Developing and Evaluation the Implementation of Construction Management Research in the Saudi Construction Industry

by

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ABSTRACT

Public construction projects in Saudi Arabia have been experiencing performance issues for the past 30 years. There have been many research efforts and publications identifying the problem and potential causes, however, there have been minimal efforts identifying how to mitigate the problem and testing to validate proposed solutions. A literature search has shown that the academic research has had minimal impact in assisting the construction industry to improve its performance. This dissertation aimed to evaluate the impact of construction management research in Saudi construction industry (SCI), and to investigate barriers that hinder the diffusion of implementing the research outcomes in the construction sector in order to develop a research roadmap to bridge the gap between academic research and practice, using the experience of other organizations that have a successful experience in developing the impact of construction management research in the construction industry. In order to achieve the aim of the study, five main objectives were set up which are: evaluate the impact of construction management research in SCI, identify the barriers that affect the implementation of construction management research in SCI, develop a research roadmap to bridge the gap between the research and practice, validating the proposed solution, and proposed implementation plan and review the result from the implementation. A literature research was performed, using 5 academic databases, identifying the impact that R&D has had on the SCI. A questionnaire was also created surveying both researchers and industry professionals. The results show evidence that the current R&D process in Saudi Arabia is not helping the SCI to increase their performance, and needs to be improved. This study provides a potential solution, and an

action plan that mirrors one of the most successful research and development programs in the construction industry in the world [+1915 tests, six different countries, 31 states in the U.S. and 98% customer satisfaction]. The solution proposed in this dissertation is unique to the strengths and weaknesses of the research and development programs at universities and research centers in Saudi Arabia. This study is the first study of its kind in Saudi Arabia.

DEDICATION

To my Father and Mother

To My Lovely Wife

To My Son Meshari

To my Future kids

To My Brothers and Sister

To My Country, Saudi Arabia

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First of all, Praise be to Allaah. Oh Allah benefit me with what you taught me, and teach me what benefits me, and increase me in knowledge.

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CHAPTER 1

INTRODUCTION

The economic prosperity of a nation is heavily influenced by its construction industry. The competitiveness level of this industry contributes a great deal to the development of the nation at large. Industry professionals, government analysts, decision makers and researchers all over the world are awarding a lot of attention to innovation performance within the construction industry (Hampson et al, 2014). In terms of management procedures, processes, enhanced materials and new technologies, the absorption rate of the industry is quite slow even after considering that these processes may be cost effective in the long run for the industry at large (McDermott, 1998). All over the world, several research institutes as well as universities have carried out research studies to extract solutions to these issues. With the help of the research, it would be possible for the practitioners to recognize the issue present and make changes as required. However, this has not been the case and some of research works are only of interest to the academics placed on the library bookshelves. (Awalla, 2006)

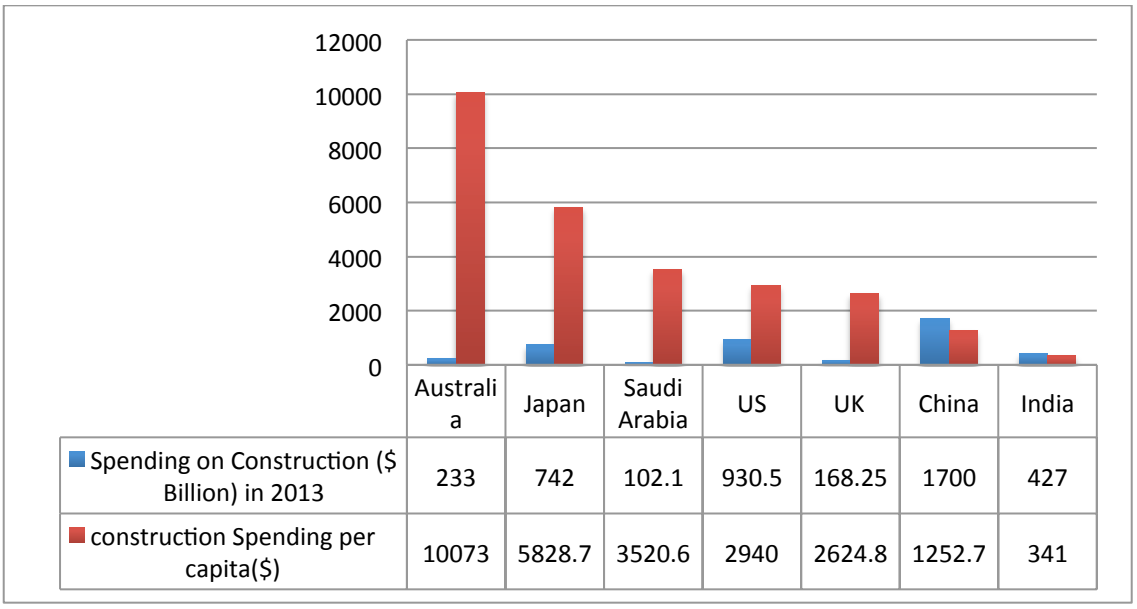
The issue of developing collaboration between universities and the industry has been explained in several studies (Barrett and Barrett, 2003, Gilkinson and Barrett, 2004, Awalla, 2006, Azhar, 2007, Liévana, 2010, Razak et al, 2010, Harrison & Graham, 2012, Bröchner, 2013, Hampson et al, 2014, Kuo et al, 2014, Daoud et al, 2016). A significant role can be played by universities in any company's innovation strategy in the form of resources. The business perspective asserts that the result of a research is merely of incidental worth and the outcome does not matter as much as the impact (Pertuze et al.

2010). According to Pertuze et al. (2010), it is imperative to know how the new knowledge attained from collaboration with an academic institute can affect the performance of the company. Hence, it is imperative to stress on the significance of creating a bridge between scientific exploration, projects, and technological development programs in universities, and research centres with the requirements of economic, social and environmental growth.

In Saudi Arabia, the construction industry has experienced a boom during the last 30 years since the government spending on infrastructure from 2008 to 2013 was estimated at $574.7 Billion (Ventures Middle East, 2011). Prince Dr. Turki Al Saud (2015) the President of King Abdulaziz City for Science and Technology (KACST) affirmed that the building and construction sector in the Kingdom ranks second after petroleum industry in contributing to the gross domestic production (GDP). The high rate of spending has made the Saudi construction industry the largest market in the Middle East and is expected to lead much of the growth in the region through 2015 (Langdon, 2012). Saudi Arabia is also considered one of the top countries in the world regarding the spending per capita as shown in Figure 1.

On the other hand, The Saudi government had done great efforts to support the research and development in both public universities and organizations. The King Abdulaziz City for Science and Technology (KACST) is involved in the national system of research and development (R&D), in addition to 200 scientific research units associated with universities and various governmental and private institutes. It was found in 2008 that R&D expenses were around 0.4% of the GDP. However, it appears that

Saudi Arabia is exhibiting dynamic responses to the global changes in the R&D environment, as can be seen from its increased R&D expenditure (Ministry of Economy and Planning, 2010).



	Australia	Japan	Saudi Arabia	US	UK	China	India
Spending on Construction ($ Billion) in 2013	233	742	102.1	930.5	168.25	1700	427
construction Spending per capita($)	10073	5828.7	3520.6	2940	2624.8	1252.7	341

Figure 1.:Total Construction Spending per capita ($) by country

It is expected that Saudi government will assign a greater budget to R&D and innovation, increasing it from 0.25% of GDP in 2000, to 1% between the years 2010 and 2015, and to 2% between the years 2015 and 2017 (Al-Sultan, 2012). Major cities are the centre of scientific exploration and technological development centres, which signifies the population concentration: the city of Riyadh, which is the capital city, is where 50% of the centres are situated, followed by Jeddah which has 19.3% of the centres, Dammam which has 12.5% of the centres, Jubail and Yanbu with about 3.5%; with the rest of the 14.7% spread out amongst other regions (Ministry of Economy and Planning, 2010). There are merely 23 scientific researchers in the population of 100,000. This rate is quite

modest compared to a few developed regions where there are 500 scientific researchers for every 100,000 individuals (Alshayea, 2013). According to a report published by the Ministry of Higher Education (2014) in 2013 the total spending in Saudi Arabia on scientific research amounted to $6.5 billion, which is 0.87% of the country's GDP as shown in Table 1 and Figure 2. The proportion of the government's spending budget on scientific research in 2013 has reached 2.94%. The engineering and technology field alone received about 23.9 % of public funding.

Table 1

Total Spending on R&D in Saudi Arabia (Ministry of Higher Education, 2014)

	2010	**2011**	**2012**	**2013**
Public Spending $ (Billion)	3.26	3.64	4.05	4.42
Private spending $ (Billion)	1.4	2.38	2.4	2.08

The Saudi government had done the following efforts to support the research and development (9th Development Plan, 2010- 2014, Ministry of Higher Education, 2014):

- There are about 200 scientific research units linked with universities and numerous public and private institutions
- $240 million annual budget for university research and national research centers
- Spending on scientific research at local universities were estimated at $351 Million in 2012 and $ 521.7 Million in 2013
- $154.6 million budget for overseas scholarships for faculty members to obtain MS, PhD degrees

- $80 million annual budget for studies in government agencies

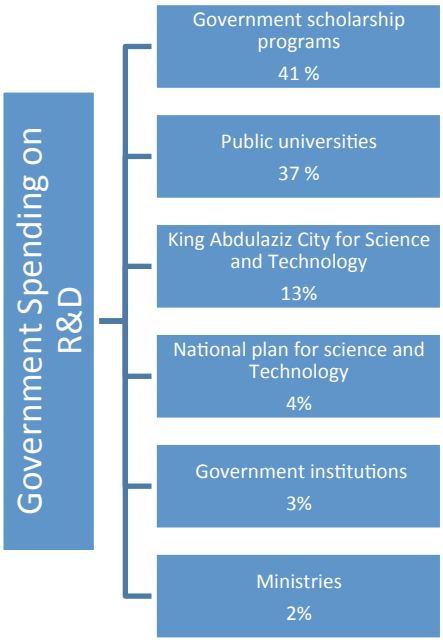


Figure 2: Types of sectors that received government funding (Ministry of Higher Education, 2014

Research Problem

The literature review indicates that the construction industry in the developed and developing nations is suffering from performance issues (Latham, 1994, Adrian 2001, Flyvbjerg et al, 2003, Frimpong 2003, Kashiwagi et al 2004, Kolltveit 2004, Omoregie & Radford 2006, Lepatner 2007, Ahmad et al 2009, Simonson 2006, Apolot et al 2011, Memon et al 2012, FICCI 2012, KPMG, 2015). Some of the issues faced by the construction projects in various nations are quality, overruns of cost and delays. The low level of performance of this industry is may due to the limited innovation activities and research and development (R&D) (Kulatunga, 2006). Furthermore, some researchers

suggested that coordination and cooperation amongst the construction industry management and practitioners and academic researchers is also quite ineffective (Khalid Huda et al, 2008, Graham et al, 2010, Razak et al, 2010, Gue and Chow, 2007, Alsehmi, 2014, Reichstein et al, 2005, NAS, 2009). The performance enhancement of this sector is not being contributed effectively by the academic research (Kashiwagi et al., 2008; Adeyemi et al., 2009; Egan, 1998; Cahill, 1994; Chan, 2004; Cox, 2003.) According to the construction professionals, the research carried out by the academics is entirely theme based and irrelevant for the industry. The results and outcomes observed along with the recommendations are also not practical in nature to be applied to the construction projects (Azhar, 2007, Kashiwagi, 2008).

