UNDERSTANDING DIGITAL TRANSFORMATION FOR FUTURE PROJECT MANAGEMENT: A REVIEW AND FRAMEWORK

Marcel Fernandes Dallaqua (marcel.dallaqua@usp.br) – Escola Politécnica, Universidade de São Paulo (EP-USP).

Samuel Laiber Bonadiman (samuelbonadiman@usp.br) – Escola Politécnica, Universidade de São Paulo (EP-USP).

Fábio Pires (fabiopires@usp.br) – Escola Politécnica, Universidade de São Paulo (EP-USP).

Marly Monteiro de Carvalho (marlymc@usp.br) – Escola Politécnica, Universidade de São Paulo (EP-USP).

ABSTRACT

The rising of digital technologies holds potential implications to disrupt many organizations' domains at different levels of analysis. However, the literature on project management (PM) still lacks research on this important phenomenon. Therefore, this study aims to investigate how digital transformation (DT) influences future PM. An in-depth literature review employed bibliometric, network, and content analyses, applying VOSviewer, UNICET and NVivo 11 software. Results show, first, that the application of intelligent artifacts for PM activities dominates the still incipient literature. Second, that artifacts proposed mainly aim at improving PM quality area. And third, that the main artifacts encountered are intelligent methods, e.g., algorithms and practices. Gap exploration and future research recommendations are also observed.

Keywords: Digital transformation, Project management, Industry 4.0, Intelligent systems, Internet of things

1. INTRODUCTION

The rising of digital transformation has the potential to disrupt many domains of the organisation looking to succeed in the future digital world (McAfee and Brynjolfsson, 2017). Digital transformation is rapidly becoming quite common (Corea, 2019; Ganis and Waszkiewicz, 2018) and goes beyond organisations, bringing profound changes in society and industries through digital technologies (Majchrzak et al., 2016), helping individuals to make decisions in their daily lives (McDaniel, 2018; Ganis and Waszkiewicz, 2018).

The body of knowledge has increased our understanding of digital transformation and the core SMACIT technologies (social, mobile, analytics, cloud, and Internet of things) (Sebastian et al., 2017), but also of platforms and blockchain (Vial, 2019). However, organisations still struggle to gain transformational effects and realize this new phenomenon (Fitzgerald et al., 2014).

The digital transformation phenomena affect business models and has an impact on PM (Ganis and Waszkiewicz, 2018). It impacts several management domains and systems of management. Project managers need to coordinate multidisciplinary knowledge, must adapt to new technologies and learn how to deal with them in the project context. Other challenges for project managers are filtering and capturing the right information and communicating effectively with stakeholders during the project lifecycle. To be successful, 21st century project managers must deal with constant changes in the PM environment (Seymour and Hussein, 2014) through networks in different cultures and countries that challenge effective communication, forcing project managers to adapt organizational structure changes.

Thus, people will interact more in the future, leading to the question of what influence Industry 4.0 will have in the work environment (Marnewick and Marnewick, 2019) in general and for project managers specifically (Seymour and Hussein, 2014; Marnewick and Marnewick, 2019). The changes in the project environment encompass: (1) multidisciplinary knowledge must be acquired and disseminated; (2) continuous adaptations to new technologies, looking for the best possible technical solution for the project; (3) organizational structure and culture will change, and project managers need to adapt (Cho, 2009; Marnewick and Marnewick, 2019); (4) uncertainties, interruptions and constant changes will be part of the life of a project manager and will need to find a way to control them (Saunders et al., 2016; Marnewick and Marnewick, 2019).

However, literature lacks a comprehensive portrait of its implications in temporary organizations, particularly in this COVID-19 pandemic period with the acceleration of the virtuality and digitization of project work that reinforces this research agenda (Mueller and Klein, 2020). Although many speculate about the impact of digital transformation upon PM work context, the extant literature lacks an in-depth understanding of the implications in PM context (Albogamy and Dawood, 2015; Hammad, Abbasi, and Ryan, 2016; Panova and Hilletofth, 2018; Strojny and Jedrusik, 2018; Koseoglu and Nurtan-Gunes 2018; Golizadeh et al., 2019; Niu, Anumba and Lu, 2019; Emblemsvåg, 2020).

In this scenario, the objective of this article is to answer the following questions: How will the digital transformation influence future PM (RQ1)? Which project knowledge areas are more affected by digital transformation (RQ2)? And what are the main gaps and key topics for a future research agenda for project management's digital transformation (RQ3)?

This paper presents a systematic literature review (SLR) combining bibliometrics, network, and content analysis, applying VOSViewer, UCINET and NVivo software to address its research questions. The sampling process was conducted in Scopus and Web of Sciences databases. This study contributes in two folds: (a) it discusses and proposes a definition for "digital project management" and (b) it presents a framework for "digital project management".

The next section will present the literature review on digital transformation. Then, Section 3 presents the research design detailing the literature review research protocol. Section 4 presents the research results and analyses. Finally, sections 5 and 6 discuss and conclude this research contributions and limitations.

2. LITERATURE REVIEW

Digital transformation (DT) means the disruptive implications of digital technologies for businesses, encompassing new business models, new types of products and services, new types of customer experiences (Nambisan et al., 2019) that distinguishes from previous IT transformations in terms of combinations of technologies, velocity, and its holistic nature (Vial, 2019). DT can alter the value creation paths in terms of value proposition, value network, digital channels, agility, and ambidexterity but also causes structural changes in organizational culture and structure, leadership, employee roles, and skills (Vial, 2019).

