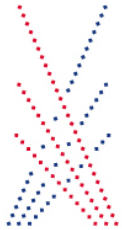

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RELATIONSHIP BETWEEN STANDARD(S) AND PERFORMANCE OF INNOVATIVE PROJECTS: A SYSTEMATIC REVIEW

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ABSTRACT

Although there has been a long-standing interest in examining the interplay between standard(s) and innovation in a project context, consensus is lacking on how standard(s) influence the performance of innovative projects. In this paper, we present results from a systematic review of 58 empirical studies on the relationship between standard(s) and performance in innovative projects. The findings show that, in a project environment where performance of an innovation is being investigated - authors take three key positions towards standard(s): advocative, ambivalent and adversarial; where the advocating position is dominant. The results also indicate that 'performance' has been rarely problematized by scholars in relation to standard(s) in innovative projects; rather, conventional performance indicators are mostly used to comprehend the impact of standard(s). The conclusions suggest that there is a need for a more nuanced understanding of standard(s) and their relationship with performance of innovative projects by the means of studying the relationship more dynamically and longitudinally.

Keywords: standard(s), innovation, project, performance, systematic review

Word Count: 7310 (the body section only except Tables and Figures)

1 INTRODUCTION

Innovation is the key to global commercial mobility as the basis of introducing new products, services and processes (Rubera and Kirca, 2012). A majority of these innovation activities are undertaken as projects (Edmondson and Nembhard, 2009), rendering performance of innovative projects as a crucial point of academic enquiry (Dyball and Wang, 2017; Wu *et al.*, 2017). Many authors have indicated the essentiality of project performance measurement for decision making (future prediction), competition enhancement, strategic process control and diffusion of new management ideas (Neely *et al.*, 2000; Bresnen and Marshall, 2001; Phusavat *et al.*, 2009). In case of innovation, studies primarily measure the performance of the newly innovated product (Aoshima, 2002; Mittra *et al.*, 2015), service (Stevens and Dimitriadis, 2005; Jaakkola and Hallin, 2018) or process (e.g. Viana *et al.*, 2017). Fewer studies look at the performance of a project or an organisation in innovating as per predefined objectives (e.g. Chaudhuri, 2013; Ernst *et al.*, 2015). The typical performance measurement criteria currently utilized are highly conventional in nature e.g. cost-efficiency, market performance, time-efficiency, quality of product, novelty of product and, speed of innovation and commercialization (see Appendix 05).

In relation to innovative projects, there is a growing body of scholarship oriented on the critical role that 'standard(s)' play. From a theoretical point of view, scholars have considered the 'project' form of undertakings as an organisation (Unterhitzenberger and Bryde, 2019) and in-extension as a standard (Brunsson *et al.*, 2012). Though the origin of project management is from an innovation context (Manhattan Project) (Lenfle and Loch, 2017), the implementation of standard approaches to instigate control over the innovation process (by the McNamara movement in the US Department of Defence and later the establishment Project Management Institute) practically demarcated innovation and project management into two separate disciplines (Davies *et al.*, 2018). Thus, standard(s) are directly related to both innovation and project management. **However,** how standard(s) influence the performance of innovative projects is still under-examined. While a few studies investigate the application of standard(s) while innovating (e.g. Olin and Wickenberg, 2001; Birkenberg and Birner, 2018) and resultant impact on (organisational and project) performance (e.g. Engwall *et al.*, 2005; Pellicer *et al.*, 2012); use of a standard performance measurement method (e.g. Edum-Fotwe *et al.*, 2004) or performance of a innovated standard (process) (Scott and Scott, 2015) are only sporadically studied.

With no existing review investigating this issue, this paper aims 'to identify the key contexts regarding how standard(s) are considered in academic studies in relation to the performance of innovative projects and the implication' by systematically reviewing the published empirical evidence base. To achieve this aim, the formulated objectives are:

a. to review the definition of 'standard(s)'
b. to review the definition of 'innovation' and 'innovative projects'
c. to identify published empirical studies on 'innovative project' context commenting on 'standard(s)'
d. to identify the 'points of convergence and divergence' regarding the consideration of 'performance' in 'innovative projects' in relation to 'standard(s)'
e. to recognise the implication of the 'points of convergence and divergence' and justify the resulting identification of 'future research gaps'

The paper consists of six sections. First, the 'theoretical background' section (Section 02) provides the definitions and typological consideration of the research constructs i.e. standard(s), project and innovation – providing a clear description of what we know in the existing literature and related theoretical arguments. In Section 03, the systematic article

selection and review methods are described in detail. Subsequently, the descriptive findings of the systematic review are offered; followed by the findings from the qualitative analysis of the review data in Section 04. In Section 05, the identified gaps in literature are discussed with arguments presented indicating future research pathway. Section 06 presents a summary of the literature review with practical and academic implications, as well as limitations of the executed review method.

2 THEORETICAL BACKGROUND

2.1 Standard(s)

From a functional point of view, standard(s) can be considered as both an object or a channel to transfer knowledge (Bozeman, 2000), depending on the application (e.g. design rulebooks - object; organisational processes like ISO 9001 - channel). More comprehensively, Fomin *et al.* (2003, p. 30) consider standard(s) as an artefact with a possible deviation or solution from existing typicality to meet a set of pre-defined requirements, innovated by involved actors and deployed for further actors to follow and embrace. In agreement with the International Organization for Standardization (2004, p. 8) this definition is adapted to be operational in this study. A highly related term in this regard is 'standardization' - which has been implicated in literature as both: the creation (De Vries, 1997) or application of a standard (David and Greenstein, 1990). Despite these implications, the contemporary literature on 'standard(s)' and 'standardization', scarcely reference each other (Botzem and Dobusch, 2012), essentially segmenting the two topics. This dichotomization between 'standard(s)' and 'standardization' and their possible distinction in the way they affect and become affected by 'innovation' and 'performance' has been recognised in this study, and a focus only on 'standard(s)' is given.

2.2 Innovation and typology

OECD defines innovation as, "the implementation of a new or significantly improved product (good or service), or process, a new marketing method, or a new organisational method in business practices, workplace organisation or external relations (either new to the firm, the market or the world) (OECD, 2005)." Summarizing, Trott (2011, p. 15) provides a comprehensive definition of innovation, which has been adopted as the operational definition,

"Innovation = theoretical conception + technical invention + commercial exploitation"

Contemporary literature debate on three key forms of innovation: product, process and service (Dosi, 1988; Hobday, 2005). Interestingly, service innovation is often considered as a part of product innovation (Bessant *et al.*, 2005; Van Beers and Zand, 2014) or process innovation (Baregheh *et al.*, 2009) or completely omitted as a form (Crossan and Apaydin, 2010). Project outputs are often considered to include both products and services providing unique solutions for the customer (PMI, 2017). Moreover, in highly competitive global markets, achieving sustainable competitive advantage, continuous streams of revenue, higher profits, and differentiation of business - through only innovating and producing superior products, without the inclusion of a service component - is challenging and unlikely (Teece, 1986; Grönroos, 2007). Thus, this study adopts two forms of innovation: product (and service) innovation and process innovation.

2.3 Standard(s) and innovation

The discussion regarding the role standard(s) play in terms of innovation is long-standing, where the researchers fail to come in a consensus. For example, it is argued that standard(s) provide the stability to catalyse product/service innovation (Hashem and Tann, 2007; Blind,

2009) and, necessary means to implement a process innovation in a new system (Rao *et al.*, 1997; Dawes, 2005). Additionally, both concepts are highly dependent and purposed towards knowledge creation and retention (Aoshima, 2002; Balland *et al.*, 2013). Oppositely, innovation is considered to be hindered by standard(s) due to reduction of options (Ralphs, 1998) constraints in creativity (Hamel, 2006), resistance in application of contemporary concepts (Stango, 2004) and introduction of 'gestation period' before commercialization (Hill and Rothaermel, 2003). Contemporary studies demonstrate that standard(s) are not only used as a guideline to innovation projects (e.g. Birkenberg and Birner, 2018; Rajakallio *et al.*, 2018), rather innovation projects are also being used to formulate standard(s) as output (e.g. Samaan *et al.*, 2016; Viana *et al.*, 2017). These conversations present a dilemma - whether to embrace control through standard(s) – or to look back at the root of project management where innovation through flexibility and novelty were the priority (Lenfle and Loch, 2010).

2.4 Standard(s) in project management

The creation of standard(s) for an innovator organization is usually internal to the project's environment (Vennström and Erik Eriksson, 2010; Pellicer *et al.*, 2012). However, the application of standard(s) in an innovative project can occur both internally and externally. For instance, contingency theory claims that with a better fit between a project organisation's structural and environmental factors (e.g. internal and external standards), the output will be more effective (Sauser *et al.*, 2009; MüLler *et al.*, 2017; Zhu and Mostafavi, 2017). Institutional theory, on the other hand, emphasizes upon the standard(s) as external factors by considering the projects as open systems with regulative (e.g. legal standards), normative (e.g. technical certifications and accreditations) and culturally cognitive factors (contextual/local standards) (Biesenthal *et al.*, 2018). Consideration of such interpretation of projects as complex adaptive systems along with complexity, co-evolutionary and chaos theory – directly challenges the classical view of project management (Klijn, 2008; Johnson, 2012; Holland, 2014).

Remarkably, as opposed to these contemporary approach, the current standard(s) of project management [e.g. PMBoK (PMI, 2017), APMBoK (APM, 2012), PRINCE2 (Mousaei and Javdani, 2018), IPMA ICB 4.0 (Vukomanović *et al.*, 2016) and ISO 21500 (Varajão *et al.*, 2017)] supports and relies upon the classical views regarding project. For example, APMBoK defines the term 'project' as - "…a unique, transient endeavour, undertaken to achieve the planned objective, which could be defined in terms of output, outcomes or benefits (APM, 2012, p. 12)". While this study is aware of and in line with the contemporary thoughts of project management, to formulate an operational definition two aspects from the classical view are considered: a) projects are *transient* endeavour i.e. with an end which separates them from business as usual; and b) the projects end when a *specific set of objectives* are fulfilled.

