

TOWARDS A CRITICAL CONSTRUCTION MANAGEMENT

RESEARCH AGENDA IN THE MENA REGION

By

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## **Dedication**

This thesis is dedicated to my father, my mother, my brothers, my sisters in law, and to my nephews. It is also dedicated to all my professors, colleagues and friends. Special dedication to my fiancé to whom there are no words that can express my appreciation for his encouragement, cheering, help and support.

## Abstract

Research in construction management has seen a lot of growth in recent years. The contribution of the Middle East and North Africa (MENA) region is still relatively low. There is a need to identify the causes of the low contribution along with identifying the gaps and future directions. The aim of this thesis is to analyze the construction management research for the period 1997-2011 and to develop a research agenda for the next ten years in the MENA region. To fulfill the first objective, data was collected from the top two journals in construction management: the Construction Management and Economics (CME) journal & the Journal of Construction Engineering and Management (JCEM) over the 1997-2011 period. The collected data was analyzed and summarized. MENA authors published 174 papers out of 2,643 papers published in the two journals. It was found that the concentrated research topics were “project Management”, “Project Delivery Systems and Contracts”, “Time/Cost Planning and Control”, and “Human Factors, Management of Safety and Labor Relationships” while the less interest research topics were “Construction Planning and Control”, “Construction Operations and Methods”, “Construction Industry Structure and Environment”, and “Technology Development Issues”. Furthermore, in order to fulfill the second objective, a survey was conducted. The survey was sent to 250 researchers. The number of returned responses is 49. The top construction management research topics for the future are “Time/Cost Planning and Control”, “Project Delivery Systems and Contracts”, and “Project Management” while the expected top construction management research sub-topics are “Sustainability”, “Project delivery systems with public and/or private financing”, and “Risk analysis and management”. Additionally, it was found that the Critical Path Method (CPM) and Line of Balance (LOB) are expected to be the most applied methods in scheduling while Building Information Modelling (BIM) and Information Technology (IT) are expected to be commonly used among other technology sub-topics for the future. Furthermore, the best action that can be taken in advancing the construction management research in the MENA is to increase the research collaboration between the three sectors (academia, industry and government). Finally, research agenda is proposed and future topics and recommendations are provided.

**Keywords:** construction management, research agenda, MENA, research topics

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## **Chapter 1: Introduction**

### **1.1. Overview**

This thesis analyzes the relevant work published in two of the top construction management journals for the period 1997-2011 and develops a critical research agenda for the discipline in the Middle East and North Africa (MENA) region. These two journals are the Construction Management and Economics journal (CME) and the Journal of Construction Engineering and Management (JCEM). The fifteen years period, studied in this thesis, constitutes a splitting point in these academic journals content. The publications have been extended in dimensions with a clear increase in the work volume that can be noted from the number of pages, issues and volumes published per year, and the appearance of new contributing authors, organizations, countries, topics, and sub-topics.

Construction is one of the largest industries, yet it has not been researched thoroughly enough. Aboulezz [1] stated that construction nowadays is more complex and sophisticated with the emergence of new business demands and challenges. He insisted that clients and competitors force civil engineers to apply new management concepts and theories to construction. There is a major need for long-term strategic planning which will give the chance to the construction field to compete with other fields in the job market [1].

Countries in the MENA region have the largest supplies of oil and gas [2]. This supply affects the entire region via its amassed profit and the movement of labor [3]. Moreover, in the MENA countries, there are other industries such as desalination, water supply, mining and power generation. These industries are considered as the latest activities in the MENA regions [2].

According to the Central Intelligence Agency (CIA) World Trade Report [4], reaching peace and stability in the MENA region is mandatory for enhancing the progress in the economy and construction. Since World War II, many attempts have been made for the purpose of developing and expanding the economy in MENA's countries, yet the financial relationships are still restricted. According to the scale of intra-regional merchandise trade in 2012 [5], the total exports and imports were only limited to 7-8% and if this is compared to Europe it would cover over 60%. The limitation in the MENA region arose not only in exports and imports, but in capital transactions as well [5]. Furthermore, according to the

statistics presented by OIFC [6], the average number of procedures to start a business in the MENA region was 8.1. When compared to the Eastern Europe & Central Asia (ECA), the same number would be higher by 1.8. Furthermore, statistics reveal that the average MENA's time to export (days) was 20.4 while in the ECA it was 26.7, and average MENA's time to import (days) was 24.2 while in the ECA it was 28.1 [6]. This study was conducted to analyze the business in the MENA region in the period 2006-2011 and other regions as well.

As mentioned above, starting a business in the MENA region takes more time than the ECA region while the opposite is valid in case of time needed to export and import. According to the statistics mentioned by OIFC [6], negative progress had occurred in some MENA countries such as Lebanon, Saudi Arabia and West Bank and Gaza in starting a business. This was due to the political restrictions and instability in these countries. All the conflicts and partisanship in the MENA region from the old days until today have caused a delay in the construction progress movement because of the lack of resources, labor, supply, etc. On the other hand, it has been stated in the Middle East economic integration in 2012 [3] that some countries in this region have gone through positive steps such as Saudi Arabia that reformed its judicial systems and adapted its capital market to international standards. Other factors that may affect the economy and construction in the MENA region are governance, tourism and labor flow [3].

The objectives of this thesis are to assess the construction management research in the MENA region over the last fifteen years and to provide a critical CM Research Agenda for the future. This thesis may help researchers in directing their research towards the most important research topics in this field that can lead us to a better construction industry in the MENA region.

## **1.2. Statement of the Problem**

“One could argue that construction management research is in need of an urgent stimulus of new thinking to prevent it from settling into a stale pattern of parochial observations which are as yet unguided by any substantial theories [7]”.

Few construction management researches have been conducted in the MENA region. There was a major need to assess the research efforts that were put in this research area to be able to discover the gaps within this field and try to improve it by conducting more research and coming up with new methods and

ideas. In addition, this study is made to shed the light on the most important and needed research areas in the MENA region that could help in improving the construction movement there.

### **1.3. Objectives**

The main objective of this thesis is to develop a critical CM Research Agenda that mainly underlined the most important construction topics for the next ten years in the MENA region. The detailed objectives are:

1. Assess and analyze the Construction Management research, its contents and major contributors and highlight the most prevailing research areas in this field over the last fifteen years in the MENA region.
2. Develop a critical CM Research Agenda for the next ten years in the MENA region.

### **1.4. Significance**

The main contribution of this research is the development of the first research agenda in the MENA region. This research agenda outlines the scope and content of the research efforts that were put at enhancing the subject of construction management over the last fifteen years in the MENA region. In addition, it provides a partial map for the construction management research for the future in the MENA region. In addition, this thesis reflects major characteristics and the progress within the discipline. It can be considered a basis from which we can develop the place of research in this area and even begin filling in the gaps. Also, this analysis will be of interest not only for researchers in the construction management area, but researchers for other management areas as well. In this regard, Shogren and Durden [8] and Tshirchart [9] stated that this type of study is very useful and valuable for different members and associates of the research community such as industry and/or colleges, personnel and completing Ph.Ds. in the job market, and to students for a powerful academic experience. In addition, this study can be very valuable in feeding the curiosity of new researchers interested in this field and in need of some guidelines to know what to concentrate on in their future research. Furthermore, it can be helpful for the students who are interested in publishing their work with high quality and importance research fields. Finally, this study can assist in studying the impact of academic contributions in this field and determining our position academically and

socioeconomically in construction management in the MENA region compared to the rest of the world.

## **1.5. Methodology**

### **1.5.1. Objective 1**

To accomplish Objective 1 of this study, the following steps were undertaken:

#### **1. Decide on the journals**

The journals that were used in investigating the contents and approaching the objectives of this thesis were chosen according to their ranking and relevance to construction management. In investigating the journals, Wing [10] classified the top two ranking construction management journals as: Construction Management and Economics, and Journal of Construction Engineering and Management. In addition, Fertigbau [11] ranked the construction management journals by giving a letter for each one of them starting by the letter A\* which is considered to be an excellent rank. He ranked them by giving Construction Management and Economics journal letter (A\*), and Journal of Construction Engineering and Management letter (A). Furthermore, EBSCO publishing team [12] ranked the Construction Management and Economics Journal to be the first one among other journals. Also, Blackwell Publishing in Computer-Aided Civil and Infrastructure Engineering [13] ranked the Journal of Construction Engineering and Management-ASCE to be in the 21<sup>st</sup> place among other civil engineering research journals and the total number of journals used in this article was 41. According to the previous paragraph, the top two journals that were used in this research were:

- Construction Management and Economics Journal (CME)
- Journal of Construction Engineering and Management (JCEM)

#### **2. Decide on the analysis period**

Dividing the analysis period into more than one interval was mostly seen through the literature review by researchers who have conducted the same type of study and did not belong to the MENA region. Hence, the analysis period was classified into three main Periods each one was of 5 years.

- Period 1: 1997-2001
- Period 2: 2002-2006
- Period 3: 2007-2011

### **3. Decide on the needed information**

To know what the needed information are to fulfilling this objective, a deeper look was taken at previous similar studies. The information included:

- Volume number, paper publication year, issue number, paper month publication, title of the paper, country of the paper, region that the country of the paper is related to, pages, number of pages, and keywords.
- Authors' names, organizations, country, email, author's affiliations categorized as academy, industry, or government, and author's region (whether form the MENA-region or not).

### **4. Filtering the papers in the MENA region**

The papers included in this study were all published papers in one of the two journals in the mentioned period. A more thorough analysis was cast on the papers related to the MENA region.

### **5. Classification of Papers**

Papers were classified according to the papers' titles, keywords, subject terms and abstract.

### **6. Classification of CM research topics and sub-topics**

The basic classification of construction management topics of both CME journal and JCEM has been carried out according to previous studies such as Aboulezz in 2003 [1], Abudayyeh, et al. in 2004 [14], Betts and Lansley in 1993 [15], Pietroforte and Aboulezz in 2005 [16], Pietroforte and Stefani in 2004 [17] and CEM body of knowledge. Further modifications were added to those classifications according to the needs. The classification has been adopted according to the papers' titles, keywords, subject terms and abstract. The final classification of both journals is reported in Chapter 3.

### **7. Analyze the data**

Two software were employed in accomplishing this objective Microsoft Excel and Microsoft Access. Statistical analysis of the data was conducted and illustrating tables and Figures were established. The analysis was carried out for both journals and each analysis was sub-divided into two regions: overall region and MENA region. The analysis was carried out for each period and for total period as well. These analyses started by the analysis of the issues for each journal apart. A detailed analysis was then created including analysis of the contributing papers, contributing authors,

contributing organizations, contributing countries, sector (academia, industry, or government), top Construction Management (CM) research topics, top CM research sub-topics, and less interest research topics for each region for each journal apart. Also, the ratio of MENA authors to non-MENA authors was calculated for each journal. In addition, the most growing and declining topics and sub-topics for the overall region as well as the most growing and declining topics for the MENA region were taken into consideration for each period and total period. Moreover, for each journal, a comparison between the overall region and the MENA region has been conducted regarding top CM research topics and less interest CM research topics for total period.

## **8. Summarize the data**

In summarizing the data, illustrating tables and figures were used. From the statistical analysis, we were able to assess the published material over the last fifteen years and know the most important areas, trends and less interest research areas in this field.

### **1.5.2. Objective 2**

For the sake of fulfilling Objective 2, a survey was conducted. Below is a detailed explanation of how the survey was developed.

#### **1. Developing the Survey (What questions to choose?)**

At the beginning of the survey, respondents were asked to provide their contact information i.e. name, email address, telephone number, and fax number. They were also requested to provide their work information i.e. position, organization name, and organization location. This survey basically discussed the main reasons/factors of the CM research gaps over the last fifteen years, top CM research topics, and top CM research sub-topics for the next ten years. Also, it was extended to discuss the most effective scheduling method, most important technology sub-topic, and the procedures that are to be followed to increase the diversity and applicability of the CM research topics in the MENA region for the next ten years. Finally, the respondents were asked to provide their opinion about the situation of the CM research over the last fifteen years and how the situation will be for the next ten years. Overall, questions were written after finishing Objective 1. Referring to the analyzed and summarized data in the literature review and coming back to previous surveys conducted in this field was the most appropriate way to come up with the survey questions. In general, the main idea of developing the survey was to enable us to

provide a critical CM Research Agenda in the MENA region for the next ten years that can lead to a better construction research and thus better construction progress.

## **2. Decide on the respondents**

The MENA researchers' emails were extracted from the data base of the two construction management journals on the internet and from the papers that were used in fulfilling Objective 1. Also, the faculty and employees in construction management, project management and construction departments at universities and companies in the MENA region were given a closer attention. Their emails were extracted, too. Additionally, faculty and employees who did not publish any paper in these two academic journals over the last fifteen years, yet they were related to the fields mentioned above were taken into consideration and the survey was sent to them. The survey was written online using "Google Documents" and it was sent to the potential researchers electronically via email. A specific deadline was given to the respondents for sending their feedback which was 1<sup>st</sup> April 2013-30<sup>th</sup> April 2013. Three reminders were sent during this duration. An extension was given until 15<sup>th</sup> May 2013 for the purpose of collecting more responses.

## **3. Collecting the feedback**

Respondents sent their feedback by email. Overall, the "survey" proved to be a very economic and efficient method from the previous studies but it was not without its drawbacks. One of the major drawbacks of this method was that some email addresses provided were invalid or not updated. Another drawback was that some researchers could not be reachable via email. In addition, some respondents who contributed to specific journals displayed some bias toward these journals. In general, although an extension had been given to the respondents, some respondents didn't meet the required date and sent their feedback after the extended deadline while most of them didn't reply the survey. This was one of the major obstacles faced when collecting the feedback. Also, the ratio of academicians to industry researchers was much higher than 1 and this led to a bias towards some CM research topics and sub-topics from academicians and thus they have gained higher weight and ranking.

## **4. Analyzing the feedback**

The answers of the respondents were examined and analyzed. In analyzing the responses, "Google Documents" provided a quick analysis of responses. Deeper analysis was carried out by one of the quantitative methods, "statistical analysis",

using Microsoft Excel. Finally, illustrating figures and tables were developed after analyzing the data.

#### **5. Summarizing the feedback**

From the statistical analysis as well as the illustrating figures and tables, a conclusion was drawn that can serve as guideline towards a better future construction world in the MENA region.

#### **6. Building up conclusions and recommendations and coming up with a critical CM research agenda for the next ten years in the MENA region**

Conclusions and recommendations have been built up depending on the analysis of the respondents and a critical construction management research agenda has been built up for the next ten years in the MENA region

### **1.6. Thesis Organization**

The following is a detailed description of the thesis organization. Chapter one presents the introduction to the research problem and the objectives. Chapter 2 presents the summary of the related literature review. Chapter 3 presents the classification of construction management topics. Chapter 4 presents the analysis of Construction Management and Economics Journal for the period 1997-2011 while Chapter 5 presents the analysis of the Journal of Construction Engineering and Management for the same period. Chapter 6 presents Objective 2 of the thesis which was the establishment of the survey and its analysis and then coming up with a critical CM Research Agenda for the next ten years in the MENA region. Finally, Chapter 7 presents the summary, conclusions and recommendations of the thesis.

## **Chapter 2: Literature Review**

### **2.1. Definition of MENA Countries**

“It is important that research is assessed on a global as well as a national basis. The evaluation of research in science and engineering is a complex process” [18].

The idea of developing a CM Research Agenda came from the need for such a study in the MENA region, since no similar studies have been done before. A research agenda was needed because it will help in assessing the development and progress of the CM field over the last fifteen years. Moreover, it will help identify the major contributors to the discipline as well as recognize the most prevailing research areas in this field. There was a need of organizing the data and the published papers, all of which was fulfilled via this thesis.

### **2.2. Definition of MENA Countries**

“We consider Algeria, Egypt, Libya, Morocco and Tunisia as North African countries and Bahrain, Iraq, Iran, Israel, Jordan, Kuwait, Lebanon, Oman, Qatar, Saudi Arabia, Syria, Turkey, United Arab Emirates and Yemen as Middle East countries” [19], [20].

On the other hand, according to the Tendersinfo Solutions Pvt. Ltd. [21], the MENA countries are stated to be, “Algeria, Bahrain, Cyprus, Djibouti, Egypt, Islamic Republic of Iran, Iraq, Israel, Jordan, Kuwait, Lebanon, Libya, Morocco, Oman, Palestine, Qatar, Saudi Arabia, Syrian Arab Republic, Tunisia, Turkey, United Arab Emirates, and Yemen”.

As can be noticed, the MENA countries are the same according to both references excluding Cyprus that has been mentioned in the second reference while it was excluded from the first one. In this study, only Northern Cyprus was considered to be part of the MENA region and Israel was considered to be part of Europe.

Based on what has been mentioned above we decided to limit the MENA region to the following countries: Algeria, Bahrain, Northern Cyprus, Djibouti, Egypt, Iran, Iraq, Jordan, Kuwait, Lebanon, Libya, Morocco, Oman, Palestine, Qatar, Saudi Arabia, Syria, Tunisia, Turkey, United Arab Emirates, and Yemen.

### **2.3. Construction Management Research Analysis**

“Construction management is broadly defined to include project management, construction economics, design economics, cost engineering, value engineering, construction law and procurement, industrial management and public policy related to the construction industry, etc [22]”.

The idea of coming up with such a study is not new and has been done before in other regions. Similar examples are Betts and Lansley [15] on construction management and economics, Betts and Lansley [23] on project management, Lakmazaheri and Rasdorf [24] on civil engineering, Hughes [25] on construction management, Morris [26] on project management, Aboulezz [1] on construction engineering and management, Abudayyeh et al. [14] on construction research, Pietroforte and Stefani [17] on construction engineering and management, and Pietroforte and Aboulezz [16] on engineering management.

Outlining and summarizing the history of construction management was a good thing to start with, yet it was not easy. Winter et al. [22] suggest that the construction field has to be more than “tools and techniques, or process and structure, people or decisions. It has to have some criteria for measuring the performance and success [22]”.

Betts and Lansley [15] analyzed all the papers published in the Construction Management and Economics Journal (CME) during the first ten years in 1993. The study was developed for the period 1983-1992 and it was divided into two intervals of five years each. In their study, they examined the contributors of the journal, the employers and their country of origin, the main issues of the papers and the way they were addressed in the journal. For developing this study, new databases and classification frameworks were created. Two databases were established: one for authors/papers and one for references. Due to the problems associated with the volume of references, only half of the papers were considered for citation analysis, with all citations from papers in the years 1983, 1985, 1987, 1989 and 1991 had been taken into consideration. Furthermore, “all citations of references to papers in the journal were included to enable complete assessment of the level of self-citation by the journal” [15]. In addition, there were two models of classification frameworks described in that paper one concerned with content and the other one with style. The content framework had six dimensions, four of them were described in that paper

which are subject, level of analysis, stage of building life cycle and sector while the other two were excluded because of their inapplicability to the contents of the journal. The style framework had two dimensions: one concerned with sources of information and the other concerned with contribution of papers. Regarding the classification of papers, the papers were classified into each one of the six dimensions mentioned in the paper by the two authors independently. The two authors reached to a level of agreement almost 100% at the end and all papers which agreement could not be reached remained unclassified. For assessing the contribution of individual authors, there were four measures weighted and unweighted pages and weighted and unweighted papers. Unweighted paper was assigned to an author, department or institution if their name appeared as any one of the authors while a weighted paper was a fraction dependent upon the number of authors. The same principle applied to pages. All papers were treated as if they have equal importance. Moreover, after analyzing all the published papers in the journal, Betts and Lansley [15] found that the academic base of papers had become stronger and a number of new authors and contributors to the journal had emerged during those ten years. It had been noticed that the contributors in the first five years were different than the contributors in the second five years. In the second five years Period, there were more international set of contributors. During this Period, the number of issues per volume and number of papers had increased while the length of papers had remained almost the same. However, the papers had become more referenced and it was found that 70% of the papers were based on data gathered from case studies or empirical data. In addition, it was concluded that Period that CME was mainly concerned with management of the project, project finances and the environment of the project and rarely dealt with technological or legal issues.

Similar to what Betts and Lansley had done in 1993 for the Construction Management and Economics Journal, they had carried out the same for the International Journal of Project Management (IJPM) in 1995 [23]. They analyzed all the published papers in this journal during the first ten years from its inception. The study period was 1983-1992 and it was divided into two intervals each one was of five years: 1983-1987 and 1988-1992. In their study, the meta- classification had two dimensions: one related to the content while the other related to the style. There were two content dimensions: class of subject and industrial sector. Style dimensions were also two which are: sources of information and contribution of papers. Furthermore,

they had classified the subjects of papers into eleven disciplines. After their study, they had found that during this period the journal had achieved a progress in terms of the number of published papers. In addition, during this period there were some published case studies and some papers based on empirical data. The main contributors to the journal were practitioners and academicians from different countries all over the world. Moreover, in the second period some topics had gained more interest such as “project start up”, “project procurement”, “conceptual models”, “project performance”, “project environment”, “project information”, “Risk Management”, and “Innovation”. On the other hand, some topics had declined in the second period such as “human factors”, “project planning”, and “project organization”. Finally, the authors highlighted the need for the future development of the project management discipline.

Lakmazaheri and Rasdorf [24] analyzed computing research in civil engineering as reflected in the Journal of Computing in Civil Engineering (JCCE) in 1998. This study was developed for the period 1987-1996 and it was divided into two time intervals each one was of five years. In their study, the authors identified the main contributing authors, organizations, and countries and they categorized the focus areas of their study based on two dimensions. The first dimension was main computing area and the second dimension was main engineering sub-discipline. Furthermore, the references were categorized according to their sources. After conducting the whole study and analyzing the results, it was discovered that during the ten years period, there were four hundred fifty four authors contributed to the journal where academicians were the main contributors. According to the statistics presented in the study [24], for the period 1987-1996 (86%) of the papers were made by authors from academia, 8% were made by industry researchers, and 6% were made by government authors. In addition, there were researchers from 26 countries contributed to the journal and two hundred seventy one solicited and unsolicited papers were published during this period. There were six engineering sub-disciplines presented in the papers which are: “Construction”, “Structures”, “Water resources and Environmental”, “Design (including Design Standards)”, “Transportation”, and “Geotechnical”. During this period, 24% of the papers were related to Construction, 24% related to Structures, 12% related to Water resources and Environmental, 11% related to Design, 27% related to Transportation and 7% related to Geotechnical. There were also other papers in the journal focused on other civil engineering topics

such as, surveying, urban planning, infrastructure, education, building, and geometric modeling. Similarly, there were other papers dealt with general applications of computing in engineering without focusing on one of the six engineering sub-disciplines. These papers were classified in the “others” and “General” categories in the paper. The authors noticed a decrease in the number of papers related to structures and geotechnical in the second period by 8% and 3% respectively. However, there was an increase in the number of papers related to water resources and environmental and transportation in the second period by 2% and 5% respectively. Moreover, the percentage of papers related to construction remained constant in the two periods whereas the total number of papers in the journal increased in the second period by 4%. Also, the authors noticed a spike in the number of references during the study period where majority of the references were made to journal articles and books. The breakdown of the cited literature was: journals (34%), books (25.6%), conference proceedings (17%), technical reports (12%), theses (3.9%), and others (7.5%) [24].

Hughes [25] combined abstracts and indexes related to construction management discipline from construction management journals for the year 1999. In his study, he used five journals: Building Research and Information (BRI) volume 27, Construction Management and Economics (CME) volume 17, Engineering, Construction, and Architectural Management (ECAM) volume 6, Journal of Construction Procurement (JCP) volume 5 and RICS Research Papers (RICS) volume 3. Abstracts had been extracted from these academic journals and listed in the thesis for the year 1999 and the volume number, issue number and pages number had been listed at the top of each abstract. In addition, list of relevant journals, index of authors and index of keywords had been attached at the end of the thesis in alphabetical order.

In 2000 Morris [26] analyzed all the papers and book reviews in the PM Network (PMN), Project Management Journal (PMJ), and International Journal of Project Management (IJPM) for the period 1990-1999. Papers were classified according to their content and relevance to project management research paradigms. Morris [26] started by analyzing the content of PMJ and PMN for the year 1990-1999 and found that the top popular topics were, examples or issues relative to particular project contexts: application areas (38), Time scheduling/phasing (22), Project Success Criteria (14), Control (12), and Project Management in General (12). In addition, he analyzed the content of IJPM and found that the most popular topics were, examples or issues relative to particular project contexts (100), Project

Management in General (47), Risk Management (42), Time scheduling/phasing (30) and Control (24). Finally, he analyzed the content of the three journals together and found that the most popular topics were, examples or issues relative to particular project contexts (148), Project Management in General (59), Risk Management (49), Control (36) and Project Management Competency Development (31). At the end of the paper, Morris [26] concluded that IJPM has to increase the number of its issues each year to cover the rising demand. In addition, he said that we have to understand the linkages between “project management and business performance”, as well as “project management’s generic responsibilities and actions in the area of technology and design”.

Aboulezz [1] developed a study in 2003 and the main objective from his study was “to map the construction engineering and management discipline, trace its evolution, and identify the most prevailing research areas”. This was carried out by analyzing the content of two academic journals related to this discipline which were, ASCE Journal of Management in Engineering (JME) and Journal of Construction Engineering and Management (JCEM). This study was developed for the years 1985-2002 and it was divided into three periods each of which was five years. Furthermore, the classification framework for assessing the data in this study was taken from a previous study carried out by Professor R. Pietroforte who analyzed the contents of the Journal of Construction Engineering and Management. In this regard, Aboulezz [1] identified thirteen subjects. Each subject was subdivided into many composing topics to obtain higher level of accuracy. The number of these topics exceeded 140. The papers were classified according to these thirteen subjects by reading their title, abstract, and the keywords of each paper. In addition, the main source of the data was ASCE online civil engineering database which was established by the author. After gathering the data and making the analysis, the author concluded that 70% of the published papers focused on four main subjects: management and organization of the firm (27%), project management (16%), industry structure and environment (14%), and management of personnel (13%). The author had also noticed that “Project Delivery Systems” was the most growing topic among the thirteen topics during this Period. Likewise, during this period, new topics had emerged such as topics of “design/build” and “project delivery systems and contracts” at the mid of nineties and so the number of papers published in this regard had been increased while some topics had been declined. The use of

research methods for this period had also changed. For example, the use of quantitative approaches varied from 2% to 5% and most of the published papers used the qualitative approach. Furthermore, Aboulezz [1] added, “some quantitative approaches are used in management-oriented studies in the attempt to link management theory and engineering science”. Regarding the authors of the journal, the author noticed that two thirds of the journal’s authors were academicians whereas the rest of the papers were published by practitioners, military, and government agencies. Furthermore, the first academic journal was mainly concerned with managerial aspects of engineering while the second journal was concerned with construction and technical issues. Aboulezz [1] suggested at the end of his paper conducting additional studies of the JCEM’s contents to be able to map the discipline more broadly in the USA.

In 2004, Abudayyeh et al. [14] analyzed the construction research trends in the American Society of Civil Engineer’s Journal of Construction Engineering and Management (JCEM) for the period 1985-2002 which included volumes 111-128 of the journal. The authors modeled the data from a previous study conducted by Lakmazaheri and Rasdorf 1998 of the Journal of Computing in Civil Engineering. After gathering the data, the construction research trends were identified and analyzed over three time intervals each one was of six years. After conducting the study, the authors concluded that U.S. writers were the largest contributors to the journal which means that there was an increasing number of international submissions to the journal during this Period. Furthermore, during this Period, there was a variety in the topics of the journal and it was found that the top research topical areas were related to “scheduling”, “productivity”, “constructability”, “simulation”, “cost control”, “planning”, “safety”, and “computer systems”. Abudayyeh et al. [14] highlighted at the end of his paper the major need for strengthening the links between industry & academia, government & academia, and industry & government to improve the construction industry.

In 2004 Pietroforte and Stefani [17] analyzed all the papers published in the ASCE Journal of Construction Engineering and Management for the year 1983-2000. The study was divided into six intervals, each interval spanning 2 years. They also identified in their study 30 institutional sources of the papers with demonstrating the specialization of these institutions in terms of subjects related to the construction engineering and management disciplines. For developing the study, Civil Engineering

Database 2000 was used and the content was analyzed according to two major dimensions: type of subject and type of institutional source of the papers. For analyzing the content of the papers in particular and the content of the journal in general, twelve subjects were created. The first seven subjects were concerned with “general contractors’ operations and business”, the following three subjects were concerned with “project planning, organizing and controlling” by a client, while the last two subjects were concerned with the “construction industry”. In addition, to classify the papers, the two authors worked independently by analyzing the title, abstract and keywords of each paper. The next step was gathering the data and narrowing the differences through iterations until the level of agreement reached almost 100%. After conducting the whole study and attaining the results, the authors noticed that the journal during this period had expanded in terms of number and length of papers, content and variety of topics as well as in terms of contributors and international institutional sources of the papers. Some topics in construction management had gained more interest during this Period such as “management of the firm”, “project delivery systems (Build-Operate-Transfer and Design/build)”, “project performance evaluation”, and “project quality planning”. The authors highlighted the need of focus on “operations” by specialty subcontractors and the same topic was raised by Pietroforte and Aboulezz 2005. At the end of the paper as a future direction, the authors suggested a study of the references of the journals’ papers and addressing the research efforts to show the evolution of the journal. Also, they suggested other classifications of the content of the paper that were, research output (type of contribution of the paper), research methods and mapping the research process (modeling of engineering and scientific method processes) to be conducted in the future.

In 2005, Pietroforte and Aboulezz [16] analyzed all the papers published in the ASCE Journal of Management in Engineering. The study was developed for the year 1985-2002 and it was divided into six periods, each of which was two years. Also, another division was analyzed, each being 8 years for two periods and the whole period was presented in the analysis too. The content was analyzed into two main dimensions: type of subject, and type of contributors to the journal. The content of this paper was built upon a database conducted earlier by Aboulezz 2003 which was ASCE’s civil engineering database. During this period, the authors noticed that the journal had extended in terms of the number of papers and contributions. Conversely,

the number of papers published by practitioners had declined. In addition, the authors noticed that the scope of engineering management discipline had been expanded to overcome the challenges of both the engineering discipline and business as well. The authors at the end of the paper suggested that having more studies of “subcontracting”, “specialty trade contractors”, and particularly “engineering design processes” is mandatory for improving the engineering management and construction management disciplines. Moreover, they referred the declining number of papers by practitioners to a gap existed between academia and practice which is something to worry about for the future.

Overall, the aim of the previous researches was to provide a partial map of the construction management discipline and trace its evolution along different periods of time in different regions. Those researches can be used as an ongoing investigation and contribution to the research analyses that was conducted before in the CM field.

#### **2.4. Developing Research Agenda**

In developing research agenda, many examples can be presented. In this regard, Lee et al. [27] developed a research agenda on anti-consumption where he defined and highlighted the importance of anti-consumption research and provided an overview of the latest studies in this field. Furthermore, Lee et al. suggested an agenda for further research on anti-consumption.

Another example can be presented by Edwards et al. [28] who discussed the phenomenon of tourism with the urban environment. He stated that the study of urban tourism and tourism in general can be considered as a growing area for practitioners, researchers and policy makers who are interested in understanding this phenomenon. He pointed out that there is a lack of research on this subject in Australia where they don't match the phenomenon of tourism with the urban environment. From here, an idea was borne for developing an agenda of urban tourism research. There were three objectives of this paper which are: to review the literature of tourism, to know the process that was undertaken for identifying the areas of urban tourism research, and to establish a framework for future urban tourism research.

Many more examples can be presented on research agendas in different disciplines.

## **2.5. Developing Construction Management Research Agenda**

A quick snap shot on some examples of construction management research agendas can be presented by Green [29], Green and Harty [30], Anvuur and Kumaraswamy [31], Brown and Phua [32], Gillen [33], and Phua [34]. In 2001, Green [29] mentioned in his article that the best practice of construction can be achieved by understanding three main concepts and practices in the construction field. These concepts are Business Process Reengineering (PBR) process improvement, lean construction and partnering. He talked in great detail about each one of these practices in relation to the best practice of construction.

Furthermore, in 2008, Green and Harty [30] tried to highlight the need of co-operation between both practitioners and academicians to come up with new knowledge and technologies together. They entitled this by “co-production” research. The same issue was presented by Anvuur and Kumaraswamy in 2006 [31].

On the other hand, in 2010, Brown and Phua [32] shed some light on another issue in the construction management discipline: identity. They highlighted in their article the need of understanding the identity issue in construction management field which can be a generative concept for college students. They classified the identity concerns as they relate to construction management into: professionalism, ethics, relational aspects of self-identity, competence, knowledge, and tools, and national culture. They argued that identity can be considered as a criterion to justify the success and the failure of the project. They added also that the need of this issue needs to be addressed in further studies to demonstrate its importance to the researchers in the construction management. Overall, the main purpose of this study was to explore ideas and generate questions for future programming research.

In addition, Gillen [33] developed a research agenda in national construction in 2010. The U.S. National Institute for Occupational Safety and Health (NIOSH) developed a research for the improvement of the health and safety of workers. In his paper, Gillen described the experience of the NIOSH Construction Program with two program planning initiatives for the purpose of improving the program. These two initiatives were (a) review of the work over the past decade (b) development of strategic goals into an agenda for the future work. These goals were intended for construction industry stakeholders and researchers to work together. In general, this paper described how research views lead to improve the health and safety of workers.

It also described the process that was used in developing the strategic goals that developed the National Construction Agenda.

Moreover, Phua [34] in 2013 discussed the construction management research at the individual level of analysis presenting the current state of the CM research, its gaps and future directions. The main idea of his article was discussing the factors that can affect the project performance issues. He addressed the main factors as culture, identity, empowerment and trust. These factors were explored in accordance to project performance issues and outcomes.

In general, these researchers tried to raise and cast attention on new issues that had not been discussed before in this field. They tried to summarize and categorize all the efforts put towards enhancing this field by making research agendas that can be used as guidelines for the future. These research agendas identify the past research trends of this field and add new technologies and techniques for developing it. Following those rules and taking them as supplementary bases for the future practice will assist in enriching this area and developing the research of it. The need for such agendas in the future is still in need since the need for construction is always growing all over the world. In this regard, Harris [35] states, “the industry needs research to increase its competitive potential in innovative projects, to participate in worldwide construction, and to provide top management personnel”.

## **2.6. Developing Research Agenda in the MENA Region**

Few research agendas have been developed in the MENA region and were related to the construction management discipline. No research agenda had been developed to assess the CM research for the past years in the MENA region. Some research agendas were developed in other fields such as El-Jardali [36] on Health Systems research priorities. The main objective of that study was to produce a national study that can set agendas into health financing, human resources for health, and the role of the non-state health sector. El-Jardali [36] stated that in this research agenda, the focus was on three questions directed to nine countries in the Middle East and North Africa region since they ranked as low and middle-income countries. These countries were Algeria, Egypt, Jordan, Lebanon, Morocco, Palestine, Syria, Tunisia and Yemen. El-Jardali [36] stated, “this is the first regional priority setting exercise conducted in the MENA region”. Typical examples of

other developed research agendas in the MENA region are Rached and Brooks. Rached and Brooks [37] developed a research agenda for water governance in the MENA region in 2010. In their paper, they focused on three subjects: demand management, wider stakeholder participation, and adoption of pro-poor strategies.

Another example can be presented by Tawfik [38] who analyzed the way North Africa is researched in Sub-Saharan Africa generally and South Africa specifically in 2010. In this paper, top issues, approaches and methodologies and resources had been addressed for analyzing the research trends. In addition, the author suggested new topics and research areas to strengthen the linkages between North and Sub-Saharan Africa in research [38].

Another example is Rached and Craissati on research for development [39]. The authors in this paper emphasized the understanding of the context for decision-making in developing countries, which included the research environment and how developing countries see the priorities of research agenda. Rached and Craissati [39] stated,

With a population of more than 250 million people and a notable strategic position between the North and South, the Middle East and North Africa (MENA) constitutes a distinct region of the developing world. Its future development is a matter of crucial importance to the world and to Canada. [39]

## **2.7. Chapter Summary**

This Chapter offered a summary of the related literature. In general, a hefty amount of research analyses and research agendas were conducted in the construction management field but these were beyond the MENA region activities. This thesis was the first of its kind that dealt with construction management analysis in the MENA region. There were other conducted research agendas related to the MENA region but not related to the construction management field.

## **Chapter 3: Classification of Construction Management Topics**

### **3.1. Introduction**

This Chapter offers a new classification of construction management research topics that have been combined from many resources. This classification consists of three levels. Level one is Construction Management. Level 2 consists of 10 divisions. Each one of these divisions has different number of sub-divisions below. The total number of sub-divisions is 75 and the total number of divisions and sub-divisions combined in the three levels is 86. This has been mentioned in details in section 3.3 of this Chapter.

### **3.2. Methodology**

The classification for CM topics for both CME journal and JCEM has been performed according to previous studies such as Aboulezz [1], Abudayyeh, et al. [14], Betts and Lansley [15], Pietroforte and Aboulezz [16], Pietroforte and Stefani [17] and CEM body of knowledge. The classification has been adopted then according to the papers' titles, keywords, subject terms and abstract. The final classification of both journals is listed in the following sections.

### **3.3. Results**

#### **3.3.1. Management and Organization of the Firm**

##### **3.3.1.1. Firm strategy, organization and culture**

This classification involves the firm organization structure and culture, information flow and communications that are related to the firm, firm strategy, competitive factors and performance, firm performance, corporate real estate practices, etc. "Firm strategy, organization and culture" includes the following keywords: construction firms, engineering firms, engineering consulting firm, minority firms, construction companies, corporations, transactional construction corporations, government-linked construction companies, firm objective, firm-specific factors, firm behavior, corporate ethics management, corporate code of ethics, corporate real estate management, corporate social responsibility, competition, competence, competitive advantage, national competitiveness, international competitiveness, performance, performance characteristics, performance evaluation, performance measurement, performance heterogeneity, corporate governance,

corporate growth, firm performance, company performance, corporate social performance, strategy, best practice, response strategies, strategic management, strategic planning, strategic groups, government policies, organizations, organization theory, matrix organization, inter-organizational governance, organizational change, organizational learning, organizational boundary, vertical boundaries, SWOT, SWOT analysis, culture, diversification, knowledge sharing, and knowledge transfer.

#### **3.3.1.2. Internationalization and Globalization**

This classification encompasses the internationalization and globalization from the firm point of view. Examples of “Internationalization and globalization” are international construction, international market, international factors, international development, international comparability, international competition, international construction research, global construction industry, etc. “Internationalization and Globalization” includes the following keywords: internationalization, international construction, international market, international factors, international development, international comparability, international competition, international construction research, multinational companies, globalization, and global construction activity.

#### **3.3.1.3. Marketing and investment patterns**

This classification deals with the strategies and policies employed and followed in the markets and investments. It also talks about the types, evaluation, patterns of marketing and investment within the construction industry. “Marketing and investment patterns” includes the following keywords: market orientation/structure, market operation, marketing, target marketing strategy, relationship marketing, property market, marketing mix, luxury residential market, mass residential market, market research, investments, investment patterns, private construction investment, and investment evaluation.

#### **3.3.1.4. Accounting and financial management**

This classification deals with the management of the finance in the construction firms. “Accounting and financial management” includes financial planning, factors, constrains. It may also include topics that are related to the loads and profits within the firm. “Accounting and financial management” includes the following keywords: financial management, financial planning, financial factors, financial constraint, loan and finance, and profits.

### **3.3.1.5. Business strategy and planning**

This classification deals with the business strategies that the firms apply. Business strategies may include business management, business failures, business processes, business systems engineering, business performance and evaluation, etc. “Business strategy and planning” includes the following keywords: business management, business failures, BPR, Business Process Re-engineering, Business Process Re-engineering (BPR), business system, business systems engineering, business definition, business performance, and business evaluation.

### **3.3.1.6. Inter-firm relationships**

This classification involves the inter-firm relationships that include partnerships, joint ventures, and subcontracting within the firm. “Inter-firm relationships” includes the following keywords: joint ventures, JV assessment, cooperation, subcontractors, partnerships, relational partnerships, partner selection, and public ownership.

### **3.3.1.7. Supply Chain management**

As Blanchard [40] mentioned “A supply chain is the sequence of events that cover a product’s entire life cycle, from conception to consumption”. According to Walsh et al. [41] “Supply Chain Management (SCM)” can be defined as a common practice between a group of companies and individuals who work collaboratively within a network of connected processes that aim to satisfy the end-customer requirements while rewarding all members of the chain. “Supply Chain management” includes the following keywords: chain management, supply chain theory, and supply chain delays.

## **3.3.2. Construction Planning and Control**

### **3.3.2.1. Designing for maintainability**

This classification deals with the repair and maintenance. It also talks about the service life of the buildings and their maintenance costs. In addition, it also deals with the maintenance programs that are conducted within the construction field. “Designing for maintainability” includes the following keywords: maintainability, repair, maintenance and repair, maintenance management, planned maintenance, maintenance program, minor maintenance, maintenance costs, building

maintainability, service life, service-led construction, service life planning, service life prediction, service-led projects, small works, small building works, performance, performance monitoring, key performance indicators, and life cycle assessment.

#### **3.3.2.2. Sustainability**

Sustainability deals with all the issues and problems that are related to the sustainability and the green environment. Manoliadis [42] stated, “sustainability recognizes that development based on the efficient and environmentally responsible use of all society’s scarce resources is essential to satisfy human needs and improve the quality of life”. “Sustainability” includes the following keywords: sustainability, sustainable, sustainable construction, sustainable policy, sustainability assessment, sustainable development, sustainable buildings, sustainable housing, building performance, rehabilitation, green buildings, design for the environment, and energy efficiency.

#### **3.3.2.3. Construction process models**

This classification deals with the modeling of the construction processes. It also deals with the construction processes simulation. “Construction process models” includes the following keywords: modeling, model, models, models and model making, process modeling, construction process, construction process modeling, construction process improvement, product modeling, product development process, object-oriented modeling, dynamic models, input-output models, linear model, mathematical models, computer programming, discrete elements, simulation, simulation models, simulation methods, computer simulation, computer aided simulation, simulation of construction operations, dynamic process simulation, object-oriented simulation, and simulation research.

#### **3.3.2.4. Constructability analysis**

This classification deals with the analysis of constructability. It also deals with all the issues and problems that are related to the constructability. Pertaining to this, the Construction Industry Institute [43] and Elazouni [44] pointed out, “constructability is the optimum use of construction knowledge and experience in planning, design, procurement, and field operations to achieve overall project objectives”. “Constructability analysis” includes the following keywords:

constructability, constructability implementation, constructability rules, and constructability improvement.

#### **3.3.2.5. Lean construction and production**

UETR [45] and Green & May [46] mentioned that the principle of lean thinking is mainly concerned with utilizing the most effective techniques for reducing waste and achieving major improvements in both efficiency and quality. This classification talks about the lean principles and procedures that are applied in the construction and production fields. “Lean construction and production” includes the following keywords: lean construction, lean production, and lean manufacturing.

#### **3.3.2.6. Planning of the construction process**

This classification deals with the planning of the construction processes. It also involves the selection of procedures and methods during the construction process and the factors affecting the planning. “Planning of the construction process” includes the following keywords: construction process, construction planning, process mapping, process protocol, and process improvement.

#### **3.3.2.7. Production management**

This classification deals with the “production management” or “production control”. As Bertrand et al. [47] and Ballard and Howell [48] mentioned, “Production control consists of aggregate production planning, material coordination, work load control, work order release, and production unit control”. It also discusses the production planning, production control, production processes, production systems engineering, production performance and evaluation, production principles and practices within the construction industry field, etc. “Production management” includes the following keywords: production management, production planning, production control, production theory, production processes, production systems, production engineering, production systems engineering, production performance, production evaluation, product management, product-service, aggregate, and aggregates.

### **3.3.3. Site, Materials and Equipment Management**

#### **3.3.3.1. Environmental management**

Environmental management is mainly concerned with the environmental contamination issues and management, waste disposal and management, and noise and air pollution. “Environmental management” includes the following keywords: environment, environmental management, environmental management system, environmental performance assessment, environmental issues, construction industry-environmental aspects, environmental impact, environmental harm, environmental ethics, environmental protection, environmental literacy, wastes, construction and demolition waste, construction waste, demolition waste, selective demolition, solid waste, waste management, waste management plan, solid waste management, waste minimization, waste reduction, waste recycling, recycling, re-use, air pollution, pollution control, emissions, and vehicles.

#### **3.3.3.2. Construction equipment management**

This classification deals with the construction equipment planning, costing, selection and management. It also deals with the construction equipment maintenance, replacement, operations, performance, and technology. “Construction equipment management” includes the following keywords: construction equipment, construction equipment industry, equipment cost and selection, equipment planning, equipment productivity, equipment maintenance, construction equipment-maintenance & repair, equipment technology, tower crane, cranes, mobile cranes, crane selection, truck mixer, and machine cycle time.

#### **3.3.3.3. Site preparation and layout**

This classification deals with the site preparation and layout including the work area planning and space usage. “Site preparation and layout” includes the following keywords: construction sites, site layout, building sites-planning, work space, site preparation, and site evaluation.

#### **3.3.3.4. Earthwork**

This type of work is mainly concerned with the process of moving soils, rocks, etc. in the site. In general, this section talks about the “earth work” and “earth moving operations” and the factors affecting them. “Earthwork” includes the following

keywords: earth work, earth works planning, earth moving, and earth moving machinery.

#### **3.3.3.5. Materials and component management**

This classification is mainly concerned with the materials and component management and handling including the logistics. It also involves the construction materials that are used in the site, their properties, admixtures and design. It even talks about bar coding, field data collection and management of information systems that are related to the site. “Materials and component management” includes the following keywords: construction materials, composite materials, materials management systems, materials planning, materials flow control, information management, information retrieval, data collection, data flow diagrams, and logistics.

#### **3.3.3.6. Production plants**

This classification deals with the production plants (aggregates) and everything related to them including their operations, maintenance, costs, downtime, etc. “Production plants” includes the following keywords: construction plants, construction plant cost, construction plant maintenance, construction plant maintenance cost, construction plant downtime, off-site production, and aggregates.

#### **3.3.3.7. Others**

The issues that are related to “Site Materials and Equipment Management” but not related directly to one of the mentioned sub-topics above. “Others” includes the following keywords: demolition and decommissioning.

### **3.3.4. Time/Cost Planning and Control**

#### **3.3.4.1. Modeling and simulation applications**

This classification deals with the modeling and simulation applications of both time and cost of the project. Modeling the cost and time of the project reduces the time and efforts required for scheduling the whole project. This may also be a good alternative for other scheduling used methods. “Modeling and simulation applications” includes the following keywords: modeling, model, models, cost models, cost modeling, time models, mathematical models, regression models,

simulation, computer applications, computer aided scheduling, computer programming, algorithms, genetic algorithms, and databases.

#### **3.3.4.2. Cost planning and control**

Cost planning and control is mainly concerned with the planning and controlling of the project cost. It is also involved with the project cash flow. Also, it discusses the cost evaluation and performance. “Cost planning and control” includes the following keywords: cost, costs, construction costs, project cost, building costs, cost planning, cost control, cost estimation, cost analysis, cost barrier, cost engineering, overhead cost allocation, cash flow, cash flow management, cash flow management strategies, cash farming, capital, performance, cost performance, and budget process.

#### **3.3.4.3. Resources planning and allocation**

This classification is mainly concerned with the planning and control of the project resources. This control includes: resources allocation and leveling. “Resources planning and allocation” includes the following keywords: resource allocation, resource allocation heuristic, resource leveling, resource management, resource scheduling, resource-driven scheduling, resource constraints, resource availability, resource importance, enterprise resource planning, and planning & scheduling.

#### **3.3.4.4. Time/cost scheduling optimization**

This classification encompasses the optimization of both time and cost of the project and reducing them as much as possible. It analyzes the relation between time and cost within the project. An example of “Time/cost scheduling optimization” is the “Time-cost tradeoff”. Feng et al. [49] mentioned that traditional time-cost trade off assumes that both time and cost are certain and deterministic in the project. In reality, this assumption is invalid since both time and cost are uncertain. For this reason, Feng et al. [49] added that, when dealing with time-cost trade off problems, simulation techniques are used for analyzing the stochastic effects of both time and cost. Finally, he suggested that algorithms too can be used in minimizing project duration and cost [49]. “Time/cost scheduling optimization” includes the following keywords: time, total cycle time, time study, scheduling, optimization, cost, cost reduction, time-cost, time cost relationship, time-cost tradeoff, integrated cost and schedule, cost and schedule control, Bromilow's time-cost model, time & economic reactions.

#### **3.3.4.5. Life cycle costing**

This classification deals with the whole life cycle cost of the project and the manner in which it is solved and applied. “Life cycle costing” includes the following keywords: life cycles, life cycle costing, and whole life cycle costing.

#### **3.3.4.6. LOB, linear and vertical scheduling**

This classification involves the “Linear and vertical scheduling” of the project. It also compares these methods to other methods used in the scheduling to highlight the weaknesses and the strengths of employing LOB in the project. “LOB, linear and vertical scheduling” includes the following keywords: LOB, line-of-balance, Line-Of-Balance (LOB), scheduling, linear scheduling, linear scheduling methods, linear scheduling problems, linear analysis, linear functions, linear programming, and time series analysis.

#### **3.3.4.7. Time scheduling and control techniques**

“Time scheduling and control techniques” deals with the different time scheduling methods and control techniques that are used during the scheduling process. “Time scheduling and control techniques” includes the following keywords: scheduling, construction schedule, multistage scheduling, control methods, and progress control.

#### **3.3.4.8. Critical path method**

This classification encompasses the “Critical Path Method (CPM)”. It also compares the CPM with other scheduling methods to highlight the weaknesses of this method. “Critical Path method” includes the following keywords: CPM, critical path method, Critical Path Method (CPM), critical path analysis, controlling path, scheduling, and time factors.

#### **3.3.4.9. Network planning and analysis**

This classification deals with the network planning and analysis that is used for scheduling the project. “Network planning and analysis” includes the following keywords: network analysis (planning), networks, and stochastic network.

#### **3.3.4.10. Non-deterministic time-cost estimating techniques**

“Non-deterministic time-cost estimating techniques” involves the non-deterministic (probabilistic) time-cost estimating techniques that are employed in the

project. Example of this method is Monte Carlo method. “Non-deterministic cost-time estimating techniques” includes the following keywords: cost estimating, cost accounting, time estimating, Monte Carlo method, probabilistic cost estimate, probabilistic time estimate, uncertainty, and forecasting.

#### **3.3.4.11. PERT and GERT**

“PERT and GERT” are used to analyze the risk of the project’s cost and time. “PERT and GERT” includes the following keywords: PERT, PERT (network analysis), and GERT.

### **3.3.5. Construction Operations and Methods**

#### **3.3.5.1. Buildings**

This classification deals with the buildings and everything related to them including their costs, repair and maintenance, operations, defects, evaluation and performance, etc. “Buildings” includes the following keywords: buildings, residential, residential buildings, high-rise, historic buildings, defects, built form, building construction, building process, building stock, building portfolio management, building performance, building enclosure performance, building stock dynamics, and building economics.

