

# REVIEW ON THE APPLICATION OF MACHINE LEARNING TECHNIQUES IN CONSTRUCTION PROJECT RISK MANAGEMENT

## 1. Abstract

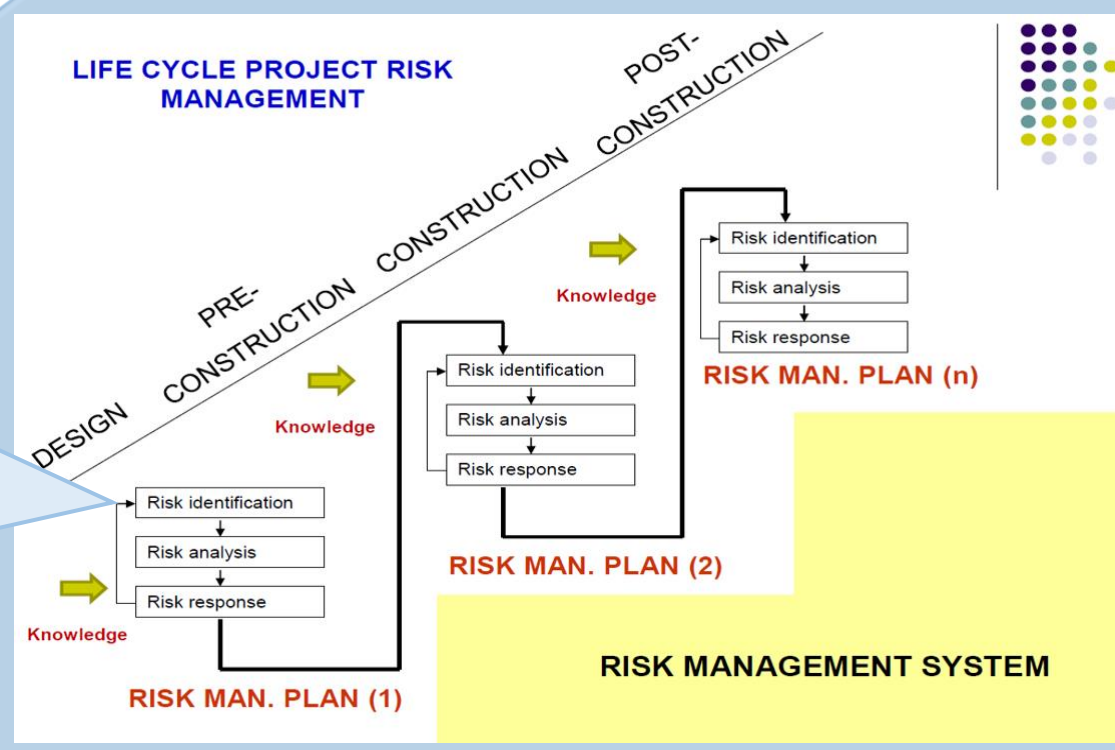
Managing risk effectively is one of the critical success factors in construction projects. Construction companies usually use systematic risk management systems throughout their projects. This involves the use of a large amount of text-based data in risk management. The usage of text-based information in decision-making can be tedious and time consuming for decision-makers. Thus, there is a need for computer-assisted analysis of text-based data to expedite the decision-making process in construction project risk management.

This review is part of a doctoral study, whose aim is to investigate the extent to which machine learning (ML) techniques can be used in construction project risk identification and assessment from documents. Within the context of this doctoral study, the state-of-the-art review of literature on ML and specifically, natural language processing (NLP) applications in construction project risk management were reviewed. This poster presents the findings of the literature review on current machine learning in construction project risk.

This research may contribute to the usage of machine learning in construction. It is believed that this research will help companies to determine the potential areas of utilisation of machine learning and to take advantage of artificial intelligence for better risk-informed decisions. Moreover, researchers can identify possible research fields regarding natural language processing that can be investigated as a future work.

