledge map implementation entirely. map implementation entirely.

IV. RESULTS AND DISCUSSION

The following will discuss the literature review results that answer the four research questions.

A. Systematic Literature Review Results

This section discusses brief statistical results about the selected prior studies before the research question analysis result discussion. In the following, we present the included studies with their sources and publication year in Figure 1.

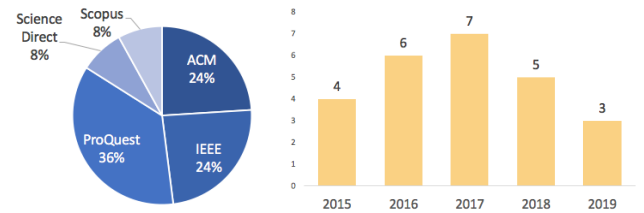


Fig. 1. Primary studies source and year distribution

• Publication sources overview

Many studies were published in ProQuest as one of the credible literature sources. Meanwhile, ACM and IEEE in the same position of studies published about knowledge maps. The other two sources also have the same number of published studies in the context of knowledge map implementation in the digital business industry.

• Publication type

As discussed earlier the publication type as one of the inclusion criteria, at least four types will be selected. Unfortunately, only the journal and conference papers relevant to the assessment criteria. The primary studies filled dominantly with the conference paper (56%) and the rest (44%) are journal paper.

• Publication year

From 2015 to 2017, it increased by three studies, but the number decreased in 2018 and 2019. This supports the statement of Balaid, Rozan, Hikmi, and Memon [1] that the concept of a knowledge map has started only for the past two decades.

B. Research Questions Results

After selecting and extracting the most relevant prior studies to the research questions and objectives, it is the subsection that will discuss information that is found summarized from each study. The following points provide the results for each of the research questions defined in Section I.

• RQ 1. Why digital business industry implemented knowledge mapping?

Based on our analysis, the reasons for stakeholders in the digital business industry implemented KM, consist of 12 distinct reasons. The three main reasons are, first, involving available knowledge in the organization for decision making [22, 23, 24]. Second, to use the knowledge in an easily

processed unit [8, 26], and to enhance corporates' sustainability. Third, to avoid redundancy in knowledge production [9, 16], and information loss in commercial software development [21].

TABLE IV. KNOWLEDGE MAP IMPLEMENTATION REASON

Reasons to Implement KM	Freq.	References	Citation
To generate knowledge for decision making	9	[9, 10, 14, 16, 18, 22, 23, 24, 25]	91
To transform the knowledge into an easily processed unit	7	[8, 12, 19, 25, 26, 27, 28]	26
To improve sustainability and create innovation		[10, 11, 12, 24, 26, 29, 30]	146
To have a macro-level view on how knowledge flows within the network	2	[28, 30]	1
To reduce reinventing the wheel phenomena		[9, 16]	27
To link the service delivery process to the intellectual property of technologies	1	[31]	3
To avoid information loss in natural language		[21]	1

- *RQ 2. What knowledge mapping tools and techniques are used in the digital business industry?*

A visual knowledge map is the most adopted KM tool. This technique creates a harmonious hierarchy, which corresponds to a comprehensible representation of the domain knowledge. It also helps to solve complex problems, as mind maps or concept maps did [23, 27]. Meanwhile, the concept map is a technique with a node-link structure, and usually has two attributes: personal knowledge structure and knowledge [1, 22]. Then, ontology, constructed to annotate the knowledge to specify the knowledge domain [14], developed while considering the product development complexity. Ontology is sometimes used along with advanced technology.

Another KM technique that also immensely popular is a mind map, that shows the connections among portions of information. Gavrilova, Alsufyev, and Gladkova [23] use this technique to frame the process of knowledge structuring for the manager's business analytics tasks and decision making. Different implementation by Tan and Jan [30] who use a cluster map, to visualize the variables to show the distance, as the importance of the resources. Keywords and semantic maps are often used to an easier mapping process of prior research in organization domain knowledge, for example in online communities [13, 17].

The means-ends map is relatively, its core concepts are from the goal-oriented requirement engineering paradigm [16] and used in earlier research to map out knowledge in some technical domains. The cognitive map was named after the socio-cognitive process, the domain in the network map includes the degree of significance. Finally, in the prior study, visual thinking network was used to build the business problem-solving model, connecting the knowledge and the resource layer.

From the earlier review results, half of the studies adopt the concept map and mind map (as part of visual knowledge map), and ontology. The citation numbers show that concept maps and mind maps are recommended by most of the prior studies. They are very suitable to implement because it does not require much effort to understand the process and most of the tools are free. Table V shows all the KM tools and techniques in the prior studies.

TABLE V. KNOWLEDGE MAP TOOLS AND TECHNIQUES

Tools/Techniques	Freq.	References	Citation
Visual knowledge map	8	[8, 10, 11, 12, 15, 18, 23, 27]	142
Concept map	6	[10, 17, 21, 24, 27, 29]	26
Ontology		[14, 15, 20, 26, 31, 32]	10
Mind map	4	[9, 23, 25, 27]	37
Cluster map	1	[30]	0
Cognitive map		[28]	1
Keywords map		[13]	0
Means-ends map		[16]	4
Semantic map		[17]	8
Visual thinking network		[19]	4

- *RQ 3. What are the obstacles to implement knowledge mapping in the digital business industry?*

Most of the obstacles discovered in prior studies happened during the knowledge capture stage. One of which is difficulty in creating a usable KM, because there is no exact definition about the right knowledge depth. Another obstacle after the KM was created, many studies said the stakeholders often unable to understand the knowledge domain correlation. This is due to stakeholder's resistance to involving in knowledge exploration. Even though so, strict procedures might also delay the knowledge conversion processes (as seen in Table VI). Therefore, it is important to define the general format of the knowledge domain from the beginning, to ease the data sources integration process. The availability of knowledge is also matters, as it will increase the captured knowledge validity and richness.