A thorough literature review has been carried out to assess the situation of Saudi Arabia along with extending recommendations to reduce the gap between the construction industry practitioners and the academia for the implementation of appropriate procedures and technologies within the construction management field, the analysis suggests that there is limited information regarding the influence of construction management research upon the construction industry. In 1991, Al-Jallal presented a research with the title "*Technology adoption and innovation patterns in construction industry in Saudi Arabia: An exploratory study*". The research results suggest that the R&D cooperation is quite low and only 3 organizations out of 25 have attained this R&D assistance from the universities, two organizations are presenting the valuable information for R&D development and none of the organizations are funding the R&D projects. The organizations seem to be using the university resources through public

events like short courses, seminars and conferences. Hence, the study results indicate how the R&D is being neglected completely by the organizations of the construction industry as well as the academics. The local engineering organizations are considering the R&D support activities as insignificant (Al-Jallal, 1991). This issue was also introduced by the Saudi government in the 9th Development plan by reported that

" *there is a need for highlighting the importance of linking scientific research and technological development programmes and projects at universities, institutes and research centers to requirements of economic, social and environmental development, within the framework of the National Science, Technology and Innovation Policy. Indeed, this calls for linking the funding of scientific and research programmes and projects to the existing and future needs of sectors such as industry, water, agriculture, construction, oil, mining, environment, trade, education, and health"* (Ministry of planning, 2010). Therefore, this research aims to discuss the impact of construction management research in Saudi construction industry and propose solution to overcome this issue.

Research Aim and Objectives

The Saudi Arabian leadership has seen a need to educate its population. There are twenty-five government universities in Saudi Arabia, 16 of them have been created in the last 10 years and at least one major university is in each region of the country. Lecturers from universities have been sent overseas to get their masters and doctorate degrees costing the Ministry of Education about $154.6 Million every year (Ministry of Higher Education, 2014). This effort is to increase the quality of university education systems

and help the population adjust to the changing world around them and the modernization of the Saudi Arabian society. Returning faculties from abroad are instructed to bring back the latest advances in all technical areas.

The main aim of this dissertation is to evaluate the impact of construction management impact in Saudi construction industry, and to investigate barriers that hinder the diffusion of implementing the research outcomes in the construction sector in order to develop a suitable framework to bridge the gap between academic research and practice, using the experience of other organizations that have a successful experience in developing the impact of construction management research in the construction industry. In order to achieve the aim of this study, there are five main objectives, which are:

- **Objective 1**: Evaluate the impact of construction management research in Saudi construction industry.
- **Objective 2**: Identify the barriers that affect the implementation of construction management research in Saudi construction industry.
- **Objective 3**: Develop a research roadmap to bridge the gap between the research and practice.
- **Objective 4**: validating the proposed model by expose it to construction experts
- **Objective 5**: Proposed Implementation plan and review the result from the implementation.

Research Methodology

The aim of this study is to investigate the impact of construction management research in the Saudi construction industry and develop a framework to help implement the research result in the construction industry. The study design steps are as following:

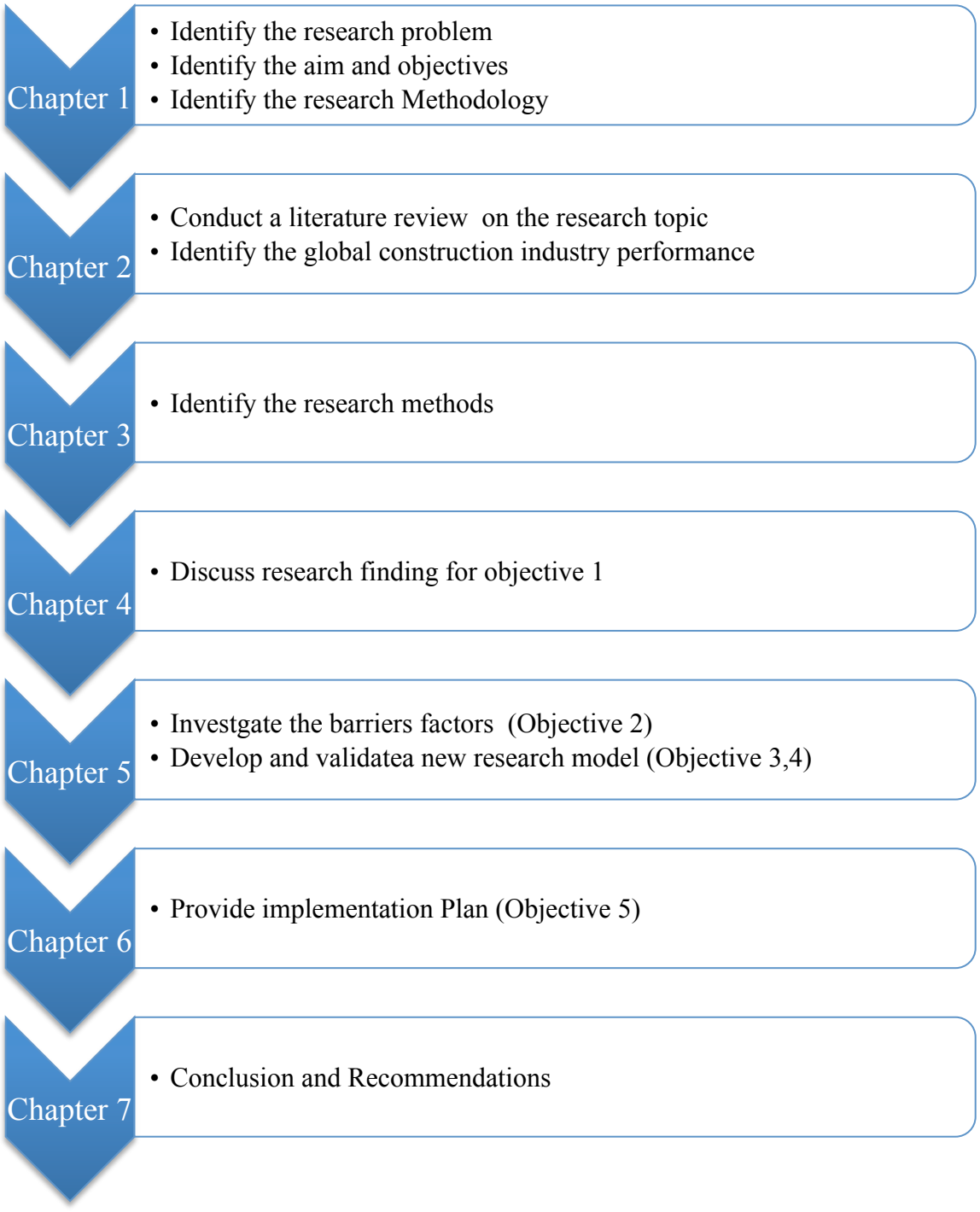
1. Identify the Saudi construction industry performance: In this step the author will conduct a literature review to identify the studies and reports that contain information about the performance of the Saudi construction industry. Also, the global construction industry performance will be researched in order to gain knowledge about the differences between the Saudi construction industry and other countries.
2. Identify the global impact of construction management research in the construction industry: In this step, a literature review will be conducted to identify the studies that discuss the gap between the construction industry and academic institutes.
3. Investigate the impact of construction management research on Saudi construction industry: The researcher will use two research methods to collect the data: A literature review and survey. In the literature review method, the research will identify academic research works in the field of construction management that were conducted in the Saudi construction industry. In the second method, a Survey will be conducted to identify the view of the professionals in both

academic institutes and the construction industry about the impact of construction management research on the Saudi construction industry.

4. Identify the barriers that affect the implementation of construction management research in the Saudi construction industry. In this step a literature review will be performed in order to identify the barriers factors. These factors will be used in a questionnaire that will be sent to both researchers and industry professionals.
5. Develop an implementation framework to bridge the gap between construction management research and the Saudi construction industry based on the literature review finding.
6. Validate the proposed model by exposing it to the professionals who have experience in the construction management field.
7. Provide an implementation plan for the proposed model. The author will start to implement the proposed model based on the plan that will be introduced later. The results from the implementations will be reported.

Research Structure

The following chart shows the structure and sequence of the chapters of this dissertation.



CHAPTER 2

LITERATURE REVIEW

In the last few years of the nineteenth century, the universities and the industry showed most regular links whenever universities assumed the responsibility of suppliers of scientists and technicians; however, cooperation agreements for R&D did not exist (Herbert, 1994). It was depicted in World War I that the technology possessed by the U.S. was lagging behind Europe in several aspects, leading to the rapid growth of chemical and textile industries (Graner, 1972). The pace of this process was so rapid that universities showed discontent at the significant decline in professors in vital areas of exploration. The American research system was organized such that the involvement of several universities in R&D arose much more rigidly in the middle of and following World War II (Liévana, 2010).

Research &Development plays a significant role in the growth of the construction industry as it improves the effectiveness of construction companies and increases international competitiveness with the help of technological and managerial developments (Hampson and Brandon, 2004). Organizations need to stay competitive in the market and for that, they should ensure that customer expectations are fulfilled completely, and future requirements of the customers are met. In this respect R&D functions as a significant input for organizational development. It is important to have R&D activities so that novel methods of developing goods and services can be discovered by using fewer time, cost and resources, but having greater quality (Kulatunga, et al, 2007). Construction firms should be involved more in R&D activities

because of the requirement for many areas such as housing facilities, renovation of infrastructure, and protection of cultural heritage (Plooij-van Gorsel, 2000). It is imperative to acknowledge the role played by R&D in dealing with viable objectives of the construction industry (Kulatunga et al, 2007).

