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Sustainability integration in the management of construction projects: A morphological analysis of over two decades' research literature

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ABSTRACT

Sustainability integration in the processes of managing and delivering projects is essential to ensure the sustainability of the projects and that of the assets created. This research synthesises over two decades of published research on sustainability integration in management of construction projects (SIMCP). A three stage research process is used for searching and shortlisting, systematically reviewing, and Morphological Analysis (MA) of 130 selected journal articles. The use of MA here, perhaps the first such attempt in sustainable construction literature, has enabled compact tabular-visual representation of the large body of knowledge on SIMCP by categorising it under 7 dimensions, viz., Motivations, Stakeholder Orientation, Organizational Context, Temporal Orientation, Benefits, Barriers, and Risks, and 31 variants. MA has confirmed significant future research scope and revealed at least 236 specific research gaps. The study has significant implications for practitioners and academicians. While the former can use it to understand the state-of-the-art in SIMCP, the latter can utilize the identified gaps to decide their future lines of academic and intellectual inquiries.

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1. Introduction

The construction industry (CI) positively impacts the human quality of life by undertaking projects to produce buildings and infrastructure, constituting the built environment, that meet the socio-economic needs of individuals, society and nations (Lee et al., 2017). However, the industry also has a dark side owing to its consumption of a large share of natural, non-renewable resources that contribute to environmental degradation through pollution, damage to delicate natural eco-systems, and release of greenhouse gases (GHGs) (Zhang et al., 2015a). Globally, consumption of 60% of raw materials (Bribián et al., 2011), 40% of energy, 12% of water (Said and Berger, 2013; Hwang and Tan, 2012) and consequently, up to 40% of GHG emissions are attributed to the CI (Son et al., 2011). Further, despite being one of largest sources of employment, the CI has a negative societal image due to the lack of employee friendly practices and ignoring societal concerns in project development (Wong et al., 2012). It is also one of the most accident prone industries, accounting for almost half of all occupational accidents globally (Patermann, 1999). Construction workers are at 50% higher risk of occupational injuries or mortality than any other major industries (Loosemore and Phua, 2011). These problems are even more pertinent in the context of developing economies —witnessing the execution of large numbers of building and engineering projects — that have not devoted as much attention to the sustainability issues (Ofori, 2018). Collectively, these issues represent a challenge for the CI, which is under increasing pressure from governments, non-governmental organizations (NGOs) and civil society to adopt sustainable construction principles which call for integration of triple bottom line (TBL) concerns of sustainable development in its objective and practices (Banihashemi et al., 2017). Past research has also confirmed that the CI can contribute to sustainable development by integrating the TBL issues of environmental protection, societal welfare and economic growth across project lifecycles (Lu and Zhang, 2016).

Sustainability integration in projects can be done either at the level of project *content* or at the level of *processes* through which projects are managed and delivered (Huemann and Silvius, 2017). Examples of the former include tangible aspects of project deliverables, like design and specifications, construction materials

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and technologies (e.g., rooftop solar systems) that are part of sustainable construction projects (SCPs). Project processes in which this integration can be achieved include feasibility studies, procurement, stakeholder involvement and communication, labour capacity building, selection of team members, and identification and management of risks (Gareis et al., 2013; Silvius et al., 2012; Silvius, 2017). The research on sustainability in project contexts has predominantly focussed on the content side with lesser attention to sustainability integration in project processes (Aarseth et al., 2017; Gareis et al., 2013). Even the project management standards have largely ignored sustainability aspects (Eid, 2009). This variance in academic pursuit is possibly due to the temporary nature of projects (and hence project processes) that seem to contradict with the long term focus of sustainable development (Huemann and Silvius, 2017). However, recent but growing research efforts on sustainable project management have recognised the importance of sustainability integration in project processes (Aarseth et al., 2017; Gareis et al., 2013; Silvius et al., 2012). This thinking originated with Labuschagne and Brent's (2005) argument that the lifecycles of a project and the project's deliverable interact, implying that the sustainability of the deliverable is shaped by the project processes.

While research on sustainability integration in project management is still nascent as a distinct area of scholarly pursuit (Huemann and Silvius, 2017), there have been recent attempts to synthesise the relevant knowledge. A systematic review by Aarseth et al. (2017) identified project sustainability strategies adopted by organizations. Another review by Silvius and Schipper (2014) identified key areas of sustainability integration and the impact of this integration on project management. However, both these reviews are general in nature and not in the context of the CI. Considering the unique features of the CI, even within the larger scope of project management, and the increased complexity associated with management of SCPs (Hwang and Ng, 2013; Shi et al., 2016), a more focused review on Sustainability integration in the management of construction projects (SIMCP) is therefore required. Further, the review by Aarseth et al. (2017) was restricted to five journals on sustainability and project management, and it did not include several leading construction management journals that cover sustainability (e.g., *Journal of Construction Engineering and Management, Building Research and Information*, *Built Environment Project and Asset Management*). Furthermore, Silvius and Schipper's (2014) review has become somewhat dated with many more publications on the subject in the last four years, including a special issue by the *International Journal of Project Management* (Huemann and Silvius, 2017).

The present review aims to address the aforesaid knowledge gap. It has three main objectives: (i) to identify publication trends in SIMCP literature, (ii) to succinctly summarize the current state-of-the-art of SIMCP and, (iii) to discover research gaps in SIMCP literature in a systematic manner. The scope of this review is defined as: a) Conceptual scope: Sustainability, within the frame of the TBL, b) Contextual scope: Management of Construction Projects, c) Methodological scope: Systematic review of literature using Morphological Analysis, d) Geographic/Spatial scope: Global, e) Temporal scope: articles published till 2018, and f) Literature scope: Journals included in either the Clarivate analytics or ABDC[1] listings. These two listings are highly reputed among academicians working in the areas of Science, Engineering and Technology for the former, and Business and Management for the latter.

The novelty of this study lies in the development of a Morphological Analysis (MA) framework to provide a compact tabular-visual representation of the vast body of knowledge on SIMCP. The framework has enabled identification of 236 research gaps that hold promise for future research.

Remaining parts of this paper are divided into six sections. Section 2 introduces the methodology for systematic review and MA. The process of basic classification of articles, to identify publication trends, is discussed in section 3, and the MA framework is presented in Section 4. The results are discussed in Section 5, and conclusions are presented in Section 6.

2. Methodology

A systematic review and MA of literature on SIMCP is performed here. Systematic reviews originated in health care and medical science literature to synthesize large bodies of knowledge in a "replicable, scientific and transparent" manner (Tranfield et al., 2003, p. 209). They are considered to be a "fundamental scientific activity" that can inform practice as well as further research (Mulrow, 1994, p. 597). Systematic reviews are characterized by a well-defined protocol to search and shortlist relevant articles (Tranfield et al., 2003). Here, a three-stage protocol (Fig. 1) has been used to generate the sample of literature pertaining to SIMCP. To keep the scope of this review manageable, the literature search was restricted to only journal articles. They are preferred to other sources of literature due to their higher academic rigour (Olanipekun et al., 2017).

A keyword based search was carried out without any restrictions on the year of publication in Title, abstract or keywords sections of 8 electronic databases. Any article having the search string terms in any of these three sections was selected for further analysis. The databases, selected for their wide coverage of construction management research (Chan and Oppong, 2017; Oladinrin and Ho, 2014) included, American Society of Civil Engineers (ASCE), ScienceDirect, Wiley, Taylor and Francis (T&F), Sage, Emerald, Inderscience, and Proquest (ABI/Inform). ACSE and T&F provided search options for the article titles only. The search string used was *((Sustainability OR Sustainable) AND (Construction) AND (Project))*. Following Webster and Watson's (2002) suggestion to include articles from reputed sources in a systematic review, articles only from journals included in either of the following lists were considered: (a) Clarivate analytics' journal list (Science Citation Index Expanded, Social Sciences Citation Index and Emerging Sources Citation Index), or (b) ABDC's journal quality list. These lists have been commonly used to benchmark the quality of journals for systematic reviews in construction management, project management and sustainability related disciplines (e.g., Holt, 2010; Prater et al., 2017; Quental and Lourenço, 2011; Yang et al., 2011).

The Initial search returned 3016 articles out of which 849 conference articles and book chapters were removed, leaving 2167 articles. Duplications in these 2167 articles were removed using the Zotero™ bibliographical software, and 1552 unique results were identified. The abstracts of these articles were carefully read and articles pertaining to SIMCP were shortlisted for further study, excluding all the others. This process resulted in the identification of 151 articles that were relevant to SIMCP. After further exclusion of 21 articles from journals not included in the either Clarivate or ABDC's list, the final sample of 130 articles was identified.

The complete search and short-listing process was conducted by the first author and later reviewed independently by the second author. Following Seuring and Gold (2012), articles considered unsuitable by both authors were not included in the final sample. To be shortlisted, the article should have related sustainability in construction projects to any of the twelve knowledge areas identified in the Construction extension to Project Management Body of Knowledge (PMBOK) (PMI, 2016). These areas pertain to

[1] Australian Business Deans Council.

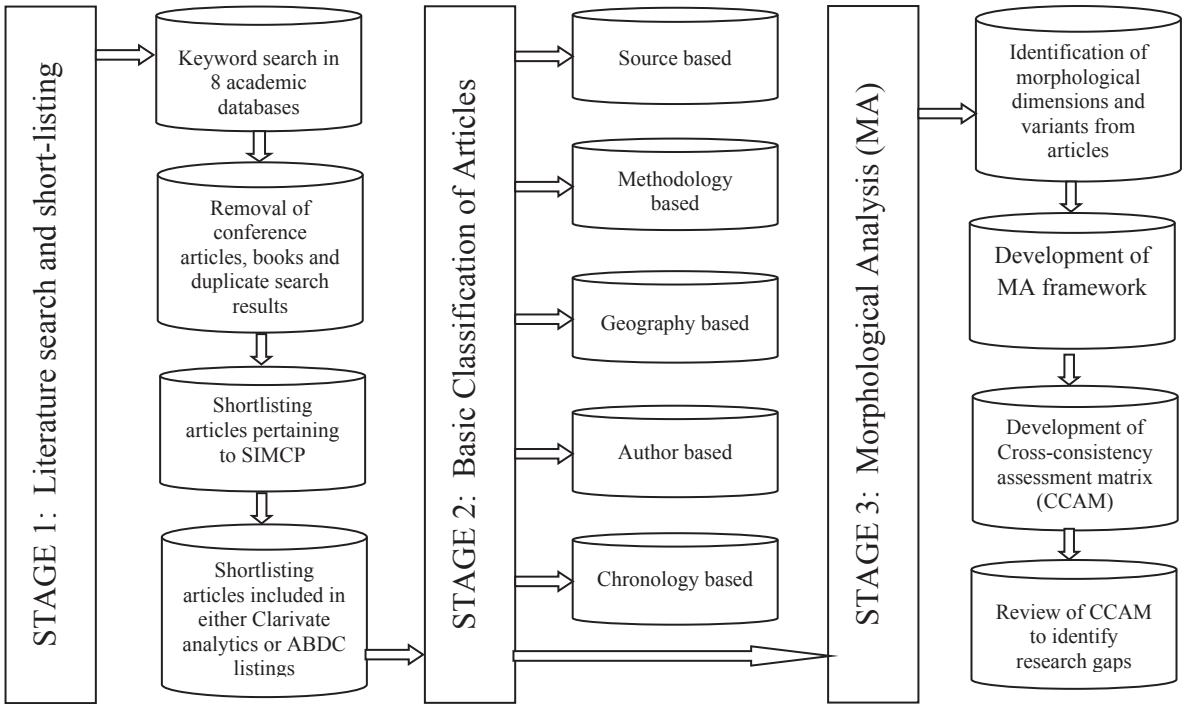

Fig. 1. The research process.

management of integration, scope, schedule, cost, quality, resources, communication, risk, procurement, stakeholders, health, safety, security and environment, and project finance (PMI, 2016). Further, considering Herazo et al.'s (2012) argument that sustainability integration in project processes necessitates alignment of initiatives at the strategic and tactical levels, articles focusing on sustainability integration in processes at temporary organizations (i.e., projects) as well as permanent organizations were considered. This also agrees with Silvius et al. (2012) that sustainable project management also spans functions under strategic management. Most of the excluded articles pertained to: (a) construction materials and technologies, (b) structural design, (c) projects related to disaster management, repair and retrofitting, (d) sustainability education in construction, and (e) projects outside the CI.

