



## **Health and Safety Considerations in Mega Construction Projects**

**Waad Waheed<sup>1</sup>, Laila Khodeir<sup>2</sup>**

*<sup>1</sup>Department of Architecture, Faculty of Engineering, Ain Shams University,*

*<sup>2</sup>Associate Professor, Department of Architecture, Faculty of Engineering, Ain Shams University, British University in Egypt*

---

### **Abstract**

The construction industry is considered one of the most hazardous industries especially in Mega projects, not only in developing countries but also throughout the world due to its unique nature. The hazards of this industry make it very essential to pay more attention to construction safety and to improve the safety performance of construction companies. However, safety is not a luxury but a necessity, and may be considered an important function to be used against unnecessary loss. International Mega Construction projects are likely to become increasingly common in the engineering and construction industry. A Mega-project as a high impact technically complex project which requires careful advanced planning, large projects are defined as those with construction work valued in excess of US \$1billion. On such projects, there may be 60 large contracting organizations and 30 to 40 consulting companies. The construction workforce could total 45,000 personnel delivering over 10 million man hours of effort per month at peak periods, so there is a need of guidance material that can be used to improve the management of health and safety(H&S) throughout these type of projects. Thus the aim of this paper is to identify the H&S considerations that are related to Mega Construction Projects. To achieve the aim of this paper a literature review analysis has been performed where more than hundred research paper that have been published from 1998, to 2018 have been analyzed. Findings of this paper have managed to identify the nature of mega construction projects, the root causes of accidents and the consequence of poor health and safety management in mega construction projects. This paper is considered of value to construction project officers and Project managers working in mega construction projects in Egypt and MENA region.

© 2020 The Authors. Published by IEREK press. This is an open access article under the CC BY license (<https://creativecommons.org/licenses/by/4.0/>).

### **Keywords**

*Health and Safety ; Mega Construction Projects*

---

### **1. Introduction**

Mega construction projects (MCPs) feature huge edifice and venues with strong symbolic significance or a larger scheme with complex contents which is encountered at the top-end of the construction industry's spectrum of activities. Mega projects are multicultural projects that involve different designers, contractors, subcontractors, and suppliers from all over the world, they have to work together and cooperate to achieve success and to accomplish the objectives from megaprojects and gain the benefits associated with these types of the projects represented in their ability to achieve a strong connection with a region's or even the society's prosper and stability as many countries use these type of projects to stimulate the development of relevant industries and increase employment.

There is no doubt that safety and health management are very important challenge that face mega projects, so we have to consider it carefully while approaching mega projects. Safety management is an underrated challenge that

wasn't studied carefully in the literature. Special considerations have to be given to safety just to keep it into high standards, this reflect on the labor and engineers participating in the projects. Strong and rigorous regulations have to be devised and applied properly to increase the safety factors associated with the project. This impacts different aspect of the project from the cost of the project up to the execution time.

The construction industry especially in the field of mega projects has been in a deep need for approaching and reconsidering the new challenges to achieve a safe working environment as they suffer from a lot of tedious and unordinary work due to their unique nature. Effective construction safety considerations require a clear vision, systematic methodology and sustained commitment to improve the whole process from the very early design stage throughout the whole other project stages focusing on every individual participating in the mega construction project to avoid their vulnerable to accidents. As a result, advanced and more rigorous considerations are to be devised to guarantee and improve the safety performance of mega projects which reflects on safety precautions in the projects.

Health and safety regulations in MCPs is one of the greatest risk presents enormous challenges to directors, construction managers and safety supervisors of the organizations involved in the construction process. Studies found that poor health and safety management in construction projects costs the construction industry millions of pounds each year due to the undesired consequences resulting from poor management systems. This cost is represented in loss of lives, medication and insurance. (Griffith and Howarth 2001) have found out that the record of health and safety in construction sector is the second worst of any other industrial sectors. This is due to its unique, complex, and hazardous workplaces. So considerations and efforts must be excreted in order to increase the levels of safety, besides the development of new efficient tools and mechanisms to avoid these losses.

### **1.1. Aim and Methodology**

The main objective of this paper is to identify considerations, that could help in achieving efficient health and safety management in mega construction projects. Any organization associated with the construction , need to apply adequate standards, structures and processes to support the right behaviors and acts by all the involving construction structure which related to health and safety. In this paper, Mega construction projects have been studied . Specifically, A literature review on different topics related to MCPs including the definitions, characteristics, factors affecting, challenges facing, and benefits of MCPs have been provided. Also factors contributing to accidents in MCPs and types of construction accidents have been covered, and finally this research studied the standards of occupational health and safety management system.

## **2. Literature review**

The following part is intended to review more than hundred research papers, thesis and books that published from 1998, to 2018 and tackled the topic of this research which provided different topics related to mega construction projects .

### **2.1. The Nature of Mega Construction Projects**

In this subsection, different aspects of MCPs which include a list of definitions , characteristics, factors, challenges and benefits of mega have been introduced .

#### **2.1.1. Definition of Mega Construction Projects**

In the construction communities, one could hear the terminology "Mega Construction Project" (MCP). The first question that could raise up to your mind is simple, when do we call a certain project a mega project? There are different approaches one can follow to define the mega projects. The literature is rich in this discipline, the divergences between different definitions depends on the researchers' perspective and their approaches in analyzing these projects. In Table 1, we are providing a brief summary for the different seven approaches that can be followed to define mega projects. In every approach, we are listing number of authors who followed that approach and some quotations from their publications that support this definition.

Table 1. Approaches of MCPs Definitions. “Source: Authors based on literature sources”

Author	Definition	Critical analysis of the definition
(Crosby 2017) (Sun, et al., 2011) (Marrewijk, 2007)	“Mega construction projects are usually described as substantial investment (more than 1 billion dollars) long schedule (over two years) public infrastructures, which usually have long life time of 50 years and more, and generate multiple social impact and invested or commissioned by governments”	Project nature, Objective, Location, Duration and the Cost of the project ( PN.O.L.D.C) Approach .
(Mok, Shen and Yang 2015)	“MCP often involve various stakeholders of diverse occupational and professional backgrounds who have different levels and types of interests in the project”	Stakeholder Approach according to the stakeholder and performing organization structure.
(Flyvbjerg, Bruzelius and Rothengatter 2003)	“ many countries take mega project as an important tool to lift the status in global political and economic systems.”	Economic Business Approach focused on defining mega construction projects as an important tool to lift the status of economic systems.
(Flyvbjerg, Bruzelius and Rothengatter 2003)	“ the world of megaproject preparation and implementation is a highly risky one where things happen only with a certain probability and rarely turn out as originally intended.	Risk Approach depends on defining them as including many risk factors that can cause delays or failures during the project life cycle.
(Albishri, 2015)	“ mega-project’s process contains project phase transitions and milestones which connect, by providing spatial and temporal platforms, the interests of project actors, interest groups and constructors”.	Project Process and Technical Requirements (PP.TR ) Approach .
(Mok, Shen and Yang 2015)	“ MCP play three major roles in the strategic development of a society: (1) satisfying human, economic and societal needs; (2) elevating a country's social image; and (3) delivering leading international events”.	Political, Society and Environment (P.S.E )Approach
(Gerald, 2009)	“complexity is something’ undesirable that made a project unique, more complicated and more difficult to execute, manage and control or even an ‘excuse’ for mistakes.	Complexity Approach leans on investigating the complexity and constraints associated with the project and their consequences.