DT primarily relates to organizations (Vial, 2019) and has been associated with the term Industry 4.0, which "comprises a variety of technologies to enable the development of a digital and automated manufacturing environment as well as the digitisation of the value chain" and "can be described as the increasing digitisation and automation of the manufacturing environment as well as the creation of a digital value chain to enable the communication between products and their environment and business partners" (Oesterreich and Teuteberg, 2016).

In the Industry 4.0, humans "are expected to do less physical but more mental work", to face "the challenge to collaborate with or manage more autonomous systems", and to "work in fully integrated environments that are optimized for maximum efficiency, while their tasks will be influenced by decentralized decision making" (Beier et al., 2020). And organizations will need to "become decentralized and flexible, in order to being able to quickly adapt to frequently changing customer requirements" and their business processes "to be integrated and to allow for more service-orientation while still being very efficient" (Beier et al., 2020). In short, "Industry 4.0 has been considered a new industrial stage in which several emerging technologies are converging to provide digital solutions" (Frank, Dalenogare, and Ayala, 2019).

The digital technologies frequently associated with DT refer to technologies related to social, mobile, analytics, cloud, and the internet of things, the so-called SMACIT acronym (Sebastian et al., 2017). However, in a recent literature review, Vial (2019) also found blockchain, platforms & ecosystem, but less frequently. For Frank et al. (2019), digital base technologies as SMACIT are embedded in front-end technologies in four blocks: smart supply chain, smart working, smart manufacturing, and smart products. PM is, as seen, neglected.

The emergence of such a diverse set of digital technologies, digital platforms, and digital infrastructures has transformed innovation in significant ways at different levels of analysis (individual, organization, ecosystem/community, regional/societal) (Nambisan et al., 2019). For Kane et al. (2017), notably, the organizational culture and structure enable digital maturity through a "supportive culture that embraces collaboration, risk-taking, and experimentation". Their research "reveals that a flexible mindset combined with a networked and team-based organizational structure supports an organization's ability to react to digital trends and become more digitally mature".

To illustrate, DT in construction projects has been pulled by Building Information Modeling (BIM) implementation that embedded the digital technologies such as cyber-physical infrastructure, horizontal and vertical integration, cloud systems, and augmented reality (Koseoglu et al., 2019). Thus, BIM allows the digital representation of information on the physical structure, collaboration, and project management, leading to numerous activities associated with design, engineering, project management, and delivery during a construction project's life cycle (Holzer, 2016).

3. RESEARCH METHODS

To reach this research goal, the systematic literature review method was adopted and carried out in two major processes: sampling and data analysis (Carvalho et al., 2013). These processes and their seven steps are described in figure 1.

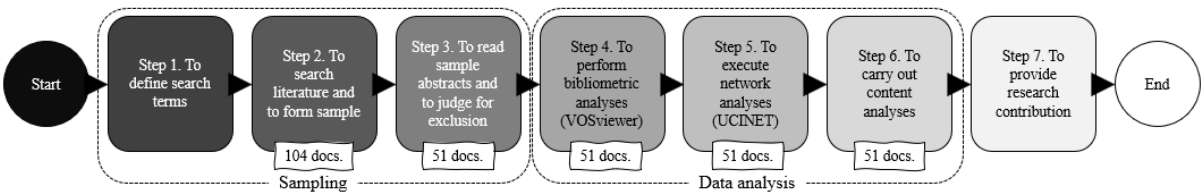

FIGURE 1 – Systematic review process

Sampling process was carried out in three steps. The first step aimed at defining the search string. The second and third steps aimed at forming the sample of documents to be reviewed.

In step one, an initial search string was generated randomly. Then, Scopus database was used to search for related terms. "Documents" were searched through "Keywords" field in an iterative way until terms' saturation was reached. Two iterations (A and B) were needed. In iteration A, 13,537 documents were found. Filters were not applied. The most frequent 160 keywords were assessed. Eleven new terms were included. And the search string was updated. In iteration B, 227,326 documents were found. Again, filters were not applied and the most frequent 160 keywords were assessed. Any new terms were included, meaning saturation was reached. Then, search strings were defined. Table 1 sums up iterations A and B until saturation.

TABLE 1 – String set definition

Iteration	Initial string	Final string	Terms included
A	"4.0" OR "digital transformation" OR "digital twin*"	"4.0" OR "digital transformation" OR "digital twin*" OR "cps*" OR "cyber physical system*" OR "cyber-physical system*" OR "digitalization" OR "digitalisation" OR "digitization" OR "digitisation" OR "iiot" OR "intelligent system*" OR "internet of thing*" OR "iot"	+ 11
B	"4.0" OR "digital transformation" OR "digital twin*" OR "cps*" OR "cyber physical system*" OR "cyber-physical system*" OR "digitalization" OR "digitalisation" OR "digitization" OR "digitisation" OR "iiot" OR "intelligent system*" OR "internet of thing*" OR "iot"	"4.0" OR "digital transformation" OR "digital twin*" OR "cps*" OR "cyber physical system*" OR "cyber-physical system*" OR "digitalization" OR "digitalisation" OR "digitization" OR "digitisation" OR "iiot" OR "intelligent system*" OR "internet of thing*" OR "iot"	0 (saturation reached)

To finish step one, words defined after iterations A and B (see table 2) were associated to the term "Project management" through the logical operator "AND", highlighting the cross-fertilization approach employed in this review, and resulting in the following: "Project management" AND ("4.0" OR "digital transformation" OR "digital twin*" OR "cps*" OR "cyber physical system*" OR "cyber-physical system*" OR "digitalization" OR "digitalisation" OR "digitization" OR "digitisation" OR "iiot" OR "intelligent system*" OR "internet of thing*" OR "iot"). Sample documents resided in the intersection (I) illustrated in figure 2.