The global Construction Industry Performance

In any country, developed or developing, the construction industry has a great impact on the economy. Numerous studies and reports have shown that during the last two decades the worldwide construction industry has had problems with projects delivering on time, on budget, and with satisfied customers (Latham, 1994, Adrian 2001, Flyvbjerg et al, 2003, Frimpong 2003, Kashiwagi et al 2004, Kolltveit 2004, Omoregie & Radford 2006, Lepatner 2007, Le-Hoai et al, 2008, Ahmad et al 2009, Simonson 2006, Apolot et al 2011, Memon et al 2012, FICCI 2012, Kärnä, 2014, KPMG, 2015). The following studies were conducted in different countries with the aim of measuring the performance of construction industry:

1. In the United States, The construction industry has experienced a decline in productivity at the rate of .8% per year (Adrian 2001). On the other hand, according to Lepatner, 2007, Due to inefficient communication, Construction companies are estimated to waste at least $15.8B per year
2. The 2011 United Kingdom Performance Report, based on the key performance indicators (KPIs) of the UK construction industry, stated that the projects completed on time were 45% whereas projects completed on budget were 63%.

3. In Australia, in 2010, a study was done by Love et al, 2010 to evaluate the performance of 115 civil infrastructure projects and found that the average rework cost was 10% of the value of project's contract.
4. In India, the FICCI-EY (2012) discussed the implementation of infrastructure projects in India. They reported that approximately 42% of the 564 infrastructure projects in India, costing more than INR 1.5 billion, have been delayed and around 31% have been sanctioned without any fixed commissioning date.
5. A study was done in Ghana revealed that only 25% of the projects were finished on time and on budget (Frimpong 2003).
6. A study conducted by Memon et al, 2012, showed that the Malaysian construction industry is also suffering from the lack of performance concluding that 92% of construction projects were overrun and only 11% of projects are finished within the budgeted cost.

KPMG during the year 2014 interviewed nearly 100 public and private organizations. The institutions are placed all over the world and their construction activities are quite significant. The annual revenue of these respondents was nearly US$250 million to US$5 billion. The owners of these organizations are subjected to project failures. The research also extracted the following issues.

- During the last year, there were nearly 53% respondents who were affected by underperforming projects. 71% of energy and natural resources and 90% of public sector respondents are being affected.

- Since the past 3 years, 10% of the budget was being spent by 31% of the respondents only.
- Since the past 3 years, only 25% of the projects were able to meet 10% of their original deadlines.

On the other hand, the author worked with a graduate students to conduct a study that aimed to identify the global construction industry performance (Rivera et al, 2017). In this study, nearly 3,200 publications were analyzed to extract information regarding additional performance by Alfredo 2017. Four research databases were present out of which the abstract of one was assessed to observe the publications that are relevant [ASCE Library, Science Direct, Taylor and Francis Online, Emerald Insights]. There were 260 publications which were relevant to the research topic out of the 3,200 publications which is why they have been reviewed in greater detail. A thorough review of these 260 publications indicates that for each nation, there were only 95 appropriate documentations keeping in mind the vital issues and four performance indicators. Table 2 indicates the nations and regions that have been researched upon. Five regions which are Africa, America, Asia, Europe, and Middle East indicated cost over runs according to the researchers. These regions include 16 nations, which are Ethiopia, Ghana, Nigeria, Uganda, India, Korea, Malaysia, Netherlands, Norway, Portugal, Turkey, United Kingdom, Kuwait, Pakistan, Palestine, United States forming 26 publications on the whole. Table 3 indicates 5 regions with 68% of projects faced over budget and the average of overrun cost was 23%. (Alfredo et al, 2017)

Table 2

List of Countries Researched (PBSRG, 2016)

Regions	**Countries (# of Documented Papers)**	**Total Countries**	**Total Papers**
Africa	Botswana (1). Ethiopia (1), Ghana (3) Kenya (1), Libya (1), Nigeria (11). Rwanda (1), Uganda (1), United Republic of Tanzania (1)	9	21
America	Canada (1), USA (4)	2	5
Asia	Cambodia (1), China (1), Hong Kong (1), India (6), Indonesia (2), Korea (3), Malaysia (6), Thailand (2), Vietnam (2)	9	24
Europe	Finland (1), Ireland (1), Netherlands (1), Norway (1), Portugal (2), Sweden (1), Turkey (3), United Kingdom (4)	8	14
Middle East	Iraq (2), Jordan (2), Kuwait (2), Oman (2), Pakistan (2), Palestine (3), Qatar (1), Saudi Arabia (5), United Arab Emirates (2)	9	21
Oceania	Australia (5)	1	5
Multiple Regions	Multiple Regions (5)	N/A	5

Additionally, within the research, five regions indicated delay from their schedule which are Africa, America, Asia, Europe, and Middle East. These regions included 17 countries which are Ghana, Nigeria, Tanzania, Uganda, Hong Kong, India, Jordan, Korea, Malaysia, Portugal, Turkey, United Kingdom, Kuwait, Oman, Palestine, Saudi Arabia, and United States. There was a total of 31 publications. The project percentage by region which have surpassed the schedule along with their average delay as compared to the original schedule is mentioned in Table 4 (Alfredo et al, 2017).

Table 3

Cost Overrun by Regions (PBSRG, 2016)

Region	**% Project Over budget**	**% Over budget amount**
Africa	69%	29%
N. America	98%	28%
Asia	59%	16%
Europe	50%	29%
Middle East	65%	15%

As compared to the cost overrun performance information, there is a similar schedule performance information for most regions shown in Table 4. Delay was experienced by nearly 74% of the projects. Out of 69%, there is 42% project duration delay as compared to the original scope. Similar to the cost overrun performance information, Table 3 shows similar schedule performance information for most regions.

Table 4

Schedule Delay Performance Metrics by Regions (PBSRG, 2016)

Region	% Projects Delayed	% Delay Amount
Africa	75%	53%
N. America	98%	37%
Asia	68%	37%
Europe	53%	55%
Middle East	79%	30%

On average, 74% of projects experience delay. Of the 69%, project duration is delayed 42% greater than the original scope. Interestingly, Europe and Africa have the highest percentage of project delay amount, despite Europe being more geographically and economically developed. The research also observed customer satisfaction levels from six regions namely Africa, America, Asia, Europe, Middle East, and Oceania which included 15 nations that are Nigeria, Tanzania, India, Korea, Malaysia, Vietnam, Finland, Portugal, United Kingdom, United Arab Emirates, Jordan, Kuwait, Saudi Arabia, Canada and Australia. There are 16 publications in total. Keeping in mind these six regions, it has been found that 100% of the publications have attained low customer satisfaction in terms of construction services since 10 years (Alfredo et al, 2017).At the same time, the reasons behind inadequate performance was assessed by the authors. There were 260 publications out of which 57 were documented and 438 issues were stated that are causing inadequate performance levels in the construction industry. Six major regions,

namely Africa, America, Asia, Europe, Middle East, and Oceania were part of the publication along with 29 nations. The major issues were in large numbers along with variations which is why the authors focused upon extracting the ten most recurring issues from each publication. Prioritization was done and a top 10 list was made from the 57 publications based on the presence of each major issue taking place. After the completion of this list, prioritization of the top 10 most to least documented issues were carried out as shown in Table 5. With the help of this list, it was possible to form a new and developed worldwide top 10 list of the vital construction issues where the projects were not performing adequately. The analysis suggests that financial issues are the most common through out the world. The table shows the complete list of causes, ranking and percentage appearance. It is these 10 vital issues which form 78% of the inadequate level of performance. Furthermore, out of the 10 causes, 9 of them was due to the people and not due to external issues like acts of God or the weather (Alfredo et al, 2017).

Table 5

Top 10 Causes of Non-Performance (PBSRG, 2016)

Top Ranked Issues	**No. of Incidents**	**Rank**	**% Appearance**
Monthly payment difficulties/ financial problems	47	1	15.3%
Poor project/contract management	28	2	9.2%
Shortage of materials/equipment	25	3	8.2%
Additional work/variation in client's	24	4	7.8%
Design change	23	5	7.5%
Poor planning and scheduling	22	6	7.2%
Poor qualification/shortage of labors	19	7	6.2%
Delay in construction/other delays	18	8	5.9%
Unforeseen site condition	17	9	5.6%
Poor/inaccurate estimate	16	10	5.2%

Overview on The Saudi Construction Industry

The Saudi Arabian kingdom is an oil-based economy. It is the largest and most powerful oil producing country in the world, exports of petroleum products 988,000 barrels per day (OPEC, 2015). The Saudi Arabian construction industry's contribution to GDP increased from 4.56 % in 2012 to 4.93 % in 2014 (Central Department of Statistics and Information, 2015). According to (Ventures Middle East, 2015) the total contracts awarded in 2013 across the Saudi construction industry was nearly $ 79.1 billion. After that the contracts awarded started to decreasing slightly to $ 58.2 billion in 2014. The contract awarded continued to falling in 2015 to $ 52.9 billion and that was because the decline of oil price. More than half of the total projects value in the construction industry building construction sector comprises more than half of the (56%) followed by power and water projects 13 % then infrastructure projects 12 %. Despite the high spending, the Saudi Arabian construction industry has had poor performance in the last 30 years. There have been several studies that have identified and documented problems in the industry. These studies are:

- In 1983, it was discovered by Zain Al- Abedien that the delays were the norm for 70% of the projects taken up by the Ministry of Housing and Public Works.
- Six years later, AlSultan (1989) reported the same percentage. He reported that 70% of Saudi Arabia's public projects had time-overrun issues.
- Al-Ghafly (1995) surveyed the contractors and the consultants and discovered that the contractors believed that 37% of the projects suffered

from delays whereas consultants agreed that 84% of the projects under their supervision suffered from delays. The researcher also reported that the estimated time overrun versus the total original time specified for a project amounted to 39%.

- In 2006, a study was conducted to identify the performance of construction projects iin Eastern Province. The study concluded that 70% of projects experienced time overrun and the average time overrun was between 10%-30% (Assaf & Al-Hejji, 2006).
- After 4 years, a study was conducted by Al Turkey (2011) with the aim of identifying the performance of construction industry. In this study, more than 300 project managers from different sectors and disciplines in construction industry agreed that 80% of the projects were subject to overrun costs, while 97% faced time issues.
- A study conducted by Alzara et al, 2016 reported that the performance of projects in University campus was facing delays between 50% to 150%.
- According to Elawi et al, 2016 the average delay found after analyzing 49 construction projects in Mecca province was 39 %.

It was observed that after conducting the literature review in Saudi construction industry, there is a scarcity of literature that documented the performance of construction industry. On the other hand, several studies have been conducted on the Saudi construction industry in order to identify the causes that affect the industry performance according to the construction stakeholders such as clients, contractors,

consultants and architects, as shown in Table 2. The top three causes of low performance were identified from each study, and the frequency of each cause were analyzed. The analysis showed that the most frequent cause appeared in the studies were related to the management practices by owners such as suspension of work, change of orders during construction, slow decision-making, late in reviewing and approving design documents, and excessive bureaucracy in projects. The second most frequent cause after management factors are financial issues. It is observed that some contractors experience cash flow problems during the projects resulting from delay in progress payments by owners. Moreover, it is clearly seen that each party blames the others for causing the low performance, which means that there is no transparency that allowed the parties to clearly identify who is causing the risks.