Different approaches for defining mega construction projects have been introduced. It can be noticed that some approaches have received more attention in the literature than other approaches. For instance PN.O.L.D.C and Complexity are the most common approaches in defining mega construction projects.

### 2.1.2. Characteristics of Mega Construction Projects

In this sub subsection, different features and characteristics of mega projects have been studied . These features are the reason behind the existence of different approaches for defining mega projects. This Research also detailed every feature with supported literature. Table 2 summarizes these characteristics and the relevant literature.

Table 2. Characteristics of Mega Construction Projects with respect to different approaches. “Source: Authors based on literature sources”

Approach	Author	Characteristics of the Approach
P N.O.L.D.C Approach	(Mackhaphonh and Jia 2017) (T. Zidanea, Johansenb and Ekambaramb 2013) (Othman 2013) (Diaz Orueta and S. Fainstein 2009) (Marrewijk 2006)	A large-scale system is usually perceived to be large and made up of a large number of system components with complex interconnections among these components. Capital asset in order to plan, design, finance and build. Located in remote and or inhospitable large areas. Long duration but program urgency Project with a total budget more than \$1 billion
Stakeholder Approach	(Kardes, et al. 2013) (Jia, Chen, et al. 2011)	The construction of MCPs involves many stakeholders that exists complicated interest relationship and Ineffective communications between them.
Economic Business Approach	(Flyvbjerg 2014)	They are keep the economic viability of the country as a whole by making large amount of money Attracting visitors and investment to help in achieving community benefits, this is due to their heavy and delegated impacts.
Risk Approach	(Gyoo Kim 2011) (Flyvbjerg, Bruzelius and Rothengatter 2003)	Increase of costs and the duration which are often due to inadequate estimates of the initial cost.
PP.TR Approach	(Flyvbjerg 2014) (T. Zidanea, Johansenb and Ekambaramb 2013) (Kardes, et al. 2013)	High design knowledge and Quality front-planning with unprecedented integration effort. Professional technological skills and highly trained employees especially in the field of the project management Logistical support.
P.S.E Approach	(Othman 2013) (Jia, Chen , et al. 2011) (Bornstein 2010)	Attract external capital and redefine a city as a whole. A higher quality of life for residents. Undervalued environmental impacts
Complexity Approach	(Thomas and Mengel 2008) (Duy Long, et al. 2004)	They distinguished by their huge size and unique nature, these bring more complexity to them. They are susceptible to the risk of increase in budget and schedule overruns which adds an additional complexity to the projects.

Characteristics of mega construction projects make them special projects with unique nature which need an efficient management with a lot of effort in different directions starting from resolving conflicts and contradictions to resources allocation, managing schedules and human power required to accomplish these types of projects and lead them to success.

### 2.1.3. Factors Affecting Mega Construction Projects

In this sub subsection, The most common and highly considered factors that affect mega construction projects have been discussed. These features have been obtained by conduction a wide literature survey. It's important to note that there are some factors with great importance and they need to be considered by most of the projects. On the other hand, there are some features of less importance and they are considered based on the project itself.

For instance. The contract term is an important factor that affects the projects because it is involved in every single detail in the project starting from determining the owner of the project up to the flow of funds and the role of every single individual participating in the project.

Risk management system has been found to be as important as the contract itself. Risk management allows for smooth accomplishment of the required tasks without delay and cost efficiently. Failure in managing the risk could case unexpected delays or increase in the estimated cost of the project. Technology is a crucial factor as well, engaging new technologies has a huge impact on the performance of mega projects. Nevertheless, project's member need to allocate sufficient time and resources to plan and execute the integration of new or unproven technologies.

Communications management is a factor that shouldn't be forgotten since good communication skills lead to the success of the project. In the following table 6, we are summarizing the factors that have been discussed in the considered literature.

There is also another way to classify the factors of mega projects. Specifically, factors can be classified into Qualitative and Quantitative . To classify a certain feature as a Qualitative and Quantitative, one need to differentiate between these two classes. Qualitative factors are factors that can be intangibles which are not purely numbers driven but they are as important as crunching the numbers., however, Quantitative factors are the ones that are related to actual numbers, financial metrics and ratios.

Thus, after studying the factors affecting mega construction projects, it is important to note that despite the many factors affecting mega construction projects, we can derive that risk management, contracts and technology are the most important factors affecting mega construction projects.

### 2.1.4. Challenges of Mega Construction projects

Overcoming the challenges that hinder the development of (MCPS) is very crucial for many large construction companies, but they first need to identify these challenges and prioritize them in order to minimize their impact on the progress of the project and smooth the project flow. Some of the challenges that face mega projects will be discussed and elaborated. Fig 1 shows the challenges iceberg which face mega construction projects from the very early stages. In Table 3, we are summarizing these challenges

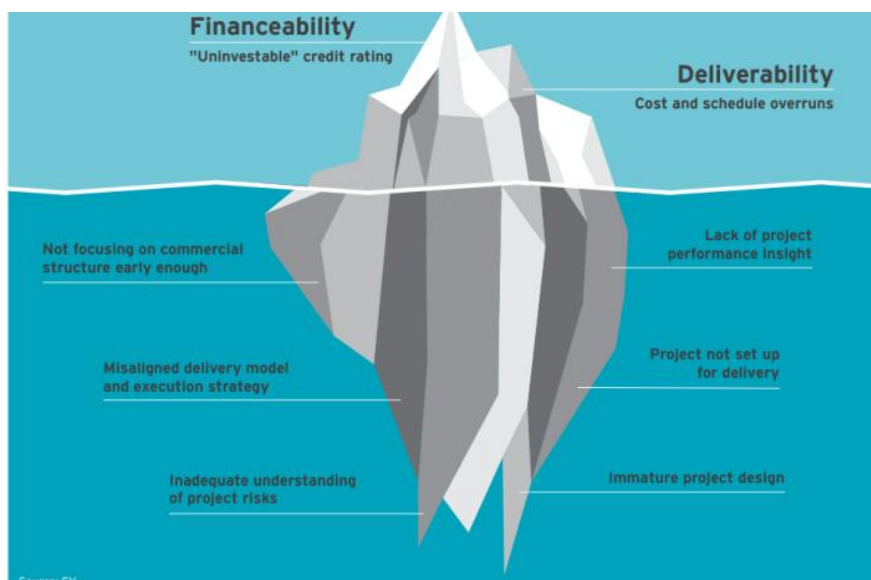


Figure 1. The challenges of the MCPs “Source: Authors based on literature sources”