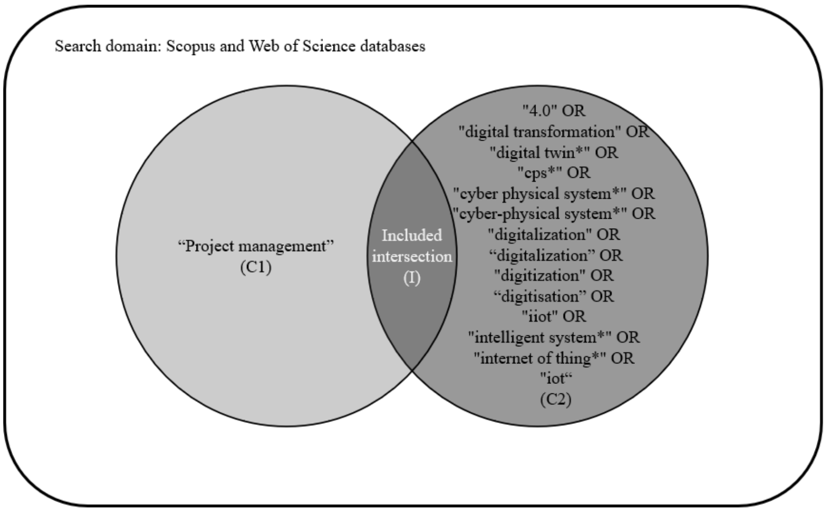

FIGURE 2 – Venn diagram

In step two, both Scopus and Web of Science databases were employed to search for research documents. On Scopus, "Documents" were searched in "Article title, Abstract, Keywords". 1,210 documents were initially found before filters. Document type filters "Article" and "Review", and subject area filter “Business, Management and Accounting” were applied. 91 documents were, then, exported. On Web of Science, "Basic Search" was carried out in "Topic". 355 results were initially obtained from "Web of Science Core Collection" before filters. Document type filters "Article", "Early Access" and "Review", and category filters “Management”, “Operations Research Management Science”, and “Business” were applied. 24 documents were, then, exported. Finally, 11 duplicated documents were excluded, and 104 were selected to form initial sample. Figure 3 illustrates sampling process step 2.

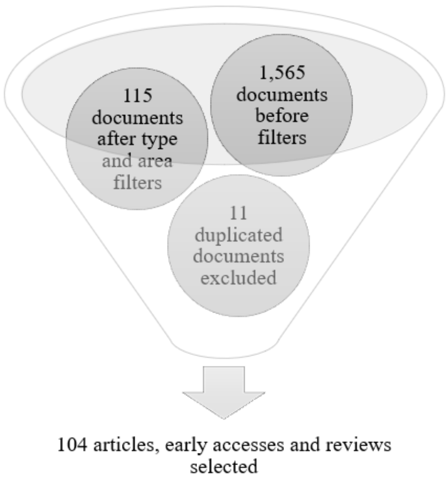

FIGURE 3 – Starting sample

In step 3, all 104 titles, abstracts, and keywords were read. Authors, then, decided to keep each document in the sample or to exclude it, based on this research goal. Finally, 51 out of the 104 documents were included in the final sample. Table 2 categorizes the 104 sample documents in six groups and helps to justify inclusion and exclusion criteria to form final sample.

TABLE 2 – Decision criteria

Group	Reason	Decision	Counting
1. Intelligent artifacts for project management	Papers in this group propose artifacts, i.e., constructs, models, methods, and systems, for executing project management	Included	51
2. Project management or digitalization not or barely addressed	Papers in this group barely or do not address circle C1 or circle C2 (see figure 2)	Excluded	26
3. Managing digitalization projects	Papers in this group discuss how to manage projects for circle C2 (see figure 2)	Excluded	17
4. Digitalization demands project management	Papers in this group highlight the importance of project management for circle C2 (see figure 2), e.g., project management skills, PMOs, etc.	Excluded	5
5. Digital capabilities for project management	Papers in this group highlight the importance of circle C2 for circle C1 (see figure 2), e.g., digital capabilities	Excluded	1
6. Full or part of paper not available	Papers are not available or present missing information	Excluded	4
Total			104

After completing the sampling process, data analyses were carried out in the additional steps, i.e., bibliometric analysis, network analysis, and content analysis, with the help of three different software. In step four, bibliometric analyses involved demographics, keywords' co-occurrence, and authors' co-citation. Bibliometric analyses were conducted with the help of VOSviewer. In step five, network analysis comprehended mapping the most relevant works into nodes and their relationships within each other within a network. Network analysis was carried out with the support of UCINET. In step six, content analyses involved coding structures and extraction of relevant information and insights from the sample, thus exploring, proposing, hypothesizing, and building knowledge. Content analyses were conducted with the use of NVivo 11.

Three coding schemes were, then, employed to perform content analysis. Out of them, one is a standard, traditional coding scheme from systematic literature reviews, i.e., kind of study (KS). Another is an important coding schemes from the project management literature, i.e., project management knowledge areas (KA) (PMI, 2017). And a third is an important coding scheme coming from information systems literature, i.e., front-end technologies for digital project management (DPM) (Hevner et al., 2004). Coding is presented in detail in the next section.

