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Accelerating Inter-Disciplinary Learning: A Scoping Review of Objective Decision-Making Research in Project Selection

Ilse Doyer and Michael K. Ayomoh
Department of Industrial and Systems Engineering
University of Pretoria
Pretoria, Gauteng, South Africa
ilse.doyer@up.ac.za, michael.ayomoh@up.ac.za

Abstract

Project selection is a complex, multi-criteria decision-making problem that is critical to the selection of meaningful, manageable, and sustainable projects and is being solved in a variety of contexts such as infrastructure, information systems, and marketing. However, the same diversity could also lead to disconnection where researchers and practitioners are unaware of the work being done on project selection and domains other than their own. This scoping review followed a systematic five-step process to screen 120 and synthesize 109 articles on project selection to firstly ascertain what research has been done in the field of project selection, where it has been done, and what techniques are the most prevalent amongst researchers. The main contribution of this research is a 'cross-pollination matrix' produced by the synthesis of the literature which will enable researchers and practitioners alike to find either similar work on which they can build or fund innovative new perspectives on a shared and complex problem: the selection of projects that will move the proverbial needle. The review found that the field is ripe for inter-disciplinary learning with publications spanning 14 different contexts, using 32 different decision-making models delivering a significant amount of case studies and theoretical contributions. Research efforts were dominated by the customization and application of existing project selection models with very little attention given to empirical research on the praxis of project selection. No other scoping reviews were identified during the screening of literature.

Keywords
Project selection, project prioritization, infrastructure, environmental, Six Sigma

1. Introduction

Operations improvement is strongly correlated to increased profitability of companies (Kaplan and Norton 2008) and the process of improvement project selection is, in turn, correlated to the success of operations improvement (Albliwi et al. 2014, Antony and Banuelas 2002, Bacdayan 2001). Lynch et al. (2003) define an improvement project as a project that "address[es] an organizational performance problem that has an unknown solution".

In the field of operations improvement, many tools and concepts can be used to identify improvement opportunities such as benchmarking, value stream mapping, statistical process control, etc. When multiple improvement opportunities are identified, and the resources with which to convert these opportunities into improvements are limited, operations management is forced to prioritize the opportunities by considering various constraints and criteria (Adams et al. 2007, Marriott et al. 2013). The topic of the selection of improvement projects that are "meaningful and manageable" (Pande et al. 2014), is well represented in the literature.

During the process of project selection, improvement practitioners can use objective or subjective prioritization methods or a hybrid of both methods. Objective prioritization methods are more analytical in nature, often employing quantitative decision-making models, whereas subjective decision-making tends to use intuition and feelings, but is considered less desirable (Harung 1993).

Operations improvement literature has comprehensively articulated guidelines and constraints to the selection of projects to prioritize them for maximum business impact, while considering resource limitations. Subsequently, these parameters have been translated into sophisticated decision-making models using a variety of approaches such as adaptive neuro fuzzy inference systems, linear programming, analytic hierarchy process (AHP), fuzzy weighted additive goal programming, etc. (Wang et al. 2014, Marriott et al. 2013). In fact, most of the literature on project selection is dedicated to proposing objective project selection tools and methodologies (Kirkham et al. 2014).

In a survey of 74 organizations, however, Kornfeld and Kara (2013) found that companies seldomly apply the sophisticated models propagated in academic literature when selecting projects and rather used subjective or unstructured project selection methods (PSMs). The research of Kirkham et al. (2014) of 203 European manufacturers reported that 51% did project selection subjectively only, 28.6% used both subjective and objective methods and 20.4% reported only using objective methods. In this study, large firms were more likely to do objective selection, whereas the Small and Medium Enterprises (SMEs) opted for subjective methods. Cost Benefit Analysis, Pareto Analysis, and a group that includes Judgement, Experience and Feelings, were the three most used project selection approaches amongst the companies surveyed by Kirkham et al. (2014), also confirming the finding by Kornfeld and Kara (2013) that the models designed by academics are not being used in industry.

The research of Kirkham et al. (2014) explored the reasons why companies do not use the available objective selection methods and report the following responses: a) Lack of awareness (23.8%), b) lack of resources (15.9%), c) preference towards subjective methods (15.9%), d) no perceived benefits of objective methods (13.5%), e) difficult or complicated theory (12.7%), f) extensive education/efforts needed (7.9%) and g) difficulty to analyze results (7.1%) and other (3.2%). Considering that reasons e, f, g, and possibly also b have to do with the objective selection methods being perceived as too difficult or cumbersome for the current context, this 'too difficult' theme would constitute 43.7% of the responses. Reasons c and d could similarly be grouped to form a 'subjective methods work well enough' group, which would then be the second most dominant theme at 29.4%, and lack of awareness still at 23.8%.

Jung and Lim (2007) also postulate that management might not have the data that will help them estimate project costs, schedules, and benefits, which might add to the reason why data-reliant prioritization methods are not used, and even the popular Cost Benefit Analysis and Pareto Analysis methods might not always be feasible.

The Kirkham et al. (2014) study focused on project selection in the Six Sigma context, whereas the Kornfeld and Kara (2013) study covered both Six Sigma and Lean deployment. Another study by Banuelas et al. (2006) also surveyed manufacturing companies in the United Kingdom implementing Six Sigma, but the focus was primarily on the selection criteria. As a secondary research focus, Banuelas et al. (2006) also surveyed PSM usage and their findings laid the foundation for the more focused PSM usage surveys done by Kirkham et al. (2014) and Kornfeld and Kara (2013), who confirmed that industry mostly does not use the mathematical PSMs.

