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Systematic Literature Review as a Methodology for Identifying Risks

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Abstract
The main purpose of this paper is to introduce the framework of Systematic Literature Review (SLR) as a methodology for research on risk identification. Risk identification is a long and tedious process that often lacks a systematic approach. Therefore, there is a need for a methodical technique to minimize bias and streamline the process of data collection and refinement in risk analysis research. Systematic Literature Review has been used vastly in fields such as software engineering and medicine but has yet to spread to construction management. This paper proposes a framework for application of Systematic Literature Review in the risk identification process of construction research and practice. In order to showcase the proposed methodology, a case study is presented where Systematic Literature Review is applied to identify risks in PPP projects in order to showcase this methodology.

Keywords
Systematic Literature Review, Risk Identification, PPP projects

1. Introduction

Risk identification is seen as an effort to gather a wide range of factors that can impact a project. However, majority of the existing efforts lack a systematic and structured approach to risk identification. The existing systematic approaches are also solely based on the frameworks to gather expert opinion data, which is a time and resource consuming process. For example, there are several studies to improve the current status of PPP projects through identifying risks that may occur and to develop mitigation plans for them. Previous researches have looked at risks in certain case studies or countries but have not attempted to create an all-encompassing list that would apply to a wide variety of projects/locations. Systematic literature review (SLR) aims to propose a structured approach to answer a question in a study from the secondary data sources, i.e., where all related data is already looked into. The methodology consists of three main steps: plan, perform and report (Brereton et al. 2007). Systematic literature review has been widely used in contexts such as software engineering (Barcelos and Travassos 2006, Brereton et

al. 2007, Beecham et al. 2008, Jørgensen and Shepperd 2007, Kitchenham et al. 2009, Turner et al. 2010) and recently in infrastructure (Roehrich, Lewis and George 2014). As a study to showcase the application of the SLR in risk identification, in this paper we attempt to follow a systematic approach that would lead to the creation of a risk registry for all PPP projects. Although the focus of this paper is the risk registry only, future papers will include applications on the use of this risk registry to assess, simulate and mitigate these risks.

2. Systematic Literature Review (SLR)

Systematic Literature Review has been promoted in fields such as systems engineering and medicine. It is beneficial for use in certain situations such as: i) summarizing data on a topic, ii) discovering and collecting advantages and disadvantages of a topic, iii) discovering research gaps, iv) proposing frameworks for research (Balaid et al. 2016, Kitchenham 2007). It is used for its high reliability as compared to other literature review methodologies that lack the established framework and consistency in data collection. As discussed, Systematic Literature Review involves three phases:

1. Plan: the first stage and involves the planning of the SLR process. The first step is identifying the objectives of the study and framing the research questions. In the planning phase, a protocol needs to be established which is followed throughout the rest of the systematic literature review stages. This protocol is a detailed description of the method to be followed, data to be collected, how the analysis will proceed and how validation will take place. Various literature sources that propose a process for SLR (Kitchenham (2004), Luederitz et al. 2016) were studied and a final process was established. Figure 1 shows the process taken to perform a SLR. This step is important because it initiates the study and is the basis for the remaining work. The next step is creating the protocol based on the research questions. This protocol identifies how the following items will be addressed:
    - How the questions will be answered
    - Sources for acquiring articles
    - How the search will proceed
    - How the articles will be chosen
    - How the analysis will be performed
    - How the reporting process will occur

    These steps will be followed throughout the SLR process therefore it is imperative to create a protocol that encompasses all areas of the research and is reviewed and updated constantly in case any changes occur.
2. Perform: the second stage and involves applying the protocol previously established in the planning stage. The "perform" stage consists of two steps. The first step is identifying sources for information, which include ASCE library, Science Direct and other search engines. Once these sources are identified, articles/books are acquired and narrowed down in the second step according to the predetermined criteria. Criteria are chosen for how to narrow down the list of articles and only include those that are relevant to the study. After reaching a final set of articles, the next stage starts.
3. Report: the third and final stage and involves analyzing and reporting of the findings. The findings can be presented in a tabular or other visual format for ease.