Table 6

Cause of none performance in Saudi construction industry

Study done by	According to	Possible causes		
		1	2	3
Mahamid, I. (2016).	Contractors	Delay in progress payment by owner	Unrealistic contract duration	Change orders
Al-Khalil & Al-Ghafly (1999)	The owners opinion	Delay in mobilization	Cash flow problems faced by the contractor	Difficulties in obtaining work permits
	The consultants opinion	Delay in mobilization	Cash flow problems faced by the contractor	Delay in the preparation of contractor submissions
AlKharashi & Skitmore (2009)	The owner opinion	Lack of finance to complete the work by the client	Slow decision-making by the owner	Suspension of work by the owner
	Contractors opinion	Replace key personnel	Slow decision making by the owner	Owner's poor communication
	The consultants	Suspension of work by the owner	Owner's poor communication with the construction parties and government authorities	Replace key personnel
Odeh &Battaineh (2002)	Contractors opinion	Labor productivity	Owner interference	Inadequate contractor experience
	Consultants opinion	Inadequate contractor experience	Finance and payments of completed work	Inadequate Subcontractors experience

Table 6: Continued

Study done by	According to	Possible causes		
		1	2	3
Assaf, S. A., & Al-Hejji, S. (2006).	Client opinion	Bidding system	Shortage of labors	Ineffective planning and scheduling
	Contractor opinion	Delay in progress payments by owner	Suspension of work by owner	Late in reviewing and approving design documents by owner
	Consultant opinion	Type of project bidding and award	Change orders by owner during construction	Shortage of labors
A. Assaf and AI-Khalil (1995)	Client opinion	Design errors	Excessive bureaucracy in project	Financing By contractor during construction
	Contractor opinion	Preparation and approval of shop drawings	Design changes by owner	Delays in contractors' progress payments by owner
	arch itectural engineering firms opinion	Cash problems during construction	Slowness of owner's decision-making process	Relationship between different subcontractors' schedules in execution of project
Ikediashi, Ogunlana and Alotaibi 2014)	civil engineers, architects, quantity surveyors and building engineers	Poor risk management	Budget overruns	Poor communication management
Arain, Pheng & Assaf, (2006).	Contractors ' opinion	Involvement of designer as consultant	Communication gap between constructor and designer	Insufficient working drawing details

The Gap Between the Construction Industry and Academic Institutes

During the 21st century, a sharp increase in the research and collaboration amongst the research institutions and organizations has been observed (Docherty, 2014). The construction industry may attain various benefits with the help of the R&D (Gue& Chow, 2007):

1. Profit margins would increase since delivery time and construction costs would reduce
2. The construction personnel may be provided with healthy and safe working environments along with enhanced productivity. Quality of life is better.
3. Global competition would help enhance the competitiveness levels.
4. Energy consumption, pollution and wastage is reduced leading to friendliness of the environment.

Nevertheless, the construction industry is still faced with issues as it is quite complex to integrate the academic research and the implementation to attain the mutual objectives. The industry support for R&D in the academic institutes is constantly on decline. Various scholars have stressed upon this issue (Shih & Chen, 2010, Dochertyet al, 2014, Daoud et al, 2016, Harty & Leiringer, 2017). The construction industry of Canada has also been receiving low level of industrial support for the R&D activities even though there are large amounts being spent upon the research for engineering and technology (Statistics Canada 2015).

In 2011, the construction R&D finances were $158 million which in 2015 were reduced to $79 million (Statistics Canada 2015). For Canadian organizations, R&D is not

one of the main focusing aspects which is why the industry and academia do not have a strong collaboration (Council of Canadian Academies 2013). Various components of the value chain construction network have been identified in the UK which are the low cost of development, operations under usual conflict conditions, low suffering, profitability is unpredictable and limited or low investment in innovation and training. In the construction industry, innovation and R&D activities are usually not associated. It is quite infrequent for the construction organizations to carry out patenting. The construction industry clients and constructors both have been subjected to various barriers when forming associations with universities. The barriers include culture, leadership and management. According to the research results, there is a strong need for the construction industry to associate with the universities so that they may develop measures that would allow for resolution of the issues like research contracts. (Dochertyet al, 2014)

The developed and developing nations are both suffering from gaps between the industry and the universities. The universities have confined themselves to their own walls and are not pursuing any activities to enhance their abilities to reduce the gaps between the industry and university. (Zaky & Faham, 1998).

Graham et al (2011) has proven this issue by showing that the construction related researches lack the capability to assist the construction industry. After reviewing 607-research publication from different journals, they found that the researches that are being done on construction industry are not aligned with the needs of the industry. They conclude their study by saying that "A review of literature shows that, historically, research has not played a major role in the advancement of the construction industry."

Moreover, Alsehaimi et, al (2013) have shown that the most existing delay studies suffer from limitations regarding their contribution to solving the problems that they identify. Similar causes of delay emerge across the studies, but a great share of authors recommends no practical solutions or methods to improve the situation. The National Academy of Sciences (NAS, 2009) in the United States of America (USA) stated that the construction industry of this nation does not have a research agenda which covers the industry at large. It is unable to identify those research areas that would be most beneficial and would enhance industry performance in terms of efficiency, productivity and competitiveness. Within the Pakistani context, there is no professional body in construction business that has significant data on the demands and prevailing market trends. Also both the private and public sectors lack a proper research organization, which may establish the existing and upcoming market needs to cover the gap. This particular industry cannot achieve its extreme potential with such a lack of constructive feedback and research. Subsequently, with the help of personal interviews and questionnaires, researchers are to evaluate the demands and needs of the industry. This, however, might be difficult because of the personal exposures and interests of an individual (Khalid Huda et al, 2008). In their 2007 study, Gue and Chow described how, aside from the Malaysian private sector's contribution in financial year 2001-02 to R&D, the construction industry has demonstrated small contribution, which has brought disappointment and, as a result, the developmental works have suggested boosting the contributions from private sector (Gue and Chow, 2007). In the United Kingdom (UK), a study by Reichstein found that the construction industry has an inconsiderable role as a

source of knowledge to bring improvement, whereas on the other hand, there is a lot of enhancement in the manufacturing industry (Reichstein, et al. 2005). In Malaysia, Razak et al, 2010 reported that "Construction industry players are not conducting Research and development (R&D) and in Malaysia most of the R&D is carried out in academic institutions. But areas covered are usually not in accordance with industry needs. This is another challenge for the industry and institutions to develop a closer working relationship with each other."

Kashiwagi, 2009, claimed that for traditional construction management, the research method is based on literature research along with the survey conducted upon the industry participants. This would help extract the construction industry issues and performance factors . Usually, hypothesis testing for real life perceptions and their validity is not carried out. Repeated industry tests would have to be carried out as part of the hypothesis testing for valid inductive testing of concepts since it would extract the reasons behind the non-performance or performance of the industry. Hence, the aspects which contribute towards enhancing the gap between the organizations and academia are the following (Kashiwagi, 2009).

1. The academic ladder can be climbed upon by the researchers using the research. The academic leadership positions would be used for success and not the dominant industry influence.
2. The cooperation from the industry and industry controlled testing does not allow the researchers to carry out their theoretical basic research, prototype testing, and

implementation of research concepts. They also do not have the capabilities like expertise, resources and time.

3. Research funding needs to be attained for which the researchers shift from one topic to another.
4. The researchers are not known for their influence on the industry at large through their research.
5. The research is conducted and documented by graduate students appointed by the researchers.
6. The construction industry makes use of academics for facilitation, education or technical expertise but they are not used as innovators who would change the structure of the entire industry. They seek to maintain the status quo.

Moreover, Alfredo, 2014 believes that the construction industry practices have not been altered through the efforts of the construction management research. The academics are in search for promotions in terms of peer reviews through paper systems and attaining grants which is why they are not focused upon becoming experts to alter the practices of the industry at large. Since the past 25 years, the international construction management field has documented construction industry performance in a poor manner. Even after spending billions of dollars upon research investment over a period of 25 years, there is no clear solution yet. The research indicates that a hypothesis is maintained by selective researchers along with limited industry research test cycles that would eventually lead to a positive change in the industry society. Abbasi, during the year 2007, conducted an exploratory research within the Middle East. The objective of the research was to analyze

the R&D carried out in the construction industry of the developing nations which includes the Middle East nations. The research results indicated that there is a pressing requirement for a strategy that is based specifically upon the region to make sure the Middle East construction carries out the R&D.

In Saudi Arabia construction industry, limited research has been conducted upon extracting the issues related to research and development. In 1991, Al-Jallal was the only researcher who carried out a study namely the Technology adoption and innovation patterns in construction industry in Saudi Arabia: An exploratory study. His research results indicated that these is minimal coordination and cooperation of R&D since only three organizations have requested university assistance for R&D, two organizations have extended R&D information for the research to be conducted at the university and there are no organization that have provided any sort of funding. It is the public events which are considered as the highly exploited university resource extraction like the short courses, seminars and conferences. The research also stated that the construction industry and universities or organizations have all neglected the importance of R&D. Hence, the local engineering organizations have also not paid any heed to the activity of R&D (Al-Jallal, 1991).

CHAPTER 3

RESEARCH DESIGN AND METHODS

Research is a simple activity where it is possible to attain the answers to the highly complicated questions related to the daily activities (Kumar 1999). Several books and articles have brought forward the definition for research. According to Grinnell (1993) “re” and “search” are the two syllables which form the word research where re means a new or over again and search is to test, assess or probe in a careful manner. Re is considered a prefix and search is a verb but when they are put together they form a noun. This noun refers to the thorough, patient and sequential assessment where the knowledge area is being analyzed to extract the facts and principles present within the scenario. Burns (1994) stated as part of his definition that it is a systematic analysis to extract solutions for an issue. At the same time, Leedy (1989) states that it is a procedure where the idea is to systematically extract using the help of demonstrable facts, the solutions to the issues or answers to the questions.

Kumar (1999) suggests that there are three perspectives involved within a research which are the application of the research, the objectives underlying the decision to carry out the research and the information type, which is to be extracted. For the initial part, the entire research activity is viewed by the researcher in terms of the application. The first kind of research can be divided into pure and applied research. In the second category, the research is assessed based on the objectives that have been integrated. The second category is further divided into exploratory, correlation, descriptive and explanatory research. In the third category, the information being extracted would be in

terms of quantitative or qualitative research. Saunders et al (2009) suggests that there are six kinds of research classifications, which are experimental, grounded theory, ethnography, case study, survey and action research. The Experimental Approach indicates the influence of the specific treatment upon the outcome. To carry out an assessment, one group is treated in a specific manner and observed while keeping it away from the other group who has not been treated to extract the performances of both. (Keppel 1991). For case studies Approach, social scenarios can be analyzed through the Case study method by taking into account individual cases. A case may be formed by a social life component or aspects such as an individual, society, community, episode, person or group. The information which is relevant to the case is extracted and then organized to help carry out an intensive analysis of the specific aspects that have not been observed by the rest of the procedures. (Kumar 1999). On the other hand, the observational study approach is carried out by making use of the personal observation of the researcher after interviewing the respondents. The present scenario is stated by the information, which is collected, and it does not include past information since that would complicate aspects in terms of attitudes and behaviors of the respondents. (Kothari 2008)

On the other hand, when a specific population was researched upon, with the help of the surveyapproach it would be possible to extend a quantitative or numeric analysis of the attitude, opinions or trend of this specific population (Babbie ,1990). The objective is to generalize from a sample to an entire population. With the help of structured interviews or questionnaires to collect information, the survey research would carry out

longitudinal and cross sectional studies. Questions related to individual behaviors, opinions and attitudes are part of the survey research (Marczyk ,2005).