Apart from the three studies already cited, no further empirical studies were found that investigated how industry approaches project selection. A Google Scholar search using the search term 'industry survey on project selection' revealed that of the first 55 search results, only 5 articles described an empirical study of PSM usage in practice, with only one focusing on operations improvement project selection – the study by Kornfeld and Kara (2013). A further Google Scholar search using the search term 'industry survey of project prioritization' reached the irrelevance plateau after 25 articles but delivered only the two studies by Kirkham et al. (2014) and Banuelas et al. (2006) already described above. An in-depth reading of a total number of 47 project selection related articles did not reveal any further mentions of empirical studies done in industry on PSM usage. Considering the prevalence of PSM development taking place in academia and the lack of research on whether the developed PSMs are being used, reveals an imbalance between what Hevner (2007) refers to as the rigor (academic or theoretical) cycle and the relevance (target domain or industry) cycle of design science research.

Although the empirical studies on PSM usage described so far (Banuelas et al. 2006, Kirkham et al. 2014, Kornfeld and Kara 2013) covered a large number of manufacturing companies in Europe, the United Kingdom, and the Asia-Pacific region, they were all focused on companies deploying Six Sigma or Lean. This means that PSM usage in industry in its more general improvement context seems not to have been covered, which is the research gap explored by this paper.

Furthermore, the existing literature tends to describe the improvement process of project identification and selection as a clean, staged process, or it assumes that a list of alternative projects exists from which to select the best one. This is indeed one of the strengths of Six Sigma, which is a project-based improvement approach with a well-defined project execution methodology (Montgomery and Woodall 2008). Improvement approaches based on the Toyota Production System, such as Lean, however, tend to follow a more decentralized approach to identifying and selecting improvement projects and focus on workforce mobilization in the improvement effort instead of selecting a few high impact projects (Womack and Jones 1997). Companies without a structured improvement approach, however, tend to be mostly reactive in their project selection by launching projects as and when management becomes aware of a repetitive or serious problem.

Indeed, the studies of Kirkham et al. (2014) and Kornfeld and Kara (2013) both found that Six Sigma companies tend to do more objective project selection than other companies surveyed but stop short of explaining how the inherently different improvement approaches correlate to the finding. Their studies, however, also revealed that the majority of companies, regardless of light the improvement approach employed, are not satisfied with their current project selection approaches.

To further explore the findings of the empirical studies mentioned here, explorative interviews were conducted with ten experienced operations improvement practitioners to explore how projects are selected in practice. Seven of the participants were engineers, of which six were Industrial Engineers who are familiar with operations research decision making models. The remaining three participants included a Chartered Accountant, a statistician, and a production manager. The interviews lasted between 60 and 90 minutes each and explored the more than 250 years of collective experience of the participants. The interviews confirmed that the sophisticated operations research project selection models are not being used in practice and that businesses opt for semi-objective approaches to decision making. Although the heuristics of approaches such as linear programming could be identified as examples of project selection were related, there was not one instance where the mathematical models were applied in full. Instead, participants highlighted the vulnerability of sophisticated models to data manipulation, dirty data, and practical issues such as not all variables being able to be quantified. These explorative interviews thus confirmed that there might be a gap between what academics do and what practitioners do when it comes to project selection. The combination of the preliminary literature review as well as these interviews prompted the further investigation into the matter that this scoping review aims to contribute to: finding out what has indeed been happening in the world of project selection research and what contributions are available to address the problem highlighted by Kirkham et al. (2014) in that companies are not yet satisfied and how projects are being selected.

"Competition between segments of the scientific community is the only historical process that ever actually results in the rejection of one previously accepted theory or in the adoption of another" (Kuhn 2004). Although the same fundamental research question being answered by different disciplines does not strictly constitute competition, the phenomenon of researchers working independently on the same problem with the same goal, shares the basic characteristics of competition and thus simulates the process promoted with such conviction by Thomas Kuhn in his seminal work 'Logic of Discovery or Psychology of Research' first published in 1970 (Kuhn 2004). The problem of selecting meaningful, manageable, and sustainable projects is addressed in a variety of contexts such as infrastructure development, construction planning, Six Sigma implementations, environmental strategic planning, information systems deployment etc. Although these contexts are not normally associated in practice, they share the complex and multi-criteria decision-making task of prioritizing and selecting projects that will move the proverbial needle, within the constraints of finite resources.

When different disciplines approach the same problem, different perspectives, and frames of reference can provide approaches previously not considered by the domain of origin (Shanableh et al. 2022). The field of project prioritization and selection has the advantage of a well-developed body of research that provides access to the application of the same techniques in different contexts. Being exposed to how different fields have customized and combined existing decision-making tools, or developed novel methods, facilitates a more creative analysis of the approach to be followed within the target domain.

The scoping review described in this paper aims to enhance awareness of similar work being done in the same, as well as in different, contexts, and to provide an accessible reference guide to researchers and practitioners. Three main perspectives were thematically analyzed: the context in which the research was conducted, the main focus of the research, and the project selection methods (PSMs) used in the research.

It is believed that this review paper provides a novel perspective on the project selection body of knowledge as none of the 120 articles screened during the five-step scoping review process described a scoping review and the review articles within the sample had a smaller, more focused scope. This review not only summarizes work done but also interprets the information from a both a process (methods used) and systems (target domain) perspective. In addition, the review synthesizes the research done into nine research foci through thematic analysis.

The rest of this paper details the design of the scoping review, and the analysis of the publications in the results and discussion chapter. The conclusion summarizes the answers to the research questions and lists further research opportunities.

2. Research Methodology

A scoping review was selected as research method for its ability to "map rapidly the key concepts underpinning a research area and the main sources and types of evidence available" (Mays et al. 2001). The five-stage scoping review process as proposed by Arksey and O'Malley (2005) was used to ensure a systematic and robust review process, namely identify the research question, identify relevant studies, study the selected studies, chart the data and collating, summarizing, and reporting of the results. The sequential application of these steps is described in this section.

2.1 Step 1: Identify the Research Question

The overarching research question addressed in this paper is: what research contributions have been made in the field of project selection research? As mentioned in the introduction, this question was investigated from three main perspectives:

- WHERE – In which domains has project selection research been conducted?
- WHY – What was the focus of the research?
- HOW – What PSMs were used in the research?