#### **3.3.5.2. Concrete construction**

This classification deals with the concrete construction including its operations, costs, structures, plants, etc. It also discusses the types of concrete, concrete structures including slabs, pavements, floors, etc. “Concrete construction” includes the following keywords: concrete, reinforced concrete, ready-mixed, ready mixed concrete, roller compacted concrete, concrete construction industry, concrete plants, concrete placing, concrete structures, concrete slabs, concrete floors, concrete pavements, and precast concrete products.

#### **3.3.5.3. Formwork, shoring and temporary structures**

This classification deals with the formwork, shoring and temporary structures practices in the construction field. “Formwork, shoring and temporary structures” includes the following keywords: formwork, formwork selection, horizontal formwork selection, false work, shoring towers, and temporary structures (building).

#### **3.3.5.4. Bridge construction**

This classification deals with the bridge construction and everything related to it including the bridge costs, maintenance, operations, types, components, systems, etc. “Bridge construction” includes the following keywords: bridge, bridges, bridge design, bridge construction, bridges-design and construction, bridge management systems, bridge health index, cantilever bridges, concrete bridges, and bridge decks.

#### **3.3.5.5. Highway construction**

This classification is mainly about highway construction and everything related to the highway structure. “Highway construction” includes the following keywords: highway construction, highway and road construction, highways, highway and roads, and highway transportation.

#### **3.3.5.6. Pile foundation and pipeline construction**

This classification concerns itself with the pile foundation and pipeline construction and all that is related to them, including their principles, practices, types, systems, costs, maintenance, applications, etc. “Pile foundation and pipeline construction” includes the following keywords: pile, piles, pipeline, and pipelines.

#### **3.3.5.7. Construction methods**

This classification deals with the different methods employed during the construction process. Examples of these methods are compaction, soil stabilization, etc. “Construction methods” includes the following keywords: construction methods soil stabilization, compaction, and directional drilling.

#### **3.3.5.8. Foundations and temporary retention walls, excavation**

This classification involves the foundations and temporary retention walls and excavation practices in the construction industry. “Foundations and temporary retention walls excavation” includes the following keywords: foundations, retaining wall selection, excavation, pile foundations, bored pile, pipes, piping, and pipeline construction.

#### **3.3.5.9. Tunnel construction**

This classification encompasses the tunnel construction and everything related to it including the tunnel costs, maintenance, operations, types, components, systems, etc. It also deals with the technologies that are established for tunneling procedures

(micro-tunneling). “Tunnel construction” includes the following keywords: tunnel, tunnels, tunnel construction, tunneling, micro-tunneling, and tunnel linings.

#### **3.3.5.10. Asphalt**

This classification deals with the asphalt and its application in the construction field. “Asphalt” includes the following keywords: asphalt, and asphalt pavements.

#### **3.3.5.11. MEP**

This classification involves the “Mechanical, Electrical and Plumbing (MEP)” activities and all what is related to them in the construction industry. “MEP” includes the following keywords: MEP, mechanical systems, electrical systems, and plumbing.

#### **3.3.5.12. Others**

The issues that are related to “Construction Operations and Methods” but not related directly to one of the mentioned sub-topics above. “Others” includes the following keywords: construction failures.

### **3.3.6. Human Factors, Management of Safety and Labor Relationships**

#### **3.3.6.1. Safety management**

Safety management encompasses the labor safety issues, safety performance and indicators, safety planning, programs and management such as first aid training programs. It is also concerned with project environment issues (if related to safety). Moreover, it involves analyzing the risk form safety point of view and discussing the health issues of the workers such as worker insurance and compensation. It even deals with injury and accidents analysis and cost. In addition, it discusses the site safety and the instructions that are applied in the site to reduce the number of site accidents.

“Safety management” includes the following keywords: safety, safety management, safety instruction, safety measures, safety factors, safety climate, behavioral safety, construction safety, site safety, safe room, health, healthcare, occupational safety, health and safety, occupational health and safety, organizational safety response, group safety climate, supervisors' safety response, co-workers' safety response, treatment programs, first aid, first aid training, HIV/AIDS, drug testing methods, disability, disability management, facilities management, occupational risk assessment, injury, injury management, injury distribution, medical treatment injuries,

lost-time injuries, accidents, construction site accidents, occupational accident, accident data, accident causes, accident prediction, accident prevention, damages, insurance, surety & fidelity insurance, and worker compensation.

### **3.3.6.2. Organized labor related issues**

This classification deals with the issues that are related to the labor including labor relations, gender, equity, disabled employees, turning over, labor relations, etc. “Organized labor related issues” includes the following keywords: labor, direct labor, workforce, craft, construction workers, disabled workers, disability, labor relations, employee relations, job demands, job satisfaction, relationship satisfaction, matrix relationship, conflict, relationship conflict, work-family conflict, work-family balance, work-life balance, work-study conflict, labor shortage, labor market, labor market characteristics, labor market flexibility, labor-only subcontracting, formalizing labor subcontracting, labor deployment, gender, gender differences, sex segregation, women, women engineers, women in construction, women in architecture, women company owners, age, skills, skills shortages, employee turnover, worker utilization, self-employment, career development, diversity, regional differences, regional perspectives, ideology, ethnic and minorities, perception, initiatives, segmentation, discrimination, equality, equal opportunities, creditability, social exchange, mainstreaming, reasonable adjustments, inclusion, social inclusion, Respect for People, reputation, employers’ associations, workplace practice and culture, workplace environments, and temporary working.

### **3.3.6.3. Performance analysis and measurement**

This classification deals with the performance analysis and measurement such as work sampling, performance improvement, quality circles, etc. Also, it deals with the factors influencing human performance such as motivation, and teamwork. “Performance analysis and measurement” includes the following keywords: labor, employees, performance, performance management, performance criteria, performance evaluation, performance measurement, estimation performance, performance improvement, enhancing performance, performance effectiveness, performance indicators, key performance indicators, performance appraisal, process performance, European contractor performance, consultant performance, behavior, behaviors, human behavior, job performance behaviors, organizational citizenship behavior, psychological well-being, psychological empowerment, burnout, role

overload, work measurement, needs assessment, ranking, pre-qualification, human factors, human error, motivation, demotivation, teams, teamwork, supervision, employee coaching, professionals, individualism, individualism-collectivism, community of practice, social support, social cognitive theory (SCT), organizations, perceived organizational support, inter-organizational cooperation, fuzzy membership functions, commitment, involvement, coping, flexibility, best practices, satisfaction measurement, conformity values, and confirmatory factor analysis

#### **3.3.6.4. Productivity issues**

This classification involves the labor productivity issues including its analysis, cost, rates, trends, and improvement. It also discusses the productivity of labor in the site and the factors that affects the productivity inside and outside the site. “Productivity issues” includes the following keywords: labor, productivity, productivity improvement, productivity rates, productivity trends, labor productivity, site labor productivity, labor inputs, labor efficiency, construction productivity, total factor productivity, translog production function, and the Malmquist total factor productivity.

#### **3.3.6.5. Communications**

This classification encompasses the human communications such as learning, training, education, personnel evaluation, etc. “Communications” includes the following keywords: communication, qualifications, skills, construction skills, construction craft skills, training, ethical training, vocational training, training provision, construction education, engineering education, accreditation (engineering), teaching, teaching methods, education and training, construction industry-study and teaching.

#### **3.3.6.6. Engineering managers characteristics and recruitment issues**

This classification deals with the manager’s characteristics and the employment/recruitment issues in the construction firms. “Engineering managers and recruitment issues” includes the following keywords: project manager, construction project managers, contractors' project construction managers, site managers, recruitment, and employment.

### **3.3.6.7. Others**

The issues that are related to “Human Factors, Management of Safety and Labor Relationships” but not related directly to one of the mentioned sub-topics above. “Others” includes the following topic: management of human-machines interfaces.

### **3.3.7. Project Management**

#### **3.3.7.1. Risk analysis and management**

This classification deals with the risk of the project. It is also involved in analyzing the risk including risk types, costs, models, systems, techniques, etc. “Risk analysis and management” includes the following keywords: risk, project risk, construction risk, financial risk, Risk Management Process (RMP), risk identification, risk perceptions, risk response, risk importance, risk management, joint risk management, risk management in business, risk analysis, quantitative risk analysis, risk assessment, estimating risk, risk attitude, risk factors, risk allocation, risk criticality, risk checklist, risk acceptance, risk mitigation, risk propagation, risk propensity, risk apportionment, risk techniques, risk modeling, risk-based entry decision model, traffic revenue risk, uncertainty, and uncertainty management.

#### **3.3.7.2. Cooperation, partnering, leadership and opportunity**

This classification analyzes the communication issues and parties involved within the project. It is also concerned with the cooperation, partnering, leadership and opportunity within the project team members. “Cooperation, partnering, leadership and opportunity” includes the following keywords: co-operation, co-operative behavior, collaboration, partnering, construction partnering, strategic partnering, Partnering Performance Index (PPI), leadership, project leadership, authenticity, authentic leadership, social networks, supervisor support, community relations, interaction, alliancing, social identity theory, organizational identification, in-group identification, inter-organizational relations, practice-based perspective, governance, and relationship.

#### **3.3.7.3. Project planning and organization**

This classification deals with the project planning and organization, project models, and project scope definition. “Project planning and organization” includes the

following keywords: planning, strategic planning, planning effectiveness, project planning, organizations, temporary organizations, project organization, project-based organizations, organizational theory, organizational values, organizational politics, organization structure, organizational design, organizational boundaries, organization behavior, organizational life cycle, organizational change, organizational learning, learning organization, modeling, dynamic models, casual models, structural equation modeling, multiple fuzzy goals programming, web-based system, project affinity, strategy, project strategies, project management decisions, project management competence, project coordinator, project chemistry, project complexity, and project arrangements.

#### **3.3.7.4. Project quality planning and control**

This classification involves the project quality issues. As example of the quality is warranty. The quality analysis includes quality control and quality assurance (performance based specifications). “Project quality planning and control” includes the following keywords: quality, construction quality, quality management, quality management system, TQM, total quality management, quality function deployment, project service quality, quality assurance, quality control, construction industry-quality control, quality assessment, quality practices, service quality, housing quality, quality clubs, contractor quality performance, cost of quality, performance specifications, performance based specifications, warranties, control, project control, portfolio of control, formal control, and drivers of control.

#### **3.3.7.5. Design management, Value engineering and management**

This classification deals involves the design management including the design types, planning, decisions, processes, documentations, standards, rules, metrics, errors, changes, revisions, research, labor, productivity, systems, components, etc. It is also involved in the design and pre-design estimates of the project. It even discusses the value management issues in the construction field. “Design management, Value engineering and management” includes the following keywords: design, designers, conceptual design, virtual design, defective design, design planning, design decision, design process, design documentation, design standards, design rules, design metrics, design errors, design changes, design rework, design revisions, design research, design labor, design productivity, life cycle design, component-based design, Design For Manufacture (DFM), and value management, and value engineering.

### **3.3.7.6. Project performance and feedback**

This classification encompasses the performance and the feedback of the project. It also discusses the measurement and the evaluation of the project as well as how to improve the projects based on the feedback. “Project performance and feedback” includes the following keywords: performance, project performance, project performance characteristics, performance evaluation, project performance evaluation, performance measurement, assessments, performance improvement, and project success factors.

### **3.3.7.7. Change management**

This classification deals with the change management including the change orders of the project. “Change management” includes the following keywords: change, changes, change orders, change management, and managing project change.

## **3.3.8. Project Delivery Systems and Contracts**

### **3.3.8.1. Selection and evaluation of bids and proposals**

This classification includes the policies applied in the projects when analyzing, selecting and evaluating the bids and proposals. This classification includes bidding procedures, strategies, models, types, decisions, evaluation, estimates, probabilities, etc. It may also include the selection and evaluation of tenders including tendering theory, documentation, pricing, types, etc. It also discusses auctions. “Selection and evaluation of bids and proposals” includes the following keywords: bid, bids, bidding, bidders, bidding procedure, bidding strategy, bid mark-up strategy, bidding strategies, competitive bidding, bidding models, parametric bidding model, ANN bidding model, Bid/No bid criteria, decision to bid, bid evaluation, pre-bid estimates, probability of lowest bid, unit bid cost, bid-unbalancing, tendering, tendering theory, tender documentation, tender price index, tender price index factor, lowest-price tender, fee tendering, auction theory, and sealed bid auctions.

### **3.3.8.2. Claims and disputes, negotiation and resolution, construction delays**

This classification deals with the claims and disputes including their processes, types, and management. It also discusses the negotiation and resolution issues within the project as well as the manner in which they have to be solved and treated. It also includes the construction delays and its consequences on the whole

project. “Claims and disputes, negotiation and resolution, construction delays” includes the following keywords: claim, claims, contract claims, construction claims, claims process, Type I claim, claims management, dispute, disputes, construction dispute, labor disputes, dispute resolution, dispute resolution strategies, ADR, ADR (Alternative Dispute Resolution), Dispute Adjudication Board, negotiation, conflict, attitudes, delay, delays, project delays, delay time, delay lines, delay analysis, delay differential equations, and delay & disruption claims.

#### **3.3.8.3. Project delivery systems with public and/or private financing**

This classification encompasses the project delivery systems in both types: project delivery systems with public financing and project delivery systems with private financing. It also includes “build operate transfer (BOT)” delivery methods, “public-private partnerships (PPP)” delivery method, etc. “Project delivery systems with public and/or private financing” includes the following keywords: project delivery methods, BOT, Build-operate-transfer, BOT projects, Build-Operate-Transfer (BOT) project, project finance, private finance, bank finance, private finance initiative, privatized infrastructure, privately financed infrastructure, private sector participation, PFI, PPPs, public-private partnerships, Public-Private Partnerships (PPP), financial analysis, financial decision-making, and governmental initiatives.

#### **3.3.8.4. Analysis and selection criteria**

This classification includes the selection and evaluation criteria of the delivery systems and contracts of the project. It includes procurement’s selection, evaluation, criteria, requirements, strategies, systems, methods, types, etc. “Analysis and selection criteria” includes the following keywords: project delivery system, contract, procurement, selection, selection criteria, procurement selection, procurement evaluation, prequalification requirements, procurement strategies, procurement systems, procurement methods, material procurement, industrial procurement, public sector procurement, procurement and social housing.

#### **3.3.8.5. Selection and evaluation of contractors**

This classification encompasses the policies applied when selecting and evaluating the contractors. It even talks about the contractor’s evaluation, prequalification, selection, abilities, etc. It is also involved with the financial evaluation of contractors. “Selection and evaluation of contractors” includes the

following keywords: contractors, evaluation, selection, contractor selection, selection criteria, prequalification, contractor pre-qualification, contractor ability, contractors, contractors' credit limits, financial factors, and financial health.

#### **3.3.8.6. Contract and contingency management**

This classification deals with the contract and contingency management including their selection, types such as incentive and disincentive contracts. This classification is also concerned with contract and contingency forms, costs, cases, etc. It even talks about contract bonds and involves the contractual clauses such as penalty clauses, and liquidated damage clauses. In addition, it deals with warranties and guarantees and their terms. “Contract and contingency management” includes the following keywords: contract, contracts, construction contracts, forms of contract, standards, standard form of contract, contract selection, contract incompleteness, incentive contracts, target cost contracts, contingency, contingency cost, contract clauses, penalty clauses, liquidated damage clauses, bonds, bonding, warranties, guarantee, guarantees, guaranteed maximum price, surety ship & guaranty, incentives, and disincentives.

#### **3.3.8.7. Design/build**

This classification includes the “Design/build” contracts and all their terms and practices. “Design/build” includes the following keywords: design/build, design and build, and enhanced design build.

### **3.3.9. Construction Industry Structure and Environment**

#### **3.3.9.1. Domestic construction issues and practices**

This classification deals with the domestic construction issues and practices. It also discusses the domestic industry structure and performance, as well as the economic issues and impacts from construction point of view. “Domestic construction issues and practices” includes the following keywords: construction, construction industry, construction sector, construction activity, construction practices, construction economics, construction management, engineering practice, construction prices, input-output analysis, construction output, construction output shock, construction output forecasting, construction output price index, construction demand, construction stage, Construction statistics, construction new orders, construction

investments, construction linkages, small construction enterprises, residential construction, economic factors, economy reform, economy development, economy sectors, economic sectors, economy theory, economy growth, economy performance, and knowledge-based economy.

#### **3.3.9.2. Codes, standards and laws**

This classification deals with the codes, standards and laws that are used in the construction industry field. “Codes, standards and laws” includes the following keywords: code, codes, building code, standards, construction industry-Standards, standardization, construction industry-law and legislation, ISO 9000 series standards, ISO 14000 series standards, ISO 9001:2000 standards, construction law, contract law, procurement law, prevailing wage laws, and litigation.

#### **3.3.9.3. Roles and cooperation in the industry**

This classification encompasses the roles and cooperation in the industry including the relation between owners, clients, contractors, subcontractors and professionals. “Roles and cooperation in the industry” includes the following keywords: contractors, main-specialty contractor relationship, client relationships, owners, subcontractors, subcontracting secondary subcontracting, and relationships.

#### **3.3.9.4. Classification and information systems**

This classification deals with the project classification and information systems. “Classification and information systems” includes the following keywords: information systems, engineering systems, information processing, information resources, information management, information resources management, knowledge, and knowledge discovery.

### **3.3.10. Technology Development Issues**

#### **3.3.10.1. Innovation and technology transfer, analysis, and mechanics**

This classification involves the innovation including its strategy, implementation, diffusion, and management in the construction field. Also, it talks about the innovation in technology and the adaption to new construction technologies, methods and techniques. “Innovation and technology transfer, analysis, and mechanics” includes the following keywords: innovation, innovations, construction

innovations, technological innovations, Construction industry -- Technological innovations, Building -- Technological innovations, technical innovation, innovation management, innovation strategy, innovation implementation, and diffusion of innovation.

#### **3.3.10.2. Research and development issues, research needs**

This classification deals with the research and development issues in the construction industry including research types, methods, policies, paradigms, priorities, needs, etc. “Research and development issues, research needs” includes the following keywords: research, research & development, research and development, research agenda, academic research, construction research, management research, future research, cross-cultural research, action research, management research, research typology, research methods, research methodology, research policy, research paradigms, research priorities, research needs, ASCE publications, education-research, construction industry -- study & teaching, comparative studies, and theories.

#### **3.3.10.3. MIS and IT based integration and communications + GPS**

This classification deals with the MIS and IT based integration and communications in the project. It also talks about the Geographic Information Systems (GIS) and the Global Positioning Systems (GPS). It also includes the web-based project management, software, innovative hardware, identification technologies (i.e. bar codes, radio frequency identification), electronic commerce, visualization, and wireless technology. “MIS and IT based integration and communication + GPS” includes the following keywords: IT, information technology, Information Technology (IT), innovative IT, IT implementation, information retrieval, information science, information processing, information systems, information management, high technology industries, technology management, communication, communication factors, communications research, mobile communication systems, electronic communications, information and communication technology, world wide web, computer, computers, computer software, internet, websites, social networks, bar coding, object-oriented programming (computer science), hybrid methods, Auto-ID, lasers, radio frequency identification systems, video recording, data collection, electronic data processing, routing, GIS, Geographic Information Systems, Geographic Information Systems (GIS), GPS, Global Positioning Systems, and Global Positioning Systems (GPS).

#### **3.3.10.4. 2-D, 3-D and 4-D CAD**

This classification is mainly concerned with CAD applications in general and their types i.e. 2-D, 3-D and 4-D applications. “2-D, 3-D and 4-D CAD” includes the following keywords: computer-aided design, computer aided drafting computer-aided engineering, (CAD), nCAD, 2D CAD, 3D CAD, 4D CAD, two-dimensional CAD, three-dimensional CAD, four-dimensional CAD, two-dimensional models, three-dimensional models, four-dimensional models, two-dimensional imaging, three-dimensional imaging, and lastly four-dimensional imaging.

#### **3.3.10.5. BIM**

Azhar [50] in 2011 mentioned that Building Information Modeling (BIM) is one of the most recent developments in the Architecture, Engineering, and Construction (AEC) industry. He added that BIM can be employed for planning, design, construction, and operation of the facility. BIM is also used to construct an accurate virtual model of a building [50]. This classification deals with the BIM systems in the project. “BIM” includes the following keywords: BIM, and Building Information Modeling (BIM).

#### **3.3.10.6. Others**

The issues that are related to “Technology Development Issues” but not related directly to one of the mentioned sub-topics above. “Others” includes the following keywords: quantitative methods, and decision analysis.

### **3.4. Chapter Summary**

The final classification consists of three levels. Level 1 is Construction Management, Level 2 comprises of 10 divisions and Level 3 involves a different number of sub-divisions according to the divisions in level 2. The final classification of topics as follows:

#### **1. Construction Management**

##### **1.1 Management and Organization of the Firm**

- 1.1.1 Firm strategy, organization and culture
- 1.1.2 Internationalization and globalization
- 1.1.3 Marketing and investment patterns
- 1.1.4 Accounting and financial management

- 1.1.5 Business strategy and planning
- 1.1.6 Inter-firm relationships
- 1.1.7 Supply chain management

## **1.2 Construction Planning and Control**

- 1.2.1 Designing for maintainability
- 1.2.2 Sustainability
- 1.2.3 Construction process models
- 1.2.4 Constructability analysis
- 1.2.5 Lean construction and production
- 1.2.6 Planning of the construction process
- 1.2.7 Production management

## **1.3 Site, Materials and Equipment Management**

- 1.3.1 Environmental management
- 1.3.2 Construction equipment management
- 1.3.3 Site preparation and layout
- 1.3.4 Earthwork
- 1.3.5 Materials and component management
- 1.3.6 Production plants
- 1.3.7 Others

## **1.4 Time/Cost Planning and Control**

- 1.4.1 Modeling and simulation applications
- 1.4.2 Cost planning and control
- 1.4.3 Resources planning and allocation
- 1.4.4 Time/cost scheduling optimization
- 1.4.5 Life cycle costing
- 1.4.6 LOB, linear and vertical scheduling
- 1.4.7 Time scheduling and control techniques
- 1.4.8 Critical path method
- 1.4.9 Network planning and analysis
- 1.4.10 Non-deterministic time-cost estimating techniques
- 1.4.11 PERT and GERT

## **1.5 Construction Operations and Methods**

- 1.5.1 Buildings
- 1.5.2 Concrete construction
- 1.5.3 Formwork, shoring and temporary structures
- 1.5.4 Bridge construction
- 1.5.5 Highway construction
- 1.5.6 Pile foundation and pipeline construction
- 1.5.7 Construction methods
- 1.5.8 Foundations and temporary retention walls, excavation
- 1.5.9 Tunnel construction
- 1.5.10 Asphalt
- 1.5.11 MEP
- 1.5.12 Others

## **1.6 Human Factors, Management of Safety and Labor Relationships**

- 1.6.1 Safety management
- 1.6.2 Organized labor related issues
- 1.6.3 Performance analysis and measurement
- 1.6.4 Productivity issues
- 1.6.5 Communications
- 1.6.6 Engineering managers characteristics and recruitment issues
- 1.6.7 Others

## **1.7 Project Management**

- 1.7.1 Risk analysis and management
- 1.7.2 Cooperation, partnering, leadership and opportunity
- 1.7.3 Project planning and organization
- 1.7.4 Project quality planning and control
- 1.7.5 Design management, Value engineering and management
- 1.7.6 Project performance and feedback
- 1.7.7 Change management

## **1.8 Project Delivery Systems and Contracts**

- 1.8.1 Selection and evaluation of bids and proposals
- 1.8.2 Claims and disputes, negotiation and resolution, construction delays
- 1.8.3 Project delivery systems with public and/or private financing
- 1.8.4 Analysis and selection criteria
- 1.8.5 Selection and evaluation of contractors
- 1.8.6 Contract and contingency management
- 1.8.7 Design/build

## **1.9 Construction Industry Structure and Environment**

- 1.9.1 Domestic construction issues and practices
- 1.9.2 Codes, standards and laws
- 1.9.3 Roles and cooperation in the industry
- 1.9.4 Classification and information systems

## **1.10 Technology Development Issues**

- 1.10.1 Innovation and technology transfer, analysis, and mechanics
- 1.10.2 Research and development issues, research needs
- 1.10.3 MIS and IT based integration and communications + GPS
- 1.10.4 2-D, 3-D and 4-D CAD
- 1.10.5 BIM
- 1.10.6 Others

## **Chapter 4: Construction Management and Economics Journal**

### **4.1. Introduction**

This section provides the analysis for the Construction Management and Economics Journal for Period 1 (1997-2001) and includes volumes 15-19, Period 2 (2002-2006) and includes volumes 20-24, Period 3 (2007-2011) and includes volumes 25-29. The total period is from 1997-2011 and includes volumes 15-29. Each technical paper in each issue of the journal for the specified period was accounted for this study. Editorials, book reviews, notes, and papers less than 2 pages were excluded from the study. For each technical paper of the journal, the following information was extracted and recorded:

- Volume number, paper publication year, issue number, paper publication month, title of the paper, country of the paper, region that the country of the paper is related to, and keywords,
- Authors' names, organizations, country, email, author's affiliations (categorized as academia, industry, or government), and author's region (whether from the MENA region or not), and
- Construction management research topics according to the classification that has been mentioned in Chapter 3.

### **4.2. Analysis of the Issues and Papers**

#### **4.2.1. Analysis of the Issues**

The number of issues was 6 for the years 1997-1999, this number has increased to 8 issues for the years 2000-2003, 10 for the years 2004-2006 and finally the number of issues reached 12 for the years 2007-2011 as one issue in each month of the year.

#### **4.2.2. Analysis of the Papers in the Overall Region**

The Construction Management and Economics Journal has been analyzed for the periods 1997-2001, 2002-2006 and 2007-2011. The number of papers published for the period 1 was 344 papers, 414 papers for Period 2 and finally 458 papers for Period 3. The total number of published papers was 1,216 for the whole period.

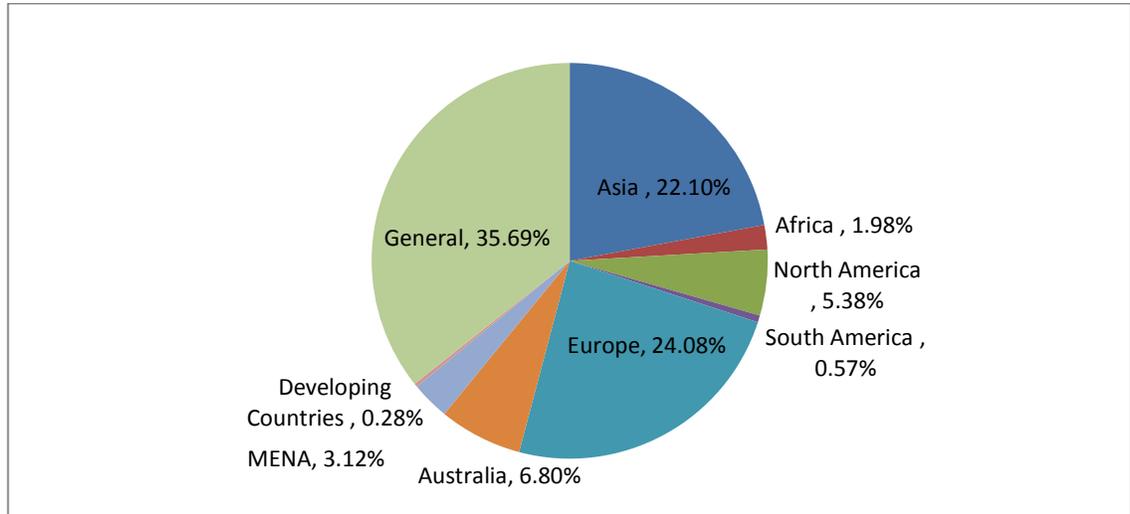
Figure 4.1 presents the distribution of the papers according to the country that the paper talked about in the overall region for Period 1. This has been carried out

according to the title of the paper, geographic terms, and abstract. Each country mentioned by the paper has been included in the distribution. There were cases where the paper talked about more than one country. In this case, the paper would be included more than once in the distribution. If there was no country mentioned, the paper would be classified as “General”.

The countries have been classified as follows:

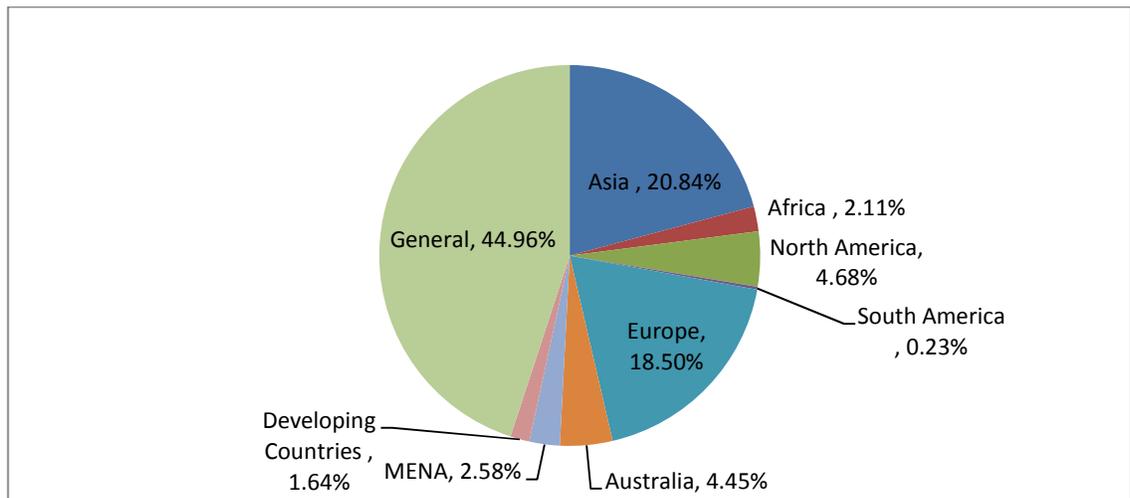
- Asia: Afghanistan, Bangladesh, Brunei, China, Hong Kong, India, Indonesia, Japan, Korea, Mainland China, Malaysia, Pakistan, Singapore, South Korea, Sri-Lanka, Taiwan, Thailand, Vietnam
- Africa: Ghana, Kenya, Nigeria, Sub-Saharan African, Tanzania, Zambia
- North America: Canada, Mexico, Trinidad & Tobago, US, Victoria
- South America: Argentina, Brazil, Colombia
- Europe: Austria, Belgium, Denmark, Finland, France, Germany, Greece, Israel, Italy, Netherlands, Northern Ireland, Norway, Poland, Portugal, Scotland, Slovenia, Spain, Sweden, UK, Wales (UK)
- Australia: Melbourne, New South Wales, New Zealand, Queensland, Samoa, Victoria
- MENA: has been defined before in Chapter 2 of the thesis
- Developing Countries: Low income and living standard countries compared to other countries that spots in different locations of the world. [51]
- General: No country or region specified

For Period 1, the largest contribution comprised of General (35.69%, 126 papers) and then Europe (24.08%, 85 papers). The next was Asia (22.10%, 78 papers), Australia (6.80%, 24 papers), and North America (5.38%, 19 papers). Furthermore, the MENA contribution accounted for (3.12%, 11 papers), and Africa (1.98%, 7 papers). Finally, South America accounted for (0.57%, 2 papers) and the minimum contribution was from Developing Countries (0.28%, 1 paper). Total number of papers published for overall region for this period was 344 papers.



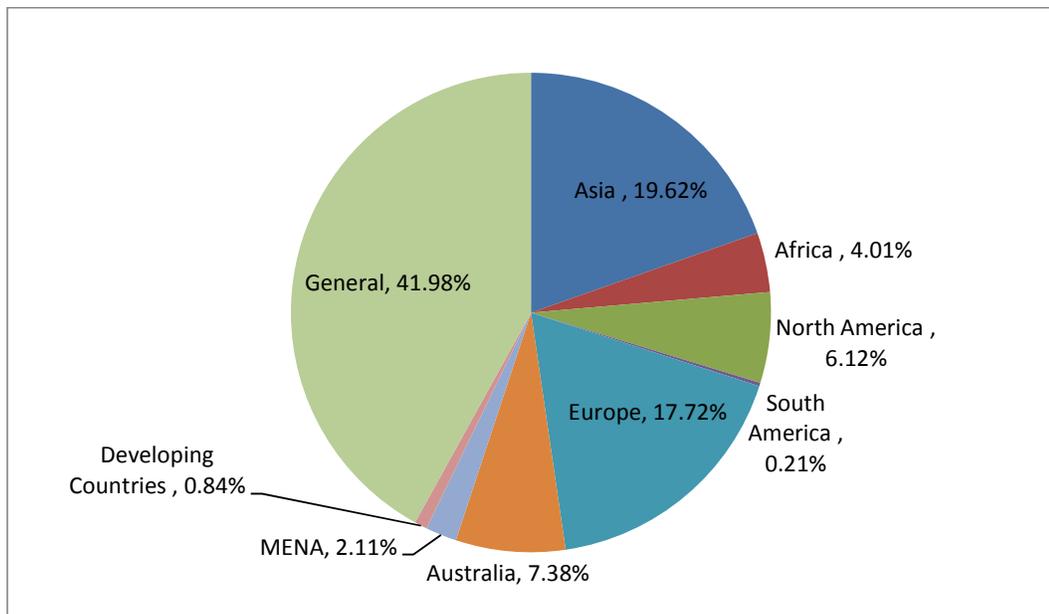
**Figure 4.1: Distribution of Papers According to their Countries in the Overall Region for Period 1**

Figure 4.2 shows the distribution of the papers according to the country that the paper talked about in the overall region for Period 2. For Period 2, the largest contribution comprised of General (44.96%, 192 papers) and then Asia (20.84%, 89 papers). The next was for Europe (18.50%, 79 papers), North America (4.68%, 20 papers), and Australia (4.45%, 19 papers). Furthermore, the MENA contribution accounted for (2.58%, 11 papers), and Africa (2.11%, 9 papers). Finally, Developing Countries accounted for (1.64%, 7 papers) and the minimum contribution was from South America (0.23%, 1 paper). Total number of papers published for overall region for this period was 414 papers.



**Figure 4.2: Distribution of Papers According to their Countries in the Overall Region for Period 2**

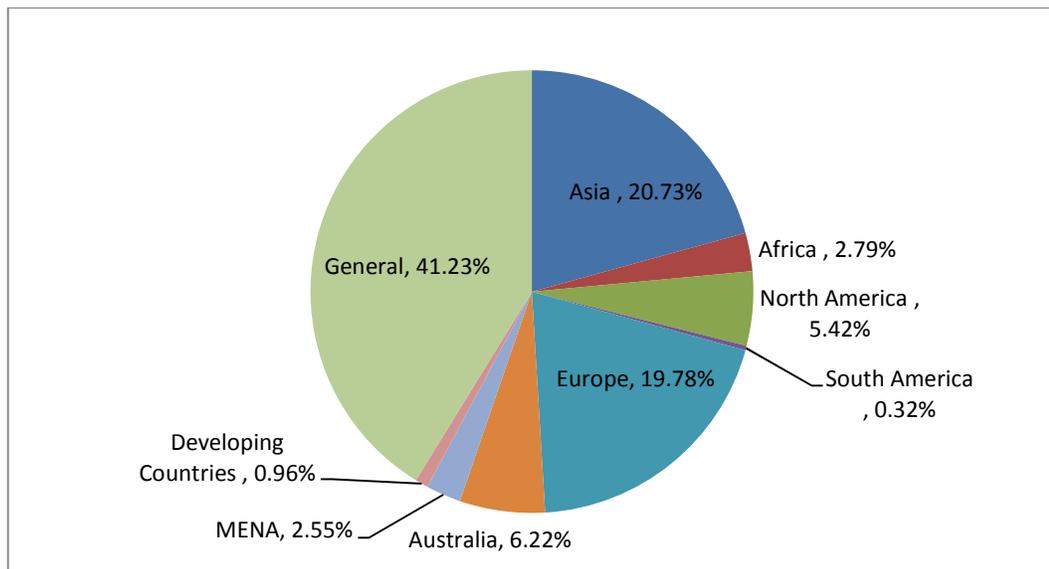
Figure 4.3 shows the distribution of the papers according to the country that the paper talked about in the overall region for Period 3. For Period 3, the largest contribution comprised of General (41.98%, 199 papers) and then Asia (19.62%, 93 papers). The next was for Europe (17.72%, 84 papers), Australia (7.38%, 35 papers), North America (6.12%, 29 papers), and Africa (4.01%, 19 papers). Furthermore, the MENA contribution accounted for (2.11%, 10 papers). Finally, Developing Countries accounted for (0.84%, 4 papers) and the minimum contribution was from South America (0.21%, 1paper). Total number of papers published for overall region for this period was 458 papers.



**Figure 4.3: Distribution of Papers According to their Countries in the Overall Region for Period 3**

Figure 4.4 shows the distribution of the papers according to the country that the paper talked about in the overall region for total period. The largest contribution of all countries for total period was General (41.23%, 517 papers) and then Asia (20.73%, 260 papers). The next was for Europe (19.78%, 248 papers), Australia (6.22%, 78 papers), North America (5.42%, 68 papers), and Africa (2.79%, 35 papers). Furthermore, the MENA contribution accounted for (2.55%, 32 papers). Finally, Developing Countries accounted for (0.96%, 12 papers) and the minimum contribution was from South America (0.32%, 4 papers). Total number of papers published for overall region for this period was 1,216 papers.

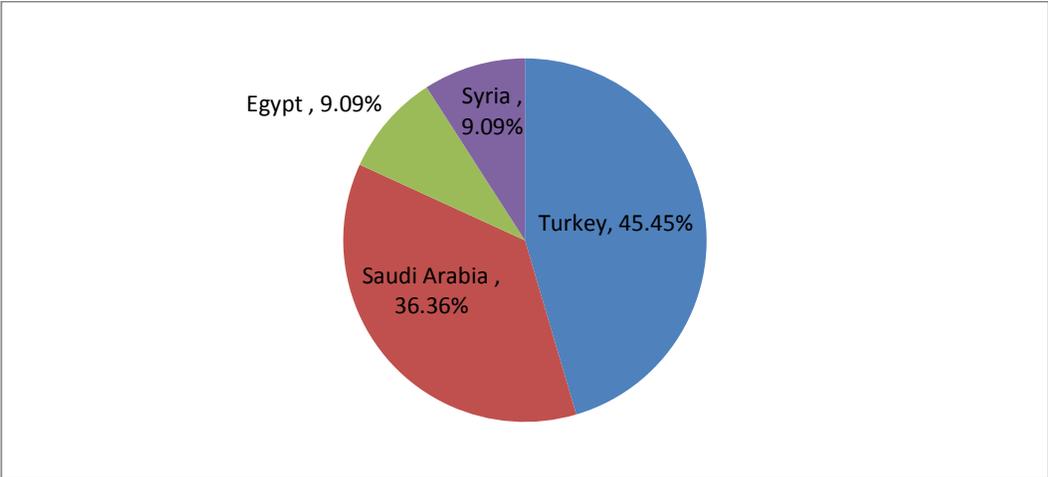
In general, the number of papers always increased from period to period. This may be attributed to the increase in the number of contributing authors and organizations as will be seen in section 4.3.1 and 4.4.1. In addition, the MENA region made a small contribution to the journal compared to other countries in the three periods and total period. One reason can be attributed to the comparative lesser number of countries in the MENA region thus resulting in lower quantities of contributing authors/organizations. Detailed MENA contribution to the journal is mentioned in section 4.2.2 of this chapter. Also, South America, Africa, and Developing Countries made small contributions to the journal through the whole period. On the other hand, the largest contribution was always by “General” through the whole period where there was no country specified in the paper.



**Figure 4.4: Distribution of Papers According to their Countries in the Overall Region for Total Period**

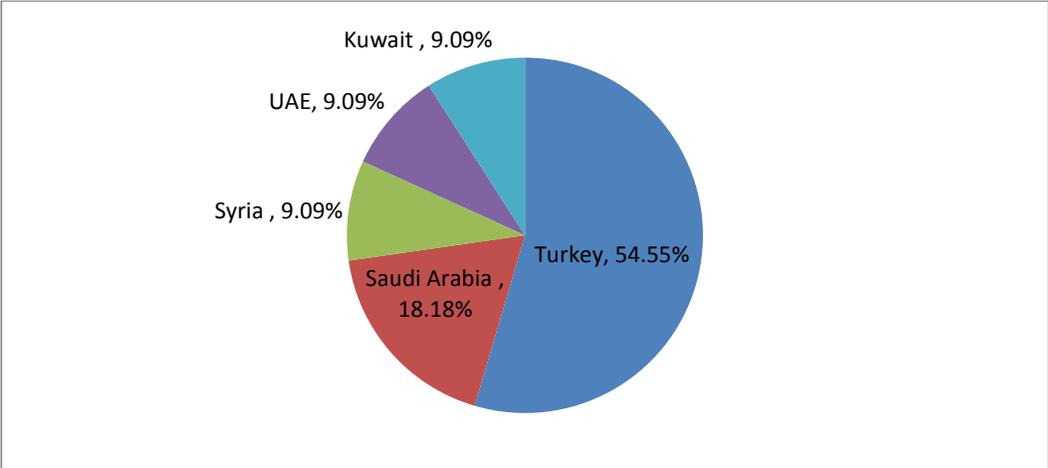
#### **4.2.3. Analysis of the Papers in the MENA Region**

Figure 4.5 depicts the distribution of the papers according to the country (in the MENA region) referred to in the paper for Period 1. For Period 1, the largest contribution comprised of Turkey (45.45%, 5 papers) and then Saudi Arabia (36.36%, 4 papers). Furthermore, Egypt, and Syria had the same contribution which was (9.09%, 1 paper). Total number of papers published for MENA region for this period was 11 papers.



**Figure 4.5: Distribution of Papers According to their Countries in the MENA Region for Period 1**

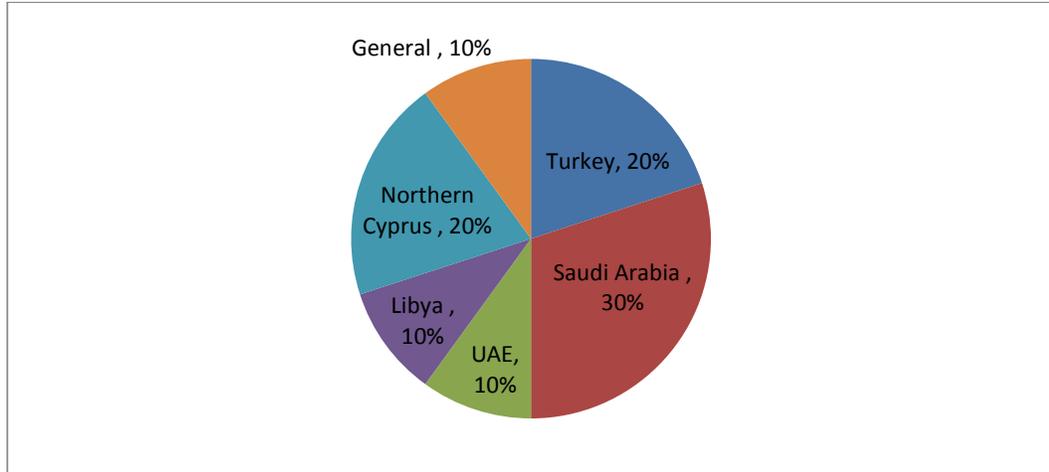
Figure 4.6 shows the distribution of the papers according to the country that the paper talked about in the MENA region for Period 2. For Period 2, the largest contribution comprised of Turkey (54.55%, 6 papers) and then Saudi Arabia (18.18%, 2 papers). Furthermore, Syria, UAE, and Kuwait had the same contribution which was (9.09%, 1 paper). Total number of papers published for MENA region for this period was 11 papers.



**Figure 4.6: Distribution of Papers According to their Countries in the MENA Region for Period 2**

Figure 4.7 shows the distribution of the papers according to the country that the paper talked about in the MENA region for Period 3. For Period 3, the largest contribution comprised of Saudi Arabia (30%, 3 papers). Furthermore, both Turkey and Northern Cyprus had the same contribution which was (20%, 2 papers).

Moreover, UAE, and Libya had the same contribution which was (10%, 1 paper). Another (10%, 1 paper) was accounted for General. Total number of papers published for MENA region for this period was 10 papers.



**Figure 4.7: Distribution of Papers According to their Countries in the MENA Region for Period 3**

Figure 4.8 shows the distribution of the papers according to the country that the paper talked about in the MENA region for the overall period. The largest contribution of all countries for total period was accounted for Turkey (40.63%, 13 papers) and then Saudi Arabia (28.13%, 9 papers). Furthermore, Syria, UAE, and Northern Cyprus had the same contribution which was (6.25%, 2 papers). Moreover, Egypt, Kuwait, and Libya had the same contribution which was (3.13%, 1 paper). Also, General papers accounted for (3.13%, 1 paper). Total number of papers published for the MENA region for total period was 32 papers. In addition, from the overall analysis, the fact that the number in contributing papers to the journal was somehow close among the three periods is noticeable. Also, the absence of most MENA countries through the whole period such as, Algeria, Bahrain, Djibouti, Iran, Iraq, Jordan, Lebanon, Morocco, Oman, Palestine, Qatar, Tunisia, and Yemen is also clear. Moreover, it can be noticed that the number of papers published in the MENA region was very minor compared to the number of papers published in the overall region. This may be attributed to the less number of MENA contributing countries compared to the overall region countries and thus less number of contributing authors and organizations in the MENA region compared with the overall region.

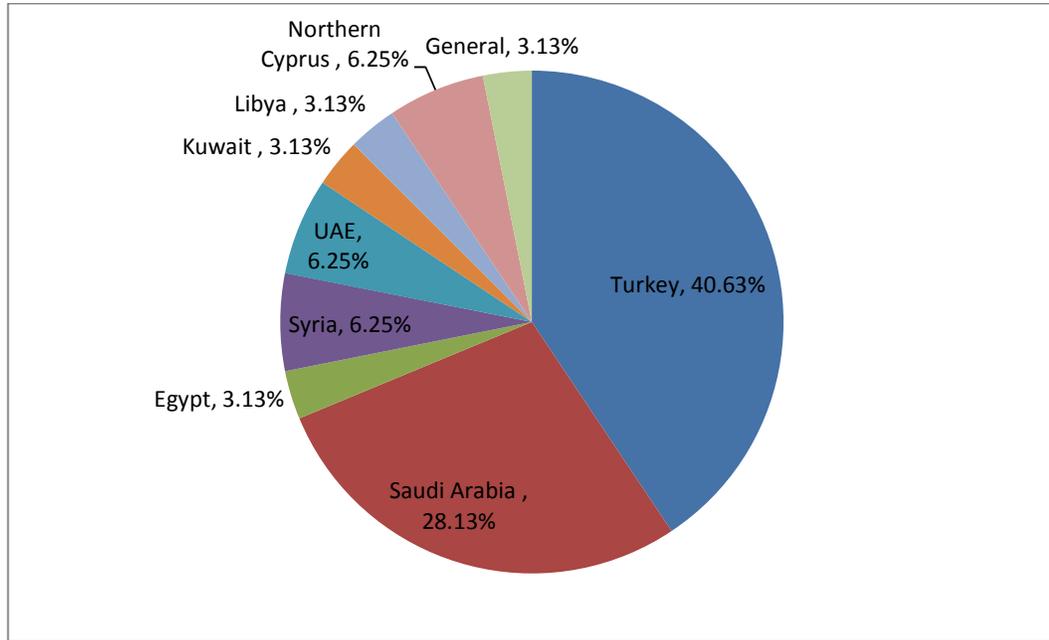


Figure 4.8: Distribution of Papers According to their Countries in the MENA Region for Total Period

### 4.3. Main Contributing Authors

#### 4.3.1. Main Contributing Authors in the Overall Region

Table 4.1 presents the main contributing authors who contributed more than four times to the journal in the overall region for Period 1. Table 4.2 shows the main contributing authors who contributed more than four times to the journal in the overall region for Period 2, whereas Table 4.3 depicts the main contributing authors who contributed more than four times to the journal in the overall region for Period 3. Each one of these tables shows the author's first name, last name, number of papers published and percentage of the number of papers published. The authors are listed in order of decreasing contribution to the journal. The number of papers published of the author is not dependent on how many coauthors there were for each paper. Each author is counted equally. The percentage of the number of papers published was calculated by dividing the number of papers published by the author over total number of papers published in the specified period.

**Table 4.1: Main Contributing Authors in the Overall Region for Period 1**

<b>No.</b>	<b>First Name</b>	<b>Last Name</b>	<b>Number of papers published</b>	<b>%Number of papers published</b>
1	R. Martin	Skitmore	17	4.94%
2	Peter E.D.	Love	11	3.20%
3	Gary D.	Holt	10	2.91%
4	Martin	Loosemore	10	2.91%
5	C. M.	Tam	9	2.62%
6	Sai-On	Cheung	8	2.33%
7	George	Ofori	8	2.33%
8	Heng	Li	8	2.33%
9	John	Raftery	7	2.03%
10	Albert P. C.	Chan	6	1.74%
11	Frank C.	Harris	6	1.74%
12	Ka Chi	Lam	6	1.74%
13	S. Thomas	Ng	6	1.74%
14	Paul O.	Olomolaty	6	1.74%
15	Graham M.	Winch	6	1.74%
16	Ranko	Bon	5	1.45%
17	Mohan M.	Kumaraswamy	5	1.45%
18	Helen	Lingard	5	1.45%
19	George	Norman	5	1.45%
20	Roberto	Pietroforte	5	1.45%
21	Malik	Ranasinghe	5	1.45%
22	David	Seymour	5	1.45%
<b>Total number of contributing papers during Period 1</b>				<b>344</b>

**Table 4.2: Main Contributing Authors in the Overall Region for Period 2**

<b>No.</b>	<b>First Name</b>	<b>Last Name</b>	<b>Number of papers published</b>	<b>%Number of papers published</b>
1	C. M.	Tam	10	2.42%
2	David	Arditi	10	2.42%
3	Low Sui	Pheng	10	2.42%
4	Martin	Skitmore	10	2.42%
5	Helen	Lingard	9	2.17%
6	Andrew R. J.	Dainty	8	1.93%
7	Anita M. M.	Liu	7	1.69%
8	Derek S.	Drew	7	1.69%
9	Florence T. T.	Phua	7	1.69%
10	Mei-Yung	Leung	7	1.69%
11	Sandy L. Y.	Tang	7	1.69%
12	Helen	Li	6	1.45%
13	S. Thomas	Ng	6	1.45%
14	Sai-On	Cheung	6	1.45%
15	Andrew D. F.	Price	5	1.21%
16	Hing-Po	Lo	5	1.21%
17	Igal M.	Shohet	5	1.21%
<b>Total number of contributing papers during Period 2</b>				<b>414</b>

According to the analysis, the number of contributing authors for the overall region for Period 1 was 483 authors. This number increased to 632 authors for Period 2, and continued to increase until it reached 750 authors for Period 3. The increase in the number of contributing authors from period to period can be related directly to the increase in the number of issues and papers published with time. The largest contribution was from Martin Skitmore, with a total of 37 published papers along the whole period. Also, it is clear that with time more authors began to publish multiple papers.