2.5 Innovative projects

While the importance of innovation in project management is widely discussed; the definition of 'innovative project' remains inconclusive and generic (Filippov and Mooi, 2009). Adopting Anbari's (2005, p. 104) definition of 'management of innovation projects' this review considers innovation projects as 'a system that transforms inputs into novel targeted outputs through invention or transformation or both'.

Other than the targeted output of an 'innovation project', innovations can also occur as a support in the process of delivering intended project output. For example, the incremental innovations (e.g., improvement in health and safety practices) have a minimal effect on the firm's project management practices (Sauser *et al.*, 2009); however, they affect the project's

outcome and overall plan to create flexibility in the execution phase (Melorose *et al.*, 2015). These incremental innovations are being defined as 'innovation in projects' in this study.

In addition, adopting Virine and Trumper (2007), the form of innovation which directly affects the ways to do a project through newness, creativity and effectiveness - is being defined as 'project innovation'. These innovations have at least three attributes, they are: a) new, at least in relation to the project, b) feasible to apply and c) useful when applied.

Therefore, this study considers three 'innovation-project' types i.e. innovation project (with a pre-defined novel project output), innovation in project (supplementary output in a project, usually a standard or a process) and project innovation (novel way to 'do' a project).

2.6 Performance of (innovation) projects

The term 'performance' means the 'ability to satisfy the settled goals' (Lebas, 1995), which is directly related to the concepts of efficiency and effectiveness (Martinsons *et al.*, 1999). Efficiency is considered as the level of resource utilisation in the economical method for reaching the projects objectives/outputs (Eckhardt and Shane, 2003). On the other hand, Reeves and Bednar (1994) define effectiveness as the degree for satisfying the client requirement which evaluates the 'results' and the correlation between the 'results' and 'project outcomes' (Edwards and Thomas, 2005). These definitions are summarized to formulate the operational definition of project performance in this study as - formal collection and evaluation of inputs, efficiency and effectiveness of projects' activities.

The concept of project performance (and project success) comes from the predefined objectives which are usually set by the stakeholders (APM, 2012; Neyestani and Juanzon, 2016). While the traditional and tangible aspects like 'iron triangles' (time, cost and quality) used to be the sole dominant in measuring project performance (Terry, 2002; Westerveld, 2003), intangible aspects like overall satisfaction of stakeholders are also currently considered in project performance evaluation criteria (Proust, 2011; Neyestani, 2016). However, projects are often unique from each other in terms of size, location, and complexity; thus making it impossible to generate a commonly agreed framework for measuring project performance (Toor and Ogunlana, 2010; Alzahrani and Emsley, 2013). Therefore, the tangible aspects are still used (see Appendix 4 for recent statistics from the USA) through various quantitative methods to measure project performance (P.P.Mane and J.R.Patil, 2015; Jong *et al.*, 2019). This manifestation extends to the context of performance measurement in innovative projects as well (see Appendix 5 for innovation performance matrices).

3 METHODS

3.1 Selection of keywords for systematic literature review

The study intended to capture as comprehensive a view of the interplay between standard(s) and innovation as possible; where the 'project' context and the 'performance' aspect provide specificity. Thus, three keywords have been chosen to ensure the identification of a) a broad range of studies that considered and commented on 'standard(s) and innovation' in a project context, and, b) previous review articles of a similar objective. The keywords are - 'standard*', 'project*' and 'innovat*'. Exhaustive literature search in four search engines (EBSCO, Web of Science, Scopus, Google Scholar) has indicated that no previous review article has examined the empirical evidence relating to standard(s) and performance of innovative projects, ascertaining the necessity of a literature review (further ensured by the systematic review conducted). Additional keywords have also been considered (e.g. product, process, program*, portfolio, practice, development, performance, efficiency, effectiveness,

standardi*ation and formali*ation); however, an evaluative search indicated the selected keywords to be sufficient in identifying the citations consisting of these additional keywords in this study's domain of interest.

To evaluate studies commenting on how standard(s) originate from or affect performance in an innovative project context, a systematic literature review method has been adopted in this study. Unlike traditional narrative reviews, this method provides a transparent and comprehensive process of reviewing the evidence presented in a specific topic area (Tranfield *et al.*, 2003; Booth *et al.*, 2016; Chan and Ejohwomu, 2018). By allowing a thorough examination of all forms of empirical evidence presented and a blend of both qualitative and quantitative analyses (Tranfield *et al.*, 2003) the systematic review method enables the examination of the relationship between standard(s) and performance of innovative projects. Rationally, other possible literature review methods like bibliometric analysis (e.g. Pollack and Adler, 2015) and analysis of meta-narratives (e.g. Padalkar and Gopinath, 2016) have been not been utilized - as they rely only on quantitative methods to identify the change of trends through fluctuation in the frequency of recurring keywords. Consequently, the systematic review framework suggested by Tranfield *et al.* (2003, p.214) has been utilized in this study to answer the 'what' and 'how' questions relating to standard(s) and performance in innovative projects.

3.2 Literature search and selection process

With the selection of the keywords ensuring the review's inclusion of widest possible extent of the research-theme related citations, the search string: [standard* AND innovat* AND project*] has been formulated and utilized; which comprises the alternative potential associations of the keywords with the asterisk (*) symbol and 'AND' boolean. To capture the mainstream of high-quality international researches and complete evolution of knowledge regarding the concepts being investigated - only peer-reviewed journal articles published in the English language has been selected; without any time boundaries. As literature database, depending on the higher volume of citations returned, two citation indexes have been selected: Scopus (6198) and Web of Science Core Collection (2779). First, on May 29 2018, the published articles have been searched, resulting in 3011 citations after de-duplication of results from the two search engines. 3 months later, the same search process has been executed again on August 29 2018, resulting in the addition of 41 new citations, totalling a number of 3052.

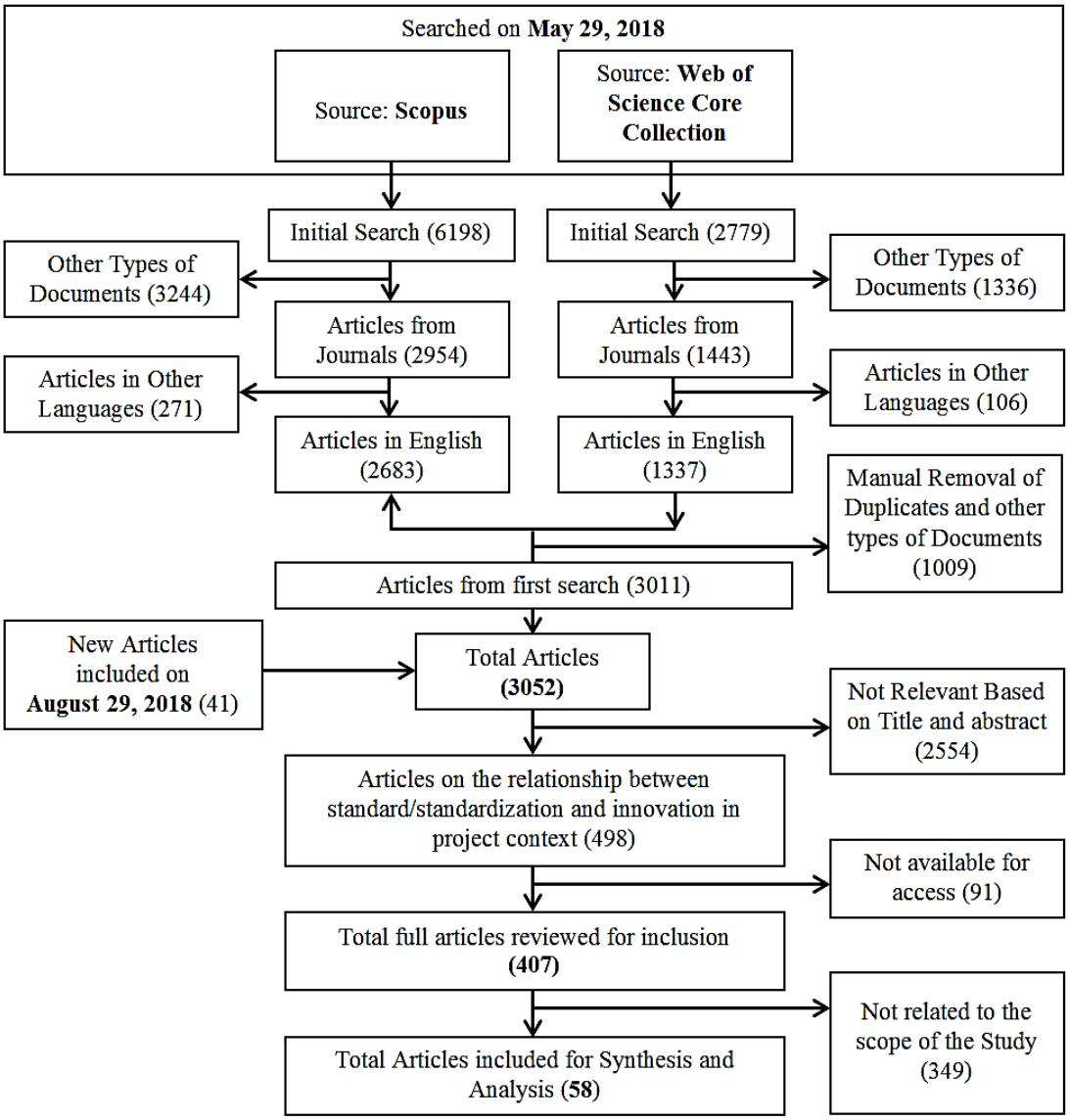
Each of the 3052 papers has then been checked for relevance by reviewing the title and abstract – to include articles for review with core focus and comments on standard(s) and innovation. Articles with ambiguousness regarding the project context and empiricality of evidence are included in this step for an in-depth review in the next step. Review articles and conceptual papers have also been selected in this stage if the abstract indicated the possible inclusion of empirical material. Of the papers selected for possible inclusion after reviewing the title and abstract, 91 were not accessible by the authors, resulting in 407 included papers in this step.