When the research in the sample of articles was conducted, is shown in Figure 1, and by whom the research was conducted is shown in the citations in Tables 2 to 9 in the reference guide in section 3.3.

2.2 Step 2: Identify Relevant Studies

A preliminary literature review indicated that the terms "project selection" and "project prioritization" were often used interchangeably and both search terms were thus targeted for mapping. Additionally, "selecting projects" and "prioritizing projects" were also used as search terms to cast as wide a net as possible to identify publications in the field. Although other search terms such as "decision making" and "decision science" could also be considered, it was decided to focus the search on project selection and prioritization specifically as the more focused terms produced a large search result by themselves and therefore could provide both a focused and large data set to be analyzed.

Google Scholar was used as a search engine for its ability to search a variety of databases, as well as its built-in algorithm that can filter results for relevance, which is in turn ranked by the academic community through citations (Rovira et al. 2019). Figure 1 shows the dates of publication and shows an upwards trend in publication frequency, but due to the fact that the Google Scholar algorithm is not available for analysis, it is unclear whether the algorithm is biased to include more recent studies and as such the upward trend cannot be included as a finding.

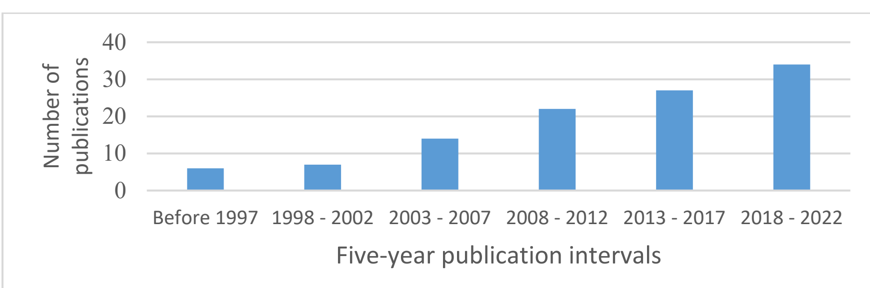

Figure 1. Publication date and frequency

Ranked by relevance, the first 120 articles were listed for review, of which 11 were excluded due to them not being readable or accessible (3), not relevant to the project selection theme (7), or of low academic quality (1). This initial screening for exclusion/inclusion process resulted in 109 articles being readable, accessible, of good quality, and deemed relevant to the answering of the research questions.

2.3 Step 3: Study the Relevant Articles

Microsoft Excel was used to capture both basic publication data as well as interpretive data during the scoping review. To extract the data required by the research questions, the articles had to be skimmed for research aim, scanned for applied PSMs and research context, and read where the scanning and skimming did not provide straight-forward data.

2.4 Step 4: Chart the Data

After the basic publication data table had been constructed, thematic analysis, as described by Braun and Clarke (2012) was used to extract common themes in the data and then to iteratively refine and update these themes as the analysis progressed. Descriptive statistics were used to further summarize, analyze, and visualize the findings of the scoping review. The results are discussed in section 3.

2.5 Step 5: Collating, Summarizing and Reporting of the Results

A cross-pollination matrix was conceptualized to synthesize the charting of the data. This matrix is a tool that makes it easy to find out which studies have been done and which areas and where the research gaps lie. The conclusion section of this article summarizes the main findings, research gaps, and future research opportunities.

3. Results and Discussion

The scoping review mapped the existing project selection research to get an understanding of what research has been conducted (approach), where (domain), and how it was conducted (PSMs). The findings of these questions are discussed in section 3.1. Section 3.2 contains a research cross-pollination matrix that can assist researchers and practitioners to identify what PSMs have been, or not yet been, used in their target domain, or, inversely, in which domains their PSM of choice has been applied. Finally, in section 3.3 a reference guide is made available to researchers and practitioners to locate relevant research within their domains, as well as in other domains.

3.1 Mapping the Current Body of Knowledge on Project Selection

Figure 2 shows the nine themes, or research aims, that were extracted from the 109 articles during the scoping review as well as their ranking based on the frequency with which the themes were identified in the sample. It should be noted that some articles addressed two themes, and thus the total themes noted in the 109 articles amount to 120. The percentages referred to in the discussion of Figure 2 thus refer to a total of 120 identified themes.

The nine identified themes could be grouped into three subsets of themes: application of existing methods, theoretical work, and independent themes. The first three themes shown in Figure 2 form part of the subset involving the application of existing methods and include application in a specific case or domain (30.0%), sequential application of various methods (20.0%), and application in cases where fuzzy data sets are present (13.3%). These applications frequently, but not always, required some customization to be able to process the data of the target domain. This application group makes up 63.3% of the 120 themes addressed in the sample of 109 articles. This means that almost two-thirds of project selection project selection effort seems to be spent on demonstrating the relevance and utility of existing techniques.

The second group of themes involved making a theoretical contribution to enable better decision-making and consisted of the evaluation of existing methods (10.0%), the study of selection criteria (9.2%), and the distillation of best practice principles (5.0%). This group of themes makes up almost a quarter (24.2%) of research time spent on project selection.

The remaining themes are not related and make up the independent themes group. These themes include the development of a novel method (7.5%), the development or evaluation of (computerized) decision support systems (3.3%), and surveys conducted of the industry regarding various aspects of project selection (1.7%).