To serve the first objective of this study, viz. identification of publication trends in literature on SIMCP, a basic classification of the sample articles was developed based on: (a) source: to identify prominent journals publishing research on SIMCP; (b) methodology: to understand the methodological orientation of the articles; (c) geography: to track the spatial distribution of research in terms of the lead author's country of domicile/Institutional affiliation, (d) author: to identify the major contributors to the field of SIMCP, and (e) chronology: to identify the temporal distribution of articles and evolution of themes.

To meet the remaining two objectives of this study, MA has been used. 'Morphology' refers to the study of different forms of a thing and MA is a qualitative, dimensional analysis technique used for developing typologies (Ritchey, 2011). While MA has been used commonly in medical science, Zwicky (1969, p.34), developed 'general morphological analysis' which could be applied to "not only the study of the shapes of geometrical, geological, biological, and generally material structures, but also to study the more abstract structural interrelations among phenomena, concepts, and ideas". The unique strength of MA lies in its potential to not only record the different states that a physical or conceptual system has at a given point of time but to also identify possible unexplored or future states of that system (Majer, 2007; Ritchey, 2011). Accordingly, MA has been used in creative pursuits by researchers in varied fields (Álvarez and Ritchey, 2015) like: conceptualization and selection of ideas for new product development (Singhal and Singhal, 2002), business model development (Im and Cho, 2013), technology development (Xin et al., 2010), and problem formulation in operation research (Müller-Merbach, 1976). Additionally, MA has been used to visually represent the literature, identify its key dimensions and variants and thereby point out a number of unexplored areas or research gaps in the literature. Some management areas in which MA has been used to this effect include, lean six sigma for services (Sunder et al., 2018), supply chain knowledge (Sudhindra et al., 2014), and organizational knowledge transfer (Kumar and Ganesh, 2009). In this paper, we use MA to represent and analyze the body of knowledge on SIMCP and to identify areas that remain unexplored. Distinct morphological dimensions and variants have been identified from the literature sample and integrated in a MA framework. The MA has enabled identification of multiple unique literature gaps that may inform the future research on SIMCP.

The overall, three-stage research process is presented in Fig. 1. A similar process has been used by Sunder et al. (2018) for MA of literature on Lean Six Sigma. The MA involved the following three steps (Ritchey, 2011):

a) All articles were read carefully to identify different dimensions based on which literature could be classified. The dimensions are the issues or "mental constructs which support a range of values or conditions" (Ritchey, 2011. p. 47).
b) Reading through the articles, different options (called variants) for each dimension were identified. The variants are "the possible, relevant states or conditions that each issue can assume" (Ritchey, 2011. p. 15).

The identification of dimensions and variants was essentially an analysis-synthesis process involving their constant review and

modification as required, thus ensuring that collectively they represented the whole sample. The final outcome of this step was the MA framework (MAF) consisting of 7 dimensions and 31 variants.

c) To identify unexplored areas of literature, a Cross consistency assessment matrix (CCAM) was developed from the MAF, which facilitated pair-wise comparisons of variants under various dimensions.

As defined in linguistic morphology (Booij, 2007), the morphological dimensions are the building blocks or the smallest meaningful unit elements in the entity under study. But, how can dimensions be identified? Firstly, in the case of any distinct set of natural or man-made physical entities, the dimensions can be identified as the intersection of components or parts across all the entities in the set of physical entities being examined. These parts are related to each other either geometrically or topologically (Ritchey, 2011). For example, if we wish to represent the MAF of toothbrushes, constituted as a distinct set, then the dimensions could be bristles, head, neck and handle – parts that are common to all toothbrushes, in general, and hence represent the intersection mentioned above. Likewise, in the case of conceptual entities, say a language (e.g., French or Spanish), a body of knowledge (e.g, Algebra or PMBoK), or a concept (e.g., Lean six sigma or Sustainability), the dimensions could be identified as the intersection of the relevant, constituent meaningful terms of that conceptual entity. Secondly, the dimensions can be observed to be the distinctive, directly relevant building blocks that collectively represent and characterize the entity under study comprehensively. For example, Sunder et al. (2018) represented the MAF of literature for a conceptual entity viz., Lean Sigma for Services in terms of the following dimensions and variants: Organizational context (inbound logistics, operations, procurement etc), Desired outcomes (short term and long term), Implementation systems (substantive approaches, resources, issues), Evaluation methods (milestone based, function based etc), Tools and techniques (graphical and statistical).

Accordingly, in this review the distinct meaningful terms or concepts related to the conceptual entity (SIMCP), presented in the results and/or recommendations in the reviewed papers were identified as dimensions. When any identified dimensions were found to manifest or be interpreted in two or more forms or ways, the latter were labelled as options or variants. For example, a large number of articles focussed on the motivations of SIMCP at the corporate and/or project levels. These motivations were then identified as the first dimension (D1) of our MA framework. Further reading through these articles revealed two distinct options (or variants) of D1 that are manifested as (a) gaining benefits or avoiding risks by the organization, together labeled as "V1-Instrumental", and (b) showing a sense of responsibility towards stakeholders and society at large without expectations of monetary benefits, labeled as "V2-Normative". While labeling the variants, the authors took cognizance of wider project management literature (as discussed in the next paragraph). Similar procedure was followed for identification of all dimensions and their respective variants. All the dimensions and variants are discussed in detail in Section 4.

Many articles contributed to identification of more than one dimension and/or variants. For example, Murtagh et al. (2016) reported that the internal or autonomous motivation of designers contribute to sustainable design. This conclusion led to identification of the variant 'normative' motivation (V2) in dimension D1. In addition, the same article also contributed to dimension D3 and variant V15 due to the suggestion that intrinsically motivated designers in the project team could contribute to more sustainable project outcomes. Overall, the MAF was developed by identifying either a dimension or an option as and when it first appeared during the review process. Accordingly, the development process has been both, a mix of the top-down and bottom-up approaches, as well as iterative. As indicated earlier, the authors specifically borrowed terms from the extant literature for the labelling of the dimensions and variants to establish a clear linkage between the MAF and the broader construction project management literature from which it has been developed. Additionally, in any methodology, like MA, using an analysis-synthesis approach for abstraction of large data, it is recommended that the resulting theory or framework remains as close to the data as possible (Partington, 2002). It improves the trustworthiness of the approach by allowing readers to connect the resulting theory or framework with the data (Elo et al., 2014). To achieve this in MA, we used constructs from the extant literature as dimensions of the MAF. For example, Dimension D1, is based on project stakeholder literature (Eskerod et al., 2015; Eskerod and Huemann, 2013), which suggests two approaches to stakeholder management; instrumental (management of stakeholders) and normative (management for stakeholders). Similarly, the other dimensions and variants have also been inferred from extant literature. Under each dimension, examples from the literature corresponding to each variant are also provided to establish clear link among the dimensions, variants and the literature sample.

Following Derakhshan et al. (2019) and Seuring and Gold (2012) regarding subjective decision making in such scholarly pursuits, the complete MA framework prepared by first author was later reviewed by second author and final MAF was based on discussion and agreement between them. Yet, the development of the MAF involved academic judgement exercised by authors. A possibility exists that different groups of scholars may develop different MAFs using the same literature sample. Yet, as Sunder et al. (2018, p.160) have argued that the "total or aggregation of all the contents of all such MA frameworks will be, or can be made, the same through intellectual discussions" and that it represents the strength and objectivity of the MA approach. However, some subjectivity remains inherent in this analysis which is one of its key limitations.

3. Basic classification of articles

This classification enabled tracing the spatio-temporal evolution of literature on SIMCP along with the key sources and contributors.

3.1. Source based

Table 1 indicates the key source-journals of articles. While the sample literature was spread across 42 journals, the top 10 journals in the list, in terms of number of identified articles, contributed 66% of the articles. We can note that considerable research on SIMCP is published in journals outside the project management domain (e.g., JCP and CME).

3.2. Methodology based

From a methodological perspective, the articles were classified into two broad categories, viz., empirical and conceptual. Empirical articles are those based on "field-based research which uses data gathered from naturally occurring situations or experiments" (Flynn et al., 1990, p. 251). These included articles in which research questions were answered using primary or secondary data, while the conceptual articles included literature reviews, theoretical articles, and mathematical models. Further, based on the research approach (Creswell, 2013), the articles were placed in seven categories: Conceptual-qualitative, Conceptual-quantitative, Empirical-quantitative, Empirical-Qualitative, Empirical-Mixed method and

Table 1
Source based classification of literature on SIMCP.

Journal	Number of articles
Journal of Cleaner Production (JCP)	17
Construction Management and Economics (CME)	13
Built Environment Project and Asset Management (BEPAM)	10
International Journal of Project Management (IJPM)	10
Journal of Construction Engineering and Management (JCEM)	9
Building Research & Information (BRI)	6
Technological and Economic Development of Economy (TEDE)	6
Engineering, Construction and Architectural Management (ECAM)	6
Sustainable Development (SD)	5
Facilities	4
International Journal of Construction Management (IJCM)	4
Journal of Architectural Engineering (JAE)	3
Building and Environment (BE)	2
Ecological Indicators (EI)	2
International Journal of Procurement Management (IJPRM)	2
Smart and Sustainable Built Environment (SASBE)	2
Structural Survey (SS)	2
Project Management Journal (PMJ)	2
Clean Technologies and Environmental Policy (CTEP)	2
Others (with 1 article each)	23
Total	**130**

Table 2
Methodological classification of articles.

Type of research	No. of articles	% of articles	Research Approach	No. of articles	% of articles
Empirical	96	74	Empirical-qualitative	41	31
			Empirical-mixed method	27	21
			Empirical-quantitative	26	20
			Empirical-multi method	2	2
Conceptual	34	26	Conceptual-qualitative	27	21
			Conceptual quantitative	7	5

Empirical-multi method. In mixed method studies both qualitative and quantitative data are collected to answer research questions while in multi-method studies "multiple types of qualitative or quantitative data are collected" (Creswell, 2011, p. 273).

Table 2 presents data on the methodological classification. Out of the 96 empirical articles, 87 articles (91%) were based on primary date while 10 articles (10.4%) used secondary data. Data on the research methods used in empirical studies are presented in Table 3.

Edmondson and McManus (2007) argue that methodological orientation of studies indicate the maturity of the corresponding theory in terms of identification of relevant constructs and variants. They suggest three stages of theory development, nascent, intermediate and mature based on predominant use of qualitative, hybrid (mixed) and quantitative data respectively. In the light of this argument, many inferences can be drawn from the present literature sample. A majority of the empirical articles used qualitative approaches (Table 2), relying on methods like interviews and case studies (Table 3). Another observable trend is the increasing use of mixed methods research, which is preferred due to the possibilities of data triangulation using different methods (Creswell, 2013). It indicates that the theory on SIMCP is shifting from the nascent to the intermediate stage, but is yet to mature.

3.3. Geography based

Based on the first author's country of domicile/Institutional affiliation, we can observe that research on SIMCP has originated

Table 3
Research Methods used for data collection in empirical studies.

Research Approach	Research method	No. of articles	% of articles (empirical, N = 96)
Empirical-qualitative	Case study	16	17
	Interviews	20	21
	Action Research	1	1
	Participant Observation	1	1
	Focus Group	1	1
	Content Analysis	2	2
Empirical-mixed method	Questionnaire Survey + Interviews	18	19
	Interviews + Case Study	3	3
	Other mixed methods	6	6
Empirical-quantitative	Questionnaire Survey	20	21
	Case Study	2	2
	Content Analysis	4	4
Empirical-multi method	Questionnaire Survey + interviews	1	1
	Interviews + Case Study	1	1

Table 4
Geographical classification of articles.

Country Classification[a]	Country	No. of articles	% of articles
Developed	UK	29	22
	USA	21	16
	Australia	9	7
	Netherlands	4	3
	Canada	5	4
	Belgium	3	2
	Italy	2	1.5
	Sweden	2	1.5
	Others (1 article each)	5	4
Developing	China	16	12
	Malaysia	6	5
	Singapore	5	4
	South Africa	5	4
	Turkey	4	3
	Brazil	2	1.5
	Korea	2	1.5
	UAE	2	1.5
	Israel	2	1.5
	Others (1 article each)	6	5

[a] As per United Nations Department of Economic and Social Affairs (UN/DESA, 2018).

from 28 countries with a majority (62%) of the articles from the developed economies (Table 4).

This agrees with similar claims of researchers (see for e.g., Banihashemi et al., 2017; Du Plessis, 2007) who call for promoting context specific sustainability research in the developing economies. Three countries, UK, USA and China together contribute around 50% of all articles. Interestingly, for each of the last four years (2015–18), the number of articles from developing economies have either equalled or surpassed those from the developed economies. It hints at the increasing recognition of SIMCP as an emerging research area in developing economies also.