4. RESULTS

This section is divided in the three topics: bibliometrics, network and content analyses.

4.1 Bibliometric analysis

In step four, bibliometric analyses were performed within the sample documents. three analyses were performed, i.e., demographics, keywords co-occurrence, and authors' co-citation. Demographics showed three main results. First, studies on intelligent systems applied to project management practice are recent, since: 32 studies (63%) have been published within the last 5 years, and 43 documents (84%) have been published within the last 10 years. Second, there is not a strong reference in the field, since: 120 authors (93%) have published only 1 document each, and the 2 authors who publish the most have only 3 publications each. And third, three main journals stood out, even though multiple journals have been interested in the field since: 23 journals (88%) have up to 2 publications each; the International Journal of Project Management publishes twice as studies as the average of published studies per journal of the sample, i.e., 4 against 1.96; the Engineering, Construction and Architectural Management journal, 8 against 1.96; and the Journal of Construction Engineering and Management, 11 against 1.96. In other words, demographics shows that intelligent systems applied to project management is a relatively recent field that awakes the interest of 3 important journals from the project management and construction fields mainly.

Keywords co-occurrence analysis demonstrated four important clusters, i.e., yellow, red, blue, and green. The yellow cluster comprehends studies that propose artifacts manly to the monitoring and controlling tasks of project management. The red cluster brings together documents from the construction contexts, involving mainly discussions on the building information modelling artifacts. The blue clusters studies that propose intelligent artifacts, e.g., neural networks, for risk analyses in the project management context. And the green cluster groups studies that propose intelligent systems mainly to decision making on investments perspectives. Figure 4 presents the keywords co-occurrence map generated in VOSviewer.

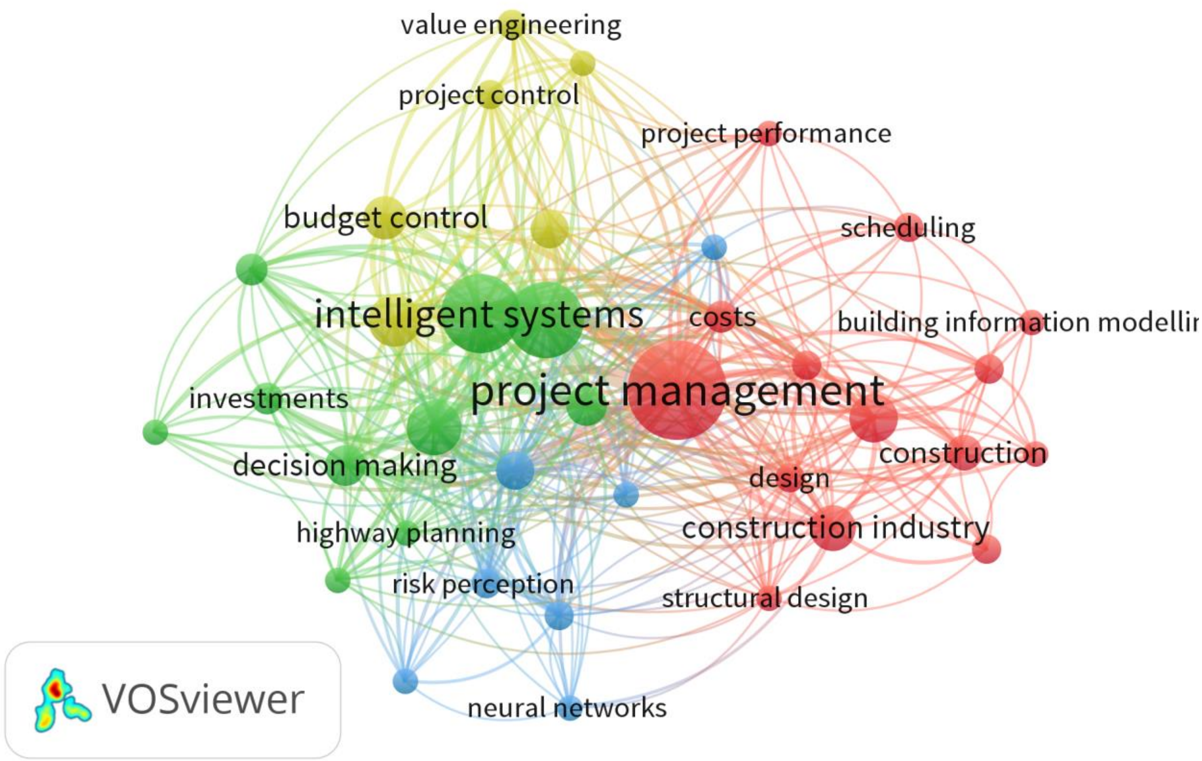

FIGURE 4 – Keyword’s co-occurrence map

Note: Figure 4 resulted from creating a map based on bibliographic data by reading data from bibliographic data files, with the following configuration: co-occurrence (type of analysis), all keywords (unit of analysis), full counting (counting method), 3 (threshold), and 37 (keywords to be selected).

To conclude step four, cited references co-citation analysis showed a main cluster comprehending main references that focus specifically on artifacts for PM scheduling and PM buffer management. Figure 5 presents the references co-citation map generated in VOSviewer.