During the final review before analysis, 349 articles (of the 407) have been excluded, as they have been deemed irrelevant to the aim of the study, due to four criteria. Firstly, despite commenting on standard(s) and innovation, a number of articles were excluded as they commented and concluded predominantly on their own niche topics (e.g. ICT or Life-science papers) rather than management of the innovation process. Secondly, though using the term 'project' in title or abstract, the detailed description of a number of study's background was business-as-usual, resulting in exclusion. Thirdly, the studies which did not collect empirical data were excluded. Finally, whence the reviewed article's adopted definition of the research

constructs (standard, innovation and project) were misaligned to this study, they were also excluded ['standard' used as a synonym of 'old', 'general' and 'regular'; and 'innovation' used as a substitute for 'invention', whereas literature considers invention only as a segment of the whole innovation process (Fagerberg, 2004)]. Finally, 58 articles have been selected for final inclusion.

Appendix 1 provides a summary of the inclusion and exclusion criteria utilized for selecting the articles to review in this study. Figure 1 illustrates the different stages of the literature search process applied to identify and select relevant studies on innovation and standardization in the project context.

Figure 1 The systematic method utilized for searching, inclusion and exclusion of studies



3.3 Coding and analysis

Each of the 58 articles included in the sample of studies has then been analysed. For the easement of close reading and analysing, a coding structure has been utilized (Table 1) using a Microsoft Excel spreadsheet. First, the studies have been coded according to general bibliometric details i.e. year of publication, details of authors and journal of publication. More specific to this study, the articles have also been categorised in terms of study sector and country of the studied project(s). As all of the included papers were empirical studies, the

qualitative or quantitative method utilized in each study has been summarized and the quality of the evidence presented has been evaluated. For this evaluation, the 'hierarchy of evidence' from Tranfield *et al.* (2003) has been utilized (Table 2). The review also captured the contributing findings of each article to this study and their main unit of analysis.

Table 1 Coding structure for the systematic review

Code	Description
• Id	Sequential (first chronological and then alphabetical sequence of the first author's last name) numbering of the selected articles
• Citation	In-text citation of the article in Harvard citation format
• Year	Year of the publication
• Author(s)	Surname and abbreviated forename of the author(s)
• Title	Title of the article
• Journal	Journal title
• Author's nationality	Nationality of the first author of the article
• Country	Country of study
• Author's locality	Similar or different nationality of the first author from the studied project's country (Local, Foreign or Not Clear)
• Sector	Industry sector
• Empirical approach	Research method(s) used and a short note of the specifications
• Quality	Numerical rating of the strength of evidence (see Table 2)
• Unit of analysis	Major entity analysed in the study
• Findings	Key findings of the article in regard to this study's interest
• Output/ Innovation Type (of the Project)	Production-based, Service-based and Mixture of both type
• Form of Innovation	Product/service innovation, Process innovation and Both forms
• Innovation and Project Type	Innovation project, Innovation in projects and Project innovation
• Type of Standard	Typology of the standard
• Consideration of Standard(s) in lieu of Innovation	Standard(s) as innovation (creating standards); Standard(s) for innovation (creating standard(s) as a support to the intended project output); Standard(s) of innovation (process)
• Organizational phenomenon in terms of standard(s)	Standard creation, Standard adoption or Standard violation
• Position towards Standard(s)	Advocating, Ambivalent and Adversarial
• Performance Measured and Unit	Performance of what entity is measured and, if a clear unit or scale for measurement is given or indicated

Table 2 'Hierarchy of evidence' utilized for qualitative evaluation of the reviewed studies [Source: Tranfield *et al.* (2003, p.210)]

Hierarchy (Higher is stronger)	Evidence type
1	Very weak evidence based on personal experiences and/or opinions
2	Weak evidence based on expert opinions (what constitutes as an 'expert' is not fully explained)
3	Neither strong nor weak evidence, often based on a mixture of personal opinions supported by data collected. It is not always clear how the data was collected in these examples
4	Strong evidence based on systematic case study research
5	Very strong evidence based on randomised experiments

3.3.1 Description of the study specific codes

Inconsistency in the literature regarding the effect of standard(s) on innovation project management (see Section 2.3 and 2.4) indicates that finding a precise link among these constructs is unlikely. More sensibly, this study adopts a contingent approach and looks for bundles of scenarios where a) position towards standard(s) in innovative projects convergences or diverges; and, b) consideration and measurement of performance in those scenarios. For this purpose, the study utilizes three different sets of classification: a) the typology of the project(s) industry (product/production based, service-based and mixed) (Baer and Frese, 2003), b) various forms of innovation in the project (product/service, process and both forms of innovation – see Section 2.2); and finally, c) typological combinations of innovation and project (innovation project, innovation in projects and project innovation – see Section 2.5).

The analysis also performed more qualitative assessments of the standard(s) examined in each study. To analyse how 'performance' is affected in varying innovation scenarios - performance of what entity is measured and if a specific unit or scale for the measurement is utilized - has been recorded. The typology of the standard(s) used in various innovation projects and role of standard(s) in terms of innovation (i.e. as, for or of) has also been recorded (adopted from Brunsson *et al.*, 2012). The studied organizations' role as a standard creator, adopter or violator has also been noted. Most importantly, the various study's overall position towards standardization (i.e. advocating, ambivalent and adversarial) has been assessed. Table 3 presents examples of studies to clarify coding of these three positions.

Table 3 Example of studies taking various positions towards 'standard(s)'

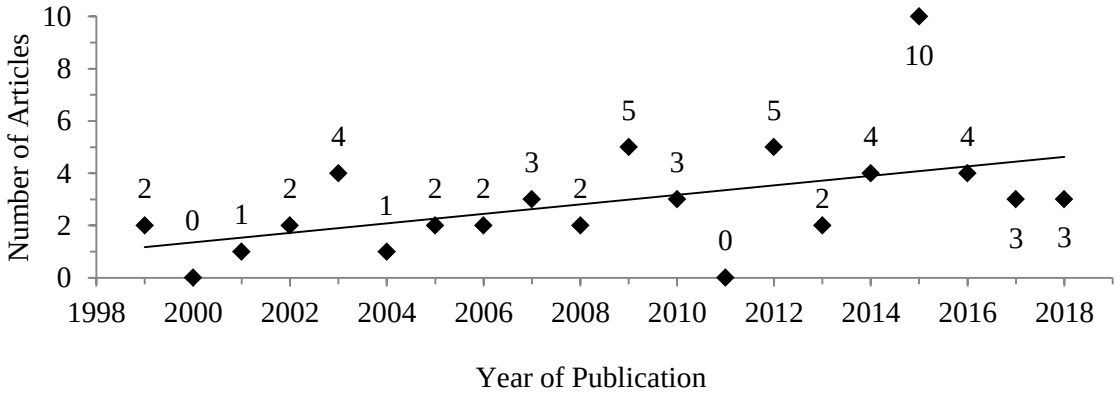
Position towards Standard(s)	Example of studies and their comments regarding 'standard(s)'
Advocating	Andersen and Vaagaasar (2009) found standardized project models in large enterprises to enhance and benefits performance. Jansson *et al.* (2016) posit standardisation to provide a basis for knowledge innovation which enables improvement using a bottom-up approach and increases the production flow.
Ambivalent	Peansupap and Walker (2006) found companies to anticipate incompatibility of internally developed ICT documentation standards to become incompatible to future industry standards. Vennström and Eriksson (2010) do not consider standardized contract as a barrier for increased client influence on the end result of the construction process.
Adversarial	Ernst *et al.* (2015) provide clear empirical evidence that adaptation rather than standardization leads to higher levels of affordable value innovation. Khurum, Fricker and Gorschek (2015) argue that innovation practice cannot be standardized, but is contextual in nature.

4 FINDINGS

4.1 Frequency Analysis

The spread of the reviewed 58 articles across the years illustrates a growing trend, after first reviewed article being published in 1999 (Figure 2), a two-decade period. During the first decade (1999-2008), 19 articles have been found; whereas the second decade (2009-2018) experiences publication of 39 articles; demonstrating a two-fold rise. A two-fold rise in the number of publications in a 10-year period indicates reception of an acknowledgement from the academic community and clear development of the research topic (Rider, 1944; Beske-Janssen *et al.*, 2015) – which has been fulfilled by the number of published literature on the reviewed topic.

Figure 2 Yearly trend of publication (1999-2018)



A descriptive analysis of the 58 reviewed articles indicate that, these articles have been published in 46 different journals – with only 02 journals consisting of more than two papers - Journal of Product Innovation Management (5; 9%) and Construction Management and Economics (3; 5%) (see Appendix 02 for complete list of journals and distribution of articles). Therefore, there is no core journal contributing to the topic of the interplay between standard(s) and innovation in a project context. Interestingly, only two project management journals (Project management Journal and International Journal of Project Management) have contributed one article each in this review, indicating that project management literature is yet to empirically examine and perhaps fully acknowledge the issue of standard(s) versus innovation. Nonetheless, the list of journals (Appendix 02) indicates that the issue has received attention in the main research arena of construction management, ICT, innovation and R&D (research and development) management, organisational studies and healthcare studies.

The distribution of the studies in various industries indicates similarity to the research arenas, with most of the studies being conducted on projects in construction and ICT sector (15 each, totalling 52%); while healthcare, automotive, manufacturing and energy industries are featured in other studies (Figure 3). To analyse the global perspective of the issue of standard(s) in 'projects featuring innovation', the distribution of the studies in major geographic areas has also been analysed, which indicates that - the majority of the studies have been conducted on projects in European countries (31; 53%) with North-American countries in far second frequency (9, 15%) (Figure 4; see Appendix 03 for country-wise distribution).