3.4. Author based

Altogether, 311 researchers contributed to the literature sample either as an author or as co-authors. Most notable contributors, in terms of number of articles, are mentioned in Table 5. 285 researchers have authored or co-authored only 1 article while 26 are associated with more than one article. This indicates that SIMCP is yet to be established as a distinct area of research with a large number of academic scholars having wide publications.

Table 5
Notable contributors to the research on SIMCP.

Author	Affiliation	No. of articles	Articles
Bon-Gang Hwang	National University of Singapore	4	Hwang et al. (2013); Hwang and Leong (2013); Hwang and Ng (2013); Hwang and Tan (2012)
Xiaoling Zhang	City University of Hong Kong	4	Li et al. (2018); Lu and Zhang (2016); Zhang et al. (2015a,b)
Matthew, R. Hallowell	Univ. of Colorado, Boulder	3	Dewlaney et al. (2012); Dewlaney and Hallowell (2012); Fortunato III et al. (2012)
Alex Opoku	London South Bank University	3	Opoku et al. (2015a,b); Opoku and Ahmed (2014)
Vian Ahmed	University of Salford	3	
John A.Gambatese	Oregon State University	3	Karakhan and Gambatese (2017a,b); Rajendran and Gambatese (2009)

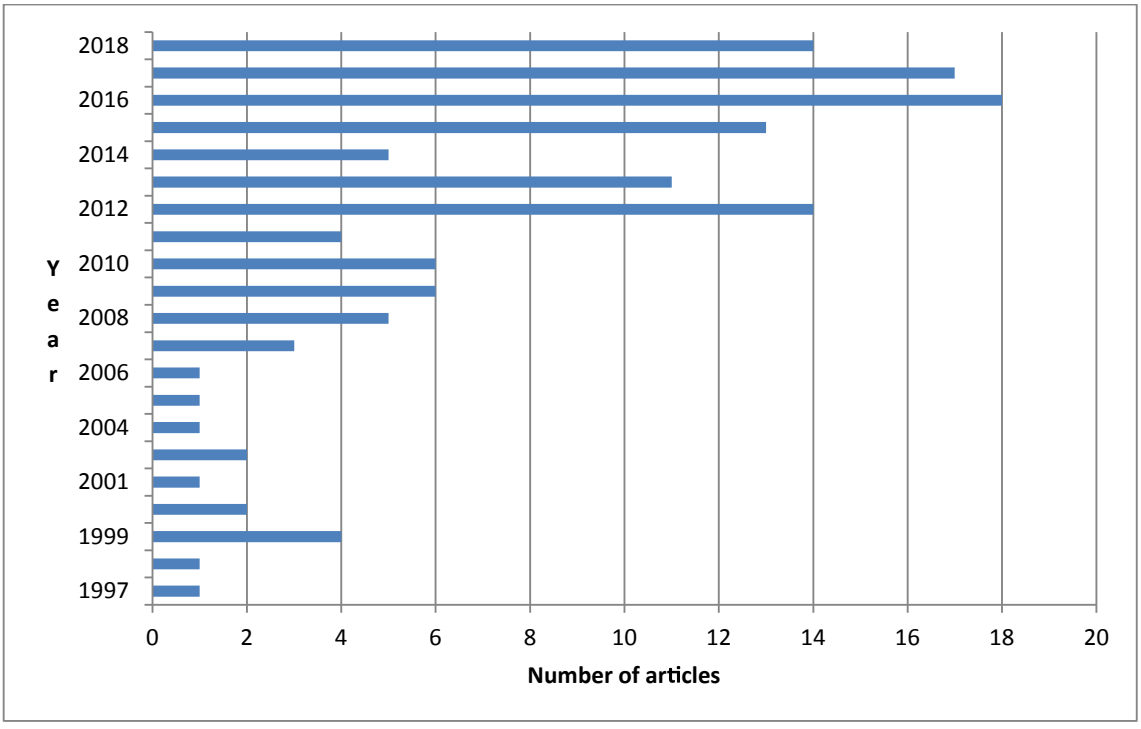

Fig. 2. Chronological distribution of articles on SIMCP.

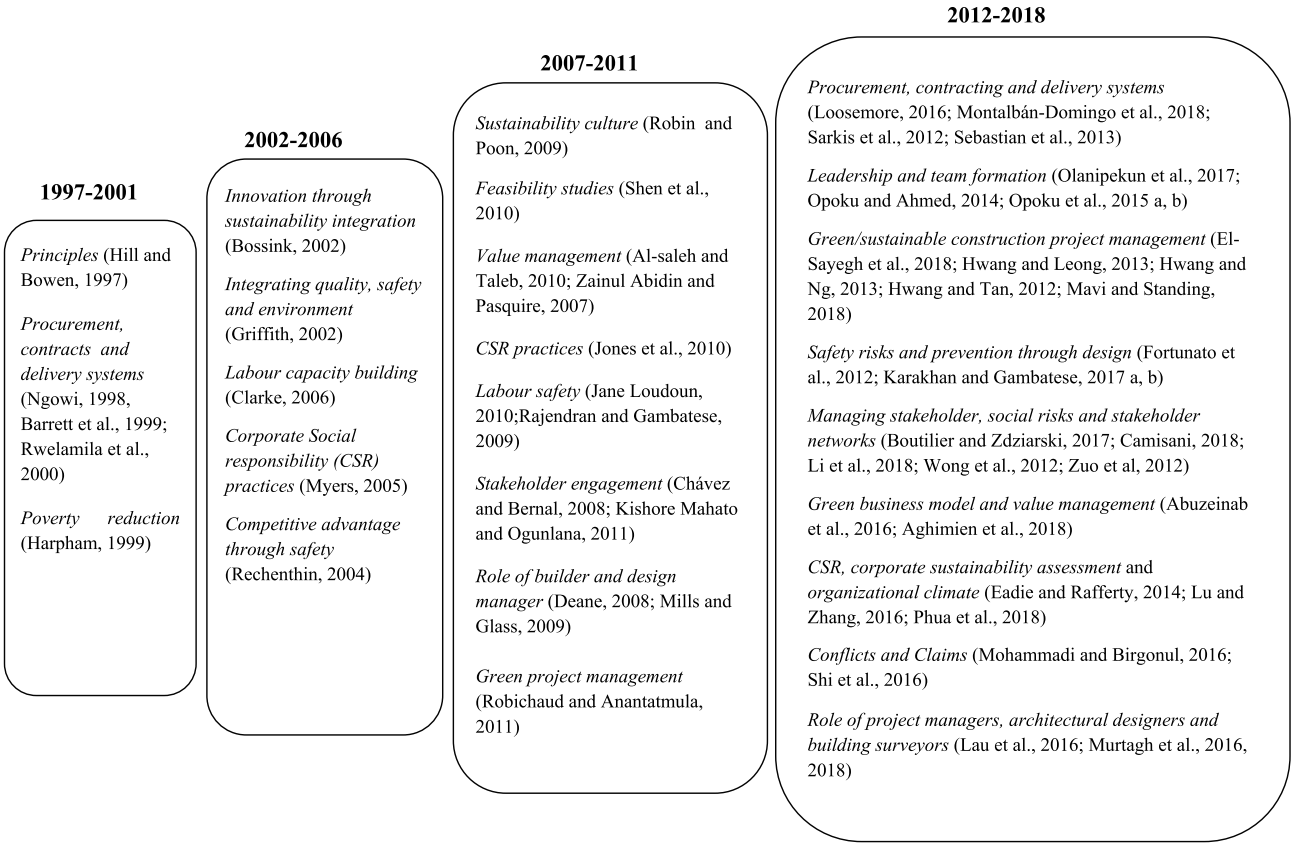

Fig. 3. Chronological evolution of major themes in the SIMCP literature[2] (Bossink, 2002, Camisani, 2018).

3.5. Chronology based

This classification not only indicates the temporal evolution of literature on SIMCP but also the emergence of different themes within this area. Fig. 2 shows the year wise distribution of articles. 52% and 83% of articles in the sample have been published during the last five years (2014–18) and ten years (2009–2018) respectively. Hence, it can be argued that SIMCP is a recent but emerging area within the broader construction project management literature.

Fig. 3 presents the evolution of various themes in the SIMCP literature from 1997 to 2018. It is evident that during this period, many new lines of enquires have emerged. While some of the earlier articles (e.g., Hill and Bowen, 1997) dealt with sustainability at the level of project content as well as management processes, those with an explicit focus on project management have emerged more recently (e.g. Robichaud and Anantatmula, 2011).

The period 1997–2001 recorded the advent of literature arguing for sustainability in construction projects, beginning with Hill and Bowen (1997). Majority of articles investigated suitability of various project procurement and delivery systems from sustainability perspective. Key recommendations included use of integrated project delivery systems (Barrett et al., 1999) instead of traditional and design-build systems (Ngowi, 1998; Rwelamila et al., 2000) and inclusion of sustainability requirements in the tender specification and contractor evaluation (Brochner et al., 1999). Taken together, the works in this period were focussed at the project level and deliberated on 'what' aspect of SIMCP through "process oriented principles" (Hill and Bowen, 1997) along-with the 'how' aspect by suggesting suitable project delivery, procurement and contracting systems.

In 2002–2006, the research focus shifted towards investing sustainability integration in processes at the strategic level. Myers (2005) performed a content analysis of 42 annual reports of UK-listed construction companies and observed that many companies use CSR reporting to further their corporate image while others use it as a "PR exercise" or "window dressing". Clarke (2006) criticised corporate practices regarding labour safety and training due to their short term utility focus and suggested labour capacity building for long term welfare. It was also suggested that project safety, achieved through proper training, could be a source of sustainable competitive advantage for contractors (Rechenthin, 2004). To get this benefit, safety should be considered at the strategic level and presented to clients as a value proposition. One approach to inculcate safety as an organizational strategy is to deploy an integrated management system encompassing quality, safety and environment (Griffith, 2002). Together, these works predominantly explored the 'how' aspects of SIMCP with special focus on the corporate or strategic level of organizations.

The period 2007–2011 is important in the SIMCP discourse due to the first dedicated article on the subject by Robichaud and Anantatmula (2011). They highlighted the increased complexity associated with management of SCPs and proposed a novel framework for SIMCP. Additionally, in this period many other 'softer' issues were explored in SIMCP context. For example, Robin and Poon (2009) explored 'sustainability culture' in organizations

[2] In case of multiple sources reflecting one theme, only two or three examples are mentioned. These have been selected based on the time of publication (earliest and latest) during that period. However, the themes mentioned within each period collectively represent the main research areas during that period as identified through the study of the literature sample.

by operationalizing it in terms of awareness, concern, motivation and implementation. Other researchers investigated the role of individual actors like builders (Deane, 2008), value managers (Al-Saleh and Taleb, 2010) and design managers (Mills and Glass, 2009) in promoting SIMCP. Mills and Glass (2009) found that passion for sustainability is the key to acquire skills for managing design for sustainability and suggested institutional support to bring awareness about importance of design managers' roles in achieving SIMCP. The focus on the corporate level of organizations continued with analysis of CSR practices (Jones et al., 2010), investment decision making (Shen et al., 2010). This period also recorded empirical investigations in the areas of labour safety (e.g., Jane Loudoun, 2010) and stakeholder management (e.g., Mathur et al., 2008). Overall, the articles during this period also concerned the 'how' aspect of SIMCP but with few changes: (i) the unit of analysis included both the organizations as well as individual actors; (ii) labour safety and management of external stakeholders emerged as key tenet of SIMCP, especially its social dimension; and (iii) the role of softer issues like culture and passion in contributing to SIMCP was explored.

The period 2012–2018 was not only most productive in terms of the number of articles, but also in terms of the variety of issues covered in SIMCP literature. While themes like CSR, stakeholder management, role of individual actors in promoting SIMCP continued, many new issues got added to the body of knowledge. Opoku et al. (2015a,b) and Sarkis et al. (2012) investigated the role of organizational leadership and project team formation in promoting sustainability integration at the strategic level. They concluded that SIMCP can be facilitated by instituting leadership positions to drive sustainability measures and also reported that the strategic management style of leadership was the most common approach adopted by sustainability managers (Opoku et al., 2015a). Attention was also drawn to additional project management risks encountered in SCPs. Fortunato III et al. (2012) and Karakhan and Gambatese (2017a,b) concluded that compared to traditional projects, SCPs have additional safety risks due to longer durations of work at heights, more electrical works, and handling of heavy components. To mitigate such risks, the design should focus on the construction processes by incorporating 'prevention through design' principles (Dewlaney and Hallowell, 2012). Hwang and Ng (2013) suggested that due to higher complexity, managing SCPs is more challenging. They identified the longer time required in the pre-construction phase as the most critical challenge followed by sub-contractor selection, higher cost, and need for more coordination with experts. These challenges resulted in additional risks like longer project completion time and more chances of delays (Hwang et al., 2013; Hwang and Leong, 2013). Other project risks include third party certification risks and legal risks due to more claims and disputes (Mohammadi and Birgonul, 2016). Taken together, the literature in this phase shows many key developments: (i) emerging focus on SIMCP issues at both corporate and project levels in developing economies (especially China, e.g., Cheng et al., 2015; Li et al., 2018; Shi et al., 2016; Zeng et al., 2015), (ii) renewed interest in use of project delivery, contracting and procurement systems through newer interventions like energy performance contracting (Zhang et al., 2015b), competitive dialogue procedure (Uttam and Roos, 2015), green procurement (Wong et al., 2016), sustainable or social procurement (Loosemore, 2016; Montalbán-Domingo et al., 2018) etc., (iii) identification of leadership styles as key facilitator of SIMCP (Opoku et al., 2015b), (iv) advancement of the green or sustainable project management literature with identification of success factors, schedule, cost and safety risks (e.g., Hwang et al., 2013; Karakhan and Gambatese, 2017b,a; Mavi and Standing, 2018), and (v) conceptualization of process oriented interventions to ensure labour safety (e.g., prevention through design, Dewlaney and Hallowell, 2012).