Surveys are of two kinds, interview and questionnaires. Over a specific purpose, the person-to-person interaction between two or more individuals or groups is referred to as the interview A flexible structure interview can be carried out where the interviewed is able to ask questions spontaneously and can manage the situation according to the earlier developments. Whereas in questionnaire survey there is no direct contact between the interviewer and respondent which is why the various aspects need to be managed appropriately (Kumar 1999).

On the other hand, there are various limitations which must be considered. The questionnaire can only be delivered to respondents who are educated so they may fill it out. The respondents are also not provided with any sort of explanation or illustration. Furthermore, the response of one question may influence the response of the other, there are no spontaneous responses, mutual consultation for the question and answer session is not present and the supplemented data is not assessed appropriately (Kumar 1999).

Additionally, depending of the type of information required, Quantitative and Qualitative research are the two kinds of research methods.Quantitative research is consideredif the researcher has an objective to quantify the situation, issues or scenario and its variations, the research can be classified as the quantitative research. The quantitative variables have been used to extract the information. This assessment would also help assess the scale of the variation (Kumar, 1999). Whereas, qualitative research is the analysis and assessment of the manner in which individuals or groups affect the

human or social issue. This research procedure also includes the extraction and collection of data within a specific and required scenario, the process and questions which arise, for generalization of the theme the data analysis is formed from specific and meaning interpreted by the researcher. (Creswell 2009). At the same time, Kumar (1999) states that the study would be referred to as a qualitative research if the information is collected through qualitative scales (nominal or ordinal) variables and assessment is done without quantification.

The Nature of the Current Research

This research project aimed to assess the impact of construction management impact in Saudi construction industry, and to investigate obstacles that hinder the diffusion of implementing the research outcomes in the construction sector in order to develop a suitable framework to bridge the gap between academic research and practice. In order to achieve the study's aim there are five objectives that need to consider which are:

- Assess the impact of construction management impact in Saudi construction industry
- Investigate obstacles that hinder the diffusion of implementing the research outcomes in the construction sector
- Develop a suitable framework to bridge the gap between academic research and practice
- Validate the proposed developed model
- Provide an implementation plan

The Research Methods Used for the Current Study

Since this study discuss the implementation of construction management research in the Saudi construction industry, the opinion of industry professionals and academic researchers regarding this issue must be considered. Based on the above information regarding the different types of research methods, the author considers survey methods as the most suitable research method for this study. These surveys will help to maximize the data collection and benefit from the experience of many industry professionals and academic researchers from different organizations. The questionnaire was designed based on the directions that were mentioned earlier. The questionnaire was divided into two main parts, namely personal questions and questions that aimed to identify the impact of construction management research works in the Saudi construction industry. The personal questions are related to:

- Work experience
- Educational background
- Participants research efforts

In the second part, the participants were asked to give their opinion if they agree or disagree with the following statements:

- Most of the construction projects in Saudi Arabia have performance issues (Delay or Cost overruns, Quality or Safety issues.
- Most of the research publications in Saudi construction industry performance have not helped to improve the construction sector performance.

- The research centers (Public/ Private) that have interest in Construction industry have helped the Saudi construction industry to improve.
- The role of Saudi universities to improve the Saudi construction industry performance is effective.
- Most of the proposed solutions\ recommendations in publications are theoretical based and not tested in the real construction projects.
- There is collaboration between universities and government agencies to find solutions for real issues in construction projects.
- There is collaboration between universities and private agencies to find solutions for real issues in construction projects.
- Overall, there is a big gap in the collaboration between the Saudi research centers and Saudi construction industry to improve the construction performance.
- There is a real need to change the Research & Development in Saudi construction industry

CHAPTER 4

RESEARCH FINDING AND DISCUSSION

The research methods used in this study are literature review and survey. For the literature review phase, the aim was to analyze the construction management research efforts that were published in Saudi Arabian construction industry. The targeted literature sources are limited to refereed academic journals, conferences and thesis/dissertations, published in English. Relevant research papers are identified and gathered using the following three methods:

1. First, the authors wanted to keep the searches as broad as possible to minimize the chances of missing any construction management related publications in Saudi Arabia. Search code was carried out on five databases, which are Emerald Journals, EI Compendex, ABI/Inform, ASCE Library, and Google Scholar. For this purpose, the search code is as follows: ("construction industry" OR "construction projects" OR "infrastructure projects") AND "Saudi".
2. The academic researchers and industry professionals were asked in the survey to help the authors to find researchers or studies that have helped the SCI performance to improve.
3. The third method was through reference lists of the papers identified.

The relevant publications (journal papers, conference papers, and dissertations) from the search results were identified through reading titles, abstracts, keywords and brief scanning of the publication's manuscript to filter out unrelated papers. Once the online databases and search engines had been exhausted with deleting the repeated titles,

an in depth search was performed for any related articles that were identified as references in the previously identified publications. The same five engines were employed to find the referenced articles. There were five other main engines were also utilized for this task which are: Saudi digital library, ProQuest, Illiad interlibrary service, ScienceDirect, and Informaworld. The researchers found an additional 28 related articles after conducting this step.

Distribution and number of identified construction management research papers published every five years is shown in Figure 3 and the most frequent sources of the identified papers are shown in table 7. As shown in figure 3 the published papers in construction management in Saudi Arabia steadily increased over the years from 1980 to 2010. However, there was a dramatic increase in the published papers from 2011 to 2015 as 140 publications were published during this period. Considering the most frequent sources of the identified papers shown in table 7, Journal of Construction Engineering and Management were found to be the most journal that authors in the Saudi construction industry publish in with 18 papers published in the journal. The second most journal that authors in the Saudi construction industry publish in is International journal of project management with 14 papers published in this journal. The third most journal that authors in the Saudi construction industry publish in is Construction Management and Economics with 13 papers published in this journal.

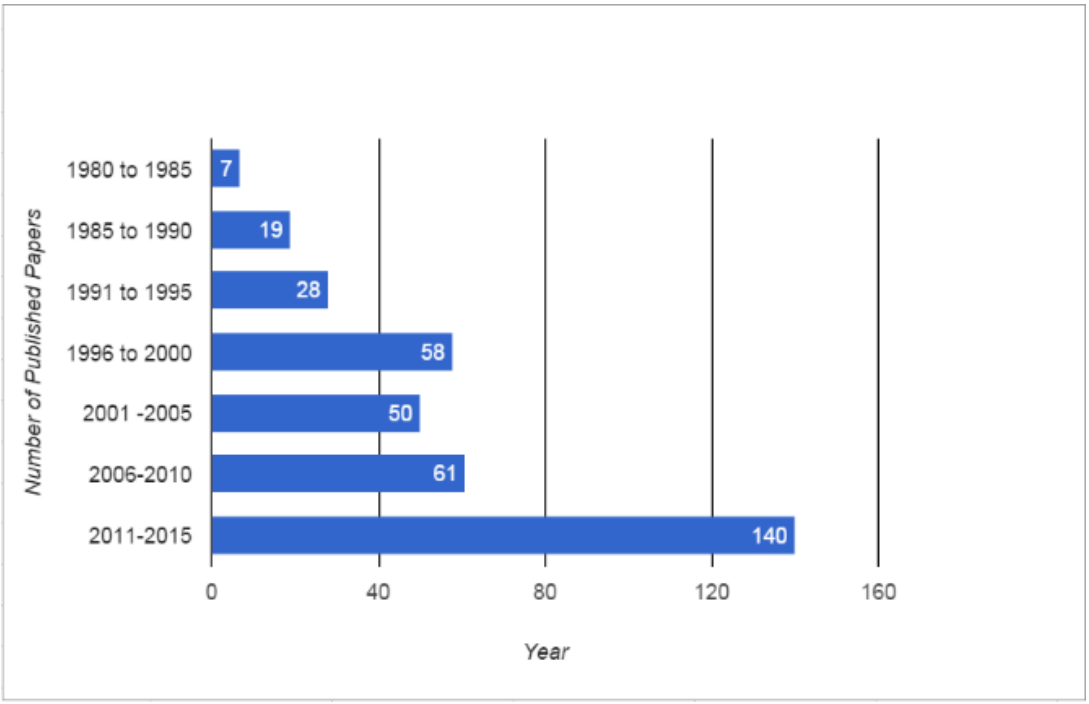


Figure 3:Distribution and number of relevant papers for every five years.

In addition to the literature search, two questions were added to the conducted survey. The questions ask academic and professional experts to identify if they published or know any research articles or researchers that applied experimental research in construction management in Saudi Arabia. The survey respondents did not provide any new information as all their responses were already included in the research database. Results of the databases search returned more than 21000 hits in the first step of the literature search. Of those publications, 483 were selected for further analysis as they fit

the criteria of the targeted publications. The identified publication was reviewed in details and essential information was captured in a literature database using Excel.

Table 7

Most frequent sources of the identified papers

Name of Sources	No. of Papers
Journal of Construction Engineering and Management	18
International journal of project management	14
Construction Management and Economics	13
Journal of management in engineering	11
Building research and information	11
Association of Researchers in Construction Management	8
Cost Engineering	7
Journal of Performance of Constructed Facilities	6

The database information included publication's title, abstract, journal or conference name, authors' names, year of publication. The search results are shown in Table 8. Once the information database was completed, quantitative methods were applied to analyze the results. The target papers is the construction management studies, (the studies that discuss planning and scheduling, managerial topics, delay, cost, quality, safety, O&M, etc.). Technical research efforts that discussed for example construction material such as concrete, cement, and soil were not considered in the analysis. The total

number of research papers found in the database is 483 studies. The technical research based studies found in the database is 120 whereas the construction management research based is 363.

Table 8

The research efforts in Saudi Arabian construction industry

Academic Search Engines	Total Results	Relevant Hits	Years Range
EI Compendex	303	222	1981- 2015
ASCE Library	221	47	1983- 2015
ABI/ Inform	3914	58	1986- 2015
Emerald Journals	201	21	1996 – 2015
Gogar Scholar	16,600	135	1977- 2015
Total		483	

As it is shown in Table 9, the collected data were grouped into three main categories, which are:

- Theoretical research based: in this category all studies that have not been implemented in the real construction projects were identified.
- Prototype test research based: all studies that have been tested one time in real construction projects were identified.