## 2. Research Background

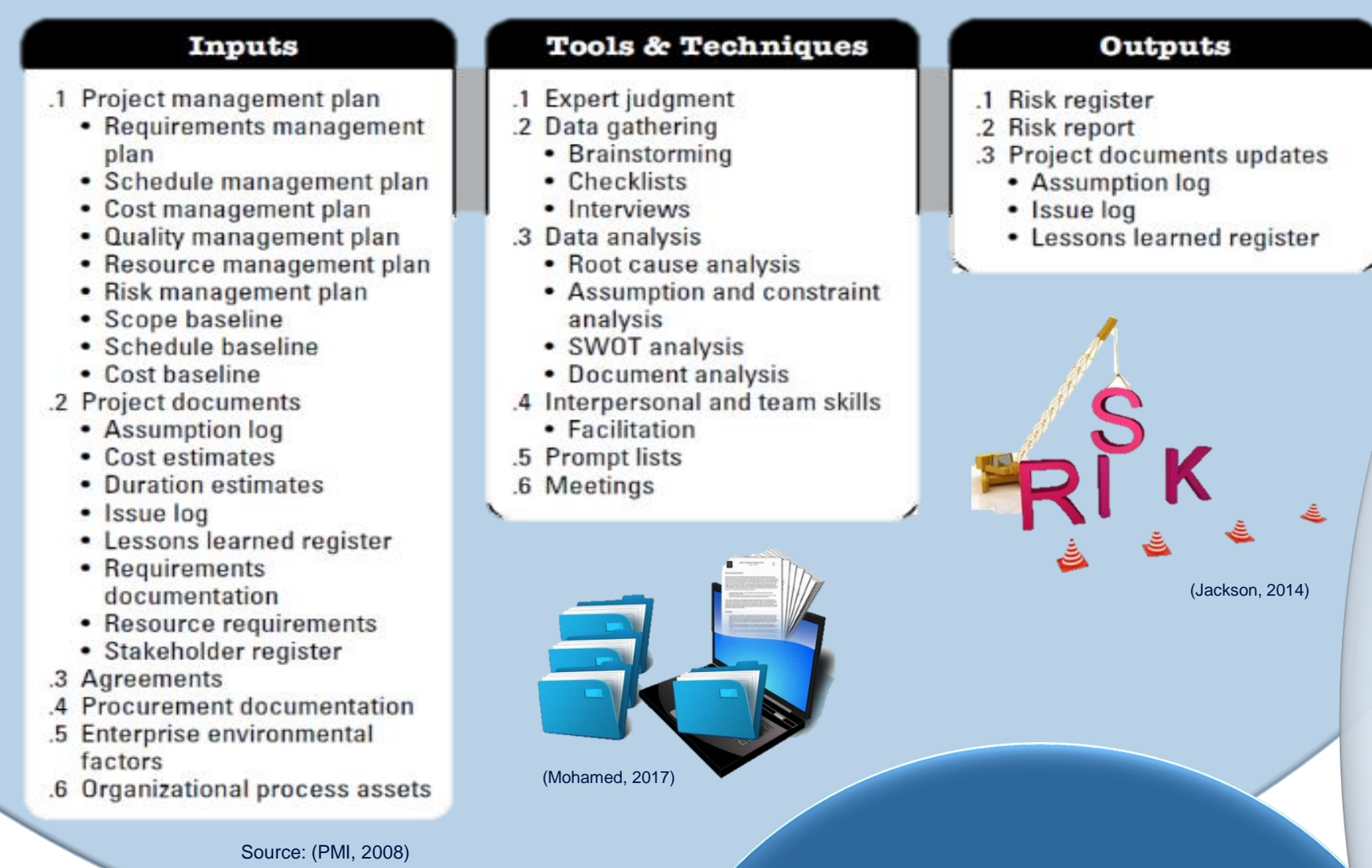
### Risk Management in Construction



Construction projects involve a high degree of risks from beginning to the end of projects.