Figure 3 Distribution of industries of reviewed studies

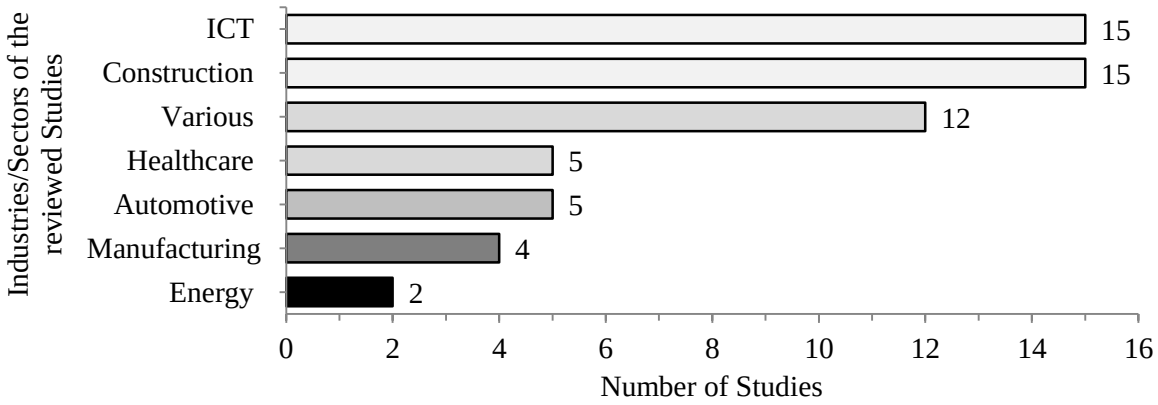
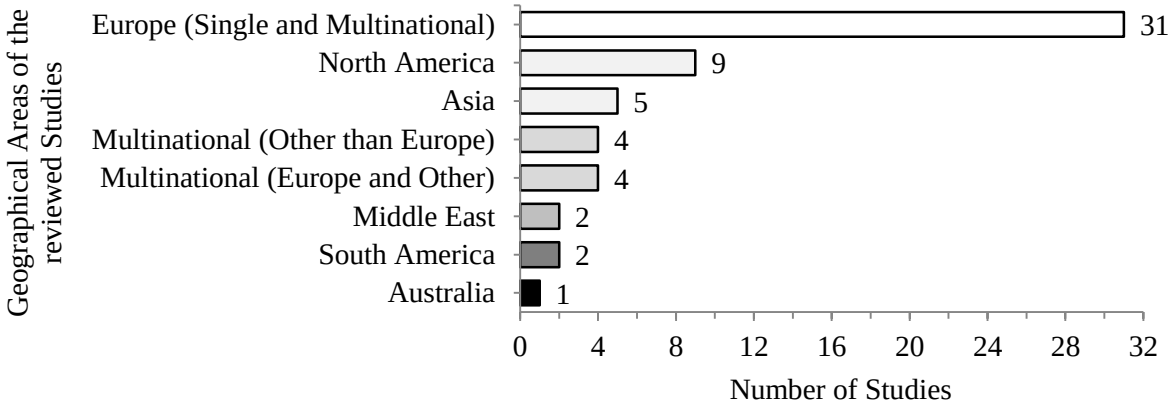


Figure 4 Distribution of geographical areas of study's conduction



4.2 Research methods utilized and the quality of evidence presented

Figure 5 presents the major research methods utilized in the reviewed studies, consecutively. The most commonly used research method was single of multiple case study (34, 58%). Data has been collected primarily through face to face interviews, workshops and seminars (29, 50%) (predominantly with participation from managers and senior officials), questionnaire surveys (22, 38%), document analysis (13), participatory observation (8) and pre-existing dataset analysis (7). 12 studies adopted a mixed method by utilizing both qualitative and quantitative data analysis. Only 6 (10%) articles have been found to adopt a longitudinal study method.

While analysing qualitative data - studies reported of interview transcription and some sort of coding - before commonly utilizing: comparative analysis of cases, content analysis, frequency analysis and thematic analysis. A noteworthy exception is Engwall *et al.'s* (2005) use of the phenomenographic method to analyse interviews. On the other hand, to analyse quantitative data collected from surveys and pre-existing datasets, researchers pre-dominantly used confirmatory factor analysis, followed by an analysis of variance (ANOVA, MANOVA) and logistic regression analysis. To ensure reliability and validity of the questionnaire surveys the Cronbach's Alpha measure have been most commonly utilized. Notably, 03 studies (Balland *et al.*, 2013; Bakker *et al.*, 2015; Mittra *et al.*, 2015) used 'social network mapping' to emphasize the interconnectivity aspect. Finally, only one study used structural equation modelling (partial least square method) to find the interwoven effect of the research constructs from survey data (Ernst *et al.*, 2015).

Following the 'hierarchy of evidence' suggested by Tranfield *et al.* (2003) (Table 2), most studies are found to present - either 'strong evidence through systematic case study research' (26; 45%) or 'neither strong nor weak' evidence based on personal opinions supported by data collection' (20; 35%) (Figure 6). 12 studies depended solely on expert opinions and questionnaire surveys (50-250 responses) based on self-reporting personal opinions, constituting fairly weak evidence. No study has conducted randomized experiments. The average strength of the evidence presented in the articles reviewed in this study has been found to be 3.10, indicating generally 'neither strong nor weak' evidence.

Figure 5 Distribution of major research methods used in the studies reviewed

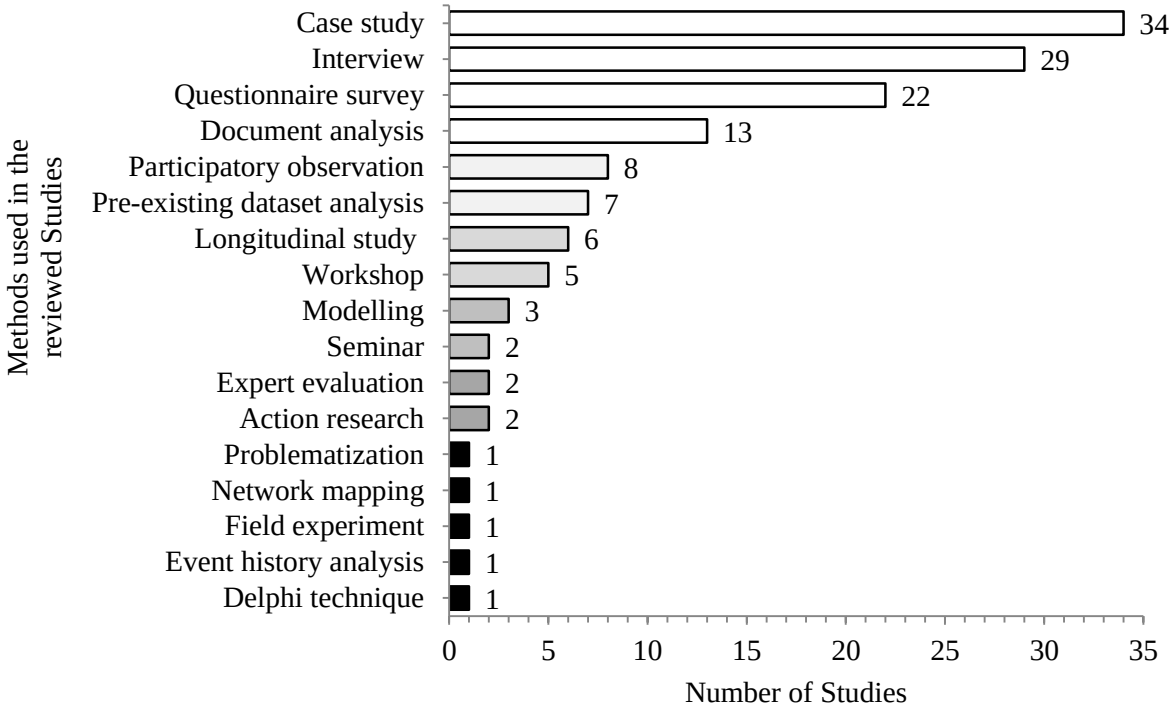
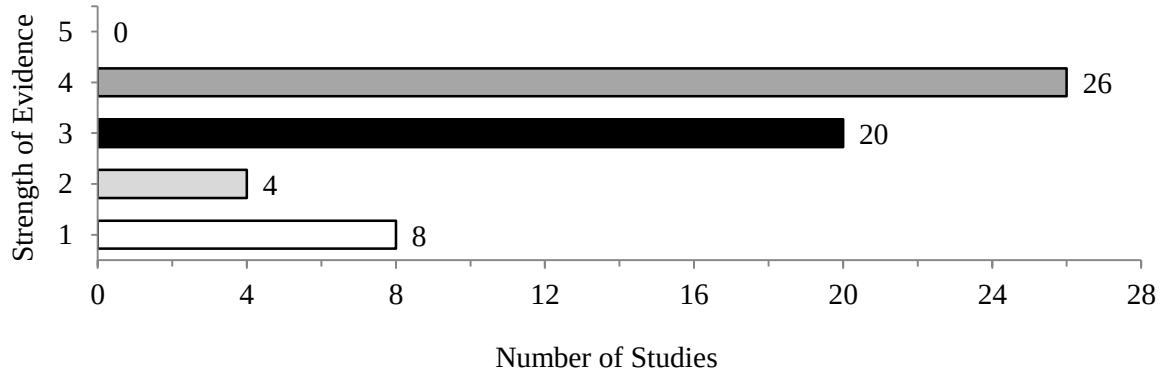


Figure 6 Distribution of strength of evidence (detailed hierarchy in Table 2)



An in-depth look at the use of research methods also allowed the examination of units of analysis used in the reviewed studies as presented in Table 4. It can be noticed that majority of papers (31; 53%) are concentrating on analysing the innovation aspect, more specifically the performance of an innovated product/service, effectiveness of an innovation process and degree of innovation diffusion. Fewer studies are engaged in the management and performance aspects from an overall project perspective (13; 22%). Only 6 studies analyse the various features of standard(s); while the remaining 8 studies are equally divided in analysing how knowledge management and documentation efficiency (i.e. information retention) is related to innovation and standard(s).