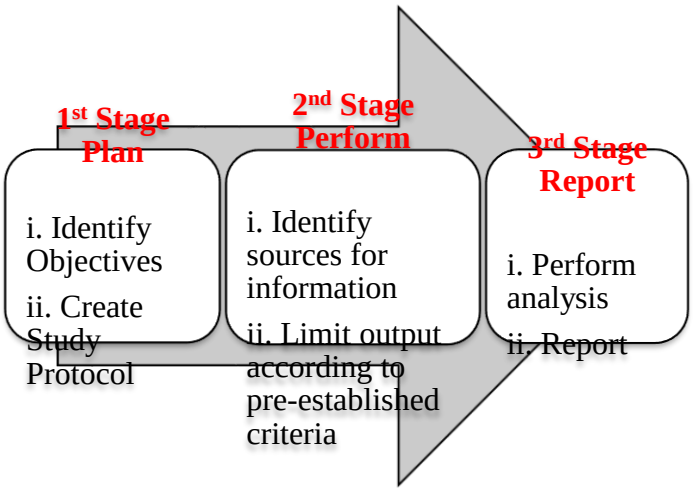

Figure 1 Stages of Systematic Literature Review

SLR has been used in various fields but yet to be used extensively in civil engineering, specifically in construction engineering and management. This paper highlights the usability and benefits from using the SLR approach in construction engineering and management by applying it to collect all risks pertaining to PPP projects.

3. Application

3.1 Introduction

This section describes the application of the SLR methodology to identify risks pertaining to public private partnership (PPP) projects. Public private partnerships refer to the contractual/delivery method where a public entity enters into contract with a private entity for the delivery of a project. This can include design, procure, build, finance, and maintain and operate. Although PPPs have spread all over the world, there are a number of risks that seem to plague them. These risks can emanate from the long duration that can last up to 99 years, the contractual relationship between the parties or external risks outside of the parties' control such as economic or country-specific risks. The list of risks will be presented in the following section.

3.2 SLR for Risk Identification in PPP Projects

This paper applies the systematic literature review (SLR) methodology, as proposed by Kitchenham (2004), Brereton et al. (2007), and Kitchenham et al. (2010), on the topic of risks in PPP projects in construction projects. SLR is a suitable methodology for studying any phenomena (in this case risks in PPP projects) within the literature of a discipline (in this case construction projects) based on primary research (in this case published articles, reports and case studies) (Kitchenham 2004, Brereton et al. 2007, and Kitchenham et al. 2010). In this research, SLR is used to provide an overview of current body of knowledge and to frame risk factors in case of PPP projects. As previously discussed, Systematic Literature Review consists of 3 stages: plan, perform, and report. Under each stage, there are a number of sub-stages. Each stage consists of two sub-stages under it as shown in Figure 2. The search for studies was conducted using a number of identified sources:

- ASCE Library
- Science Direct
- Google Scholar
- Purdue Online Library

- List of literature related to PPP collected by Gross (2010)

A tabulated list of literature on PPP by Gross (2010) consisting of about 450 articles was used as a starting point to establish the final set of primary articles for use in this research. This list is classified according to the following eight categories: (1) general concepts, (2) governance issues, (3) procurement, (4) contract design, (5) risk management, (6) financial elements, (7) public sector considerations and (8) national applications and case studies. This list was first updated through the addition of 105 articles. An online search for these articles was conducted using sources such as the ASCE library, Science direct, Google scholar and Purdue online library. The second step was limiting the selection from over 500 articles on PPPs to articles that only discuss risks in PPP projects. Within this selected set, all case studies were chosen as well. The next step of SLR involved creating criteria of the selection. Two criteria had to be met in order for the article to be selected with the following keywords chosen:

(i) One of the following 4 terms: "Private finance initiative, Public private partnerships (PPP), Private sector participation, 3P, P3" due to different terms used in different countries, and

(ii) One of the following 4 terms: "Risk management/assessment/ allocation/factors"

All the chosen articles met both criteria with the exception of 2 articles that only had PPP as a keyword but discussed risks in the body. The final set consisted of 44 articles that were used to identify suggested risk indicators. A pre-existing risk assessment module, the International Construction Risk Assessment Model (ICRAM-1) was used as the basis for risk classification. It consists of 73 risk indicators, which are categorized based on higher-level risk indicators under three main categories: macro, market and project. For example, societal conflicts (e.g., demonstrations, strikes, & street violence) and instability because of non-constitutional changes are under the symptoms of instability. This model targets international construction projects so it was necessary to modify it in order to establish a new model for PPP projects only. The higher-level categories were kept unchanged since they also apply to PPP projects. Finally, a table was created using higher-level risk indicators suggested by ICRAM-1, to classify risk indicators suggested by the literature under these higher-level criteria. It includes the exact wording of the referenced articles for risks and reference to their location in the reviewed article to facilitate the review, revision and validation process. This table is not shown here for its excessive length; however, the final result is displayed.