Table 3.Challenges of Mega construction Projects with respect to different approaches “Source: Authors based on literature sources”

Approach	Author	Challenges of the Approach
P N.O.L.D.C Approach	(Gupta 2015) (He, et al. 2014) (T. Zidanea, Johansenb and Ekambaramb 2013) (Jia, Chen, et al. 2011)	Challenges due to the unique nature that conclude to increase of the size of the project. Difficult to define and achieve the program objectives and their alignment with the organizations' strategies. Unfamiliar location . Schedule overruns Huge and expensive cost
Stakeholder Approach	(Mackhaphonh and JIA 2017) (Gupta 2015) (Othman 2013)	Variety of cultural differences and backgrounds Complexity organization lack of efficiency, effectiveness behavior and performance especially in project management process Inadvisable communication skills which decrease the required coordination to achieve the project objectives
Economic Business Approach	(C.Esty 2004)	Challenges associated with bad performing project could have a negative impact on the society due to their fail to achieve the intended financial and operating objectives.
Risk Approach	(Flyvbjerg, Bruzelius and Rothengatter 2003)	Efforts to reduce the possible harm that may occur such as an increase in the project’s cost, unplanned elongation in the execution duration of the project.
PP.TR Approach	(Othman 2013) (Sun and Zhang 2011)	Lack of design knowledge and experience on practicing good skills and concepts that improve chances of success on the project. Lack of technological knowledge and application requirement
P.S.E Approach	(Mok, Shen and Yang 2015) (Flyvbjerg 2014) (Othman 2014)	Political imperatives and authority misuse Public acceptance is against the social impact lack of considering environmental requirements, preserving historical sites, and natural reserve
Complexity Approach	(Giezen 2012)	Managing complexities that bring a lot of difficulties and challenges in implementing and constructing

Mega construction projects face different challenges and each challenge has its own impacts and concerns. Thus, we cannot conclude that some challenges are more important or have huge impacts than other challenges and every challenge has to be considered independently and inclusively for each project.

### 2.1.5. Benefits of Mega Construction projects

Mega projects have become a key part of the wider project ecosystem due to their impacts on their surroundings. Fulfilling business, social and environmental objectives for a huge number of stakeholders by creating a product or a service, to serve to the community or to yield benefits are the main benefits of the mega construction projects. In this subsection, different benefits based on the approaches we have selected before will be introduced in order to show the importance of constructing these types of projects Table 4 summarizes all these benefits.

Table 4. Benefits of Mega Construction Projects with respect to different approaches “Source: Authors based on literature sources”

Approach	Author	Benefits of the Approach
P.N.O.L.D.C Approach	(Jia, Chen , et al.) (Diaz Orueta and S. Fainstein)	Benefits of projects that don't have a direct impact or return These projects impact the society and the country in a way Benefits and value of mega construction projects
Stakeholder Approach	(Gupta 2015) (Flyvbjerg) (Duy Long, et al. 2004)	Cooperation between stakeholders and different governmental agencies Experience exchange between different participating parties New and efficient communication tools could be invented.
Economic Business Approach	(Flyvbjerg, 2014) (C.Esty 2004)	There is significant cash flow between different governmental agencies. The cooperation between governmental agencies and the private sector leads to a significant improvement to the economic status of the society while strengthening it.
Risk Approach	(Kimiagari and Keivanpourb 2018) (Gyoo Kim 2011)	Developing new management techniques and tools that aim at keeping the construction process smooth and flawless which helps the project to satisfy its deadline and hence maintain its objective which typically leads to the project's success.
PP.TR Approach	(Zhou, Whyte and Sacks 2012) (Zidane, Johansen and Ekambaram 2012)	New knowledge and tools. New technologies. Knowledge transfer
P.S.E Approach	(Bornstein 2010) (C.Esty 2004)	Brings harmony between different agencies in the country Bring comfortable life for residents. Projects that target the environment To achieve sustainable projects.

Mega construction projects have a lot of positive impacts on different life aspects. However, the most remarkable and recognizable ones are their social and economic impacts.

## 2.2. The Root Causes of Accidents in Mega Construction Projects

The construction industry is considered as one of the most dangerous and hazardous industries in the world due to the high number of persons who have died on the construction sites and the other many who suffered from occupational diseases.

### 2.2.1. Contributing Factors to Accidents in Mega Construction Projects

Accidents avoidance requires the development of a clear understanding of the factors involved in the causation of these accidents. Accidents and their causes have been studied in literature which reveals that there are common factors that mostly cause most of the accidents occurring in mega construction projects. One of the most important approaches in identifying the root causes of accidents in Mega construction projects is based on information aggregation. Figure 2. shows the factors causing accidents based on the previous studies.