**Table 4.3: Main Contributing Authors in the Overall Region for Period 3**

<b>No.</b>	<b>First Name</b>	<b>Last Name</b>	<b>Number of papers published</b>	<b>%Number of papers published</b>
1	Martin	Skitmore	10	2.18%
2	Paul Anthony	Bowen	10	2.18%
3	S. Thomas	Ng	10	2.18%
4	Steve	Rowlinson	10	2.18%
5	Andrew R. J.	Dainty	9	1.97%
6	Helen Clare	Lingard	8	1.75%
7	Alexander	Styhre	7	1.53%
8	Hemanta	Doloi	7	1.53%
9	Kumar Neeraj	Jha	7	1.53%
10	Carlos H.	Caldas	7	1.53%
11	Matthew	Hallowell	7	1.53%
12	Martin	Loosemore	6	1.31%
13	George	Ofori	6	1.31%
14	Martin	Sexton	6	1.31%
15	Hedley	Smyth	5	1.09%
16	James M. W.	Wong	5	1.09%
17	Heng	Li	5	1.09%
<b>Total number of contributing papers during Period 3</b>				<b>458</b>

#### **4.3.2. Main Contributing Authors in the MENA Region**

Table 4.4 depicts the main contributing authors in the MENA region for Period 1. Table 4.5 shows the main contributing authors in the MENA region for Period 2 while Table 4.6 shows the main contributing authors in the MENA region for Period 3. Furthermore, Table 4.7 presents the main contributing authors in the MENA region for the total period. Each one of these tables shows the author's first name, last name, number of papers published and percentage of the number of papers published. The authors are listed in order of decreasing contribution to the journal. Papers in the MENA region have been listed according to both authors and the country that the paper referred to. This way, if the paper was written by an author from the MENA region or talked about the MENA region, it was considered a paper related to the MENA region was thus listed in the below analysis. The number of papers published of the author is not dependent on how many coauthors there were for each paper. Each author is counted equally. The percentage of the number of papers published

was calculated by dividing the number of papers published by the author over total number of papers published about the MENA region in the specified period.

**Table 4.4: Main Contributing Authors in the MENA Region for Period 1**

<b>No.</b>	<b>First Name</b>	<b>Last Name</b>	<b>Number of papers published</b>	<b>%Number of papers published</b>
1	M. Talat	Birgonul	2	18.18%
2	Abdel Hady	Hosny	1	9.09%
3	Abdulaziz A.	Bubshait	1	9.09%
4	Adel	Eldosouky	1	9.09%
5	Ali A.	Shash	1	9.09%
6	Emad	Elbeltagi	1	9.09%
7	Gulam	Farooq	1	9.09%
8	Irem	Ozdogan	1	9.09%
9	Irem	Dikmen	1	9.09%
10	M. Osama	Jannadi	1	9.09%
11	Mahmoud M.	Idris	1	9.09%
12	Mehmet All	Küçük	1	9.09%
13	Mohammed	Al-Amir	1	9.09%
14	Mohammed A.	Al-Ghafly	1	9.09%
15	Mohammed I.	Al-Khalil	1	9.09%
16	Olcay	Kayahan	1	9.09%
17		Özdoganm	1	9.09%
18	Özlem	Öz	1	9.09%
19	Sadi A.	Assaf	1	9.09%
20	Serdar	Kale	1	9.09%
21	Zeynep	Sözen	1	9.09%
<b>Total number of contributing papers during Period 1</b>				<b>11</b>

**Table 4.5: Main Contributing Authors in the MENA Region for Period 2**

<b>No.</b>	<b>First Name</b>	<b>Last Name</b>	<b>Number of papers published</b>	<b>%Number of papers published</b>
1	Gul	Polat	3	14.29%
2	Mohammad A.	Ammar	2	9.52%
3	Abdulsalam	Al-Sudairi	1	4.76%
4	Arshi Shakeel	Faridi	1	4.76%
5	Attila	Dikbas	1	4.76%
6	Cenk	Balcik	1	4.76%
7	Emrah	Acar	1	4.76%
8	G. Topcu	Oraz	1	4.76%
9	H.	Giritli	1	4.76%
10	H. A.	Bassioni	1	4.76%
11	Irem	Dikmen	1	4.76%
12	Ismail	Koçak	1	4.76%
13	Ismail M.	Basha	1	4.76%
14	K.	Al-Rashid	1	4.76%
15	Khalied	Hyari	1	4.76%
16	M. Talat	Birgonul	1	4.76%
17	Mahdi H.	Mattar	1	4.76%
18	Mohammed Fadhil	Dulaimi	1	4.76%
19	N.	Kartam	1	4.76%
20	Nader	Abdul-Hadi	1	4.76%
21	Obaid Saad	Al-Sobiei	1	4.76%
22	P. A.	Koushki	1	4.76%
23	Saleh	Alqahtani	1	4.76%
24	Sameh Monir	El-Sayegh	1	4.76%
25	Serdar	Kale	1	4.76%
26	Sevda B.	Koraltan	1	4.76%
27	Ugur	Mungen	1	4.76%
28	Yildiz	Sey	1	4.76%
29	Youssef A.	Mohieldin	1	4.76%
<b>Total number of contributing papers during Period 2</b>				<b>21</b>

**Table 4.6: Main Contributing Authors in the MENA Region for Period 3**

<b>No.</b>	<b>First Name</b>	<b>Last Name</b>	<b>Number of papers published</b>	<b>%Number of papers published</b>
1	Ashraf	ElAzouni	3	11.54%
2	AbdulAziz	Jarkas	2	7.69%
3	Selin	Gundes	2	7.69%
4	Vedat	Yorucu	2	7.69%
5	Abbas	Afshar	2	7.69%
6	AbdulAlSalam	Al-Sudairi	1	3.85%
7	Ahmed	Elhakeem	1	3.85%
8	Ahmed	Abdullah	1	3.85%
9	Ahmed	El-Sheikh	1	3.85%
10	Emad	Elbeltagi	1	3.85%
11	Emrah	Acar	1	3.85%
12	Ilknur	Akiner	1	3.85%
13	Khalied Hesham	Hyari	1	3.85%
14	Maged E.	Georgy	1	3.85%
15	Mohamed	AlHashemi	1	3.85%
16	Mohamed Emam	Abd-Elrazek	1	3.85%
17	Mohamed M.	Matar	1	3.85%
18	Mohammad	El-Mashaleh	1	3.85%
19	Mohammed Fadhil	Dulaimi	1	3.85%
20	Mohammed Mubashir	ALI	1	3.85%
21	Mohammed S.	Al-Motairi	1	3.85%
22	Moheeb Elsaid	Ibrahim	1	3.85%
23	Osama A.	Salem	1	3.85%
24	Ossama A.	Hosny	1	3.85%
25	Ozay	Mehmet	1	3.85%
26	Rusen	Keles	1	3.85%
27	Sameh Monir	El-Sayegh	1	3.85%
28	Yasemin	Göç	1	3.85%
29	Zedan	Hatush	1	3.85%
30	Ehsan	Eshtehardian	1	3.85%
31	Farnad	Nasirzadeh	1	3.85%
32	Reza	Abbasnia	1	3.85%

<b>33</b>	Mostafa	Khanzadi	1	3.85%
<b>Total number of contributing papers during Period 3</b>				<b>26</b>

As can be observed, the number of contributing authors in the MENA region was increasing with 22 authors for Period 1, then reached 29 authors for Period 2, and kept increasing until it reached 33 authors for Period 3. Furthermore, the total number of contributing authors for total period was 74. The increase in the number of contributing authors from period to period can be related directly to the increase in the number of papers.

published with time. Despite how the number of authors in the MENA region kept increasing, it is still a relatively small number in comparison to the number of authors for the overall region in the three periods and total period. One reason can be attributed to the lesser number of MENA countries when compared with other regions' countries and thus lesser number of contributing authors and organizations. Overall, the largest contribution was from Ashraf ElAzouni, Gul Polat, and M. Talat Birgönül along the whole period with three contributing papers for each. Also, it is clear that with time more authors began to publish multiple papers.

**Table 4.7: Main Contributing Authors in the MENA Region for Total Period**

<b>No.</b>	<b>First Name</b>	<b>Last Name</b>	<b>Number of Papers Published</b>	<b>%Number of Papers Published</b>
1	Ashraf	ElAzouni	3	5.17%
2	Gul	Polat	3	5.17%
3	M. Talat	Birgönül	3	5.17%
4	Abbas	Afshar	2	3.45%
5	AbdulAziz	Jarkas	2	3.45%
6	Abdulsalam	Al-Sudairi	2	3.45%
7	Emad	Elbeltagi	2	3.45%
8	Emrah	Acar	2	3.45%
9	Irem	Dikmen	2	3.45%
10	Khalied Hesham	Hyari	2	3.45%
11	Mohammad A.	Ammar	2	3.45%
12	Mohammed Fadhil	Dulaimi	2	3.45%
13	Sameh Monir	El-Sayegh	2	3.45%
14	Selin	Gundes	2	3.45%
15	Serdar	Kale	2	3.45%
16	Vedat	Yorucu	2	3.45%
17	Abdel Hady	Hosny	1	1.72%
18	Abdulaziz A.	Bubshait	1	1.72%
19	Adel	Eldosouky	1	1.72%
20	Ahmed	Elhakeem	1	1.72%
21	Ahmed	Abdullah	1	1.72%
22	Ahmed	El-Sheikh	1	1.72%
23	Ali A.	Shash	1	1.72%
24	Arshi Shakeel	Faridi	1	1.72%
25	Attila	Dikbas	1	1.72%
26	Cenk	Balcik	1	1.72%
27	Ehsan	Eshtehardian	1	1.72%
28	Farnad	Nasirzadeh	1	1.72%
29	G. Topcu	Oraz	1	1.72%
30	Gulam	Farooq	1	1.72%
31	H.	Giritli	1	1.72%
32	H. A.	Bassioni	1	1.72%
33	Ilknur	Akiner	1	1.72%
34	Irem	Ozdogan	1	1.72%
35	Ismail	Koçak	1	1.72%
36	Ismail M.	Basha	1	1.72%

37	K.	Al-Rashid	1	1.72%
38	M. Osama	Jannadi	1	1.72%
39	Maged E.	Georgy	1	1.72%
40	Mahdi H.	Mattar	1	1.72%
41	Mahmoud M.	Idris	1	1.72%
42	Mehmet All	Küçük	1	1.72%
43	Mohamed	AlHashemi	1	1.72%
44	Mohamed Emam	Abd-Elrazek	1	1.72%
45	Mohamed M.	Matar	1	1.72%
46	Mohammad	El-Mashaleh	1	1.72%
47	Mohammed	Al-Amir	1	1.72%
48	Mohammed A.	Al-Ghafly	1	1.72%
49	Mohammed I.	Al-Khalil	1	1.72%
50	Mohammed Mubashir	ALI	1	1.72%
51	Mohammed S.	Al-Motairi	1	1.72%
52	Moheeb Elsaid	Ibrahim	1	1.72%
53	Mostafa	Khazadi	1	1.72%
54	N.	Kartam	1	1.72%
55	Nader	Abdul-Hadi	1	1.72%
56	Obaid Saad	Al-Sobie	1	1.72%
57	Olçay	Kayahan	1	1.72%
58	Osama A.	Salem	1	1.72%
59	Ossama A.	Hosny	1	1.72%
60	Ozay	Mehmet	1	1.72%
61	Özlem	Öz	1	1.72%
62	P. A.	Koushki	1	1.72%
63	Reza	Abbasnia	1	1.72%
64	Rusen	Keles	1	1.72%
65	Sadi A.	Assaf	1	1.72%
66	Saleh	Alqahtani	1	1.72%
67	Sevda B.	Koraltan	1	1.72%
68	Ugur	Mungen	1	1.72%
69	Yasemin	Göç	1	1.72%
70	Yildiz	Sey	1	1.72%
71	Youssef A.	Mohieldin	1	1.72%
72	Zedan	Hatush	1	1.72%
73	Zeynep	Sözen	1	1.72%
74		Özdoğanm	1	1.72%

<b>Total number of contributing papers during total period</b>	<b>58</b>
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#### **4.4. Main Contributing Organizations**

##### **4.4.1. Main Contributing Organizations in the Overall Region**

This section analyzes the top organizations in the overall region for each period and total period of the journal. The number of appearances of each organization according to the appearance of authors and number of published papers related to each organization has been analyzed. The percentage of the number of papers published was calculated by dividing the number of papers published by the organization over total number of papers published in the specified period.

Table 4.8 shows the main contributing organizations in the overall region for Period 1. It presents the organization name, organization country, number of appearances, number of published papers, and percentage of the number of papers published. The organizations are listed in order of decreasing contribution according to the number of appearances. For Period 1, the top five organizations in terms of published papers were the Hong Kong Polytechnic University in Hong Kong, University of Hong Kong in Hong Kong, National University of Singapore in Singapore, City University of Hong Kong in Hong Kong, and the University of Reading in UK.

Table 4.9 shows the main contributing organizations in the overall region for Period 2. It presents the organization name, organization country, number of appearances, number of published papers, and percentage of the number of papers published. The organizations are listed in order of decreasing contribution according to the number of appearances. For Period 2, the top five organizations in terms of published papers were the City University of Hong Kong in Hong Kong, Hong Kong Polytechnic University in Hong Kong, National University of Singapore in Singapore, Loughborough University in UK, University of Hong Kong in Hong Kong, and the Queensland University of Technology in Australia.

Table 4.10 shows the main contributing organizations in the overall region for Period 3. It presents the organization name, organization country, number of appearances, number of published papers, and percentage of the number of papers published. The organizations are listed in order of decreasing contribution according to the number of appearances. For Period 3, the top five organizations in terms of

published papers were the University of Hong Kong in Hong Kong, Hong Kong Polytechnic University in Hong Kong, University of Reading in UK, Loughborough University in UK, and the Queensland University of Technology in Australia.

Table 4.11 shows the main contributing organizations in the overall region for total period. It presents the organization name, organization country, number of appearances, number of published papers, and percentage of the number of papers published. The organizations are listed in order of decreasing contribution according to the number of appearances. Overall (15-year rank) the top five organizations in terms of published papers were the Hong Kong Polytechnic University in Hong Kong, University of Hong Kong in Hong Kong, National University of Singapore in Singapore, City University of Hong Kong in Hong Kong, and the Queensland University of Technology in Australia. It is interesting to note that the top two ranking institutions in Periods one, two, and three came from the Hong Kong institutions as indicated by Tables 4.8, 4.9, and 4.10. However, academic institutions from countries as UK, Singapore, and Australia had major contribution to the journal and they are on the rise which indicates that CME journal is gaining worldwide recognition as a leading construction journal. It also indicates that there is more established construction programs becoming involved in research and that construction research is gaining more appreciation. In addition, it is noticeable that academic institutions were the main contributing organizations to the journal during these years and there is no appearance for industry and government institutions as main contributing organizations.

**Table 4.8: Main Contributing Organizations in the Overall Region for Period 1**

<b>No.</b>	<b>Organization</b>	<b>Country</b>	<b>Number of appearances</b>	<b>Number of published papers</b>	<b>%Number of published papers</b>
<b>1</b>	Hong Kong Polytechnic University	Hong Kong	54	37	10.76%
<b>2</b>	City University of Hong Kong	Hong Kong	45	21	6.10%
<b>3</b>	University of Wolverhampton	UK	38	16	4.65%
<b>4</b>	University of Hong Kong	Hong Kong	32	24	6.98%
<b>5</b>	National University of Singapore	Singapore	31	23	6.69%
<b>6</b>	University of Reading	UK	28	20	5.81%
<b>7</b>	Queensland University of Technology	Australia	25	16	4.65%
<b>8</b>	Deakin University	Australia	19	13	3.78%
<b>9</b>	University of New South Wales	Australia	19	14	4.07%
<b>10</b>	Loughborough University	UK	18	9	2.62%
<b>11</b>	University of Birmingham	UK	17	7	2.03%
<b>12</b>	University of Melbourne	Australia	14	11	3.20%
<b>13</b>	Glasgow Caledonian University	UK	11	6	1.74%
<b>14</b>	South Bank University	UK	11	6	1.74%
<b>15</b>	University of Edinburgh	UK	10	5	1.45%
<b>Total number of contributing papers during Period 1</b>					<b>344</b>

**Table 4.9: Main Contributing Organizations in the Overall Region for Period 2**

<b>No.</b>	<b>Organization</b>	<b>Country</b>	<b>Number of appearances</b>	<b>Number of published papers</b>	<b>%Number of published papers</b>
1	City University of Hong Kong	Hong Kong	73	35	8.45%
2	Hong Kong Polytechnic University	Hong Kong	70	33	7.97%
3	National University of Singapore	Singapore	46	28	6.76%
4	Loughborough University	UK	44	22	5.31%
5	University of Hong Kong	Hong Kong	33	21	5.07%
6	Queensland University of Technology	Australia	27	21	5.07%
7	University of Salford	UK	26	17	4.11%
8	University of New South Wales	Australia	20	13	3.14%
9	Technion-Israel Institute of Technology	Israel	19	11	2.66%
10	Illinois Institute of Technology	US	16	12	2.90%
11	University of the West of England	UK	13	9	2.17%
12	Chalmers University of Technology	Sweden	12	6	1.45%
13	University of Melbourne	Australia	12	8	1.93%
14	Deakin University	Australia	11	5	1.21%
15	University of Reading	UK	11	8	1.93%
<b>Total number of contributing papers during Period 2</b>					<b>414</b>

**Table 4.10: Main Contributing Organizations in the Overall Region for Period 3**

<b>No.</b>	<b>Organization</b>	<b>Country</b>	<b>Number of appearances</b>	<b>Number of published papers</b>	<b>%Number of published papers</b>
1	Hong Kong Polytechnic University	Hong Kong	60	29	6.33%
2	University of Hong Kong	Hong Kong	56	30	6.55%
3	Loughborough University	UK	45	21	4.59%
4	University of Reading	UK	44	25	5.46%
5	University of Salford	UK	34	14	3.06%
6	National University of Singapore	Singapore	29	16	3.49%
7	Queensland University of Technology	Australia	27	18	3.93%
8	RMIT University	Australia	24	14	3.06%
9	University of Cape Town	South Africa	22	10	2.18%
10	University of Melbourne	Australia	21	16	3.49%
11	University of New South Wales	Australia	19	12	2.62%
12	Luleå University of Technology	Sweden	17	8	1.75%
13	Chalmers University of Technology	Sweden	16	10	2.18%
14	City University of Hong Kong	Hong Kong	16	10	2.18%
15	University College London	UK	13	9	1.97%
16	University of Texas at Austin	US	13	9	1.97%
<b>Total number of contributing papers during Period 3</b>					<b>458</b>

**Table 4.11: Main Contributing Organizations in the Overall Region for Total Period**

<b>No.</b>	<b>Organization</b>	<b>Country</b>	<b>Number of appearances</b>	<b>Number of published papers</b>	<b>%Number of published papers</b>
<b>1</b>	Hong Kong Polytechnic University	Hong Kong	184	99	8.14%
<b>2</b>	City University of Hong Kong	Hong Kong	134	66	5.43%
<b>3</b>	University of Hong Kong	Hong Kong	122	75	6.17%
<b>4</b>	National University of Singapore	Singapore	106	67	5.51%
<b>5</b>	Loughborough University	UK	107	52	4.28%
<b>6</b>	University of Reading	UK	83	53	4.36%
<b>7</b>	Queensland University of Technology	Australia	79	55	4.52%
<b>8</b>	University of Salford	UK	69	37	3.04%
<b>9</b>	University of New South Wales	Australia	58	39	3.21%
<b>10</b>	University of Wolverhampton	UK	52	27	2.22%
<b>Total number of contributing papers during total period</b>					<b>1,216</b>

#### **4.4.2. Main Contributing Organizations in the MENA Region**

Table 4.12 displays the main contributing organizations in the MENA region for Period 1. It presents the organization name, organization country, number of appearances, number of published papers, and percentage of the number of papers published. The organizations are listed in order of decreasing contribution according to the number of appearances. For Period 1, the top three organizations in terms of published papers were the King Fahd University of Petroleum & Minerals in Saudi Arabia, Middle East Technical University in Turkey, and the Istanbul Technical University in Turkey. The percentage of the number of papers published was calculated by dividing the number of papers published by the organization over total number of papers published about the MENA region in the specified period.

**Table 4.12: Main Contributing Organizations in the MENA Region for Period 1**

<b>No.</b>	<b>Organization</b>	<b>Country</b>	<b>Number of appearances</b>	<b>Number of published papers</b>	<b>%Number of published papers</b>
<b>1</b>	King Fahd University of Petroleum and Minerals	Saudi Arabia	8	3	27.27%
<b>2</b>	Middle East Technical University	Turkey	6	3	27.27%
<b>3</b>	Istanbul Technical University	Turkey	3	2	18.18%
<b>4</b>	Am Shams University	Egypt	1	1	9.09%
<b>5</b>	Balikesir University	Turkey	1	1	9.09%
<b>6</b>	King Saud University	Saudi Arabia	1	1	9.09%
<b>7</b>	Mansoura University	Egypt	1	1	9.09%
<b>8</b>	Tanta University	Egypt	1	1	9.09%
<b>Total number of contributing papers during Period 1</b>					<b>11</b>

Table 4.13 shows the main contributing organizations in the MENA region for Period 2. It presents the organization name, organization country, number of appearances, number of published papers, and percentage of the number of papers published. The organizations are listed in order of decreasing contribution according to the number of appearances. For Period 2, the top three organizations in terms of published papers were the Istanbul Technical University in Turkey, Zagazig University in Egypt, and the Tanta University in Egypt.

Table 4.14 shows the main contributing organizations in the MENA region for Period 3. It presents the organization name, organization country, number of appearances, number of published papers, and percentage of the number of papers published. The organizations are listed in order of decreasing contribution according to the number of appearances. For Period 3, the top five contributing organizations in terms of published papers were the King Fahd University of Petroleum & Minerals in Saudi Arabia, Iran University of Science and Technology in Iran, Eastern Mediterranean University in Turkey, Mimar Sinan Fine Arts University in Turkey, and the Mazaya Holding Co. in Kuwait.

**Table 4.13: Main Contributing Organizations in the MENA Region for Period 2**

<b>No.</b>	<b>Organization</b>	<b>Country</b>	<b>Number of appearances</b>	<b>Number of published papers</b>	<b>%Number of published papers</b>
1	Istanbul Technical University	Turkey	11	6	28.57%
2	King Faisal University	Saudi Arabia	3	1	4.76%
3	Kuwait University	Kuwait	3	1	4.76%
4	Zagazig University	Egypt	2	2	9.52%
5	American University of Sharjah	UAE	2	1	4.76%
6	Middle East Technical University	Turkey	2	1	4.76%
7	Tanta University	Egypt	2	2	9.52%
8	American University of Beirut	Lebanon	1	1	4.76%
9	Arab Academy for Science and Technology and Maritime Transport	Egypt	1	1	4.76%
10	Balikesir University	Turkey	1	1	4.76%
11	Baskent University	Turkey	1	1	4.76%
12	British University in Dubai	UAE	1	1	4.76%
13	GDMW/MODA	Saudi Arabia	1	1	4.76%
14	Hashemite University	Jordan	1	1	4.76%
<b>Total number of contributing papers during Period 2</b>					<b>21</b>

Table 4.15 shows the main contributing organizations in the MENA region for total period. It presents the organization name, organization country, number of appearances, number of published papers, and percentage of the number of papers published. The organizations are listed in order of decreasing contribution according to the number of appearances. Overall (15-year rank) the top four organizations in terms of published papers were the Istanbul Technical University in Turkey, King Fahd University of Petroleum & Minerals in Saudi Arabia, Middle East Technical University in Turkey, and the Tanta University in Egypt. It is interesting to note that the top ranking institutions in Period one came from the Turkey and Saudi Arabia institutions as indicated by Table 4.12. However, in Period two, each of the Zagazig University in Egypt and the Tanta University in Egypt ranked second as indicated by

Table 4.13, and in Period three each of the Iran University of Science and Technology in Iran and the Mazaya Holding Co. in Kuwait ranked the second with other organizations as indicated by Table 4.14. This indicates that construction research in the MENA region is gaining more appreciation and that more construction programs are becoming involved in research. In addition, it is noticeable that academic institutions were the main contributing organizations to the journal during these years, however in Period three Mazaya Holding Co. in Kuwait ranked the second with other organizations which indicates that industry research contribution is on the rise.

#### **4.5. Main Contributing Countries**

##### **4.5.1. Main Contributing Countries in the Overall Region**

This section analyzes the top countries in the overall region for each period and total period of the journal. The number of appearances of each country according to the appearance of authors as well as the number of published papers pertaining to each country has been analyzed. The percentage of the number of papers published was calculated by dividing the number of papers published by the country over total number of papers published in the specified period.

Table 4.16 shows the main contributing countries in the overall region for Period 1. It presents the name of the country, number of appearances, number of published papers, and percentage of the number of papers published. The countries are listed in order of decreasing contribution according to the number of appearances. Total authors that contributed to the journal during these years represent six different continents and 32 different countries. The authors represent all continents except for Antarctica. Europe was represented the most with number of appearances of 299. In second place was Asia with number of appearances of 229. In terms of published papers; the top five contributing countries were the UK, Hong Kong, Australia, US and the Singapore.

**Table 4.14: Main Contributing Organizations in the MENA Region for Period 3**

<b>No.</b>	<b>Organization</b>	<b>Country</b>	<b>Number of appearances</b>	<b>Number of published papers</b>	<b>%Number of published papers</b>
1	Iran University of Science and Technology	Iran	6	2	7.69%
2	Eastern Mediterranean University	Turkey	4	2	7.69%
3	King Fahd University of Petroleum and Minerals	Saudi Arabia	4	3	11.54%
4	Cairo University	Egypt	3	1	3.85%
5	American University in Cairo	Egypt	2	1	3.85%
6	British University in Dubai	UAE	2	1	3.85%
7	Hashemite University	Jordan	2	1	3.85%
8	Mazaya Holding Co.	Kuwait	2	2	7.69%
9	Mimar Sinan Fine Arts University	Turkey	2	2	7.69%
10	Arab Academy for Science, Technology, and Maritime Transport	Egypt	2	1	3.85%
11	American University of Sharjah	UAE	1	1	3.85%
12	ECF Architecture	Turkey	1	1	3.85%
13	El-Fateh University	Libya	1	1	3.85%
14	Ernst and Young	Bahrain	1	1	3.85%
15	Istanbul Technical University	Turkey	1	1	3.85%
16	King Faisal University	Saudi Arabia	1	1	3.85%
17	Mansoura University	Egypt	1	1	3.85%
18	Qassim University	Saudi Arabia	1	1	3.85%
19	Saudi Industrial Property Authority	Saudi Arabia	1	1	3.85%
20	University of Mersin	Turkey	1	1	3.85%
<b>Total number of contributing papers during Period 3</b>					<b>26</b>

**Table 4.15: Main Contributing Organizations in the MENA Region for Total Period**

<b>No.</b>	<b>Organization</b>	<b>Country</b>	<b>Number of appearances</b>	<b>Number of published papers</b>	<b>%Number of published papers</b>
1	Istanbul Technical University	Turkey	15	9	15.52%
2	King Fahd University of Petroleum and Minerals	Saudi Arabia	12	6	10.34%
3	Middle East Technical University	Turkey	8	4	6.90%
4	Iran University of Science and Technology	Iran	6	2	3.45%
5	King Faisal University	Saudi Arabia	4	2	3.45%
6	Eastern Mediterranean University	Turkey	4	2	3.45%
7	Tanta University	Egypt	3	3	5.17%
8	Arab Academy for Science and Technology and Maritime Transport	Egypt	3	2	3.45%
9	American University of Sharjah	UAE	3	2	3.45%
10	British University in Dubai	UAE	3	2	3.45%
11	Hashemite University	Jordan	3	2	3.45%
12	Kuwait University	Kuwait	3	1	1.72%
13	Cairo University	Egypt	3	1	1.72%
14	Balikesir University	Turkey	2	2	3.45%
15	Mansoura University	Egypt	2	2	3.45%
16	Zagazig University	Egypt	2	2	3.45%
17	American University in Cairo	Egypt	2	1	1.72%
18	Mazaya Holding Co.	Kuwait	2	2	3.45%
19	Mimar Sinan Fine Arts University	Turkey	2	2	3.45%
<b>Total number of contributing papers during total period</b>					<b>58</b>

Table 4.17 shows the main contributing countries in the overall region for Period 2. It presents the name of the country, number of appearances, number of

published papers, and percentage of the number of papers published. The countries are listed in order of decreasing contribution according to the number of appearances. Total authors that contributed to the journal during these years represent six different continents and 44 different countries. The authors represent all continents except for Antarctica. Europe was represented the most with number of appearances of 352. In second place was Asia with number of appearances of 322. In terms of published papers; the top five contributing countries were the UK, Hong Kong, Australia, US and the Singapore.

**Table 4.16: Main Contributing Countries in the Overall Region for Period 1**

<b>No.</b>	<b>Country</b>	<b>Number of appearances</b>	<b>Number of published papers</b>	<b>%Number of published papers</b>
1	UK	267	138	40.12%
2	Hong Kong	141	69	20.06%
3	Australia	103	62	18.02%
4	US	64	38	11.05%
5	Singapore	39	25	7.27%
6	Taiwan	13	6	1.74%
7	Turkey	11	6	1.74%
8	Saudi Arabia	9	4	1.16%
9	Canada	8	6	1.74%
10	Korea	8	4	1.16%
11	South Africa	8	5	1.45%
12	China	8	5	1.45%
13	Malaysia	7	4	1.16%
14	France	6	4	1.16%
15	Israel	6	3	0.87%
<b>Total number of contributing papers during Period 1</b>				<b>344</b>

Table 4.18 shows the main contributing countries in the overall region for Period 3. It presents the name of the country, number of appearances, number of published papers, and percentage of the number of papers published. The countries are listed in order of decreasing contribution according to the number of appearances. Total authors that contributed to the journal during these years represent six different continents and 47 different countries. The authors represent all continents except for Antarctica. Europe was represented the most with number of appearances of 406. In second place was Asia with number of appearances of 303. In terms of published

papers; the top five contributing countries were the UK, Australia, Hong Kong, US and the Sweden.

**Table 4.17: Main Contributing Countries in the Overall Region for Period 2**

<b>No.</b>	<b>Country</b>	<b>Number of appearances</b>	<b>Number of published papers</b>	<b>%Number of published papers</b>
<b>1</b>	UK	250	124	29.95%
<b>2</b>	Hong Kong	182	72	17.39%
<b>3</b>	Australia	94	56	13.53%
<b>4</b>	US	88	52	12.56%
<b>5</b>	Singapore	58	35	8.45%
<b>6</b>	Taiwan	31	18	4.35%
<b>7</b>	Canada	23	11	2.66%
<b>8</b>	Israel	22	11	2.66%
<b>9</b>	The Netherlands	20	10	2.42%
<b>10</b>	China	19	11	2.66%
<b>11</b>	Sweden	18	9	2.17%
<b>12</b>	Turkey	15	9	2.17%
<b>13</b>	Thailand	10	6	1.45%
<b>14</b>	India	8	3	0.72%
<b>15</b>	Trinidad & Tobago	7	4	0.97%
<b>Total number of contributing papers during Period 2</b>				<b>414</b>

**Table 4.18: Main Contributing Countries in the Overall Region for Period 3**

<b>No.</b>	<b>Country</b>	<b>Number of appearances</b>	<b>Number of published papers</b>	<b>%Number of published papers</b>
1	UK	260	129	28.17%
2	Hong Kong	137	64	13.97%
3	Australia	125	71	15.50%
4	US	117	55	12.01%
5	Sweden	57	33	7.21%
6	Taiwan	47	21	4.59%
7	Singapore	36	19	4.15%
8	South Africa	29	13	2.84%
9	China	26	17	3.71%
10	The Netherlands	21	11	2.40%
11	India	15	8	1.75%
12	New Zealand	15	8	1.75%
13	Malaysia	14	5	1.09%
14	Canada	12	7	1.53%
15	Greece	10	5	1.09%
<b>Total number of contributing papers during Period 3</b>				<b>458</b>

Table 4.19 depicts the main contributing countries in the overall region for total period. It presents the name of the country, number of appearances, number of published papers, and percentage of the number of papers published. The countries are listed in order of decreasing contribution according to the number of appearances. Total authors that contributed to the journal during these years represent six different continents and 57 different countries. The authors represent all continents except for Antarctica. Europe was represented the most with number of appearances of 1,057. In second place was Asia with number of appearances of 854. Overall (15-year) rank the top five contributing countries in terms of published papers were the UK, Hong Kong, Australia, US and the Singapore. As shown in Tables 4.16, 4.17, 4.18, and 4.19, each of UK, Hong Kong, Australia and US were always the top four contributing countries to the journal during these years.

**Table 4.19: Main Contributing Countries in the Overall Region for Total Period**

<b>No.</b>	<b>Country</b>	<b>Number of appearances</b>	<b>Number of published papers</b>	<b>%Number of published papers</b>
1	UK	777	391	32.15%
2	Hong Kong	460	205	16.86%
3	Australia	322	189	15.54%
4	US	269	145	11.92%
5	Singapore	133	79	6.50%
6	Taiwan	91	45	3.70%
7	Sweden	78	45	3.70%
8	China	53	33	2.71%
9	The Netherlands	45	23	1.89%
10	Canada	43	24	1.97%
<b>Total number of contributing papers during total period</b>				<b>1,216</b>

#### **4.5.2. Main Contributing Countries in the MENA Region**

Total authors that contributed to the journal during Period 1 represent three countries out of the twenty one MENA countries as they are listed in Table 4.20. Table 4.20 presents the name of the country, number of appearances, number of published papers, and percentage of the number of papers published. The countries are listed in order of decreasing contribution according to the number of appearances. In terms of published papers; the top three contributing countries were the Turkey, Saudi Arabia, and the Egypt. The percentage of number of papers published was calculated by dividing the number of papers published by the country over total number of papers published about the MENA region in the specified period.

**Table 4.20: Main Contributing Countries in the MENA Region for Period 1**

<b>No.</b>	<b>Country</b>	<b>Number of appearances</b>	<b>Number of published papers</b>	<b>%Number of published papers</b>
1	Turkey	10	6	54.55%
2	Saudi Arabia	9	4	36.36%
3	Egypt	3	1	9.09%
<b>Total number of contributing papers during Period 1</b>				<b>11</b>

Total authors that contributed to the journal during Period 2 represent seven countries out of the twenty one MENA countries as they are listed in Table 4.21.

Table 4.21 presents the name of the country, number of appearances, number of published papers, and percentage of the number of papers published. The countries are listed in order of decreasing contribution according to the number of appearances. In terms of published papers; the top four contributing countries were the Turkey, Egypt, Saudi Arabia, and the United Arab Emirates.

**Table 4.21: Main Contributing Countries in the MENA Region for Period 2**

<b>No.</b>	<b>Country</b>	<b>Number of appearances</b>	<b>Number of published papers</b>	<b>%Number of published papers</b>
<b>1</b>	Turkey	15	9	42.86%
<b>2</b>	Egypt	5	3	14.29%
<b>3</b>	Saudi Arabia	4	2	9.52%
<b>4</b>	Kuwait	3	1	4.76%
<b>5</b>	United Arab Emirates	3	2	9.52%
<b>6</b>	Jordan	1	1	4.76%
<b>7</b>	Lebanon	1	1	4.76%
<b>Total number of contributing papers during Period 2</b>				<b>21</b>

Total authors that contributed to the journal during Period 3 represent ten countries out of the twenty one MENA countries as they are listed in Table 4.22. Table 4.22 presents the name of the country, number of appearances, number of published papers, and percentage of the number of papers published. The countries are listed in order of decreasing contribution according to the number of appearances. In terms of published papers; the top contributing countries were the Turkey, Saudi Arabia, Egypt, Iran, United Arab Emirates, Northern Cyprus, and the Kuwait.

Total authors that contributed to the journal during total period represent eleven countries out of the twenty one MENA countries as they are listed in Table 4.23. Table 4.23 presents the name of the country, number of appearances, number of published papers, and percentage of the number of papers published. The countries are listed in order of decreasing contribution according to the number of appearances. Overall (15-year) rank the top five contributing countries in terms of published papers were the Turkey, Saudi Arabia, Egypt, United Arab Emirates, and the Kuwait.

**Table 4.22: Main Contributing Countries in the MENA Region for Period 3**

<b>No.</b>	<b>Country</b>	<b>Number of appearances</b>	<b>Number of published papers</b>	<b>%Number of published papers</b>
1	Egypt	8	2	7.69%
2	Saudi Arabia	7	4	15.38%
3	Turkey	6	5	19.23%
4	Iran	6	2	7.69%
5	United Arab Emirates	3	2	7.69%
6	Northern Cyprus	3	2	7.69%
7	Jordan	2	1	3.85%
8	Kuwait	2	2	7.69%
9	Bahrain	1	1	3.85%
10	Libya	1	1	3.85%
<b>Total number of contributing papers during Period 3</b>				<b>26</b>

As shown in Tables 4.20, 4.21, 4.22, and 4.23, each of Turkey, Saudi Arabia and Egypt were always the top three contributing countries to the journal during these years. In addition, as shown in Tables 4.21 and 4.22, the United Arab Emirates had major contribution to the journal in periods two and three as in period 2 it was on the third rank with the Saudi Arabia, and in Period 3 it was on the third rank with other countries. On the other hand, there were no contributing authors from some MENA countries through the whole period such as: Algeria, Djibouti, Iraq, Morocco, Oman, Palestine, Qatar, Syria, Tunisia, and Yemen.

#### **4.6. Analysis Based on Sector**

##### **4.6.1. Analysis Based on Sector in the Overall Region**

Table 4.24 shows the distribution of the authors based on sector in the overall region for each period and total period.

**Table 4.23: Main Contributing Countries in the MENA Region for Total Period**

No.	Country	Number of appearances	Number of published papers	%Number of published papers
1	Turkey	31	20	34.48%
2	Saudi Arabia	20	10	17.24%
3	Egypt	16	6	10.34%
4	United Arab Emirates	6	4	6.90%
5	Iran	6	2	3.45%
6	Kuwait	5	3	5.17%
7	Jordan	3	2	3.45%
8	Northern Cyprus	3	2	3.45%
9	Lebanon	1	1	1.72%
10	Bahrain	1	1	1.72%
11	Libyan Arab Jamahiriya	1	1	1.72%
<b>Total number of contributing papers during Period 1</b>				<b>58</b>

**Table 4.24: Author's Distribution According to their Sector in the Overall Region**

Sector		Period 1	Period 2	Period 3
<b>Academia</b>	Number of Authors	451	595	707
	Percentage of Authors	93.57%	94.15%	94.27%
<b>Industry</b>	Number of Authors	30	30	36
	Percentage of Authors	6.22%	4.75%	4.80%
<b>Government</b>	Number of Authors	1	7	7
	Percentage of Authors	0.21%	1.11%	0.93%
<b>Total Number of Authors</b>		<b>482</b>	<b>632</b>	<b>750</b>

As can be noticed, the largest contribution was from academia for all periods while the industry made a small contribution. The government contribution was marginal in comparison. The huge gap in contribution between academia, industry and government is evident. This raises concern that this gap might continue to increase unless a solution can be found to increase the collaboration between the three sectors. Also, there is closeness in the ratios of the three sectors in Periods 1, 2 and 3.

In general, the less contribution from industry researchers to the journal during the last fifteen years can be attributed to the progressed economic situation of these countries and that practitioners were busy due to the high economic and civilized movement.

#### 4.6.2. Analysis Based on Sector in the MENA Region

Table 4.25 shows the distribution of the authors based on sector in the MENA region for each period and total period.

**Table 4.25: Author's Distribution According to their Sector in the MENA Region**

Sector		Period 1	Period 2	Period 3	Total period
<b>Academia</b>	Number of Authors	21	28	30	70
	Percentage of Authors	100%	96.55%	90.91%	94.59%
<b>Industry</b>	Number of Authors	0	0	2	2
	Percentage of Authors	0.00%	0.00%	6.06%	2.70%
<b>Government</b>	Number of Authors	0	1	1	2
	Percentage of Authors	0.00%	3.45%	3.03%	2.70%
<b>Total Number of Authors</b>		<b>21</b>	<b>29</b>	<b>33</b>	<b>74</b>

As can be noticed, the largest contribution was from academia for all periods. For Period 1, there was no contribution from both industry and government and each one of them accounted for 0% of contribution. For Period 2, there was a small contribution from government while the industry remained at 0% contribution. For Period 3, there was a small contribution to the journal from both industry and government. In general, both industry and government contributions were unnoticed compared to the academia contribution. Furthermore, if the overall contribution is compared with the MENA contribution, it can be observed that the MENA contribution to the journal was marginal. Overall, one can say that there was a deficit in the collaboration among the three sectors in both regions, overall region and MENA region.

#### 4.7. MENA to non-MENA Authors

Table 4.26 depicts the distribution of the authors depending on whether they were related to the MENA region or not for each period. The ratio of MENA authors to non-MENA authors was almost the same in the three periods. In general, over the three periods the number of authors from both regions was increasing with time. Also,

the number of non-MENA authors was much higher than the number of MENA authors in the three periods and total period as well.

**Table 4.26: MENA & Non-MENA Authors' Distribution**

<b>Period</b>	<b>Total Number of Authors</b>	<b>Number of non-MENA Authors</b>	<b>Percentage of non-MENA Authors</b>	<b>Number of MENA Authors</b>	<b>Percentage of MENA Authors</b>	<b>Percentage of MENA Authors to non-MENA Authors</b>
<b>Period 1</b>	482	461	95.64%	21	4.36%	4.56%
<b>Period 2</b>	632	603	95.41%	29	4.59%	4.81%
<b>Period 3</b>	750	717	95.60%	33	4.40%	4.60%

From the above analysis, it is easily observed that the number of MENA authors was very small compared to the number of non-MENA authors. Furthermore, there was closeness in the ratios over the three periods.

#### **4.8. Analysis of Research Topics**

##### **4.8.1. Analysis of Research Topics in the Overall Region**

Tables 4.27-4.36 show the detailed distribution for the research and research sub-topics in the overall region for each period and total period. The percentage of papers published was calculated by dividing the number of papers published about the topic during the total period over total number of papers published during the total period.

**Table 4.27: Management and Organization of the Firm Analysis (Overall Region)**

<b>Classification</b>	<b>Period 1</b>	<b>Period 2</b>	<b>Period 3</b>	<b>Total period</b>	<b>% Papers published</b>
Management and Organization of the Firm	35	44	53	132	10.86%
Firm strategy, organization and culture	9	15	23	47	3.87%
Internationalization and globalization	5	12	9	26	2.14%
Marketing and investment patterns	4	5	10	19	1.56%
Accounting and financial management	4	3	6	13	1.07%
Business strategy and planning	3	4	2	9	0.74%
Inter-firm relationships	6	1	2	9	0.74%
Supply Chain Management	4	4	1	9	0.74%

**Table 4.28: Construction Planning and Control Analysis (Overall Region)**

Classification	Period 1	Period 2	Period 3	Total period	% Papers published
Construction Planning and Control	22	37	27	86	7.07%
Designing for maintainability	7	15	7	29	2.38%
Sustainability	5	9	10	24	1.97%
Construction process models	6	5	4	15	1.23%
Constructability analysis	2	4	1	7	0.58%
Lean construction and production	1	1	3	5	0.41%
Planning of the construction process	1	2	0	3	0.25%
Production management	0	1	2	3	0.25%

**Table 4.29: Site, Materials, and Equipment Management Analysis (Overall Region)**

Classification	Period 1	Period 2	Period 3	Total period	% Papers published
Site, Materials and Equipment Management	24	24	10	58	4.77%
Environmental management	10	11	6	27	2.22%
Construction equipment management	3	5	0	8	0.66%
Site preparation and layout	3	2	2	7	0.58%
Earthwork	2	2	2	6	0.49%
Materials and component management	4	2	0	5	0.41%
Production plants	2	2	0	4	0.33%
Others	0	0	0	0	0.00%

**Table 4.30: Time/Cost Planning and Control Analysis (Overall Region)**

Classification	Period 1	Period 2	Period 3	Total period	% Papers published
Time/Cost Planning and Control	29	45	33	107	8.80%
Modeling and simulation applications	8	15	5	28	2.30%
Cost planning and control	6	6	13	25	2.06%
Resources planning and allocation	3	9	3	15	1.23%
Time/cost scheduling optimization	5	4	5	14	1.15%
Life cycle costing	2	4	1	7	0.58%
LOB, linear and vertical scheduling	1	4	2	7	0.58%
Time scheduling and control techniques	0	2	1	3	0.25%
Critical path method	0	1	2	3	0.25%
Network planning and analysis	1	0	1	2	0.16%
Non-deterministic time-cost estimating techniques	2	0	0	2	0.16%
PERT and GERT	1	0	0	1	0.08%

**Table 4.31: Construction Operations and Methods Analysis (Overall Region)**

Classification	Period 1	Period 2	Period 3	Total period	% Papers published
Construction Operations and Methods	9	13	10	32	2.63%
Buildings	4	4	3	11	0.90%
Concrete construction	2	5	1	8	0.66%
Formwork, shoring and temporary structures	1	1	1	3	0.25%
Bridge construction	0	1	2	3	0.25%
Highway construction	0	1	2	3	0.25%
Pile foundation and pipeline construction	1	1	0	2	0.16%
Construction methods	0	0	1	1	0.08%
Foundations and temporary retention walls, excavation	1	0	0	1	0.08%
Tunnel Construction	0	0	0	0	0.00%
Asphalt	0	0	0	0	0.00%
MEP	0	0	0	0	0.00%
Others	0	0	0	0	0.00%

**Table 4.32: Human Factors, Management of Safety and Labor Relationships Analysis (Overall Region)**

Classification	Period 1	Period 2	Period 3	Total period	% Papers published
Human Factors, Management of Safety and Labor Relationships	45	60	78	183	15.05%
Safety management	8	13	28	49	4.03%
Organized labor related issues	10	20	13	43	3.54%
Performance analysis and measurement	6	10	16	32	2.63%
Productivity issues	9	5	9	23	1.89%
Communications	9	7	6	22	1.81%
Engineering managers characteristics and recruitment issues	3	5	6	14	1.15%
Others	0	0	0	0	0.00%

**Table 4.33: Project Management Analysis (Overall Region)**

Classification	Period 1	Period 2	Period 3	Total period	% Papers published
Project Management	49	64	96	209	17.19%
Risk analysis and management	15	14	21	50	4.11%
Cooperation, partnering, leadership and opportunity	5	11	22	38	3.13%
Project planning and organization	2	17	16	35	2.88%
Project quality planning and control	13	9	11	33	2.71%
Design management, Value engineering and management	10	8	12	30	2.47%
Project performance and feedback	2	3	12	17	1.40%
Change management	2	2	2	6	0.49%

**Table 4.34: Project Delivery Systems and Contracts Analysis (Overall Region)**

Classification	Period 1	Period 2	Period 3	Total period	% Papers published
Project Delivery Systems and Contracts	66	58	72	196	16.12%
Selection and evaluation of bids and proposals	18	19	22	59	4.85%
Claims and disputes, negotiation and resolution, construction delays	19	12	10	41	3.37%
Project delivery systems with public and/or private financing	7	17	17	41	3.37%
Analysis and selection criteria	6	5	8	19	1.57%
Contract and contingency management	6	1	11	18	1.48%
Selection and evaluation of contractors	7	4	3	14	1.15%
Design/build	3	0	1	4	0.33%

**Table 4.35: Construction Industry Structure and Environment Analysis (Overall Region)**

Classification	Period 1	Period 2	Period 3	Total period	% Papers published
Construction Industry Structure and Environment	34	30	41	105	8.63%
Domestic construction issues and practices	18	21	28	67	5.51%
Codes, standards and laws	9	7	6	22	1.81%
Roles and cooperation in the industry	7	2	5	14	1.15%
Classification and information systems	0	0	2	2	0.16%

**Table 4.36: Technology Development Issues Analysis (Overall Region)**

Classification	Period 1	Period 2	Period 3	Total period	% Papers published
Technology Development Issues	31	39	38	108	8.88%
Innovation and technology transfer, analysis, and mechanics	8	28	15	51	4.19%
Research and development issues, research needs	15	3	13	31	2.55%
MIS and IT based integration and communications + GPS	5	6	5	16	1.32%
2-D, 3-D and 4-D CAD	0	2	1	3	0.25%
BIM	0	0	1	1	0.08%
Others	3	0	3	6	0.49%

Table 4.37 shows the detailed distribution for the research topics in the overall region for each period and for total period.

**Table 4.37: Analysis of Research Topics in the Overall Region for Total Period**

<b>Classification</b>	<b>Period 1</b>	<b>Period 2</b>	<b>Period 3</b>	<b>Total period</b>	<b>% Papers published</b>
Management and Organization of the Firm	35	44	53	132	10.86%
Construction Planning and Control	22	37	27	86	7.07%
Site, Materials and Equipment Management	24	24	10	58	4.77%
Time/Cost Planning and Control	29	45	33	107	8.80%
Construction Operations and Methods	9	13	10	32	2.63%
Human Factors, Management of Safety and Labor Relationships	45	60	78	183	15.05%
Project Management	49	64	96	209	17.19%
Project Delivery Systems and Contracts	66	58	72	196	16.12%
Construction Industry Structure and Environment	34	30	41	105	8.63%
Technology Development Issues	31	39	38	108	8.88%
<b>Total</b>	<b>344</b>	<b>414</b>	<b>458</b>	<b>1,216</b>	<b>100.00%</b>

From the above analysis, the top research topics in the overall region for Period 1 respectively were, “Project Delivery Systems and Contracts” (19.19%), “Project Management” (14.24%), and “Human Factors, Management of Safety and Labor Relationships” (13.08%). On the other hand, the lowest interest research topics respectively were, “Construction Operations and Methods” (2.62%), “Construction Planning and Control” (6.40%), and “Site, Materials and Equipment Management” (6.98%).

Furthermore, the top research topics in the overall region for Period 2 respectively were, “Project Management” (15.46%), “Human Factors, Management of Safety and Labor Relationships” (14.49%), and “Project Delivery Systems and Contracts” (14.01%). On the other hand, the lowest interest research topics respectively were, “Construction Operations and Methods” (3.14%), “Site, Materials and Equipment Management” (5.80%), and “Construction Industry Structure and Environment” (7.25%).

In addition, for Period 3 the top research topics in the overall region respectively were, “Project Management” (20.96%), “Human Factors, Management of Safety and Labor Relationships” (17.03%), and “Project Delivery Systems and Contracts” (15.72%). On the other hand, the lowest interest research topics respectively were, “Site, Materials and Equipment Management” (2.18%), “Construction Operations and Methods” (2.18%), and “Construction Planning and Control” (5.90%).

For total period, the top research topics in the overall region respectively were, “Project Management” (17.19%), “Project Delivery Systems and Contracts” (16.12%), and “Human Factors, Management of Safety and Labor Relationships” (15.05%). On the other hand, the lowest interest research topics respectively were, “Construction Operations and Methods” (2.63%), “Site, Materials and Equipment Management” (4.77%), and “Construction Planning and Control” (7.07%).