4. Morphological analysis

In this paper, we use MA to represent and analyze the body of knowledge on SIMCP and identify areas that remain unexplored. The resulting MA framework is schematically represented in Fig. 4 and described subsequently.

4.1. Development of the MAF

The 7 dimensions and 31 variants, identified from literature are presented as a MAF. Each of these dimensions presents a distinct aspect of SIMCP (refer Table 6). The complete MAF is presented in Table 7. Its constituent dimensions and variants are described next.

4.1.1. Dimension D1 – motivations of SIMCP

SIMCP is a recent development and its motivations lie in the actions of individuals and organizations to generate benefits for themselves and/or for the society at large. This dimension takes the terminology from stakeholder theory (Freeman et al., 2007, 2010) which recognizes instrumental or benefits driven and normative or ethics driven approaches of organizations to manage their stakeholders. Likewise, initiatives for SIMCP may have instrumental or normative origins and the same form the two variants under this dimension (Table 7).

V1-Instrumental –signifies sustainability integration initiatives driven either by financial prospects or to ensure that the projects do not face objections or protests from external stakeholders. Such motivations normally concern the short-term benefits and include: improving organizations' corporate image (Myers, 2005), gaining competitive edge (Abuzeinab et al., 2016), avoiding social risks (Liu et al., 2016) and exploiting the financial benefits provided to SCPs by governments (Bohari et al., 2017).

V2-Normative –some SIMCP initiatives are driven by the desire for social good even with additional cost and or efforts (Thomson and El-Haram, 2014; Zeng et al., 2015). Such motivations may include: transformation to responsible organizations (Lu and Zhang, 2016), preserving cultural heritage of places (Cheng et al., 2015), preventing occupational injuries (Karakhan and Gambatese, 2017b) or the personal passion and commitment of actors like designers (Murtagh et al., 2016).

4.1.2. Dimension D2 – stakeholder orientation of SIMCP

It is widely accepted that SIMCP requires efforts from various stakeholders across the project lifecycle (Robichaud and Anantatmula, 2011). This dimension identifies and records the roles of various stakeholders to this effect, with different stakeholders being identified as variants under this dimension. In construction projects, stakeholders have been broadly classified as internal and external stakeholders (Olander, 2007). The former, closely related to the financing the implementation of project, include the clients, contractors, consultants (including architects and engineers) and the wider industry constituting these three stakeholders; the latter are those affected by the project while not being actively involved in its execution (Olander, 2007). Possible initiatives for SIMCP from internal as well as external stakeholders have been identified from the literature sample and coded in this dimension.

V3-Client –individuals or organizations that promote a project and provide resources for the same. Emphasizing clients' role, Ofori and Chan (1998, p. 1522), suggest that "the issues relating to the attainment of sustainable construction can only be successfully addressed if clients show interest in, and commitment to, the concept of sustainability". Initiatives taken by clients, both at the

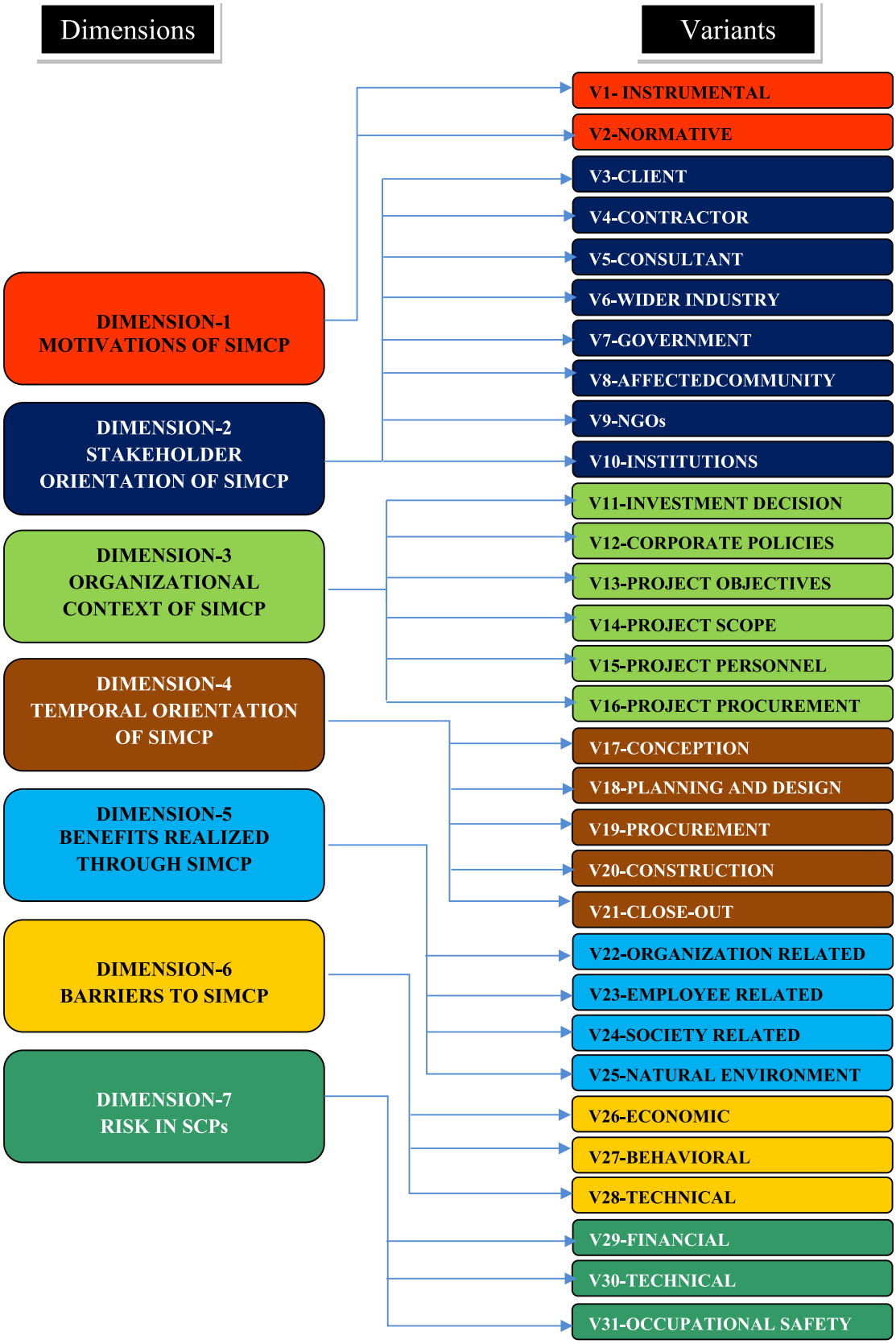

Fig. 4. Constituent dimensions and variants of the MA framework.

Table 6
Dimensions and variants in the MAF.

Dimension	Dimension title	Number of Variants	Importance
D1	Motivations for SIMCP	2 (V1, V2)	Describes *why* different actors or organizations take initiatives for sustainability integration.
D2	Stakeholder Orientation of SIMCP	8 (V3–V10)	Describes *who* takes initiatives, and which ones, for sustainability integration
D3	Organizational Context of SIMCP	6 (V11–V16)	Describes *how or at what level* sustainability integration can happen in an organizational context
D4	Temporal orientation of SIMCP	5 (V17–V21)	Describes *when* the initiatives for sustainability integration can happen in a project lifecycle.
D5	Benefits of SIMCP	4 (V22–V25)	Describes *what* can be achieved by sustainability integration.
D6	Barriers to SIMCP	3 (V26–V28)	Describes *challenges* to initiatives for sustainability integration.
D7	Risks in SCPs	3 (V29–V31)	Describes the additional *threats* in SCPs that should be mitigated through SIMCP initiatives.

level of permanent organization (e.g. vision and mission with sustainability focus) or temporary organization (e.g. project procurement) have significant bearing on the success of SIMCP (Herazo et al., 2012).

V4-Contractor – the party selected by clients for implementing the project. The literature sample suggests a critical role for contractors in SIMCP by motivating clients to undertake SCPs through sustainability based value propositions (Abuzeinab et al., 2016; Rechenthin, 2004). Additionally, contractors can facilitate SIMCP by deploying a project sustainability manager (Schröpfer et al., 2017), selecting subcontractors based on TBL criteria (Rajendran and Gambatese, 2009; Sarkis et al., 2012), and deploying special safety staff in high risk projects (Rajendran and Gambatese, 2009).

V5-Consultant – the party deployed by either the client or the contractor for providing varied services including design, project management, and surveying. Consultants may help protect the natural and cultural heritage of a place during construction (Cheng et al., 2015) and also reduce occupational injuries by adopting prevention through a design approach (Karakhan and Gambatese, 2017b). Such a design approach, however, requires technical and behavioural training (Toole and Carpenter, 2013) due to consultants' reluctance to take responsibility of labour safety.

V6-Wider Industry – refers to clients, consultants and contractors together. This variant was selected as the literature suggested multiple initiatives that need to be taken at the level of broader industry. For Example, Lu and Zhang (2016) called for transition from green projects to green organizations. This could improve the image of construction industry and lead to higher societal acceptance of projects (Wong et al., 2012). It is also suggested that there is a need to extend the triple constraint model to integrate ethics (Agyekum-Mensah et al., 2012) and consciously record and manage sustainability knowledge from a project for future use. The leadership style of managers across industry also needs to evolve to facilitate SIMCP (Opoku et al., 2015a).

V7-Government –the main entity responsible for formulating policies and regulations that influence sustainability integration. Such policies may prompt the wider industry to adopt sustainable practices (Robin and Poon, 2009) by providing incentives to cover the high upfront cost of SCPs (Shi et al., 2016). Regulations like sustainable procurement are particularly suited for SIMCP (Wong et al., 2016) as they promote market orientation culture of organizations and positively impact their social sustainability performance (Bamgbade et al., 2017).

V8- Affected Community –includes the part of society which is directly or indirectly affected by the project. While initiative to involve community in the project development process originate from the clients (Boutilier and Zdziarski, 2017); the community can play a constructive role in SIMCP by clearly conveying their expectations (Liu et al., 2016), by actively participating in the process and by targeting social learning (Chávez and Bernal, 2008).

V9-Non-Government Organizations (NGOs) –that serve diverse social and environmental concerns. These organizations can act as partners to industry for promoting sustainable practices (Kong et al., 2002). Wong et al. (2016) identified requirements of NGOs as one of the key factors in enhancement of green procurement.

V10-Institutions – the literature sample has highlighted the role of institutions that provide trade based or professional education and those carrying out the sustainability assessment in SIMCP by including sustainability in educational curricula (Bohari et al., 2017) and by providing credits for leadership in sustainability rating systems (Tabassi et al., 2016).

4.1.3. Dimension D3 – organizational context of SIMCP

Based on the literature on organizing through projects (Miterev et al., 2017; Söderlund, 2013) and construction project management (Herazo et al., 2012; Walker, 2015), two levels of SIMCP have been identified for MA.

a) Strategic level-concerning the permanent organization and focusing on Mission, Vision and Values and corporate practices concerning the entire business, including all business units, viz., the conglomerate. This level is critical for implementing SIMCP which is "usually approached with policies that are established at a strategic level within the organization" (PMBoK, 2016, p. 15).

b) Tactical level-concerning the temporary organization and focusing on project level practices; this level is concerned with formulation of goals, including the performance criteria that should reflect the Mission, Vision and Values for transformation into ground-level project work (Herazo et al., 2012).