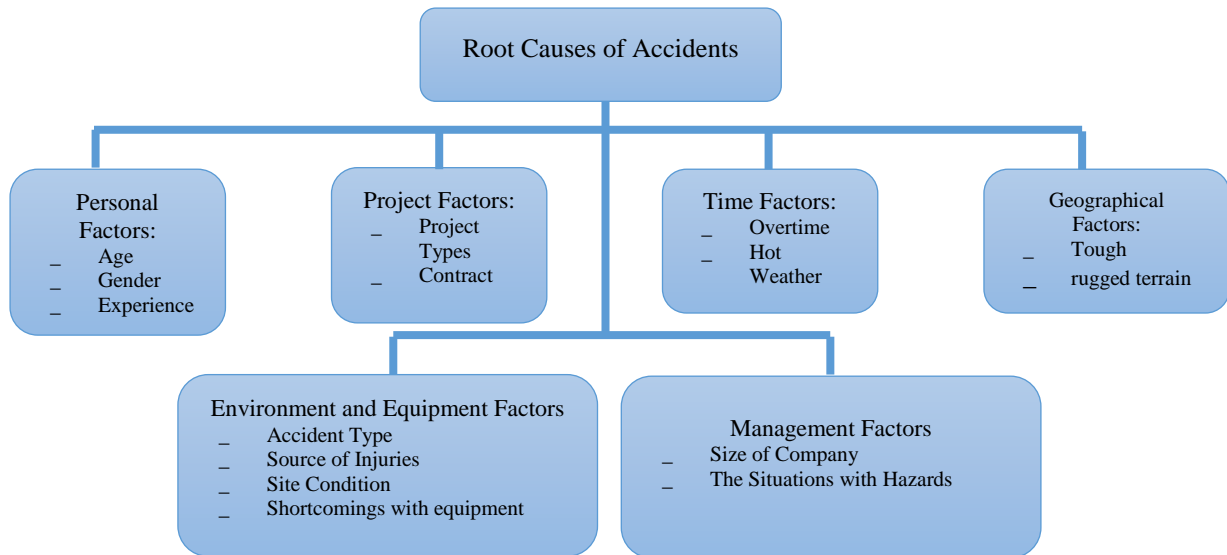


Figure 2. The root causes of accidents in Mega construction projects. “Source: Authors”

In this part factors affecting accidents in Mega construction sites have been discussed and analyzed. By identifying these root causes, proper measures and considerations can be developed to approach the root causes of accidents and prevent their occurrence. This study is so critical and represents one of the main component of this research. Since we are interested in studying health and safety in Mega construction projects.

### 2.2.2. Types of Construction Accidents

Analyzing the accidents is very crucial in order to orientate safety practitioners and adopt appropriate measures in all construction stages that include different scenarios of accidents and to develop new, and concrete safety regulations that could prevent possible accidents. Figure 3 summarizes the main types of Accidents

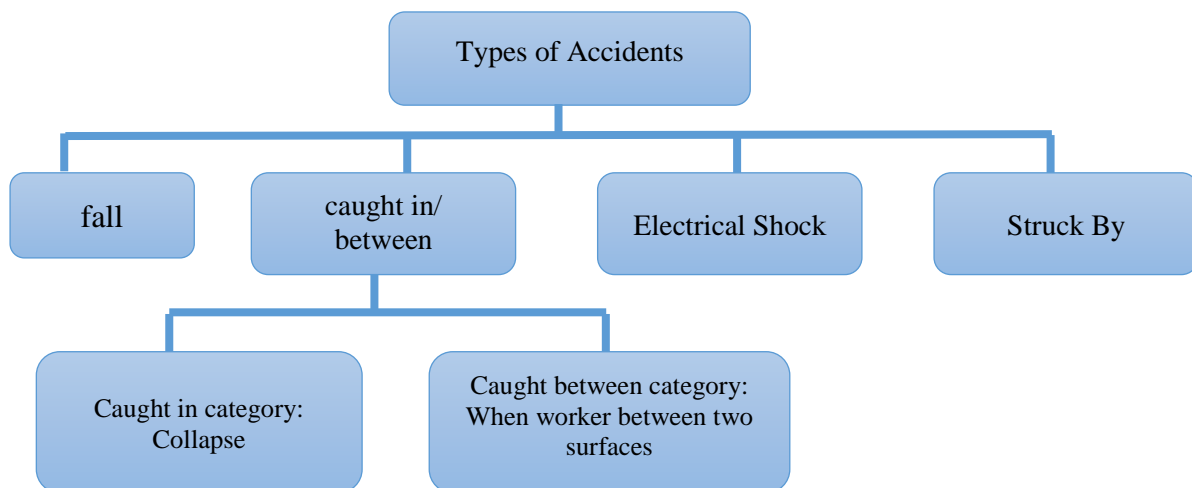


Figure 3. The main types of Accidents “Source: Authors”

Identification of the accident types raise our ability in developing methods and procedures to prevent these accidents. Predicting the type of accidents is critical since we can utilize these predictions to provide the workers with efficient ways to apply health and safety considerations.

### 2.3. The Consequences of Poor Health and Safety Management in Mega Construction Sites

Over the last 20 years, there has been an increase on the rate of accidents occurring in construction projects, this increase is due to the increase on the construction and expansion capacity along with the poor health and safety regulations that fail to manage the tremendous number of workers, large and heavy plants, huge amount of material, complicated construction operation and multi-interface between different entities.

### 2.3.1. Standards of Occupational Health and Safety Management System.

Quality ratings of previous studies have discussed the standards of the safety management systems in construction industry and they concluded to divide them into two main categories. The first category includes standards related to organization level, while the other category is linked to standards related to the project level. Figure 4 summarizes the categories representing the occupational health and safety management systems and show different trends in each category, this categorization has been studied in the work of Chia-Fen Chi.