In general, it can be concluded that Periods one, two, three and total period had the same top research topics with different orders. The top research topics were associated with “project”, “human factors”, and “safety and labor relationships” related issues. On the other hand, regarding the lowest interest research topics, it can be noticed that there was a less interest in the research that is related to the “site” and “construction” fields in the overall region over the three periods and total period as well. In addition, the lack of diversification in research topics can be attributed to the

bias of the authors to not publish beyond their disciplines including authors from academia, industry and government. At the same time, it was noticed the change in the types of papers being published from period to period and this may be attributed to the increase in participation by countries. These countries came from different parts of the world. Each country from these countries has different economy and different lifestyle which is concerned with different aspects of the construction industry. The main contributing countries in each region are as follows:

- Asia: Hong Kong, Singapore, Taiwan, and China
- Africa: Africa's papers mostly came from South Africa
- North America: US and Canada
- South America: Brazil
- Europe: UK, Sweden, and the Netherlands
- MENA Region: Turkey, Saudi Arabia, and Egypt

In terms of growth, "Time/Cost Planning and Control" was found to be the fastest growing topic for Period 1-2 as the number of papers published regarding this topic increased by 35.56% (16 papers). On the other hand, "Project Management" was found to be the fastest growing topic for Period 2-3 as the number of papers published increased by 33.33% (32 papers). The same applied for total period, as the number of papers published on "Project Management" increased by 48.96% (47 papers).

Contrary to this, "Project Delivery Systems and Contracts" was found to be the most declining topic for Period 1-2 as the number of papers published regarding this topic decreased by 12.12% (8 papers). On the other hand, "Site, Materials and Equipment Management" was found to be the most declining topic for Period 2-3 as the number of papers published decreased by 58.33% (14 papers). The same applied for total period, as the number of papers published on "Site, Materials and Equipment Management" decreased by 58.33% (14 papers).

Among the topics that did not change, "Site, Materials and Equipment Management" had the same number of published papers for both Periods one and two.

**Table 4.38: Top Research Sub-topics in the Overall Region for Period 1**

<b>Sub-topic</b>	<b>Number of published papers</b>	<b>%Number of published papers</b>
Claims and disputes, negotiation and resolution, construction delays	19	5.52%
Selection and evaluation of bids and proposals	18	5.23%
Domestic construction issues and practices	18	5.23%
Risk Analysis and Management	15	4.36%
Research and development issues, research needs	15	4.36%
Project quality planning and control	13	3.78%
Environmental management	10	2.91%
Organized labor related issues	10	2.91%
Design management, value engineering and management	10	2.91%
Firm strategy, organization and culture	9	2.62%
Productivity issues	9	2.62%
Communications	9	2.62%
Codes, standards and laws	9	2.62%
<b>Total</b>	<b>344</b>	<b>100.00%</b>

**Table 4.39: Top Research Sub-topics in the Overall Region for Period 2**

<b>Sub-topic</b>	<b>Number of published papers</b>	<b>%Number of published papers</b>
Innovation and technology transfer, analysis, and mechanics	28	6.76%
Domestic construction issues and practices	21	5.07%
Organized labor related issues	20	4.83%
Selection and evaluation of bids and proposals	19	4.59%
Project planning and organization	17	4.11%
Project delivery systems with public and/or private financing	17	4.11%
Firm strategy, organization and culture	15	3.62%
Designing for maintainability	15	3.62%
Modeling and simulation applications	15	3.62%
Risk analysis and management	14	3.38%
<b>Total</b>	<b>414</b>	<b>100.00%</b>

**Table 4.40: Top Research Sub-topics in the Overall Region for Period 3**

<b>Sub-topic</b>	<b>Number of published papers</b>	<b>%Number of published papers</b>
Safety management	28	6.11%
Domestic construction issues and practices	28	6.11%
Firm strategy, organization and culture	23	5.02%
Cooperation, partnering, leadership and opportunity	22	4.80%
Selection and evaluation of bids and proposals	22	4.80%
Risk analysis and management	21	4.59%
Project delivery systems with public and/or private financing	17	3.71%
Performance analysis and measurement	16	3.49%
Project planning and organization	16	3.49%
Innovation and technology transfer, analysis, and mechanics	15	3.28%
<b>Total</b>	<b>458</b>	<b>100.00%</b>

Tables 4.38, 4.39, & 4.40 show the top research sub-topics in the overall region for Periods 1, 2, & 3 respectively according to the number of published papers. Table 4.41 shows the top research sub-topics in the overall region for total period. The percentage of the number of papers published was calculated by dividing the number of papers published about the sub-topic during the period over total number of papers published during the specified period.

**Table 4.41: Top Research Sub-topics in the Overall Region for Total Period**

<b>Sub-topic</b>	<b>Number of published papers</b>	<b>%Number of published papers</b>
Domestic construction issues and practices	67	5.51%
Selection and evaluation of bids and proposals	59	4.85%
Innovation and technology transfer, analysis, and mechanics	51	4.19%
Risk analysis and management	50	4.11%
Safety management	49	4.03%
Firm strategy, organization and culture	47	3.87%
Organized labor related issues	43	3.54%
Claims and disputes, negotiation and resolution, construction delays	41	3.37%
Project delivery systems with public and/or private financing	41	3.37%
Cooperation, partnering, leadership and opportunity	38	3.13%
<b>Total</b>	<b>1,216</b>	<b>100.00%</b>

Form the overall analysis, it can be noticed that each period had different distribution according to the research sub-topics. Overall, the top five CM sub-topics in the overall region for total period were associated with “Domestic construction issues and practices”, “Selection and evaluation of bids and proposals”, “Innovation and technology transfer, analysis, and mechanics”, “Risk analysis and management”, and “Safety management”.

Also, it can be noticed that the appearance of new topics form period to period such as “Production management”, “Time scheduling and control techniques”, “Critical path method”, “Bridge construction”, “Highway construction”, “Construction methods”, “Tunnel construction”, “Asphalt”, “MEP”, “Classification and information systems”, “2-D, 3-D and 4-D CAD”, and “BIM” as there were no published papers about them in Period one. This may be attributed to the increase in number of published papers in Periods two and three compared to Period one. This raises some crucial topics that were not raised during Period one such as “technology”, “2-D, 3-D and 4-D CAD” and, “BIM”.

Furthermore, regarding the sub-topics in terms of growth, “Innovation and technology transfer, analysis and mechanics” was found to be the fastest growing sub-topic for Period 1-2 as the number of papers published regarding this topic increased by 71.43% (20 papers). On the other hand, “Safety management” was found to be the fastest growing sub-topic for Period 2-3 as the number of published papers increased by 53.57% (15 papers). The same applied for total period, as the number of papers published on “Safety management” increased by 71.43% (20 papers).

Contrary to this, “Research and development issues, research needs” was found to be the most declining sub-topic for Period 1-2 as the number of papers published regarding this topic decreased by 80.00% (12 papers). On the other hand, “Innovation and technology transfer, analysis and mechanics” was found to be the most declining sub-topic for Period 2-3 as the number of published papers decreased by 46.43% (13 papers). Furthermore, “Claims and disputes, negotiation and resolution, construction delays” was found to be the most declining sub-topic for total period as the number of papers published decreased by 47.37% (9 papers).

#### **4.8.2. Analysis of Research Topics in the MENA Region**

Tables 4.42-4.51 show the detailed distribution for the research and research sub-topics in the MENA region for each period and total period. Papers in the MENA region have been listed according to both authors and the country that the paper talked about. This way, if the paper was written by an author from the MENA region or talked about the MENA region, it was considered as a paper related to the MENA region and has been accounted in the below analysis. The percentage of papers published was calculated by dividing the number of papers published about the topic in the MENA region during the total period, over total number of papers published in the MENA region during the total period.

**Table 4.42: Management and Organization of the Firm Analysis (MENA Region)**

Classification	Period 1	Period 2	Period 3	Total period	% Papers published
Management and Organization of the Firm	2	3	0	5	8.62%
Internationalization and globalization	1	1	0	2	3.45%
Business strategy and planning	0	2	0	2	3.45%
Firm strategy, organization and culture	1	0	0	1	1.72%
Marketing and investment patterns	0	0	0	0	0.00%
Accounting and financial management	0	0	0	0	0.00%
Inter-firm relationships	0	0	0	0	0.00%
Supply Chain Management	0	0	0	0	0.00%

**Table 4.43: Construction Planning and Control Analysis (MENA Region)**

Classification	Period 1	Period 2	Period 3	Total period	% Papers published
Construction Planning and Control	1	1	1	3	5.17%
Designing for maintainability	1	0	0	1	1.72%
Sustainability	0	0	1	1	1.72%
Lean construction and production	0	1	0	1	1.72%
Construction process models	0	0	0	0	0.00%
Constructability analysis	0	0	0	0	0.00%
Planning of the construction process	0	0	0	0	0.00%
Production management	0	0	0	0	0.00%

**Table 4.44: Site, Materials, and Equipment Management Analysis (MENA Region)**

Classification	Period 1	Period 2	Period 3	Total period	% Papers published
Site, Materials and Equipment Management	1	2	2	5	8.62%
Environmental management	0	0	2	2	3.45%
Construction equipment management	0	1	0	1	1.72%
Site preparation and layout	1	0	0	1	1.72%
Materials and component management	0	1	0	1	1.72%
Earthwork	0	0	0	0	0.00%
Production plants	0	0	0	0	0.00%
Others	0	0	0	0	0.00%

**Table 4.45: Time/Cost Planning and Control Analysis (MENA Region)**

Classification	Period 1	Period 2	Period 3	Total period	% Papers published
Time/Cost Planning and Control	0	3	5	8	13.79%
Time/cost scheduling optimization	0	0	2	2	3.45%
LOB, linear and vertical scheduling	0	1	1	2	3.45%
Critical path method	0	1	1	2	3.45%
Cost planning and control	0	0	1	1	1.72%
Resources planning and allocation	0	1	0	1	1.72%
Modeling and simulation applications	0	0	0	0	0.00%
Life cycle costing	0	0	0	0	0.00%
Time scheduling and control techniques	0	0	0	0	0.00%
Network planning and analysis	0	0	0	0	0.00%
Non-deterministic time-cost estimating techniques	0	0	0	0	0.00%
PERT and GERT	0	0	0	0	0.00%

**Table 4.46: Construction Operations and Methods Analysis (MENA Region)**

Classification	Period 1	Period 2	Period 3	Total period	% Papers published
Construction Operations and Methods	0	1	1	2	3.45%
Formwork, shoring and temporary structures	0	0	1	1	1.72%
Highway construction	0	1	0	1	1.72%
Buildings	0	0	0	0	0.00%
Concrete construction	0	0	0	0	0.00%
Bridge construction	0	0	0	0	0.00%
Pile foundation and pipeline construction	0	0	0	0	0.00%
Construction methods	0	0	0	0	0.00%
Foundations and temporary retention walls, excavation	0	0	0	0	0.00%
Tunnel Construction	0	0	0	0	0.00%
Asphalt	0	0	0	0	0.00%
MEP	0	0	0	0	0.00%
Others	0	0	0	0	0.00%

**Table 4.47: Human Factors, Management of Safety and Labor Relationships Analysis (MENA Region)**

Classification	Period 1	Period 2	Period 3	Total period	% Papers published
Human Factors, Management of Safety and Labor Relationships	0	0	5	5	8.62%
Productivity issues	0	0	2	2	3.45%
Organized labor related issues	0	0	1	1	1.72%
Performance analysis and measurement	0	0	1	1	1.72%
Communications	0	0	1	1	1.72%
Safety management	0	0	0	0	0.00%
Engineering managers characteristics and recruitment issues	0	0	0	0	0.00%
Others	0	0	0	0	0.00%

**Table 4.48: Project Management Analysis (MENA Region)**

Classification	Period 1	Period 2	Period 3	Total period	% Papers published
Project Management	1	5	6	12	20.69%
Risk analysis and management	0	2	2	4	6.90%
Project quality planning and control	1	0	2	3	5.17%
Cooperation, partnering, leadership and opportunity	0	2	0	2	3.45%
Project planning and organization	0	1	1	2	3.45%
Project performance and feedback	0	0	1	1	1.72%
Design management, Value engineering and management	0	0	0	0	0.00%
Change management	0	0	0	0	0.00%

**Table 4.49: Project Delivery Systems and Contracts Analysis (MENA Region)**

Classification	Period 1	Period 2	Period 3	Total period	% Papers published
Project Delivery Systems and Contracts	2	3	4	9	15.52%
Claims and disputes, negotiation and resolution, construction delays	1	2	1	4	6.90%
Selection and evaluation of bids and proposals	0	1	2	3	5.17%
Project delivery systems with public and/or private financing	1	0	1	2	3.45%
Analysis and selection criteria	0	0	0	0	0.00%
Contract and contingency management	0	0	0	0	0.00%
Selection and evaluation of contractors	0	0	0	0	0.00%
Design/build	0	0	0	0	0.00%

**Table 4.50: Construction Industry Structure and Environment Analysis (MENA Region)**

Classification	Period 1	Period 2	Period 3	Total period	% Papers published
Construction Industry Structure and Environment	3	1	2	6	10.34%
Domestic construction issues and practices	1	0	2	3	5.17%
Roles and cooperation in the industry	2	0	0	2	3.45%
Codes, standards and laws	0	1	0	1	1.72%
Classification and information systems	0	0	0	0	0.00%

**Table 4.51: Technology Development Issues Analysis (MENA Region)**

Classification	Period 1	Period 2	Period 3	Total period	% Papers published
Technology Development Issues	1	2	0	3	5.17%
MIS and IT based integration and communications + GPS	1	1	0	2	3.45%
Innovation and technology transfer, analysis, and mechanics	0	1	0	1	1.72%
Research and development issues, research needs	0	0	0	0	0.00%
2-D, 3-D and 4-D CAD	0	0	0	0	0.00%
BIM	0	0	0	0	0.00%
Others	0	0	0	0	0.00%

Table 4.52 shows the detailed distribution for the research topics in the MENA region for each period and for total period.

**Table 4.52: Analysis of Top Research Topics in the MENA Region for Total Period**

<b>Classification</b>	<b>Period 1</b>	<b>Period 2</b>	<b>Period 3</b>	<b>Total period</b>	<b>% Papers published</b>
Management and Organization of the Firm	2	3	0	5	8.62%
Construction Planning and Control	1	1	1	3	5.17%
Site, Materials and Equipment Management	1	2	2	5	8.62%
Time/Cost Planning and Control	0	3	5	8	13.79%
Construction Operations and Methods	0	1	1	2	3.45%
Human Factors, Management of Safety and Labor Relationships	0	0	5	5	8.62%
Project Management	1	5	6	12	20.69%
Project Delivery Systems and Contracts	2	3	4	9	15.52%
Construction Industry Structure and Environment	3	1	2	6	10.34%
Technology Development Issues	1	2	0	3	5.17%
<b>Total</b>	<b>11</b>	<b>21</b>	<b>26</b>	<b>58</b>	<b>100.00%</b>

From the above analysis, the top research topics in the MENA region for Period 1 respectively were, “Construction Industry Structure and Environment” (27.27%), “Management and Organization of the Firm” (18.18%), and “Project Delivery Systems and Contracts” (18.18%). On the other hand, the lowest interest research topics respectively were, “Time/Cost Planning and Control” (0.00%), “Construction Operations and Methods” (0.00%), and “Human Factors, Management of Safety and Labor Relationships” (0.00%).

Furthermore, the top research topics in the MENA region for Period 2 respectively were, “Project Management” (23.81%), “Management and Organization of the Firm” (14.29%), “Time/Cost Planning and Control” (14.29%), and “Project Delivery Systems and Contracts” (14.29%). On the other hand, the lowest interest research topic was “Human Factors, Management of Safety and Labor Relationships” (0.00%).

In addition, for Period 3 the top research topics in the MENA region respectively were, “Project Management” (23.08%), “Time/Cost Planning and Control” (19.23%), and “Human Factors, Management of Safety and Labor Relationships” (19.23%). On the other hand, lowest interest research topics respectively were on, “Management and Organization of the Firm” (0.00%), and “Technology Development Issues” (0.00%).

For Total period, the top research topics in the MENA region respectively were, “Project Management” (20.69%), “Project Delivery Systems and Contracts” (15.52%), and “Time/Cost Planning and Control” (13.79%). On the other hand, the lowest interest research topics respectively were, “Construction Operations and Methods” (3.45%), “Construction Planning and Control” (5.17%), and “Technology Development Issues” (5.17%).

In general, it can be concluded that most of the top research topics were associated with “project”, and “time/cost” related issues. On the other hand, regarding the lowest interest research topics, for Period one there were no contributing papers on each of “Time/Cost Planning and Control”, “Construction Operations and Methods”, and “Human Factors, Management of Safety and Labor Relationships”. For Period two, there were no contributing papers on “Human Factors, Management of Safety and Labor Relationships”. For Period three, there were no contributing papers on both “Management and Organization of the Firm” and “Technology Development Issues”. Also, it can be noticed that there was a less interest in the

research that is related to the construction field in Period one, two, three and total period. Moreover, “technology” was a less interest research topic from CM researchers in Period three and total period. In general, from the overall analysis, it can be that there was a lack of diversity of research topics in the MENA region. The lack of diversification in research topics can be attributed to the bias of the authors to not publish beyond their disciplines including authors from academia, industry and government. At the same time, it was noticed the change in the types of papers being published from period to period and this may be attributed to the increase in participation by countries. These countries come from different parts of the world. Each country from these countries has different economy and different lifestyle which is concerned with different aspects of the construction industry.

In terms of growth, “Project Management” was found to be the fastest growing topic in the MENA region for Period 1-2 as the number of published papers regarding this topic increased by 80.00% (4 papers). On the other hand, “Human Factors, Management of Safety and Labor Relationships” was found to be the fastest growing topic for Period 2-3 as the number of published papers increased by 100.00% (0 papers→5 papers). For total period, “Time/Cost Planning and Control”, “Human Factors, Management of Safety and Labor Relationships”, and “Project Management” were found to be the fastest growing topics in the MENA region as the number of published papers increased by 5 papers for each.

Contrary to this, “Construction Industry Structure and Environment” was found to be the most declining topic for Period 1-2 as the number of published papers regarding this topic decreased by 66.67% (2 papers). On the other hand, “Management and Organization of the Firm” was found to be the most declining topic for Period 2-3 as the number of published papers decreased by 100.00% (3 papers-0 papers). The same applied for total period, as the number of published papers on “Management and Organization of the Firm” decreased by 60.00% (2 papers).

On the other hand, some topics did not achieve any change. For example, “Construction Planning and Control” and “Human Factors, Management of Safety and Labor Relationships” had the same number of published papers for both Periods one and two. Also, “Construction Planning and Control”, “Site, Materials and Equipment Management”, and “Construction Operations and Methods” had the same number of published papers for both Periods two and three. In addition, “Construction

Planning and Control” had the same number of published papers for Periods one, two and three.

By analyzing the CME journal, the top research topics for the total period were, “Project Management”, “Project Delivery Systems and Contracts”, and “Human Factors, Management of Safety and Labor Relationships” while the top research topics in the MENA region were, “Project Management”, “Project Delivery Systems and Contracts”, and “Time/Cost Planning and Control”. Comparing the MENA region with the overall region, it can be noticed that “Project Management” and “Project Delivery Systems and Contracts” were at the top weighted topics for CME journal for both regions for the total period.

From the analysis of the CME journal, it can be noticed that there was less interest in research topics for the following areas in the overall region for total period “Construction Operations and Methods”, “Site, Materials and Equipment Management”, and “Construction Planning and Control”. The less interest research topics in the MENA region were, “Construction Operations and Methods”, “Construction Planning and Control”, and “Technology Development Issues”.

As can be observed, there were similarities among the less interest research topics in the overall region and the MENA region regarding the “construction” related issues, and this may lead us to say that there was a less interest in the research that is related to the construction field in both regions. This may be attributed to the presence of other leading journals that focus on pure “construction” related issues rather than “construction management” related issues such as “Construction and building materials”, “Construction innovation”, “Automation in Construction”, “International Journal of Construction Education and Research”, “Construction law and business”, etc. Moreover, “Technology Development Issues” was a less interest research topic in the MENA region and this is may be attributed to the presence of other leading journals that focus on “technology” related issues such as “Technology business journal”, “Technology analysis and strategic management”, “Technology and culture”, “Technology connection”, “Global technology hardware and equipment”, etc.

Tables 4.53, 4.54, & 4.55 show the top research sub-topics in the MENA region for Periods 1, 2 & 3 respectively according to the number of published papers. Table 4.56 shows the top research sub-topics for total period. The percentage of papers published was calculated by dividing the number of papers published about the

sub-topic in the MENA region during the period over total number of papers published in the MENA region during the specified period.

**Table 4.53: Top Research Sub-topics in the MENA Region for Period 1**

<b>Sub-topic</b>	<b>Number of published papers</b>	<b>%Number of published papers</b>
Roles and cooperation in the industry	2	18.18%
Firm strategy, organization and culture	1	9.09%
Internationalization and globalization	1	9.09%
Designing for maintainability	1	9.09%
Site preparation and layout	1	9.09%
Project quality planning and control	1	9.09%
Claims and disputes, negotiation and resolution, construction delays	1	9.09%
Project delivery systems with public and/or private financing	1	9.09%
Domestic construction issues and practices	1	9.09%
MIS and IT based integration and communications + GPS	1	9.09%
<b>Total</b>	<b>11</b>	<b>100.00%</b>

As can be noticed, each period had different distribution according to the research sub-topics. Also, the appearance of new topics from Period to period is also noticeable. Overall, the top five CM sub-topics in the MENA region for total period were associated with “Risk analysis and management”, “Claims and disputes, negotiation and resolution, construction delays”, “Project quality planning and control”, “Selection and evaluation of bids and proposals”, and “Domestic construction issues and practices”. It can be noticed that the top CM sub-topics in the overall region and in the MENA region were somehow close to each other.

**Table 4.54: Top Research Sub-topics in the MENA Region for Period 2**

<b>Sub-topic</b>	<b>Number of published papers</b>	<b>%Number of published papers</b>
Business strategy and planning	2	9.52%
Risk analysis and management	2	9.52%
Cooperation, partnering, leadership and opportunity	2	9.52%
Claims and disputes, negotiation and resolution, construction delays	2	9.52%
Internationalization and globalization	1	4.76%
Lean construction and production	1	4.76%
Construction equipment management	1	4.76%
Materials and component management	1	4.76%
Resources planning and allocation	1	4.76%
LOB, linear and vertical scheduling	1	4.76%
Critical path method	1	4.76%
Highway construction	1	4.76%
Project planning and organization	1	4.76%
Selection and evaluation of bids and proposals	1	4.76%
Codes, standards and laws	1	4.76%
Innovation and technology transfer, analysis, and mechanics	1	4.76%
MIS and IT based integration and communications + GPS	1	4.76%
<b>Total</b>	<b>21</b>	<b>100.00%</b>

**Table 4.55: Top Research Sub-topics in the MENA Region for Period 3**

<b>Sub-topic</b>	<b>Number of published papers</b>	<b>%Number of published papers</b>
Environmental management	2	7.69%
Time/cost scheduling optimization	2	7.69%
Productivity issues	2	7.69%
Risk analysis and management	2	7.69%
Project quality planning and control	2	7.69%
Selection and evaluation of bids and proposals	2	7.69%
Domestic construction issues and practices	2	7.69%
Sustainability	1	3.85%
Cost planning and control	1	3.85%
Resources planning and allocation	1	3.85%
LOB, linear and vertical scheduling	1	3.85%
Formwork, shoring and temporary structures	1	3.85%
Performance analysis and measurement	1	3.85%
Organized labor related issues	1	3.85%
Communications	1	3.85%
Project planning and organization	1	3.85%
Project performance and feedback	1	3.85%
Claims and disputes, negotiation and resolution, construction delays	1	3.85%
Project delivery systems with public and/or private financing	1	3.85%
<b>Total</b>	<b>26</b>	<b>100.00%</b>

**Table 4.56: Top Research Sub-topics in the MENA Region for Total Period**

<b>Sub-topic</b>	<b>Number of published papers</b>	<b>%Number of published papers</b>
Risk analysis and management	4	6.90%
Claims and disputes, negotiation and resolution, construction delays	4	6.90%
Project quality planning and control	3	5.17%
Selection and evaluation of bids and proposals	3	5.17%
Domestic construction issues and practices	3	5.17%
Internationalization and globalization	2	3.45%
Business strategy and planning	2	3.45%
Environmental management	2	3.45%
Time/cost scheduling optimization	2	3.45%
LOB, linear and vertical scheduling	2	3.45%
Critical path method	2	3.45%
Productivity issues	2	3.45%
Cooperation, partnering, leadership and opportunity	2	3.45%
Project planning and organization	2	3.45%
Project delivery systems with public and/or private financing	2	3.45%
Roles and cooperation in the industry	2	3.45%
MIS and IT based integration and communications + GPS	2	3.45%
<b>Total</b>	<b>58</b>	<b>100.00%</b>

#### **4.9. Chapter Summary**

This Chapter presents the analysis of the Construction Management and Economics Journal for the three periods: Period 1 (1997-2001) and includes volumes 15-19, Period 2 (2002-2006) and includes volumes 20-24 and Period 3 (2007-2011) and includes volumes 25-29. The total period is from 1997-2011 and includes volumes 15-29. The analysis included analysis of the issues, papers and authors. The analysis started by analyzing the issues during the specified period. Regarding the papers, were analyzed the papers' numbers and the country that the paper talked about were analyzed. Regarding the authors, the authors' names, organizations, countries, sector (academia, industry, or government) were analyzed. This has been carried out

for all countries and for MENA region apart. Furthermore, the ratio of MENA authors to non-MENA authors was analyzed, too. In addition, analysis of CM research topics, sub-topics, and less interest topics have been taken into consideration for all countries and for MENA region apart. Moreover, the most growing and declining topics and sub-topics for the overall region and the most growing and declining topics for the MENA region have been taken into consideration for each period and total period. Finally, a comparison has been conducted between the overall region and MENA region regarding top CM research topics and gaps for total period.

## **Chapter 5: Journal of Construction Engineering and Management**

### **5.1. Introduction**

This section provides the analysis for the Journal of Construction Engineering and Management for Period 1 (1997-2001) and includes volumes 123-127, Period 2 (2002-2006) and includes volumes 128-132, and Period 3 (2007-2011) and includes volumes 133-137. The total period is from 1997-2011 and includes volumes 123-137. Each technical paper in each issue of the journal for the specified period was accounted for this study. Editorials, book reviews, notes, and any paper less than 2 pages were excluded from the study. For each paper of the journal, the following information was collected:

- Volume number, paper publication year, issue number, paper publication month, title of the paper, country of the paper, region that the country of the paper is related to, and keywords
- Authors' names, organizations, country, email, author's affiliations (categorized as academia, industry, or government), and author's region (whether from the MENA region or not)
- Construction management research topic according to the classification that has been mentioned in Chapter 3.

### **5.2. Analysis of the Issues and Papers**

#### **5.2.1. Analysis of the Issues**

The number of issues was 4 for the year 1997, which increased to 6 issues for the years 1998-2004, and finally reached 12 for the years 2005-2011 as one issue in each month of the year.

#### **5.2.2. Analysis of the Papers in the Overall Region**

The Journal of Construction Engineering and Management has been analyzed for the periods: 1997-2001, 2002-2006 and 2007-2011. The number of papers published for the period 1 was 299 papers, the number has increased to 513 papers for Period 2 and it kept increasing until it reached 615 papers for Period 3. The total number of published papers was 1,427 for the whole period.

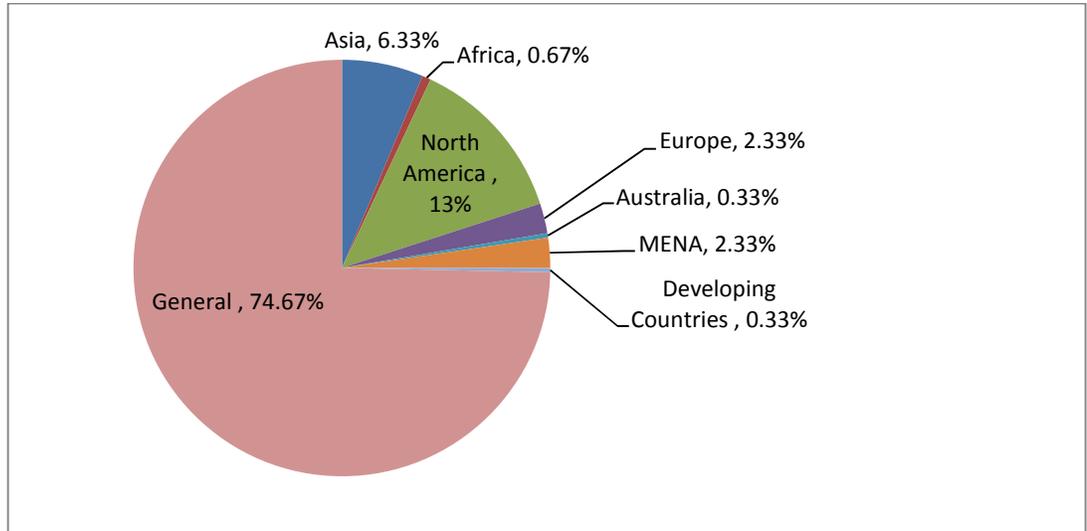
Figure 5.1 shows the distribution of the papers according to the country that the paper talked about in the overall region for Period 1. This has been carried out

according to the title of the paper, geographic terms, and abstract. Each country mentioned by the paper has been accounted in the distribution. There were cases where the paper talked about more than one country. In this case, the paper would be accounted more than one time in the distribution. If there was no country mentioned, the paper would be classified as “General”.

The countries have been classified according to the following:

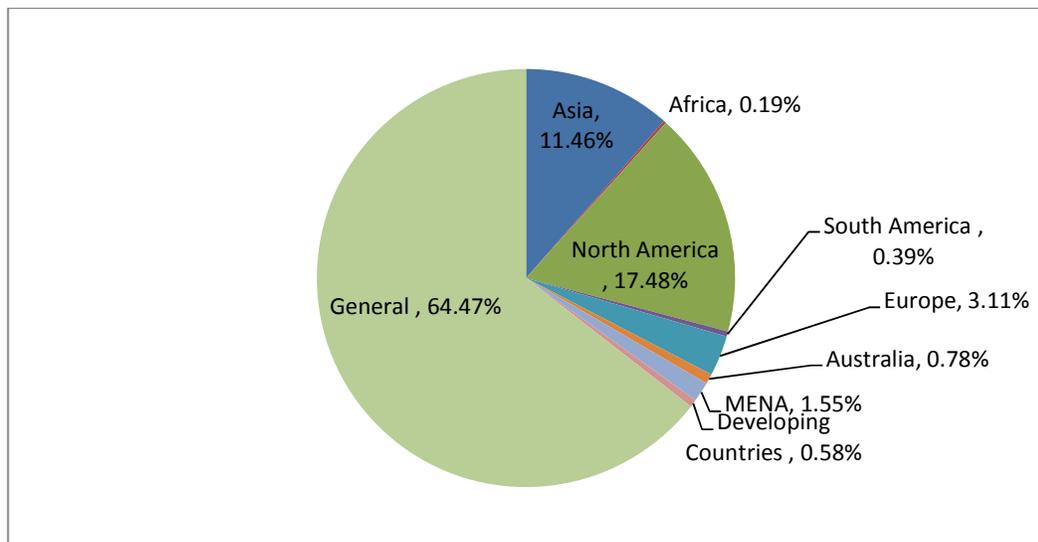
- Asia: China, Hong Kong, India, Indonesia, Japan, Korea, Malaysia, Pakistan, Singapore, South Korea, Taiwan, Thailand, Vietnam
- Africa: Ghana, Kenya, Nigeria, South Africa, Sub-Saharan African, Tanzania, Zambia
- North America: British Columbia, Canada, Mexico, US
- South America: Brazil, Colombia,
- Europe: Germany, Israel, Italy, Lithuania, Netherlands, Norway, Portugal, Scotland, Spain, Sweden, UK
- Australia: New South Wales, Victoria
- MENA: has been defined before in Chapter 2 of the thesis
- Developing Countries: Low income and living standard countries compared to other countries that spots in different locations of the world. [51]
- General: No country or region specified

For Period 1, the largest contribution comprised of General (74.67%, 224 papers) and then North America (13.00%, 39 papers). The next was for Asia (6.33%, 19 papers). Both MENA and Europe accounted for the same contribution which was (2.33%, 7 papers). Finally, Africa accounted for (0.67%, 2 papers) and the minimum contribution was from both Australia and Developing Countries that accounted for (0.33%, 1 paper). The total number of papers published for overall region for this period was 299 papers.



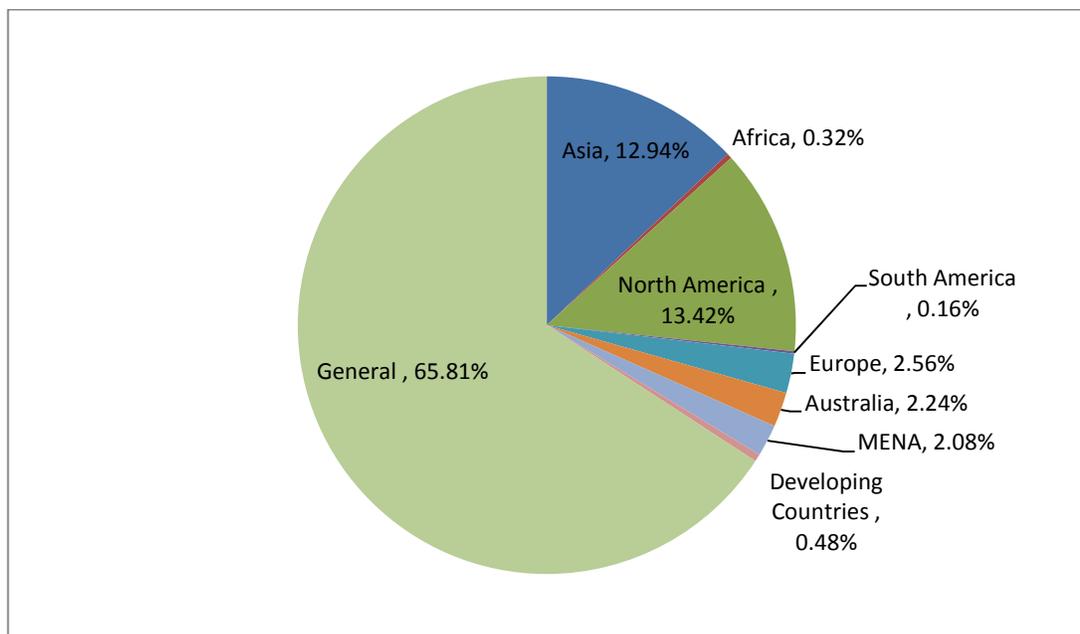
**Figure 5.1: Distribution of papers according to their countries in the overall region for Period 1**

Figure 5.2 shows the distribution of the papers according to the country that the paper talked about in the overall region for Period 2. For Period 2, the largest contribution comprised of General (64.47%, 332 papers) and then North America (17.48%, 90 papers). The next was for Asia (11.46%, 59 papers), and Europe (3.11%, 16 papers). Furthermore, the MENA contribution accounted for (1.55%, 8 papers), Australia (0.78%, 4 papers), and Developing Countries (0.58%, 3 papers). Finally, South America accounted for (0.39%, 2 papers) and the minimum contribution was from Africa (0.19%, 1 paper). The total number of papers published for overall region for this period was 513 papers.



**Figure 5.2: Distribution of papers according to their countries in the overall region for Period 2**

Figure 5.3 shows the distribution of the papers according to the country that the paper talked about in the overall region for Period 3. For Period 3, the largest contribution comprised of General (65.92%, 412 papers) and then North America (13.44%, 84 papers). The next was for Asia (12.96%, 81 papers), Europe (2.56%, 16 papers), and Australia (2.24%, 14 papers). Furthermore, the MENA contribution accounted for (2.08%, 13 papers). Finally, Developing Countries accounted for (0.48%, 3 papers), Africa accounted for (0.32%, 2 papers) and the minimum contribution was from South America (0.16%, 1 paper). The total number of papers published for overall region for this period was 615 papers.



**Figure 5.3: Distribution of papers according to their countries in the overall region for Period 3**

Figure 5.4 shows the distribution of the papers according to the country that the paper talked about in the overall region for total period. The largest contribution of all countries for total period was accounted for General (67.18%, 968 papers) and then North America (14.78%, 213 papers). The next was for Asia (11.03%, 159 papers), and Europe (2.71%, 39 papers). Furthermore, the MENA contribution accounted for (1.94%, 28 papers), Australia (1.32%, 19 papers), and Developing Countries (0.49%, 7 papers). Finally, Africa accounted for (0.35%, 5 papers) and the minimum contribution was from South America that accounted for (0.21%, 3 papers). Total number of papers published for overall region for this period was 1,427 papers.

In general, the number of papers always increased from period to period. This may be attributed to the rise in the number of contributing authors and organizations, although the number of contributing authors in Period 2 was higher than the number of contributing authors for Period 3 (details available in section 5.3.1 and 5.4.1). In addition, the MENA region made a small contribution to the journal compared to other countries in the three periods and total period. One reason can be attributed to the lesser number of countries in the MENA region when compared to other regions and thus, a lesser number of contributing authors and organizations. Detailed MENA contribution to the journal is mentioned in section 4.2.2 of this Chapter. Also, South America, Africa, and Developing Countries made small contributions to the journal through the total period. On the other hand, the largest contribution was always accounted for “General” during the total period where there was no country specified in the paper.

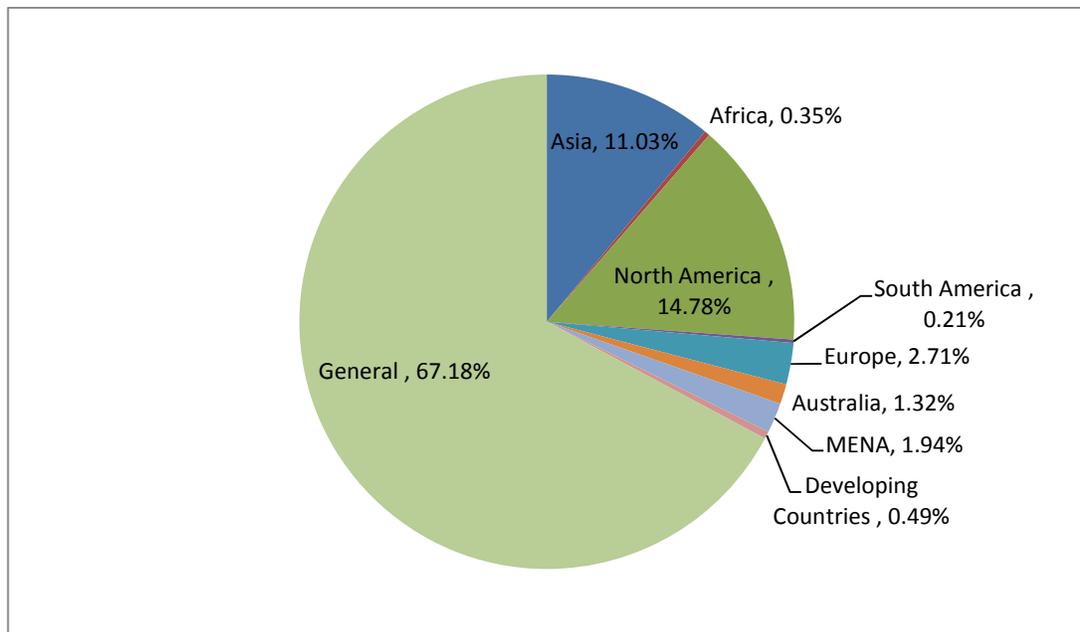
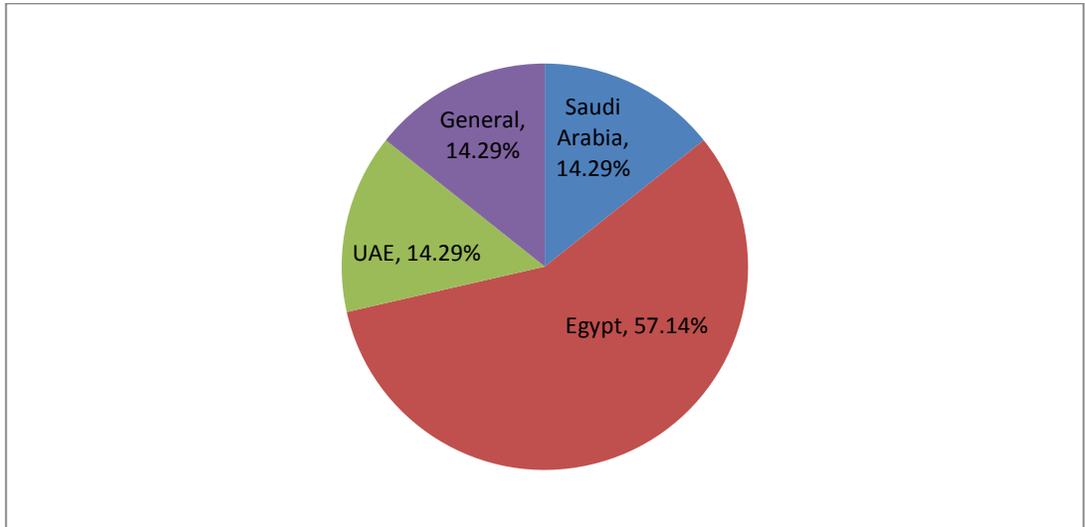


Figure 5.4: Distribution of papers according to their countries in the overall region for total period

### 5.2.3. Analysis of the Papers in the MENA Region

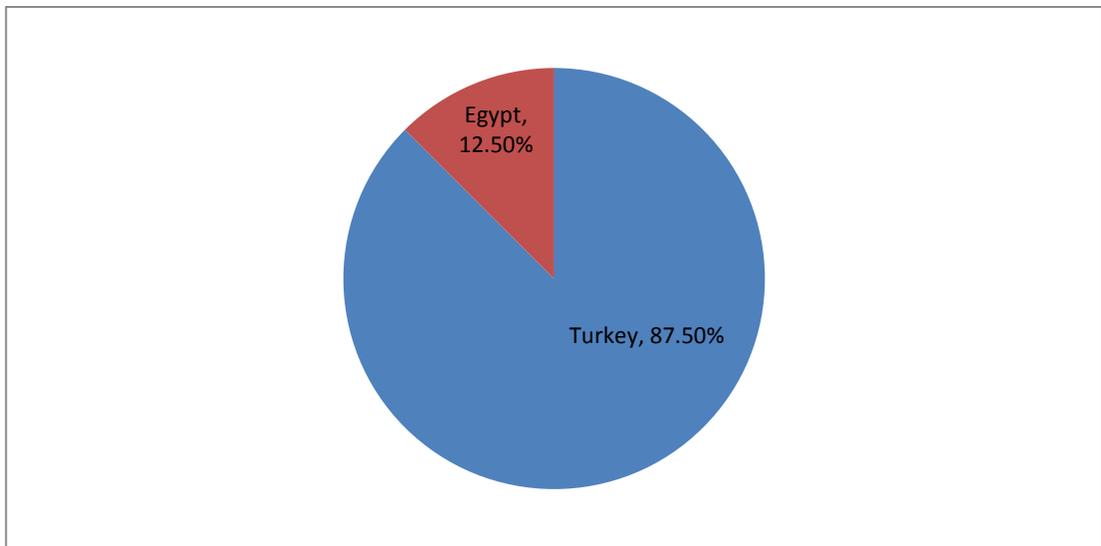
Figure 5.5 shows the distribution of the papers according to the country that the paper concerns itself with in the MENA region for Period 1. For Period 1, the largest contribution comprised of Egypt (57.14%, 4 papers). Saudi Arabia, and UAE had the same contribution (14.29%, 1 paper). The remaining 14.3% (1 paper)

accounted for General. Total number of papers published for MENA region for this period was 7 papers.



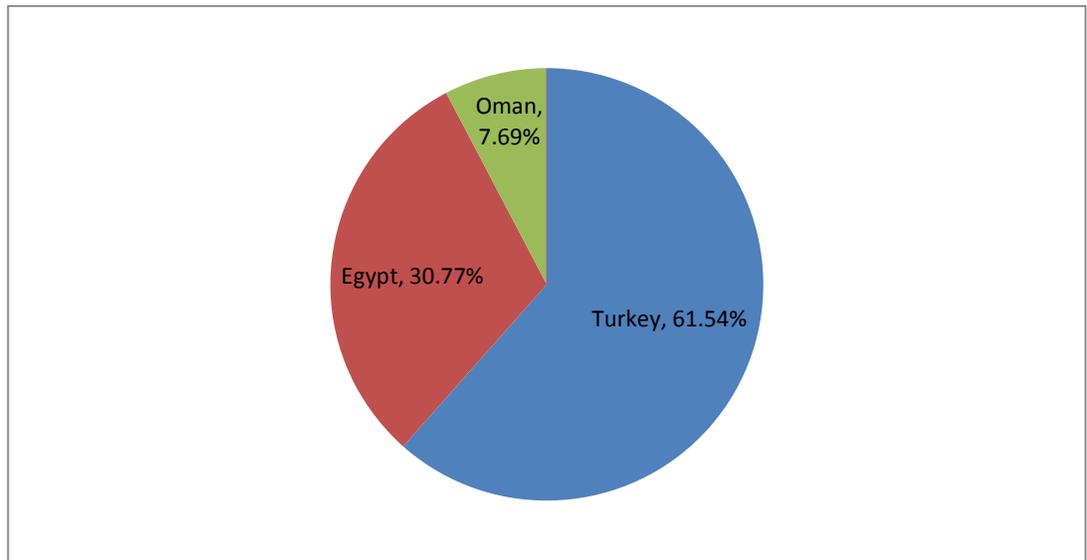
**Figure 5.5: Distribution of papers according to their countries in the MENA region for Period 1**

Figure 5.6 displays the distribution of the papers according to the country that the paper talked about in the MENA region for Period 2. For Period 2, the largest contribution comprised of Turkey (87.50%, 7 papers) and then Egypt (12.50%, 1 paper). Total number of papers published for MENA region for this period was 8 papers.



**Figure 5.6: Distribution of papers according to their countries in the MENA region for Period 2**

Figure 5.7 shows the distribution of the papers according to the country that the paper talked about in the MENA region for Period 3. For Period 3, the largest contribution comprised of Turkey (61.5%, 8 papers) and then Egypt (30.8%, 4 papers). The remaining (7.7%, 1 paper) was accounted for Oman. Total number of papers published for MENA region for this period was 13 papers.



**Figure 5.7: Distribution of papers according to their countries in the MENA region for Period 3**

Figure 5.8 shows the distribution of the papers according to the country that the paper talked about in the MENA region for total period. The largest contribution of all countries for total period was accounted for Turkey (53.57%, 15 papers) and then Egypt (32.14%, 9 papers). Furthermore, Saudi Arabia, UAE, Oman and General accounted for (3.57%, 1 paper). Total number of papers published for the MENA region for total period was 28 papers. In addition, from the overall analysis it can be noticed that the absence of most MENA countries for the whole period such as: Algeria, Bahrain, Northern Cyprus, Djibouti, Iran, Iraq, Jordan, Kuwait, Lebanon, Libya, Morocco, Palestine, Qatar, Syria, Tunisia, and Yemen. Moreover, it can be noticed that the number of papers published in the MENA region was minimal compared to the number of papers published in the overall region. This may be attributed to the less number of MENA contributing countries compared to the overall region countries and thus less number of contributing authors and organizations in the MENA region compared with the overall region.

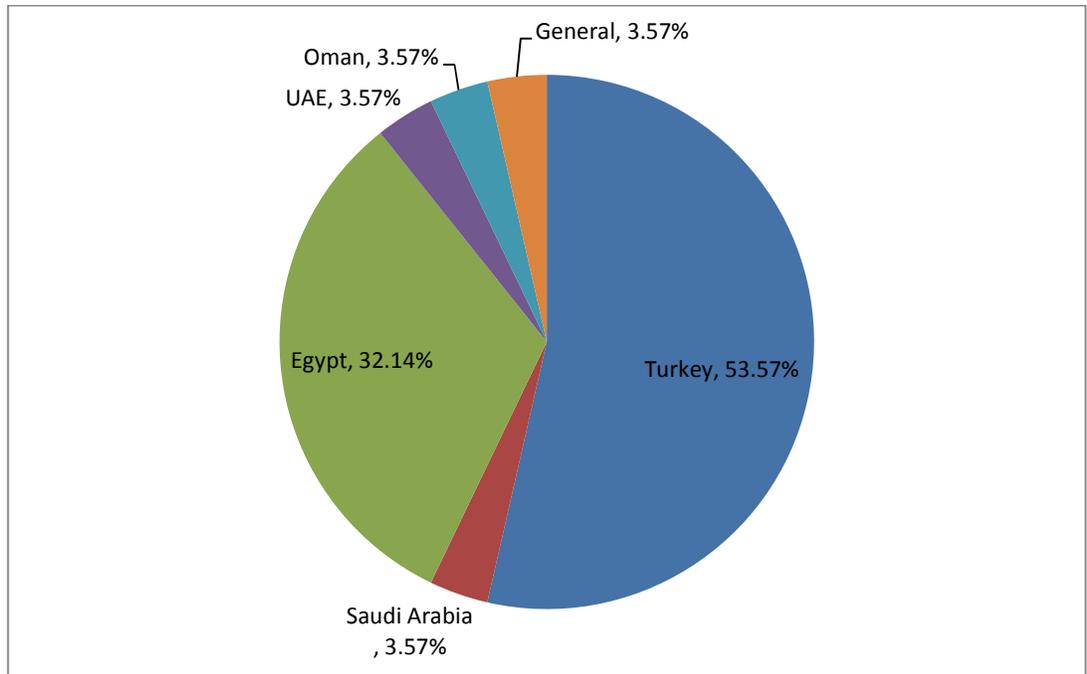


Figure 5.8: Distribution of papers according to their countries in the MENA region for total period

### 5.3. Main Contributing Authors

#### 5.3.1. Main Contributing Authors in the Overall Region

Table 5.1 presents the main contributing authors who contributed more than four times to the journal in the overall region for Period 1. Table 5.2 shows the main contributing authors who contributed more than six times to the journal in the overall region for Period 2, whereas Table 5.3 depicts the main contributing authors who contributed more than six times to the journal in the overall region for Period 3. Each one of these tables shows the author’s first name, last name, number of papers published and percentage of the number of papers published. The authors are listed in order of decreasing contribution to the journal. The number of papers published of the author is not dependent on how many coauthors there were for each paper. Each author is counted equally. The percentage of the number of papers published was calculated by dividing the number of papers published by the author over total number of papers published in the specified period.