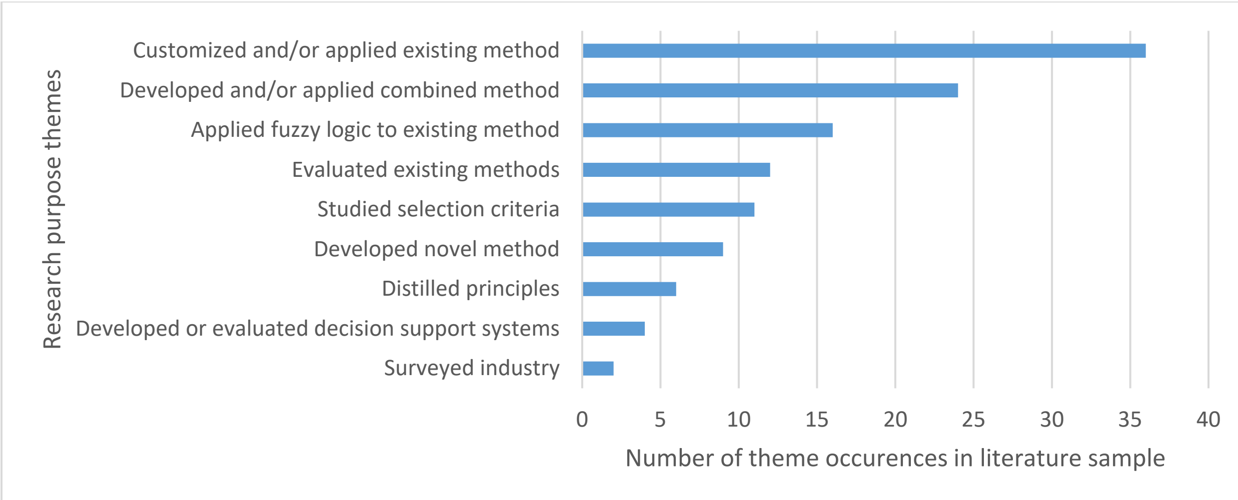

Figure 2. Frequency of the research purpose themes

The analysis thus indicates that there is both a wealth of case studies and customizations available to researchers, and practitioners, as well as critical assessments and distillation of fundamental principles available within the published literature. It is however concerning to note that research efforts do not seem to be in line with what is needed in practice as the research efforts are dominated by ’doing more of the same, with a twist', Meaning that the very PSM that are not being used in practice Focus of research efforts with researchers proving that these methods are in fact useful in the various domains. It would be interesting to explore the research outputs stemmed from master’s studies where it is common for an existing method to be applied in a new domain, or where a customization of an existing technique could qualify as a novel contribution to the field. Whether the articles originate from master’s studies or simply researchers operating in their comfort zone, the charting of the literature seemed to confirm that there is a gap between what researchers are doing and what the practitioners are doing. If academia keeps on refining models that are not being used in practice, project selection research has little chance of being relevant in solving the problem of selecting meaningful, manageable, and sustainable projects, a key driver in growth and development,

As all good problem solving starts with a thorough understanding of the target process in the target domain, The realities challenges constraints, and preferences, it is imperative that more empirical research is added to the body of knowledge on project selection. Without understanding how and why projects are selected in the manner that they are currently selected in practice; researchers will be ill equipped to deliver contributions that will be relevant to the domains they aim to influence and strengthen. As little is known about the praxis of project selection, there is a research opportunity for explorative, qualitative research to be done in the field to provide a thorough description of project selection praxis.

Figure 3 shows the domains in which the research efforts were focused, with 82.6% of the research being conducted within specific domains, and only 17.4% of the research focused on generic application. Apart from the generic domain, another 13 domains were identified, with infrastructure and construction planning leading the research production with just over a fifth (21.1%) of the publication sample. The second most prolific field was that of research and development (R&D) portfolio management accounting for 14.7% of the publications.

Just over a tenth (11.0%) of research focused on Six Sigma project selection, and another 7.3% and 3.7% on the closely related fields of general operations improvement and continuous improvement, respectively. This group thus makes up almost a quarter (22.0%) of the research. Information system planning (9.2%), and environmental project planning (6.4%) were two other well represented categories, with healthcare, higher education, petrochemical, the public sector, marketing, and supply chain receiving less than 10% of the research focus.