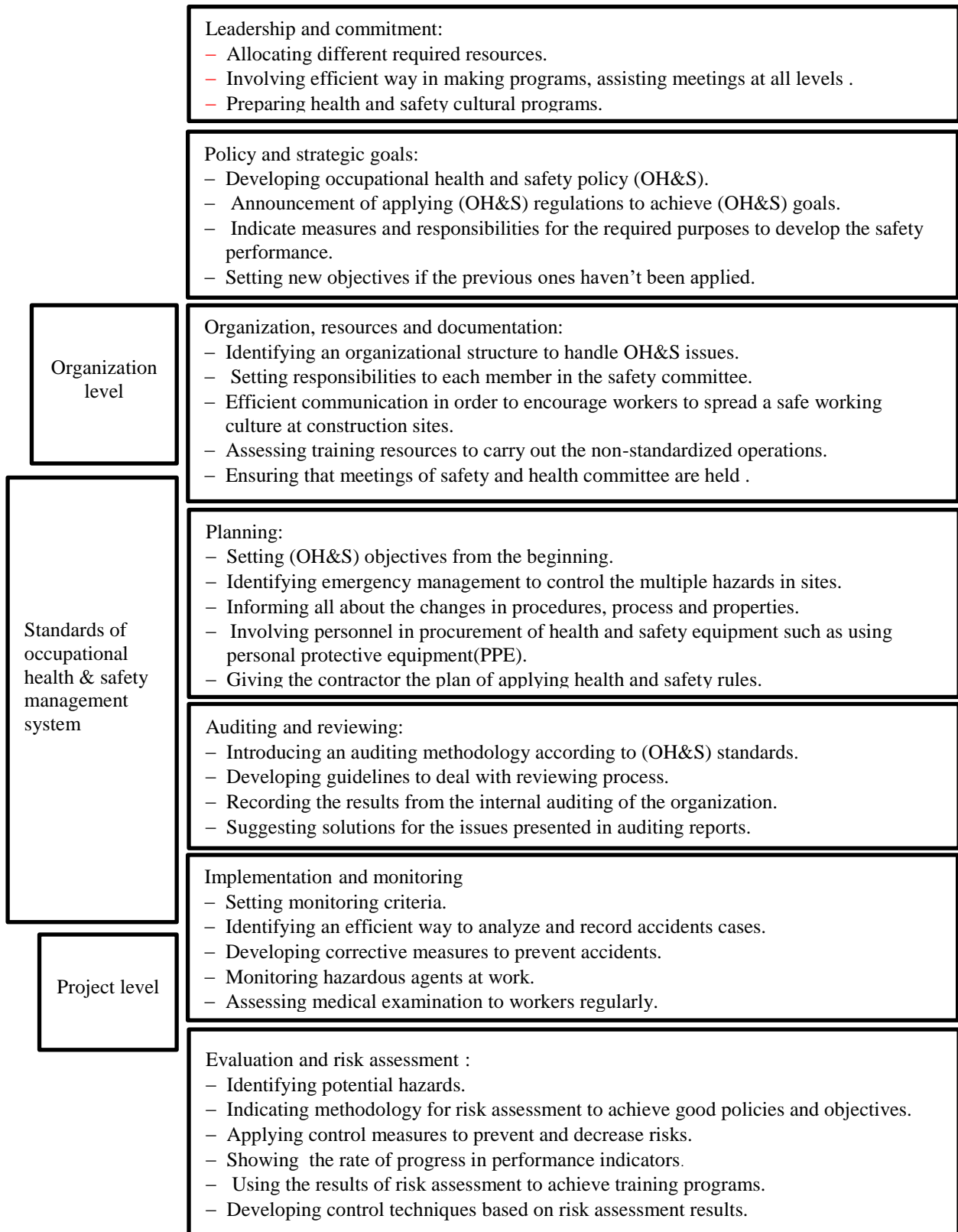


Figure 4. Health and Safety considerations based on literature review “Source: Authors”

The Advantages of applying the standards of occupational health and safety management system in their organization and project levels at Mega construction Projects are including a safer workplace, improved employee behaviors, reduced costs related with accidents and compensation and stakeholder confidence.

### 3. Findings

In this paper, extensive literature reviews governing different aspects of MCPs have been conducted. The results of this literature review are summarized in different charts. Figure 5. shows the approaches that have been tackled in literature from 1998 to 2018 to define Mega construction Projects. it could be observed that the definition based on approach PN.O.L.D.C and Complexity approach are the most comprehensive definitions, and thus this research shall adopt them. The chronological ranking of these ordering is shown in Figure 6.

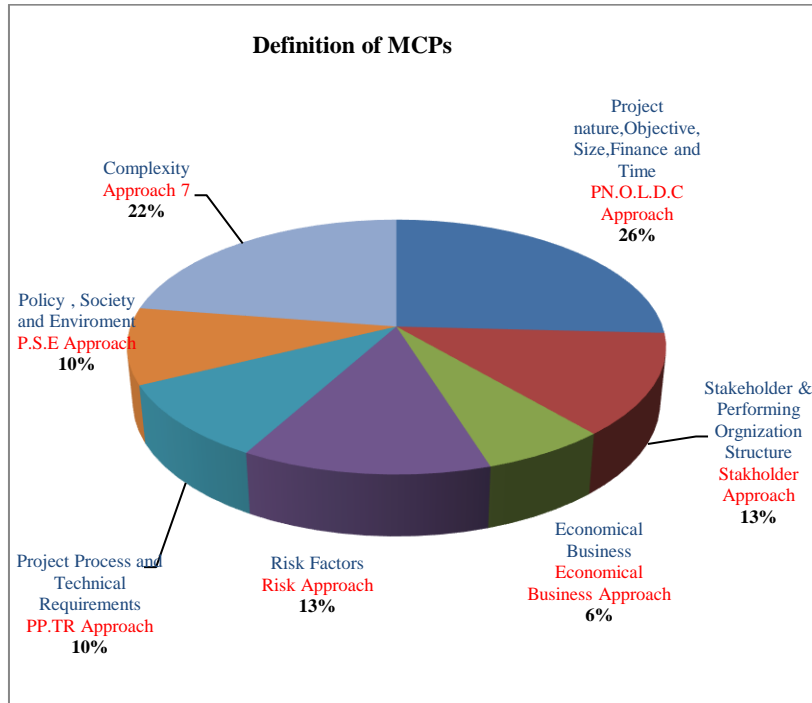


Figure 5. Percentage of Agreement among authors about the Definition of MCPs. “Source: Authors”

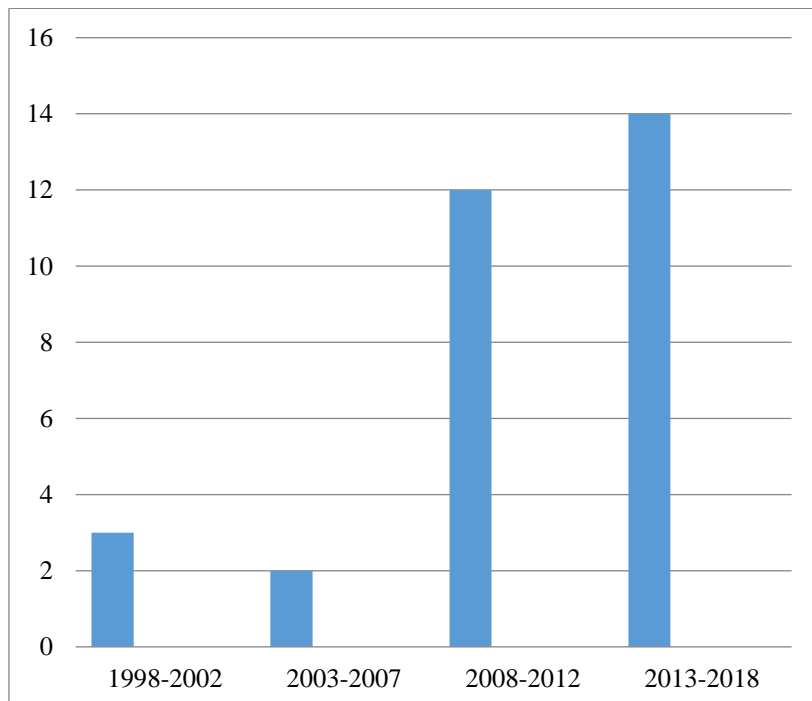


Figure 6. Period of 31 papers that showed the agreement about definition of MCPs. “Source: Authors”

Figure 7. shows mega construction projects and their relation with the finance, time, stakeholder management, economical business, risk assessment, project process, political rules, environmental legislations, social surroundings and complexity. It's clear that Mega projects composed of many individual project groups, e.g., government, numbers of investment companies and the residents with different culture backgrounds, manners, political systems and languages that adds an additional complexity to mega projects, are the most common shared characteristics among authors.