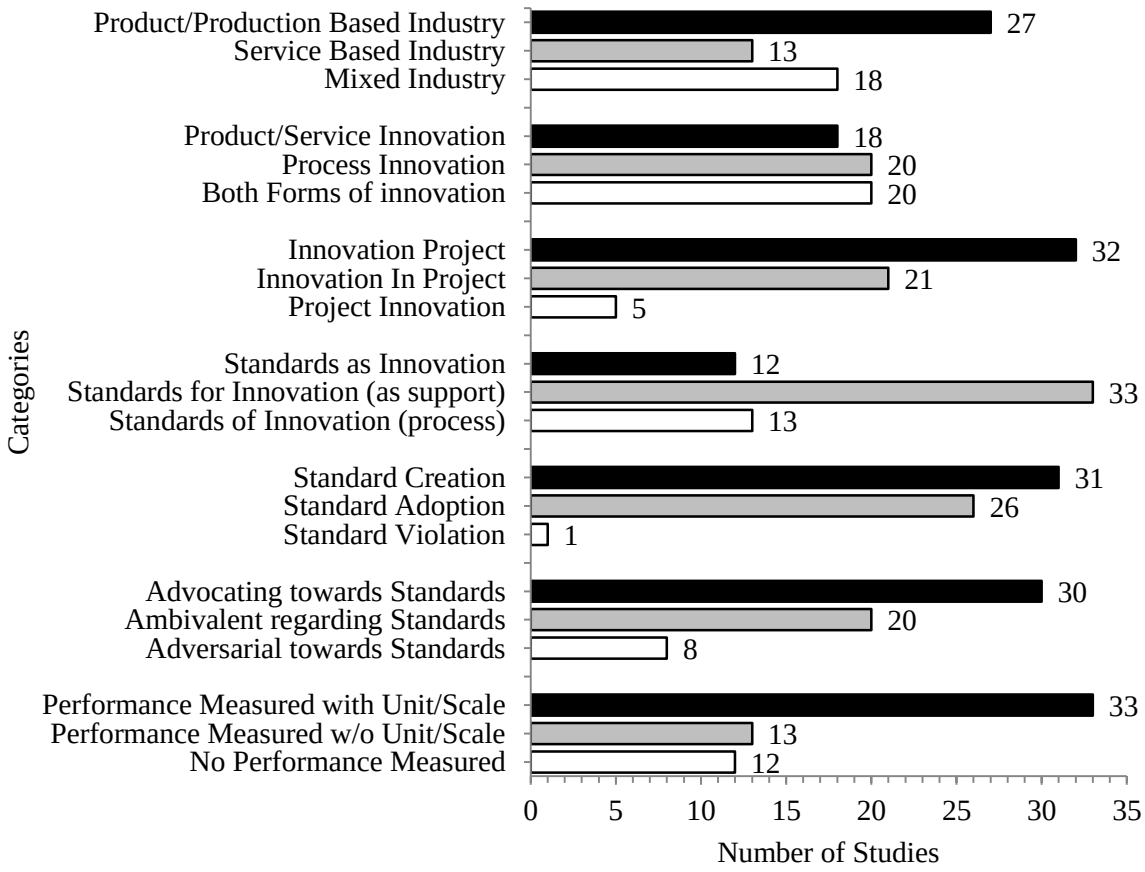
Table 4 Units of Analysis of the reviewed articles

Unit of Analysis	Articles	No. of Articles
Innovation (process) performance	Drejer and Gudmundsson (2002), Nidumolu and Subramani (2003), Stevens and Dimitriadis (2005), Choi *et al.* (2012), Pellicer *et al.* (2012), Chaudhuri (2013), Khurum *et al.* (2015), Li and Reimers (2015), Marion *et al.* (2015)	9
Innovation (product/service) performance	Mathiassen *et al.* (2003), Vermeulen and Hovens (2006), Keizer and Halman (2007), Shum and Watanabe (2008), Van Beers and Zand (2014), Ernst *et al.* (2015), Kowalkowski *et al.* (2015), Samaan *et al.* (2016), Jaakkola and Hallin (2018)	9
Innovation	Roediger-Schluga (2003), Gremyr *et al.* (2010), Hommels and Egyedi (2010), Lopez-Berzosa and Gawer (2014), Mittra *et al.* (2015), Chang *et al.* (2016), Rajakallio *et al.* (2018)	7
Innovation Diffusion	Maansaari and Iivari (1999), Peansupap and Walker (2006), Jagodic *et al.* (2009), Gil *et al.* (2012), Shibeika and Harty (2015), Prado and Sapsed (2016)	6
Project Management	Olin and Wickenberg (2001), Edum-Fotwe *et al.* (2004), Engwall *et al.* (2005), Dittrich and Duysters (2007), Schwabenland and Tomlinson (2008), Vennström and Eriksson (2010), Koch and Bertelsen (2014), Ghasemi *et al.* (2017)	8
Project performance	Blind and Hipp (2003), Andersen and Vaagaasar (2009), Davies *et al.* (2009), Teller *et al.* (2012), Larsson *et al.* (2014)	5
Standard(s)	Bakker *et al.* (2015), Herazo and Lizarralde (2015), Scott and Scott (2015), Molnar *et al.* (2017), Viana *et al.* (2017), Birkenberg and Birner (2018)	6
Documentation efficiency/ Information Quality	Borchers (1999), Giuseppe and Maccarrone (2007), Costanza *et al.* (2009), Kayaçetin and Tanyer (2009)	4
Knowledge Management	Jansson *et al.* (2016), Aoshima (2002), Merminod and Rowe (2012), Balland *et al.* (2013)	4

4.3 Qualitative analysis

As explained earlier, for in-depth reading and easement of analysing the reviewed studies have been categorized into 07 sets of classifications, each consisting of 03 types - Figure 7 presents the distribution of the studies. It is noticeable that most of the studies are a) investigating innovation projects (32, 55%), b) in a production-based industry (27, 46%), and c) utilizing standard(s) 'for' innovation (33, 57%) i.e. as a support to the intended project output. Oppositely, the studied projects are almost uniformly distributed regarding the forms of innovation (product/service, process or both). Most of the studied organizations are found to be either rule maker (standard creator) or rule taker (standard adopter) – almost evenly distributed; whereas only one study - Olin and Wickenberg (2001) - reports on project personnel who are rule-breakers (standard violators). Only 8 studies (14%) have concluded with adversarial recommendation towards standard(s), while others remain mostly advocating (30, 52%) or ambivalent (20, 34%). Finally, the studies do measure some form of performance of (or in) the project - with (33, 57%) or without (13, 22%) a defined scale or unit; except 12 studies which do not measure any performance.

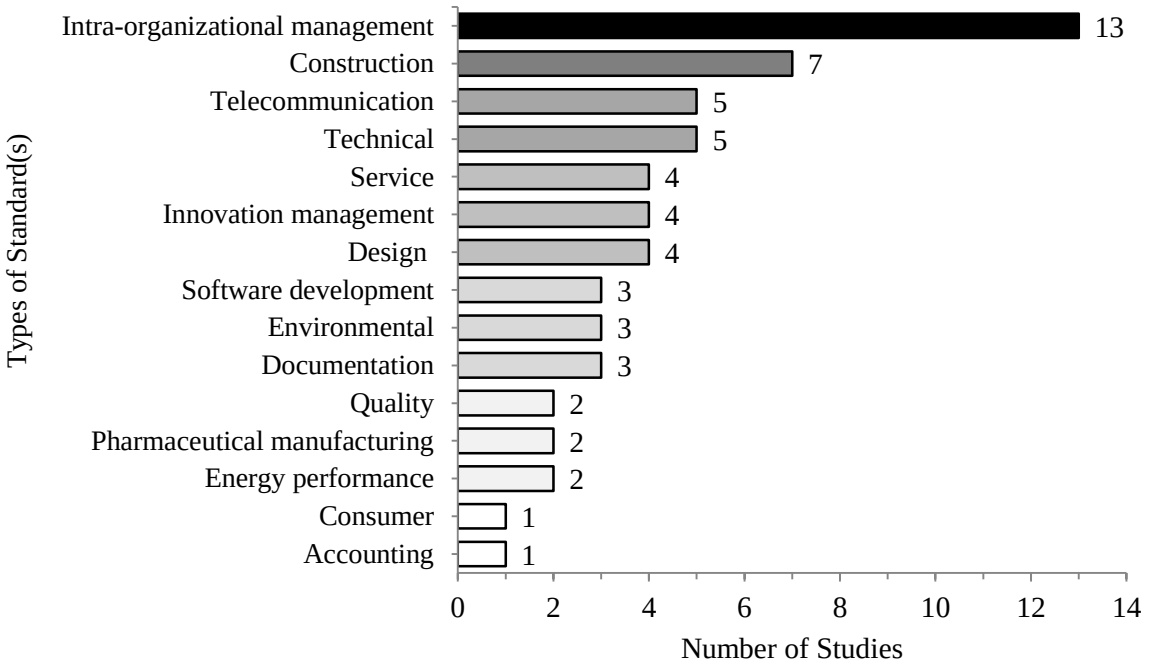
Figure 7 Distribution of definitional, typological and categorical classifications in the reviewed papers



The 6 longitudinal studies reviewed in this study remains uniform in distribution on the types of standard(s) inspected and classifications utilized in this study – except the projects investigated are mostly on production-based industry (04 of 06); and, regarding standard(s) they are either advocative (5) [Stevens and Dimitriadis (2005), Merminod and Rowe (2012), Shibeika and Harty (2015), Jansson *et al.* (2016) and Molnar *et al.* (2017)] or remains ambivalent (1) [Dittrich and Duysters (2007)].

Lastly, regarding the types of standard(s), most of the studies examined intra-organisational management standard(s) (13, 22%) like Six Sigma, Project Management BoKs (Bodies of Knowledge), PLM (product lifecycle management) etc.; and construction standard(s) (9, 12%) like BIM (Building Information Modelling). Telecommunication and other technical standard(s) related to green Building (C2000), solar photovoltaic and electric-vehicle charging are also significantly investigated (total 10, 17%). Figure 8 presents the frequency of different types of standard(s) studied in the reviewed papers.

Figure 8 Frequency of different types of standard(s) studied in the reviewed papers



4.4 Performance of innovative projects

Table 5.1, 5.2 and 5.3 presents the analysis of innovation-project typology, performance measurement typology and position towards standard(s) of the studies in consecutively production-based, service-based and mixed industries.

The analysis finds that, the studies investigating projects in the production-based industries are more prone to measure performance using a defined scale/unit. For example: new product development performance is measured by time and cost (Viana *et al.*, 2017), user requirements and bill-of-materials (Zanichelli *et al.*, 2018) or predefined innovation objectives/deliverables (Merminod and Rowe, 2012; Chaudhuri, 2013); with implementation of design, intra-organizational management, pharmaceutical manufacturing and construction standard(s). Oppositely, studies investigating projects in the service-based industry consider effects on performance without defined quantitative measurements. These studies consider effectiveness (rather than efficiency) of documentation system (Costanza *et al.*, 2009), innovation diffusion (Peansupap and Walker, 2006) and newly developed standard(s) (Jaakkola and Hallin, 2018); with implementation and development of documentation, ICT and software development standard(s). Interestingly, relatively more studies investigating mixed-industries with implementation of service, telecommunication, construction and intra-organizational management standard(s) (e.g. Gremyr *et al.*, 2010; Hommels and Egyedi, 2010; Li and Reimers, 2015; Rajakallio *et al.*, 2018), do not measure performance. These findings are quite relatable to the conversation in the literature, as production-industry are more related to productivity (speed of construction or number of parts manufactured etc. i.e. efficiency of output); whereas the service industry is oriented around customer-satisfaction (i.e. effectiveness of outcome). Logically, in amalgamation, the performance of projects in the mixed industry becomes more concerned with stakeholder satisfaction.