- Implementation research based: all studies that have been implemented with repeating the actual testing to validate the proposed solution and document the performance result.

The results reveled that, most of the existing construction management publication (94.5 %) are theoretical based whereas only 5.5% are tested in real construction projects. However, there were no publications found that repeat the actual testing to validate the proposed solution and document performance metrics on the action research results. Interestingly, the total papers that proposed solution found in the database are 237(65%).

Table 9

The analysis of construction management research based

Category	Number
Total construction management research based	363
Theoretical research based	343 (94.5 %)
Prototype test research based	20 (5.5 %)
Implementation research based	0

The second method was to conduct a survey. A survey was designed for measuring the SCI academics and professionals' perceptions towards the current R&D practices in the construction management, and their receptivity towards the proposed solution, to contribute to the solution development. The survey was composed of sixteen questions and was distributed through emails to over 110 SCI professionals. Those

professionals have experience as construction managers and are registered in the project management chapter in Saudi Council of Engineers. The other targeted sample is the academic researchers. 25 Saudi universities were identified and 56 emails were sent to the academic researchers who are specialized in construction engineering and management.

The survey received 76 respondents (41 professionals and 35 academics). They were asked to identify their background and then to answer R&D related questions. The background questions were about the participants' level of experience and type of organization they work in. Five areas of work were targeted which are: university, private or public organization, governmental or private research center. Also, the respondents were asked to specify how many research publications have they involved in. For the R&D related questions, participants were asked to rate their answers on a scale of (strongly agree, agree, not sure, does not agree, and strongly does not agree). There are two questions that have different style. The respondents were asked to identify if they published or know any research article or researchers that implemented their proposed solutions in real construction projects in Saudi Arabia and published the results. If the respondents answered "yes", they were asked to provide the study name. Most of the respondents have skipped this question, which means researchers do not track their studies and work with the industry professionals to implement the research outcomes. One of the respondents stated that " I have published many researches, I don't now if the construction practitioners used my research outcomes". The educational background of respondents spans all the levels of education with 26.3 % having PhD degree, 47.37 %

having MS degree and 26.32% having bachelor degree. On the other hand, the level of experience and the number of publications respondents involved in are presented in Table 10 and Table 11 respectively.

Table 10

Participants' years of experience

Years of experience	**Percentages (%)**
1-5	34.21
5-10	31.58
10-20	21.05
More than 20	13.16

Table 11

Participants research efforts

Number of publications	**Percentages (%)**
None	39.47
1-5	39.47
5-10	7.89
More than 10	13.16

As it is shown in Table 12, In the first question considering the respondents' perceptions about the construction industry performance, almost all of the respondents (97%) either strongly agree or agree that most of the construction projects in Saudi Arabia have performance issues considering delay, cost overruns, quality or safety issues. This shows that the construction industry in Saudi Arabia is suffering from a low performance that needs to be improved. Researchers in the context of construction

industry should help in finding solution to improve the performance of the construction industry. However, the second question of the survey investigated the previous scenario. 69% of respondents either strongly agree or agree that most of the research publications in the Saudi construction industry (SCI) have not helped to improve the SCI performance, whereas only 11% of respondents disagreed with the previous statement.The third question was about the effectiveness of research centers both public and private in helping the construction industry to improve in Saudi. The majority of the respondents (70%) disagree of strongly disagree that the research centers (Public/ Private) that have interest in Construction industry have helped the SCI to improve.Only 11% of the respondents agreed with the previous statement. Most of public research centers in Saudi Arabia are within the universities.

A question was asked about the effectiveness of universities in Saudi Arabia to help the construction industry to improve. 78% of the respondents disagree of strongly disagree that that the role of Saudi universities to improve the SCI performance is effective whereas only 11% agree with the statement. This shows that universities and their research center in Saudi do not have an impact in developing new approaches that improve the performance of the industry.

The effectiveness of universities in Saudi Arabia to help the construction industry was further investigated in more details considering the universities collaboration with government agencies and private agencies to interact in applying research and developing solutions. A question was asked about if there is there is collaboration between universities and government agencies to find solutions for real issues in construction

projects. The majority of respondents (61%) either disagree or strongly disagree that there is collaboration between universities and government agencies to find solutions for real issues in construction projects whereas only 14% disagreed with the statement. Another question investigated if there is collaboration between universities and private agencies to find solutions for real issues in construction projects. 58% of the respondents either disagree or strongly disagree that there is collaboration between universities and private agencies to find solutions for real issues in construction projects. However, a considerable percentage of respondents (22%) agreed that there is collaboration between universities and private agencies to find solutions for real issues in construction projects. Overall, the majority of respondents in another question (94%) agreed or strongly agreed that there is a big gap in the collaboration between the Saudi research centers and SCI to improve the Saudi construction performance. Furthermore, another question was asked about the proposed solutions and recommendation by authors in the available publications in the context of the Saudi construction industry. 86% of the respondents either strongly agree or agree that most of the proposed solutions\ recommendations in publications in the context of the Saudi construction industry are theoretical based and not tested in the real construction projects. Finally, the majority of respondents (94%) strongly agree and agree that there is a real need to change the research and development methodologies in Saudi construction industry. Overall, table (12) provides the results of the descriptive statistics for the academic efforts being conducted in SCI. Analysis of samples response using the concept of weighted mean and standard deviation. The formulas being used to calculate the mentioned statistical indices were

1. The mean

Mean (m) = Σ [a. (n/N)]

Where :

a is the weight being used

n The weight frequency

N is the sample size

2. The standard deviation

$$SD = \sqrt{\frac{\sum (x - \bar{x})^2}{N - 1}}$$

Where:

x is the response value

x bar is the mean

n is the sample size

The results tell that the effort represented by question no. 9 (There is a real need to change the R&D in Saudi Construction industry (SCI)) has recorded the greatest mean (4.66) while the effort represented by question no. 4 (The role of Saudi universities to improve the SCI performance is effective) has ranked the last order as it recorded the minimum mean (2.11). All other values ranged between these two values.

The responses have agreements on the following

- The SCI performance is suffering from performance issues.
- The research publications have minimal impact in the SCI
- There is a lack of collaboration between the universities and the SCI (public and private sectors).

Table 12:

Descriptive statistics for the academic efforts being conducted in SCI

no.	Question	%					mean	sd
		strongly agree	agree	Not sure	disagree	Strongly disagree		
1	Most of the construction projects in Saudi Arabia have performance issues (Delay or Cost overruns, Quality or Safety issues	66.67	30.56	2.78	0.00	0.00	4.64	0.53
2	Most of the research publications in Saudi Construction industry (SCI) have not helped to improve the SCI performance	38.89	30.56	19.4	11.11	0.00	3.99	1.01
3	The research centers (Public/ Private) that have interest in Construction industry have helped the SCI to improve	0.00	11.11	19.4	44.44	25.00	2.16	0.92
4	The role of Saudi universities to improve the SCI performance is effective	5.56	5.56	11.1	52.78	25.00	2.11	1.03
5	Most of the proposed solutions\ recommendations in publications are theoretical based and not tested in the real construction projects	33.33	52.78	11.1	2.78	0.00	4.14	0.76

Table 12: Continued

no.	Question	%					mean	sd
		strongly agree	agree	Not sure	disagree	Strongly disagree		
6	There is a collaboration between universities and government agencies to find solutions for real issues in construction projects	0.00	13.89	25.00	19.44	41.67	2.13	1.11
7	There is a collaboration between universities and private agencies to find solutions for real issues in construction projects	0.00	22.22	19.44	27.78	30.56	2.34	1.14
8	Overall, There is a big gap in the collaboration between the Saudi research centers and SCI to improve the Saudi construction performance	55.56	38.89	5.56	0.00	0.00	4.50	0.60
9	There is a real need to change the R&D in Saudi Construction industry (SCI)	70.59	23.53	5.88	0.00	0.00	4.66	0.58

The finding is an evidence to show that the construction management research efforts are not helping the SCI performance to improve. Thus, the existing academic research efforts have had minimal impact in assisting the construction industry to overcome its performance issues.

Questions reliability and validity

The construct validity was used to evaluate the degree that each question being stated to serve the main idea of academic research efforts being conducted in SCI to explore the impact of the construction management. This type of validity evaluates the magnitude and direction of the Person correlation coefficient between the responds of the sample on a given question and the total representing all questions. Generally a correlation value of 0.70 or higher (max value of correlation that could be reached is 1) is reflecting a strong (high) relationship, consequently the question is said to converge (i.e. correlates strongly) to the main topic. The results of person correlations are presented in the table 13. The correlation values provided suggest a very strong relationship between each question and the total of the questions, suggesting a very satisfactory level of construct validity. All the values were statistically significant at < 0.001 level. Noting that most of the values provided in the table were close to the integer 1 which represents the maximum possible value a relationship could be reached. Exploring the correlation values, the minimum correlation value was noticed in question 9 (0.820). These valuesexpress a strong relationship (generally a value of 0.70 or higher is considered to express a strong relationship)

Table 13

The construct validity for the questions expressing the academic efforts being conducted in SCI to explore the impact

Question		r	sig
1	Most of the construction projects in Saudi Arabia have performance issues (Delay or Cost overruns, Quality or Safety issues	0.836	< 0.001
2	Most of the research publications in Saudi Construction industry (SCI) have not helped to improve the SCI performance	0.951	< 0.001
3	The research centers (Public/ Private) that have interest in Construction industry have helped the SCI to improve	0.935	< 0.001
4	The role of Saudi universities to improve the SCI performance is effective	0.867	< 0.001
5	Most of the proposed solutions\ recommendations in publications are theoretical based and not tested in the real construction projects	0.886	< 0.001
6	There is a collaboration between universities and government agencies to find solutions for real issues in construction projects	0.930	< 0.001
7	There is a collaboration between universities and private agencies to find solutions for real issues in construction projects	0.959	< 0.001
8	Overall, There is a big gap in the collaboration between the Saudi research centers and SCI to improve the Saudi construction performance	0.861	< 0.001
9	There is a real need to change the R&D in Saudi Construction industry (SCI)	0.820	< 0.001

Reliability:

The approach of internal consistency suggested by cronback alpha was used to describe the degree that the questions of the academic efforts being conducted in SCI to explore the impact of the construction management is reliable to evaluate the efforts being conducted in SCI to explore the impact of the construction management. The idea is based on calculating the ratio of the sum of questions variance to the variance

representing the total questions and adjusting the answer to the number of questions. The cronback alpha formula (α) is:

Given that: n is the number of items

V_i is the item variance

V_t is the variance of the items total

Table (14)

Cronback alpha reliability for academic efforts being conducted in SCI to explore the impact of the construction management (n=76)

No. of questions	value
9	0.962

$$\alpha = \frac{n}{n-1}\left(1 - \frac{\sum_i V_i}{V_t}\right)$$ (Cronbach, 1951, p. 299)

The value of the internal consistency provided in table (14) suggests a very meaningful reliability. Generally a value of 0.60 or greater expresses a good reliability so the provided values express a high degree of consistency; consequently good reliability was concluded (here also the maximum possible value that may be obtained is 1)

CHAPTER 5

DEVELOPMENT of A NEW RESEARCH ROADMAP

Before developing a new research roadmap, it is important to understand the barriers that affect the research implementation in construction industry. To achieve the second objective, a literature review was performed to identify the studies that discuss the barriers that affect the implementation of research outcomes in the industry. Awalla, 2006 designed a questionnaire to identify the barriers factors that influencing dissemination of research. Engineer, Architect, Academia, Quantity Surveyor, and Contractor were participated in the survey. The top barriers factors are:

- *Relevant literature on research is not compiled in one place*
- *Research reports/articles are not easily available*
- *The University/Institution does not have research dissemination policies and strategy.*
- *Information about the existence of relevant research is not available*
- *No time is allocated to dissemination research findings.*
- *There is no effort in transforming putting out "readable" information for practitioners.*
- *There is lack of funding for dissemination of research results*
- *Research reports/articles are not published fast enough*

Bruneel et al, 2010 also Identified in their study the factors that diminish the barriers to university–industry collaboration. The top factors are

- Long-term orientation of university research.