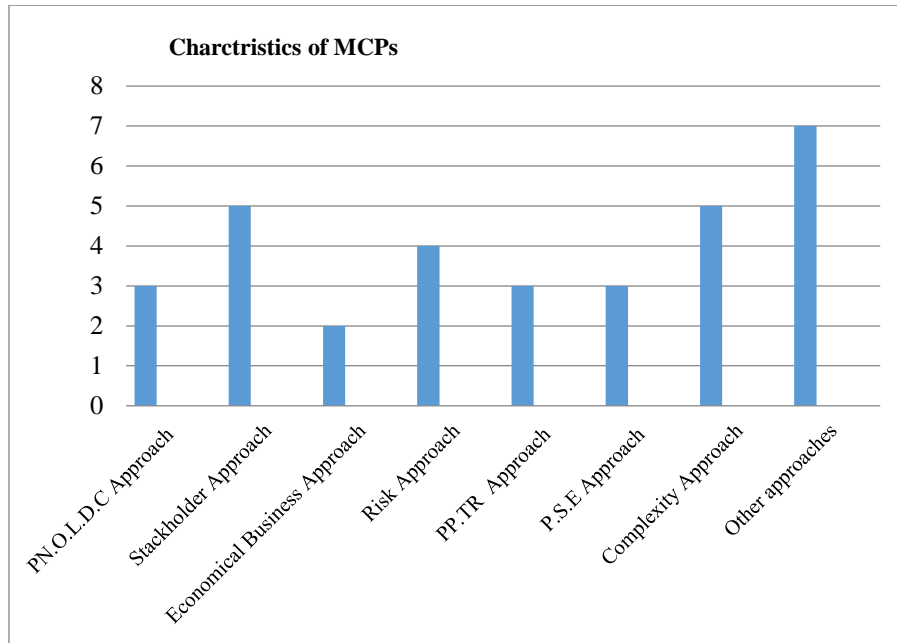


Figure 7. Degree of agreement among authors about the characteristics of MCPs depends on the previous approaches. “Source: Authors”

Figure 8. shows the factors affecting mega construction projects, and the chronological ranking of this study is shown in Figure 9. Technology, risk management, and contracts are the most important factors impacting mega construction projects and effect their performance.

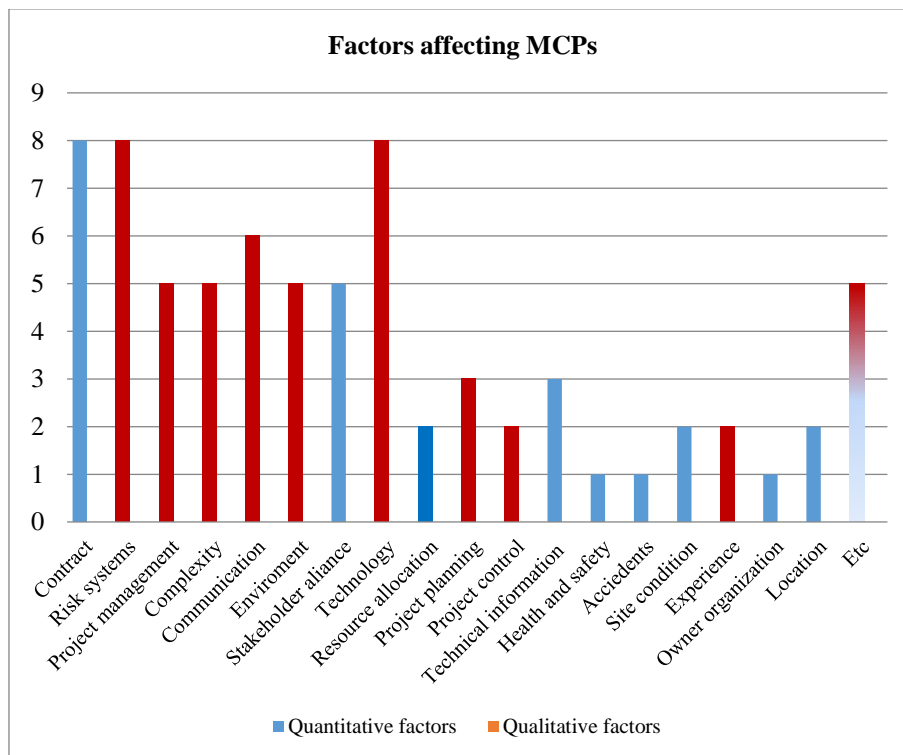


Figure 8. Degree of agreement among authors about the Factors affecting MCPs. “Source: Authors”

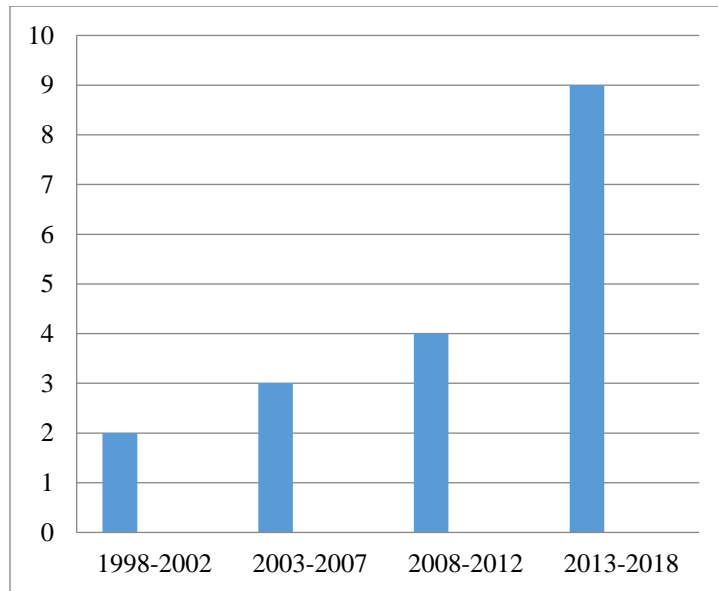


Figure 9. Period of 18 papers that showed the agreement about factors affecting MCPs. “Source: Authors”

Challenges facing mega construction projects are shown in Figure 10. It is important to note that there exists a gap in the literature covering the challenges facing mega construction projects from safety perspective. Finally, the benefits associated with mega construction projects have been studied and the literature interest is shown in Figure11.