Also, while some innovation projects and innovation in project contexts are found to be less concerned with performance measurement in both production and service based industries (e.g. Gremyr *et al.*, 2010; Larsson *et al.*, 2014; Khurum *et al.*, 2015; Prado and Sapsed, 2016;

Ghasemi *et al.*, 2017); there is no project with project innovation (novel way to do a project) which does not measure performance (with or without defined scale/unit). This is also not surprising, as new innovations of project management process are only accepted as standard when they can demonstrate improvement in performance.

Regarding the positions of the studies towards standard(s), most studies remain advocating, where less remains ambivalent and only 08 studies posit adversarially. The findings of these 08 studies build the argument that, due to contextual nature of innovative projects, rather than transforming a well-functioning process in a standard - flexible rules are more useful in practice (Olin and Wickenberg, 2001; Khurum *et al.*, 2015). In addition, when a better solution to a problem is available, contractors and supplier voluntarily adopt those to improve performance without the necessity for developing a standard first (Ernst *et al.*, 2015; Prado and Sapsed, 2016). Finally, in cases where standard(s) are absolutely necessary (for example, in technological projects) a bottom-up approach will allow better acceptance of the standard with necessary complementary innovation room, rather than forcing a standard down from the top (Li and Reimers, 2015).

Unsurprisingly, the studies measuring performance with a defined scale or unit are found to be more advocating towards the creation and adoption of standard(s), as standard are deemed useful in improving performance and provides a method to compare the performance of similar innovative projects. Oppositely, studies with ambivalent and adversarial recommendation towards standard(s) are found to either comment on performance ‘without using a definite unit/scale’ or ‘no measure performance at all’ [only one exception - Ernst *et al.* (2015); which needed to measure performance due to the implementation of an innovation management standard].

Table 5.1 Analysis of innovation-project typology, performance measurement typology and position towards standard(s) in Production based industry

Industry type	Innovation -project typology	Performance measurement typology	Position towards standard creation and adoption		
			Advocating	Ambivalent	Adversarial
Production based industry	Innovation projects	Performance measured with defined unit/scale	Aoshima (2002), Roediger-Schluga (2003), Merminod and Rowe (2012), Chaudhuri (2013), Marion *et al.* (2015), Mittra *et al.* (2015), Viana *et al.* (2017), Birkenberg and Birner (2018) *Industry (Country):* Automotive (Japan), Manufacturing (Austria, Europe-China, Costa Rica), Health Care (India, UK), ICT (USA), Construction (USA) *Standard(s):* Design, Environmental, Intra-organizational management, Pharmaceutical manufacturing, Innovation Management, Construction	Keizer and Halman (2007), Bakker *et al.* (2015), Scott and Scott (2015) *Industry (Country):* Various (Netherlands), Automotive (Multinational, USA) *Standard(s):* Consumer, Technological	-
		Performance measured without defined unit/scale	Engwall *et al.* (2005), Molnar *et al.* (2017) *Industry (Country):* ICT (Sweden), Automotive (Germany) *Standard(s):* Intra-organizational management, Quality	-	-
		No performance measured	-	-	Khurum *et al.* (2015) *Industry (Country):* ICT (Sweden, USA, South Africa) *Standard(s):* Software development
	Innovation in projects	Performance measured with defined unit/scale	Edum-Fotwe *et al.* (2004), Vermeulen and Hovens (2006), Davies *et al.* (2009), Kayaçetin and Tanyer (2009), Gil *et al.* (2012), Pellicer *et al.* (2012) *Industry (Country):* Construction (UK, Netherlands, Turkey, Spain) *Standard(s):* Construction, Energy performance, Intra-organizational management, Design, Technological, Innovation Management	Koch and Bertelsen (2014), Chang *et al.* (2016) *Industry (Country):* Construction (Denmark, Malaysia) *Standard(s):* Energy performance, Construction	-
		Performance measured without defined unit/scale	-	-	Herazo and Lizarralde (2015) *Industry (Country):* Construction (Canada) *Standard(s):* Environmental
		No performance measured	Larsson *et al.* (2014), Jansson *et al.* (2016) *Industry (Country):* Construction (Sweden) *Standard(s):* Construction, Design	Vennström and Eriksson (2010), Shibeika and Harty (2015) *Industry (Country):* Construction (Sweden, UK) *Standard(s):* Construction	-
	Project innovation	Performance measured without defined unit/scale	-	-	Olin and Wickenberg (2001) *Industry (Country):* Various (Sweden) *Standard(s):* Intra-organizational management

Table 5.2 Analysis of innovation-project typology, performance measurement typology and position towards standard(s) in Service based industry

Industry type	Innovation-project typology	Performance measurement typology	Position towards standard creation and adoption		
			Advocating	Ambivalent	Adversarial
Service based industry	Innovation projects	Performance measured with defined unit/scale	Borchers (1999), Stevens and Dimitriadis (2005), Kowalkowski *et al.* (2015), Samaan *et al.* (2016), Giuseppe and Maccarrone (2007) *Industry (Country):* Healthcare (USA), Various (France, Multinational), ICT (Italy) *Standard(s):* Documentation, Service, Intra-organizational management, Accounting	-	Ernst *et al.* (2015) *Industry (Country):* Various (Multinational) *Standard(s):* Innovation Management
		Performance measured without defined unit/scale	Costanza *et al.* (2009) *Industry (Country):* ICT (USA) *Standard(s):* Documentation	Peansupap and Walker (2006) *Industry (Country):* ICT (Australia) *Standard(s):* Documentation	-
		No performance measured	Ghasemi *et al.* (2017) *Industry (Country):* Healthcare (Turkey) *Standard(s):* Intra-organizational management	Lopez-Berzosa and Gawer (2014) *Industry (Country):* ICT (Multinational) *Standard(s):* Telecommunication	-
	Innovation in projects	Performance measured without defined unit/scale	-	Maansaari and Iivari (1999), Jaakkola and Hallin (2018) *Industry (Country):* ICT (Finland), Various (Sweden, Finland) *Standard(s):* Software development, Service	-
	Project innovation	Performance measured without defined unit/scale	-	-	Schwabenland and Tomlinson (2008) *Industry (Country):* Various (UK) *Standard(s):* Intra-organizational management

Table 5.3 Analysis of innovation-project typology, performance measurement typology and position towards standard(s) in Mixed industry

Industry type	Innovation-project typology	Performance measurement typology	Position towards standard creation and adoption		
			Advocating	Ambivalent	Adversarial
Mixed industry	Innovation projects	Performance measured with defined unit/scale	Blind and Hipp (2003) *Industry (Country):* Various (Germany) *Standard(s):* Quality	Van Beers and Zand (2014) *Industry (Country):* Various (Netherland and multinational) *Standard(s):* Technological	-
		Performance measured without defined unit/scale	Drejer and Gudmundsson (2002), Balland *et al.* (2013) *Industry (Country):* Manufacturing (Denmark), ICT (Europe) *Standard(s):* Innovation Management, Telecommunication	Dittrich and Duysters (2007) *Industry (Country):* ICT (Finland) *Standard(s):* Telecommunication	-
		No performance measured	-	Gremyr *et al.* (2010), Hommels and Egyedi (2010) *Industry (Country):* Automotive (Sweden), ICT (Netherlands) *Standard(s):* Service, Telecommunication	Li and Reimers (2015) *Industry (Country):* ICT (China) *Standard(s):* Telecommunication
	Innovation in projects	Performance measured with defined unit/scale	Mathiassen *et al.* (2003), Shum and Watanabe (2008), Choi *et al.* (2012), Teller *et al.* (2012) *Industry (Country):* ICT (Sweden), Energy (USA), Various (Korea, Germany) *Standard(s):* Software Development, Technological, Intra-organizational management	-	-
		No performance measured	-	Rajakallio *et al.* (2018) *Industry (Country):* Construction (Finland) *Standard(s):* Construction	Prado and Sapsed (2016) *Industry (Country):* Energy (Brazil) *Standard(s):* Intra-organizational management
	Project innovation	Performance measured with defined unit/scale	Andersen and Vaagaasar (2009) *Industry (Country):* Various (Norway) *Standard(s):* Intra-organizational management	Nidumolu and Subramani (2003) *Industry (Country):* ICT (USA) *Standard(s):* Intra-organizational management	-
		Performance measured without defined unit/scale	-	Jagodic *et al.* (2009) *Industry (Country):* ICT (Australia, Germany) *Standard(s):* Intra-organizational management	-

5 DISCUSSION

5.1 General discussions

The analysis of the 58 studies has developed interesting findings elucidating the underexposed aspects of the relationship between standard(s) and performance of innovative projects. The findings from frequency analysis (Section 4.1 and 4.2) indicate five specific research gaps, contextual and methodological in nature.

a) Majority of the studies investigated projects in the production-based or mixed industries which only peripherally incorporate services to increase sales (e.g. construction, automotive and other manufacturing industries). However, due to globalisation, the service aspect is being regarded to be increasingly crucial (Bohn *et al.*, 2018) and service-innovations are evidenced to be impacted by standard(s) (e.g. Blind and Hipp, 2003). Thus, the lower frequency of studies examining primarily service-oriented innovation projects (especially other than ICT and healthcare industries) is a lacking of the literary field focusing on the effect of standard(s) on innovation performance.
b) Location of a project introduces the cultural aspect – a direct barrier in creating a unified framework of measuring project performance (Toor and Ogunlana, 2010). However, the review finds only a handful of studies investigating projects located outside Europe and North America (Appendix 03). As the innovation and project management culture are immensely different in different global regions (Hofstede, 1984; Tellis *et al.*, 2009; Meyer *et al.*, 2015; Amster and Böhm, 2016), further studies are required on projects located in Asian, Middle Eastern, South American, African and Australian countries.
c) While collecting empirical data, almost all the studies depended on participation from (project) managers and senior officials only. Nevertheless, literature suggests that in the case of lower-level employees - the effect of delegation in managing projects (Paper and Johnson, 1997), adherence to standard(s) (Schütz and Schrefl, 2014) and innovation behaviour (Kurz *et al.*, 2018), are significantly different; which calls for further investigations.
d) Following the hierarchy of evidence suggested by Tranfield *et al.* (2003), the overall average quality of evidence presented in the 58 studies has been found to be 3.10, suggesting 'neither weak nor strong' evidence. More importantly, no studies have undertaken randomized experimental methods, which are regarded to produce the strongest form of evidence. This lacking remains to be fulfilled by future studies and the use of quasi-experiment method (Cohen and Ledford, 1994; Cabigiosu *et al.*, 2012; Thirukumaran *et al.*, 2015; Venkatesh *et al.*, 2017) is being suggested considering a 'performance of innovative projects' focus.
e) Finally, project management literature has been found yet to empirically examine and perhaps fully acknowledge the issue of standard(s) versus innovation. This is possibly due to the still reigning belief of the "one size fits all" concept (Shenhar, 2001) in practice due to significant professional reliance on project management standard(s). Accordingly, this study calls for a general move away.