- Potential conflicts with university regarding royalty payments from patents or other
- intellectual property rights and concerns about confidentiality.
- Rules and regulations imposed by universities or government funding agencies
- Industrial liaison offices tend to oversell research or have unrealistic expectations

Moreover, Othman and Omar 2012 identified and categorized the gaps in both industrial firms and institutional organizations as a step to insure a successful partnership between the two sectors. . The barriers related to the industrial firms are

- The industry is not willing to support the education program financially.
- The industry does not perceive the value of the training program offered by universities.
- The industry believes that they know more than academics on how to solve their problems.

The barriers related to the institutional organizations are

- The institute's trainers might not be sensible about the time limitations required by the industry.
- The real issues are faced by the industry may not be addressed by the universities.
- The facilities provided by universities are not adequate with the industry requirements.

In Saudi Arabia, a study was done to investigate the technology adoption and innovation patterns in construction industry. One of the study's objectives was to identify the barriers that affect the cooperation between universities and construction industry. According to

study the result, the limited level of cooperation by the universities for the organizations in construction industry is due to the following barriers (Al-Jallal, 1991).

- University services being provided are not appropriately defined
- Faculty is lacking the desired level of practical experience
- The established communication channels are lacking
- Issues of logistics
- Coordination complexity and time restraints of the projects

Successful Factors to Bridge the Gap between Research and Practice

It is vital that there is a strong integration between the construction industry and the academics. To carry out this activity, the research and development for both sides must be enhanced. Winer & Ray, 1994 define their collaboration as a mutual benefit and well stated association formed by two or more entities to attain objectives which would not be possible to be achieved by themselves.

According to Van de Ven & Johnson (2006) "The gap between theory and practice is typically formulated as a knowledge transfer problem". As part of the applied regulation, knowledge includes two key flows to be available for research and practice (Moody, 2003) (Figure 4):

- Practice → Research: The society and practice needs must contribute towards the research activity. It makes sure that the research takes into account the practical and social issues which are important or relevant.

- Research → Practice: In practice, the research results are to be broadcasted and implemented. The research would help enhance the practical activities and the society would benefit at large. For an applied field, it is quite possible that eventually the outcome would be socially beneficial.

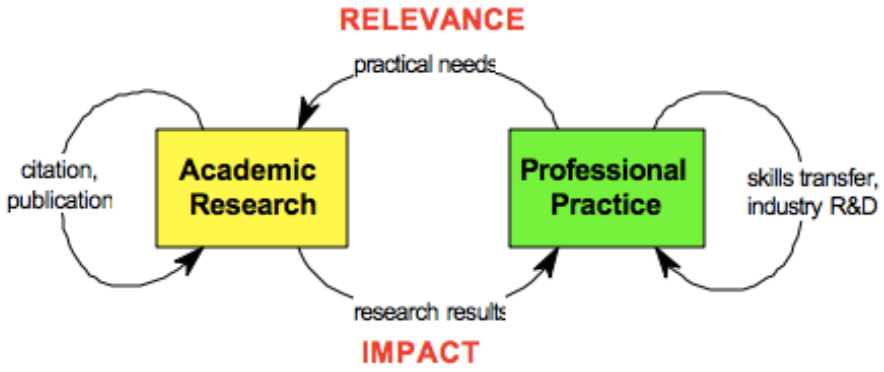


Figure 4:Knowledge Flows between Research and Practice Source: (Moody, 2003)

There are several studies that point out successful factors that help to improve the collaboration between the academia and industry practitioners.(CII 1997, Harrison & Graham2012, Ferguson 2005 , Ntshwene et al, 2009, Aouad et al, 2010, Kelemen & Bansal, 2002, Fotwe et al, 1997). studies point out Within the construction industry, the managers require that the research outcomes are such that they can be applied in a ready manner upon the practical world. This would only be possible if the research is applied in nature. It is vital to make sure that the practical aspects of the industry are integrated with the solutions presented in the research study. For the construction management field, the established research perspectives would not be appropriate for the modern development systems in the industry (Fotwe et al, 1997).

Usually, the practitioners are not attracted towards the academic knowledge being supplied. A framework must be established where the practitioners as well as academics are satisfied. They must be brought together on one platform through appropriate negotiations so that a substantial outcome may be attained through the research style adopted. For the promotion of construction innovation using the research, an engagement mechanism must be applied according to various scholars. This mechanism would help integrate the industry and the academics along with helping recognize as well as respond to the various innovation perspectives (Aouad et al, 2010, Kelemen & Bansal, 2002). The critical success factors that would help diminish the gap between research and practice according to Ferguson 2005 are:

1. Stakeholder involvement where the students, researchers, development practitioners and other parties are also integrated.
2. The momentum must be harnessed to make sure there is active motivation that is above and beyond the defined partnership.
3. The partnering stakeholders must be delivered the results attained.

On the other hand, it is important to realize that one of the successful factors to bridge the gap between research and practice is to hire experts who have a successful experience in developing the construction industry and meet the industry requirements. According to Edmondson et al, 2012 "*people determine the success or failure of industry-university partnerships. To attract industry involvement, universities must have people capable of building and managing partnerships. Collaborations only work well when*

they are managed by people who cross boundaries easily and who have a deep understanding of the two cultures they need to bridge."

In Hong Kong, a new strategy to develop research and development was introduced in 2005. This strategy consisted of two main initiatives, namely "*identify the strategic technological areas to be actively promoted by the government*" and "*set up R&D centers in selected areas to conduct applied R&D and to facilitate technology transfer from universities and research institutes to the business sector*". The primary criteria to select the required areas include (Shih & Chen 2010)

- *Existing research capabilities of universities and other research institutes*
- *Hong Kong companies' competitive advantages*
- *Industrial needs*
- *Market potentials.*

Moreover, The Queen's University Research Roadmap introduced Knowledge Implementation called (QuRKI). Three main phases conclude the The QuRKI model which are (Harrison & Graham2012)

- Phase 1: Issue Identification/Clarification.
- Phase 2: Solution Building.
- Phase 3: Implementation, Evaluation, and Nurturing the Change.

In 1997, an assessment was carried out by the Construction Industry Institute (CII) and NSF upon the principles to recognize where change needs to occur within the engineering and construction. This change would only take place if new technologies are integrated and information is transferred.

1. Owner must value it: If the owner demands the change, it would occur. Financial value must be observed by the owner since he provides and controls the funds for the change to take place.
2. There must be proof that the solution would be successful: It is necessary for the change to actually take place. The research carried out usually is present in a controlled environment which is why the question may arise if it would be suitable for the practical world in terms of implementation of new technologies and practices. To provide proof that implementation would be suitable, verification must be present. Satisfaction and proof is present if prototype model is present, experiment is conducted and the verification of the results is made.
3. Change agents: For various organizations, change would only take place using a champion. Through the designation of this champion, the change implementation or innovation responsibility would be handled appropriately.

Literature review has been conducted to investigate the research efforts that aimed to provide solutions that help to bridge the gap between the academia and construction industry in implementation construction management research field. Unfortunately, there are a very few studies that provide a solution and test the proposed solution to see if the solution helped to bridge the gap between the industry and academia.

In 2008, TG61, a group sanctioned by the International Council for Building (CIB), performed a worldwide literature search study detecting construction innovative approaches that used performance metrics to increase performance of projects. The study

reviewed more than 4,500 papers. The study concluded that only 16 published papers documented actual performance increase due to hypothesis testing the use of performance information practices. The study found that 75% (12) out of the 16 papers that documented performance practices were projects performed by the Performance Based Studies Research Group (Egbu et al., 2008). This group had sufficient documentations and publications that identified the increase in performance, value and customer satisfaction in the construction industry due to concepts.

The group has carried out research tests and published them with the help of the industry partners. More than 300 papers have been published and a licensed technology is extracted that includes 47 licenses from AZTech which is the licensing body of ASU for intellectual property rights. In the US, it is considered as the most innovative university with the highest level of licensed technology (as rated by U.S. News and World Report 2016). A unique research approach is followed by the PBSRG. It organizes the expertise which is why it is considered unique. The information technology is proliferated with the help of the research and its publications . The implementations of the future have also been optimized as nations over the world are readily adopting the new approach and documenting the result database (CIB, 2016). The author utilized the unique research approach that is used by PBSRG and benefit from the successful factors that were identified from the literature review to develop a research approach.

The Proposed Research Roadmap to Bridge the Gap between Construction Management Research and Practice in Saudi Arabia

The structure of the proposed model is shown in fig 5. Each step is important in order to help both construction practitioners and academia to work together to meet their requirements. The framework is developed through three main steps as follows.