- *RQ 4. What are the benefits of adopting knowledge mapping in the digital business industry?*

As a summary (all the benefits in Table VII) of the benefit of KM, it makes firms possible to process large volumes of data and reflect its knowledge relationship structure. The captured knowledge will unlock the hidden innovation of the firm's product and services. KM grants the overview and tracks the knowledge details. So, when the KM is shared amongst the employees, their learning enthusiasm tends to rise as well. Prior studies mentioned knowledge maps allowed them to discover knowledge domains in the organization and process the knowledge under organization goals. Eventually, the captured and produced knowledge helps the organization to transform and escalate the business.

TABLE VI. KNOWLEDGE MAP OBSTACLES

Obstacles	Freq.	References	Citation
No exact measurement of the right knowledge correlation complexity and knowledge graph size	5	[13, 19, 20, 26, 28]	5
Asymmetric depth of knowledge branches	4	[13, 14, 23, 30]	9
Knowledge unit and scenario factors limited		[12, 16, 19, 26]	14
Advanced technology required (e.g., big data)		[15, 21, 27, 29]	5
Strategists avoid taking parts in knowledge exploration		[8, 17, 18, 25]	25
Lack of textual and visual representation of user requirements	3	[18, 21, 32]	7
Unable to decide which knowledge to visualize	2	[15, 12]	6
Knowledge graph size limited		[19, 26]	4
Strict procedures in knowledge conversion processes		[17, 31]	11
Created in different formats		[17, 29]	12
Difficult to integrate sources of data		[10, 15]	30
Lack of available knowledge		[22, 25]	12

C. Discussion

The background of this study is to find the solution, of stakeholders in startup organizations who assumed knowledge mapping is a waste of the time and hard to implement. The earlier section has revealed the answers to each research question, through implementing systematic literature review protocols by Kitchenham [4]. Some studies refer to organization intellectual capital [9, 11, 23, 27], or business knowledge mapping [10, 18, 22, 30, 31].

In the case of a startup organization, intellectual capital knowledge is the top priority and often the one to be left out. Thus, a knowledge map will not only help the organization to get an expert's knowledge, but it will also trigger the next stage of knowledge management and increases employees learning enthusiasm at the same time [13, 21, 27]. First, mining the existing data, if the data volume is unbearable to be processed manually [15, 27]. Unless it is possible, many studies map the knowledge in a concept map [22] or mind map [23]. Second, there is no certain estimation of the right knowledge depth, but some studies are recommended to make it symmetrical [13, 23]. Third, in knowledge domain exploration and KM implementation, make sure to involve "the strategists" in the organization. Prior studies had experienced the difficulties of managing the available knowledge, result in a lack of knowledge unit [12, 26], and missing knowledge [25]. Forth, to keep the knowledge maintainable, accessible, and integrated across the corporate business unit, and the knowledge format should not be varied [15, 17, 29].

The practical implication for initial KM implementation in startup organization, start with group brainstorming, and sketch the main idea of the observed knowledge domain in a mind map. In the end, a knowledge map is simply about tracking, recording, and mapping the knowledge visually. The beginning of KM implementation not only will open employee's perspective on the existing knowledge in the

organization, but it will lead to business process improvement [8, 31], product development [33], and determine the decision making [10, 11, 22, 26]. A knowledge map is a step for any organization to sustain their intellectual capital and use it for a continuous change.

TABLE VII. KNOWLEDGE MAP BENEFITS

Benefits	Freq.	References	Citation
Clear up the knowledge relationship structure	10	[8, 9, 10, 14, 18, 22, 26, 29, 30]	71
Easier to process a large volume of data and discover knowledge pattern	9	[11, 13, 17, 22, 23, 25, 26, 29, 30]	123
Facilitate the realization of organizational goals through rapid product innovation	6	[10, 15, 17, 18, 19, 25]	54
Record knowledge attributes (e.g., expert)		[8, 9, 12, 16, 17, 23]	50
Provide an overview of the observed knowledge domain	5	[13, 15, 21, 24, 32]	16
Improve learning enthusiasm	3	[13, 21, 27]	1
A foundation to assign relevant knowledge in the organization		[9, 15, 30]	23
Realize a structured product requirement analysis result	2	[10, 21]	31
Organization knowledge domain discovery		[11, 30]	95
Able to map and compare business process portfolios	1	[31]	3
Target specific type of knowledge		[16]	4
Better knowledge management			4

V. CONCLUSION AND FUTURE RESEARCH

In conclusion, after reviewing the selected studies with their practical knowledge of the knowledge map, we found some highlights to share. A knowledge map is used more often at the strategic level, as it is related to decision making and business transformation. Even though so, there is no prohibition for a non-strategic level to collect the relevant research on the business they worked on. The conventional KM technique, known as a visual knowledge map, is still used by many people. Though missing data is unavoidable, the use of an advanced KM technique is suggested. Hence, the knowledge depth alignment and knowledge conversion will be executed automatically.

This study also has some limitations. The digital business industry observed is not included every organizations whose business runs digitally. The reason is a few organizations in the digital business industry published and shared their KM implementation. Last, the implications are seen only in the startup organization perspectives, it does not include other parts of the digital business industry. Future research is recommended to correlate risk management, human capital, and knowledge mapping. Those topics are the second and third positions on the knowledge management trend lists. Future research might also find KM implementation in particular organizations and the details about its adoption.

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