Risk management, which is a systematic approach to managing project risk, is essential for survival and growth in the industry.

### Identify Risks

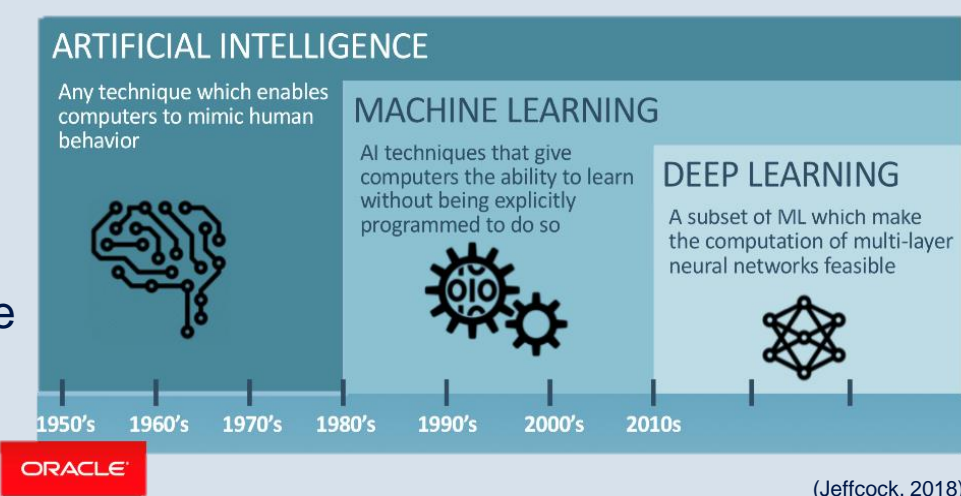


According to Project Management Institute (PMI, 2008), project risk identification processes include various tools and techniques.

## 2. Research Background (continued)

### Machine Learning

ML is a computer science area that creates and applies methods for learning from training data. This can be achieved by supervised or unsupervised learning. Systems can automatically learn then make predictions without being explicitly programmed.