**Table 5.1: Main Contributing Authors in the Overall Region or Period 1**

<b>No.</b>	<b>First Name</b>	<b>Last Name</b>	<b>Number of papers published</b>	<b>%Number of papers published</b>
<b>1</b>	John G.	Everett	9	3.01%
<b>2</b>	Tarek	Hegazy	9	3.01%
<b>3</b>	Simaan M.	AbouRizk	8	2.68%
<b>4</b>	Cliff	Schexnayder	7	2.34%
<b>5</b>	Robert Lee-Kong	Tiong	7	2.34%
<b>6</b>	David	Arditi	6	2.01%
<b>7</b>	Leonard E.	Bernold	6	2.01%
<b>8</b>	Iris D.	Tommelein	6	2.01%
<b>9</b>	Jeffrey S.	Russell	6	2.01%
<b>10</b>	Hojjat	Adeli	5	1.67%
<b>11</b>	Carl T.	Haas	5	1.67%
<b>12</b>	Edward J.	Jaselkis	5	1.67%
<b>13</b>	Heng	Li	5	1.67%
<b>14</b>	H. Randolph	Thomas	5	1.67%
<b>Total number of contributing papers during Period 1</b>				<b>299</b>

According to the analysis, the number of contributing authors for the overall region for Period 1 was 419 authors. The number of authors increased to 1,263 authors for Period 2, which was the maximum in the whole period. The number of authors decreased to 1,046 authors in Period 3. The increase in the number of contributing authors from period to period can be related directly to the increase in the number of issues and papers published with time. The largest contribution was from David Arditi, with a total of 30 published papers along the whole period. It is clear that with time more authors began to publish multiple papers.

**Table 5.2: Main Contributing Authors in the Overall Region for Period 2**

<b>No.</b>	<b>First Name</b>	<b>Last Name</b>	<b>Number of papers published</b>	<b>%Number of papers published</b>
<b>1</b>	David	Arditi	13	2.53%
<b>2</b>	Carl T.	Haas	11	2.14%
<b>3</b>	Tarek	Hegazy	11	2.14%
<b>4</b>	Xueqing	Zhang	11	2.14%
<b>5</b>	Michael J.	Horman	11	2.14%
<b>6</b>	Jimmie W.	Hinze	10	1.95%
<b>7</b>	Heng	Li	10	1.95%
<b>8</b>	Simaan	AbouRizk	9	1.75%
<b>9</b>	Leonhard E.	Bernold	9	1.75%
<b>10</b>	David Kim Huat	Chua	9	1.75%
<b>11</b>	Awad S.	Hanna	9	1.75%
<b>12</b>	Osama	Moseihi	9	1.75%
<b>13</b>	Khaled	El-Rayes	8	1.56%
<b>14</b>	Mohan M.	Kumaraswamy	8	1.56%
<b>15</b>	Li Yin	Shen	8	1.56%
<b>16</b>	H. Randolph	Thomas	8	1.56%
<b>17</b>	Daniel W.	Halpin	7	1.36%
<b>18</b>	Edward J.	Jaseiskis	7	1.36%
<b>19</b>	Tarek M.	Zayed	7	1.36%
<b>Total number of contributing papers during Period 2</b>				<b>513</b>

**Table 5.3: Main Contributing Authors in the Overall Region for Period 3**

<b>No.</b>	<b>First Name</b>	<b>Last Name</b>	<b>Number of papers published</b>	<b>%Number of papers published</b>
1	Paul M.	Goodrum	12	1.95%
2	David	Arditi	11	1.79%
3	Albert P. C.	Chan	11	1.79%
4	Carlos H.	Caldas	10	1.63%
5	Khaled	El-Rayes	10	1.63%
6	Carl	Haas	10	1.63%
7	Gunnar	Lucko	10	1.63%
8	Awad S.	Hanna	9	1.46%
9	Aviad	Shapira	9	1.46%
10	C. William	Ibbs	8	1.30%
11	Ming	Lu	8	1.30%
12	Simaan M.	AbouRizk	7	1.14%
13	Mohamed	Al-Hussein	7	1.14%
14	Matthew R.	Hallowell	7	1.14%
15	Mei-yung	Leung	7	1.14%
16	Raymond E.	Levitt	7	1.14%
17	Peter E. D.	Love	7	1.14%
18	Rafael	Sacks	7	1.14%
<b>Total number of contributing papers during Period 3</b>				<b>615</b>

### **5.3.2. Main Contributing Authors in the MENA Region**

Table 5.4 shows the main contributing authors in the MENA region for Period 1. Table 5.5 shows the main contributing authors in the MENA region for Period 2 whereas table 5.6 shows the main contributing authors in the MENA region for Period 3. Furthermore, Table 5.7 shows the main contributing authors in the MENA region for the total period. Each one of these tables shows the author's first name, last name, number of papers published and percentage of the number of papers published. The authors are listed in order of decreasing contribution to the journal. Papers in the MENA region have been listed according to both authors and the country that the paper concerns itself with. Therefore, if the paper referred to (or is written by

someone from) the MENA region, it was considered a paper related to the MENA region and has been accounted in the below analysis. The number of papers published of the author is not dependent on how many coauthors there were for each paper. Each author is counted equally. The percentage of the number of papers published was calculated by dividing the number of papers published by the author over total number of papers published about the MENA region in the specified period.

**Table 5.4: Main Contributing Authors in the MENA Region for Period 1**

<b>No.</b>	<b>First Name</b>	<b>Last Name</b>	<b>Number of papers published</b>	<b>%Number of papers published</b>
1	Ashraf M.	Elazouni	3	12%
2	Ali A.	Shash	2	8%
3	Mohamed Emam	Abd El-Razek	2	8%
4	Mohammed A.	Salem Hiyassat	2	8%
5	P.P.	Zouein	2	8%
6	Refaat H.	Abdel-Razek	2	8%
7	Abdulaziz A.	Bubshait	1	4%
8	Abdulaziz I.	Al-Negheimish	1	4%
9	Abdulrahman M.	Alhozaimy	1	4%
10	Ahmed B.	Senouci	1	4%
11	Emad	Elbeltagi	1	4%
12	Fikry G.	Metwally	1	4%
13	H.	Shawa	1	4%
14	Ismail M.	Basha	1	4%
15	Michael J.	Cunningham	1	4%
16	Moataz	Bakheet	1	4%
17	Nabil A.	Kartam	1	4%
18	Nader N.	Chehayeb	1	4%
19	Osama E.K.	Daoud	1	4%
20	Rifat	Sonmez	1	4%
21	Tamer E.	El-Diraby	1	4%
22	Tariq	Cheema	1	4%
23	A.	Hassasein	1	4%
<b>Total number of contributing papers during Period 1</b>				<b>25</b>

**Table 5.5: Main Contributing Authors in the MENA Region for Period 2**

<b>No.</b>	<b>First Name</b>	<b>Last Name</b>	<b>Number of papers published</b>	<b>%Number of papers published</b>
1	Ashraf M.	Elazouni	4	10.81%
2	M. Talat	Birgonul	4	10.81%
3	Emad	Elbeltagi	3	8.11%
4	Irem	Dikmen	3	8.11%
5	Maged E.	Georgy	2	5.41%
6	Mohamed	Marzouk	2	5.41%
7	A. Samer	Ezeldin	1	2.70%
8	Abdurahman	Ammar	1	2.70%
9	Adel	Eldosouky	1	2.70%
10	Ahmed	Elhakeem	1	2.70%
11	Ahmed A.	Gab-allah	1	2.70%
12	Ahmed B.	Senouci	1	2.70%
13	Ahmed M.	Al-Ghassani	1	2.70%
14	Almula	Koksal	1	2.70%
15	Amal E.	Ali	1	2.70%
16	Aynur	Kazaz	1	2.70%
17	Beliz	Ozorhon	1	2.70%
18	Fikry Gomaa	Metwally	1	2.70%
19	Fred	Rahbar	1	2.70%
20	Gökhan	Yazici	1	2.70%
21	H. Ali	Şentürk	1	2.70%
22	H. Murat	Günaydın	1	2.70%
23	Khalied	Hyari	1	2.70%
24	Lokman M.	Sharara	1	2.70%
25	Metin	Arikan	1	2.70%
26	Mohammad	El-Mashaleh	1	2.70%
27	Mohammed	Arif	1	2.70%
28	Murat	Gunduz	1	2.70%
29	Obaid Saad	Al-Sobie	1	2.70%
30	Osama Ahmed	Jannadi	1	2.70%
31	Refaat H.	Abdel-Razek	1	2.70%
32	Salman	Almishari	1	2.70%
33	Salwa M. A.	Beheiry	1	2.70%

<b>34</b>	Sandalkhan	Bakatjan	1	2.70%
<b>35</b>	Semiha	Kiziltas	1	2.70%
<b>36</b>	Serdar	Kale	1	2.70%
<b>37</b>	Tarek	Elmisalami	1	2.70%
<b>38</b>	Walid M.	Nassar	1	2.70%
<b>39</b>	Y. Cengiz	Toklu	1	2.70%
<b>40</b>	Faramarz	Moodi	1	2.70%
<b>Total number of contributing papers during Period 2</b>				<b>37</b>

**Table 5.6: Main Contributing Authors in the MENA Region for Period 3**

<b>No.</b>	<b>First Name</b>	<b>Last Name</b>	<b>Number of papers published</b>	<b>%Number of papers published</b>
1	Irem	Dikmen	4	7.41%
2	M. Talat	Birgonul	4	7.41%
3	Gul	Polat	3	5.56%
4	Serdar	Kale	3	5.56%
5	Ahmed B.	Senouci	2	3.70%
6	Esin	Ergen	2	3.70%
7	Mohamed	Marzouk	2	3.70%
8	Mohammad A.	Ammar	2	3.70%
9	Moheeb	El-Said	2	3.70%
10	Sameh M.	El-Sayegh	2	3.70%
11	Abbas	Afshar	2	3.70%
12	Ali	Kaveh	2	3.70%
13	A. Samer	Ezeldin	1	1.85%
14	Abdulaziz M.	Jarkas	1	1.85%
15	Ahmed	Soliman	1	1.85%
16	Ahmed F. M.	Salman	1	1.85%
17	Ahmet	Öztaş	1	1.85%
18	Ali S.	Alnuaimi	1	1.85%
19	Ali S.	Al-Harhi	1	1.85%
20	Amjad	El-Tayeh	1	1.85%
21	Amr A. G.	Hassanein	1	1.85%
22	Ashraf M.	Elazouni	1	1.85%
23	Ayed Muhammad	Algarni	1	1.85%
24	Beliz	Ozorhon	1	1.85%
25	Cenk	Budayan	1	1.85%
26	Engy	Serag	1	1.85%
27	Erkan A.	Karaman	1	1.85%
28	Esin	Kasapoğlu	1	1.85%
29	Fikry G.	Metwally	1	1.85%
30	H. A.	Bashir	1	1.85%
31	H. A.	Bassioni	1	1.85%
32	H. M.	Osman	1	1.85%
33	H. Murat	Günaydin	1	1.85%
34	Hassan	Al-Derham	1	1.85%
35	Haytham M.	Sanad	1	1.85%

36	Heyecan	Giritli	1	1.85%
37	Ishtiyag	Gull	1	1.85%
38	Ismail	Basha	1	1.85%
39	Khaled	Nassar	1	1.85%
40	Khalid S.	Al-Gahtani	1	1.85%
41	M. E.	Abd El-Razek	1	1.85%
42	Matineh	Eybpoosh	1	1.85%
43	Mehmet Serkan	Kirgiz	1	1.85%
44	Moatasseem	Abdallah	1	1.85%
45	Mohamed	Amer	1	1.85%
46	Mohammed	Al Mohsin	1	1.85%
47	Mohammed	Dulaimi	1	1.85%
48	Moheeb E.	Ibrahim	1	1.85%
49	Moncer	Hariga	1	1.85%
50	Murat	Gunduz	1	1.85%
51	Omer	Ozkan	1	1.85%
52	Önder	Ökmen	1	1.85%
53	Ragaa S.	Hanna	1	1.85%
54	Ramzi A.	Taha	1	1.85%
55	Rana	Bou-Matar	1	1.85%
56	Recep	Kanit	1	1.85%
57	Rifat	Sonmez	1	1.85%
58	Semiha	Kiziltas	1	1.85%
59	Sevgi Zeynep	Doğan	1	1.85%
60	Suat	Günhan	1	1.85%
61	Ugur	Mungen	1	1.85%
62	Walid F.	Nasrallah	1	1.85%
63	A. M.	Mobarak	1	1.85%
64	Shahram Mohamad	Karimi	1	1.85%
65	Hassan	Hashemi	1	1.85%
66	Seyed	Hossein Hashemi Doulabi	1	1.85%
67	Fateme	Jazebi	1	1.85%
68	S. Mohammad H.	Mojtahedi	1	1.85%
69	Seyed Jamshid	Mousavi	2	1.85%
70	Abbas	Seifi	1	1.85%
71	Seyed Yasser	Shariat	1	1.85%
72	F.	Sharifi	1	1.85%
73	Banafsheh	Zahraie	1	1.85%

74	A. Kasaeian	Ziaraty	1	1.85%
<b>Total number of contributing papers during Period 3</b>			<b>54</b>	

As can be observed, the number of contributing authors in the MENA region increased up to 23 authors for Period 1, then reached 40 authors for Period 2 and continued increasing until it reached 74 authors for Period 3. Furthermore, the number of authors for total period was 117 authors. The increase in the number of contributing authors from period to period can be related directly to the increase in the number of papers published with time. Despite the number of authors in the MENA region is constantly increasing, it is still considerably small in comparison to the number of authors for the overall region in the three periods and total period. One reason can be attributed to the fewer number of MENA countries when compared to other regions' countries and thus lesser number of contributing authors and organizations. Overall, the largest contribution was from Ashraf ElAzouni and M. Talat Birgönül along the whole period with eight contributing papers for each. Also, it is clear that with time more authors began to publish multiple papers.

**Table 5.7: Main Contributing Authors in the MENA Region for Total Period**

<b>No.</b>	<b>First Name</b>	<b>Last Name</b>	<b>Number of papers published</b>	<b>%Number of papers published</b>
1	Ashraf M.	Elazouni	8	6.90%
2	M. Talat	Birgonul	8	6.90%
3	Irem	Dikmen	7	6.03%
4	Emad	Elbeltagi	4	3.45%
5	Serdar	Kale	4	3.45%
6	Mohamed	Marzouk	4	3.45%
7	Ahmed B.	Senouci	4	3.45%
8	Mohamed Emam	Abd El-Razek	3	2.59%
9	Refaat H.	Abdel-Razek	3	2.59%
10	Fikry Gomaa	Metwally	3	2.59%
11	Ismail	Basha	2	1.72%
12	A. Samer	Ezeldin	2	1.72%
13	H. Murat	Günaydin	2	1.72%
14	Murat	Gunduz	2	1.72%
15	Semiha	Kiziltas	2	1.72%
16	Seyed Jamshid	Mousavi	2	1.72%
17	Beliz	Ozorhon	2	1.72%
18	Rifat	Sonmez	2	1.72%
19	Moatassem	Abdallah	1	0.86%
20	Abbas	Afshar	1	0.86%
21	Mohammed	Al Mohsin	1	0.86%
22	Hassan	Al-Derham	1	0.86%
23	Khalid S.	Al-Gahtani	1	0.86%
24	Ayed Muhammad	Algarni	1	0.86%
25	Ahmed M.	Al-Ghassani	1	0.86%
26	Ali S.	Al-Harhi	1	0.86%
27	Abdulrahman M.	Alhozaimy	1	0.86%
28	Amal E.	Ali	1	0.86%
29	Salman	Almishari	1	0.86%
30	Abdulaziz I.	Al-Negheimish	1	0.86%
31	Ali S.	Alnuaimi	1	0.86%
32	Obaid Saad	Al-Sobie	1	0.86%
33	Mohamed	Amer	1	0.86%
34	Abdurahman	Ammar	1	0.86%
35	Mohammad A.	Ammar	1	0.86%
36	Mohammed	Arif	1	0.86%

37	Metin	Arikan	1	0.86%
38	Sandalkhan	Bakatjan	1	0.86%
39	Moataz	Bakheet	1	0.86%
40	H. A.	Bashir	1	0.86%
41	H. A.	Bassioni	1	0.86%
42	Salwa M. A.	Beheiry	1	0.86%
43	Rana	Bou-Matar	1	0.86%
44	Abdulaziz A.	Bubshait	1	0.86%
45	Cenk	Budayan	1	0.86%
46	Tariq	Cheema	1	0.86%
47	Nader N.	Chehayeb	1	0.86%
48	Michael J.	Cunningham	1	0.86%
49	Osama E.K.	Daoud	1	0.86%
50	Sevgi Zeynep	Doğan	1	0.86%
51	Mohammed	Dulaimi	1	0.86%
52	Tamer E.	El-Diraby	1	0.86%
53	Adel	Eldosouky	1	0.86%
54	Ahmed	Elhakeem	1	0.86%
55	Mohammad	El-Mashaleh	1	0.86%
56	Tarek	Elmisalami	1	0.86%
57	Moheeb	El-Said	1	0.86%
58	Sameh M.	El-Sayegh	1	0.86%
59	Amjad	El-Tayeh	1	0.86%
60	Esin	Ergen	1	0.86%
61	Matineh	Eybpoosh	1	0.86%
62	Ahmed A.	Gab-allah	1	0.86%
63	Maged E.	Georgy	1	0.86%
64	Heyecan	Giritli	1	0.86%
65	Suat	Günhan	1	0.86%
66	Ishtiyag	Gull	1	0.86%
67	Ragaa S.	Hanna	1	0.86%
68	Moncer	Hariga	1	0.86%
69	Hassan	Hashemi	1	0.86%
70	Amr A. G.	Hassanein	1	0.86%
71	A.	Hassasein	1	0.86%
72	Seyed	Hossein Hashemi Doulabi	1	0.86%
73	Khalied	Hyari	1	0.86%
74	Moheeb E.	Ibrahim	1	0.86%
75	Osama Ahmed	Jannadi	1	0.86%

76	Abdulaziz M.	Jarkas	1	0.86%
77	Fateme	Jazebi	1	0.86%
78	Recep	Kanit	1	0.86%
79	Erkan A.	Karaman	1	0.86%
80	Shahram Mohamad	Karimi	1	0.86%
81	Nabil A.	Kartam	1	0.86%
82	Esin	Kasapoğlu	1	0.86%
83	Ali	Kaveh	1	0.86%
84	Aynur	Kazaz	1	0.86%
85	Mehmet Serkan	Kirgiz	1	0.86%
86	Almula	Koksal	1	0.86%
87	A. M.	Mobarak	1	0.86%
88	S. Mohammad H.	Mojtahedi	1	0.86%
89	Faramarz	Moodi	1	0.86%
90	Ugur	Mungen	1	0.86%
91	Walid F.	Nasrallah	1	0.86%
92	Khaled	Nassar	1	0.86%
93	Walid M.	Nassar	1	0.86%
94	Önder	Ökmen	1	0.86%
95	H. M.	Osman	1	0.86%
96	Omer	Ozkan	1	0.86%
97	Ahmet	Öztaş	1	0.86%
98	Gul	Polat	1	0.86%
99	Fred	Rahbar	1	0.86%
100	Mohammed A.	Salem Hiyassat	1	0.86%
101	Ahmed F. M.	Salman	1	0.86%
102	Haytham M.	Sanad	1	0.86%
103	Abbas	Seifi	1	0.86%
104	H. Ali	Şentürk	1	0.86%
105	Engy	Serag	1	0.86%
106	Lokman M.	Sharara	1	0.86%
107	Seyed Yasser	Shariat	1	0.86%
108	F.	Sharifi	1	0.86%
109	Ali A.	Shash	1	0.86%
110	H.	Shawa	1	0.86%
111	Ahmed	Soliman	1	0.86%
112	Ramzi A.	Taha	1	0.86%
113	Y. Cengiz	Toklu	1	0.86%
114	Gökhan	Yazici	1	0.86%

<b>115</b>	Banafsheh	Zahraie	1	0.86%
<b>116</b>	A. Kasaeian	Ziaraty	1	0.86%
<b>117</b>	P.P.	Zouein	1	0.86%
<b>Total number of contributing papers during total period</b>			<b>116</b>	

#### **5.4. Main Contributing Organizations**

##### **5.4.1. Main Contributing Organizations in the Overall Region**

This section analyzes the top organizations in the overall region for each period and total period of the journal. The number of appearances of each organization according to the appearance of authors and number of published papers related to each organization has been analyzed. The percentage of the number of papers published was calculated by dividing the number of papers published by the organization over total number of papers published in the specified period.

Table 5.8 indicates the main contributing organizations in the overall region for Period 1. It presents the organization name, organization country, number of appearances, number of published papers, and percentage of the number of papers published. The organizations are listed in order of decreasing contribution according to the number of appearances. For Period 1, the top five organizations in terms of published papers were the University of Michigan in US, Purdue University in US, Hong Kong Polytechnic University in Hong Kong, Stanford University in US, and the University of California at Berkeley in US.

Table 5.9 shows the main contributing organizations in the overall region for Period 2. It presents the organization name, organization country, number of appearances, number of published papers, and percentage of the number of papers published. The organizations are listed in order of decreasing contribution according to the number of appearances. For Period 2, the top five organizations in terms of published papers were the Hong Kong Polytechnic University in Hong Kong, National University of Singapore in Singapore, University of Texas at Austin in US, Purdue University in US, and the University of Florida in US.

Table 5.10 shows the main contributing organizations in the overall region for Period 3. It presents the organization name, organization country, number of appearances, number of published papers, and percentage of the number of papers published. The organizations are listed in order of decreasing contribution according

to the number of appearances. For Period 3, the top five organizations in terms of published papers were the Hong Kong Polytechnic University in Hong Kong, Purdue University in US, University of Alberta in Canada, City University of Hong Kong in Hong Kong, and the University of Texas at Austin in US.

**Table 5.8: Main Contributing Organizations in the Overall Region for Period 1**

<b>No.</b>	<b>Organization</b>	<b>Country</b>	<b>Number of appearances</b>	<b>Number of published papers</b>	<b>%Number of published papers</b>
1	University of Texas at Austin	US	22	9	3.01%
2	University of Michigan	US	22	14	4.68%
3	Hong Kong Polytechnic University	Hong Kong	21	13	4.35%
4	Arizona State University	US	19	10	3.34%
5	Nanyang Technological University	Singapore	19	8	2.68%
6	Purdue University	US	19	14	4.68%
7	University of Alberta	Canada	17	10	3.34%
8	University of Waterloo	Canada	16	9	3.01%
9	Illinois Institute of Technology	US	15	7	2.34%
10	Stanford University	US	15	12	4.01%
11	National University of Singapore	Singapore	14	8	2.68%
12	University of California at Berkeley	US	14	11	3.68%
13	University of Wisconsin-Madison	US	13	7	2.34%
14	Ohio State University	US	12	8	2.68%
15	Iowa State University	US	11	7	2.34%
16	Technion-Israel Institute of Technology	Israel	11	6	2.01%
17	Texas A & M University	US	11	8	2.68%
<b>Total number of contributing papers during Period 1</b>					<b>299</b>

**Table 5.9: Main Contributing Organizations in the Overall Region for Period 2**

<b>No.</b>	<b>Organization</b>	<b>Country</b>	<b>Number of appearances</b>	<b>Number of published papers</b>	<b>%Number of published papers</b>
1	Hong Kong Polytechnic University	Hong Kong	68	35	6.82%
2	National University of Singapore	Singapore	49	27	5.26%
3	University of Texas at Austin	US	36	25	4.87%
4	City University of Hong Kong	Hong Kong	36	15	2.92%
5	Pennsylvania State University, University Park	US	34	17	3.31%
6	Purdue University	US	32	21	4.09%
7	University of Illinois at Urbana-Champaign	US	28	18	3.51%
8	University of Florida	US	26	20	3.90%
9	Arizona State University	US	25	17	3.31%
10	University of Hong Kong	Hong Kong	25	13	2.53%
11	University of Alberta	Canada	25	15	2.92%
12	University of Waterloo	Canada	25	17	3.31%
13	Concordia University	Canada	24	16	3.12%
14	Illinois Institute of Technology	US	23	19	3.70%
15	Technion-Israel Institute of Technology	Israel	20	14	2.73%
16	University of California at Berkeley	US	20	12	2.34%
17	University of Wisconsin-Madison	US	20	11	2.14%
18	Iowa State University	US	18	9	1.75%
19	National Taiwan University of Science and Technology	Taiwan	15	6	1.17%
20	Western Michigan University	US	15	5	0.97%
21	Loughborough University	UK	13	7	1.36%
22	Stanford University	US	13	8	1.56%
<b>Total number of contributing papers during Period 2</b>					<b>513</b>

**Table 5.10: Main Contributing Organizations in the Overall Region for Period 3**

<b>No.</b>	<b>Organization</b>	<b>Country</b>	<b>Number of appearances</b>	<b>Number of published papers</b>	<b>%Number of published papers</b>
1	Hong Kong Polytechnic University	Hong Kong	88	40	6.50%
2	City University of Hong Kong	Hong Kong	45	21	3.41%
3	University of Alberta	Canada	42	24	3.90%
4	Purdue University	US	40	25	4.07%
5	National University of Singapore	Singapore	31	18	2.93%
6	University of Colorado at Boulder	US	29	17	2.76%
7	University of Wisconsin-Madison	US	29	12	1.95%
8	University of Illinois at Urbana Champaign	US	28	18	2.93%
9	University of Texas at Austin	US	28	20	3.25%
10	University of Kentucky	US	26	13	2.11%
11	Iowa State University	US	25	9	1.46%
12	Yonsei University	Korea	25	11	1.79%
13	Arizona State University	US	24	17	2.76%
14	Technion-Israel Institute of Technology	Israel	24	14	2.28%
15	Virginia Polytechnic Institute and State University (Virginia Tech.)	US	23	17	2.76%
16	University of California at Berkeley	US	21	13	2.11%
17	University of Waterloo	Canada	21	14	2.28%
18	Tsinghua University	China	19	10	1.63%
19	Queensland University of Technology	Australia	19	9	1.46%
20	Stanford University	US	18	16	2.60%
21	University of Hong Kong	Hong Kong	17	12	1.95%
<b>Total number of contributing papers during Period 3</b>					<b>615</b>

Table 5.11 shows the main contributing organizations in the overall region for total period. It presents the organization name, organization country, number of appearances, number of published papers, and percentage of the number of papers published. The organizations are listed in order of decreasing contribution according to the number of appearances. Overall (15-year rank) the top five contributing organizations in terms of published papers were the Hong Kong Polytechnic University in Hong Kong, Purdue University in US, University of Texas at Austin in US, National University of Singapore in Singapore, and the University of Alberta in Canada. It is interesting to note that the top ranking institutions in Period 1 came from the US and Hong Kong institutions as indicated by Table 5.8.

**Table 5.11: Main Contributing Organizations in the Overall Region for Total Period**

<b>No.</b>	<b>Organization</b>	<b>Country</b>	<b>Number of appearances</b>	<b>Number of published papers</b>	<b>%Number of published papers</b>
<b>1</b>	Hong Kong Polytechnic University	Hong Kong	177	88	6.17%
<b>2</b>	National University of Singapore	Singapore	94	53	3.71%
<b>3</b>	Purdue University	US	91	60	4.20%
<b>4</b>	City University of Hong Kong	Hong Kong	90	42	2.94%
<b>5</b>	University of Texas at Austin	US	86	54	3.78%
<b>6</b>	University of Alberta	Canada	84	49	3.43%
<b>7</b>	Arizona State University	US	68	44	3.08%
<b>8</b>	University of Illionis at Urbana-Champaign	US	63	42	2.94%
<b>9</b>	University of Waterloo	Canada	62	40	2.80%
<b>10</b>	University of Wisconsin-Madison	US	62	30	2.10%
<b>Total number of contributing papers during total period</b>					<b>1,427</b>

However, in Period 2, the National University of Singapore in Singapore ranked second and in Period 3 the University of Alberta in Canada ranked third which indicates that JCEM is gaining worldwide recognition as a leading construction journal. It also indicates that there is more established construction programs

becoming involved in research and that construction research is gaining more appreciation. In addition, it is noticeable that academic institutions were the main contributing organizations to the journal during these years and there is no appearance for industry and government institutions as main contributing organizations.

#### **5.4.2. Main Contributing Organizations in the MENA Region**

Table 5.12 shows the top contributing organizations in the MENA region for Period 1. It presents the organization name, organization country, number of appearances, number of published papers, and percentage of the number of papers published. The organizations are listed in order of decreasing contribution according to the number of appearances. For Period 1, the top four organizations in terms of published papers were the Zagazig University in Egypt, King Fahd University of Petroleum & Minerals in Saudi Arabia, Lebanese American University in Lebanon, and the University of Jordan in Jordan. The percentage of number of papers published was calculated by dividing the number of papers published by the organization over total number of papers published about the MENA region in the specified period.

Table 5.13 shows the top contributing organizations in the MENA region for Period 2. It presents the organization name, organization country, number of appearances, number of published papers, and percentage of the number of papers published. The organizations are listed in order of decreasing contribution according to the number of appearances. For Period 2, the top four organizations in terms of published papers were the Middle East Technical University in Turkey, King Fahd University of Petroleum & Minerals in Saudi Arabia, Cairo University in Egypt, and the Mansoura University in Egypt.

Table 5.14 shows the top contributing organizations in the MENA region for Period 3. It presents the organization name, organization country, number of appearances, number of published papers, and percentage of the number of papers published. The organizations are listed in order of decreasing contribution according to the number of appearances. For Period 3, the top four organizations in terms of published papers were the Middle East Technical University in Turkey, Istanbul Technical University in Turkey, Cairo University in Egypt, and the Balikesir University in Turkey.

**Table 5.12: Main Contributing Organizations in the MENA Region for Period 1**

<b>No.</b>	<b>Organization</b>	<b>Country</b>	<b>Number of appearances</b>	<b>Number of published papers</b>	<b>%Number of published papers</b>
1	Zagazig University	Egypt	9	8	32%
2	King Fahd University of Petroleum and Minerals	Saudi Arabia	3	3	12%
3	King Saud University	Saudi Arabia	2	1	4%
4	Lebanese American University	Lebanon	2	2	8%
5	University of Jordan	Jordan	2	2	8%
6	American University in Cairo	Egypt	1	1	4%
7	Arab Academy for Science and Technology and Maritime Transport	Egypt	1	1	8%
8	Attila Dogan Design and Construction Corporation	Turkey	1	1	8%
9	Bank of Palestine Ltd.	Palestine	1	1	8%
10	Benha High Institute of Technology	Egypt	1	1	8%
11	Dar Al-Handasah Consultants (Shair and Partners)	Egypt	1	1	8%
12	Dar Al-Handasah Engineering	Lebanon	1	1	8%
13	El-Saif Construction Co.	Saudi Arabia	1	1	8%
14	Institute of Public Administration	Saudi Arabia	1	1	8%
15	Kuwait University	Kuwait	1	1	8%
16	Mansoura University	Egypt	1	1	8%
17	Saudi Aramco	Saudi Arabia	1	1	8%
18	University of Qatar	Qatar	1	1	8%
<b>Total number of contributing papers during Period 1</b>					<b>25</b>

**Table 5.13: Main Contributing Organizations in the MENA Region for Period 2**

<b>No.</b>	<b>Organization</b>	<b>Country</b>	<b>Number of appearances</b>	<b>Number of published papers</b>	<b>%Number of published papers</b>
1	Middle East Technical University	Turkey	11	6	16.22%
2	King Fahd University of Petroleum & Minerals	Saudi Arabia	5	4	10.81%
3	Cairo University	Egypt	4	4	10.81%
4	Mansoura University	Egypt	4	3	8.11%
5	Zagazig University	Egypt	4	2	5.41%
6	American University in Cairo	Egypt	2	1	2.70%
7	Balikesir University	Turkey	2	2	5.41%
8	Istanbul Kultur University	Turkey	2	1	2.70%
9	The Hashemite University	Jordan	2	2	5.41%
10	Akdeniz University	Turkey	1	1	2.70%
11	Al-Musanna College of Technology	Oman	1	1	2.70%
12	ATLAS Construction Inc. Corporation	Turkey	1	1	2.70%
13	British University in Dubai	UAE	1	1	2.70%
14	Dar Group	Egypt	1	1	2.70%
15	Eastern Mediterranean University	Northern Cyprus	1	1	2.70%
16	GDMW/MODA	Saudi Arabia	1	1	2.70%
17	Institute of Public Administration	Saudi Arabia	1	1	2.70%
18	Izmir Institute of Technology	Turkey	1	1	2.70%
19	Misr University	Egypt	1	1	2.70%
20	Petronas (Sudan) Limited	Sudan	1	1	2.70%

21	Saudi Aramco	Saudi Arabia	2	2	2.70%
22	Tanta University	Egypt	1	1	2.70%
23	University of Qatar	Qatar	1	1	2.70%
24	Yildiz Technical University	Turkey	1	1	2.70%
25	Amirkabir University of Technology	Iran	1	1	2.70%
<b>Total number of contributing papers during Period 2</b>					<b>37</b>

Table 5.15 shows the top contributing organizations in the MENA region for total period. It presents the organization name, organization country, number of appearances, number of published papers, and percentage of the number of papers published. The organizations are listed in order of decreasing contribution according to the number of appearances. Overall (15-year rank) the top six contributing organizations in terms of published papers were the Middle East Technical University in Turkey, Zagazig University in Egypt, Cairo University in Egypt, King Fahd University of Petroleum & Minerals in Saudi Arabia, Istanbul Technical University in Turkey, and the Balikesir University in Turkey. It is interesting to note that the top ranking institutions came from the Turkey, Egypt, and Saudi Arabia institutions as indicated by Table 5.15 with the appearance of new countries from period to period. This indicates that construction research in the MENA region is gaining more appreciation and that more construction programs are becoming involved in research. In addition, it is noticeable that academic institutions were the main contributing organizations to the journal during these years and there is no appearance for industry and government institutions as main contributing organizations.

**Table 5.14: Main Contributing Organizations in the MENA Region for Period 3**

<b>No.</b>	<b>Organization</b>	<b>Country</b>	<b>Number of appearances</b>	<b>Number of published papers</b>	<b>%Number of published papers</b>
1	Middle East Technical University	Turkey	13	7	12.96%
2	Cairo University	Egypt	8	5	9.26%
3	Istanbul Technical University	Turkey	7	6	11.11%
4	Iran University of Science and Technology	Iran	7	2	3.70%
5	American University in Cairo	Egypt	3	2	3.70%
6	American University of Sharjah	UAE	3	2	3.70%
7	Balikesir University	Turkey	3	3	5.56%
8	Izmir Institute of Technology	Turkey	3	2	3.70%
9	Sultan Qaboos University	Oman	3	2	3.70%
10	Tanta University	Egypt	3	2	3.70%
11	Zagazig University	Egypt	3	2	3.70%
12	University of Qatar	Qatar	3	1	1.85%
13	Amirkabir University of Technology	Iran	3	2	3.70%
14	Arab Academy for Science, Technology and Maritime Transport	Egypt	2	1	1.85%
15	University of Gaziantep	Turkey	2	1	1.85%
16	University of Tahrán	Iran	2	2	3.70%
17	Air Defense Forces	Saudi Arabia	1	1	1.85%
18	Al Mazaya Real Estate Development Company	Kuwait	1	1	1.85%
19	American University in Dubai	UAE	1	1	1.85%
20	American University of Beirut	Lebanon	1	1	1.85%
21	Benha Institute of Technology	Egypt	1	1	1.85%
22	Bogazici University	Turkey	1	1	1.85%
23	British University in Dubai	UAE	1	1	1.85%
24	Daleel Petroleum	Oman	1	1	1.85%

25	Davis Langdon & Seah International	Lebanon	1	1	1.85%
26	DEPA United Group	Egypt	1		1.85%
27	Gazi University	Turkey	1	1	1.85%
28	Hacettepe University Polatli Technical Sciences Vocational School	Turkey	1	1	1.85%
29	Higher College of Technology	Oman	1	1	1.85%
30	Istanbul Kultur University	Turkey	1	1	1.85%
31	Izmir University of Economics	Turkey	1	1	1.85%
32	King Fahd University of Petroleum and Minerals	Saudi Arabia	1	1	1.85%
33	King Saud University	Saudi Arabia	1	1	1.85%
34	Orascom Construction Industries	Egypt	1	1	1.85%
35	Sakarya University	Turkey	1	1	1.85%
36	University of Sharjah	UAE	1	1	1.85%
37	WSP Middle East	UAE	1	1	1.85%
38	Zanjan University	Iran	1	1	1.85%
39	Payame Noor University	Iran	1	1	1.85%
40	Imam Khomeini International University	Iran	1	1	1.85%
41	Islamic Azad University- South Tehran Branch, IPMI Company	Iran	1	1	1.85%
<b>Total number of contributing papers during Period 3</b>					<b>54</b>

## 5.5. Main Contributing Countries

### 5.5.1. Main Contributing Countries in the Overall Region

This section analyzes the top countries in the overall region for each period and total period of the journal. The number of appearances of each country according to the appearance of authors and number of published papers related to each country has been analyzed. The percentage of the number of papers published was calculated

by dividing the number of papers published by the country over total number of papers published in the specified period.

Table 5.16 shows the top contributing countries in the overall region for Period 1. It presents the name of the country, number of appearances, number of published papers, and percentage of the number of papers published. The countries are listed in order of decreasing contribution according to the number of appearances. Total authors that contributed to the journal during these years represent six different continents and 29 different countries. The authors represent all continents except for Antarctica. North America was represented the most with number of appearances of 442. In second place was Asia with number of appearances of 113. In terms of published papers; the top five contributing countries were the US, Canada, Hong Kong, Singapore, and the UK.

Table 5.17 shows the top contributing countries in the overall region for Period 2. It presents the name of the country, number of appearances, number of published papers, and percentage of the number of papers published. The countries are listed in order of decreasing contribution according to the number of appearances. Total authors that contributed to the journal during these years represent six different continents and 45 different countries. The authors represent all continents except for Antarctica. North America was represented the most with number of appearances of 686. In second place was Asia with number of appearances of 392. In terms of published papers; the top five contributing countries were the US, Canada, Hong Kong, Singapore, and the China.

**Table 5.15: Main Contributing Organizations in the MENA Region for Total Period**

<b>No.</b>	<b>Organization</b>	<b>Country</b>	<b>Number of appearances</b>	<b>Number of published papers</b>	<b>%Number of published papers</b>
1	Middle East Technical University	Turkey	24	13	11.21%
2	Zagazig University	Egypt	16	12	10.34%
3	Cairo University	Egypt	12	9	7.76%
4	King Fahd University of Petroleum & Minerals	Saudi Arabia	9	8	6.90%
5	Istanbul Technical University	Turkey	7	6	5.17%
6	Iran University of Science and Technology	Iran	7	2	1.72%
7	American University in Cairo	Egypt	6	4	3.45%
8	University of Qatar	Qatar	5	4	3.45%
9	Balikesir University	Turkey	5	5	4.31%
10	Mansoura University	Egypt	5	4	3.45%
11	Izmir Institute of Technology	Turkey	4	3	2.59%
12	Tanta University	Egypt	4	3	2.59%
13	Amirkabir University of Technology	Iran	4	3	2.59%
14	King Saud University	Saudi Arabia	3	2	1.72%
15	Istanbul Kultur University	Turkey	3	2	1.72%
16	Arab Academy for Science, Technology and Maritime Transport	Egypt	3	2	1.72%
17	American University of Sharjah	UAE	3	2	1.72%
18	Sultan Qaboos University	Oman	3	2	1.72%
19	British University in Dubai	UAE	2	2	1.72%
20	Lebanese American	Lebanon	2	2	1.72%

	University				
21	University of Jordan	Jordan	2	2	1.72%
22	University of Gaziantep	Turkey	2	1	0.86%
23	The Hashemite University	Jordan	2	2	1.72%
24	Saudi Aramco	Saudi Arabia	2	2	1.72%
25	Dar Al-Handasah Engineering	Egypt	2	2	1.72%
26	University of Tahrn	Iran	2	2	1.72%
<b>Total number of contributing papers during total period</b>					<b>116</b>

**Table 5.16: Main Contributing Countries in the Overall Region for Period 1**

No.	Country	Number of appearances	Number of published papers	%Number of published papers
1	US	383	195	65.22%
2	Canada	55	28	9.36%
3	Hong Kong	38	21	7.02%
4	Singapore	35	14	4.68%
5	UK	29	14	4.68%
6	Australia	18	13	4.35%
7	Korea	16	11	3.68%
8	Taiwan	16	10	3.34%
9	Egypt	14	11	3.68%
10	Israel	13	6	2.01%
11	Saudi Arabia	8	6	2.01%
12	Nigeria	4	2	0.67%
<b>Total number of contributing papers during Period 1</b>				<b>299</b>

**Table 5.17: Main Contributing Countries in the Overall Region for Period 2**

<b>No.</b>	<b>Country</b>	<b>Number of appearances</b>	<b>Number of published papers</b>	<b>%Number of published papers</b>
1	US	578	270	52.63%
2	Hong Kong	140	62	12.09%
3	Canada	106	63	12.28%
4	Singapore	67	34	6.63%
5	Taiwan	46	25	4.87%
6	Korea	46	26	5.07%
7	UK	41	25	4.87%
8	China	38	30	5.85%
9	Israel	30	15	2.92%
10	Australia	20	15	2.92%
11	Turkey	19	11	2.14%
12	Egypt	17	12	2.34%
13	Malaysia	17	5	0.97%
14	Saudi Arabia	9	7	1.36%
<b>Total number of contributing papers during Period 2</b>				<b>513</b>

Table 5.18 shows the top contributing countries in the overall region for Period 3. It presents the name of the country, number of appearances, number of published papers, and percentage of the number of papers published. The countries are listed in order of decreasing contribution according to the number of appearances. Total authors that contributed to the journal during these years represent six different continents and 53 different countries. The authors represent all continents except for Antarctica. North America was represented the most with number of appearances of 847. In second place was Asia with number of appearances of 481. In terms of published papers; the top five contributing countries were the US, Hong Kong, Canada, Australia, and the China.

**Table 5.18: Main Contributing Countries in the Overall Region for Period 3**

<b>No.</b>	<b>Country</b>	<b>Number of appearances</b>	<b>Number of published papers</b>	<b>%Number of published papers</b>
1	US	715	317	51.54%
2	Hong Kong	161	73	11.87%
3	Canada	126	59	9.59%
4	Korea	88	35	5.69%
5	Australia	83	49	7.97%
6	China	67	40	6.50%
7	UK	53	30	4.88%
8	Singapore	48	23	3.74%
9	Taiwan	46	22	3.58%
10	Turkey	34	21	3.41%
11	Israel	29	16	2.60%
12	Egypt	22	12	1.95%
13	Iran	16	6	0.98%
14	The Netherlands	13	8	1.30%
<b>Total number of contributing papers during Period 3</b>				<b>615</b>

Table 5.19 shows the top contributing countries in the overall region for total period. It presents the name of the country, number of appearances, number of published papers, and percentage of the number of papers published. The countries are listed in order of decreasing contribution according to the number of appearances. Total authors that contributed to the journal during these years represent six different continents and 69 different countries. The authors represent all continents except for Antarctica. North America was represented the most with number of appearances of 1,975. In second place was Asia with number of appearances of 986. They are listed in order of decreasing contribution. Overall (15-year rank) the top five contributing countries in terms of published papers were the US, Hong Kong, Canada, Australia, and the China. As Table 5.19 shows, US was always the top first contributing country, and with time the contribution from countries other than the U.S. were on the rise. Countries such as Canada, Hong Kong, Singapore, UK, China, and Australia had major contribution to the journal during these years and their contribution continued to increase with time.

**Table 5.19: Main Contributing Countries in the Overall Region for Total Period**

<b>No.</b>	<b>Country</b>	<b>Number of appearances</b>	<b>Number of published papers</b>	<b>%Number of published papers</b>
1	US	1676	782	54.80%
2	Hong Kong	339	156	10.93%
3	Canada	287	150	10.51%
4	Singapore	150	71	4.98%
5	Korea	150	72	5.05%
6	UK	123	69	4.84%
7	Australia	121	77	5.40%
8	Taiwan	108	57	3.99%
9	China	108	73	5.12%
10	Israel	72	37	2.59%
11	Turkey	54	33	2.31%
12	Egypt	53	35	2.45%
<b>Total number of contributing papers during total period</b>				<b>1,427</b>

### **5.5.2. Main Contributing Countries in the MENA Region**

Total authors that contributed to the journal during Period 1 represent eight countries out of the twenty one MENA countries as they are listed in Table 5.20. Table 5.20 presents the name of the country, number of appearances, number of published papers, and percentage of the number of papers published. The countries are listed in order of decreasing contribution according to the number of appearances. In terms of published papers; the top four contributing countries were the Egypt, Saudi Arabia, Lebanon, and the Jordan. The percentage of number of papers published was calculated by dividing the number of papers published by the country over total number of papers published about the MENA region in the specified period.

Total authors that contributed to the journal during Period 2 represent nine countries out of the twenty one MENA countries as they are listed in Table 5.21. Table 5.21 presents the name of the country, number of appearances, number of published papers, and percentage of the number of papers published. The countries are listed in order of decreasing contribution according to the number of appearances. In terms of published papers; the top four contributing countries were the Turkey, Egypt, Saudi Arabia, and the Jordan.

**Table 5.20: Main Contributing Countries in the MENA Region for Period 1**

<b>No.</b>	<b>Country</b>	<b>Number of appearances</b>	<b>Number of published papers</b>	<b>%Number of published papers</b>
1	Egypt	14	11	44.00%
2	Saudi Arabia	8	6	24.00%
3	Lebanon	3	3	12.00%
4	Jordan	2	2	8.00%
5	Kuwait	1	1	4.00%
6	Palestine	1	1	4.00%
7	Qatar	1	1	4.00%
8	Turkey	1	1	4.00%
<b>Total number of contributing papers during Period 1</b>				<b>25</b>

**Table 5.21: Main Contributing Countries in the MENA Region for Period 2**

<b>No.</b>	<b>Country</b>	<b>Number of appearances</b>	<b>Number of published papers</b>	<b>%Number of published papers</b>
1	Turkey	19	11	29.73%
2	Egypt	17	12	32.43%
3	Saudi Arabia	9	7	18.92%
4	Jordan	2	2	5.41%
5	Northern Cyprus	1	1	2.70%
6	Oman	1	1	2.70%
7	Qatar	1	1	2.70%
8	UAE	1	1	2.70%
9	Iran	1	1	2.70%
<b>Total number of contributing papers during Period 2</b>				<b>37</b>

Total authors that contributed to the journal during Period 3 represent nine countries out of the twenty one MENA countries as they are listed in Table 5.22. Table 5.22 presents the name of the country, number of appearances, number of published papers, and percentage of the number of papers published. The countries are listed in order of decreasing contribution according to the number of appearances. In terms of published papers; the top five contributing countries were the Turkey, Egypt, Iran, United Arab Emirates, and the Saudi Arabia.

**Table 5.22: Main Contributing Countries in the MENA Region for Period 3**

<b>No.</b>	<b>Country</b>	<b>Number of appearances</b>	<b>Number of published papers</b>	<b>%Number of published papers</b>
1	Turkey	34	21	38.89%
2	Egypt	22	12	22.22%
3	Iran	16	6	11.11%
4	UAE	7	6	11.11%
5	Oman	5	2	3.70%
6	Qatar	3	2	3.70%
7	Saudi Arabia	3	3	5.56%
8	Lebanon	2	1	1.85%
9	Kuwait	1	1	1.85%
<b>Total number of contributing papers during Period 3</b>				<b>54</b>

Total authors that contributed to the journal during total period represent twelve countries out of the twenty one MENA countries as they are listed in Table 5.23. Table 5.23 presents the name of the country, number of appearances, number of published papers, and percentage of the number of papers published. The countries are listed in order of decreasing contribution according to the number of appearances. Overall (15-year) rank the top five contributing countries in terms of published papers were the Turkey, Egypt, Saudi Arabia, Iran, and the United Arab Emirates.

As shown in Tables 5.21, 5.22, and 5.23, each of Turkey, Egypt, and Saudi Arabia were always the top three contributing countries to the journal during these years. In addition, as shown in Tables 5.20 and 5.21, Jordan had major contribution to the journal in Periods one and two whereas the United Arab Emirates had major contribution to the journal in Period three as shown in Table 5.22. On the other hand, there were no contributing authors from some MENA countries through the whole period such as: Algeria, Bahrain, Northern Cyprus, Djibouti, Iraq, Libya, Morocco, Syria, Tunisia, and Yemen.

**Table 5.23: Main Contributing Countries in the MENA Region for Total Period**

No.	Country	Number of appearances	Number of published papers	%Number of published papers
1	Turkey	54	33	28.45%
2	Egypt	53	35	30.17%
3	Saudi Arabia	20	16	13.79%
4	Iran	17	7	6.03%
5	UAE	8	7	6.03%
6	Oman	6	3	2.59%
7	Qatar	5	4	3.45%
8	Lebanon	5	4	3.45%
9	Jordan	4	4	3.45%
10	Kuwait	2	2	1.72%
11	Palestine	1	1	0.86%
12	Northern Cyprus	1	1	0.86%
<b>Total number of contributing papers during total period</b>				<b>116</b>

## 5.6. Analysis Based on Sector

### 5.6.1. Analysis Based on Sector in the Overall Region

Table 5.24 shows the distribution of the authors based on sector in the overall region for each period and total period.

**Table 5.24: Author's Distribution According to their Sector in the Overall Region**

Sector		Period 1	Period 2	Period 3
<b>Academia</b>	Number of Authors	348	1,104	894
	Percentage of Authors	83.05%	87.41%	85.47%
<b>Industry</b>	Number of Authors	63	136	137
	Percentage of Authors	15.04%	10.77%	13.10%
<b>Government</b>	Number of Authors	8	23	15
	Percentage of Authors	1.91%	1.82%	1.43%
<b>Total Number of Authors</b>		<b>419</b>	<b>1,263</b>	<b>1,046</b>

As can be noticed, the largest contribution was from academia for all periods while both industry and government made a small contribution to the journal. The huge gap in contribution between academia, industry and government is clear. This raises concern whether this gap keeps increasing and widening or a solution can be

found and applied to increase the collaboration between the three sectors. Also, there is closeness in the ratios of the three sectors in Periods 1, 2 and 3.

In general, the less contribution from industry researchers to the journal during the last fifteen years can be attributed to the progressed economic situation of these countries and that practitioners were busy due to the high economic and civilized movement.

### 5.6.2. Analysis Based on Sector in the MENA Region

Table 4.25 shows the distribution of the authors based on sector in the MENA region for each period and total period.

**Table 5.25: Author's Distribution According to their Sector in the MENA Region**

<b>Sector</b>		<b>Period 1</b>	<b>Period 2</b>	<b>Period 3</b>	<b>Total period</b>
<b>Academia</b>	Number of Authors	19	34	68	101
	Percentage of Authors	82.61%	85.00%	91.89%	86.32%
<b>Industry</b>	Number of Authors	3	5	6	14
	Percentage of Authors	13.04%	12.50%	8.11%	11.97%
<b>Government</b>	Number of Authors	1	1	0	2
	Percentage of Authors	4.35%	2.50%	0.00%	1.71%
<b>Total Number of Authors</b>		<b>23</b>	<b>40</b>	<b>74</b>	<b>117</b>

As can be noticed, the largest contribution was from academia for all periods. The industry and government contributions were marginal in comparison to the journal. Also, the government contribution accounted for 0 for Period 3. Furthermore, if the overall contribution is compared with the MENA contribution, it can be noticed that the MENA contribution was very small to the journal. Overall, one can say that there was a lack in the collaboration among the three sectors in both regions, overall region and MENA region.

### 5.7. MENA to non-MENA Authors

Table 5.26 displays the distribution of the authors depending on whether they were related to the MENA region or not for each period. The ratio of MENA authors to non-MENA authors virtually the same in the three periods. In general, over the

three periods the number of authors from both regions was increasing with time. Also, the number of non-MENA authors was much higher than the number of MENA authors in the three periods and total period as well.