5.2 Definitions of various 'project featuring innovation' contexts

It has been already established in project performance literature that, due to the uniqueness of projects, generating a unified framework of measuring performance is impossible (Toor and Ogunlana, 2010). This uniqueness aspect forces most of the projects to be innovative in some aspect or another, even if they are not directly an 'innovation project' (Bibarsov *et al.*, 2017).

When measuring performance, the contextuality of the innovation in relation to the project becomes crucial – as the actual project performance for different projects is depicted by the performance measurement of different entities (see Section 4.4 for example). In addition, as explained in Section 2.5, the contextual definition of innovation project remains quite inconclusive in literature - and accordingly, the only 7 (12% of 58) reviewed studies which addressed the definitional perspective of 'innovation' and/or 'project', lament this non-specificity (Gremyr *et al.*, 2010; Pellicer *et al.*, 2012; Van Beers and Zand, 2014; Khurum *et al.*, 2015; Marion *et al.*, 2015; Shibeika and Harty, 2015; Ghasemi *et al.*, 2017). The fuzzy borders in the literature between - a) project and process (processes regarded as projects to appear appealing) and b) invention and innovation (a minor change or improvement with no commercial implementation considered as innovation) – are to blame for this occurrence (Filippov and Mooi, 2009). Therefore, this study demarcated the three contextual definitions, namely: innovation project, innovation in project and project innovation (described in Section 2.5) - and utilized these as codes during categorization of the reviewed studies (See Table 5 for sample studies). However, this newly formulated and contextual classification needs further examination in relation to standard(s) and performance to mandate academic recognition.

5.3 Further examination of standard(s) in relation to performance

Standard(s) are often assumed as rigid and stable 'packages' which are beneficial when adopted and applied. This can be perceived with an abundance of the reviewed studies taking advocating and ambivalent positions towards standard(s). While adoption of standard(s) is by definition a voluntary commotion (Brunsson *et al.*, 2012), their application is much more regulatory in innovative projects (e.g. Olin and Wickenberg, 2001; Herazo and Lizarralde, 2015; Birkenberg and Birner, 2018). For example, though completion with ISO 9001 does not have any legal consequence, many corporations exclusively look for suppliers who have this certification (Guler *et al.*, 2002); considering the standard as an assurance of better performance (Terlaak, 2007).

The creation of external standard(s) is controversial as standard(s) can either be highly stable or highly effective, but not both at the same time (Brunsson *et al.*, 2012). Standard creating organisations (rule makers) always attempt to balance efficiency of the standard with wide participation. Wide participation during creating a standard ensures greater adoption and increased legitimacy; however, complicates reaching of consensus and reduces the efficiency of the agreed upon standard (Hallström, 2008). As standard(s) get widely adopted, the relative importance of efficiency changes (increases) – resulting in consequent revisions of the standard(s) where different sets of participants takes part (Botzem and Dobusch, 2012). Though 'expert' participants are invited to create standard(s), they always represent a sponsoring interest group - hindering the creation of the best possible standard for innovation; rather, the final standard is usually the most commonly-acceptable solution (van Den Ende *et al.*, 2012). Additionally, as everyone is free to set standard(s), multiple similar standard(s) create complexity in an innovation project and reach the point of 'standardization war' e.g. APMBoK vs PMBoK (Information Commissioner's Office, 2014) and electric-vehicles charging standard(s) in Europe (Bakker *et al.*, 2015).

Organizations often use internal standard(s) for innovation management (e.g. Pellicer *et al.*, 2012; Ernst *et al.*, 2015) and intra-organisational management (e.g. Schwabenland and Tomlinson, 2008; Jagodic *et al.*, 2009), which are usually more created than adopted, ensuring they are more tailored towards context specific innovation and performance. However, rule-breaking can also create and evolve standard(s) (Purcell, 1979; Masson *et al.*, 2012; Warren and Smith, 2015; Nørkjaer Gade *et al.*, 2018), which has been rarely examined

in relation to performance of innovative projects (for example, in only 01 of the reviewed studies - Olin and Wickenberg, 2001). Finally, adoption and evolution of specific performance measurement methods can also result in creation (e.g. standard performance measurement method - Edum-Fotwe *et al.*, 2004) or alteration of standard(s). Thus, the controversy remains - whether a standard should be adapted to the context of the innovator organization, or the organization should bring changes in its systems and structures to fit an existing standard (Zbaracki, 2006).

Similar to standard(s), performance management is also largely assumed to be static in the reviewed studies - and predominant use of conventional measurement criteria is evident (Appendix 04). Scholars have essentially avoided problematization of the concept of 'performance', especially in relation to standard(s), as evident from the reviewed studies. Due to the concurrent changing nature of - work, organisational roles, external demands and competition, as well as introduction of information technology - performance management needs to be highly dynamic to become meaningful and impactful (Neely, 1999). Thus, with strong polemics against regular conjecture of 'stable and useful' standard(s) and 'static' performance measurement, further studies are necessary: a) considering standard(s) and performance measurement methods as 'dynamics' rather than objects and tools and b) with adversarial assumptions towards standard(s).

Hence, the importance of the mostly avoided temporal aspect (i.e. longitudinal studies) in the relationship between standard(s) and performance of innovative projects becomes apparent. Longitudinal studies particularity support in-depth data collection and scrutinization over a period of time (Stake, 2018). It is surprising that, of the 6 longitudinal studies reviewed, none posits adversarially towards standard(s); and build up the argument that, long-term and in-depth understanding of the standard(s) creation and adoption process - allows consideration of standard(s) as dynamic objects rather than 'pre-packed entities', resolving the fundamental contradiction between standard(s) and innovation. Thus, this study calls for further longitudinal studies with a historical/archival approach combined with engaged scholarship such as ethnography (e.g. Rowland and Hall, 2012; Gross and Geiger, 2017).

6 CONCLUSIONS

To recapitulate, the systematic review of 58 papers has examined how standard(s) affect the performance of innovative projects. The review method utilizes seven sets of classifications to create bundles of scenarios to find points of interesting phenomena. It is found that, in the reviewed studies, scholars have taken three significant positions towards creation and adoption of standard(s) (advocating, ambivalent and adversarial); advocacy being the dominant position. Additionally, the studies are found to merely measure performance using conventional indicators (e.g. time, cost, sales, profit, quality and standard(s) like - ISO, CAD, TQM, agency standard etc.), rather than problematizing the concept (i.e. why and how performance affects and is affected). Unsurprisingly, the studies measuring performance with a defined scale/unit are more advocative towards the creation and adoption of standard(s); whereas, studies positing ambivalently and adversarially are either commenting on performance measured without a definite unit/scale or not measuring performance at all.

6.1 Limitations of the review method

Four methodological limitations of the review are acknowledged. Firstly, in the conversation between standard(s) and innovation, the review focuses only on project context - excluding continuous innovation processes and business-as-usual. Secondly, the arguments are drawn from the findings of peer-reviewed journal articles published in English only; excluding other languages and types of publication. As some academic disciplines are reliant on specific

publication formats other than journal articles e.g. conference-proceedings in computer science, useful contributions may have been overlooked. Thirdly, only two search engines returning highest volume of citations (Scopus and Web of Science) have been utilized, with a loss of possible inclusions. Finally, to find thematically relevant articles, in the first exclusion stage, only the 'titles and abstracts' of the articles have been reviewed. As a result, articles with poorly written abstracts but of relevance might have been excluded.

6.2 Academic implications and future research directions

This review identifies the definitional inconsistency regarding innovative projects in literature; and consequently considers three types of innovative-projects: innovation project, innovation in project and project innovation. This consideration calls for further examination in relation to standard(s) and performance. The review also identifies the rare empirical contribution of project management journals to the conversation between standard(s) and innovation and calls for participation. In addition, a lesser segment of reviewed studies is found to investigate projects in service-based industries and nations out of North America and Europe. Current rapid globalization and cultural difference in project and innovation management among nations necessitate these contextual gaps to be fulfilled.

The most important academic contribution of this review is the proposition of considering standard(s) and performance management as dynamics, rather than static objects and tools; in coherence with Brunsson *et al.* (2012) and Neely (1999). These considerations can resolve the direct conflict between standard(s) and innovation and problematize the concept of performance. Inline, this study also suggests further research with adversarial assumption towards standard(s), rather than considering them to be always stable and useful. Additionally, where most of the reviewed studies consider the creation and adoption of standard(s), this study calls for research on how violation of standard(s) can result in the evolution and creation of new standard(s).

The review also evaluates the overall evidence-base of the studies examining standard(s) and performance of innovative projects to be 'neither strong nor weak'. To create a stronger evidence-base, conduction of further systematic case studies and inclusion of quasi-experiments are recommended. While collecting data, a tendency to avoid lower-level employees is also recognised, which has been argued against. Methodically, the temporal aspect in relation to standard(s) and performance of innovative projects has been found to be under-examined. As this aspect indicates a possible resolution of the fundamental contradiction between standard(s) and innovation, further longitudinal studies with an archival approach are suggested.