Within each level, different areas of sustainability integration serve as the variant. A total of six variants (V11 to V16) have been identified.

V11-Investment Decision/Business case –sustainability integration into the project's business case and making investment decisions based not only on the financial returns, but also its lifecycle impacts (positive or negative) on society and natural environment (Goodman, 1988). It can be done by including social and environmental concerns in the feasibility study (Shen et al., 2010) and key value drivers of project investment decision (Karunasena et al., 2016).

V12-Corporate Policies and Practices – Corporate commitment to sustainability, even with additional first cost, is a key success factor for SIMCP (Banihashemi et al., 2017). Other practices like proactive stakeholder compensation policy (Lee et al., 2017), commitment to occupation safety (Rechenthin, 2004) and sustainable procurement policy (Ruparathna and Hewage, 2015) can facilitate SIMCP by top-down transfer of corporate values from strategic to the tactical or project level (Herazo et al., 2012).

V13-Project Objectives – the traditional project management is primarily concerned with meeting the triple constraints criteria viz. schedule, cost and scope/quality (PMI, 2016). SIMCP requires additional considerations in project objectives like poverty reduction (Harpham and Anelay, 1999), promoting natural and cultural heritage of a place (Cheng et al., 2015) and achieving social learning through stakeholder engagement (Mathur et al., 2008).

V14-Project Scope – includes those activities that need to be performed due to sustainability integration. V13 influences V14 as

Table 7
Morphological analysis framework (MAF) of the research literature on SIMCP.

D1 Motivations of SIMCP	V1-Instrumental	V2-Normative
	to avail tax exemption benefits (Bohari et al., 2017)	to become responsible construction organizations (Lu and Zhang, 2016)
	to improve corporate image (Myers, 2005)	to achieve better quality of life for society (Thomson and El-Haram, 2014)
		to preserve natural and cultural heritage of a place (Cheng et al., 2015)
	to satisfy government regulations and avoid non-compliance risks (Albino and Berardi, 2012; Murtagh et al., 2016)	to prevent occupational injuries (Dewlaney and Hallowell, 2012; Karakhan and Gambatese, 2017b)
	to display moral leadership (Brown, 2010)	Personal commitment and moral imperatives of designers (Murtagh et al., 2016)
	to gain competitive edge and increase market demand (Abuzeinab et al., 2016; Albino and Berardi, 2012; Deane, 2008)	to reduce carbon emissions and environmental harm (Anthonissen et al., 2015; Zeng et al., 2015)
	to align strategic and tactical management (Herazo et al., 2012)	to benefit the poorest through large infra structure projects (Harpham and Anelay, 1999)
	to securing higher rental returns (Deane, 2008)	to get better value for public money (Akbiyikli et al., 2012)
	to avoid social risks, conflicts and enlist public support for projects (Chávez and Bernal, 2008; KishorMahato and Ogunlana, 2011; Liu et al., 2016)	to meet the increased quality of life aspirations of people (Lee et al., 2017)

D2 Stakeholder orientation of SIMCP	Internal				External			
	V3-Client	V4-Contractor	V5- Consultant	V6-Wider industry	V7-Government	V8- affected community	V9-NGOs	V10-Institutions
	Incorporating EIA concerns in project development (KishorMahato and Ogunlana, 2011)	training for construction managers and team members (Bakshan et al., 2017; Alnaser and Flanagan, 2007)	design for preserving natural and cultural heritage (Cheng et al., 2015)	transition from "green projects" to "green organizations" (Lu and Zhang, 2016)	policies and regulations to facilitate cultural shift to sustainability (Robin and Poon, 2009)	convey expectations and engage with client (Liu et al., 2016)	demanding use of sustainable procurement practices in organizations (Wong et al., 2016)	including sustainability in educational curricula (Al-Saleh and Taleb, 2010; Bohari et al., 2017)
	external stakeholder identification and engagement by analyzing social network (Almahmoud and Doloi, 2015; Boutilier and Zdziarski, 2017)	sustainability and safety based value propositions and business models (Abuzeinab et al., 2016; Rechenthin, 2004; Zhao et al., 2016)		integrating ethics in time cost quality model of project management (Agyekum-Mensah et al., 2012)				
	adopting whole life costing (D'Incognito et al., 2015; Opoku and Ahmed, 2014)	using BIM tools to bring stakeholders together (Reychav et al., 2017)		recording sustainability lessons from projects (O'Connor et al., 2016)				
	adopting sustainable procurement Eadie and Rafferty (2014); Hueskes et al., 2017; (Loosemore, 2016)	subcontractor selection based on TBL and safety criteria (Rajendran and Gambatese, 2009; Sarkis et al., 2012)		adopting strategic style of leadership to promote sustainable practices (Opoku et al., 2015a)	incentives to cover upfront cost (Shi et al., 2016; Hwang and Tan, 2012)			
	selecting contractor and designers with similar corporate sustainability approaches (Jones et al., 2010)	using integrated management system for quality, safety and environment (Griffith, 2002)		facilitating trust based knowledge transfer (Schröpfer et al., 2017)				
	selecting project managers based on intellectual and managerial competence (Tabassi et al., 2016)	knowledge management for using past sustainability knowledge (Ofori-Boadu et al., 2012)		changing attitude towards labour health, safety and knowledge based pay (Clarke, 2006; Zuo et al., 2012)				
	Employing design managers with sustainability passion (Mills and Glass, 2009; Murtagh et al., 2016)	implementing environmental management system (Hill and Bowen, 1997; Srdić; Šelih, 2011)	design with focus on improving labour safety (Dewlaney and Hallowell, 2012; Karakhan and Gambatese, 2017b)	partnering with NGOs and civil society (Harpham and Anelay, 1999)	sustainable procurement regulations (Wong et al., 2016)	target social learning from public participation process (Chávez and Bernal, 2008)		providing credits for leadership in sustainability rating systems (Tabassi et al., 2016)
	undertaking social and environmental risk assessment in feasibility phase (Liu et al., 2016; Shen et al., 2010)	using open book sub-contracting for transparency (Robichaud and Anantatmula, 2011)		adopting community based approach to train low paid workers (Forst et al., 2013)				
	using CSR clauses in contracts to benefit local community (Eadie and Rafferty, 2014)	allocating only day shifts to young males to reduce accidents (Jane Loudoun, 2010)		improving professionalism to attract young talent (Wong et al., 2012)				
	considering sustainability in value management (Zainul Abidin and Pasquire, 2007; Karunasena et al., 2016)	activity sequencing to avoid overcrowding and injuries (Dewlaney and Hallowell, 2012)		societal engagement to improve industry image (Wong et al., 2012)	Encouraging representatives (e.g., building surveyors) to guide contractors (Murtagh et al., 2018; Zeng et al., 2015)			
	promoting social equity by proactive compensation (Lee et al., 2017)	deploying project sustainability manager (Ofori-Boadu et al., 2012;		web based platform to provide knowledge to smaller firms				

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Table 7 (*continued*)

	Collaborating with energy service companies (Zeng et al., 2015)	Schröpfer et al., 2017)		(Wilson and Rezgui, 2013)		
	Obtaining green certificate to display moral leadership (Brown, 2010)	organizing sustainability tours for clients, public (Hwang and Tan, 2012)		adopting firm level environmental practice to influence project level behavior (Yusof et al., 2016)		
	Targeting poverty reduction through project Harpham and Anelay (1999)	barricading and signage at site to protect community (Zuo et al., 2012)				
	using integrated, partnering type of project delivery systems (Lenferink et al., 2013; Son et al., 2011; Sertyesilisik, 2017)	monitoring physiological strain of workers (Gatti et al., 2012)	employee training in prevention through design (Toole and Carpenter, 2013)	including sustainability in professional discourse (Murtagh et al., 2016)	regulations and incentives to support social sustainability (Bamgbade et al., 2017)	
	incorporating users requirement in project (Rohracher, 2001)	deploying special safety staff in high risk projects (Rajendran and Gambatese, 2009)		using building control surveyors' expertise (Murtagh et al., 2018)		
	Deputing project champion (Herazo et al., 2012)			green-labeling of projects to inform end users (Bohari et al., 2017)		

D3Organizational context of SIMCP	Strategic (parent organization level)		Tactical (temporary organization or project level)			
	V11-Investment Decision/Business case	V12-Corporate policies and practices	V13-Project objectives	V14-Project scope	V15-Project personnel and organization	V16-Project procurement
	energy performance contracting (Zhang et al., 2015b)	sustainable and innovative business model (Abuzeinab et al., 2016; Zhao et al., 2016)	reducing poverty (Harpham and Anelay, 1999)	employee training for awareness and positive attitude (Bakshan et al., 2017; Olanipekun et al., 2017; Wilson and Rezgui, 2013)	intrinsically motivated design managers (Mills and Glass, 2009; Murtagh et al., 2016)	sustainability oriented procurement and social procurement (Bohari et al., 2017; Loosemore, 2016; Montalbán-Domingo et al., 2018)
		commitment to invest in third party certification (Brown, 2010)		Design with safety focus (Dewlaney and Hallowell, 2012; Karakhan and Gambatese, 2017b)		
	sustainability concerns in business case and feasibility (Lee et al., 2017; Liu et al., 2016)	Management position, governance board for sustainability (Ghosh et al., 2014; Ofori-Boadu et al., 2012)		engagement with affected community leaders and incorporating their interest in project plan (Banihashemi et al., 2017; Chávez and Bernal, 2008; Liu et al., 2016)	local employment (O'Connor et al., 2016)	contractor prequalification based on sustainability (O'Connor et al., 2016; Rajendran and Gambatese, 2009)
		top down approach to transfer organizational values to project team (Herazo et al., 2012)	aligning objectives with circular building principles (Sanchez and Haas, 2018)			
		fair and respectful stakeholder engagement policy (Chávez and Bernal, 2008; Mathur et al., 2008)		building information modeling (BIM) implementation to integrate stakeholders (Reychav et al., 2017)	sustainability focused leadership positions (Herazo et al., 2012; Schröpfer et al., 2017)	relational project delivery systems (Karakhan and Gambatese, 2017b; Toole and Carpenter, 2013)
		organizational strategy based on project safety (Rechenthin, 2004)		Planning and design with user requirement focus (Rohracher, 2001; Valdes-Vasquez and Klotz, 2013)		
	investment decisions based on lifecycle costing and implications (Opoku and Ahmed, 2014)	commitment to sustainability despite high upfront cost (Banihashemi et al., 2017; Yusof et al., 2016)		Budgeting for sustainability integration (Ofori-Boadu et al., 2012)	energy service company in organization (Zeng et al., 2015)	subcontractors selection based on TBL criteria (Sarkis et al., 2012)
		sustainability centric CSR initiatives, including local needs (Glass and Dainty, 2011; Myers, 2005)		recording sustainability lessons learned (O'Connor et al., 2016)		contract with CSR clauses, sustainability incentives (Eadie and Rafferty, 2014; Robichaud and Anantatmula, 2011)
		sustainability focussed value planning and value management (Alencar et al., 2017; Karunasena et al., 2016)		signage and barricading installation (Zuo et al., 2012)	sustainability experts in project team (de Paula et al., 2017)	
	sustainability focussed value management (Al-Saleh and Taleb, 2010)	integrated management system for quality, safety and environment (Griffith, 2002)		engineer-artist collaboration for cultural heritage preservation(Cheng et al., 2015)		project delivery system that facilitate early contractor involvement (Hwang and Tan, 2012; Lenferink et al., 2013)
		adopting sustainability as core competency and not value added service (Deane, 2008)	preserving and promoting Cultural heritage (Cheng et al., 2015)	labour training focussed on young and long term capacity building (Clarke, 2006; Jane Loudoun, 2010)	special safety staff in high risk projects (Rajendran and Gambatese, 2009)	
	business case based on energy savings performance (Sanders et al., 2013)	adopting environmental management system (Zeng et al., 2015)		implementation of project environmental management system (Srdić; Šelih, 2011)		procurement as per concurrent engineering (Ngowi,1998)
		sustainability integration in organizational values, vision and climate (Olanipekun et al., 2017; Phua, 2018; Thomson and El-Haram, 2014)		regenerative design based on whole systems approach (Sertyesilisik,2017)	project manager with intellectual and managerial leadership competence (Meng et al., 2015; Tabassi et al., 2016)	carbon emissions based contract award (Anthonissen et al., 2015)
		Strategic leadership style (Opoku et al., 2015a)		Employee training to market green value propositions (Abuzeinab et al., 2016)		
	business case with poverty reduction potential or other social returns (Harpham and Anelay, 1999; Higham et al., 2018)	market orientation culture to improve social performance (Bamgbade et al., 2017)	achieving reusable social learning by stakeholder engagement (Mathur et al., 2008)	third party sustainability certification (Brown, 2010)		selecting contractor sharing client's sustainability vision (Thomson and El-Haram, 2014)
		sustainable procurement policy (Ruparathna and Hewage, 2015)		Project safety planning using Pre-task hazard analysis (Rajendran and Gambatese, 2009)	designers trained in prevention through design (Toole and Carpenter, 2013)	
		proactive compensation policy to promote to social equity (Lee et al., 2017)		analysing project's social network to identify interested stakeholders (Boutilier and Zdziarski, 2017)		lifecycle performance-based procurement (Akbiyikli