**Table 5.26: MENA & Non-MENA Authors' Distribution**

<b>Period</b>	<b>Total Number of Authors</b>	<b>Number of non-MENA Authors</b>	<b>Percentage of non-MENA Authors</b>	<b>Number of MENA Authors</b>	<b>Percentage of MENA Authors</b>	<b>Percentage of MENA Authors and non-MENA Authors</b>
<b>Period 1</b>	419	396	94.51%	23	5.49%	5.81%
<b>Period 2</b>	1,263	1,223	96.83%	40	3.17%	3.27%
<b>Period 3</b>	1,046	972	92.93%	74	7.07%	7.61%

From the above analysis, it can be clearly observed that the number of MENA authors was minute compared to the number of non-MENA authors. Furthermore, there was closeness in the ratios over the three periods.

## **5.8. Analysis of Research Topics**

### **5.8.1. Analysis of Research Topics in the Overall Region**

Tables 5.27-5.36 show the detailed distribution for the research and research sub-topics in the overall region for each period and total period. The percentage of papers published was calculated by dividing the number of papers published about the topic during the total period over total number of papers published during the total period.

**Table 5.27: Management and Organization of the Firm Analysis (Overall Region)**

<b>Classification</b>	<b>Period 1</b>	<b>Period 2</b>	<b>Period 3</b>	<b>Total period</b>	<b>% Papers published</b>
Management and Organization of the Firm	5	22	34	61	4.27%
Firm strategy, organization and culture	2	9	15	26	1.82%
Inter-firm relationships	1	3	6	10	0.70%
Accounting and financial management	0	5	4	9	0.63%
Marketing and investment patterns	0	3	4	7	0.49%
Internationalization and globalization	0	1	3	4	0.28%
Supply Chain Management	0	1	2	3	0.21%
Business strategy and planning	2	0	0	2	0.14%

**Table 5.28: Construction Planning and Control Analysis (Overall Region)**

<b>Classification</b>	<b>Period 1</b>	<b>Period 2</b>	<b>Period 3</b>	<b>Total period</b>	<b>% Papers published</b>
Construction Planning and Control	24	28	27	79	5.54%
Construction process models	8	5	7	20	1.40%
Constructability analysis	7	11	1	19	1.33%
Sustainability	0	5	8	13	0.91%
Lean construction and production	1	2	6	9	0.63%
Production management	2	3	3	8	0.56%
Designing for maintainability	3	1	2	6	0.42%
Planning of the construction process	3	1	0	4	0.28%

**Table 5.29: Site, Materials, and Equipment Management Analysis (Overall Region)**

<b>Classification</b>	<b>Period 1</b>	<b>Period 2</b>	<b>Period 3</b>	<b>Total period</b>	<b>% Papers published</b>
Site, Materials and Equipment Management	27	48	55	130	9.11%
Construction equipment management	9	13	19	41	2.87%
Materials and component management	5	10	14	29	2.03%
Environmental management	5	9	13	27	1.89%
Site preparation and layout	4	11	6	21	1.47%
Earthwork	2	4	2	8	0.56%
Production plants	2	0	1	3	0.21%
Others	0	1	0	1	0.07%

**Table 5.30: Time/Cost Planning and Control Analysis (Overall Region)**

<b>Classification</b>	<b>Period 1</b>	<b>Period 2</b>	<b>Period 3</b>	<b>Total period</b>	<b>% Papers published</b>
Time/Cost Planning and Control	60	80	92	232	16.26%
Modeling and simulation applications	13	18	17	48	3.36%
Time/cost scheduling optimization	12	16	15	43	3.01%
Cost planning and control	6	16	19	41	2.87%
Resources planning and allocation	12	10	14	36	2.52%
Critical path method	2	10	7	19	1.33%
Non-deterministic time-cost estimating techniques	4	1	8	13	0.91%
LOB, linear and vertical scheduling	3	2	5	10	0.70%
Time scheduling and control techniques	2	3	5	10	0.70%
Network planning and analysis	3	1	1	5	0.35%
PERT and GERT	2	2	0	4	0.28%
Life cycle costing	1	1	1	3	0.21%

**Table 5.31: Construction Operations and Methods Analysis (Overall Region)**

<b>Classification</b>	<b>Period 1</b>	<b>Period 2</b>	<b>Period 3</b>	<b>Total period</b>	<b>% Papers published</b>
Construction Operations and Methods	26	51	35	112	7.85%
Concrete construction	5	10	12	27	1.89%
Bridge construction	7	5	3	15	1.05%
Construction methods	6	4	4	14	0.98%
Tunnel construction	2	5	5	12	0.84%
Pile foundation and pipeline construction	1	8	2	11	0.77%
Buildings	1	3	5	9	0.63%
Highway construction	2	4	3	9	0.63%
Formwork, shoring and temporary structures	2	4	0	6	0.42%
Foundations and temporary retention walls, excavation	0	4	0	4	0.28%
Asphalt	0	1	1	2	0.14%
MEP	0	2	0	2	0.14%
Others	0	1	0	1	0.07%

**Table 5.32: Human Factors, Management of Safety and Labor Relationships Analysis (Overall Region)**

<b>Classification</b>	<b>Period 1</b>	<b>Period 2</b>	<b>Period 3</b>	<b>Total period</b>	<b>% Papers published</b>
Human Factors, Management of Safety and Labor Relationships	39	86	103	228	15.98%
Safety management	16	35	41	92	6.45%
Productivity issues	13	22	22	57	3.99%
Performance analysis and measurement	2	15	12	29	2.03%
Communications	5	8	15	28	1.96%
Organized labor related issues	1	5	5	11	0.77%
Engineering managers characteristics and recruitment issues	1	1	8	10	0.70%
Others	1	0	0	1	0.07%

**Table 5.33: Project Management Analysis (Overall Region)**

<b>Classification</b>	<b>Period 1</b>	<b>Period 2</b>	<b>Period 3</b>	<b>Total period</b>	<b>% Papers published</b>
Project Management	44	73	84	201	14.09%
Risk analysis and management	13	19	33	65	4.56%
Project planning and organization	6	11	18	35	2.45%
Project quality planning and control	8	13	7	28	1.96%
Project performance and feedback	6	11	9	26	1.82%
Cooperation, partnering, leadership and opportunity	4	9	7	20	1.40%
Design management, Value engineering and management	5	7	5	17	1.19%
Change management	2	3	5	10	0.70%

**Table 5.34: Project Delivery Systems and Contracts Analysis (Overall Region)**

<b>Classification</b>	<b>Period 1</b>	<b>Period 2</b>	<b>Period 3</b>	<b>Total period</b>	<b>% Papers published</b>
Project Delivery Systems and Contracts	46	72	97	215	15.07%
Claims and disputes, negotiation and resolution, construction delays	10	20	30	60	4.20%
Project delivery systems with public and/or private financing	7	17	18	42	2.94%
Selection and evaluation of bids and proposals	12	10	20	42	2.94%
Contract and contingency management	7	6	12	25	1.75%
Design/build	7	3	11	21	1.47%
Selection and evaluation of contractors	0	10	4	14	0.98%
Analysis and selection criteria	3	6	2	11	0.77%

**Table 5.35: Construction Industry Structure and Environment Analysis (Overall Region)**

<b>Classification</b>	<b>Period 1</b>	<b>Period 2</b>	<b>Period 3</b>	<b>Total period</b>	<b>% Papers published</b>
Construction Industry Structure and Environment	9	15	14	38	2.66%
Domestic construction issues and practices	1	6	5	12	0.84%
Roles and cooperation in the industry	2	2	7	11	0.77%
Classification and information systems	4	3	2	9	0.63%
Codes, standards and laws	2	4	0	6	0.42%

**Table 5.36: Technology Development Issues Analysis (Overall Region)**

<b>Classification</b>	<b>Period 1</b>	<b>Period 2</b>	<b>Period 3</b>	<b>Total period</b>	<b>% Papers published</b>
Technology Development Issues	19	38	74	131	9.18%
MIS and IT based integration and communications + GPS	5	18	19	42	2.94%
Research and development issues, research needs	1	5	25	31	2.17%
Innovation and technology transfer, analysis, and mechanics	7	8	13	28	1.96%
2-D, 3-D and 4-D CAD	6	6	14	26	1.82%
BIM	0	0	3	3	0.21%
Others	0	1	0	1	0.07%

Table 5.37 shows the detailed distribution for the research topics in the overall region for each period and for total period.

**Table 5.37: Analysis of Top Research Topics in the Overall Region for Total Period**

<b>Classification</b>	<b>Period 1</b>	<b>Period 2</b>	<b>Period 3</b>	<b>Total period</b>	<b>% Papers published</b>
Management and Organization of the Firm	5	22	34	61	4.27%
Construction Planning and Control	24	28	27	79	5.54%
Site, Materials and Equipment Management	27	48	55	130	9.11%
Time/Cost Planning and Control	60	80	92	232	16.26%
Construction Operations and Methods	26	51	35	112	7.85%
Human Factors, Management of Safety and Labor Relationships	39	86	103	228	15.98%
Project Management	44	73	84	201	14.09%
Project Delivery Systems and Contracts	46	72	97	215	15.07%
Construction Industry Structure and Environment	9	15	14	38	2.66%
Technology Development Issues	19	38	74	131	9.18%
<b>Total</b>	<b>299</b>	<b>513</b>	<b>615</b>	<b>1,427</b>	<b>100.00%</b>

From the above analysis, the top research topics in the overall region for Period 1 respectively were, “Time/Cost Planning and Control” (20.07%), “Project Delivery Systems and Contracts” (15.38%), and “Project Management” (14.72%). In contrast, the lowest interest research topics respectively were, “Management and Organization of the Firm” (1.67%), “Construction Industry Structure and Environment” (3.01%), and “Technology Development Issues” (6.35%).

Furthermore, the top research topics in the overall region for Period 2 respectively were, “Human Factors, Management of Safety and Labor Relationships” (16.76%), “Time/Cost Planning and Control” (15.59%), and “Project Management” (14.23%). On the other hand, the lowest interest research topics respectively were, “Construction Industry Structure and Environment” (2.92%), “Management and Organization of the Firm” (4.29%), and “Construction Planning and Control” (5.46%).

In addition, for Period 3 the top research topics in the overall region respectively were, “Human Factors, Management of Safety and Labor Relationships” (16.75%), “Project Delivery Systems and Contracts” (15.77%), and “Time/Cost Planning and Control” (14.96%). Alternatively, the lowest interest research topics respectively were, “Construction Industry Structure and Environment” (2.28%), “Construction Planning and Control” (4.39%), and “Management and Organization of the Firm” (5.69%).

For total period, the top research topics in the overall region respectively were, “Time/Cost Planning and Control” (16.26%), “Human Factors, Management of Safety and Labor Relationships” (15.98%), and “Project Delivery Systems and Contracts” (15.07%). Conversely, the lowest interest research topics respectively were, “Construction Industry Structure and Environment” (2.66%), “Management and Organization of the Firm” (4.27%), and “Construction Planning and Control” (5.54%).

In general, it can be concluded that most of the top research topics were associated with “time/cost”, “human factors and safety management”, and “project” related issues. In contrast, most of the lowest interest research topics were about “construction” and “firm” related issues. Moreover, the lack of diversification in research topics can be attributed to the bias of the authors to not publish beyond their disciplines including authors from academia, industry and government. At the same time, it was noticed the change in the types of papers being published from period to

period and this may be attributed to the increase in participation by countries. These countries come from different parts of the world. Each country from these countries has different economy and different lifestyle which is concerned with different aspects of the construction industry. The main contributing countries in each region are as follows:

- Asia: Hong Kong, Singapore, Korea, Taiwan, and China
- Africa: Africa's papers mostly came from Nigeria
- North America: US and Canada
- South America: Chile
- Europe: UK and Israel
- MENA Region: Turkey, Egypt, and Saudi Arabia

In terms of growth, "Human Factors, Management of Safety and Labor Relationships" was found to be the fastest growing topic for Period 1-2 as the number of papers published regarding this topic increased by 54.65% (47 papers). On the other hand, "Technology Development Issues" was found to be the fastest growing topic for Period 2-3 as the number of papers published increased by 48.65% (36 papers). For total period, "Human Factors, Management of Safety and Labor Relationships" was observed as the highest topic that achieved relative growth in number of published papers for total period, since the number of papers published increased by 62.14% (64 papers).

Contrary to this to the CME journal, for Period 1-2 there were no declining topics. All topics had an increase in number of published papers in Period 2 compared to Period 1. On the other hand, "Construction Operations and Methods" was found to be the most declining topic for Period 2-3 as the number of papers published regarding this topic decreased by 31.37% (16 papers). In addition, "Construction Planning and Control" and "Construction Industry Structure and Environment" has decreased in amount of published papers by 1 paper for Period 2-3. This may lead us to say that "construction" related topics had more interest in Period 1-2 compared to Period 2-3. For total period, there were no declining topics.

Tables 5.38, 5.39, & 5.40 show the top research sub-topics in the overall region for Periods 1, 2, & 3 respectively, according to the number of published papers. Table 5.41 shows the top research sub-topics in the overall region for total period. The percentage of the number of papers published was calculated by dividing

the number of papers published about the sub-topic during the period over total number of papers published during the specified period.

**Table 5.38: Top Research Sub-topics in the Overall Region for Period 1**

<b>Sub-topic</b>	<b>Number of published papers</b>	<b>%Number of published papers</b>
Safety management	16	5.35%
Modeling and simulation applications	13	4.35%
Productivity issues	13	4.35%
Risk analysis and management	13	4.35%
Time/cost scheduling optimization	12	4.01%
Resources planning and allocation	12	4.01%
Selection and evaluation of bids and proposals	12	4.01%
Claims and disputes, negotiation and resolution, construction delays	10	3.34%
Construction equipment management	9	3.01%
Construction process models	8	2.68%
Project quality planning and control	8	2.68%
<b>Total</b>	<b>299</b>	<b>100.00%</b>

**Table 5.39: Top Research Sub-topics in the Overall Region for Period 2**

<b>Sub-topic</b>	<b>Number of published papers</b>	<b>%Number of published papers</b>
Safety management	35	6.82%
Productivity issues	22	4.29%
Claims and disputes, negotiation and resolution, construction delays	20	3.90%
Risk analysis and management	19	3.70%
Modeling and simulation applications	18	3.51%
MIS and IT based integration and communications + GPS	18	3.51%
Project delivery systems with public and/or private financing	17	3.31%
Time/cost scheduling optimization	16	3.12%
Cost planning and control	16	3.12%
Performance analysis and measurement	15	2.92%
<b>Total</b>	<b>513</b>	<b>100.00%</b>

**Table 5.40: Top Research Sub-topics in the Overall Region for Period 3**

<b>Sub-topic</b>	<b>Number of published papers</b>	<b>%Number of published paper</b>
Safety management	41	6.67%
Risk analysis and management	33	5.37%
Claims and disputes, negotiation and resolution, construction delays	30	4.88%
Research and development issues, research needs	25	4.07%
Productivity issues	22	3.58%
Selection and evaluation of bids and proposals	20	3.25%
Construction equipment management	19	3.09%
Cost planning and control	19	3.09%
MIS and IT based integration and communications + GPS	19	3.09%
Project planning and organization	18	2.93%
Project delivery systems with public and/or private financing	18	2.93%
<b>Total</b>	<b>615</b>	<b>100.00%</b>

Form the overall analysis, it can be noticed that each period had different distribution according to the research sub-topics. Overall, the top five CM sub-topics in the overall region for total period were associated with “Safety management”, “Risk analysis and management”, “Claims and disputes, negotiation and resolution, construction delays”, “Productivity issues”, and “Modeling and simulation applications”.

Also, the appearance of new topics form period to period is noticeable, such as “Accounting and financial management”, “Marketing and investment patterns”, “Internationalization and globalization”, “Supply chain management”, “Sustainability”, “Foundations and temporary retention walls, excavation”, “Asphalt”, “MEP”, “Selection and evaluation of contractors”, and “BIM” as there were no published papers about them in Period one. This may be attributed to the increase in number of published papers in Periods two and three compared to Period one and raising some important topics that were not raised during Period one such as “Sustainability” and “BIM”.

**Table 5.41: Top Research Sub-topics in the Overall Region for Total Period**

<b>Sub-topic</b>	<b>Number of published papers</b>	<b>%Number of published papers</b>
Safety management	92	6.45%
Risk analysis and management	65	4.56%
Claims and disputes, negotiation and resolution, construction delays	60	4.20%
Productivity issues	57	3.99%
Modeling and simulation applications	48	3.36%
Time/cost scheduling optimization	43	3.01%
Project delivery systems with public and/or private financing	42	2.94%
Selection and evaluation of bids and proposals	42	2.94%
MIS and IT based integration and communications + GPS	42	2.94%
Construction equipment management	41	2.87%
Cost planning and control	41	2.87%
<b>Total</b>	<b>1,427</b>	<b>100.00%</b>

Appertaining to the sub-topics in terms of growth, “Safety management” was found to be the fastest growing sub-topic for Period 1-2 as the number of published papers regarding this topic increased by 54.29% (19 papers). Alternatively, “Research and development issues, research needs” was established to be the fastest growing sub-topic for Period 2-3 as the number of published papers increased by 80.00% (20 papers). For the overall period, “Safety management” was noticed as the highest sub-topic that achieved relative growth in number of papers published for total period as the number of papers published increased by 60.98% (25 papers).

Contrary to this, “Design/build” was found to be the most declining sub-topic for Period 1-2 as the number of published papers regarding this topic decreased by 57.14% (4 papers). On the other hand, “Pile foundation and pipeline construction”, “Project quality planning and control”, and “Selection and evaluation of contractors” were found to be the most declining sub-topics for Period 2-3 as they have decreased in amount of published papers by 6 papers. Furthermore, “Constructability analysis”

was found to be the most declining sub-topic for total period as the number of published papers decreased by 85.71% (6 papers).

### 5.8.2. Analysis of Research Topics in the MENA Region

Tables 5.42-5.51 show the detailed distribution for the research and research sub-topics in the MENA region for each period and total period. Papers in the MENA region were listed according to both authors and the country that the paper addressed. This was because if the paper was written by an author from the MENA region or it talked about the MENA region, it was considered as a paper related to the MENA region and hence included in the below analysis. The percentage of papers published was calculated by dividing the number of papers published about the topic in the MENA region during the total period over total number of papers published in the MENA region during the total period.

**Table 5.42: Management and Organization of the Firm Analysis (MENA Region)**

<b>Classification</b>	<b>Period 1</b>	<b>Period 2</b>	<b>Period 3</b>	<b>Total period</b>	<b>% Papers published</b>
Management and Organization of the Firm	0	6	6	12	10.34%
Firm strategy, organization and culture	0	3	3	6	5.17%
Inter-firm relationships	0	0	2	2	1.72%
Accounting and financial management	0	1	1	2	1.72%
Marketing and investment patterns	0	2	0	2	1.72%
Internationalization and globalization	0	0	0	0	0.00%
Supply Chain Management	0	0	0	0	0.00%
Business strategy and planning	0	0	0	0	0.00%

**Table 5.43: Construction Planning and Control Analysis (MENA Region)**

<b>Classification</b>	<b>Period 1</b>	<b>Period 2</b>	<b>Period 3</b>	<b>Total period</b>	<b>% Papers published</b>
Construction Planning and Control	2	2	0	4	3.45%
Constructability analysis	1	1	0	2	1.72%
Sustainability	0	1	0	1	0.86%
Planning of the construction process	1	0	0	1	0.86%
Construction process models	0	0	0	0	0.00%
Lean construction and production	0	0	0	0	0.00%
Production management	0	0	0	0	0.00%
Designing for maintainability	0	0	0	0	0.00%

**Table 5.44: Site, Materials, and Equipment Management Analysis (MENA Region)**

<b>Classification</b>	<b>Period 1</b>	<b>Period 2</b>	<b>Period 3</b>	<b>Total period</b>	<b>% Papers published</b>
Site, Materials and Equipment Management	0	4	7	11	9.48%
Materials and component management	0	1	4	5	4.31%
Earthwork	0	2	1	3	2.59%
Site preparation and layout	0	1	1	2	1.72%
Environmental management	0	0	1	1	0.86%
Construction equipment management	0	0	0	0	0.00%
	0	0	0	0	0.00%
Others	0	0	0	0	0.00%

**Table 5.45: Time/Cost Planning and Control Analysis (MENA Region)**

<b>Classification</b>	<b>Period 1</b>	<b>Period 2</b>	<b>Period 3</b>	<b>Total period</b>	<b>% Papers published</b>
Time/Cost Planning and Control	6	6	14	26	22.41%
Resources planning and allocation	4	1	4	9	7.76%
Modeling and simulation applications	2	3	3	8	6.90%
Time/cost scheduling optimization	0	1	5	6	5.17%
Cost planning and control	0	1	1	2	1.72%
Network planning and analysis	0	0	1	1	0.86%
Critical path method	0	0	0	0	0.00%
Non-deterministic time-cost estimating techniques	0	0	0	0	0.00%
LOB, linear and vertical scheduling	0	0	0	0	0.00%
Time scheduling and control techniques	0	0	0	0	0.00%
PERT and GERT	0	0	0	0	0.00%
Life cycle costing	0	0	0	0	0.00%

**Table 5.46: Construction Operations and Methods Analysis (MENA Region)**

<b>Classification</b>	<b>Period 1</b>	<b>Period 2</b>	<b>Period 3</b>	<b>Total period</b>	<b>% Papers published</b>
Construction Operations and Methods	6	1	6	13	11.21%
Concrete construction	1	1	2	4	3.45%
Bridge construction	2	0	1	3	2.59%
Buildings	1	0	1	2	1.72%
Construction methods	1	0	0	1	0.86%
Tunnel Construction	0	0	1	1	0.86%
Pile foundation and pipeline construction	1	0	0	1	0.86%
Highway construction	0	0	1	1	0.86%
Formwork, shoring and temporary structures	0	0	0	0	0.00%
Foundations and temporary retention walls, excavation	0	0	0	0	0.00%
Asphalt	0	0	0	0	0.00%
MEP	0	0	0	0	0.00%
Others	0	0	0	0	0.00%

**Table 5.47: Human Factors, Management of Safety and Labor Relationships Analysis (MENA Region)**

<b>Classification</b>	<b>Period 1</b>	<b>Period 2</b>	<b>Period 3</b>	<b>Total period</b>	<b>% Papers published</b>
Human Factors, Management of Safety and Labor Relationships	3	5	5	13	11.21%
Safety management	1	1	2	4	3.45%
Productivity issues	1	2	1	4	3.45%
Performance analysis and measurement	1	2	1	4	3.45%
Engineering managers characteristics and recruitment issues	0	0	1	1	0.86%
Communications	0	0	0	0	0.00%
Organized labor related issues	0	0	0	0	0.00%
Others	0	0	0	0	0.00%

**Table 5.48 Project Management Analysis (MENA Region)**

<b>Classification</b>	<b>Period 1</b>	<b>Period 2</b>	<b>Period 3</b>	<b>Total period</b>	<b>% Papers published</b>
Project Management	1	4	6	11	9.48%
Risk analysis and management	0	3	3	6	5.17%
Project quality planning and control	1	1	0	2	1.72%
Change management	0	0	2	2	1.72%
Project planning and organization	0	0	1	1	0.86%
Project performance and feedback	0	0	0	0	0.00%
Cooperation, partnering, leadership and opportunity	0	0	0	0	0.00%
Design management, Value engineering and management	0	0	0	0	0.00%

**Table 5.49: Project Delivery Systems and Contracts Analysis (MENA Region)**

<b>Classification</b>	<b>Period 1</b>	<b>Period 2</b>	<b>Period 3</b>	<b>Total period</b>	<b>% Papers published</b>
Project Delivery Systems and Contracts	5	4	5	14	12.07%
Project delivery systems with public and/or private financing	1	2	2	5	4.31%
Claims and disputes, negotiation and resolution, construction delays	1	0	2	3	2.59%
Selection and evaluation of bids and proposals	2	0	0	2	1.72%
Contract and contingency management	1	0	1	2	1.72%
Selection and evaluation of contractors	0	2	0	2	1.72%
Design/build	0	0	0	0	0.00%
Analysis and selection criteria	0	0	0	0	0.00%

**Table 5.50: Construction Industry Structure and Environment Analysis (MENA Region)**

<b>Classification</b>	<b>Period 1</b>	<b>Period 2</b>	<b>Period 3</b>	<b>Total period</b>	<b>% Papers published</b>
Construction Industry Structure and Environment	2	0	1	3	2.59%
Roles and cooperation in the industry	2	0	0	2	1.72%
Domestic construction issues and practices	0	0	1	1	0.86%
Classification and information systems	0	0	0	0	0.00%
Codes, standards and laws	0	0	0	0	0.00%

**Table 5.51: Technology Development Issues Analysis (MENA Region)**

<b>Classification</b>	<b>Period 1</b>	<b>Period 2</b>	<b>Period 3</b>	<b>Total period</b>	<b>% Papers published</b>
Technology Development Issues	0	5	4	9	7.76%
MIS and IT based integration and communications + GPS	0	3	1	4	3.45%
Innovation and technology transfer, analysis, and mechanics	0	1	2	3	2.59%
2-D, 3-D and 4-D CAD	0	1	1	2	1.72%
Research and development issues, research needs	0	0	0	0	0.00%
BIM	0	0	0	0	0.00%
Others	0	0	0	0	0.00%

Table 5.52 shows the detailed distribution for the research topics in the MENA region for each period and for total period.

**Table 5.52: Analysis of Top Research Topics in the MENA Region for Total Period**

<b>Classification</b>	<b>Period 1</b>	<b>Period 2</b>	<b>Period 3</b>	<b>Total period</b>	<b>% Papers published</b>
Management and Organization of the Firm	0	6	6	12	10.34%
Construction Planning and Control	2	2	0	4	3.45%
Site, Materials and Equipment Management	0	4	7	11	9.48%
Time/Cost Planning and Control	6	6	14	26	22.41%
Construction Operations and Methods	6	1	6	13	11.21%
Human Factors, Management of Safety and Labor Relationships	3	5	5	13	11.21%
Project Management	1	4	6	11	9.48%
Project Delivery Systems and Contracts	5	4	5	14	12.07%
Construction Industry Structure and Environment	2	0	1	3	2.59%
Technology Development Issues	0	5	4	9	7.76%
<b>Total</b>	<b>25</b>	<b>37</b>	<b>54</b>	<b>116</b>	<b>100.00%</b>

From the above analysis, the top research topics in the MENA region for Period 1 respectively were, “Time/Cost Planning and Control” (24.00%), “Construction Operations and Methods” (24.00%), and “Project Delivery Systems and Contracts” (20.00%). Alternatively, the lowest interest research topics respectively were, “Management and Organization of the Firm” (0.00%), “Site, Materials and Equipment Management” (0.00%), and “Technology Development Issues” (0.00%).

Furthermore, the top research topics in the MENA region for Period 2 respectively were, “Management and Organization of the Firm” (16.22%), “Time/Cost Planning and Control” (16.22%), “Human Factors, Management of Safety and Labor Relationships” (13.51%), and “Technology Development Issues” (13.51%). On the other hand, the lowest interest research topic was “Construction Industry Structure and Environment” (0.00%).

In addition, for Period 3 the top research topics in the MENA region respectively were, “Time/Cost Planning and Control” (25.93%), “Site, Materials and Equipment Management” (12.96%), “Management and Organization of the Firm” (11.11%), “Construction Operations and Methods” (11.11%), and “Project Management” (11.11%). Conversely, the lowest interest research topic was “Construction Planning and Control” (0.00%).

For Total period, the top research topics in the MENA region respectively were, “Time/Cost Planning and Control” (22.41%), “Project Delivery Systems and Contracts” (12.07%), “Construction Operations and Methods” (11.21%), and “Human Factors, Management of Safety and Labor Relationships” (11.21%). On the other hand, the lowest interest research topics respectively were, “Construction Industry Structure and Environment” (2.59%), “Construction Planning and Control” (3.45%), and “Technology Development Issues” (7.76%).

In general, it can be noticed that most of the top research topics were associated with “time/cost”, “project”, and “human factors and safety management” related issues. On the other hand, regarding the lowest interest research topics, for Period one there were no contributing papers on each of “Management and Organization of the Firm”, “Site, Materials and Equipment Management”, and “Technology Development Issues”. For Period two, there was a noticed increase in the number of published papers and difference in research topics in the MENA region compared to Period one since there were no published papers only about

“Construction Industry Structure and Environment”. For Period three, there were published papers regarding each research topic.

In general, from the overall analysis, it can be noticed that there was a less interest in the in the MENA region regarding the topics associated with “construction” and “technology” issues and a lack in the variance of research topics compared to the overall region. In addition, the lack of diversification in research topics can be attributed to the bias of the authors to not publish beyond their disciplines. This includes authors from academia, industry as well as government. At the same time, it was noticed the change in the types of papers being published from period to period and this may be attributed to the increase in participation by countries. These countries come from different parts of the world. Each country from these countries has different economy and different lifestyle which is concerned with different aspects of the construction industry.

In terms of growth, “Management and Organization of the Firm” was found to be the fastest growing topic in the MENA region for Period 1-2 as the number of published papers regarding this topic increased by 100.00% (0 papers to 6 papers). On the flipside, “Time/Cost Planning and Control” was found to be the fastest growing topic for Period 2-3 as the number of published papers increased by 57.14% (8 papers). The same applied for the overall period, as “Time/Cost Planning and Control” was noticed as the highest topic that achieved relative growth in number of published papers for total period as the number of papers published increased by 57.14% (8 papers).

Contrary to this, “Construction Operations and Methods” was found to be the most declining topic for Period 1-2 as the number of published papers regarding this topic decreased by 83.33% (5 papers). On the other hand, “Construction Planning and Control” was found to be the most declining topic for Period 2-3 as the number of published papers decreased by 100.00% (2 papers to 0 papers). The same applied for total period, as the number of published papers on “Construction Planning and Control” decreased by 100.00% (2 papers to 0 papers) and this proves the existence of the gap in “construction” related issues through the total period.

On the other hand, some topics did not achieve any change. For example, “Construction Planning and Control” and “Time/Cost Planning and Control” had the same number of published papers for both Periods one & two. Also, “Management and Organization of the Firm” and “Human Factors, Management of Safety and Labor

Relationships” had the same number of published papers for both Periods two & three.

From the analysis of the JCEM, the top research topics for the total period were, “Time/Cost Planning and Control”, “Human Factors, Management of Safety and Labor Relationships”, and “Project Delivery Systems and Contracts” while the top research topics in the MENA region were, “Time/Cost Planning and Control”, “Site, Materials and Equipment Management”, “Management and Organization of the Firm”, “Construction Operations and Methods”, and “Project Management”. Comparing the MENA region with the overall region, it can be noticed that “Time/Cost Planning and Control” was at the top weighted topics for JCEM for both regions for the total period. In addition, “project” related issues had been in interest for both regions.

From the analysis of the JCEM, it can be noticed that the less interest research topics in the overall region for total period were, “Construction Industry Structure and Environment”, “Management and Organization of the Firm”, and “Construction Planning and Control” while the less interest research topics in the MENA region were, “Construction Industry Structure and Environment”, “Construction Planning and Control”, and “Technology Development Issues”. As can be noticed, there was similarity in the less interest research topics between the overall region the MENA region. Both have showed less interest regarding the “construction” related issues and this may lead us to say that there was a less interest in the research that is related to the construction field in both regions. This may be attributed to the presence of other leading journals that focus on pure “construction” related issues rather than “construction management” related issues such as “Construction and building materials”, “Construction innovation”, “Automation in Construction”, “International Journal of Construction Education and Research”, “Construction law and business”, etc. Moreover, “Management and Organization of the Firm” was a less interest research area in the overall region and this is may be attributed to the presence of other leading journals that focus on “management” related issues such as “Journal of Management”, Journal of Management in Engineering”, “Journal of Contemporary Management Issues”, etc. On the other hand, “Technology Development Issues” was a less interest research topic in the MENA region and this is may be attributed to the presence of other leading journals that focus on “technology” related issues such as “Technology business journal”, “Technology analysis and strategic management”,

“Technology and culture”, “Technology connection”, “Global technology hardware and equipment”, etc.

Tables 5.53, 5.54, & 5.55 display the top research sub-topics in the MENA region for Periods one, two and three respectively according to the number of published papers. Table 5.56 shows the top research sub-topics in the MENA region for total period. The percentage of papers published was calculated by dividing the number of papers published about the sub-topic in the MENA region during the period over total number of papers published in the MENA region during the specified period.

**Table 5.53: Top Research Sub-topics in the MENA Region for Period 1**

<b>Sub-topic</b>	<b>Number of Published Papers</b>	<b>%Number of published papers</b>
Resources planning and allocation	4	16.00%
Modeling and simulation applications	2	8.00%
Bridge construction	2	8.00%
Selection and evaluation of bids and proposals	2	8.00%
Roles and cooperation in the industry	2	8.00%
Constructability analysis	1	4.00%
Planning of the construction process	1	4.00%
Concrete construction	1	4.00%
Construction methods	1	4.00%
Pile foundation and pipeline construction	1	4.00%
Buildings	1	4.00%
Safety management	1	4.00%
Productivity issues	1	4.00%
Performance analysis and measurement	1	4.00%
Project quality planning and control	1	4.00%
Claims and disputes, negotiation and resolution, construction delays	1	4.00%
Project delivery systems with public and/or private financing	1	4.00%
Contract and contingency management	1	4.00%
<b>Total</b>	<b>25</b>	<b>100.00%</b>

**Table 5.54: Top Research Sub-topics in the MENA Region for Period 2**

<b>Sub-topic</b>	<b>Number of Published Papers</b>	<b>%Number of published papers</b>
Firm strategy, organization and culture	3	8.11%
Modeling and simulation applications	3	8.11%
Risk analysis and management	3	8.11%
MIS and IT based integration and communications + GPS	3	8.11%
Marketing and investment patterns	2	5.41%
Earthwork	2	5.41%
Performance analysis and measurement	2	5.41%
Productivity issues	2	5.41%
Project delivery systems with public and/or private financing	2	5.41%
Selection and evaluation of contractors	2	5.41%
Accounting and financial management	1	2.70%
Sustainability	1	2.70%
Constructability analysis	1	2.70%
Site preparation and layout	1	2.70%
Materials and component management	1	2.70%
Cost planning and control	1	2.70%
Resources planning and allocation	1	2.70%
Time/cost scheduling optimization	1	2.70%
Concrete construction	1	2.70%
Safety management	1	2.70%
Project quality planning and control	1	2.70%
Innovation and technology transfer, analysis, and mechanics	1	2.70%
2-D, 3-D and 4-D CAD	1	2.70%
<b>Total</b>	<b>37</b>	<b>100.00%</b>

**Table 5.55: Top Research Sub-topics in the MENA Region for Period 3**

<b>Sub-topic</b>	<b>Number of Published Papers</b>	<b>%Number of Published Papers</b>
Time/cost scheduling optimization	5	9.26%
Materials and component management	4	7.41%
Resources planning and allocation	4	7.41%
Modeling and simulation applications	3	5.56%
Risk analysis and management	3	5.56%
Firm strategy, organization, and culture	3	5.56%
Inter-firm relationships	2	3.70%
Concrete construction	2	3.70%
Safety management	2	3.70%
Change management	2	3.70%
Claims and disputes, negotiation and resolution, construction delays	2	3.70%
Project delivery systems with public and/or private financing	2	3.70%
Innovation and technology transfer, analysis, and mechanics	2	3.70%
Accounting and financial management	1	1.85%
Environmental management	1	1.85%
Site preparation and layout	1	1.85%
Earthwork	1	1.85%
Cost planning and control	1	1.85%
Network planning and analysis	1	1.85%
Buildings	1	1.85%
Bridge construction	1	1.85%
Tunnel construction	1	1.85%
Highway construction	1	1.85%
Productivity issues	1	1.85%
Performance analysis and measurement	1	1.85%
Engineering managers characteristics and recruitment issues	1	1.85%
Project planning and organization	1	1.85%
Contract and contingency management	1	1.85%
Domestic construction issues and practices	1	1.85%
MIS and IT based integration and communications + GPS	1	1.85%
2-D, 3-D and 4-D CAD	1	1.85%

<b>Total</b>	<b>54</b>	<b>100.00%</b>
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**Table 5.56: Top Research Sub-topics in the MENA Region for Total Period**

<b>Sub-topic</b>	<b>Number of Published Papers</b>	<b>%Number of Published Papers</b>
Resources planning and allocation	9	7.76%
Modeling and simulation applications	8	6.90%
Time/cost scheduling optimization	6	5.17%
Risk analysis and management	6	5.17%
Firm strategy, organization and culture	5	4.31%
Materials and component management	5	4.31%
Project delivery systems with public and/or private financing	5	4.31%
Concrete construction	4	3.45%
Productivity issues	4	3.45%
Performance analysis and measurement	4	3.45%
MIS and IT based integration and communications + GPS	4	3.45%
<b>Total</b>	<b>116</b>	<b>100.00%</b>

As can be noticed, each period had different distribution according to the research sub-topics. Also, the appearance of new topics form Period to period is clearly noticeable. Overall, the top five CM sub-topics in the MENA region for total period were associated with “Resources planning and allocation”, “Modeling and simulation applications”, “Time/cost scheduling optimization”, and “Risk analysis and management”. It can be noticed that the top CM sub-topics in the overall region and in the MENA region were somehow close to each other.

## **5.9. Chapter Summary**

This Chapter presents the analysis of the Journal of Construction Engineering and Management for the three periods: Period 1 (1997-2001) and includes volumes 123-127, Period 2 (2002-2006) and includes volumes 128-132 and Period 3 (2007-2011) and includes volumes 133-137. The total period is from 1997-2011 and includes volumes 123-137. The analysis included analysis of the issues, papers and authors. The analysis started by analyzing the issues during the specified period. Regarding the papers, it has been analyzed the papers’ numbers and the country that the paper talked about. Regarding the authors, it has been analyzed the authors’

names, organizations, countries, sector (academia, industry, or government). This has been carried out for all countries and for MENA region apart. Furthermore, the ratio of MENA authors to non-MENA authors has been analyzed, too. In addition, analysis of CM research topics, sub-topics, and less interest topics have been taken into consideration for all countries and for MENA region apart. Also, the most growing and declining topics and sub-topics for the overall region and the most growing and declining topics for the MENA region have been taken into consideration for each period and total period. Moreover, a comparison has been conducted between the overall region and MENA region regarding top CM research topics and less interest research topics for total period.

## **Chapter 6: Construction Management Research Agenda**

### **6.1. Introduction**

This chapter presents the body of Objective 2 of the thesis dedicated to developing a research agenda for construction management in the MENA region for the next ten years. Both CME journal and JCEM have been analyzed in Objective 1 of the thesis, the data were extracted and analyzed, and a survey has been set up depending on these data. The survey was sent via email to the authors in the MENA region and the answers were collected, recorded and analyzed. Finally, conclusions and recommendations have been given depending on the analysis of the survey responses’.

This research agenda is aimed to address the main reasons/factors of the construction management research gaps over the last fifteen years, top research topics and top research sub-topics for the next ten years. Also, it was extended to discuss the most effective scheduling method, the most important sub-topic in “Technology Development Issues” and the procedures that have to be followed to increase the diversity and applicability of the research topics in the MENA region for the next decade.

Finally, the respondents were asked to provide their opinion about the situation of the construction management research over the last fifteen years and how the situation is expected to be ten years from now. This has been summarized in Figure 6.1. In general, the main idea of developing the survey was to enable us to provide a critical CM Research Agenda in the MENA region for the next ten years.

### **6.2. Survey Development**

The survey of this study aimed to discuss the construction management research in the MENA region for the next ten years via questions. Each question represents one topic of the research agenda. Detailed explanation of each topic of the survey is presented in the following sections.

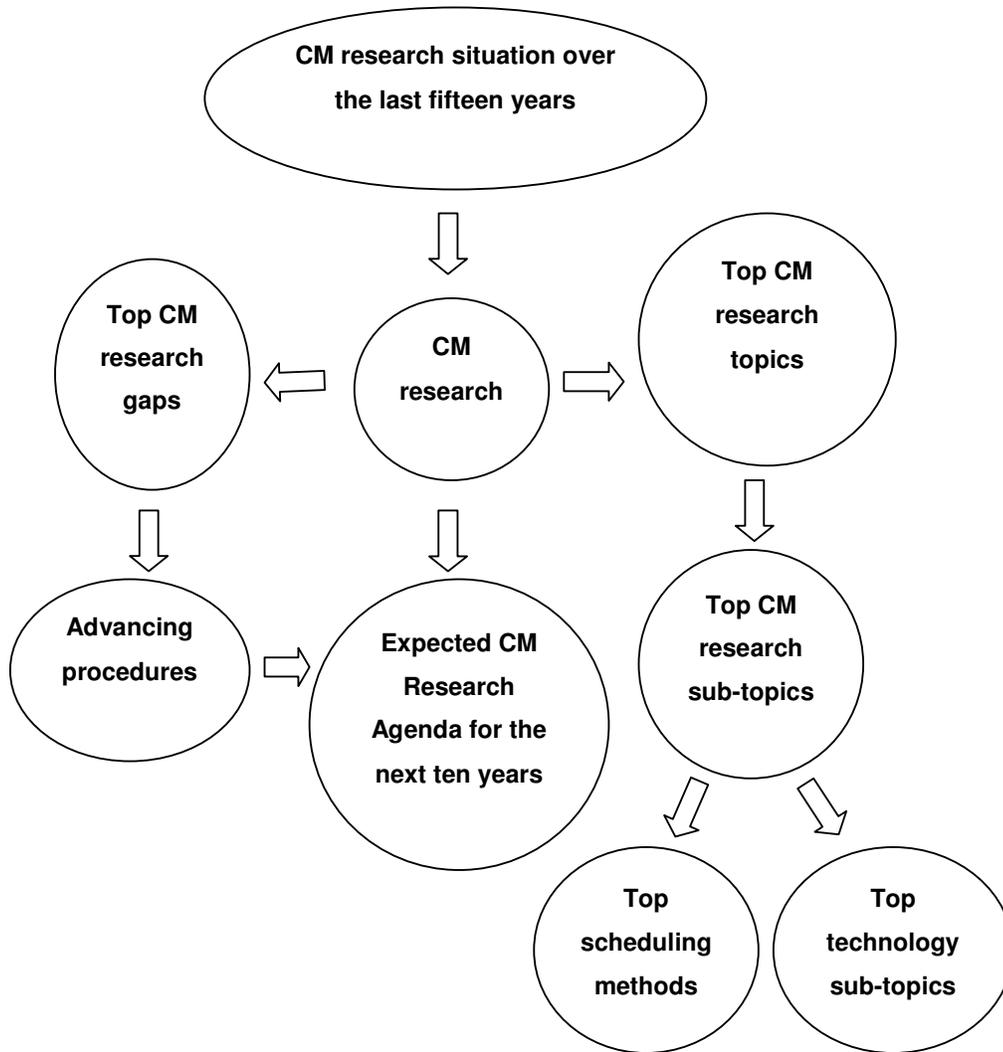


Figure 6.1: Summary of CM Research Agenda Components

### 6.2.1. Main Reasons/Factors of CM Research Gaps

Section 1 of the survey discussed mainly the main reasons/factors of the construction management research gaps over the last fifteen years. The reasons that were mentioned in the survey have been set up after the analysis of both CME journal and JCEM over the last fifteen years divided into three time intervals each was of 5 years. The analysis of both journals has been carried out for the overall region and for the MENA region apart. The data were analyzed and compared for both regions. The mentioned reasons were written depending on the comparison of the construction management research for the specified period for both regions including number of papers and issues, number of contributing authors, organizations and countries, analysis based on sector, ratio between MENA authors and non-MENA authors,

analysis of research and research sub-topics, etc. In brief, these reasons have been set up from the overall analysis and comparison of both journals for both regions for the mentioned Period of time.

### **6.2.2. Top CM Research Topics**

Section 2 of the survey mainly discussed the top construction management research topics in the MENA region for the next ten years. Top research topics and gaps over the last fifteen years in the MENA region have been mentioned in page 1 of the survey as a reference for both journals. Overall, there were ten research topics which are the research topics that were analyzed in Objective 1 of this thesis. These topics have been mentioned in details in Chapter 3 of the thesis.

### **6.2.3. Top CM Research Sub-topics**

The following is a justification for the research sub-topics mentioned in the survey among many other sub-topics in the construction management area. The selection of these topics was based on the literature review and the analysis that has been carried out in Objective 1 of the thesis as well as the analysis for both CME journal and JCEM for the period 1997-2011.

- **Internationalization and globalization**

Aboulezz [1], who analyzed the JME and JCEM for the period 1985-2002, stated that “globalization” emerged as a new area of interest for the period 2001-2002 according to JME.

According to Mayo [52] part of the construction will remain the same, while some topics and procedures will be very different. Mayo highlighted the future of construction and, concurrently, the future of construction education for the next century. One of the topics that will gain some changes is “internationalization and globalization”. He added that the construction companies will purchase materials and services from all over the world.

According to our analysis of CME journal, “International and globalization” was one of the top topics for the overall region for the following Periods: Period 1, Period 2 and overall period. The same case applied for the MENA region for the following Periods: Period 2, Period 3 and overall period which is why it is expected to continue the same in the coming years.

- **Designing for maintainability**

According to Mayo [52] there will be less new construction, instead the focus will be more into “maintainability”, repair and rehabilitation of the existing structure. According to our analysis of CME journal, “Designing for maintainability” was one of the top topics for the overall region for Period 2. The same case applied for the MENA region for Period 1.

Dunston and Williamson [53] explained the incorporation of maintainability in the Constructability Review Process (CRP). In their article, they tried to describe a model format for incorporating maintainability into the CRP. A decision regarding the cost of the facility whether it is life cycle cost or total cost usually begins with the initial design and ends with decommissioning the facility. Usually decisions are made during the design phase and construction phases and only construction costs are taken into consideration while maintenance costs are neither fully appreciated nor formally addressed. Therefore, the authors tried with their model to add life cycle value of incorporating maintainability into the CRP. This can be carried out only by assessing the analysis of accurate and complete maintenance cost data. This will make estimating the total cost of facilities easier and more accurate.

According to Meier and Russell [54] most companies lack a formal method for addressing maintainability through the project delivery process. On the other hand, maintenance can have serious adverse effects on project costs. Discussing this concept, the Construction Industry Institute established the Maintainability Research Team, using a combination of recent literature, a questionnaire survey, personal interviews and case studies with industry professionals. Furthermore, the research team had developed a model implementation process for organizing maintainability best practices. This model had two levels: corporate and project. At each level, milestones, steps and activities were defined. The main usage from the model was that it provides the owners with a starting point for implementing maintainability. Overall, the study aimed to propose the model process and to describe the potential roles and benefits of maintainability on different types of projects.

As an extension to the previous research that was conducted by Meier and Russell [54], Moua and Russell [55] compared and analysed the two formal maintainability programs that were drawn on that research. These two programs differ in terms of application, project type and size, and organization leading the implementation (owner-led versus contractor-led). The main aim of this paper was to

identify the programs' attributes as they are related to effective maintainability programs. This was divided into five categories: corporate commitment, program resources, maintainability planning, maintainability implementation, and program updating. In addition, this study provided readers with different applications in implementing maintainability.

This gives us a hint that “Designing for maintainability” can be one of the top sub-topics in the MENA region for the next ten years as it is a developing topic and it is an area of interest for so many researchers in the construction field. Models have to be established for enhancing this topic for the future as well.

- **Sustainability**

According to WCED [56] and Keiner [57], it was mentioned that: “What is needed now is a new era of economic growth, growth that is forceful and at the same time socially and environmentally sustainable”. Keiner [57] mentioned that sustainable development had been considered all international organizations, national governments, and private enterprises. Jickling [58] stated, “Sustainability has become a focal topic and important goal for many people concerned about environmental issues. It is, therefore, important for educators (and others), to talk about sustainability with their students and colleagues—about its meaning, curricular application, and practice”. This reflects the importance of “sustainability” in the construction field nowadays and why it is anticipated to be one of the top construction research sub-topics in the MENA region for the next ten years.

According to our analysis of CME journal, “Sustainability” was one of the top topics for the MENA region emerged in Period 3. Also, According to our analysis of JCEM, “sustainability” was one of the top topics for the MENA region emerged in Period 2.

- **Constructability analysis**

Abudayyeh et al. [14] after his analysis of JCEM for the period 1985-2002 found that “constructability” was on the top second order among other research topics (29 topics) for the period 1991-1996 and on the sixth order for the period 1997-2002 and for the overall period 1985-2002. In general, “constructability” was one of the most widely published topics in the journal for the period 1985-2002.

Also, According to our analysis of JCEM, “constructability analysis” was one of the top topics for the MENA region for both Periods 1 and 2.

- **Lean construction and production**

Green [29] indicated that the best construction practice can be fulfilled by “Business Process Reengineering (BPR)”, “lean construction” and “partnering”. According to our analysis of CME journal, “Lean construction and production” was one of the top topics for the MENA region emerged in Period 2.

- **Materials and component management**

According to the JCEM Aboulez [1] mentioned that “construction material handling” was an area of interest to the journal for the period 1995-2002. Mayo [52] mentioned that construction processes will be changed little in the future of construction. On the other hand, “construction materials” will experience great changes. On the changes of “construction materials”, Mayo mentioned that 100,000 psi will be common, Ceramics, composites and fiber reinforced polymers will be in common use, wood products will turn to be high performance, structures will have stress indicators, more usage of new aluminum alloys will be seen, construction materials will be 100% recyclable, time to complete the project will be reduced to half, deeper concentration on both quality and safety will be common, technology that are not yet envisioned will be common, etc. All these expected changes in “construction materials” need further research so that they can be understandable for researchers, practitioners and anyone else are interested in this field.

According to our analysis of CME journal, “Materials and component management” was one of the top topics for the MENA region emerged in Period 2.

Also, According to our analysis of JCEM, “Materials and component management” was one of the top topics for the MENA region for the following Periods: Period 2, Period 3 and overall period and that is why it is expected to be one of the top topics in the MENA region in the coming decade.

- **Resources planning and allocation**

Morris [26] when analyzing the content of PMJ and PMN for the years 1990-1999 found that “resources management” was amongst the most popular topics,

appearing in papers and books. It even appeared when Morris analyzed the content of IJPM and all three journals together.

Pietroforte and Stefani [17] who analyzed the JCEM from 1983-2000 mentioned that “resources planning” was one of the major sources of growth in subjects.

According to our analysis of CME journal, “Resources planning and allocation” was one of the top topics for the MENA region emerged in Period 2.

Also, According to our analysis of JCEM, “Resources planning and allocation” was one of the top topics for the overall region for Period 1. The same applied for the MENA region for the following Periods: Period 1, Period 2, Period 3 and overall period and that is why “Resources planning and allocation” is expected to be one of the top topics in the MENA region for the next coming years.

- **Safety management**

According to Aboulezz [1] “safety” was an area of interest in the JCEM for the period 1995-2002.

Abudayyeh et al. [14] after his analysis of JCEM found that “safety” ranked fifth amongst 29 other research topics from 1991-1996. Also, “safety” was one of the top research topics (fifth) in the Middle East for the period 1985-2002 as Abudayyeh et al. mentioned. In general, “safety” was one of the most widely published topics in the journal for the period 1985-2002.