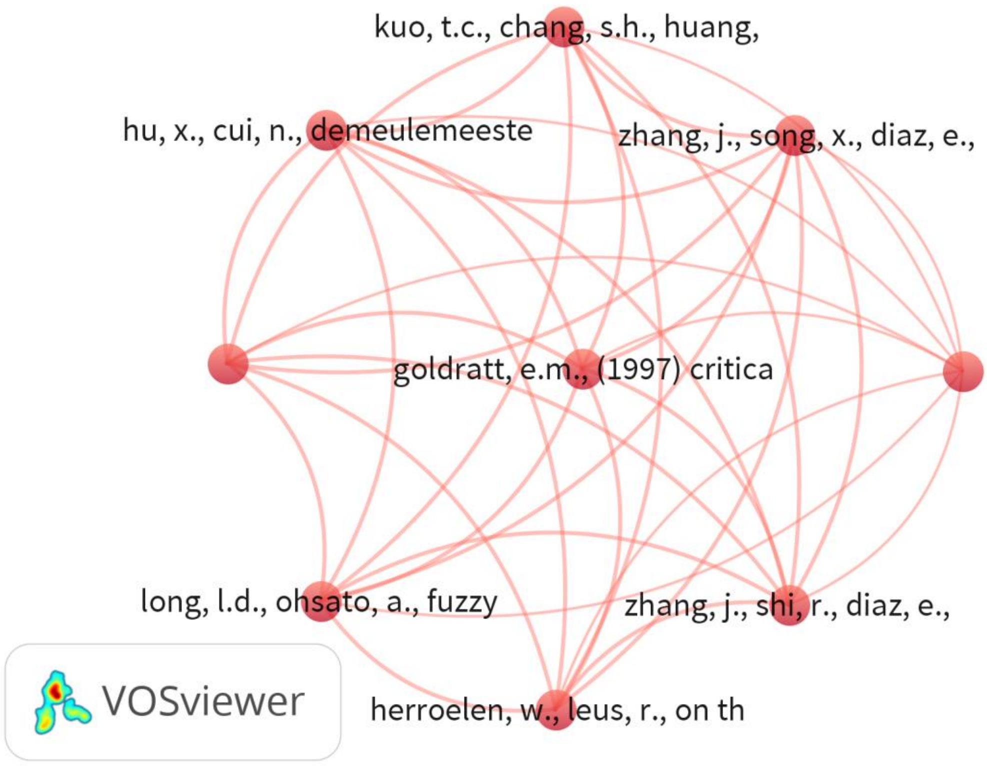

FIGURE 5 – Reference's co-citation map

Note: Figure 5 resulted from creating a map based on bibliographic data by reading data from bibliographic data files, with the following configuration: co-citation (type of analysis), cited references (unit of analysis), full counting (counting method), 2 (threshold), and 16 (references to be selected). Section 4.2 presents the network analysis results.

4.2 Network analysis

In step five, network analysis was executed, and three important results could be highlighted. First, 38 documents (75%) presented themselves completely isolated. Second, 5 isolated groups were identified, say: group [4-12-52], group [19-27], group [31-53], group [9-10], and group [8-13-26-47] (see figure 6). Group [4-12-52] works with the Earned Value

Management (EVM) methodology for project duration monitoring. Group [19-27] proposes artifacts for capital projects and public-private partnerships (PPP). Group [31-53] studies the application of the Internet of Things (IoT) to construction project management. Group [9-10] discusses the application of the Cyber Physical Systems (CPS) to construction project management. And, finally, group [8-13-26-47] proposes artifacts for risk management in the context of projects. And third, the absence of relevant central nodes in figure 6 (due to a high degree of isolation in the network) may be an indicative of a lack of influential or significant works within the literature sample analyzed. For instance, network centrality measures (e.g., degree connectivity, closeness, betweenness, and prestige centralities) cannot be even significantly calculated in this specific "network." Figure 6 presents the network generated in UNICET.