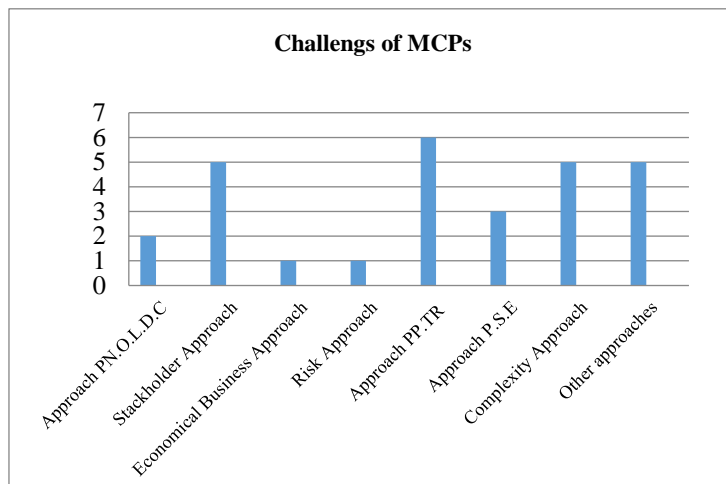


Figure 10. Degree of agreement among authors about the Challenges of MCPs depends on previous approaches. “Source: Authors”

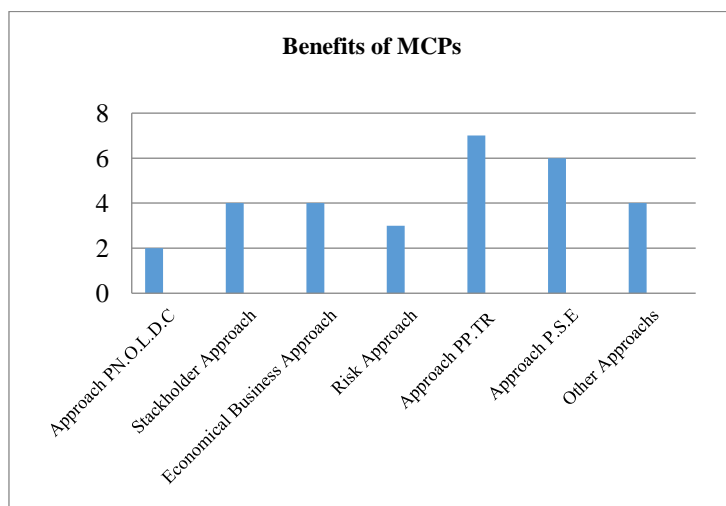


Figure 11. Degree of agreement among authors about the benefits of MCPs depends on previous approaches. “Source: Authors”

Figure12. shows that the most common accidents occurring in mega construction project is falling and caught in/between. This ranking is very crucial in developing health regulations for safety in construction projects. The chronological ranking of the contributing literature is shown in Figure 13.

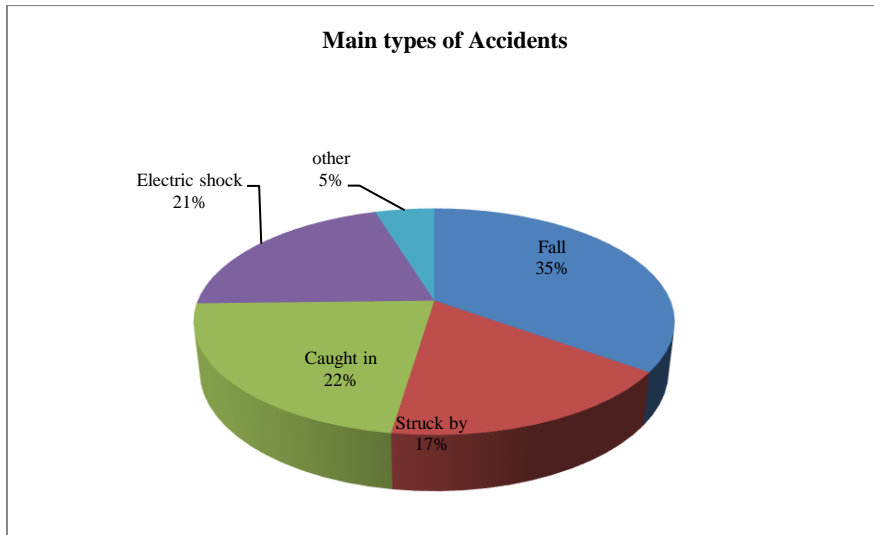


Figure 12. Degree of agreement among authors about the main types of accidents. “Source: Authors”

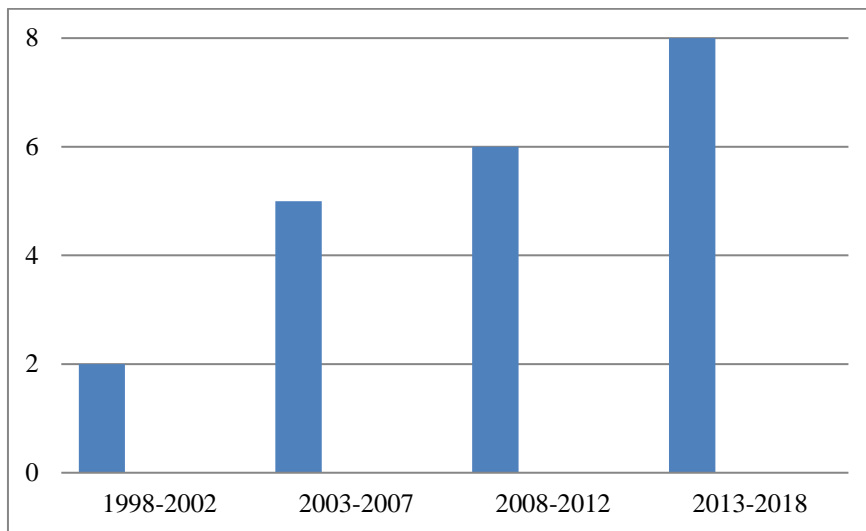


Figure 13. Period of 21 papers that showed the degree of agreement about accident types. “Source: Authors”

#### 4. Conclusion

In this paper, A comprehensive study for MCPs have been conducted, this study covers different perspectives. Various existing definitions for MCPs have been explored. This Research shows that there are some approaches received more attention than others. For instance, P.N.O.L.D.C Approach and Complexity Approach are the most common approaches in defining MCPs. By adopting every approach followed in defining mega construction projects, the characteristics of mega construction projects have been studied in accordance with the adopted approaches. Factors affecting mega construction projects have been discussed. The Research presents that technology, risk management, and contracts are the most important factors impacting mega construction projects. It’s important to shed a light on the fact that accidents have not been considered as a factor affecting mega construction project. However, accidents are very important factor affecting mega construction projects, some projects could be halted sue to since they are very dangerous and thus that is why our research paper considered as very important due to the crucial topic it tackled .Then this research moves to describe the challenges facing MCPs based on the same approaches and It has been observed that there is a gap in the literature covering the challenges facing mega construction projects from safety perspective. Finally, the benefits associated with mega construction projects have been studied to explain why MCPs have become a key part of the wider project ecosystem and their impacts on their surroundings.