Table 7 (*continued*)

		instituting corporate sustainability assessment system (Lu and Zhang, 2016) corporate support for occupational safety and prevention through design approach Rajendran and Gambatese (2009); Toole and Carpenter (2013)		project plan development with EIA concerns (KishorMahato and Ogunlana, 2011) monitoring workers' physiological strain (Gatti et al., 2012)	building control surveyors involvement in project team (Murtagh et al., 2018)	et al., 2012; Sebastian et al., 2013; Wyatt et al., 2000) specialist task organization procurement (Oyegoke et al., 2009)	
D4Temporal orientation of SIMCP	V17-Conception	V18-Planning and Design		V19-Procurement	V20-Construction	V21-Close-out	
	business case based on sustainable, innovative business models (Zhao et al., 2016)	adopting design-build project delivery system (Zhao et al., 2016) life-cycle-assessment based planning and design (D'Incognito et al., 2015)		adopting cost-plus contracts with sustainability incentives (Robichaud and Anantatmula, 2011)	training for on-site employees to change attitude towards sustainability (Bakshan et al., 2017; Robichaud and Anantatmula, 2011)	recording sustainability lessons learnt (O'Connor et al., 2016; Ofori-Boadu et al., 2012)	
	Appointing sustainability expert or champion (Herazo et al., 2012; Opoku et al., 2015a; Thomson and El-Haram, 2014)	understanding and incorporating stakeholders' expectation in project plan (Banihashemi et al., 2017; Harpham and Anelay, 1999; Liu et al., 2016; Nik-Bakht and El-diraby, 2016)		incorporating competitive dialogue in bidding process (Uttam and Roos, 2015) using contracts integrated across time, space and actors (Akbiyikli et al., 2012; Lenferink et al., 2013)	engaging stakeholders and addressing their concerns through constant communication (Banihashemi et al., 2017; Liu et al., 2016)		
	including sustainability agenda in project value drivers (Zainul Abidin and Pasquire, 2007; Al-Saleh and Taleb, 2010; Karunasena et al., 2016; Yu et al., 2018)	engaging architect-designers intrinsically motivated for sustainability (Mills and Glass, 2009; Murtagh et al., 2016)		sustainable and social procurement (Loosemore, 2016; Montalbán-Domingo et al., 2018; Ruparathna and Hewage, 2015; Wong et al., 2016) carbon emissions based project procurement (Anthonissen et al., 2015)	continuous training and supervision for young workers (Jane Loudoun, 2010) adopting community based approach for training workers (Forst et al., 2013)		
		integrating end users in project team (Rohracher, 2001) integrating EIA and project planning (KishorMahato and Ogunlana, 2011)		using sustainability oriented output specification and bidding criteria (Brochner et al., 1999; Hueskes et al., 2017; Sebastian et al., 2013)	selecting subcontractors based on TBL criteria (Sarkis et al., 2012)		
	Conducting feasibility study with social and environmental concerns (Liu et al., 2016; Shen et al., 2010)	aesthetic design to preserve local natural and cultural heritage (Cheng et al., 2015) design based on whole systems approach (Sertyesilisik,2017)		using contracts with mid-life modernisation provisions (Sertyesilisik,2017) reviewing contractor's corporate sustainability policies before contract award (Jones et al., 2010)	constituting green building project team with experienced participants (Olanipekun et al., 2017)		
	adopting partnering approach between stakeholders (Sertyesilisik,2017)	developing fair and proactive compensation policy for project affected community (Lee et al., 2017; Liu et al., 2016)		contractor prequalification based on past sustainability performance (Eadie and Rafferty, 2014; O'Connor et al., 2016)	implementing environmental management system (Hill and Bowen, 1997)		
	developing project vision with sustainability concerns (Thomson and El-Haram, 2014)	design with specific focus on preventing accidents (Dewlaney and Hallowell, 2012; Karakhan and Gambatese, 2017b) include requirements of temporary and end users in planning (Valdes-Vasquez and Klotz, 2013)		using procurement to integrate CSR and sustainability (Glass and Dainty, 2011) specialist task organization procurement approach (Oyegoke et al., 2009)	providing signages and barricading at site (Zuo et al., 2012) employing local talent at site (O'Connor et al., 2016)		
	appointing project manager with sustainability knowledge (Banihashemi et al., 2017; Hwang and Ng, 2013; Robichaud and Anantatmula, 2011)	using BIM tools to integrate stakeholders during planning (Reychav et al., 2017) using PDS that allow early collaboration between contractors, designers (Alnaser and Flanagan, 2007; Hwang and Tan, 2012; Ofori-Boadu et al., 2012) budgeting for sustainability integration (Ofori-Boadu et al., 2012)		Evaluating contractors' past safety record in contractor selection (Rechenthin, 2004) evaluating contractor's alignment with project vision before contract award (Thomson and El-Haram, 2014) using concurrent engineering principles in procurement (Ngowi,1998) awarding energy performance contracts (Zeng et al., 2015)	using paperless correspondence (O'Connor et al., 2016) physiological strain monitoring for workers (Gatti et al., 2012)		

D5 Benefits realized through SIMCP	V22-Organization related	V23- Employee related	V24- Society related	V25- Natural environment related	D6 Barriers to SIMCP	V26-Economic	V27-Behavioral	V28-Technical
	competitive edge due to project safety performance of contracting firms (Rechenthin, 2004).	Reduced injuries through community based training (Forst et al., 2013)	employment to locals using CSR clauses in contracts (Eadie and Rafferty, 2014)	lifecycle resource optimisations through integrated contracts (Lenferink et al., 2013)		high upfront cost and low demand for SCPs (Alnaser and Flanagan, 2007; Hwang and Tan, 2012)	cultural resistance to transition to sustainable practices (Aghimien et al., 2018; D'Incognito et al., 2015; Hwang and Ng, 2013; Zhang et al., 2015a)	lack of sustainability knowledge among project managers, policymakers (Alnaser and Flanagan, 2007; Banihashemi et al., 2017)
	promoting innovation in contractors' proposals and practices (Akbiyikli et al., 2012; Brochner et al., 1999; Uttam and Roos, 2015)					lack of adequate insurance for risks in SCPs (Mohammadi and Birgonul, 2016) using procurement, a neo-liberal measures	lack of client's preference for sustainable practices (Zhang et al., 2015a) disinclination of designers to take	loss of knowledge due to uneven workloads and low staff retention (Wong et al., 2012) lack of knowledge to include sustainability

(*continued on next page*)

Table 7 (*continued*)

					that ignores socio-cultural aspects (White, 2016)	responsibility for project safety (Karakhan and Gambatese, 2017b)	consideration in feasibility reports (Shen et al., 2010)
	increased public support and acceptance for infrastructure projects (Mathur et al., 2008; Nik-Bakht and El-diraby, 2016)	improved labour health through physiological strain monitoring (Gatti et al., 2012)	better preservation of society's cultural identity (Lu and Zhang, 2016)	reduced carbon emissions in road projects (Anthonissen et al., 2015)	clash of sustainability with client's profit value driver (Zainul Abidin and Pasquire, 2007; Abuzeinab et al., 2016; Opoku and Ahmed, 2014)	conflicting objectives pursued by different stakeholders (Chan and Oppong, 2017; Shi et al., 2016; Zeng et al., 2015)	Lack of reliable data on lifecycle analysis and costing (D'Incognito et al., 2015; Wilson and Rezgui, 2013)
						utilitarian approach to stakeholder engagement (Mathur et al., 2008)	frequent design changes during construction (Hwang and Ng, 2013)
	better staff retention, satisfaction and lower absenteeism (Eadie and Rafferty, 2014; Eilers et al., 2016)		social equity due to proactive compensation (Lee et al., 2017)		clients' focus on first cost, not lifecycle cost and lifecycle implications (D'Incognito et al., 2015; Ruparathna and Hewage, 2015)	organizational cultural barrier to social procurement (Loosemore, 2016)	higher complexity and longer time required in pre-construction process for SCPs (Hwang and Ng, 2013)
						language barriers in training non-native workers (Forst et al., 2013)	non-availability of competent sub-contractors (Hwang and Ng, 2013)
	improved competitive advantage (Eilers et al., 2016)	identification of potentially unsafe activities (Gatti et al., 2012)	improved health and satisfaction of end users (Leaman and Bordass, 2007)		use of lowest bid system(Opoku and Ahmed, 2014; Rwelamila et al., 2000)	low aspiration value of construction amongst youngsters (Wong et al., 2012)	rigid by-laws restricting sustainability innovation (Brown, 2010)
	re-useable social learning through stakeholder engagement(Mathur et al., 2008)			energy savings through energy performance contracting (Zeng et al., 2015)	inadequate sustainability training to employees due to cost concerns (Wilson and Rezgui, 2013)	human tendency to focus on short term benefits and not long term welfare (Al-Saleh and Taleb, 2010; Sev, 2009)	lack of integration between design and construction phases (Deane, 2008; Hwang and Tan, 2012)
	better retention of clients and talent (Eilers et al., 2016)		social and organizational learning for organizations and public (Chávez and Bernal, 2008)		pressure to ensure short term shareholder returns (de Paula et al., 2017; Glass and Dainty, 2011)	non-revealing sustainability knowledge to maintain leadership (Wilson and Rezgui, 2013)	varying interpretations of sustainability, a value laden concept (Jones et al., 2010)
							firm specific, short term need based labour training (Clarke, 2006)
	promoting creativity and innovation in intrinsically motivated designers (Murtagh et al., 2016)				output based and not knowledge based labour pay structure (Clarke, 2006)	tendency of taking cosmetic measures that do not contribute to sustainability (White, 2016)	fragmentation of sustainability knowledge across time and actors (Wilson and Rezgui, 2013)
					adopting financial criteria for project success ignoring its potential for social contribution or labour welfare (Harpham and Anelay, 1999; Zuo et al., 2012)	project managers' worldview of human dominance over nature (Lau et al., 2016)	lack of knowledge to integrate sustainability concerns in value planning (Karunasena et al., 2016)
	higher rent premium for certified buildings (Deane, 2008)					tendency to shrug labour health and safety obligations to other parties (Zuo et al., 2012)	detachment of EIA process from planning process (KishorMahato and Ogunlana, 2011)
D7 Risks in SCPs	V29-Financial		V30-Technical		V-31-Occupational Safety		
	increased claims and disputes (Mohammadi and Birgonul, 2016) poor schedule performance and higher chances of cost overrun (Hwang et al., 2013; Hwang and Leong, 2013)		third party certification failure risk (Mohammadi and Birgonul, 2016) slower decision making due to high complexity and multiple stakeholders (Hwang and Leong, 2013; Leaman and Bordass, 2007) ambiguity in the scope definition (El-Sayegh et al., 2018)		higher occupational injury risk (Dewlaney and Hallowell, 2012; Dewlaney et al., 2012; Fortunato et al., 2012)		

sustainability focussed objectives add to project scope (Silvius et al., 2012).

V15-Project Personnel and Organization —includes the personnel or actors that need to be included in the project organization to facilitate SIMCP. It also delves on the early inclusion of certain actors (e.g., contractors) in the project organization to achieve better sustainability results (Lenferink et al., 2013). Other such initiatives could include deployment of design managers intrinsically motivated towards sustainability (Murtagh et al., 2016) and instituting sustainability specific leadership positions and experts in the project team (de Paula et al., 2017; Schröpfer et al., 2017).

V16-Project Procurement—As the "Construction projects are almost entirely based on the procurement of contractual arrangements between the multitude of sellers and buyers" (PMI, 2016, p. 23), the project contracts and delivery methods present a promising prospect of achieving SIMCP (Karakhan and Gambatese, 2017b). Starting from early publications (e.g. Hill and Bowen, 1997), procurement has been identified as a vehicle for SIMCP. Some specific recommendations to this effect include: social procurement (Loosemore, 2016); contracts with sustainability incentives (Robichaud andAnantatmula, 2011) and use of project delivery systems (PDSs) that facilitate relational contracting (Toole and Carpenter, 2013) and early contractor involvement (Hwang and Tan, 2012).