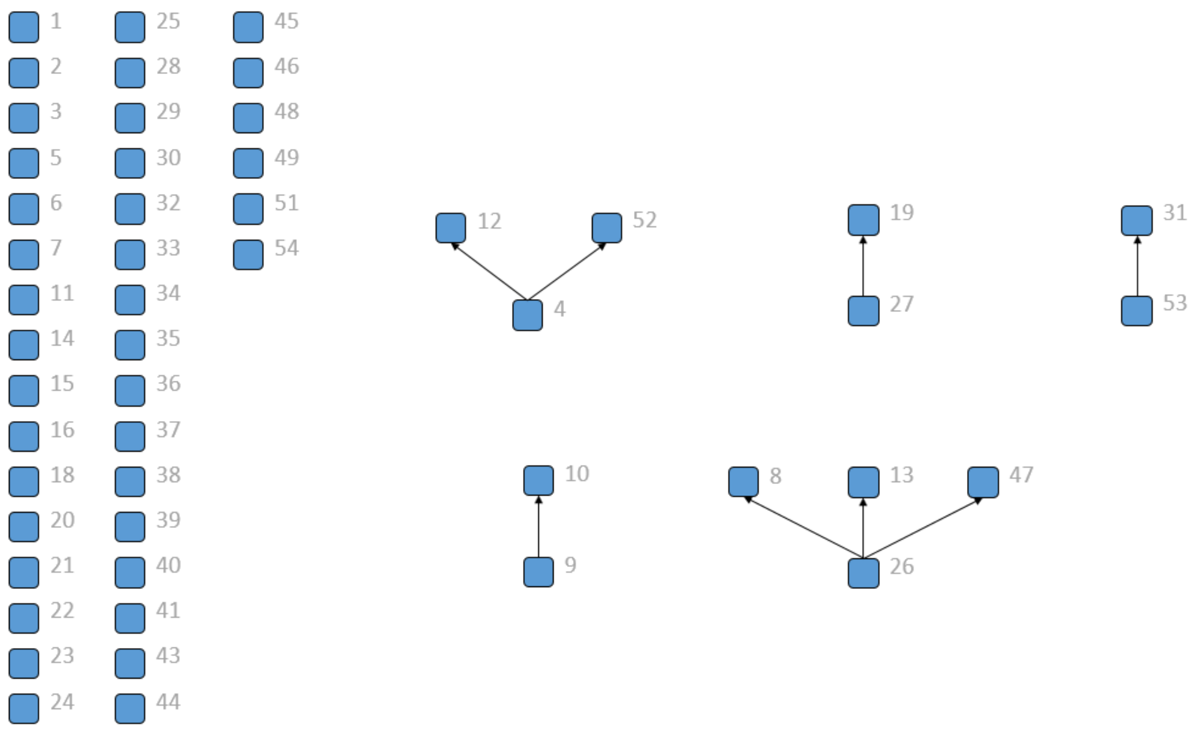

FIGURE 6 – Network

Figure 6 presents the network generated in UCINET with this research 51 sample documents. Section 4.3 presents the results for this work content analysis.

4.3 Content analysis

In step six, content analyses were carried out looking for providing answers to this research questions. The 51 sample documents were, then, classified accordingly to the coding structures. Table 3 presents such classification.

TABLE 3 – Codified documents

ID	Work	Coding structure		
		KA	DPM	KS
1	Hammad et al. (2016)	KA4	DPM3	KS3 | KS1 | KS6
2	Haller et al. (2015)	KA5	DPM2	KS1 | KS4
3	Martinez-Rojas et al. (2016)	KA5	DPM4	KS1 | KS6
4	Votto et al. (2020)	KA3	DPM3	KS1 | KS6 | KS4
5	Sun and Zhang (2015)	KA4	DPM3	KS1 | KS6 | KS4
6	Firouzi and Khayyati (2020)	KA3	DPM3	KS1 | KS6 | KS4
7	Bosch-Sijtsema and Gluch (2019)	KA5	DPM1	KS6
8	Salah and Moselhi (2015)	KA4	DPM3	KS1 | KS6
9	Jiang et al. (2020)	KA5	DPM4	KS1 | KS6
10	Akanmu and Anumba (2015)	KA5	DPM4	KS1 | KS6
11	Belaid (2011)	KA9	DPM4	KS1 | KS6 | KS4
12	Hammad et al. (2018)	KA3	DPM3	KS1 | KS6
13	Albogamy and Dawood (2015)	KA9	DPM3	KS3 | KS5 | KS1 | KS6
14	Ganis and Waszkiewicz (2018)	KA8	DPM4	KS6
15	Mazouak et al. (2019)	KA5	DPM4	KS7 | KS5 | KS1 | KS5
16	Kaewunruen and Lian (2019)	KA5	DPM4	KS1
18	Matthies and Coners (2018)	KA5	DPM3	KS1 | KS6
19	Alasad and Motawa (2015)	KA9	DPM2	KS5 | KS6 | KS1 | KS6 | KS4
20	Zhang, Jia, and Diaz (2018)	KA4	DPM3	KS1 | KS6 | KS4
21	Batselier and Vanhoucke (2015)	KA5	DPM3	KS6 | KS4
22	Chang et al. (2018)	KA4	DPM4	KS1 | KS6
23	Eke et al. (2019)	KA9	DPM3	KS6 | KS4 | KS1 | KS6
24	Yoon and Yu (2019)	KA3	DPM2	KS5 | KS6 | KS4 | KS1 | KS6
25	Le et al. (2020)	KA5	DPM3	KS1 | KS6 | KS4
26	Lee (2019)	KA5	DPM3	KS1 | KS6 | KS4
27	Du et al. (2019)	KA8	DPM2	KS8 | KS6 | KS4
28	Niebecker et al. (2008)	KA5	DPM3	KS1 | KS6
29	Liu et al. (2017)	KA9	DPM3	KS1 | KS6 | KS4
30	Zhang and Wan (2019)	KA3	DPM3	KS1 | KS6 | KS4
31	Ghimire et al. (2017)	KA9	DPM4	KS1 | KS6
32	Kayis et al. (2007)	KA5	DPM4	KS6 | KS1 | KS6
33	Golly et al. (2008)	KA5	DPM3	KS1 | KS6
34	Marques et al. (2017)	KA5	DPM3	KS6 | KS1 | KS6
35	Panova and Hilletofth (2018)	KA9	DPM3	KS3 | KS4 | KS1
36	Koseoglu and Nurtan-Gunes (2018)	KA5	DPM4	KS6 | KS3
37	Andalib et al. (2018)	KA9	DPM3	KS1 | KS6
38	Moselhi et al. (1991)	KA5	DPM3	KS1
39	Chang and Ko (2017)	KA9	DPM3	KS1 | KS6
40	Vanhoucke et al. (2001)	KA5	DPM3	KS1 | KS6
41	Emblemsvåg (2020)	KA5	DPM2	KS3 | KS1
43	Georgy et al. (2005)	KA5	DPM4	KS5 | KS1 | KS6
44	Shahrara et al. (2017)	KA9	DPM3	KS6 | KS1
45	Tran and Molenaar (2015)	KA9	DPM3	KS1 | KS6
46	Zhang et al. (2020)	KA5	DPM3	KS1 | KS6 | KS4
47	Okmen and Oztaş (2015)	KA4	DPM3	KS4
48	Golizadeh et al. (2019)	KA5	DPM4	KS3
49	Harvey (2004)	KA2	DPM3	KS2
51	Strojny and Jedrusik (2018)	KA10	DPM3	KS3 | KS1 | KS6
52	Acebes et al. (2015)	KA9	DPM3	KS1 | KS4
53	Niu et al. (2019)	KA5	DPM1	KS3 | KS6 | KS7 | KS1
54	Smith (1992)	KA5	DPM4	KS1