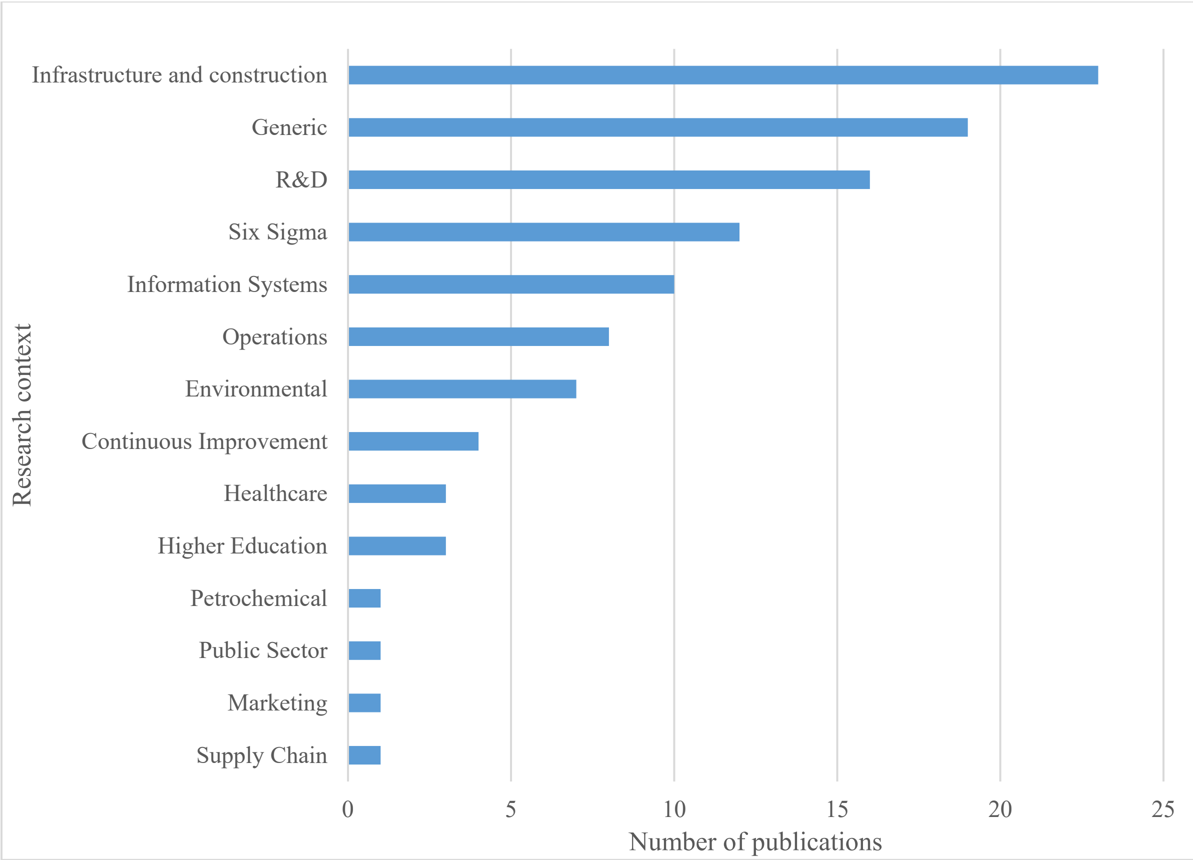

Figure 3. Research context of the 109 analyzed articles

There is thus a clear proliferation of project selection research across various domains, and it is encouraging to see the diversity amongst the domains from which both researchers and practitioners can learn. Emergent domains such as the public sector and marketing can benefit greatly from the case studies that exist within the more established domains. It is also encouraging to see the number of domains strongly aligned with the Sustainable Development Goals of the United Nations such as infrastructure development environmental initiatives, healthcare, and higher education. In these domains where development opportunities often exceed the available resources, objective and systematic project selection methods can make a significant contribution. However, researchers will once again have to ensure that they thoroughly understand the realities of the target domain for which they aim to make a research contribution, once again highlighting the need for more descriptive, empirical research to be done to enable the alignment of research and practice.

Figure 4 shows the 32 different PSMs identified within the research. It must be noted that a total of 143 PSMs were applied in the 109 articles analyzed as some studies used a combination of methods. The percentages described are thus based on a total number of 143 occurrences of the PSM within the sample.

At 21.7%, Analytical Hierarchy Process or AHP is the most popular PSM being used. Tracing the Pareto analysis line along the 50% mark reveals that, along with AHP, generic multi-criteria/attribute decision-making (MCDM / MADM) (9.1%), Cost-Benefit Analysis (CBA) (7.7%), Analytical Network Programming (ANP) (7.7%), and Data Envelopment Analysis (DEA) (6.3%) make up more than half of the preferred PSMs. The 80% Pareto mark lists the following methods as part of the critical few being used by academia: risk analysis (4.9%), net present value (NPV) (3.5%), DEMATEL (3.5%), Linear programming (3.5%), ranking models (3.5%), TOPSIS (3.5%), PROMETHEE (2.8%), Best-worst method (2.1%) and the Monte Carlo method (2.1%).