Phua [34] studied the effect of understanding the identity issues on the safety of the workers. Better understanding of identity issues leads to better safety climate. Relating the identity issues to the safety of the workers reflects the importance of the safety issues in the construction management research and the necessity of highlighting it for the next coming years.

According to our analysis of CME journal, “Safety management” was one of the top topics for the overall region for Period 3 and overall period. The same case applied for the MENA region for Period 2.

Also, According to our analysis of JCEM, “Safety management” was one of the top topics for the overall region for the following Periods: Period 1, Period 2, Period 3 and overall period. The same case applied for the MENA region for the following Periods: Period 1, Period 2 and Period 3 and that is why “Safety

management” is expected to be one of the top topics in the MENA region for the next coming years.

- **Performance analysis and measurement**

Aboulezz [1] mentioned that “performance improvement” was an area of interest for the period 1985-2000 as it was mentioned in the JME. Aboulezz while his study, investigated a sample of 24 books for the purpose of mapping the CEM discipline based on the number of occurrence of topics and subjects in those books. Aboulezz after his study concluded that “motivation and performance evaluation” was one of the frequent topics that had been published in several books.

Abudayyeh et al. [14] after his analysis of JCEM found that “performance” was on the forth order among research topics (29 topics) for the period 1997-2002.

Pietroforte and Aboulezz [16] after their analysis of JME for the period 1985-2002 ranked “factors affecting human behavior and performance” as one of the top four topics for the period 1985- 1993 by education.

According to our analysis of CME journal, “Performance analysis and measurement” was one of the top topics for the overall region for Period 3. The same case applied for the MENA region for Period 3, too.

Also, According to our analysis of JCEM, “Performance analysis and measurement” was one of the top topics for the overall region for Period 2. The same case applied for the MENA region for the following Periods: Period 1, Period 2, Period 3 and overall period and that is why “Performance analysis and measurement” is expected to be one of the top topics in the MENA region for the next coming years.

- **Productivity issues**

Aboulezz [1] mentioned according to the JCEM that “labor productivity” was an area of interest for the period 1995-2002. According to Aboulezz who investigated a sample of 24 books for the purpose of mapping the CEM discipline based on the number of occurrence of topics and subjects in those books and compared them with the JCEM and JME, “productivity management” was a common topic between both journals and the books.

Abudayyeh et al. [14] after his analysis of JCEM found that “productivity” ranked second amongst 29 other research topics from 1985-1990, forth from 1991-

1996 and third from 1997-2002. In addition, “productivity” placed forth on the overall period 1985-2002. Also, “productivity” was one of the top research topics (forth) in the Middle East for the period 1985-2002 as Abudayyeh et al. mentioned. In general, “productivity” was one of the most widely published topics in the journal for the period 1985-2002.

Pietroforte and Stefani [17] after their analysis of JCEM for the period 1983-2000 mentioned that most of the civil engineering work is focused on the optimization of in-house human and equipment resources and this justifies the lack number of papers deal with “productivity” and “bidding practices topics”.

According to our analysis of CME journal, “Productivity issues” was one of the top topics for the overall region for Period 1. The same case applied for the MENA region for Period 3 and overall period.

Also, according to our analysis of JCEM, “Productivity issues” was one of the top topics for the overall region for the following Periods: Period 1, Period 2, Period 3 and overall period. The same case applied for the MENA region for the following Periods: Period 1, Period 2, Period 3 and overall period. Hence “Productivity issues” is expected to be one of the top topics in the MENA region for the next coming years.

- **Risk analysis and management**

Morris [26] started by analyzing the content of PMJ and PMN for the years 1990-1999 and found that “risk management” was one among the most popular topics appearing in papers and books 7 times. The same topic appeared 42 times when Morris analyzed the content of IJPM. In addition, the same topic appeared among the most popular topics when Morris analyzed the three journals, with number of appearances equaling 49. At the end, Morris concluded that the output of “risk management” was vast and whether there are still too many areas to be researched in risk or not. Aboulezz [1] mentioned that “risk management” was an area of interest for the period 1985-2002 as it was mentioned in the JME.

According to our analysis of CME journal, “Risk analysis and management” was one of the top topics for the overall region for the following Periods: Period 1, Period 2, Period 3 and overall period. The same case applied for the MENA region for the following Periods: Period 2, Period 3 and overall period.

Also, according to our analysis of JCEM, “Risk analysis and management” was one of the top topics for the overall region for the following Periods: Period 1,

Period 2, Period 3 and overall period. The same case applied for the MENA region for the following Periods: Period 2, Period 3 and overall period and that is why “Risk analysis and management” is expected to be one of the top topics in the MENA region for the next coming years.

- **Cooperation, partnering, leadership and opportunity**

“Partnering and Ecommerce are currently extremely hot topics [26]”.

Green [29] mentioned according to DETR [45], Bennett and Jayes [59], and Construction Industry Board [60] that “partnering” had received huge endorsement in the UK construction industry. Green [29] added that the best construction practice can be fulfilled by Business Process Reengineering (BPR), “lean construction” and “partnering”.

Aboulezz [1] mentioned that “partnering” emerged as a new area of interest for the period 2001-2002 as it was mentioned in JME. He added that there was a lack in the papers that talked about “partnering” for the period 1985-2001 for the same journal. Aboulezz after his investigation to a sample of 24 books and comparing them with the JCEM and JME found that “partnering” was a common topic between the books and the JME. Also, while his analyzing the JME, he noticed that “partnering and cooperation” was the most growing topic in the journal for the period 1994-2002 compared with the period 1985-1993. Aboulezz [1] commented on this, “In these days engineering and construction firms pursue all management avenues, including emerging with other co-operations and implementing quality planning and control techniques, to achieve their strategic goals”.

Pietroforte and Aboulezz [16] mentioned in their study that “project partnering” was one of the topics that experienced relative growth among project management topics. Pietroforte and Aboulezz [16] added, “Over the years the traditional interest in operations and personnel has been complemented by a focus on corporate activities such as in-house programs (e.g. total quality management (TQM), strategy, organizational change and culture issues, and interfirm relationships, particularly partnering)”.

Anvuur and Kumaraswamy [31] highlighted the importance of “cooperation” to the success of the construction project and its effect on the contractual behaviors. According to our analysis of CME journal, “Cooperation, partnering, leadership and

opportunity” was one of the top topics for the overall region for Period 3 and overall period. The same case applied for the MENA region for Period 2 and overall period.

- **Design management, Value engineering and management**

“Research is always needed to improve design and construction practices and processes [14]”. Aboulezz [1] after his analysis to a sample of 24 books related to the construction management and project management fields, found that “design management and value engineering” was a common topic in those books.

Morris [26] after analyzing the content of PMJ and PMN for 1990-1999 found that “design & production management” was amongst the most popular topics appeared in papers and books with 6 appearances. In addition, the same topic appeared among the most popular topics when Morris analyzed the three journals (PMJ, PMN & IJPM) with number of appearances of 11. At the end, Morris suggested that “design management” was still weakly served and it needs more continued research and development. He also added that there was nothing mentioned about “value management” in the journals, whereas both “value engineering” and “value management” have great potential to business.

Mayo [52] in his future vision of the “design” in the construction field mentioned that design processes will go through deep changes in the coming years. Most of the construction companies will be interested in hiring architects, engineers, and constructors. Instead of the design team being in the same place, the internet will be used. Most of the design will be performed via electronic means thus resulting in fewer errors and omissions in design. No design for the entire project will be carried out before the construction starts. Instead versions of fast-track design will evolve in normal design processes. In addition, some aspects of design and engineering will remain the same. As an example on this, engineers are always required to take borings for the foundation design.

According to our analysis of CME journal, “Design management, Value engineering and management” was one of the top topics for the overall region for Period 1.

- **Project performance and feedback**

“The movement has been away from planning techniques and descriptions of organizations. More emphasis is now being given to issues of performance, innovation and information [23]”.

Morris [26] when analyzing the content of PMJ and PMN for the years 1990-1999 found that “project success criteria” and “performance management” were among the most popular topics appeared in papers and books. The number of appearances of “project success criteria” was 14 and the number of appearances of “performance management” was 10. The same topics appeared when Morris analyzed the content of IJPM with number of appearances of 11 and 6 respectively. In addition, the same topics appeared among the most popular topics when Morris analyzed the three journals with number of appearances of 25 and 18 respectively.

Pietroforte and Stefani [17], upon analyzing JCEM for the period 1983-2000, mentioned that “project performance evaluation and feedback” was one of the major sources of growth in subjects.

Pietroforte and Aboulezz [16] when analyzed the JME found that “project performance and feedback” was one of the topics that experienced relative growth among other project management topics. Pietroforte and Aboulezz [16] ranked “project performance and feedback” as one of the top four topics for the period 1994-2002 by education.

Anvuur and Kumaraswamy [31] discussed the major effect of “cooperation” on the project success. In addition, Brown and Phua [32] studied the effect of “identity” issues in relation to the success or failure of the project. Also, Phua [34] studied the effect of “culture”, “identity”, “empowerment” and “trust” on “project performance issues”. According to our analysis of CME journal, “Project performance and feedback” was one of the top topics for the MENA region emerged in Period 3.

From the above, one can realize the importance of deep understanding of the “project performance issues” and the factors that can affect the success and the failure of the project. This can be carried out by going deeper and wider into project performance related issues in construction management research.

- **Selection and evaluation of bids and proposals**

Morris [26] after analyzing the content of IJPM for the years 1990-1999 found that “bidding” was amongst the most popular topics appeared in papers and books with number of appearances of 10. In addition, the same topic appeared among the most popular topics when Morris analyzed the three journals with number of appearances of 12.

Pietroforte and Stefani [17] found that “bidding activities and strategies” was one of the major sources of growth in subjects according to the JCEM for the period 1983-2000.

According to Mayo [52] “bids” is one of the topics that will gain some changes and various techniques in the future of construction. Work progress will be done automatically and instantaneous payments can be applicable in the future. In addition, there will performance and maintenance bonds but there will be no bid bonds because perhaps there will be no bidding by that time. Trust-based administration will be standard and construction services will require more knowledge.

According to our analysis of CME journal, “Selection and evaluation of bids and proposals” was one of the top topics for the overall region for the following Periods: Period 1, Period 2, Period 3 and overall period. The same case applied for the MENA region for the following Periods: Period 2, Period 3 and overall period.

Likewise, according to our analysis of JCEM, “Selection and evaluation of bids and proposals” was one of the top topics for the overall region for the following Periods: Period 1, Period 3 and overall period. The same case applied for the MENA region for Period 1. Hence “Selection and evaluation of bids and proposals” is expected to be one of the top topics in the MENA region for the coming years.

- **Project delivery systems with public and/or private financing**

Much is on-going, both in industry-competencies, BOTs, concurrent engineering, etc. and in research groups [26]”.

Pietroforte and Stefani [17] mentioned after their analysis for the JCEM for the years 1983-2000 that “delivery systems with private financing [i.e. build-operate-transfer (BOT)]” was one of the major sources of growth in subjects.

Pietroforte and Aboulezz [16] stated that the dissatisfying outcome from both competitive bedding system and project funding was an incentive towards improving the efficiency of the construction process specifically in terms of quality and alternative sources of project funding. This led to an increase in the number of papers talked about project quality planning and control, selection and evaluation of bids, selection and evaluation of contractors, and alternative project delivery systems: design/build and build/operate/transfer (BOT) over the years. They ranked in their study “analysis and selection criteria of delivery systems” as one of the topics that experienced relative growth among project delivery systems topics. “Analysis and selection of project delivery systems and contracts” was one of the top four topics for the period 1994-2002 by education. They added that over time, construction becomes more complex in terms of organization and technology, and thus the number of specialized contributors and engineering services are on the rise. This had been reflected to an increase in subcontracting and engineering services such as shop drawings and calculations. Pietroforte and Aboulezz [16] concluded: “Unfortunately this important feature of the construction process has received little attention in the examined papers”. The same concern had been raised by Pietroforte and Stefani [17] in 2004.

According to our analysis of CME journal, “Project delivery systems with public and/or private financing” was one of the top topics for the overall region for the following Periods: Period 2, Period 3 and overall period. The same case applied for the MENA region for the following Periods: Period 1, Period 3 and overall period.

Also, According to our analysis of JCEM, “Project delivery systems with public and/or private financing” was one of the top topics for the overall region for the following Periods: Period 2, Period 3 and overall period. The same case applied for the MENA region for the following Periods: Period 1, Period 2, Period 3 and overall period and that is why “Project delivery systems with public and/or private financing” is expected to be one of the top topics in the MENA region for the next coming years.

- **Contract and contingency management**

“It would be beneficial for the engineering management and construction management discipline to have more studies of subcontracting, specialty trade contractors, and particularly engineering design processes [16]” .

According to Betts and Lansley [15], although the papers addressed the whole lifecycle of the project, the trend of the CME in its first ten years was away from design and feasibility and more onto tendering and contractual issues.

Morris [26] found that “contract management” was one among the most popular topics appearing in papers and books, with 5 appearances. The same topic appeared when Morris analyzed the content of IJPM, with 9 appearances. In addition, the same topic appeared among the most popular topics when Morris analyzed the three journals with number of appearances of 14.

Aboulezz [1] mentioned according to the JCEM that “contract administration” was an area of interest during 1995-2002. In addition, after his analysis of the books, Aboulezz [1] found that “contract administration” was one among the topics that had received considerable attention. In general, it was found that “contract administration” was a common topic between the analyzed books as well as JCEM and JME.

Moreover, Anvuur and Kumaraswamy [31] discussed the effect of “cooperation” on the contractual behaviors and this reflects the importance of understanding the contractual concepts in relation to the other aspects of the construction management field.

According to Mayo [52] “construction contract administration” is one of the topics that will gain some changes in the future of construction.

Also, According to our analysis of Journal JCEM, “Contract and contingency management” was one of the top topics for the MENA region for Periods 1 and 3.

- **Selection and evaluation of contractors**

Pietroforte and Aboulezz [16] mentioned in their study that “selection and evaluation of contractors” was one of the topics that experienced relative growth among project delivery systems topics. Pietroforte and Aboulezz [16] ranked “selection and evaluation of contractors” as one of the top four topics for 1994-2002 by education.

As Mayo [52] mentioned, “contractor selection” is one of the topics that will gain some changes and various techniques in the future of construction. As Mayo foresees the future vision, there will be no bid processing because a better way will eventually be discovered by the government. Both contractors and designers will work together at the same company. Contractors will be selected depending on the

following characteristics performance, quality, safety, reliability, and other factors defined by the owner.

Also, According to our analysis of JCEM, “Selection and evaluation of contractors” was one of the top topics for the MENA region in Period 2.

- **Design/build**

“In particular we can foresee a greater support for market-driven trends towards design and build and multidisciplinary practice by the evolutionary application of BPR concepts [7]”.

Pietroforte and Stefani [17], after their study for the JCEM for 1983-2000, mentioned that “design/build” was one of the major sources of growth in subjects.

Pietroforte and Aboulez [16] mentioned in their study that “design/build” was one of the topics that experienced relative growth among other project delivery systems topics. Also, Pietroforte and Aboulez [16] suggested after their analysis of JME for the period 1985-2002, “It would be beneficial for the engineering management and construction management discipline to have more studies of subcontracting, specialty trade contractors, and particularly engineering design processes”.

According to Mayo [52], “design” is one of the topics that will gain some changes in the future of construction.

- **Business Process Reengineering (BPR)**

According to Hammer [61], and Delvin [62] “PBR” can be defined as making changes to the business processes that will lead in organizational improvements. Delvin [62] contradicted Hammer with his point of view. Delvin had a wider view of BPR definition which was that reengineering can be extended to include communication, people, processes and structures as well. On the other hand, Process improvement or BPR can be defined according to Dock and Hipkin [63] and Green [29] “BPR only differs from TQM in terms of the rhetoric in which it is presented”.

On the need for BPR research, the UK’s construction industry board [64] in 1996 suggested that BPR has to be part of the industry’s ongoing program of continuing professional development. According to Green [29] Mohamed and Tucker

[65] mentioned in their article, “many industries worldwide have found BPR to be an effective approach in achieving dramatic improvements in production time and cost”.

Additionally, Green [29] mentioned in his article that the best construction practice can be fulfilled by BPR, lean construction and partnering. Aboulezz [1] mentioned that Business Process Reengineering emerged as a new area of interest for the period 2001-2002 as it was mentioned in the JME. Pietroforte and Stefani [17] mentioned that “business strategy” was one of the major sources of growth in subjects. The same issue had been raised by Betts and Harper [7] where they presented a research agenda of IT in construction by BPR theory. Betts and Harper [7] concluded: “In particular we can foresee a greater support for market-driven trends towards design and build and multidisciplinary practice by the evolutionary application of BPR concepts”.

According to our analysis of the CME journal, “Business strategy and planning” was one of the top topics for the MENA region for Period 2 and overall period.

From the above, one can say that having more research on BPR can add to the construction management research in the MENA region and come up with better level of variance and renewal of research topics for the coming years.

- **Understanding identity and competitiveness in construction**

Brown and Phua [32] discussed the identity issues. They defined the identity as a “key performance issue” and it can be an explanation of the success or failure of the project. They discussed the identity concerns as they relate to construction managers focusing on five main points which were, professionalism, ethics, relational aspects of self-identity, competence, knowledge and tools, and national culture.

The same issue had been raised by Phua [34]. According to Phua [34], Phua [66] and Phua and Rowlinson [67] until now the identity research didn’t receive direct attention in construction management. Phua [34] discussed the culture, identity, empowerment and trust as they are related to the project performance issues. Phua [34] added:

They are important themes to be taken into account, not only because they are constructs that are already often used in studies related to project performance but more importantly because they are constructs that have been widely researched at the

individual level of analysis as having significant implications for organizational performance [34].

He also suggested that the attitudes of the workers towards safety are influenced by identity perceptions between themselves and between themselves and management. Overall, understanding the identity issues in the construction management research will add to the construction management field and enhance many areas within it. That is why it needs to be highlighted for the future research.

Green and Harty [30] tried to come up with a unified theory of “construction competitiveness”. They started by arguing that a unified theory of construction competitiveness is neither plausible nor desirable. Moreover, they presented some of the core research findings in terms of the research process to support the competitiveness of the UK construction industry. In addition, they presented their findings by co-production research where both practitioners and academicians work to come up with new knowledge and technologies together. They entitled this by “co-production” research. Then, they summarized what was learned and the way competitiveness acted with construction firms. They also gave attention to innovation and to substantive topics for future research.

As had been mentioned according to Brown and Phua [32] that competitiveness can be defined as the application of the scientific knowledge [68], bodily knowledge [69], various skills, attitudes, and personal characteristics that all can affect the quality of the work performance [70]. Its definition can be extended to include knowledge-in-action [71], understanding of works [72], and practices that relate individuals to communities [73]. On the other hand, Porter [74] insists that, “there was no accepted definition of competitiveness”. In addition, Flanagan et al. [75] mentioned that researchers failed in finding a specific definition of competitiveness in construction despite its widespread in both academia and industry. Flanagan et al. [75] added in this regard:

Since its popularization in the 1980s, competitiveness has received close attention from practitioners and researchers across a wide range of industries. In the construction sector, many works competitiveness have also been published. So far, however, there seems to be no comprehensive review to summarize and critique existing research on competitiveness in construction [75].

From all what has been mentioned above, it can be concluded that the construction management research needs to shed light on such topics since it is widespread and researchers need to understand it more deeply and thoroughly.

### **Summary**

From the above, one can say that further research regarding the mentioned sub-topics is needed to overcome the changes and the challenges of them. More interconnected research between these topics is needed, too. From the literature review presented in this section, most of these sub-topics were areas of interest in the last years and that is why they are expected to continue the same for the next coming years.

#### **6.2.4. Top Scheduling Methods**

Section 4 of the survey mainly discussed the most effective “scheduling method” to be concentrated on for the future research in the MENA for the next ten years. Special attention had been given to the “scheduling methods” due to the lack in the papers that talked about scheduling methods in both journals, CME journal and JCEM, in the MENA region over the last fifteen years. Most of the papers that talked about “scheduling” were on specific topics while other topics were neglected. More papers related to scheduling are needed in the MENA region for the future.

Morris [26] when analyzing the content of PMJ and PMN for the years 1990-1999 found that “time scheduling/phasing” was one among the most popular topics appeared in papers and books with number of appearances of 22. The same topic appeared when Morris analyzed the content of IJPM with number of appearances of 30.

Also, Aboulezz [1] mentioned that “scheduling” was an area of interest to the JME for the period 1985-1988 and to the JCEM for the period 1995-2002.

Abudayyeh et al. [14], for his analysis sent to JCEM, found that “scheduling” was ranked first amongst 29 research topics for the period 1985-1990 and 1991-1996. IT was also ranked second for the period 1997-2002. In addition, “scheduling” was first in the overall period 1985-2002. Also, “scheduling” was a top research topic in the Middle East from 1985-2002 as Abudayyeh et al. mentioned. In general, “scheduling” was one of the most widely published topics in the journal for the period 1985-2002.

- **Critical Path Method (CPM)**

According to our analysis of CME journal, “Critical path method” was one of the top topics for the MENA region for the following Periods: Period 2 and overall period.

- **Linear and vertical scheduling (LOB)**

According to our analysis of CME journal, “LOB, linear and vertical scheduling” was one of the top topics for the MENA region for the following Periods: Period 2, Period 3 and overall period.

Critical Path Method (CPM) and Linear and Vertical Scheduling (LOB) are commonly used in the projects. In addition, these two methods assume complete knowledge of project parameters while neglecting the impact of float loss on project’s time and cost.

- **PERT and GERT**

On this regard, Zhong and Zhang [76] had developed a new method for calculating path float in Program Evaluation and Review Technique (PERT). Pertaining to this, the author [76] said, “The new path float concept will bring useful planning information to the managers and the planners in the construction”.

- **Other deterministic time scheduling techniques**

Other deterministic time scheduling techniques other than CPM and LOB are also based on the principle of complete knowledge of project parameters while neglecting the impact of float loss on project’s time and cost.

- **Other non-deterministic time scheduling techniques**

Non-deterministic time scheduling techniques talks about the non-deterministic (probabilistic) time estimating techniques that are used in the project. Example of this method is “Monte Carlo” method. This method quantifies the float loss impact on project cost and duration and reduces the risk of the project.

### **6.2.5. Top Technology Sub-topics**

Section 5 of the survey mainly discussed the most important research sub-topic in “Technology Development Issues” in the MENA region for the next decade.

Special attention had been given to the “technology” related issues due to the lack of papers that talked about technology in both journals in the MENA region over the last fifteen years as mentioned in page 1 of the survey. Most of the papers were concerned about technology on specific topics while other topics were neglected. More papers related to “technology” issues are needed in the MENA region for the future so we can be at a suitable pace with the construction management research in the overall region.

- **Innovation and technology transfer, analysis, and mechanisms**

“Adoption of innovation and evaluation of methods and technologies” was one of the major sources of growth in subjects [17].

After their analysis for the IJPM from 1983-1992, Betts and Lansley [23] inferred that, “The movement has been away from planning techniques and descriptions of organizations. More emphasis is now being given to issues of performance, innovation and information”.

Also, Aboulezz [1] mentioned that “innovation and technology management” was a new area of interest to the JME emerged during the period 2001-2002.

Abudayyeh et al. [14] after his analysis of JCEM found that “innovation” was on the sixth order and “robotics” on the ninth order among other research topics (29 topics) for the period 1985-1990. Also, he found that “technology” was on the tenth order for the period 1985-1990, 1991-1996 and overall period 1985-2002.

According to our analysis of CME journal, “Innovation and technology transfer, analysis, and mechanics” was one of the top topics for the overall region for the following Periods: Period 2, Period 3 and overall period. The same case applied for the MENA region for Period 2.

Also, According to our analysis of JCEM, “Innovation and technology transfer, analysis, and mechanics” emerged as new topics for the MENA region for Periods 2 and 3 and that is why “Innovation and technology transfer, analysis, and mechanics” is expected to be one of the top topics in the MENA region for the next coming years.

- **Research and development issues**

Research and development issues can enhance the field of CM and add new topics and sub-topics to the field.

- **IT integration and communications + GPS**

“The movement has been away from planning techniques and descriptions of organizations. More emphasis is now being given to issues of performance, innovation and information [23]”.

Betts and Harper [7] tried to present the way “information technology” and construction management interact by using the principle of BPR theory.

During their analysis for the Journal of Computing in Civil Engineering from 1987-1996, Lakmazaheri and Rasdorf [24] noticed an increase in “neural networks”, “data modeling/databases”, “software engineering/development”, “programming languages” and “GIS, geographic information systems” in the second half of the decade when compared to the first half.

Morris [26] when analyzing the content of PMJ and PMN for the years 1990-1999 found that “information management” was one among the most popular topics appeared in papers and books with number of appearances of 7. Morris analyzed the same topic when it when scrutinizing the content of IJPM, with 19 appearances. In addition, the same topic also appeared amongst the most popular topics when Morris analyzed the three journals, with number 26 of appearances in total. Morris suggested that “information management” is a strong area for continued research.

According to Aboulezz [1] after his analysis of 24 books that were related to the CM field and JCEM and JME, “MIS” was a common topic between both journals and the books. Also, Aboulezz [1] mentioned that according to the JME, “computer systems management” and “networking” emerged as new areas of interest between 2001-2002. The same issue “computer applications” had been raised by Aboulezz [1] in 2003 mentioning it as an area of interest for the period 1995-2002 according to JCEM.

Abudayyeh et al. [14] after his analysis of JCEM found that “computer systems” ranked eighth amongst 29 other research topics from 1991-1996 and ranked ninth from 1997-2002. It also ranked eighth for the overall period 1985-2002.

Pietroforte and Aboulezz [16] ranked “management of information systems” as one of the top four topics for the period 1985-1993 by education and government as well as for the period 1994-2002 by education.

According to our analysis of CME journal, “MIS and IT based integration and communications + GPS” was one of the top topics for the MENA region for the following Periods: Period 1, Period 2 and overall period.

Also, According to our analysis of JCEM, “MIS and IT based integrations and communications + GPS” was one of the top topics for the overall region for the following Periods: Period 2, Period 3 and overall period. The same case applied for the MENA region for the following Periods: Period 2, Period 3 and overall period. That is why “MIS and IT based integrations and communications + GPS” is expected to be one of the top topics in the MENA region for the next coming years.

- **2-D, 3-D and 4-D CAD**

According to our analysis of JCEM, “2-D, 3-D, and 4-D CAD” emerged as new topics for the MENA region for Periods 2 and 3 hence why “2-D, 3-D and 4-D CAD” is expected to be one of the top topics in the MENA region for many years to come coming years.

- **BIM**

“Building Information Modeling (**BIM**) is an emerging phenomenon in which business processes combine with innovative information technology to optimize efficiency and minimize waste in the design, building, and operations of a facility [77]”.

BIM is one of the most recent developments in the Architecture, Engineering, and Construction (AEC) industry as mentioned before and can be utilized for planning, design, construction, and operation of the facility. BIM is also employed for the development of an accurate virtual model of a building [50].

#### **6.2.6. Procedures in Advancement of CM Research**

Section 6 of the survey was dedicated to chiefly discuss the procedures to increase the diversity of the research topics in the MENA region.

- **Increase research collaboration between the three sectors (academia, industry and government)**

Betts and Lansley [23] after their analysis of the IJPM for its first ten years showed great concern about the lack of academic identity for the journal although the papers from academicians were in surplus during the first ten years.

Abudayyeh et al. [14] after his analysis of JCEM for the period 1985-2002 mentioned that there was a need for collaboration between industry and academia, between government and academia, and between industry and government to improve and develop the construction industry.

Table 6.1 presents a summary of the literature review put forth in Objective 1 of this thesis. It can be noticed that the bulk of the research was limited to academia, with industry and government sectors making only minor contributions. The same held true when CME journal and JCEM were analyzed for the period 1997-2011. It was noticed that most of the contribution to both journals was from academia. This highlights the need for increasing the collaboration among the sectors for future research because different contributions results in different aspects, topics and styles to the journal.

- **Integrate construction with other areas**

According to Betts and Lansley [15], most of the content published in the journal was related primarily to the construction projects, and a substantial part was related to companies and countries. This leads us to the say that the content published in the CM journals must relate construction to more than one area and it shouldn't be specific to a particular field or country.

- **Increase the communications between researchers in the MENA region and the rest of the world**

According to Abudayyeh et al. [14] in his analysis of JCEM for the period 1985-2002, most of the authors that contributed to the Journal in the first years were from the US. Over the years, there was an increase in participation from other countries, thus changing the types of papers being published on the journal. Abudayyeh et al. [14] added, "Countries from different parts of the world, with

different economies, and different lifestyles are concerned with different aspects of the construction industry”.

**Table 6.1: Summary of the Three Sectors Contribution**

Reference	Study period	Academia	Industry	Government
Lakmazaheri and Rasdorf 1998 [24]	1987-1996	86%	8%	6%
Aboulezz 2003 [1]	1985-2002	48%	41%	11%
Abudayyeh et al. 2004 [14]	1985-2002	79.4%	18.4%	2.2%
Pietroforte and Stefani 2004 [17]	1983-1991	74%	20%	6%
	1992-2000	84%	13%	4%
Pietroforte and Aboulezz 2005 [16]	1985-2002	56%	36%	8%
CME journal analysis (Overall region)	1997-2011	94.3%	4.8%	0.9%
CME journal analysis (MENA region)	1997-2011	94.6%	2.7%	2.7%
JCEM analysis (Overall region)	1997-2011	85.5%	13.1%	1.4%
JCEM analysis (MENA region)	1997-2011	86.3%	12%	1.7%

- **Construct a two-way flow between construction theory and practice**

“There is little evidence of experimental research [15]”. Betts and Lansley [23], after their analysis for IJPM for the period 1983-1992, mentioned that the journal was fairly stable due to the balance in papers between private practice, private consultants and universities. This was one of the good aspects noticed by Betts and Lansley in the journal for its first ten years.

This point had also been raised up by Betts and Harper [7] who talked about the necessity of linkage between construction theory and practice.

Aboulezz [1] mentioned that there was a need for the enhancement of the practical knowledge. He added that the published topics in both JCEM and JME for Period 1985-2002 would raise the interest of readers and reduce the gap between construction theory and practice.

Pietroforte and Aboulezz [16], after their analysis for JME for 1985-2002, had a main concern about the decreasing number of industry contributors to the journal and its result of widening the gap between academia and practice.

Winter et al. [22] had come up with 5 directions that can reflect his future vision to the project management discipline. Two dimensions had two necessary implications for research. The first one was about practitioner's concerns toward project complexity, social process, value creation, project conceptualization and practitioner development. The second dimension was about "the need for an interdisciplinary approach to conceptualization and theorizing of project management practice" and special attention to the methodological issues by researchers in order to come up with useful knowledge that can be utilized by practicing managers. In the network, direction 1 was "Theory ABOUT Practice", directions 2, 3 and 4 were "Theory FOR Practice", and direction 5 was "Theory IN Practice". At the end, Winter et al. [22] proposed a "Rethinking Project Management" network where both academicians and practitioners had active membership. He concluded that the main aim from the research agenda was not meant to be for future research but rather to inform and guide people already working in the project management field and interested in developing it further.

Mayo [52] in his article highlighted the importance between relating academia to practice so that high school graduates and university students will be motivated to enter the construction industry. This would increase the number of tomorrow's construction industry leaders.

- **Put more attention to the latest and different topics in the Construction Management field and try to come up with new ideas and techniques related to it**

Betts and Harper [7] suggested re-examining the latest advances in management discipline so that we can know the future vision of this discipline and where it is going.

Aboulezz [1] mentioned that some universities had the tendency to concentrate on specific topics that were within their area of expertise. He added that this might lead to a concentration on particular topics from a large number of universities or might not. In general, concentration on specific knowledge on construction management field will lead to a lack of diversification and renewal of research topics.

Abudayyeh et al. [14] after submitting his analysis of JCEM for 1985-2002, concluded that research was increasing and topics were changing to adopt current needs. He added that if those topics continue to improve in a positive way, the construction industry will be enhanced and improved by research.

Pietroforte and Aboulezz [16], while conducting their analysis for the JME during 1985-2002, mentioned that the topics had been changing during this Period which expanded the scope of the journal to meet the increasing challenges in engineering professions and business as well.

Each of Betts and Lansley [15], Betts and Lansley [23], Lakmazaheri and Rasdorf [24], Morris [26] and Pietroforte and Stefani [17] marked that topics were in change over the years.

From the analysis carried out in Chapters 4 and 5 of this thesis for both journals over the last fifteen years, there was a concentration on specific topics (project and time-cost related issues) while the overall variance in research topics was low. This highlights the necessity of shedding light on different topics for the future of construction management research so as to meet the challenges and changes in this field.

- **Internationalize the systems, codes, standards, laws, and contracting methods in the MENA region**

This was one of the main issues that was raised by Mayo [52] who discussed the future of construction and, concurrently, the future of construction education. Mayo was interested in knowing the future of “internationalization” in the construction industry and whether it will be faced in the future or not.

- **Build research centers**

Building research centers helps enhance the efforts and attention put forth to advance the CM research. Furthermore, research centers help in increasing the

communications between researchers from different disciplines and thus decreasing the gap between the three sectors (academia, industry, and government).

- **Conduct more conferences in this field**

Conferences can come up with new ideas and techniques to the CM field and increase the communications between researchers and thus mitigate the gap between the three sectors.

- **Conduct research groups teams across MENA**

Morris [26] stated, “Much is on-going, both in industry-competencies, BOTs, concurrent engineering, etc.-and in research groups”.

- **Conduct more research focused graduate programs**

Conducting more research focused graduate programs results in better communication between researchers and helps in discovering and sharing new ideas and techniques that can be applied in enhancing CM research. In addition, it will help in decreasing the gap between the three sectors (academia, industry, and government).

- **Use more advanced technology in research**

Aboulezz [1] recommended the use of “Data mining”, defining it as a powerful new technology that focuses on the most important information in the database. This new technology can help researchers in predicting future trends and behaviors, allowing policy makers to make proactive decisions, answering time consuming questions, etc. He added that “Data mining” can also assist in predicting the future evolution of the CEM discipline and to shed some light on new and neglected areas.

- **Specify more budget for research**

More budgets should be specified for research so that better technology can be applied to, more equipment can be utilized and more software used. Expanding the budgets specified for research can help in conducting more workshops, conferences, etc. which will result in a better communication and information sharing between

researchers from different disciplines. Furthermore, this will add more flexibility for expansion and enhancement for the research.

- **New studies, models and styles should be applied to Construction Management research**

“We now have a need for further research that would provide suggestions for or evidence of alternative multiple-process models [7]”.

Betts and Lansley [15], while carrying out their analysis of CME journal in its first ten years, developed a meta-model classification that comprised of two dimensions. One dimension was concerned with content while the other was concerned with style. Below those two dimensions, there were eight more dimensions. Six of those eight were mentioned in the paper. Content dimensions were subject, level of analysis, stage of building lifecycle and sector. Style dimensions were sources of information “input” and contribution of papers “output”. Each paper published in the journal during that Period was classified according to one of the six dimensions mentioned above. Overall, this model presented a new style of the database study of the journal content for its first decade. This database was basically used in classifying the topics of the papers published in the journal. The database had the following icons: articles, reports, classifications, authors, countries, keywords, universities and exit system. Future construction management research requires similar models that can direct the researchers to their studies and help them make decisions. It can also make their future vision clearer and wider whilst saving a lot of their time and effort.

According to Betts and Lansley [23] who analyzed the IJPM for the period 1983-1992, development of new systems or new theory had received little attention. Betts and Lansley [23] added, “It could be argued that the next stage in the development of an academic discipline is the building and testing of models such that a theory of project management may emerge”.

RAE [18] suggested “bibliometrics” as one of the current methods for engineering research assessment.

Pietroforte and Aboulezz [16] suggested conducting more bibliometric studies in construction management field as it helps in addressing existing research areas, exploring past and current research gaps and establishing new directions.

Winter et al. [22] had come up with “Rethinking Project Management” network where both academicians and practitioners had active membership. Aspects

of the network were understanding and choice, research methodology that reflects serious action of the level of inquiry (macro and micro), type of concepts and the theory used in formulating questions and answers, assumptions about empirical data and the way they were collected. The main aim from the research agenda was not meant to be for future research but rather to inform and guide people already working in the project management field who are interested in developing it further.

#### **6.2.7. Situation of the CM Research over the Last Fifteen Years**

Section 7 of the survey was about giving a scale of the construction management research in the MENA region over the last fifteen years i.e. whether it was improving quickly, improving slowly, did not change, or getting worse. Overall, the aim of this section was to know the movement and development of the MENA construction management research over the last fifteen years and its current standing. Knowing the level of the CM research will be beneficial for researchers in choosing an appropriate course of action for the future and help them know where improvements must be made.

#### **6.2.8. CM Research Agenda for the Next Ten Years**

“It is an important role in developing a clear idea of where a discipline has come from, what stage of development it has reached, and where and how fast it is developing [15]”. Section 8 in the survey was geared towards providing a hint at whether the situation of construction management research will be improving quickly, improving slowly, will not change, or get worse in the MENA region in the coming decade.

### **6.3. Survey Analysis**

#### **6.3.1. Analysis of Respondents**

The survey was sent to 250 researchers, 185 of which were sent to academia while the remaining 65 were sent to industry. Out of the 250 researchers, only 39 academicians and 10 industry researchers replied to the survey thus bringing the total number of respondents to 49. The time for answering the survey was set from 1<sup>st</sup> April 2013 to 30<sup>th</sup> April 2013. Even though an extension had been granted until 15<sup>th</sup> May 2013, some respondents sent their feedback after the extended deadline or simply didn't reply. This was one of the major obstacles faced when collecting the feedback

data. Also, as noted later in this paper, the ratio of academicians to industry researchers was much higher than 1 and pay have constituted to a bias towards some CM research topics and sub-topics from academicians.

Table 6.2 presents the number and percentage of number of responses according to the organizations.

**Table 6.2 Analysis of Respondents Based on Organization**

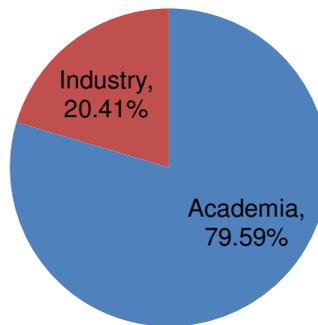
<b>Organization Name</b>	<b>Organization Location</b>	<b>Number of Responses</b>	<b>%Number of Responses</b>
American University of Sharjah	UAE	4	8.16%
American University of Dubai	UAE	2	4.08%
British University in Dubai	UAE	2	4.08%
United Arab Emirates University	UAE	1	2.04%
Abu Dhabi University	UAE	1	2.04%
Hugro Engineering Projects	UAE	1	2.04%
Alfuttaim Carillion	UAE	1	2.04%
Eagle Electromechanical	UAE	1	2.04%
Saverglass	UAE	1	2.04%
Kuwait University	Kuwait	2	4.08%
American University of Beirut	Lebanon	2	4.08%
Lebanese American University	Lebanon	1	2.04%
Davia Langdon, An Aecom Company	Lebanon	1	2.04%
American University of Cairo	Egypt	2	4.08%
Tanta University	Egypt	1	2.04%
Mansoura University	Egypt	1	2.04%
Dar Group	Egypt	1	2.04%
CRC Dorra	Egypt	1	2.04%
Sakarya University	Turkey	1	2.04%
Bogazici University	Turkey	1	2.04%

Balikesir University	Turkey	1	2.04%
Izmir University of Economics	Turkey	1	2.04%
Middle East Technical University	Turkey	1	2.04%
University of Akdeniz	Turkey	1	2.04%
Istanbul Technical University	Turkey	1	2.04%
University of Mersin	Turkey	1	
King Saud University	Saudi Arabia	2	4.08%
King Fahd University of Petroleum and Minerals	Saudi Arabia	1	2.04%
Iran University of Science and Technology	Iran	2	4.08%
Zanjan University	Iran	1	2.04%
Hashemite University	Jordan	1	2.04%
University of Jordan	Jordan	1	2.04%
Qatar University	Qatar	3	2.04%
SPQ	Qatar	1	2.04%
Louis Berger-PMC for Qatar Rail	Qatar	1	2.04%
Sultan Qaboos University	Oman	1	2.04%
Tender Board	Oman	1	2.04%
<b>Total</b>	-	<b>49</b>	<b>100%</b>

Table 6.3 presents the number and percentage of responses according to the MENA countries. Moreover, Figure 6.2 displays the analysis of respondents based on sector. The total number of respondents was 49. Of the 49 respondents, 79.59% (39) were academicians and 20.41% (10) were industry researchers.

**Table 6.3: Analysis of Respondents Based on Country**

Organization Location	Number of Responses	%Number of Responses
UAE	14	28.57%
Turkey	8	16.33%
Egypt	6	12.24%
Qatar	5	10.20%
Lebanon	4	8.16%
Saudi Arabia	3	6.12%
Iran	3	6.12%
Jordan	2	4.08%
Oman	2	4.08%
Kuwait	2	4.08%
<b>Total</b>	<b>49</b>	<b>100%</b>



**Figure 6.2: Analysis of Respondents Based on Sector**

### 6.3.2. Analysis of CM Research Gaps

Table 6.4 presents the main reasons/factors of construction management research gaps over the last fifteen years in the MENA region. It also presents the Relative Importance Index (RII) and the rank of each factor. The Relative Importance Index was used to analyse the main reasons/factors of CM research gaps. Equation (1) [78] was used to compute the Relative Importance Index (RII) for all the factors.

$$\text{Relative Importance Index, RII} = \frac{\sum W_i X_i}{\sum X_i} \quad (1)$$

Where,

$W_i$  = Weight assigned to the  $i$ th response,  $W_i = 5, 4, 3, 2$  and  $1$  for  $i = 1, 2, 3, 4$  and  $5$  respectively,

$X_i$  = Frequency of the  $i$ th response,

$i$  = Response category index = 1, 2, 3, 4 and 5 for Strongly agree, Agree, Neutral, Disagree, and Strongly disagree respectively.

Accordingly,  $W_1 = 5$  for Strongly agree,  $W_2 = 4$  for Agree,  $W_3 = 3$  for Neutral,  $W_4 = 2$  for Strongly disagree, and  $W_5 = 1$  for Strongly disagree have been used for this analysis.

**Table 6.4: Ranking of Reasons/Factors of CM Research Gaps**

Reason	RII	Rank
Lack of research collaboration between the three sectors (academia, industry and government)	4.16	1
Less care is given to research in both industry and government fields compared to academia and fewer budget is specified for them	4.00	2
The MENA governments don't allocate enough budgets for research	3.96	3
Lack of linkage between construction theory and practice	3.88	4
Lesser number of contributing authors, organizations and countries	3.69	5
The political situation of the region	3.24	6
Lack of communications between the MENA region and the countries outside the region	3.16	7
Lack of technology and research equipment	3.08	8

As can be seen from Table 6.4, the RII of the factors varied between 3.08 and 4.16. This is almost considered a high weight. The RII's were somehow close to each other. 81.63% of the respondents strongly agreed or agreed that the gaps in CM research can be attributed to "lack of research collaboration between the three sectors (academia, industry and government)". 77.55% strongly agreed or agreed that the main reason can be attributed to "Less care is given to research in both industry and government fields compared to academia and fewer budget is specified for them".

On the other hand, 71.42% strongly agreed or agreed that the gap can be attributed to "the MENA governments don't allocate enough budgets for research". Contrary to this, 34.69% strongly disagreed or disagreed that "Lack of technology and research equipment" can be a main reason for CM gaps which is something that is disagreed with and to be discussed later. Moreover, 28.57% strongly disagreed or disagreed that "lack of communications between the MENA region and the countries outside the region" and 22.44% strongly disagreed or disagreed that "The political situation of the region" can be considered reasons for CM gaps. In general, it can be concluded from the weights mentioned above that the major reasons for CM research gaps are the absence of collaboration between the three sectors, the less care that is

given to industry and government fields compared to academia field, and not enough budget is allocated for research in the MENA region. There is a huge necessity for increasing the communications in CM field and not to concentrate on the academic sector only. Increasing the communications will broaden the research topics in this field and will add new interests and trends to the researchers interested in enhancing the CM research in the MENA region. In addition, there is a need to increase the number of contributing authors in the three sectors and to increase the communications between researchers inside the MENA region with researchers outside the MENA region as well. On the other hand, “technology and research equipment” should have gained higher weight and be at the top ranking as it has huge effect on research and it can play a major role in enhancing and developing the CM research inside the MENA.

Also, no one can deny that the recent political situation of the region affects the research and the number of researchers. It can also affect the value of budget specified for research, too. In some MENA countries such as Syria, Libya, Tunisia, Egypt, Palestine and Turkey the political situation should be considered as one of the top factors because it plays a major role in affecting the CM research adversely. Consequently, the political situation, the economy in the whole MENA region, the CM research situation and the budget specified for it will be adversely affected, too.

Furthermore, some respondents suggested lack of research culture as one of the reasons for gaps in construction management research. One respondent claimed, “Academic culture does not promote research”. Other reasons pointed out were the absence of real commitment in implementing management processes, insufficient academicians in this area, a lack of researchers in the construction management field, inadequate levels of awareness among the participants in the sector regarding the necessity of utilizing construction management techniques to achieve success in construction projects, and management and organization issues.

One respondent also inferred that a leading cause for construction management research gaps may be the secured positions of academics in universities. In such universities, there is little urgency to conduct research for tenures and a disregard for the research impact on the industry. Other reasons attributed this gap to the fact that research institutions lag behind construction industry & business demand, a lack of sponsoring/funding by business leaders, inadequate support to create a local world class construction and project management capability. It was mentioned that “if

research does not prove it's there to support training, coaching and capability increase, it'll be considered pure academic pass time". Another respondent said, "in the MENA Region there is often a reliance on traditional forms of "Contract" and less on "Alternative Procurement" approaches such as construction management" and "design and build".

As discussed above, future researchers have to shed light on these reasons/factors that led to that gap in CM research in order to close this gap. Alternative solutions must also be sought in MENA CM research.

### 6.3.3. Analysis of Top CM Research Topics

Table 6.5 presents the RII and the rank of the construction management research topics. The Relative Importance Index was used to analyse the CM research topics.

**Table 6.5: Ranking of Top CM Research Topics**

Research Topic	RII	Rank
Time/Cost Planning and Control	4.06	1
Project Delivery Systems and Contracts	4.04	2
Project Management	4.00	3
Human Factors, Management of Safety and Labor Relationships	3.98	4
Construction Planning and Control	3.88	5
Management and Organization of the Firm	3.86	6
Construction Operations and Methods	3.65	7
Technology Development Issues	3.65	7
Construction Industry Structure and Environment	3.61	8
Site, Materials and Equipment Management	3.51	9

As can be seen from Table 6.5, the RII of the factors varied between 3.51 and 4.06, thus considered a high weight. The RII's were somehow close to each other. 69.39% of the respondents strongly agreed or agreed that "Time/Cost Planning and Control" and "Project Delivery Systems and Contracts" can be one of the top CM research topics for the next ten years in the MENA region.

Conversely, 16.33% strongly disagreed or disagreed that "Site, Materials and Equipment Management" can be one of the top research topics. "Construction Operations and Methods" and "Technology Development Issues" also has the same RII i.e. 3.65, considered a low weight. In addition, the highest ranking has been given to "time/cost" and "project" related issues which is similar to the case of CME journal

and JCEM in the MENA region over the last fifteen years where the concentrated topics were about “time/cost” and “project” related issues, too.

On the other hand, less weight has been given to “site”, “construction” and “technology” related issues. Surprisingly, this was similar to the gap in both journals in the MENA region over the last fifteen years. Overall, the expectations regarding the construction concentrated topics for the future was similar to the concentrated topics over the last fifteen years in both journals. In regards to this, one can suggest that more interest has to be given to “technology” related issues. “Technology Development issues” plays a major role in advancing and broadening the CM research inside the MENA so we can be at a suitable pace with the CM research for the overall region. One respondent suggested that there will be new topics appearing on technology and construction for the next ten years. On the other hand, one respondent suggested that the focus will shift towards cost since money is a driving force in this part of the world than technology methods and safety. The respondents disagreed since one respondent said, “I don’t think the emphasized trend of research will change in the coming ten years”.

#### **6.3.4. Analysis of Top CM Research Sub-topics**

Table 6.6 presents the RII and the rank of the construction management research sub-topics. The Relative Importance Index was used to analyse the CM research sub-topics.

As can be seen from Table 6.6, the RII of the factors varied between 3.37 and 4.29, which is almost considered a high weight. The RII’s were somehow close to each other. 83.67% of the respondents strongly agreed or agreed that “Sustainability” can be one of the top CM research sub-topics for the next ten years in the MENA region. On the other hand, 79.59% strongly agreed or agreed that “Project delivery systems with public and/or private financing” can be so. Moreover, 77.55% strongly agreed or agreed that “Risk analysis and management” can be top CM research sub-topic, too. Contrary to this, 16.32% strongly disagreed or disagreed that “Design/build” can be top CM research sub-topic. Furthermore, “Productivity issues”, “cooperation, partnering, leadership and opportunity”, “Design management, Value engineering and management”, and “Contract and contingency management” has the same RII which is 3.88 and it is considered a high weight compared to other research sub-topics.

**Table 6.6: Ranking of Top CM Research Sub- topics**

<b>Research sub-topic</b>	<b>RII</b>	<b>Rank</b>
Sustainability	4.29	1
Project delivery systems with public and/or private financing	4.10	2
Risk analysis and management	4.08	3
Performance analysis and measurement	3.98	4
Productivity issues	3.88	5
Cooperation, partnering, leadership and opportunity	3.88	5
Design management, Value engineering and management	3.88	5
Contract and contingency management	3.88	5
Designing for maintainability	3.84	6
Resources planning and allocation	3.84	6
Safety management	3.82	7
Lean construction and production	3.78	8
Selection and evaluation of bids and proposals	3.76	9
Constructability analysis	3.71	10
Selection and evaluation of contractors	3.69	11
Project performance and feedback	3.67	12
Understanding identity and competitiveness in construction	3.65	13
Internationalization and Globalization	3.59	14
Business Process Reengineering (BPR)	3.49	15
Materials and component management	3.45	16
Design/build	3.37	17

Moreover, “Designing for maintainability” and “Resources planning and allocation” has the same RII which is 3.84 and it is considered a high relative weight compared to others, too.

Some topics have gained higher weight and rank in comparison to others. These include “Sustainability”, “Project delivery systems with public and/or private financing” and “Risk analysis and management” (which is something that can be expected from the analysis of both journals). Furthermore, even though some topics have attained lower rankings such as “Constructability analysis”, “Understanding identity and competitiveness in construction”, “Internationalization and globalization”, “Business Process Reengineering (PBR)” and “Design/build”, once can expect these topics to gain higher rankings in the coming decade since most of them were suggested topics by so many authors in the construction field (see section 6.3). Others topics were also suggested by some respondents. In addition, a good number of suggested sub-topics from respondents was concentrated on “project

delivery systems and contractual” issues which means that this field will be of interest from CM researchers, too.