From table 3, three important results may be observed. First, analysis in code KA showed that the articles are mainly aimed at the areas of knowledge Quality (47%), followed by the areas of Risk (24%), Cost (12%), Time (10%), Communication (4%), Stakeholder (2%) and Scope (2%). The other areas of knowledge did not appear in the classification. Second, analysis in code DPM showed that literature mainly discusses or proposes methods for PM, i.e., algorithms and practices (59%), followed by: instantiations, i.e., implemented and prototype systems (27%); models, i.e., abstractions and representations (10%); and constructs, i.e., vocabulary and symbols. And third, most of the studies (84%) employ a multi-method approach, frequently designing and evaluating artifacts for PM. In short, it was observed that all articles present tools, methods and simulations that assist in the performance of the different phases of a project's life cycle and do not necessarily present a technological base involved (IoT, Cloud, Big Data, Analytics), or discuss a success dimension for projects (Carvalho and Rabechini, 2015). Section 5 presents this work discussion and claimed main contribution.

Also, there were only eight related works that review the literature on “digitalisation” or “industry 4.0”, and “project management” concomitantly. However, all of them present different objectives and, therefore, limited scopes. In other words, they are limited to a specific: (a) project management knowledge area, e.g., risk (Albogamy and Dawood, 2015; Panova and Hilletofth , 2018), cost (Hammad, Abbasi, and Ryan, 2016), stakeholder management (Strojny and Jedrusik, 2018), or quality (Emblemsvåg, 2020); (b) project management context, e.g., construction (Koseoglu and Nurtan-Gunes 2018; Panova and Hilletofth, 2018; Golizadeh et al., 2019); or (c) technology, e.g., Building Information Modelling (Koseoglu and Nurtan-Gunes 2018), Remoted Piloted Aircrafts (Golizadeh et al., 2019), Internet of Things, Cyber-Physical Systems, or Smart Construction Objects (Niu, Anumba and Lu, 2019). Albogamy and Dawood (2015), for instance, review the literature to “design an effective risk assessment methodology”. Panova and Hilletofth (2018), in their turn, carry out their review aiming at investigating “models and methods for managing supply chain risks and delays in construction”. Hammad, Abbasi, and Ryan (2016) execute another literature review to introduce “a new methodology to estimate and allocate cost contingency during the planning phase, as well as managing cost contingency during the execution phase”. Strojny and Jedrusik (2018), also as an example, perform a review “to identify the basic methodological assumptions of the process of stakeholder analysis” in project management.

Emblemsvåg (2020), in addition, produce a review paper with the goal of discussing some of the critical aspects of project-based industries concerning quality management and particularly Quality 4.0". Koseoglu and Nurtan-Gunes (2018), through another review, aim to define "interactions between BIM [Building Information Modelling] process and lean". Golizadeh et al. (2019) also review the literature, but to assess RPA (Remoted Piloted Aircrafts) systems in the construction industry. Finally, Niu, Anumba, and Lu (2019) work on a review to propose "a deployment framework that integrates IoT [Internet of Things], CPS [Cyber-Physical Systems], and SCOs [Smart Construction Objects]". This way, there is a need for a (systematic and holistic) literature review on "digitalisation" in the project management field, that is not limited to any specific project management context, nor to any specific project management knowledge area, nor to a specific technology.

5. DISCUSSION

Five main points for discussion stood out from section 4. First, in terms of KA, it is observed a strong tendency in research towards project management quality, i.e., 47% of the reviewed documents are dedicated to quality, as mentioned before. Therefore, this work suggests that future research could focus on the application of intelligent artifacts to other PMKA to develop research in a more balanced way. Figure 7 illustrates this recommendation.

FIGURE 7 – Future research recommendation based on KA

Second, in terms of DPM, it is observed a strong tendency in research towards digital project management methods, i.e., 59% of the reviewed documents are dedicated to discussing or proposing intelligent methods, as also mentioned before. Therefore, this work suggests that future research could focus on the development of other DPM artifacts to develop research in a more robust way, i.e., focus on constructs and their relationships. Figure 8 illustrates this recommendation.

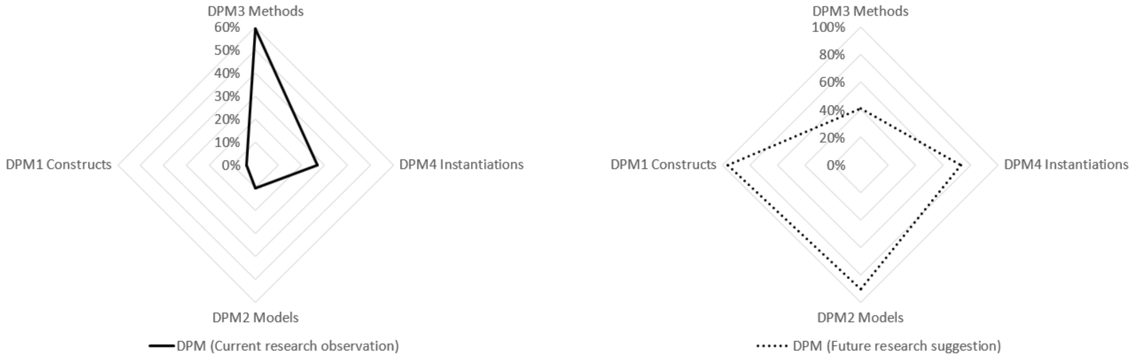

FIGURE 8 – Future research recommendation based on DPM artifacts

Third, in terms of KS, it is observed, first, a strong tendency multi-methods approach, i.e., 48 documents (84%) employ a multi-method approach, being modelling (34%) and case study (36%) methods the most frequent ones. Thus, it is highlighted the way literature authors like to work. Any future research suggestion is presented here.