The result was over 400 risk factors, which were then integrated with existing risk factors from ICRAM-1 and refined to eliminate repetition. Cross analysis between existing and identified risks was also conducted and few risk indicators from ICRAM-1 that were not traced in the (PPP) literature were eliminated or integrated into the identified risk indicator. In order to validate the results, NVivo, a data analysis tool was also used in triangulating the results and refining the table. For example, coded literature into NVivo was used as a query for the most referred risks available in literature under each category (such as political risk). This query then was compared to extracted risks for potential elimination of risks from ICRAM-1 that were not related to PPP projects. The final outcome is a tabulated risk registry for risk indicators associated with PPP projects based on contrasting risks from ICRAM-1 as an established risk framework with the structured literature of PPP. Tables 1 through 3 show the final list of 82 risks extracted from literature that form ICRAM-PPP.

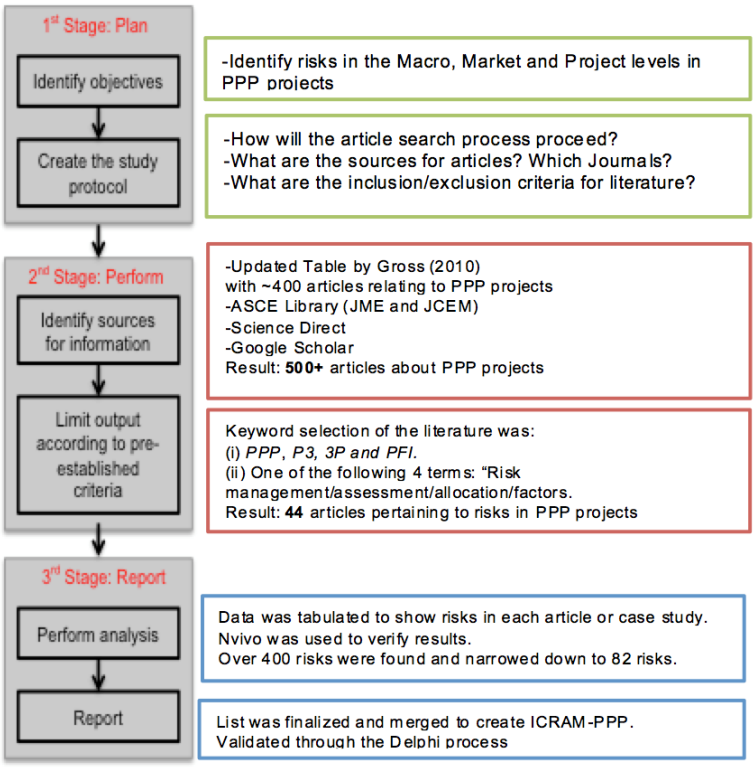

Figure 2 Stages of Systematic Literature Review for Risk Identification in PPP projects

Table 1 Macro Level Risks

Criteria	Sub-Criteria (Risk Indicators)
Operational Risk	1.orc=Political continuity/Stability of Government
	2.orc=Attitude toward foreign/private investors and profit
	3.orc=Nationalization/Expropriation/sequestration of assets
	4.orc=Enforceability of contracts
	5.orc=Government Incentives
	6.orc=Inadequate/Absence/Change of national PPP laws and standardized models for PPP projects
	7.orc=Changes in country/region legislation and regulation
	8.orc=Monetary inflation
	9.orc=Economic growth and volatility
	10.orc=Bureaucratic delays
	11.orc=Required services (IT infrastructure, Communication, Transportation, etc.)
Political Risk	1.prc=Regional turbulences (war, etc.)
	2.prc=Dependence on or importance of major power network
	3.prc=Fragmented political structure (e.g. local and federal governments)
	5.prc=Institutional behaviors including nationalism, corruption, and dishonesty
	6.prc=Social conditions (e.g., population, density & wealth distribution)
	7.prc=Satisfying short-term interest of the governing body
	8.prc=Societal conflicts
	9.prc=Government reliability/creditworthiness/cooperation
	10.prc=Instability because of nonconstitutional changes
Financial	1.frc=Actual laws versus practices for repatriation of capital