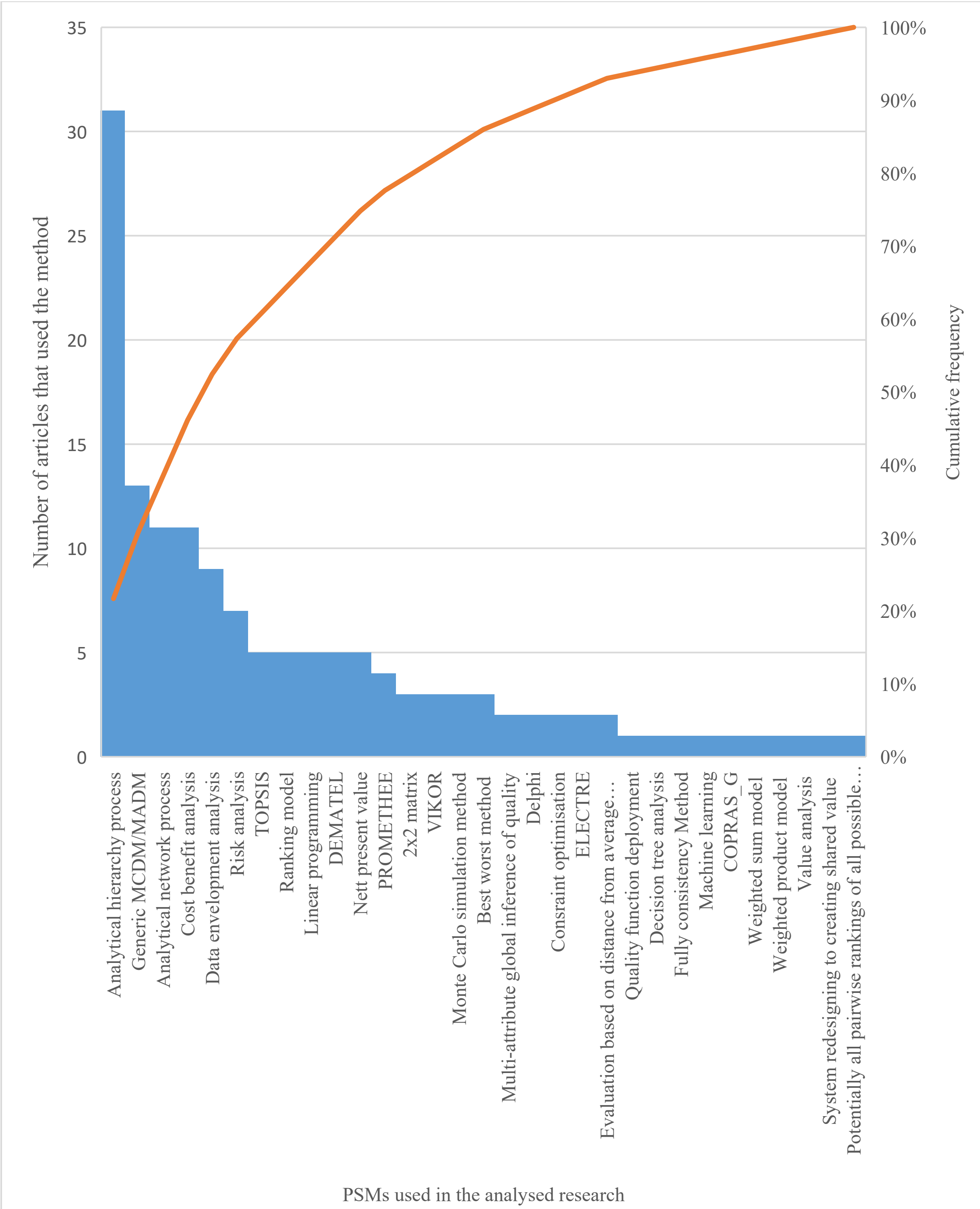

Figure 4. Pareto analysis of project selection method usage

This scoping review thus found that there is also a proliferation of many different project selection approaches in use within the research landscape making it it's diverse and interesting field. However, developing more tools or refining the existing tools when they are not used in practice may not be the best use of research resources. Although many of the articles prove the usefulness of the different PSM's in solving various project selection problems, some research focus should be directed towards ensuring that these PSM's are simplified to become more accessible to guide businesses through the process of objective project selection. It should also be investigated how problems such as certain decision-making criteria not being quantifiable, for example safety risks, or employee well-being, can be overcome to make the use of objective decision-making models more feasible in practice.

3.2 Research Cross-Pollination Matrix

The analysis visualized by Figures 3 and 4 shows a general overview of the state of project selection research, but for researchers and practitioners to be able to find synergistic or lacking research, a cross-pollination research matrix was conceptualized (Table 1). This matrix shows which PSMs have been applied or studied in the various domains, and where there are still novel contributions to be made to either the expansion of the application of a specific PSM, or the strengthening of a domain.

Table 1. Research cross-pollination matrix

		Infrastructure and Construction	Generic (No specific context)	Six Sigma	Environmental	Information Systems	Operations	Research and Development	Higher Education	Healthcare	Petrochemical	Public Sector	Marketing	Continuous Improvement	Supply Chain
	TOTAL	**45**	**21**	**17**	**13**	**13**	**13**	**12**	**6**	**2**	**2**	**2**	**1**	**0**	**0**
AHP	**32**	**7**	**7**	**2**	**1**	**3**	**1**	**7**	**1**	**1**	**1**	**1**			
MCDM / MADM	**13**	**7**		**3**	**1**	**1**	**1**								
ANP	**11**	**3**		**1**	**1**	**2**	**1**	**1**	**1**				**1**		
CBA	**12**	**8**	**2**		**2**										
DEA	**10**	**2**	**2**	**2**		**2**	**2**								
Risk analysis	**7**	**4**			**3**										
Ranking model	**6**	**2**	**2**		**2**										
Linear programming	**6**	**2**	**2**	**2**											
TOPSIS	**5**		**1**				**1**	**1**	**1**		**1**				
DEMATEL	**5**		**1**	**1**		**1**	**1**	**1**							
NPV	**5**	**1**	**1**		**1**		**1**					**1**			
PROMETHEE	**4**	**3**							**1**						
2x2 matrix	**3**			**2**		**1**									
VIKOR	**3**			**1**				**1**	**1**						
Monte Carlo simulation method	**3**	**1**	**1**		**1**										
Best worst method	**3**		**1**	**1**			**1**								
Constraint optimisation	**2**	**1**		**1**											
ELECTRE	**2**							**1**	**1**						
Delphi	**2**		**1**			**1**									
Evaluation based on distance from average solution	**2**	**1**			**1**										
Decision tree analysis	**1**						**1**								
Quality function deployment	**0**														
Fully consistency Method	**1**									**1**					
Machine learning	**1**						**1**								

Goal programming	**1**					**1**									
Multi-attribute global inference of quality	**1**	**1**													
Potentially all pairwise rankings of all possible alternatives	**1**					**1**									
System redesigning to creating shared value	**1**	**1**													
Value analysis	**1**			**1**											
Weighted product model	**1**						**1**								
Weighted sum model	**1**						**1**								
COPRAS_G	**1**	**1**													

Researchers and practitioners can use this matrix to extract a number of different perspectives such as:

- Which PSMs are well-established in a target domain.
- Which PSMs remain relatively unexplored in a target domain.
- Which PSMs have been applied in other domains which may share similar characteristics and interest with the target domain, such as infrastructure and the public sector, or Six Sigma and operations.
- Which PSMs are restricted to limited domains, such as risk analysis.

If a specific area of the matrix interests the researcher or practitioner, the reference guide in section 3.3 will direct them to the relevant studies.

3.3 Reference Guide for Researchers and Practitioners

Tables 2 to 10 cover the research analyzed in each of the ten domains. Publications within each domain have been grouped by the research focus or purpose, and where possible also by the PSM employed in the study.

Table 2. Project selection research conducted in the continuous improvement domain

Research purpose	Methods employed	Reference
Developed and/or applied combined method	2x2 matrix	(Setijono and Dahlgaard, 2007)
Developed novel method or method		(Salah, 2015)
Distilled principles		(Gels, 2005)
Surveyed industry		(Bumblauskas and Meyer, 2015)

Table 3. Project selection research done in the operations domain

Research purpose	Methods employed	Reference
Applied fuzzy logic to existing method	Analytical Hierarchy Process	(Marek-Kolodziej and Lapunka, 2020)
	Analytical Network Process	
	Data envelopment analysis	
	Nett Present value	
	Weighted product model	(Rudnik et al., 2021)
	Weighted sum model	
Customised and/or applied existing method	Best worst method	(Herps et al., 2003)
	DEMATEL	(Quezada et al., 2022)
	Data envelopment analysis	(Rezaee et al., 2021)