4.1.4. Dimension D4 — temporal orientation of SIMCP

Different stakeholders may take initiatives for sustainability integration during different phases of a project lifecycle (Robichaud

and Anantatmula, 2011). These phases form the variants under this dimension. While the "project life cycle varies depending on the perspective taken" (PMI, 2016, p. 16), for this study, five project phases (V17 to V21) were defined and they serve as the variants under this dimension.

V17-Conception —This phase involves project identification, based on the needs of an organization; project formulation, stating broad project objectives, expected results, and rough estimates of resources; and project feasibility study, based on its business case (Goodman, 1988; PMI, 2017). While the business case for projects are traditionally based on the economic feasibility (PMI, 2017), Goodman (1988) suggests that a feasibility study should cover five other areas viz. technical, managerial, environmental, social and financial. Incorporating social and environmental concerns in a project feasibility study could mitigate the potential social risks and improve its long term environmental performance (Liu et al., 2016; Shen et al., 2010).

V18-Planning and Design—this phase involves selection of design team and development of initial budget, schedule and scope which are to be specified in the bidding documents for procurement (Robichaud and Anantatmula, 2011). It offers great potential for SIMCP as public involvement during this phase may improve social sustainability and also influence project decisions including design (Valdes-Vasquez and Klotz, 2013). Further, the client may choose a suitable PDS that allows early inclusion of contractor and sub-contractors in the project team and use their sustainability inputs (Ofori-Boadu et al., 2012).

V19-Procurement—the process of creating, managing and fulfilling contracts (ISO, 2010) "is seen as being one of the most important and powerful agents of change" (Bohari et al., 2017) from a sustainability perspective. SIMCP initiatives that can be taken during procurement of project include use of cost plus contracts with sustainability incentives (Robichaud and Anantatmula, 2011), carbon emissions based contract award (Anthonissen et al., 2015), sustainability oriented output specification and bidding criteria (Hueskes et al., 2017; Sebastian et al., 2013) and contracts with mid-life modernisation provisions (Sertyesilisik, 2017).

V20-Construction— this phase presents opportunities for SIMCP by educating the site team to cultivate a positive attitude towards sustainability (Bakshan et al., 2017). The stakeholders, identified in the previous phases should be engaged through constant communication during construction (Banihashemi et al., 2017). Further, occupation health and safety of workers, a key requirement of social sustainability (Valdes-Vasquez and Klotz, 2013), can be ensured by proving proper training and supervision with focus on young workers (Jane Loudoun, 2010) and by monitoring their physiological strain (Gatti et al., 2012).

V21-Close out— while this phase presents lesser opportunities for SIMCP, it is still important as project handing over and contract closure are carried out in this phase (Silvius et al., 2012). Thereafter, the organizations should carefully record the sustainability lessons learned for their future use (O'Connor et al., 2016).

4.1.5. Dimension D5 – benefits realized through SIMCP

Theoretically, SIMCP is beneficial for the organizations, society as well as for the natural environment (Robichaud and Anantatmula, 2011). This dimension recognises such benefits from the literature sample. The benefits, segregated based on the beneficiary, viz., the organizations, the employees, the society and the natural environment, constitute the variants under this dimension.

V22-Organization related—for organizations, SIMCP initiatives for engaging external stakeholders result in reusable organizational learning (Mathur et al., 2008) and increased public support and acceptance for projects (Nik-Bakht and El-diraby, 2016). Corporate sustainability practices help in improved talent retention due to better employee satisfaction (Eilers et al., 2016). Additionally, the contracting firms achieve higher client retention due to competitive edge derived from project safety performance (Rechenthin, 2004), ethical practices (Eilers et al., 2016) and innovative proposals (Akbiyikli et al., 2012; Uttam and Roos, 2015). The clients earn higher rent premium for sustainable buildings (Deane, 2008).

V23-Employee related—SIMCP initiatives at corporate level result in higher employees' satisfaction. The employees "enjoy coming to work [….] are likely to be more engaged, have fewer absences," (Eilers et al., 2016, p. 340). At the site level, SIMCP initiatives like community based training and physiological strain monitoring reduce occupational injuries (Forst et al., 2013) and improve labour health (Gatti et al., 2012).

V24-Soceity related—sustainability, now recognized as an emerging school of thought in project management, has inherent societal orientation (Silvius, 2017). It implies that SIMCP initiatives should necessarily result in benefits for the project affected community and society at large. Proactive engagement with internal stakeholders provides social learning to the community which increases their willingness in future engagements (Chávez and Bernal, 2008). SIMCP initiatives also improve social equity through respectful compensation (Lee et al., 2017), and facilitate preservation of cultural heritage of a place (Cheng et al., 2015). They also result in wider distribution of projects' benefits among the disadvantaged groups.

V25-Natural environment related— benefits for the natural environment include reduction in resource requirements due to lifecycle optimizations through integrated contracts (Lenferink et al., 2013), and reduced carbon emissions through sustainable procurement practices (Anthonissen et al., 2015) and energy performance contracting (Zhang et al., 2015b).

4.1.6. Dimension D6 – barriers to SIMCP

Literature suggests that various barriers impede the initiatives for SIMCP. The barriers exist at the level of individuals, organizations and wider industry (Abuzeinab et al., 2016; D'Incognito et al., 2015). These barriers represent a new dimension, and their three types have been identified as the variants in the MAF.

V26-Economic—owing to the pressure of ensuring short-term shareholder returns (de Paula et al., 2017) the clients mostly focus on the first-cost of projects and not on the lifecycle cost (D'Incognito et al., 2015; Ruparathna and Hewage, 2015) or the social contribution and societal welfare through projects (Harpham and Anelay, 1999; Zuo et al., 2012). Additional costs associated with SIMCP initiatives clash with clients' profit value driver (Abuzeinab et al., 2016; Opoku and Ahmed, 2014) and also lead to reduction in demand as end users are unwilling to bear this burden (Hwang and Tan, 2012; Zeng et al., 2015). The lowest bid system of contract award, followed globally, is also a barrier to SIMCP as cost cutting by contractors to survive in the intense competition leaves little or no scope to spend money on SIMCP initiatives (Opoku and Ahmed, 2014; Rwelamila et al., 2000).

V27-Behavioural—at a broader industry level, there is a tendency to maintain the status quo along-with cultural resistance among organizations and individuals to transition to sustainable practices (D'Incognito et al., 2015; Hwang and Ng, 2013; Zhang et al., 2015a). Additionally, there are other behavioural aspects that impede SIMCP initiatives, like: hiding sustainability knowledge to maintain leadership (Wilson and Rezgui, 2013), tendency to shrug labour health and safety obligations to other parties (Zuo et al., 2012), project managers' worldview of human dominance over nature (Lau et al., 2016), disinclination of designers to take responsibility for occupational safety (Karakhan and Gambatese, 2017b) and human tendency to focus on short-term benefits rather than long-

term welfare (Al-Saleh and Taleb, 2010; Sev, 2009).

V28-Technical—higher complexity of SCPs calls for superior techno-managerial skills for the success of SIMCP initiatives (Hwang and Ng, 2013a, b). However the prevailing knowledge gap, especially among the project managers, is a key barrier to SIMCP (Alnaser and Flanagan, 2007). Also, the fragmented structure of the construction industry does not allow integration between planning, design and construction phases (Deane, 2008; Hwang and Tan, 2012). The fragmentation also leads to scattered sustainability knowledge among numerous actors spread across the project lifecycle (Wilson and Rezgui, 2013). The 'feast or famine' nature of the industry also adds to loss of sustainability knowledge (Wong et al., 2012). Lack of reliable data on lifecycle analysis and costing is also a deterrent for clients in taking SIMCP initiatives (D'Incognito et al., 2015).

4.1.7. Dimension D7 – risks in SCPs

With multiple benefits, SCPs also encounter additional project management risks (Hwang and Leong, 2013). This dimension represents such risks and various types of risks are the variants under this dimension. The initiatives for SIMCP should include measures to manage these risks.

V29-Financial– higher complexity of SCPs necessitates interaction and coordination among larger groups of professionals, including experts, and external stakeholder (Hwang et al., 2013). This results in a longer pre-construction period and poor schedule performance with high chances of cost overrun (Hwang et al., 2013; Hwang and Leong, 2013). It also leads to additional financial risks for the internal stakeholders due to more claims and disputes, and increased professional liability (Mohammadi and Birgonul, 2016). The industry currently lacks insurance schemes to cover these risks (Mohammadi and Birgonul, 2016).

V30-Technical—introducing sustainability elements in planning, design and construction practices increases the overall technical complexity of projects. It calls for inclusion of additional members in the project organization which often leads to slower decision making (Hwang and Leong, 2013; Leaman and Bordass, 2007). SCPs often target a third party certification to attain wider recognition and benefits. However, failure to obtain the certificate remains a potential technical risk for organizations and it also has severe financial implications (Mohammadi and Birgonul, 2016).

V31-Occupational safety—recent research suggests that additional human safety risks are present in SCPs compared to traditional projects. Fortunato III et al. (2012, p. 507) reported "significant increases in safety and health risks" for workers due to "increased exposure durations to known hazards […...] work at height, with electrical current, near unstable soils, and near heavy equipment for a greater period of time". Dewlaney et al. (2012, p.964) quantified such risks and reported "a 36% increase in lacerations, strains, and sprains …; a 24% increase in falls to lower level, ….a 19% increase in eye strain; …. and a 14% increase in exposure to harmful substances...".

4.2. Identification of research gaps

The MAF can be used to identify the unexplored research areas (i.e. research gaps) by exploring various combinations between the variants captured in the MAF (Sunder et al., 2018). Considering the 7 dimensions and the 31 variants constituting the MAF, a total of 17280 (2 x 8 x 6 x 5 × 4 × 3 x 3) such morphological combinations are possible. However, some variants may not have any meaningful relationship with others due to normative, logical or empirical inconsistencies and hence such combinations can be ignored (Ritchey, 2011). To facilitate identification of research gaps, Ritchey (2011) suggested a pair-wise comparison of variants by formulating them as a matrix developed from the corresponding MAF. This matrix, called cross consistency assessment matrix (CCAM), presents the possible configurations between all pair-wise combinations of variants.

While any pair of variants that is unexplored represents a research gap, researchers' judgement is required to gauge the research potential of any such pair in the light of possible inconsistencies. The inconsistencies or lack of meaningful relationships or associations between the elements of a pair are more likely between the variants under a single dimension (Sunder et al., 2018). For example, in the MAF, variants V17 to V21 from dimension D4 represent the linear transition from one phase to another, and examining any pair from these variants will not lead to any logical conclusion from a SIMCP perspective unless these variants are paired with some other context, like the stakeholders (variants V3 to V10, dimension D2), barriers (variants V26 to V28, dimension D6), etc. Similarly, the variants under dimension D3 (V11 to V16) representing the organizational context of SIMCP do not lead to meaningful pairs unless combined with variants from other dimensions like D5, benefits (variants V22 to V25) or D6, barriers (variants V26 to V28). Therefore, the final CCAM has been developed here considering the variants belonging to different dimensions.

To identify and segregate pairs of variants that present research gaps, each variant under a given dimension was paired with every other variant under the other remaining dimensions and the outcome of this assessment was marked in the CCAM (Fig. 5). The pairs have been analyzed without any reference to causality or direction of association between the two variants. This process resulted in identification of at least 236 research gaps that may be considered by researchers for further examination after due deliberation on their research potential. Though space restriction prohibits detailed discussions on all these gaps (refer Fig. 5), some examples of possible research question arising out of such pairs are presented in Table 8. In-depth analysis of the CCAM may also reveal additional research gaps (over and above 236) cutting across variants from more than two dimensions or by considering more than two variants from any two dimensions.

5. Results and discussion

This paper presents a systematic review and MA of over two decades' research literature on SIMCP. It highlights the evolution of research literature on this subject, and identifies many unexplored areas that may inform future research.

The review has revealed that the literature on SIMCP is spread across a large number of journals related to project management as well as construction management. Ten journals that have published more than 66% of this research have been identified (Table 1). A majority of the articles covered in this study were empirical and adopted empirical-qualitative and empirical mixed method research approaches (Tables 2 and 3). Interviews have been the most commonly adopted method for data collection. The data show that the theory of sustainability integration into project management is yet to mature in terms of identification of relevant constructs and corresponding indicators. In contrast, the TBL is being increasingly operationalized through quantitative indicators in other fields like supply chain management and urban development (e.g., Girardi and Temporelli, 2017; Popovic et al., 2018).

[3] The cells marked with '?' are those which represent a research gap, i.e. a pair of variants that is yet to be researched upon. Other cells, not marked with '?', either represent an inconsistent pair of variants or a pair which has been explored. This assessment is based on the authors' analysis of articles in this review.