Some respondents suggested other sub-topics that, in the coming decade, will gain more interest from MENA CM researchers. These were,

- Strategic planning
- Strategic program management
- Organizational behavior
- Restructuring
- Delay impact analysis
- Innovative materials and construction methods
- Team building
- Quality management system
- Contract and relationship management
- Contractors relationship management
- Client Selection of Contractors and Pre-Qualification

In addition, one respondent added: “More innovation and sustainability projects and research into renewable energy for the region as well as basic requirements for infrastructure, housing and basic resources such as electricity and water and waste water treatment will be of interest for CM research”. Another respondent stated, “We are developing country, I am expecting research on strategic level not in detail level”. Another opinion was offered by a respondent who suggested that the CM research shall highlight the effect of shale oil outside of MENA on the oil price for Organization of the Petroleum Exporting Countries (OPEC) and future investment in oil and gas and petro chemicals in the region. Furthermore, another respondent suggested that cost loading to schedules and BIM models has to be applied to give better understanding of cost modeling.

Below is a detailed description of the top five ranking research sub-topics according to the ranking of the respondents starting from the highest rank:

#### **6.3.4.1. Sustainability**

“Sustainability” was discussed briefly in section 6.2.3 of this Chapter. More details are to be presented on “Sustainability” in this section.

After conducting the survey for fulfilling Objective 2 of this study, it was found that “Sustainability” ranked highest in a total of 21 sub-topics.

According to Green Meeting Industry Council (GMIC) [79] and Carroll and Buchholtz [80] “Sustainability is just about business’s ability to survive and thrive over the long term”. Carroll and Buchholtz [80] added Sustainability has become one of the most business related concepts. The discussion of sustainability concept has commenced as it is related to the natural environment. As time has passed, it was noticed that sustainability concept is not just limited to the natural environment but it can be expanded to include business existence and processes as well. This is especially relevant to business’s global role and development. The term sustainability is derived from the concept of sustainable development, which is the use of resources that aims to meet human needs while preserving the environment to ensure that the needs of future generations are being met. This concept has been used by Brundtland Commissions [81], [80], who defined the sustainability as “development that meets the needs of the present without compromising the ability of future generations to meet their own needs”. By now, the concept of sustainability is extended to include environmental, economic, and social criteria.

According to the Economist Intelligence Unit [82], a survey was conducted and distributed among 280 senior executives. Nine interviews were also carried out with corporate executives, academics and industry experts. The main objectives of these interviews and surveys was to determine why these experts are pursuing sustainability, what type of challenges they are expecting to be, and how their efforts are going to promote long-term business growth.

The key finding of this study was that “Sustainability is spreading from developed to developing markets”. Globally, 78% of the respondents suggested that “Sustainability” will be important for their firms for the coming three years. 85% from developing economies suggested the same. Furthermore, emerging markets firms consider sustainability-oriented environmental, social and governance (ESG) practices a chance to support the relations between customers and investors in developed countries. Another finding was that “Sustainability reporting is not widespread—but is growing fast in emerging markets”. Although firms are increasingly embedding ESG principles into strategy, 18% of them only publish ESG targets and performance yearly. On the other hand, 45% of companies in developing countries do not currently publish ESG information, yet are willing to do so in the coming two years while only 19% of companies in developed countries stated this. Another finding was that companies try to include sustainability in risk management.

22% of the executives suggested that sustainability is an important part of their risk management programs. 35% depended more on an ad hoc approach whereas 22% only of respondents expected to start including sustainability in risk management for the future.

This leads us to say that there is a huge probability for the sustainability research trend to thrive and improve in the MENA region for the next ten years. This sub-topic is a developing topic and will be an area of interest by so many researchers in the MENA.

#### **6.3.4.2. Project Delivery Systems with public and/or private financing**

“Project delivery systems with public and/or private financing” was touched upon briefly in section 6.2.3 of this chapter. More details are to be presented on “Project delivery systems with public and/or private financing” in this section.

After conducting the survey for fulfilling Objective 2 of this study, it was discovered that “Project delivery systems with public and/or private financing” was the second highest rank among other 21 sub-topics in construction.

Li et al., [83] discussed the public private partnerships (PPPs). They mentioned that public private partnerships (PPPs) are considered one of the major approaches for delivering the infrastructure projects nowadays. In addition, PPPs can provide several benefits to the public sector such as reducing the financial burden on the public sector due to the rising costs of the infrastructure development, transferring the risks from the public to the private sector, and increasing the “value for money” put on infrastructure services by providing more reliable, efficient, and lower cost services.

Asian Business [83], [84] added that the experience of PPPs cannot always be considered positive. Many PPP projects may be held up or terminated. Asian Business associated this to many reasons such as, existence of wide gaps between public and private sector expectations, lack of clear government commitment and objectives, poor risk management, lack of competition, poorly defined sector policies, complex decision making, poor transparency, inadequate legal/regulatory frameworks, low credibility of government policies, lack of mechanisms to attract long-term finance from private sources at affordable rates, and inadequate domestic capital markets.

Although there is a number of negative experiences mentioned by Kwak [85], [83] many governments such as in Australia and UK, still consider PPPs as one of the

key strategies for delivering public services and infrastructure. In the past few decades, researchers have developed new insights on numerous topics such as, “how to select an appropriate concessionaire, what are the critical factors for the success or failure of PPP projects, what roles the government should play in PPP projects, and more”. Kwak et al. [83] added: “Therefore, understanding and enhancing knowledge of PPPs continue to be a matter of significance and importance”. The main aim of this article was to review the previous research findings and to provide a comprehensive understanding of PPPs. Additionally, this article discussed the definitions, types, examples of worldwide applications, benefits, and obstacles of PPPs by going in depth through a literature review that presented PPPs related research for the last 20 years. At the end of the article, key findings and recommendations for both public and private sectors were offered for the future of PPPs for infrastructure development. Regarding the public sector, some recommendations were given as policy implications such as, “identify and prioritize PPP projects, develop a database for historical PPP projects, standardize PPP procurement process and contract documentation, provide training at all levels for government staff, and establish two-way communication channels with the private sector [83]”.

Moreover, some recommendations were given to the private sector as management implications such as, “knowledge sharing with the public sector, early involvement of the financial institutions, and maintain long-term relationships with industrial partners [83]”. Also, at the end of the study some lessons were presented such as,

Adopting a PPP scheme is not easy, the credibility and competence of the government plays a critical role in PPP infrastructure development, a financially strong, technically competent, and managerially outstanding concessionaire is required for the success of a PPP project, all potential risks of the project should be identified and an appropriate risk allocation should be secured, and reasonable financial incentives and a stable revenue stream are critical to attract private investments [83].

Abdel Aziz [86] stated regarding this that the government applies two approaches for the implementation of public-private partnerships (PPPs), which are: finance-based approach and service-based approach.

The finance-based approach aims to use private financing to satisfy infrastructure needs while the service-based approach aims to optimize the time and

cost efficiencies in service delivery. However, the implementation of PPPs may suffer from legal, political, and cultural obstacles. For example, in the United States, the number of acts was enabled by the federal government to ease the obstacles and promote PPPs for infrastructure development. Depending on a detailed analysis of PPPs in the UK, the paper aimed to describe the principle of implementing the PPPs at the program level and test whether the implementation is successful or not. The principles were related to the following subjects: “availability of a PPP legal framework and implementation units, perception of the private finance objectives, risk allocation consequences, and value-for-money objectives, maintenance of PPPs process transparency, standardization of procedures, and use of performance specifications” [86]. At the end, guidelines for successful implementation of PPPs were explained and discussed according to United States PPPs experience and obstacles.

From what has been mentioned above, one can affirm that there is a huge probability that “Project delivery systems with public and/or private financing” will be one of the top sub-topics in the MENA region in the coming years. This topic is a developing topic and will gain much more interest from MENA researchers in the future due to its importance and wide usage in the construction field.

#### **6.3.4.3. Risk analysis and management**

“Risk analysis and management” was discussed briefly in section 6.2.3 of this Chapter. More details are to be presented on “Risk analysis and management” in this section.

Upon conducting the survey for fulfilling Objective 2 of this study, it was discovered that “Risk analysis and management” was on the third highest rank among 21 sub-topics in construction.

Akintoye and MacLeod [87] discussed the concept of risk associated with its practices in the construction industry field and the extent to which the risk analysis and management techniques are used in the industry. For this sake, Akintoye and MacLeod made a questionnaire survey and distributed it among general contractors and project management practices. The conclusions that they came up with after conducting the survey was that the risk management is a very important concept that is used in construction activities for minimizing the losses and enhancing the profitability. This concept affects cost, time and quality of the project. In addition, it

mainly depends on intuition, judgment and experience in construction. Formal risk analysis and management techniques are barely used in the construction industry because of the lack of knowledge and doubts whether these techniques suit the construction industry activities or not.

Abu Mousa [88] stated that the construction is a risky industry and that no other industry requires proper application of business practices as much as the construction industry. The main objective from his study was to demonstrate 44 risk factors that can affect building projects in Gaza Strip. In addition, the author aimed to explain the effectiveness of risk preventive methods, risk mitigating methods and the employment of risk analysis techniques. His study's conclusion was that there is a greater need for standardization along with effective forms of contract that address issues of clarity, fairness, roles and responsibilities, allocation of risks, dispute resolution and payment. Both owners and contractors have the responsibility of identifying and allocating possible risk factors that can face them contractually. Furthermore, there is a need for keeping a computerized historical data of finished projects for the sake of rights reservation and a source of information for the future comparison. In addition, there is a need to apply standard form of contracts that address clarity, fairness, roles and responsibilities, allocation of risks, dispute resolution and payment for all projects in Gaza strip rather than using different types of contracts that resulted in a consequential disorder. More efforts are needed for applying risk management techniques in the construction industry as well.

This lead us to say that having “Risk analysis and Management” as one of the top ranking sub-topics in construction is somehow reasonable. At the same time, this gives us a hint for the risk research trend in the MENA region as it will be a developing topic in the coming ten years.

#### **6.3.4.4. Performance analysis and measurement**

“Performance analysis and measurement” was lightly touched upon in section 6.2.3 of this Chapter. More details are to be presented on “Performance analysis and measurement” on this section.

After conducting the survey for fulfilling Objective 2 of this study, it was found that “Performance analysis and measurement” ranked fourth highest amongst 21 sub-topics in construction.

Jiang et al. [89] designed an ability-motivation-opportunity model. The main objective of this meta-analysis was to examine the effect of three dimensions of HR systems. These HR systems were skills-enhancing, motivation-enhancing, and opportunity-enhancing. Moreover, the effect of these HR systems on proximal organizational outcome (human capital and motivation) and distal organizational outcome (voluntary turnover, operational outcomes, and financial outcomes) had been analysed through this study, too. After conducting the whole study, the main findings were that skill-enhancing practices were more positively related to human capital and less positively related to employee motivation in comparison to motivation-enhancing practices and opportunity enhancing practices. In addition, the three HR systems were found to be related to financial outcome both directly and indirectly by “influencing human capital and employee motivation as well as voluntary turnover and operational outcomes in sequence [89]”.

Hannan et. al. [90] established a study to investigate how Relative Performance Information (RPI) has a serious effect on employee performance and allocation of effort across tasks in a multi-task environment. Based on theories of behavior, it was predicted that the social comparison process inherent in RPI contains both a motivation-effect and effort-distortion-effect. Motivation-effect resulted in increased effort while effort-distortion-effect resulted in the distortion of effort allocations across tasks far from the firm-preferred allocations. In addition, it was also predicted that both effects are magnified when the RPI is public instead of private. The authors argued that despite the motivation-effect influencing performance positively, the effort-distortion-effect can be detrimental to performance. Therefore, an experiment was designed to isolate these two effects. It was discovered that RPI includes both motivation-effect and effort-distortion-effect, with both effects being magnified when the RPI is public rather than private. Furthermore, it was found that the motivation effect increases performance while the effort-distortion-effect decreases performance. Isolating both effects provide researchers with insights into the costs and benefits of RPI in a multi-task environment. Also, it informs accountants with the design of information systems and the time by which the tasks should be aggregated or disaggregated across employees.

This leads us to say that having “Performance analysis and measurement” as one of the top ranking sub-topics in construction is somehow reasonable. Concurrently, this gives us a hint for the human performance research trend in the

MENA region as it will be a developing topic for the coming decade. More interest and further research is vital for this topic if we are progress in a suitable pace with the worldwide construction research.

#### **6.3.4.5. Productivity issues**

“Productivity issues” was briefly discussed in section 6.2.3 of this Chapter. More details are to be presented on “Productivity issues” on this section.

After conducting the survey for fulfilling Objective 2 of this study, it was found that “Productivity issues” was on the fifth highest rank among other 21 sub-topics in construction.

Stevens [91] tried to raise the following questions: “What type of research is needed to serve state and local government needs? How should research be structured and organized to support productivity project planning, implementation, and evaluation? What agencies or organizations should initiate or support such research?”.

The study of these questions resulted in the main objective of the productivity research process being to determine state and local needs, which has not to be an isolated exercise. This type of practice should continue by trying to integrate and incorporate the values, goals, needs, and objectives of federal, state, and local government managers along with their publics. The view should be promptly adopted as it facilitates the combination of productivity knowledge with productivity needs at the state and local levels of government. This theme was documented in the following “Report to the National Productivity Council.” It was agreed that no one level of government can be isolated from the others when productivity needs are taken into consideration.

The importance of highlighting this method for the future CM research had been highlighted by Aboulezz [1], Abudayyeh et al. [14] and Pietroforte and Stefani [17] as mentioned in section 6.2.3 of this chapter.

As has been mentioned above, one can say that there is a huge probability that “Productivity issues” will become a top sub-topic in MENA in the coming years. This topic is a developing topic and will gain much more interest from MENA researchers in the future due to its importance and wide application in the construction field.

#### **6.3.5. Analysis of Top Scheduling Methods**

Table 6.7 presents the RII and the rank of the top scheduling methods. The Relative Importance Index was used to analyse the top scheduling methods.

**Table 6.7: Ranking of Top Scheduling Methods**

Scheduling Method	RII	Rank
CPM (Critical Path Method)	3.96	1
LOB (linear and vertical scheduling)	3.65	2
PERT and GERT	3.47	3
Other non-deterministic time scheduling techniques	3.41	4
Other deterministic time scheduling techniques	3.31	5

As can be seen from Table 6.7, the RII of the factors varied between 3.31 and 3.96, which is considered a high weight. The RII's were somehow close to each other. According to Figure 6.6, 69.38% of the respondents strongly agreed or agreed that "Critical Path Method (CPM)" can be one of the top scheduling methods for the next decade in the MENA region while 61.23% strongly agreed or agreed that "linear and vertical scheduling (LOB)" will be such. In addition, 53.06% strongly agreed or agreed that "PERT and GERT" can be one of the top scheduling methods while 48.98% strongly agreed or agreed that "Other non-deterministic time scheduling techniques" can be so. Furthermore, 36.73% strongly agreed or agreed that "Other deterministic time scheduling techniques" may be of interest for CM researchers for the next ten years and thus can be one of the top scheduling methods. In general, the highest weight was given to the "Critical Path Method" and "Linear and vertical scheduling" by respondents. Conversely, "Other non-deterministic time scheduling techniques" was given a lower weight in comparison to others. Although "CPM" and "LOB" are very important methods still employed in scheduling techniques, they are old methods and have a lot of limitations. "PERT and GERT" and "Other non-deterministic time scheduling techniques" are newer and broader topics to the field and thus were expected to gain higher ranking by respondents.

In regards to this, Zhong and Zhang [76] had developed a new method for calculating path float in Program Evaluation and Review Technique (PERT). The path float use is a beneficial method is used to cope with various uncertainties existing with the construction. Nevertheless, the current path float calculating method may cause misleading information to the managers and cause risk on the duration of the project. The main aim of this paper was to present a new method that calculates the non-critical path float in the Program Evaluation and Review Technique (PERT). This paper also aimed at coping with the uncertainties within the network implementation and to eliminate the misleading information that is caused by the current path float.

An example network was presented through this study using the new method, the results of which presented the consistent path float under required completion probability and duration. The author [76] added that, “the new path float concept will bring useful planning information to the managers and the planners in the construction”.

Sakka and El-Sayegh [92] suggested a new method for studying the float consumption impact on cost and schedule in the construction industry. One of the main challenges faced during the project is minimizing and quantifying the risks associated with delays in the construction industry for all parties involved. For non-critical activities, float loss impact is one of the complicated delays to assess on a project’s cost and duration. This is because of the deterministic critical path method that cannot cope with such delays unless they exceed the total float values. Simultaneously, many planners look at the stochastic analysis as if it is complicated and time consuming. The main aim of this study was to come up with a method that can control the risks associated with float loss in construction projects. The method employed a developed multiple simulation analysis technique. This technique can combine the data of cost range estimates and stochastic scheduling using Monte Carlo simulation. This method quantifies the float loss impact on project cost and duration. In addition, least-squares nonlinear regression was used to be able to convert the stochastic results into a polynomial function that can quantify the float loss impact by relating directly the float loss value to project cost and duration at a particular confidence level.

Bruni et al. [93] had developed a scheduling methodology for dealing with uncertainty in construction projects. The usual methods used in project scheduling are based on assumption of complete knowledge of project parameters. In reality, however, this is not the case. There is uncertainty in construction projects derived from a multitude of context-dependent sources causing risk for the project. Classical deterministic analysis affords a schedule that might be not sufficiently protected against possible disruptions. Therefore, a quantitative methodology was developed for planning construction projects under uncertainty. This method determines a reliable resource feasible project schedule. This can be fulfilled by taking into account the available probabilistic information. The aim of this information is to produce less sensitive solutions to arising perturbations. This methodology relies on computer-supported system that can identify, analyse and quantify the schedule reliability in

addition to the impact of possible disruptions that can affect the duration of the project. It was found that this method can exploit more information about the uncertain parameters compared with the deterministic method. In addition, it can provide an advanced understanding of the schedule reliability in uncertainty existence. Schedules generated by deterministic methods result in unrealistic planned project delivery date of about 1,250 days with a probability of 50% to be exceeded. This causes unsatisfactory results to the construction projects with having high penalties. The paper presented an approach for robust scheduling for construction project under uncertain parameters. Similarly, it provides a tool for the project managers to help them in providing a workable realistic project schedule with uncertain parameters and can be used as a guideline to control and monitor the project.

### 6.3.6. Analysis of Top Technology Sub-topics

Table 6.8 presents the RII and the rank of the top technology sub-topics. The Relative Importance Index was used to analyze the top technology sub-topics.

**Table 6.8: Ranking of Top Technology Sub-topics**

<b>Technology sub-topic</b>	<b>RII</b>	<b>Rank</b>
BIM	4.04	1
IT integration and communications + GPS	3.94	2
Research and development issues	3.88	3
Innovation and technology transfer, analysis, and mechanics	3.80	4
2-D, 3-D and 4-D CAD	3.67	5

As can be seen from Table 6.8, the RII of the factors varied between 3.67 and 4.04, which is almost considered a high weight. The RII's were somehow close to each other. 69.39% of the respondents strongly agreed or agreed that "BIM" can be one of the top technology sub-topics for the next ten years in the MENA region. 65.31% strongly agreed or agreed that "Research and development issues" and "Innovation and technology transfer, analysis, and mechanics" can be so. On the other hand, 65.30% strongly agreed or agreed that "IT integration and communications + GPS" and 59.18% strongly agreed or agreed that "2-D, 3-D and 4-D CAD" can be top technology sub-topics for the next ten years, too. In general, according to the ranking mentioned above, "BIM" has gained the highest rank which is something expected

and reasonable. In contrast, having “2-D, 3-D and 4-D CAD” at the last rank is something that can be disagreed in terms of the future. This is a new topic to the field and should have gained higher ranking compared to others.

Pertaining to this, Azhar [50] stated that Building Information Modeling (BIM) is one of the most recent developments in the Architecture, Engineering, and Construction (AEC) industry as mentioned before. BIM can be used for planning, design, construction, and operation of the facility. BIM is used to construct an accurate virtual model of a building.

When it comes to the employment of 2-D, 3-D and 4-D CAD, it has been stated, As manufacturers rapidly transition from 2D to 3D CAD in today’s digital world, designers are demanding 3D to enhance their designs and improve communication. From websites to rapid prototyping, customers, designers, and engineers now depend on the latest 3D modeling tools [94].

McKinney [95] stated that the use of 4D CAD models (3D CAD model with time as the 4<sup>th</sup> dimension) is becoming more common in design and construction. However, the usage and the characteristics of these tools are still under exploration. A research was conducted by Centre for Integrated Facility Engineering (CIFE) focusing on the use of these models in terms of both their visual and communicative impact as well as their impact on the construction design process also. For this purpose, a 4D-CAD tool was developed to enable the construction designers to build and interact with a 4D model easily. The aim was to enhance the decision power of 4D models through facilitating rapid prototyping and analysis of alternative schedule proposals.

Yerrapathruni et al. [96] stated that the ability of visualizing a project via 4D CAD model allows the construction planners to review and produce better construction plans. The authors added, “Over the past ten years, several researchers and industry practitioners have defined many benefits attributed to 4D CAD model development. In all but a few applications, a personal computer based monitor has been used to view and analyse these 4D models” [96].

### **6.3.7. Analysis of Procedures in Advancement of CM Research**

Table 6.9 demonstrates the RII and the rank of the procedures that can produce advancement in construction management research. The Relative Importance Index was used to analyse the procedures.

**Table 6.9: Ranking of Procedures in Advancement of CM Research**

Procedure	RII	Rank
Increase research collaboration between the three sectors (academia, industry and government)	4.27	1
Allocate more budget for research	4.10	2
Increase the communication between researchers in the MENA region and the rest of the world	4.08	3
Construct a two-way flow between construction theory and practice	4.06	4
Build research centers	4.02	5
Form research groups across MENA	3.90	6
Internationalize the systems, codes, standards, laws, and contracting methods in the MENA region	3.88	6
Integrate construction with other areas	3.88	6
New studies, models and styles should be applied to Construction Management research	3.86	7
Put more attention to the latest and different topics in the Construction Management field and try to come up with new ideas and techniques related to it	3.84	8
Develop more research focused graduate programs	3.84	8
Use more advanced technology in research	3.69	9
Conduct more conferences in this field	3.59	10

As can be seen from Table 6.9, the RII of the factors varied between 3.59 and 4.27 which is almost considered a high weight. The RII's were somehow close to each other. 83.67% of the respondents strongly agreed or agreed that "Increase research collaboration between the three sectors (academia, industry and government)" can be one of the procedures that will lead to an advancement in the CM research for the next ten years in the MENA region. On the other hand, 81.63% strongly agreed or agreed that "Allocate more budget for research" can be so. Contrary to this, 16.33% strongly disagreed or disagreed that "Conduct more conferences in this field" can lead to a better CM research for the future. Furthermore, "Internationalize the systems, codes, standards, laws and contracting methods" and "Integrate construction with other areas" has the same RII which is 3.88 and this is considered somehow a high average weight compared to other procedures. In addition, "Put more attention to the latest and different topics in the Construction Management field and try to come up with new ideas and techniques related to it" and "Develop more research focused graduate programs" has the same average weight which is 3.84 and it is considered a high

weight, too. In general, one of the major ways that can come up with a major advancement in CM research inside the MENA region according to the ranking mentioned above is to increase the communications between researchers among the three sectors, allocate more budgets for research, and increase the communications between researchers inside and outside the MENA region. On the other hand, “Use more advanced technology in research” should have gained higher ranking as it has a very important role in advancing the CM research as mentioned before. In addition, the respondents added some more suggestions or alternative ways for enhancing the CM research such as, highlight and minimize the gaps between the education and the private sector demand, decentralize research efforts in university, give departments more power to hire high caliber researchers and do research independently, consider training and developing of candidates in the construction industry, etc. One respondent suggested that each country has to have its own agenda and priorities and more research and feedback should be given to governments by academia.

#### **6.3.8. Analysis of CM Research Situation over the Last Fifteen Years**

This section presents the situation of the construction management research over the last fifteen years in the MENA region, according to the respondents’ opinion. The RII was almost **2.76** which is something between “Did not change” and “Improving slowly” but is closer to “**Improving slowly**”. In fact, the respondents had different opinions regarding this.

#### **6.3.9. Analysis of the CM Research Agenda for the Next Ten Years**

Betts and Lansley [23] in their analysis of IJPM for the period 1983-1992 highlighted the need to speculative studies to determine what the future holds even if the journal has reached its maturity for its first ten years of inception.

This section presents the expected situation of the construction management research for the next ten years in the MENA region according to the respondents’ opinion. The RII was almost **3.10** which lies between “Improving quickly” and “Improving slowly” but is closer to “**Improving slowly**”. In fact, the respondents had different opinions regarding this. Regardless, this weight provides an optimistic view for the future of construction management research in its developments and enhancement movement in the MENA region. Furthermore, the situation of the construction management research over the last fifteen years and the expected

situation for the next ten years have gained approximately the same judgement from the respondents i.e. “**Improving slowly**”.

## 6.4. Comparisons

### 6.4.1. Analysis of Top Research Topics Based on Sector

Table 6.10 displays the comparison of the academic sector with the industry sector according to their ranking of CM research topics. The Relative Importance Index was used to analyse CM research topics for both sectors.

**Table 6.10: Comparison of Top CM Research Topics between Academia and Industry**

Research Topic		Academia		Industry	
		RII	Rank	RII	Rank
1	Management and Organization of the Firm	3.79	5	3.93	4
2	Construction Planning and Control	3.84	4	3.91	5
3	Site, Materials and Equipment Management	3.51	9	3.57	9
4	Time/Cost Planning and Control	4.05	1	4.14	1
5	Construction Operations and Methods	3.63	8	3.68	6
6	Human Factors, Management of Safety and Labor Relationships	4.05	1	4.02	3
7	Project Management	3.98	3	4.05	2
8	Project Delivery Systems and Contracts	4.02	2	4.05	2
9	Construction Industry Structure and Environment	3.65	7	3.61	8
10	Technology Development Issues	3.74	6	3.64	7

In comparison the academic sector with the industry sector, both sectors had the highest rank in “Time/Cost Planning and Control” and “Project delivery systems and contracts”. Moreover, according to the academic sector “Time/Cost Planning and Control” and “Human Factors, Management of Safety and Labor Relationships” has the same RII which is the highest weight among other research topics. On the other hand, according to the industry sector “Project Management” and “Project Delivery Systems and Contracts” have gained the same RII and were on the second highest rank.

In addition, what can be noticed from Table 6.10 is that academicians and industry researchers are mostly in mutual agreement on the same top topics for the next ten years in the MENA region. These topics, however, have gained higher weight

from industry researchers compared to academicians which may be due to the lesser number of industry researchers compared to academicians contributed in the survey. Moreover, it can be easily concluded that both sectors had almost the same low ranking topics including “site”, “construction” and “technology” related topics even if these topics gained higher weight from industry researchers compared to academicians. This is something that is unreasonable because “technology” related issues must be one of the top ranking topics for the construction future in the MENA region to make it almost in the same pace with the overall region as mentioned before.

The closeness in ranking from both academicians and industry researchers can be clearly noticed from Figure 6.3. This graph presents the comparative profile of overall 10 CM research topics in terms of RII with respect to academicians and industry researchers.

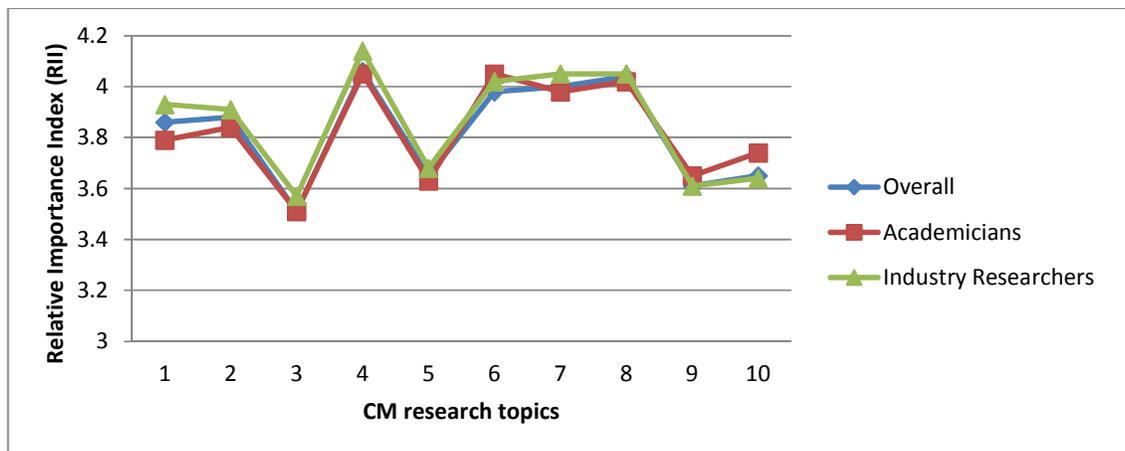


Figure 6.3: Comparative Profiles of Overall 10 CM Research Topics

Furthermore, in order to study the strength of relationship between two sets of ranking, the Spearman correlation coefficient was determined. The Spearman rank correlation coefficient is calculated using equation (2) [78], [97]

$$r_s = 1 - \frac{6 \sum d^2}{(N^3 - N)} \quad (2)$$

Where:

$r_s$  = Spearman rank correlation coefficient,

$d$  = difference in ranking between academicians and industry researchers,

$N$  = number of variables (CM research topics) = 10

“The higher the value of  $r_s$  (approaching 1 or -1) indicates a strong association between the two sets of ranking [78], [98]”.

The Spearman Correlation Coefficient was calculated and found to be 0.995 which is almost 1. This proves the strong association between academicians and industry researchers and that both had close opinions in ranking CM research topics.

Overall, the ratio of academicians to industry researchers was 3.9. Thus, the comparison between both sectors needs more responses from industry researchers to bring the ratio closer to 1 and get more accurate comparisons among both sectors.

#### **6.4.2. Analysis of Top Research Sub-topics Based on Sector**

Table 6.11 presents the comparison of the academic sector with the industry sector according to their ranking of CM research sub-topics. The Relative Importance Index was employed to analyse the CM research sub-topics.

Comparing both sectors from Table 6.11, “Sustainability” has gained the highest rank from both sectors while “project delivery systems with public and/or private financing” has gained the second highest rank from academicians and “risk analysis and management” has gained the second highest rank from industry researchers. In addition, according to the academic sector, “cooperation, partnering, leadership and opportunity” and “Contract and contingency management” has gained the same RII which was 3.86 and this is considered a high weight compared to other research sub-topics. Furthermore, the same two topics have been given the same RII from industry researchers i.e. 3.91.

Moreover, referring to the academicians, both “Resources planning and allocation” and “productivity issues” have gained the same RII and they were on the sixth rank whereas “safety management” and “design management, value engineering and management” has gained the same RII and were on the seventh rank. Also, by academicians, “designing for maintainability” and “lean construction and production” has been given the same RII and were on the eighth rank and “constructability analysis” and “selection and evaluation of contractors” has been given the same RII and were on the ninth rank. Finally, in the academic sector, “project performance and feedback” and “selection and evaluation of bids and proposals” has been given the same RII and they were on the tenth rank. On the other hand, according to the industry sector, “constructability analysis” and “understanding identity and

competitiveness in construction” has gained the same RII and rank which was the fourteenth rank.

**Table 6.11: Comparison of Top CM Research Sub-topics between Academia and Industry**

Research sub-topics	Academia		Industry	
	RII	Rank	RII	Rank
Internationalization and Globalization	3.58	12	3.56	16
Designing for maintainability	3.79	8	3.82	10
Sustainability	4.21	1	4.32	1
Constructability analysis	3.72	9	3.73	14
Lean construction and production	3.79	8	3.75	13
Materials and component management	3.51	13	3.41	18
Resources planning and allocation	3.84	6	3.89	7
Safety management	3.81	7	3.77	12
Performance analysis and measurement	3.93	4	3.95	4
Productivity issues	3.84	6	3.86	8
Risk analysis and management	4.02	3	4.16	2
Cooperation, partnering, leadership and opportunity	3.86	5	3.91	6
Design management, Value engineering and management	3.81	7	3.93	5
Project performance and feedback	3.67	10	3.66	15
Selection and evaluation of bids and proposals	3.67	10	3.84	9
Project delivery systems with public and/or private financing	4.09	2	4.09	3
Contract and contingency management	3.86	5	3.91	6
Selection and evaluation of contractors	3.72	9	3.78	11
Design/build	3.30	15	3.39	19
Business Process Reengineering (BPR)	3.49	14	3.52	17
Understanding identity and competitiveness in construction	3.63	11	3.73	14

Also, what can be noticed from Table 6.11 is that both academicians and industry researchers had close opinions (and thus close weights) in ranking the research sub-topics. Still, some topics have gained higher weight from industry researchers compared to academicians and this may be attributed to the lesser number of industry researchers compared to academicians contributed in the survey as mentioned before. Overall, it can be noticed that the top three research sub-topics

were the same for both academicians and industry researchers regardless of their order. In addition, it can also be noticed that both academicians and industry researchers had the lowest ranking for the same research sub-topics regardless of their order. Commenting on this, one can say that “Business Process Reengineering (PBR)” and “understanding identity and competitiveness in construction” has gained low ranking by both sectors compared to other CM research sub-topics. This may be pointing towards the fact that, as has been mentioned by many authors, they still remain new and developing topics to the construction field. [Check section 6.2.3 of this Chapter]. In general, it will be reasonable to expect higher ranking for these two topics for the MENA construction future.

The closeness in ranking from both academicians and industry researchers is clearly noticeable from Figure 6.4 which presents the comparative profile of overall 8 top CM research sub-topics in terms of RII with respect to academicians and industry researchers.

In both sectors, “Project delivery systems with public and/or private financing” has the same RII (4.09). The Spearman Correlation Coefficient was calculated using equation (2) and found to be 0.999 which is almost 1. This proves the strong association between academicians and industry researchers and that both had close opinions in ranking CM research sub-topics.

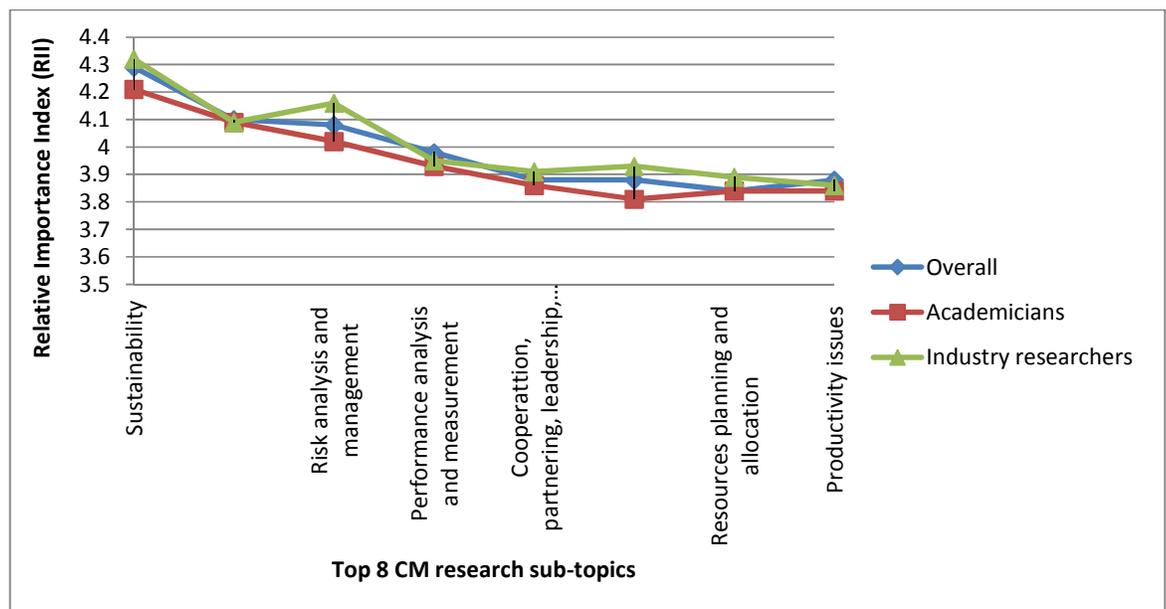


Figure 6.4: Comparative Profile of Overall 8 top CM Research Sub-topics

Overall, as mentioned before the ratio of academicians to industry researchers was 3.9. Thus the comparison between both sectors requires more responses from industry researchers to make the ratio somehow closer to 1, thereby getting more accurate comparisons between both sectors regarding research sub-topics.

## **6.5. Chapter Summary**

Expecting the trend of construction management research in the MENA region for the future will provide the researchers an idea about what to concentrate on in their studies. Additionally, knowing the gaps for the current construction management research will offer an insight for CM researchers about what they should highlight to enrich this field and narrow its gaps.

This chapter has presented more than one topic in CM field which were, main reasons/factors of CM research gaps, top CM research topics, top CM research sub-topics, top scheduling methods to be applied for the next ten years, top technology sub-topics to be applied for the next ten years, procedures to advance and come up with a better CM research for the next ten years, analysis of current situation of CM research over the last fifteen years, and lastly establishing a CM Research Agenda for the next ten years.

Each section in this chapter comprised of a topic. The survey's responses were analyzed and conclusions and recommendations were drawn through the analysis of the responses. Overall, this chapter was to cover selected topics in the CM research in the MENA region for the next ten years.

## **Chapter 7: Summary, Conclusions & Recommendations**

### **7.1. Summary**

This thesis was conducted to assess the CM research in the MENA region over the last fifteen years and to come up with a CM Research Agenda for the next ten years. This study was conducted for the period 1997-2011 and it was divided into three periods, which was of five years. The thesis organization was as follows:

Chapter 1 presents the statement of the problem, objectives, significance and the methodology of both objectives of the thesis.

Chapter 2 presents the introduction, definition of MENA countries, literature review of conducted construction management research analyses in the past years, literature review of developing research agenda and of developing construction management research agenda, and finally a literature review of developing research agenda in the MENA region.

Chapter 3 presents the classification of construction management topics. There were three levels. Level 1 is Construction Management. Level 2 consists of 10 divisions and each one of these divisions has different number of sub-divisions below. Total number of sub-divisions is 75 and the total number of divisions and sub-divisions in the three levels is 86.

Chapter 4 presents the analysis of the CME journal for the period 1997-2011 while Chapter 5 presents the analysis of the JCEM for the same Period. For each journal, the following has been analyzed: issues, contributing papers, contributing authors, contributing organizations, contributing countries, analysis based on sector (academia, industry, or government), ratio of MENA to non-MENA authors, top CM research topics, top CM research sub-topics, and less interest research topics. This was carried out for each period and total period for the overall region. This was also done for the MENA region as well. Also, the most growing/declining topics and sub-topics for the overall region and the most growing/declining topics for the MENA region have also been taken into consideration for each period and total period. Moreover, for each journal a comparison of top CM research topics and sub-topics as well as for less interest research topics has been conducted between the overall region and MENA region.

Chapter 6 presents Objective 2 of the thesis which was the establishment of the survey and its analysis. This Chapter was divided to discuss the following issues:

main reasons/factors of CM research gaps, top CM research topics, top CM research sub-topics, top scheduling methods, top technology methods, procedures in advancement of CM research, situation of the CM research over the last fifteen years and expected CM Research Agenda for the next ten years.

In general, the analysis and the conclusions of this thesis have been built up depending only on two of the top construction management journals; Construction Management and Economics journal and Journal of Construction Engineering and Management. Analysis of other construction management journals may lead to different analysis and conclusions. Our main concern was only the top two leading construction management journals and thus the analysis and the conclusions were all associated with these two journals. Analysis of other journals could not be applicable for this study due to the huge data and limited time.

## **7.2 Conclusions**

In the past, there was no CM Research Agenda conducted in the MENA region. This is the first CM Research Agenda in the MENA region. Moreover, after the analysis of the CME journal and JCEM, it was found that there was a little contribution in CM research in the MENA region compared to the overall region, a bias towards specific topics, inadequacy in other topics and thus, a lack of diversification in research topics.

Furthermore, after analyzing the survey, it was found that there was a huge gap between the three sectors (academia, industry, and government) for both regions. There was also a lack of linkage between construction theory and practice. For MENA region, one of the major reasons behind a gap in CM research was the scarcity of budgets specified for research by MENA governments and a lack of sponsoring/funding by business leaders. Moreover, there are other reasons led to that gap that include: inadequate number of contributing authors, organizations, and countries compared to the overall region; fluctuating, ambivalent political situation of the region; lack of communications between MENA countries and non-MENA countries; and insufficient interest and understanding of research impact on the industry. Also, the fact that research institutions are often lagging behind construction industry and business demand and the shortage of technology and research equipment can be considered reasons of CM gaps, too. In addition, other suggested reasons can be lack of awareness among the participants in the sector regarding the necessity of

utilizing construction management techniques to achieve success in construction projects; management and organization issues; absence of real commitment in implementing management processes; shortage of sufficient number of academicians in this area; paucity in researchers in the CM field; secured positions of academics in universities without need to conduct research to get tenured; and no enough support exists to create a local world class construction and project management capability. Furthermore, lack of support when it comes to training, coaching, and capability increase which in turn lead to a pure academic pass time and over-dependence on the traditional forms of contract and less on alternative procurement approaches such as construction management and design/build can be considered factors that led to the CM gap, too.

Similarly, regarding the main CM topics, it was found that “time/cost” and “project” related issues may gain high interest from MENA CM researchers for the next ten years. Pertaining to the main CM sub-topics, most of the respondents agreed that “sustainability” will be the top sub-topic in CM research in the coming decade.

Regarding the top scheduling methods, “CPM”, “LOB” and “PERT and GERT” all ended up ranked in the top slots. Conversely, regarding the top technology sub-topics, “BIM”, “IT integration and communications + GPS”, and “Research and development issues” gained the highest weight by respondents.

In addition, most respondents suggested that increasing the research collaboration between the three sectors as well as the collaboration between MENA and non-MENA countries can be the best solution in getting advanced CM research for the future. Finally, most of the respondents agreed that the CM research was improving slowly over the last fifteen years and will continue to do so for the coming decade.

### **7.3 Recommendations**

For a better CM research in the future, the following recommendations can be given. Special attention has to be given for increasing the research collaboration between the three sectors (academia, industry, and government). Furthermore, the MENA governments have to allocate more budgets for research and the communications between MENA and non-MENA countries in research have to increase. Moreover, construct a two-way flow between construction theory and practice, build more research centers, form research groups across MENA and

integrate construction with other areas can lead to a better CM research for the future. In addition, internationalizing the systems, codes, standards, laws, and contracting methods in the MENA region and applying new studies, models, and styles to the CM field can be a good recommendation for the CM researchers in the MENA region across MENA. Also, researchers have to put more attention to the latest and different topics in the CM field and try to come up with new related ideas and techniques. Also, they have to develop more research focused graduate programs, use more advanced technology in research, and conduct more conferences in this field.

Other suggested recommendations are: to highlight and minimize the gaps between the education and the private sector demand, to consider training and developing of candidates in the construction industry and to decentralize research efforts in university.

Lastly, one can suggest providing departments with opportunities to hire high-caliber, independent researchers in order to progress in the CM research. Furthermore, each country has to organize its own priorities such that more research and feedback is made available for governments by the academia.

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## Appendix

### Survey

1<sup>st</sup> April 2013

**Dear Sir/Madame,**

I am Alaa' Abu-Salah Master student at the American University of Sharjah (AUS)-Civil Engineering Department. I am conducting a research to develop Construction Management research agenda in the MENA region for the next 10 years. The survey is designed to get your input based on your experience as a researcher and author in the Construction Management field. Your valuable input will contribute to the success of this research. Please fill the attached survey. The information that you provide will be kept confidential.

Last day to submit your response: 30<sup>th</sup> April, 2013

Link:

<https://docs.google.com/forms/d/17Z6UYTD2kQNwzEOxVstrjKeecWe93EYMswluJ3K3n4w/viewform>

If you have any question or comment, please feel free to contact me by e-mail [g00025682@aus.edu](mailto:g00025682@aus.edu), phone + (971)50-8083393.

Thanks in advance,

Alaa' Abu-Salah

Civil Engineering Department

American University of Sharjah

### ***Contact Information***

Name: \_\_\_\_\_

Email Address: \_\_\_\_\_

Telephone No.: \_\_\_\_\_

Fax No.: \_\_\_\_\_

### ***Work Information***

Position: \_\_\_\_\_

Organization Name: \_\_\_\_\_

Organization Location: \_\_\_\_\_

For the survey questions, please use the following scale:

**1: Strongly agree, 2: Agree, 3: Neutral, 4: Disagree and 5: Strongly disagree.**

**1. From the analysis, it was found that the MENA region suffers from a huge gap in Construction Management research compared to the rest of the world for the period 1997-2011, what do you think the main reasons/factors that led to that gap?**

- **Less care is given to research in both industry and government fields compared to academia and fewer budget is specified for them**      ①   ②   ③   ④   ⑤
  
- **Lack of research collaboration between the three sectors (academia, industry and government)**      ①   ②   ③   ④   ⑤
  
- **Lack of linkage between construction theory and practice**      ①   ②   ③   ④   ⑤
  
- **Less number of contributing authors, organizations and countries**      ①   ②   ③   ④   ⑤
  
- **Lack of communications between the MENA region and the countries outside the region**      ①   ②   ③   ④   ⑤
  
- **Lack of technology and research equipment**      ①   ②   ③   ④   ⑤

- The MENA governments don't allocate enough budget for research  1  2  3  4  5

- The political situation of the region  1  2  3  4  5

2. From the analysis of Construction Management and Economics Journal (CME) and Journal of Construction Engineering and Management (JCEM) for the period 1997-2011, it was found that the top research topics in the MENA region were project, human factors including safety and time/cost planning and control related issues. On the other hand, the gaps of research were in the issues related to construction and technology. From what has been mentioned above, what do you expect the top research topics in the MENA region will be for the next 10 years?

- Management and Organization of the Firm  1  2  3  4  5

- Construction Planning and Control  1  2  3  4  5

- Site, Materials and Equipment Management  1  2  3  4  5

- Time/Cost Planning and Control  1  2  3  4  5

- Construction Operations and Methods  1  2  3  4  5

- Human Factors, Management of Safety and Labor Relationships  1  2  3  4  5

- Project Management  1  2  3  4  5

- Project Delivery Systems and Contracts  1  2  3  4  5

- Construction Industry Structure and Environment  1  2  3  4  5

- Technology Development Issues  1  2  3  4  5

3. In your own perspective, what are the latest and most developing sub-research topics that need to be taken into consideration for the next 10 years to come up with a better Construction Management research in the MENA region?

- Internationalization and globalization      ①    ②    ③    ④    ⑤
- Designing for maintainability              ①    ②    ③    ④    ⑤
- Sustainability                                    ①    ②    ③    ④    ⑤
- Constructability analysis                    ①    ②    ③    ④    ⑤
- Lean construction and production         ①    ②    ③    ④    ⑤
- Materials and component management     ①    ②    ③    ④    ⑤
- Resources planning and allocation         ①    ②    ③    ④    ⑤
- Safety management                            ①    ②    ③    ④    ⑤
- Performance analysis and management     ①    ②    ③    ④    ⑤
- Productivity issues                            ①    ②    ③    ④    ⑤
- Risk analysis and management             ①    ②    ③    ④    ⑤
- Cooperation, partnering, leadership and opportunity    ①    ②    ③    ④    ⑤
- Design management, Value engineering and management    ①    ②    ③    ④    ⑤
- Project performance and feedback         ①    ②    ③    ④    ⑤
- Selection and evaluation of bids and proposals    ①    ②    ③    ④    ⑤
- Project delivery systems with public and/or private financing    ①    ②    ③    ④    ⑤
- Contract and contingency management     ①    ②    ③    ④    ⑤

- Selection and evaluation of contractors      ①   ②   ③   ④   ⑤
- Design/build      ①   ②   ③   ④   ⑤
- Business Process Reengineering (BPR)      ①   ②   ③   ④   ⑤
- Understanding identity and competitiveness in construction      ①   ②   ③   ④   ⑤

Are there other topics? Suggest if any

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4. From the analysis of both journals, it was found that there is a lack in the papers that talked about scheduling methods in the MENA region during the period 1997-2011. Scale the following methods according to their importance for the mid future scheduling research in the MENA, next 10 years?

- CPM (Critical Path Method)      ①   ②   ③   ④   ⑤
- LOB (linear and vertical scheduling)      ①   ②   ③   ④   ⑤
- PERT and GERT      ①   ②   ③   ④   ⑤
- Other deterministic time scheduling techniques      ①   ②   ③   ④   ⑤
- Other non-deterministic time scheduling techniques      ①   ②   ③   ④   ⑤

5. What do you think the most important sub-topic in Technology Development Issues that has to be researched more in the MENA region for the next 10 years?

- Innovation and technology transfer, analysis, and mechanisms      ①   ②   ③   ④   ⑤
- Research and development issues      ①   ②   ③   ④   ⑤

- IT integration and communications + GPS    ①    ②    ③    ④    ⑤
- 2-D, 3-D and 4-D CAD    ①    ②    ③    ④    ⑤
- BIM    ①    ②    ③    ④    ⑤

Are there other topics? Suggest if any

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**6. What are the procedures that have to be followed to increase the diversity and applicability of the research topics in the MENA region for the next 10 years?**

- Increase research collaboration between the three sectors (academia, industry and government)    ①    ②    ③    ④    ⑤
- Construct a two-way flow between construction theory and practice    ①    ②    ③    ④    ⑤
- Integrate construction with other areas    ①    ②    ③    ④    ⑤
- Increase the communications between researchers in the MENA region and the rest of the world    ①    ②    ③    ④    ⑤
- Put more attention to the latest and different topics in the Construction Management field and try to come up with new ideas and techniques related to it    ①    ②    ③    ④    ⑤
- Internationalize the systems, codes, standards, laws, and contracting methods in the MENA region    ①    ②    ③    ④    ⑤
- Build research centers    ①    ②    ③    ④    ⑤
- Conduct more conferences in this field    ①    ②    ③    ④    ⑤
- Form research groups across MENA    ①    ②    ③    ④    ⑤

- Develop more research focused graduate programs      ①    ②    ③    ④    ⑤
- Use more advanced technology in research      ①    ②    ③    ④    ⑤
- Allocate more budget for research      ①    ②    ③    ④    ⑤
- New studies, models and styles should be applied to Construction Management research      ①    ②    ③    ④    ⑤

7. In general, how can you judge the Construction Management research in the MENA region for the period 1997-2011?

- a) Improving quickly    b) Improving slowly    c) Did not change    d) Getting worse

8. From the overall picture, how do you see the situation of the Construction Management research in the MENA region will be for the next 10 years?

- b) Improving quickly    b) Improving slowly    c) Did not change    d) Getting worse

Please, mention if you have any comments/suggestions on this survey

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*Thank you for filling the survey your effort is really appreciated, all data provided will remain confidential and will be used for academic purposes only*

## **Vita**

Alaa' Abu-Salah was born on June 12, 1988, in Kuwait. She graduated from Al-Ghubaiba High School as class valedictorian in 2006. In 2010, she graduated from the American University of Sharjah in UAE with a degree in Bachelor of Science in Civil Engineering.

In the same year, Ms. Abu-Salah received an assistantship to the American University of Sharjah to embark upon her Master's program in Civil Engineering while simultaneously working as a research assistant.