Developed and/or applied combined method	Machine learning	
Evaluated existing methods	Generic Multi-Criteria / Attribute Decision Making	(Mittal et al., 2017)
	TOPSIS	
Studied selection criteria		(Sharma and Chetiya, 2010)
Surveyed industry		(Kirkham et al., 2014)

Table 4. Project selection research done in the Six Sigma domain

Research purpose	Methods employed	Reference
Applied fuzzy logic to existing method	Generic Multi-Criteria / Attribute Decision Making	(Rathi et al., 2017)
Customised and/or applied existing method	2x2 matrix	(Chakravorty, 2012)
	Best worst method	(Shukla et al., 2021)
	Constrained Optimisation Method	(Köksal*, 2004)
	Linear Programming	
	Value analysis (VA)	
	Data envelopment analysis	(Bazrkar and Iranzadeh, 2017)
	Generic Multi-Criteria / Attribute Decision Making	(Pakdil et al., 2020)
Developed and/or applied combined method	Analytical Hierarchy Process	(Kumar et al., 2009)
	Analytical Network Process	(Wang et al., 2014)
	DEMATEL	
	VIKOR	
Distilled principles		(Snee and Rodenbaugh Jr, 2002)
		(Bertels and Patterson, 2003)
Evaluated existing methods		(Yousefi and Hadi-Vencheh, 2016)
Studied selection criteria	Analytical Hierarchy Process	(Adebanjo et al., 2016)

Table 5. Project selection research done in the generic domain

Research purpose	Methods employed	Reference
Applied fuzzy logic to existing method	Analytical Hierarchy Process	(Alyamani and Long, 2020)
		(Chatterjee et al., 2018)
	Nett Present value	(Dutra et al., 2014)
	Analytical Hierarchy Process	(Vargas and IPMA-B, 2010)
		(Basheer et al., 2018)
		(Palcic and Lalic, 2009)
	Best worst method	(Purnus and Bodea, 2014)
	Monte Carlo Simulation Method	

Customised and/or applied existing method	Data envelopment analysis	(Cook and Green, 2000)
	Linear Programming	
Developed and/or applied combined method		(Ghapanchi et al., 2012)
	DEMATEL	(Sorourkhah and Edalatpanah, 2022)
	Analytical Hierarchy Process	
	Cost Benefit Analysis	(Pererva et al., 2019)
	Delphi	
	TOPSIS	
Developed novel method or method		(Zheng and Vaishnavi, 2011)
		(Villafáñez et al., 2020)
Distilled principles		(Dean and Nishry, 1965)
		(Gaynor, 1990)
Evaluated existing methods		(Baker and Freeland, 1975)
		(Turkmen and Topcu, 2021)
	Ranking model	(Scheiblich et al., 2016)

Table 6. Project selection research done in the infrastructure and construction domain

Research purpose	Methods employed	Reference
Applied fuzzy logic to existing method	Analytical Hierarchy Process	(Phong and Quyen, 2017)
	Generic Multi-Criteria / Attribute Decision Making	
Customised and/or applied existing method	Linear Programming	(Rodriguez-Roman, 2018)
	Cost Benefit Analysis	(Rezvani et al., 2015)
	PROMETHEE	(Singh and Nachtnebel, 2016)
	Multi-Attribute Global Inference of Quality (MAGIQ)	(Joshi and Lambert, 2007)
	Analytical Network Process	(Shang et al., 2004)
		(Cheng and Li, 2005)
		(Henriksen and Christian Røstad, 2010)
	Analytical Hierarchy Process	
	Cost Benefit Analysis	
		(Novak et al., 2015)
	System Redesigning to Creating Shared Value (SYRCS)	
	Risk Analysis	
	Generic Multi-Criteria / Attribute Decision Making	
		(Frohwein et al., 1999)

	Analytical Hierarchy Process	(Yu and Liu, 2012)
		(Outwater et al., 2012)
	Constrained Optimisation Method	(Montesinos-Valera et al., 2017)
Developed and/or applied combined method	Constrained Optimization Method	(Keshavarz-Ghorabaee et al., 2020)
	Analytical Hierarchy Process	(Kelle et al., 2013)
	Cost Benefit Analysis	
	Data envelopment analysis	
	Generic Multi-Criteria / Attribute Decision Making	
	Linear Programming	
	PROMETHEE	
	Ranking model	
	Cost Benefit Analysis	(Schutte and Brits, 2012)
	Generic Multi-Criteria / Attribute Decision Making	
	Cost Benefit Analysis	(Nagel and Elenbaas, 2006)
	Nett Present value	
	Monte Carlo Simulation Method	
	Analytical Hierarchy Process	
	Ranking model	
	Risk Analysis	
	Analytical Hierarchy Process	(Aghdaie et al., 2012)
Developed novel method		(García-Fuentes et al., 2019)
Evaluated existing methods	Risk Analysis	(Lima et al., 2014)
	Cost Benefit Analysis	
	Generic Multi-Criteria / Attribute Decision Making	
	PROMETHEE	
Studied selection criteria	Cost Benefit Analysis	(Krapp et al., 2021)
	Generic Multi-Criteria / Attribute Decision Making	
		(Hansen et al., 2019)
		(Murray et al., 2009)
	Risk Analysis	(Krapp et al., 2021)

Table 7. Project selection research done in the research and development domain

Research purpose	Methods employed	Reference
Applied fuzzy logic to existing method	ELECTRE	(Daneshvar Rouyendegh and Erol, 2012)
	Analytical Network Process	(Cheng et al., 2017)
	Analytical Hierarchy Process	(Huang et al., 2008)
		(Brenner, 1994)

Customised and/or applied existing method		(Liang, 2003)
		(Hall and Nauda, 1990)
Developed and/or applied combined method		(Chien, 2002)
		(Kavta and Goswami, 2021)
	DEMATEL	
	TOPSIS	
	VIKOR	
Developed novel method or method		(Lee et al., 2017)
		(Lee et al., 2020)
		(Loch et al., 2001)
Evaluated existing methods		(Souder, 1973)
		(Verbano and Nosella, 2010)
		(Tuffaha et al., 2018)
		(de Souza et al., 2021)
Studied selection criteria		(Chien, 2002)
		(Yoon et al., 2020)