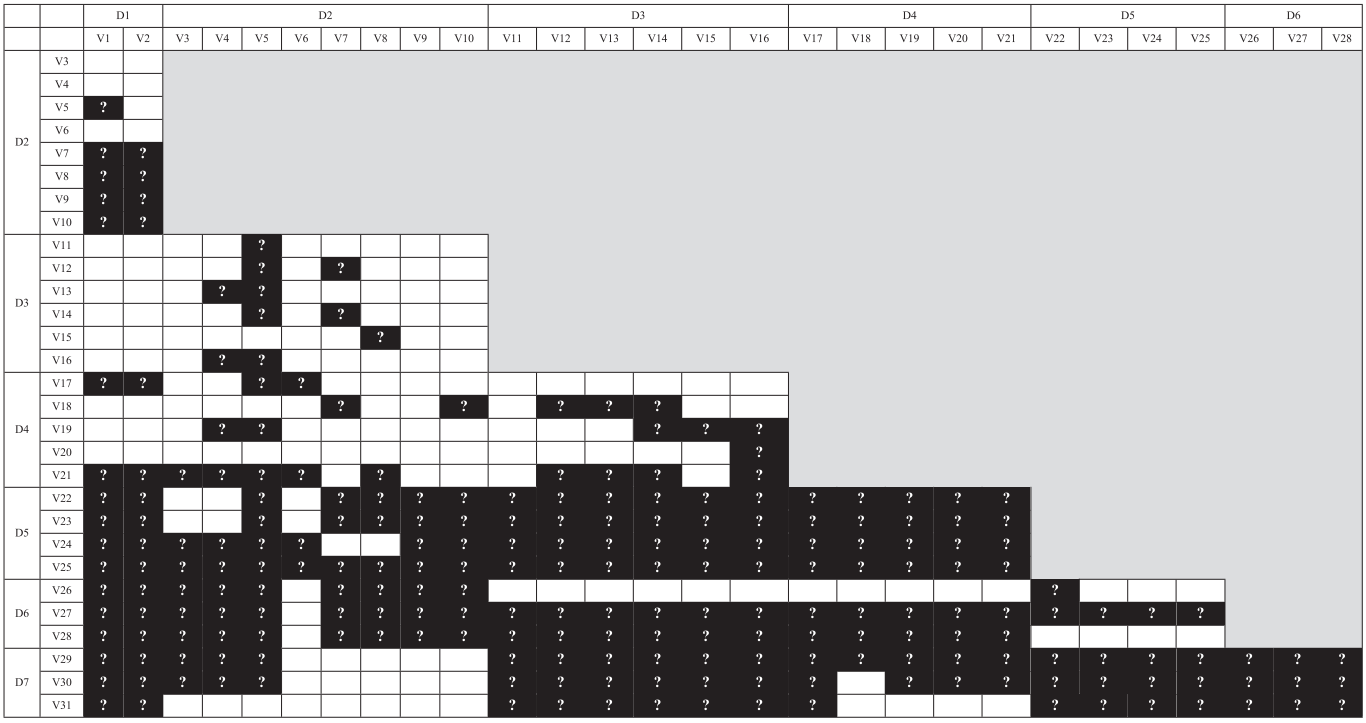

Fig. 5. Cross consistency assessment matrix. [3].

Table 8
Representative examples of variant pairs from CCAM that represent research gaps.

Sl. No.	Associated dimension pair	Associated variant pair(s) representing research gaps	Possible research questions based on identified research gaps
1	*D1 and D5*	*V1 and V23* *V1 and V24* *V1 and V25*	To what extent, and in what ways, do instrumental motivations of SIMCP also result in any tangible benefits for (a) employees, (b) society and (c) natural environment?
2	*D2 and D6*	*V5 and V26*	To what extent do consultancy organizations face economic barriers to SIMCP?
3	*D2 and D7*	*V5 and V27*	What are the possible financial risks of SIMCP for consultancy organizations?
4	*D4 and D5*	*V21 and V22*	What kind of organizational benefits are provided by SIMCP initiatives taken during close-out phase (e.g., recording lessons learned)?
5	*D2 and D7*	*V5 and V22* *V5 and V23*	What specific benefits of SIMCP are derived by (a) consultancy organizations and (b) employees of consultancy organizations?
6	*D2 and D1*	*V8 and V1; V8 and V2* *V8 and V1; V8 and V2*	Is the motivation of (a) project affected communities and (b) institutions to participate in the project development predominantly instrumental or normative?
7	*D2 and D1*	*V1 and V5; V2 and V5*	What are the (a) normative and (b) instrumental motivations of sustainability integration in consultancy originations?
8	*D4 and D5*	*V17 and V22; V18 and V22; V19 and V22; V20 and V22; V21 and V22*	To what extent does temporal orientation (project phases) of involving affected community in project development influence the potential benefits of SIMCP for organizations?
9	*D4 and D6*	*V17 and V26; V17 and V27; V17 and V28*	Can taking early SIMCP initiatives (in the conception phase) overcome the (a) economic (b) behavioural and (c) technical barriers to SIMCP?
10	*D3 and D4*	*V15 and V17; V15 and V18;* *V15 and V19; V15 and V21*	What changes are required in the project personnel and organization to facilitate SIMCP initiatives during (a) conception, (b) planning and design, (c) procurement and (d) close-out phase?

On a positive side, the number of articles on this subject has been rising consistently over the years. Though more than 60% of the articles have originated in developed economies, the trend seems to be reversing during the last four years with more publications from the developing economies. This is in agreement with Ofori (2018) who called for more construction management research rooted in context of the developing economies which have a largely informal industry structure, low technology penetration and lack of managerial skills. Further, the literature on SIMCP has been covering diverse areas recently (Fig. 3), including the role of various actors in sustainability integration and particularly focussing at the strategic level of organizations, dealing with topics like business models, corporate social responsibility (CSR), risks, value management and leadership.

The MAF has provided some interesting insights for SIMCP initiatives which do not necessarily agree with the broader sustainability literature. For example, this literature suggests that instrumental motivations like "… government intervention and standards and norms imposed by industry and stakeholders [….] societal expectations" are predominant drivers of organizational sustainability initiatives (Horak et al., 2018). But, in this review, many normative motivations have also been noted, implying that a few organizations are taking such initiatives without any external pressure (e.g., Lu and Zhang, 2016). This provides a hope for success of SIMCP initiatives in construction as the reluctance of organizations to take such costly initiatives has been termed as "one of the

largest barriers to sustainable development" (Bansal, 2002). At the same time, the MAF has also revealed multiple behavioural barriers to sustainability initiatives in construction. This is not surprising as construction is "perceived as dirty, dangerous and old fashioned" (Fairclough, 2002, p. 30) due to reluctance-to-change of its key actors (D'Incognito et al., 2015). In contrast, the response by other sectors like IT has been more proactive and forthcoming (Rajagopal et al., 2016).

The MAF has also pointed out that unlike other industries; the government has a more prominent role as facilitator of sustainability in construction. This is due to the dual role of government; first as the buyer for a majority of large construction projects globally, and second as the policymaker and regulator (Hwang and Tan, 2012; Wong et al., 2016). Similarly, the role of society - comprising the project affected community as well as other external stakeholders – is unique to construction projects which have higher impact on human quality of life compared to projects in other sectors (Loosemore, 2016). Accordingly, ensuring societal benefits of construction projects for these stakeholders has emerged a necessity and new challenge for the organizations (Lee et al., 2017; Lu and Zhang, 2016). To this end, the planning and design phase, considered crucial for project success on triple constraint criteria (Atkinson, 1999) has been identified as key for SIMCP initiatives also, for integrating the concerns for environment, external stakeholders, occupational safety etc (Dewlaney and Hallowell, 2012; Liu et al., 2016).

This review has also revealed disparities in pursuits of the research on SIMCP. It has enabled identification of scope for future research to further strengthen the body of knowledge on SIMCP. The basic classification of articles (Section 3) has highlighted the need for more research in the specific context of developing economies and for confirming the qualitative findings by operationalizing the sustainability indicators. Several emerging themes identified in the chronological evolution (Fig. 3), like culture, passion, leadership styles and other determinants of behaviour that support SIMCP, offer promising scope for future research. The CCAM (Fig. 5) provides further guidance by pointing to 236 specific research gaps that can be explored by researchers to aid their theory building efforts. The matrix suggests that while instrumental motivations (D1) like tax benefits, competitive edge and improving corporate image are established (e.g., Bohari et al., 2017), more research is called for to validate the normative motivations across internal and external stakeholders (e.g., Murtagh et al., 2016). Stakeholder orientation (D2) has predominantly focussed on the internal stakeholders. Even within the set of internal stakeholders, most articles pertain to clients and contractors with fewer studies on consulting organizations (Mills and Glass, 2009). Sub-contractors, another key stakeholder group, find only a passing mention in the literature sample. Considering their key role in project success (Ng and Tang, 2010), their involvement in and influence on SIMCP is worth exploring. From the organizational context (D3) perspective, more research efforts have focussed on the tactical level compared to the strategic level. There is a need for empirical evidence on the status and means of sustainability integration at strategic level so as to align them with those at tactical level (Herazo et al., 2012). The temporal orientation (D4) shows most research gaps in the close-out phase. Empirical studies are required to examine how management of close-out phase processes differs in SCPs compared to traditional projects (e.g., Ofori-Boadu et al., 2012). The 'benefits' of SIMCP (D5) have been empirically investigated for internal stakeholders (organizations). Similarly, sound empirical validation of tangible or intangible benefits realised by society and natural environment is needed (e.g., Lu and Zhang, 2016). While the literature has acknowledged multiple 'barriers' to sustainability integration (D6), more attention has been given to economic and technical barriers. The role of behavioural barriers (e.g., culture) has been largely ignored and this presents a promising area for research across countries differing culturally. The risk dimension (D7) is found to be the least investigated among the seven dimensions. Noticing the early indications of financial, technical and safety risks from literature (e.g., Hwang et al., 2013; Mohammadi and Birgonul, 2016) specific attention on possible risks in SCPs across project phases and project stakeholders is called for.

The results of this study have several managerial implications. First, it has summarized a vast body of knowledge on a wide subject (SIMCP) which was hitherto not holistically available to practitioners, for the context of construction projects. The temporal evolution of possible initiatives by researchers and industry over the last two decades (Fig. 3) also enables the practitioners to quickly access the latest trends and emerging areas in the field of SIMCP. Second, the MAF provides a structured guiding tool for organizations to take SIMCP initiatives. For example, if any organization wishes to take such initiatives, the MAF can provide guidance as to the possible organizational contexts (D3), temporal orientations (D4), benefits (D5) and risks (D6) of such initiatives through multiple examples listed in the MAF. Third, for construction organizations in developing economies which lag significantly in sustainability initiatives, this review provides numerable insights from large developing economies (like China) as well as from many developed economies. These could provide initial guidance to such organizations for developing context-specific initiatives for SIMCP in their geographical areas of operations.

6. Conclusions

SIMCP has emerged as a pre-requisite to make construction projects sustainable from concept to decommissioning. Though it is yet to mature into a distinct field of research, academic publications on this subject have been increasing steadily. The present study has attempted to systematically shortlist and review articles focussed on SIMCP out of a vast body of sustainable construction literature. This paper, perhaps the first to use MA in the context of sustainability literature, makes four distinct contributions through this unique mode of literature review: First, it has contextualised the research on sustainability in project management to the construction industry by relating it to the typical stakeholders, lifecycle phases, risks and benefits in construction projects. Second, the MA used in this study has enabled a compact visual-tabular representation of literature on SIMCP by categorising it under 7 dimensions and 31 variants. Third, the MA has also confirmed the existence of significant research scope and facilitated identification of 236 focussed research gaps. Fourth, the MAF developed here, can be suitably modified and used in contexts other than construction (e.g., IT/IS projects) to investigate sustainability integration across different organizational contexts, project phases and stakeholders.

The main limitation of study, common to any such analysis-synthesis based qualitative methodology (Creswell, 2013) is the subjectivity involved in the identification of dimensions and variants. Yet, by giving detailed explanation of the process of developing MAF, by involving multiple authors, and by specifying numerous examples from the literature in the MAF (Table 7), the authors have attempted to ensure verifiability of this framework. Another limitation of this study is restriction on the number of keywords in the literature search stage due to which some of the pertinent articles may be missing in the analyzed literature sample. It was done to keep the scope of research manageable. The study may be further expanded by including other pertinent keywords like "responsible business practices", "corporate social responsibility", "green project management", "green construction",

"climate change", "ecology" etc. When these keywords were used to search articles in the selected databases, more than five thousand results were pointed to. Examining them would have been quite an enormous task.

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