Fourth, according to the sample of articles analyzed in this research, a definition for the term “digital project management” can be proposed: the application of intelligent artifacts, i.e., constructs, models, methods, or instantiations, to project management discipline. Figure 9 presents a first framework based on the just proposed definition.

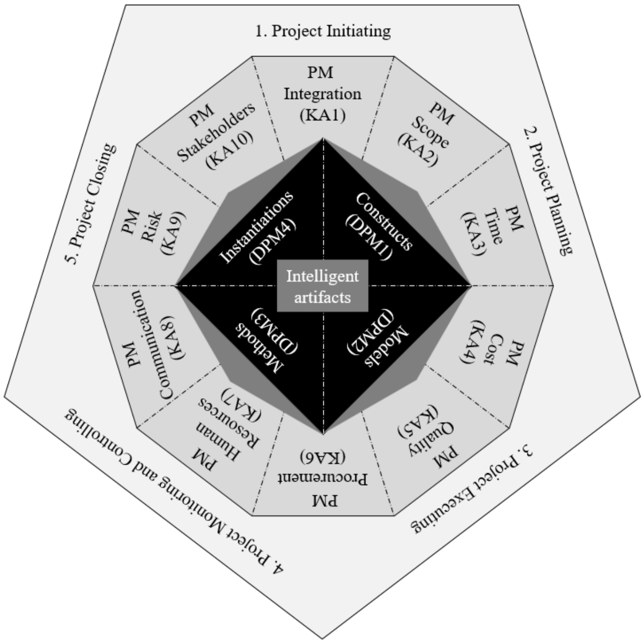

FIGURE 9 – Digital project management

And fifth, finally, a contribution to an important and existing framework from the industry 4.0 (Frank, Dalenogare, and Ayala, 2019) can also be suggested here. Figure 10 presents a second framework contribution, because of this literature review, concluding step seven.

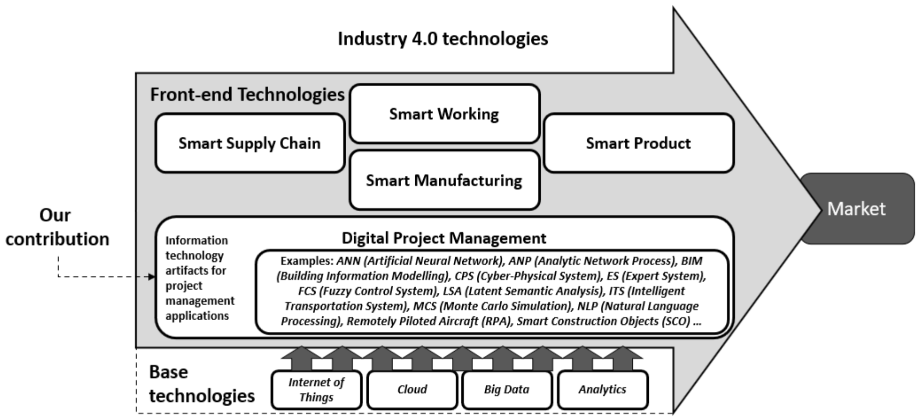

FIGURE 10 – Digital project management in the Industry 4.0 context (see Frank et al., 2019)

6. CONCLUSION

A systematic literature review on project management and digital transformation has been presented in the last pages (see figure 1). Multiple analyses have been conducted (see sections 4.1, 4.2, and 4.3), and a more structured view of this literature has been pictured (see table 5). Structured suggestions for future research have been made (see figures 7 and 8). And, finally, a definition for digital project management is proposed in line with two framework contribution (see figures 9 and 10).

This research main limitation is imposed by a manual and subjective process to remove documents from the research sample, thus reducing the systematic characteristic of this review and the ability to reproduce it (see table 2). This limitation is, however, a setback from the iterative process implemented to include as many related terms as needed (see table 1). In other words, authors have chosen carefully to read all related titles, abstracts, and keywords, as opposed to incurring the risk of leaving one or more important search term(s) out.

Other limitations can also be pointed out, such as: (i) the need for previous and more substantial discussion on global virtual teams, digital technologies, BIM and how they impact PM. It could enrich discussion proposed in chapter five. (ii) The need to include new terms in table 1, such as artificial intelligence and blockchain. They could enrich initial sample. (iii) The need to enrich coding structure, e.g., including codes from Frank et al. (2019). It could provide different perspectives, thus, richer content analysis. (iv) The need to discuss VOSViewer maps deeper. It could provide new avenues for future research. (v) The need for a more detailed and less statistically descriptive content analysis. It could enrich and make this work more robust. (vi) To deepen the discussion with previous literature. It could enrich concluding remarks. (vii) The eventual need to clarify the origin of the contributions proposed, i.e., definition and framework. And, (viii) the need to build the sample with a snowballing technique.

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