Table 8. Project selection research done in the information system domain

Research purpose	Methods employed	Reference
Applied fuzzy logic to existing method	Analytical Network Process	(Kim et al., 2021)
	Data envelopment analysis	
	Goal Programming	(Deng and Wibowo, 2004)
	Delphi	
	Analytical Hierarchy Process	
		(Zou et al., 2019)
Customised and/or applied existing method	Data envelopment analysis	(Sowlati et al., 2005)
	Generic Multi-Criteria / Attribute Decision Making	(Dutta and Burgess, 2003)
	Analytical Network Process	(Afshani et al., 2022)
	DEMATEL	
	Potentially All Pairwise Rankings of all possible Alternatives (PAPRIKA)	(Kanwar et al., 2023)
Developed or evaluated decision support systems	Decision Support System	(Deng and Wibowo, 2008)
Distilled principles	2x2 matrix	(Alonso et al., 2010)
Studied selection criteria	Analytical Hierarchy Process	(Ahmad, 2016)

Table 9. Project selection research done in the environmental domain

Research purpose	Methods employed	Reference
Customised and/or applied existing method	Analytical Network Process	(Cullen and White, 2013)
	Nett Present value	(Wang et al., 2021)
	Ranking model	(Brazill-Boast et al., 2018)
		(Beher et al., 2016)
Developed and/or applied combined method	Analytical Hierarchy Process	(Serrano-Gomez and Munoz-Hernandez, 2019)
	Monte Carlo Simulation Method	
	Risk Analysis	
	Generic Multi-Criteria / Attribute Decision Making	(Pannell et al., 2013)
	Cost Benefit Analysis	
	Risk Analysis	(Joseph et al., 2009)
	Evaluation Based on Distance from Average Solution (EDAS)	

Table 10. Project selection research done in remaining domains

Domain	Research purpose	Methods employed	Reference
Supply Chain	Evaluated existing methods	Review	(Keshavarz Ghorabaee et al., 2017)
Petrochemical	Applied fuzzy logic to existing method	Analytical Hierarchy Process	(Amiri, 2010)
		TOPSIS	
Public Sector	Developed and/or applied combined method	Analytical Hierarchy Process	(Hoyos et al., 2021)
		Nett Present value	
Marketing	Customised and/or applied existing method	Analytical Network Process	(Polat and Donmez, 2010)
Healthcare	Applied fuzzy logic to existing method	Analytical Hierarchy Process	(Shaygan and Testik, 2019)
	Developed and/or applied combined method		(Testik et al., 2017)
	Developed and/or applied combined method	Fully consistency Method	(Saha et al., 2022)
Higher Education	Customised and/or applied existing method	Analytical Hierarchy Process	(Maccari et al., 2015)
		Analytical Network Process	(Begičević et al., 2010)
	Developed and/or applied combined method	ELECTRE	(Mohammadnazari et al., 2022)
		PROMETHEE	
		TOPSIS	
		VIKOR	

4. Conclusion

The purpose of this research was to encourage inter-disciplinary learning in the field of project prioritization and selection. This was done by mapping a sample of the 109 most relevant publications around three high-level perspectives, namely in which domains the research was conducted (Figure 3), what the approach or purpose of the research was (Figure 2), and what PSMs have been studied or applied (Figure 4).

The infrastructure and construction domain has contributed the most publications, with R&D and Six Sigma in second and third place, but with six other practical domains represented in literature. The analysis also showed that the customization, combination, and application of existing PSMs makes up nearly two-thirds (63.3%) of the published research, creating a rich source of case studies and applications for researchers and practitioners to draw inspiration from. AHP, ANP and MCDM/MADM are the most popular PSMs and are well-represented in the literature for further research and expansion. The conclusion of the literature mapping is that there is a well-developed and diverse body of knowledge, meaning that the field of project selection is ripe for inter-disciplinary learning.

To enable inter-disciplinary learning, a research cross-pollination matrix (Table 1) has been created with which researchers and practitioners can identify synergies and gaps within the field. Once a gap or synergy has been identified, practitioners and researchers can then use Tables 2 to 10, which have been grouped sequentially in domains, research purpose and, where possible, PSMs for ease of use and to identify further or more targeted synergies and gaps.

Although the field of project selection is clearly well developed both in available techniques and domains of application, the fact remains that, at least an operations management, these objective approaches being used in practice, even though practitioners have expressed the need for more user friendly and effective decision making tools, this scoping review thus also confirms that there is a gap between what academia does and what practice does when it comes to project selection. For research to be aligned to its target domain it needs to start by understanding the realities of that target domain. The field of project selection can therefore benefit from quantitative, exploratory, descriptive, and empirical research. Grounded theory research could provide a framework with which to conduct open-minded, open-ended research that aims to understand and document the challenges that need to be overcome to strengthen the praxis of the selection of meaningful, manageable, and sustainable projects, towards growth and development.

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Biographies

Ilse Doyer is a lecturer and PhD student in the Department of Industrial and Systems Engineering at the University of Pretoria. She has more than 20 years of industry experience focusing on operations excellence in the manufacturing, mining, agricultural and services sectors – in South Africa and Europe. Her research focus is on the cross-section between operations excellence and organizational behavior.

Professor Michael K. Ayomoh is an Associate Professor with the Department of Industrial and Systems Engineering at the University of Pretoria. His research interests spread across: Management Systems covering: Systems Engineering Design, Systems Complexity Analysis and Evaluation, Multi-objective Decision Support Systems, Optimization and Reliability of Systems; Artificial Intelligent Systems including- Robotics research, Machine Learning, Artificial Neural Networks, Manufacturing Systems Automation, Haptics and Smart Control Systems amongst others.