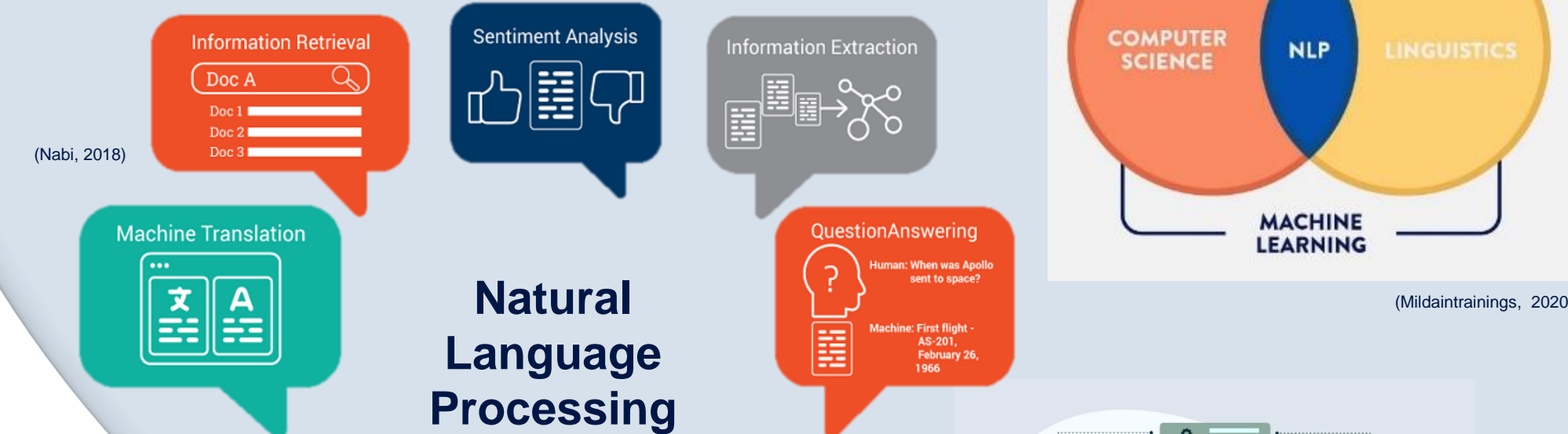


Evolution of ML has attracted the attention of the academic researchers as well as the various analysts/industry practitioners in different sectors such as from Computational science, Financial services, Logistics, Transportation, Telecommunications, Government, Retail, Customer service, Entertainment, Manufacturing, Energy, Healthcare, Biology and Agriculture.



### Natural Language Processing

NLP is interdisciplinary area dealing with the interactions between computers and human/natural languages, in particular how computers are programmed to process large amounts of text-based data.



## 3. Research Objective

The objective of this work is to critically review the literature on machine learning techniques applicable to construction risk management generally, and particularly applicable to document processing in construction risk management.

## 4. Literature Review

### Searching the Literature

- Online publications on ML, specifically NLP applications in the construction management field, were reviewed.
- Only journal articles and proceedings/conference papers were used.
- Search string is used to conduct online searches in Web of Science (WoS).
- Title, abstract, author keywords, and Keywords Plus were searched.
- WoS Core Data Collection were accessed within 1970-2020 Timespan.
- "Risk", "Construction", "Management", "ML" and "NLP" were used as search items.

Table 1. Search Queries with the Number of Publications (from WoS)

Query	#
"Risk" AND "Machine Learning"	5776
"Risk" AND "Construction" AND "Machine Learning"	136
"Risk" AND "Construction" AND "Natural Language Processing"	10
"Risk management" AND "Construction" AND "Machine Learning"	7
"Risk management" AND "Construction" AND "Natural Language Processing"	1
"Risk" AND "Machine Learning" AND "Construction Management"	2
"Risk" AND "Natural Language Processing" AND "Construction Management"	0
"Risk" AND "Natural Language Processing" AND "Construction" AND "Management"	5

### Selecting Studies

The main selection criteria is the relevance of construction management field. Only construction related studies with the applications of ML, mainly NLP, were selected to be reviewed.

First, the titles, abstracts and keywords were reviewed and subsequently full text reviews conducted in order to select relevant publications based on the criteria.

Each was recorded individually into an Excel Spreadsheet and also in Mendeley, reference manager, as separate folders to remove duplicates.

A total of 34 publications were included in this review, in accordance with the selection criteria.

## 5. Discussion and Conclusions

### Characteristics of the Reviewed Publications

Main sources of data used in ML applications:

- Photos, videos, sensors and documents

The majority (N=24) used ML applications were related to:

- Safety Risks and OHS

Only 3 of these applications were utilised NLP for safety issues through:

- Automated content analysis of injury reports, construction site accident analysis, and written reports

### Discussion

Although there is a number of studies using ML-based approaches for construction management literature, only a limited/few number of studies have utilised the NLP applications into construction project risk management.

This indicates a need to investigate the different applications of NLP for risk management in construction projects.

This also demonstrates new possibilities of facilitating risk identification steps through NLP using unstructured and structured data such as reports, post-project appraisals, minutes of meetings and correspondence.

The remaining 10 studies were related to:

- Delay risk, contract risk, energy and environmental risk, knowledge/information management and facility management

Among these studies, NLP was applied only 4 of them:

- For extracting the poisonous clauses in contracts; for better forensic engineering; for better knowledge management through semi-fiction narratives and for construction risk management through retrieving similar cases

## Acknowledgement

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Beste Ozyurt

Postgraduate Exchange Student

19043897@brookes.ac.uk

Faculty of Technology, Design and Environment

School of Built Environment

Supervisors

Prof Dr. Joseph Tah @ Oxford Brookes University

Prof Dr. Irem Dikmen and Prof Dr. M. Talat Birgonul @ METU