Risk	2.frc=Current account balance
	3.frc=Capital flow
	4.frc=foreign exchange reserves
	6.frc=Debt as GDP converted to US dollars
	7.frc=Capacity to service debt
	8.frc=Extent of deficit/surplus
	9.frc=Restrictions to refinancing schemes
	10.frc=Sources of revenue and major spending

Table 2 Market Level Risks

Criteria	Sub-Criteria (Risk Indicators)
Technology	1m=Investor's technological advantage
	2m=Availability of basic construction technologies and equipment
Contracts & Legal Req.	3m=Type of partnership
	4m=Type and enforceability of construction and concession contract
	5m=Procedure for bidding and design approvals (e.g., presence of many agencies, delay in granting approvals)
Resources	6m=Availability and quality of local…
	7m=Availability of construction material
	8m=Availability of skilled and unskilled labor
	9m=Labor cost/productivity
	10m=Availability of equipment and parts
Financing	11m=Availability of financing
	12m=Tax and non tax incentives
	13m=Fluctuation in interest rate/exchange rate
	14m=Financial/Insurance market maturity and stability
Business Cultural Differences	15m=Interaction of foreign management…
	16m=A/E/C firms and client-owner relationship
	17m=Risk management practices of parties involved
Market Potential	18m=Current market volume in core competency
	19m=Future market industry volume
	20m=Bidding volume index resulting in competition
	21m=Stability of associated industries

Table 3 Project Level Risks

Criteria	Sub-Criteria (Risk Indicators)
Technology	1p=Problem with technology transfer and implementation
	2p=Retention of technological advantage
Contracts and Legal Issues	3p=Possibility of contractual disputes
	4p=Problems in dispute settlements due to country's laws
	5p=Inadequate distribution of responsibilities/authorities/risk allocation
	6p=Problems in contract conditions
	7p=Capability and experience of Special Purpose Vehicle (SPV) including management, construction, operation, and financing capability
Resources	8p=Shortage of skilled and unskilled workers
	9p=Insolvency / default of subcontractor or operator or suppliers
	10p=Delay/unavailability/unreliability of material supply
Design	11p=Delay with design and regulatory approvals
	12p=Complex/Defective design, error, and rework
	13p=Change orders/variations
	14p=Difficulties to meet construction programs
	15p=Unforeseen adverse ground conditions

Quality	16p=Bad quality of materials
	17p=Bad quality of workmanship
	18p=Uncertainty regarding the quality required for maintenance
Financing	19p=Financial difficulties because of tax/capital movement restrictions
	20p=Financial difficulties because of currency exchange rate
	21p=Drop in project revenue
	22p=Non-payment/delayed payment by the public (Delay in annuity)
	23p=Tariff problems
Construction And Cultural Issues	24p=High costs of project operations
	25p=Third party delays
	26p=Safety/Security/Failure problems at project site
	27p=Managerial Issues
	28p=Organization/coordination/commitment risks between parties
Other	29p=Weather or other natural disaster
	30p=Physical damage to the project

4. Conclusion

This paper proposed the application of Systematic Literature Review for identifying and collecting risk factors in the construction industry. It was proven to be valuable as a methodical research tool to extract information on a topic. A traditional literature review approach can be random and chaotic causing important data to be overlooked. On the other hand, SLR is a methodical technique which requires the creation of a protocol that includes all the objectives, steps, and criteria leading to a reliable and easy approach. This paper showcased an application for the SLR methodology for identifying risks that occur in public private partnership projects. This methodology can be applied to identify other risk factors or can be expanded beyong risk identification. It can also be used to identify previous work performed in an area and suggest current gaps for future work. The proposed study showed the potential for use of Systematic Literature Review as an alternative to exisiting cost and resource intensive approaches of risk identification based on the opinion of experts. This current work is part of an overall system that identifies risks in PPP projects in order to study the interaction between the parties of the risk and propose best strategies for each party. ICRAM-PPP is used to assess risks in a project and uses AHP and pairwise comparison to reach risk assessment per risk and overall risk category. The results of SLR were further refined through a Delphi study. The risk registry as a result of the SLR and Delphi processes was used to conduct two case studies to explore interactional risk. However, due to space limitations, the results are presented in other publications. Researchers can apply the proposed methodology beyond risk identification and to other problems in construction engineering such as identification of key performance indices (KPIs) for projects, identification of best practices, or collection of previous trends. The owners and contractors can also use this approach to explore new markets, risk factors in a specific type of project, or factors for successful delivery of a project. More specifically, the practitioners can expand the focus of the proposed risk registry and apply it in a specific industry/country/project delivery type.

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