6.3 Implication for management and practice

To survive the global competition, (project) managers are constantly pressurized to innovate and support channels for diffusion of innovations. In achieving high performance while managing innovative projects, the contingency of standard creation and adoption are crucial, which has been reviewed in this paper. Moreover, the research also offers enhancement of practitioners' conception regarding the contextuality of innovation projects and the necessity of 'fit to the context rules' rather than adopting an effective process into 'penned down' standard(s). In practice, this will - encourage 'bottom-up' approach while creating standard(s), avoid systematic barriers, enhance creativity and accelerate diffusion and adoption of innovation.

To encapsulate, the systematic review fulfils its aim through identifying key contexts regarding how standard(s) affect the performance of innovative projects; elucidating the

underexposed aspects like inconsideration of organisational settings leading to the creation of standard(s), and disregard of the dynamism of standard(s) and performance measurement criteria - indicating promising future research agendas.

LIST OF REVIEWED STUDIES (FOR THE SYSTEMATIC REVIEW)

1. Andersen, E. S. and Vaagaasar, A. L. (2009) 'Project management improvement efforts-creating project management value by uniqueness or mainstream thinking?', *Project Management Journal*. USA, 40(1), pp. 19–27. doi: 10.1002/pmj.20096.
2. Aoshima, Y. (2002) 'Transfer of system knowledge across generations in new product development: Empirical observations from Japanese automobile development', *Industrial Relations*, 41(4), pp. 605–628. doi: 10.1111/1468-232X.00266.
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APPENDICES

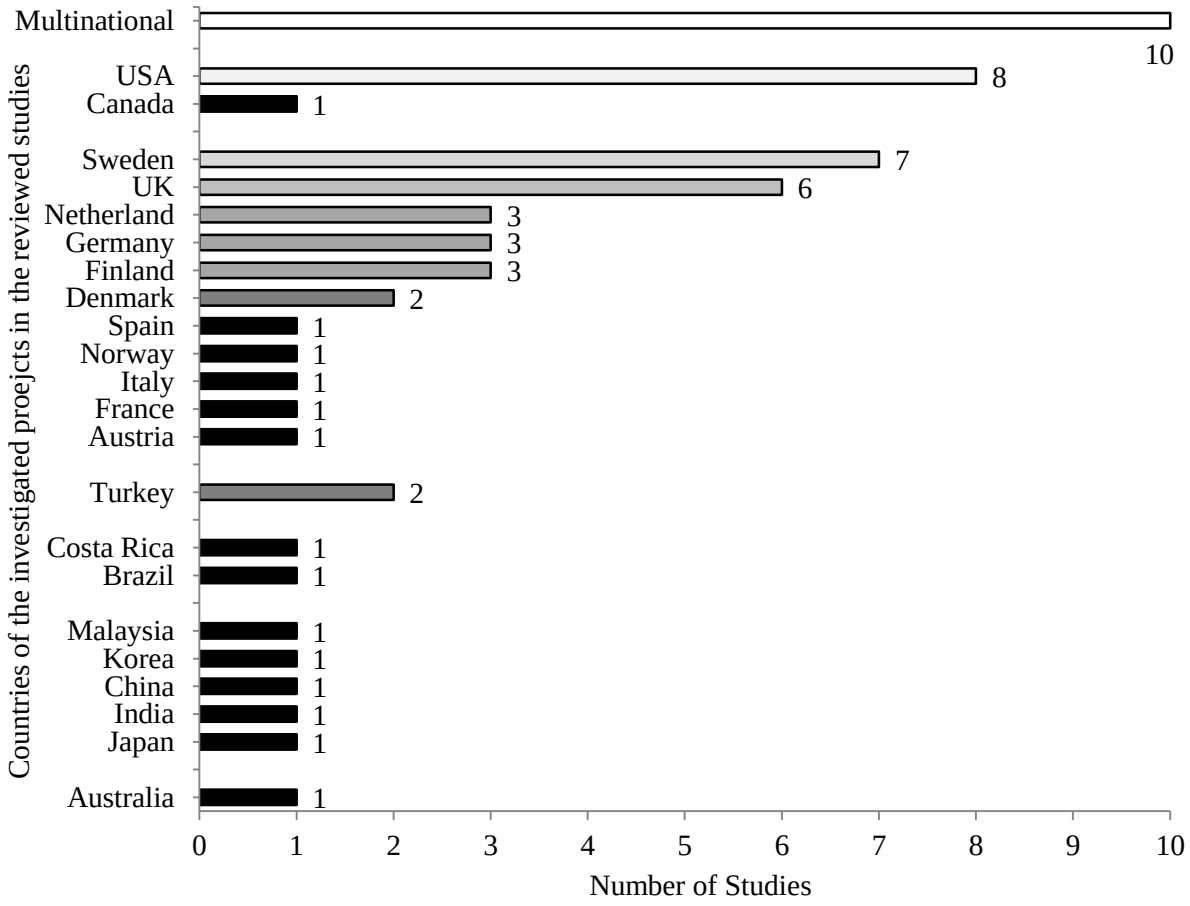
Appendix 01 Inclusion and exclusion criteria for the systematic review

Inclusion Criteria	Exclusion Criteria
• Peer-reviewed journal articles published in English (published any time) • Articles that comment on standard/s and innovation in projects	• Standard/s or innovation were not the core focus of study (when one is core focus, at least commenting on other was deemed necessary) • Study is not in a project context • Article does not utilize an empirical method • Concept of constructs (standard, innovation, project) does not conform to the working definition of this study

Appendix 02 Distribution of articles per journal

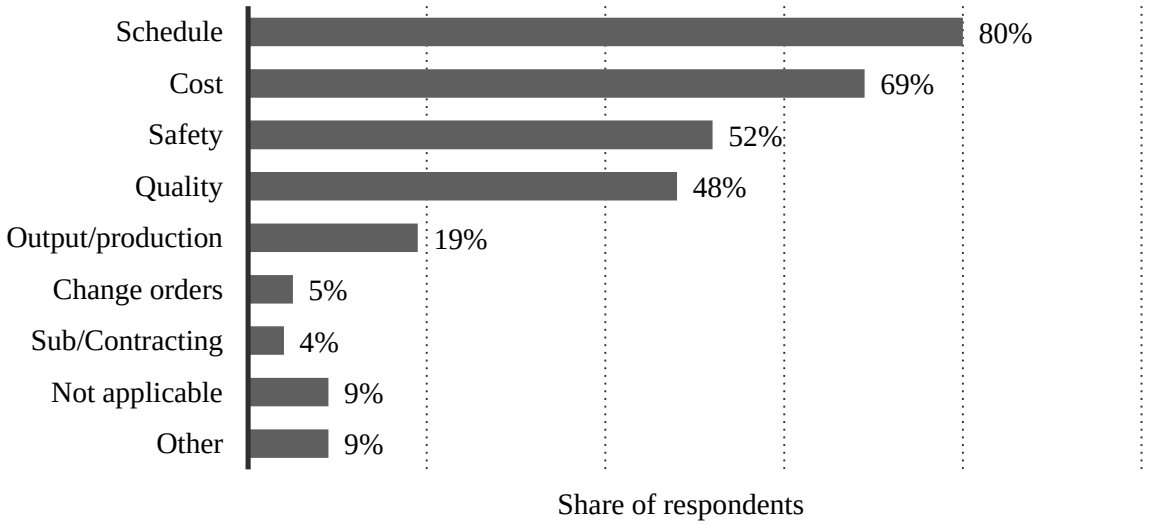
Journal	Frequency
Journal of Product Innovation Management	5
Construction Management and Economics	3
Economics of Innovation and New Technology, Energy Policy, Engineering, Construction and Architectural Management, Journal of Cleaner Production, R&D Management, Technovation	2
Asian Journal of Technology Innovation, Automation in Construction, California Management Review, Chinese Management Studies, Cities, Construction Innovation, Creativity and Innovation Management, Critical Perspectives on International Business, EMJ - Engineering Management Journal, Energies, European Journal of Marketing, Growth and Change, Industrial Marketing Management, Industrial Relations, Information and Management, Information and Organization, Information and Software Technology, Innovation: Management, Policy and Practice, International Journal of IT Standards and Standardization Research, International Journal of Operations and Production Management, International Journal of Project Management, Iranian Journal of Public Health, Journal of Information Technology, Journal of Intellectual Capital, Journal of Library Metadata, Journal of Management Information Systems, Journal of Nursing Care Quality, Journal of the Association of Information Systems, Managing Service Quality, METU Journal of the Faculty of Architecture, New Biotechnology, Organization Studies, Pediatrics, Project Management Journal, Research Policy, Research Technology Management, Technological Forecasting and Social Change, The Open Construction and Building Technology Journal	1

Appendix 03 Country-wise distribution of reviewed studies' conduction



Appendix 04 Top performance measures used in contracts in United States

[Source(s): KPMG; ID 805182; © Statista 2018]



Note: Information collected at mid-2017; 198 Respondents; senior leaders from US organizations that own capital construction projects and from engineering and construction companies

Appendix 05 Commonly used performance matrices for innovation projects

[Adopted from: Hoegl *et al.* (2017), Kristiansen and Ritala (2018)]

Performance measurement dimensions / indicators	Applicability
Net present value (Cost-efficiency)	Assesses (pre-launch) the difference between future cash inflows and outflows and discounts it to the value represented today; related to effectiveness of a project in relation to the time needed to achieve that level of effectiveness
Return on investment (Market performance)	Gives (post-launch) feedback on the net income from launched projects. Compares gains versus costs of investments
Percentage of profits from products less than *n* years old (Cost-efficiency, time-efficiency)	Provides information on how new projects contribute to the firm's turnover and the firm's competitive position
Total patents filed / pending / awarded (Product Novelty)	Explains how firms are able to secure patent rights, giving an idea of future licensing potential, etc.
Time-to-market (Speed)	Describes the speed from innovation project investment to the first customer
Success / failure rate of projects (New Product Quality)	Measures the degree to which new projects in the portfolio succeed/fail. Indicates ability to select "the right" projects for the pipeline with predefined product properties