In a complete turn over for the research focus, the accidents and their root causes in mega construction projects have been introduced, this can be fully justified due to the existence gap in the literature as we have shown earlier. This is very crucial for the research since this study has shown that health and safety regulations are not well studied nor covered in the literature. So, this research is motivated, However, it is important to note that these findings are limited, as the research was mainly based on literature review, and that it is recommended to do further analysis to case studies to validate the results of the paper

Consequently, different types of accidents have been studied. It has been shown that falls and caught in/between are the most common accidents occurring in mega construction projects. Then a general safety consideration to be used as a draft by construction project officers and Project managers working in mega construction projects in Egypt and MENA region have been suggested, these considerations are extracted from the literature.

## References

- Bornstein, Lisa. (2010). "Mega-projects, city-building and community benefits." *City, Culture and Society*, 1, 199-206. DOI:10.1016/j.ccs.2011.01.006
- C.Esty, Benjamin. (2004). "Why Study Large Projects? An Introduction to Research on Project Fiance." *European Financial Management*, 10(2), 213-224.
- Crosby, P. (2017) "Shaping complex mega-projects: practical steps for success." *Australian Journal of Civil Engineering*, 12(1), 2204-2245. DOI: 10.1080/14488353.2017.1362806
- Diaz Orueta, Fernando, and Susan S. Fainstein. (2009) "The New Mega-Projects." *International Journal of Urban and Regional Research*, 760-767. DOI:10.1111/j.1468-2427.2008.00829.x.
- Duy Long, Nguyen, Stephen Ogunlana, Truong Quang, and Ka Chi Lam (2004). "Large construction projects in developing countries: a case study from Vietnam." *International Journal of Project Management*, 22, 553-561. DOI:10.1016/j.ijproman.2004.03.004
- Flyvbjerg, Bent. (2014) "What You Should Know About Megaprojects, and Why: An Overview." *Project Management Journal*, 45(2), 6-19. DOI: 10.1002/pmj.21409
- Giezen, Mendel. (2012) "Keeping it simple? A case study into the advantages and disadvantages of reducing complexity in mega project planning." *International Journal of Project Management*, 30, 781-790. DOI:10.1016/j.ijproman.2012.01.010
- Gupta, Ashish. (2015), Successful Delivery of Mega-projects (Master's thesis).
- Gyoo Kim, Seon. (2010) "Risk performance indexes and measurement systems for mega construction projects." *Journal of Civil Engineering and Management*, 16(4), 586-594. DOI:10.3846/jcem.2010.65
- He, Qinghua, Lan Luo, Yi Hu, and Albert Chan . (2014) "Measuring the complexity of mega construction projects in China—A fuzzy analytic network process analysis." *International Journal of Project Management*, 1-15. DOI:10.1016/j.ijproman.2014.07.009
- Jia, Guangshe, Yuting Chen , Xiangdong Xue, Jianguo Chen, Jiming Cao, and Kewei Tang. (2011) "Program management organization maturity integrated model for mega construction projects in china." *International Journal of Project Management*, 29, 834-845. DOI:10.1016/j.ijproman.2011.03.003
- Kardes, Ilke, Ayse Ozturk, S. Tamer Cavusgil, and Erin Cavusgil. (2013) "Managing global megaprojects: Complexity and risk management." *International Business Review*, 22, 905-917. DOI:10.1016/j.ibusrev.2013.01.003
- Kimiagari, Salman, and Samira Keivanpourb. (2018) "An interactive risk visualisation tool for largescale and complex engineering and construction projects under uncertainty and interdependence." *International Journal of Production Research*, 1-30. DOI:10.1080/00207543.2018.1503426
- Mackhaphonh, Nikhaphone, and Guangshe Jia. (2017) "Megaprojects in Developing Countries and their Challenges." *International Journal of Business, Economics and Management Works*, 4 (11), 6-12 . Reterived from Google Scholer.com
- Marrewijk, Alfons. (2006) "Managing project culture: The case of Environ Megaproject." *International Journal of Project Management*, 25, 290-299. DOI:10.1016/j.ijproman.2006.11.004
- Mok, Ka, Geoffrey Shen, and Jing Yang. (2015) "Stakeholder management studies in mega construction projects: A review and future directions." *International Journal of Project Management*, 33, 446-457. DOI:10.1016/j.ijproman.2014.08.007
- Othman, Ayman.(2014) "A conceptual model for overcoming the challenges of mega construction projects in developing countries." *African Journal of Engineering Research*, 2 (4), 73-84 . Retrieved from: <https://www.researchgate.net/publication/271262017>.
- Othman, Ayman. (2013) "Challenges of mega construction projects in developing countries. " *organization, technology and management in construction*, 5(1), 730-746. DOI: 10.5592/otmcj.2013.1.10
- Sun, Jide, and Peiliang Zhang.(2011) "Owner organization design for mega industrial construction projects." *International Journal of Project Management*, 29, 828-833. DOI:10.1016/j.ijproman.2011.04.005
- T. Zidanea, Youcef, J, Agnar Johansenb, and Anandasivakumar Ekambaramb. (2013) "Megaprojects - Challenges and Lessons Learned." *Procedia - Social and Behavioral Sciences*, 74, 349 - 357. DOI: 10.1016/j.sbspro.2013.03.041
- Thomas, Janice, and Thomas Mengel. (2008) "Preparing project managers to deal with complexity – Advanced project management education." *International Journal of Project Management*, 26, 304-315. Reterived from Google Scholer.com
- Zhou, W, J Whyte, and R Sacks. (2012) "Construction safety and digital design: a review." *Automation in construction*, 22, 102-111. DOI:10.1016/j.autcon.2011.07.005