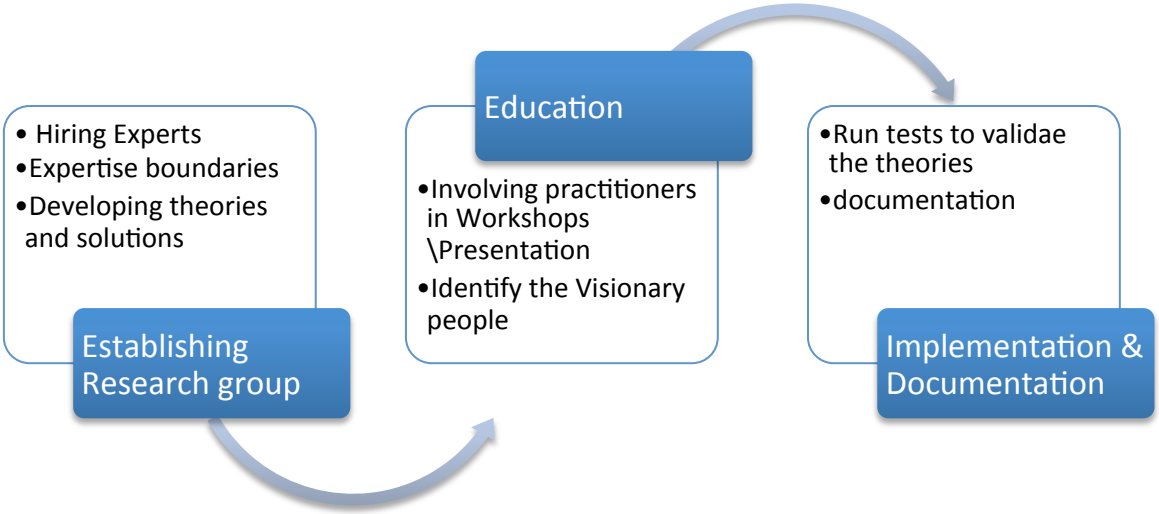


Figure 5:The Proposed Research Roadmap Model

Establishing a research center\group

This step is extremely important to develop effective communication channels among the academia and construction firms to help bridge the gap between the research and practice. By doing so, the construction practitioners can easily track the efforts of the research center and determine the expertise that the research group can provide for them. The main role of the research group should not stop at publishing research papers at conferences and journals; instead, the main objective of the research group is constantly

evolving and impacting the improvement of the construction industry performance. The following factors are extremely important to insure the success of having a strong research group:

- Hire/cooperate with expert researchers (those who have performance metrics from successful implementation)
- Identify the scope of research activities
- Developing theories and solutions that led to the development of the construction industry practices
- Demonstrate the center's potential (value) through media
- Integrate the industry with the education programs
- Engage students in research activities to learn the real issues and needs of the construction industry
- The researcher's knowledge on the current practices within the group expertise area
- Using performance measurement to determine the success rate of the research center by documenting the number of collaborations with construction companies, customer Satisfaction (Unit from 1 to 10) and project performance (time and cost deviation).

This step is aligned with the vision proposed in the 9th development plan. One of the future visions introduced by the Saudi government, is that "… *establishing intermediary institutions to interface education and R&D with the productive and service sectors; such*

as incubators, technology parks, centers of excellence and industrial solidarity centers (centers for collaborative R&D and technology transfer for a specific industry)."

Education

This step is the most important phase because it will let the participants in the construction industry work together with researchers in academia at the beginning of the research process. According to Bruneel, et al, 2010 "Research impact depends on researchers valuing the involvement of industry professionals during the process of the research and not only treating the industry as a data collection" . The participants will be involved in organized workshops\ presentations to discuss the theories that the researchers proposed. According to Jallal, 1990 the participants in the construction industry in Saudi Arabia want to attend the workshops and the academic conferences. The researchers have to make their solution simple to understand. These questions should be addressed before the participants attend the workshops: Why should you need to attend the workshop? What is the value you will get and how you will implement the solutions? What are the risks that you may face? Having performance metrics of the efforts of the research group will help to demonstrate the value of the research center. Another method of educating participants is to publish research studies in journals and give presentations at conference. However, in order to insure the impact of theses studies on the construction industry professionals, it is important to include successful performance metrics from implementation.

Implementation

The outcome of the education phase is identifying a visionary people who want to utilize researchers expertise to run prototype tests. This phase is critical since the researcher will conduct a non-traditional research with the participants starting with identifying the root cause of the problem—and not the symptoms of the problem— that the participants experience. They then propose a solution by identifying the implementation plan from the beginning to the end and what are the risks that may affect the project performance. Thus, both researcher and participants will work as team in a win-win environment to achieve their objective. After achieving the objectives from the prototype test, both researchers and participants will move to the implementation step. The researchers have to document the results and use it in terms of metrics in education in order to demonstrate the value of the research group. As it is shown in Fig 6, the main difference between the proposed research model and the traditional research model used in Saudi construction industry are:

- The involvement of construction professionals in the research process. In the proposed model, the construction professionals will be involved at the beginning of the research process in education. This will help to identify their real need and understand how they will implement the solutions. In contrast, the traditional research model used in SCI is treating the construction industry as data collection and a receiver.
- The validation of the research group's theories will be the running test in the construction industry. Running tests are extremely important to provide proof for

the industry professionals that the academic research can add value to their organizations. Thus, the outcome of this model is aimed to develop the performance of the construction industry.

- Tracking the impact of research efforts and identified the impact of these studies. This step will help to identify the value of research group.

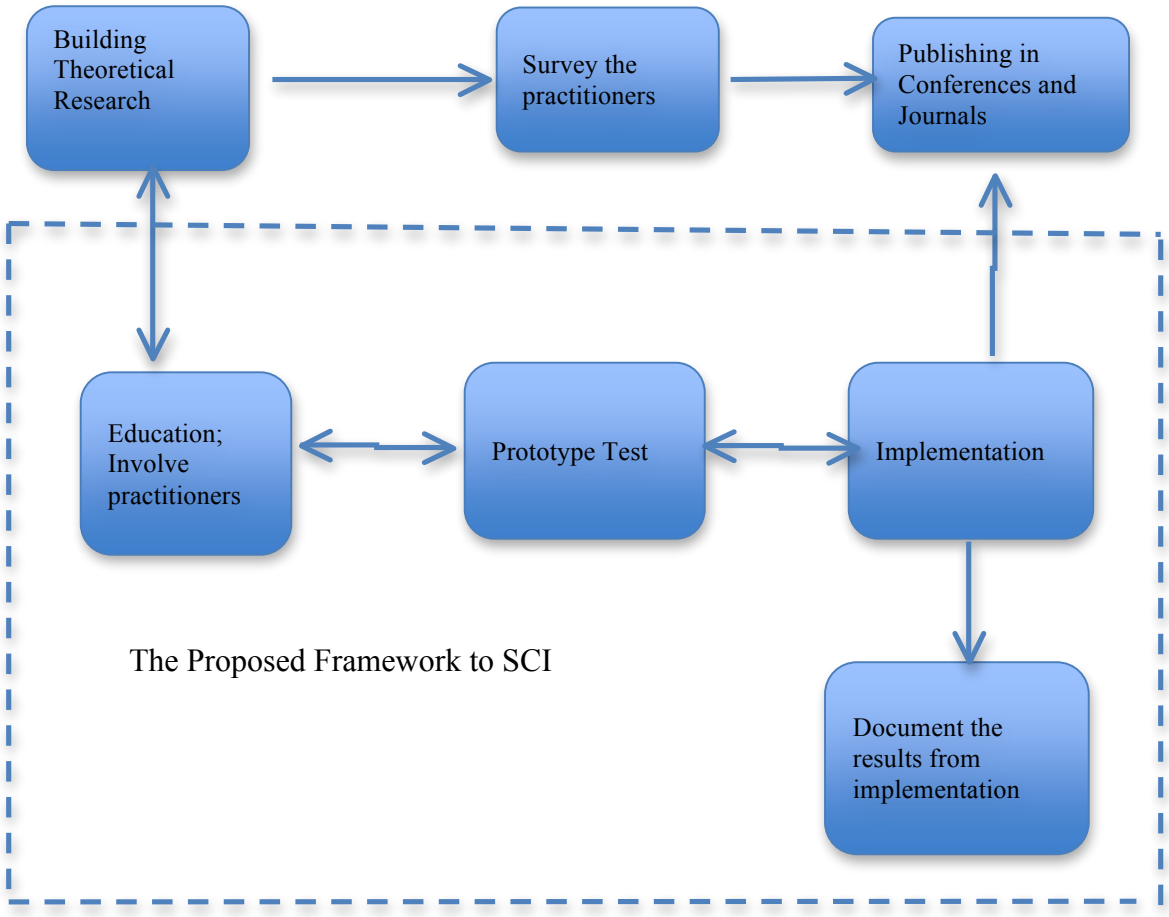


Figure 6: The difference between the proposed research model and the traditional research

Research Validation

The proposed research model was validated by introducing it to professionals who are involved in construction management from both academic institutes and public organizations. The study sample was selected carefully. Those who have many years of experience in construction management in both sectors, universities and public organizations, will be involved in the study. In order to do that, the following methods in selecting the sample was set up:

- The Saudi public organizations that have a high spending in construction projects were selected according to the annual budget that was issued by the ministry of Finance, 2016. The top four identified organizations are Ministry of Education, Ministry of Transportation, Ministry of Health, and Ministry of Municipal and Rural Affair
- For Academic institutes, the universities that have a high budget in funding scientific researches, more than SR 100 millions ($ 1= SR 3.75), were identified according to the report that was issued in 2014 by the Ministry of Higher Education. The Saudi universities that spend more than SR 100 Million are King Saud University, King Abdul-Aziz University and King Fahd University of Petroleum and Minerals.

A survey was designed and sent to the audiences in the above organizations. For the Academic institutes, the author identified those who have specialties in construction management filed through the university website. A total of 15 faculty members were

identified and the survey was sent to their email address. For the public organizations, the survey was sent to the project management department.

Survey Design

The questionnaire consisted of three main parts, namely personal information, questions regarding the proposed solution, and finally the barriers that may affect the implementation of research outcomes in the construction industry. For the first part, the respondents were asked to identify their level of education, experience, and the size of the construction projects cost that they were involved in. In the second part, respondents were given statements that conclude the proposed model in this study as it is shown below:

- Having specialized research groups\centers at universities will help the construction professionals to perceived the research information and the expertise of faculty members
- Having specialized research groups\centers at universities will help to develop the communication between the industry professionals and researchers
- Hiring research experts who have a successful performance measurement in theirs fields from implementing the research in the industry will help to bridge the gap between industry and academia
- Identifying the boundaries of the research groups\centers will help to develop the expertise of the research groups\centers and increase the chance of collaboration between the academic and industry

- Having a performance measurement to measure the impact of the research efforts will help to develop the collaboration between the academic and industry in implementing the research in the industry
- Having specialized research groups\centers at universities will help to improve the construction management education for the students and junior researchers
- Having specialized research groups\centers at universities will attracts the experts researchers from worldwide to participate and share the new idea
- Involving the industry professionals in organized workshop\presentations given by expert researchers who run the research centers will help to identify the real industry need.
- Using the implementation results from pervious case studies in education sessions will help the construction professionals to perceive the impact of research and increase the chance of implementing the research
- Inviting the champion individuals who control the changes in organization is important in order to implement the research in the industry.
- Involving the industry professionals in organized workshop\presentations will help them more to understand the theories and increase the chance of implementing the research.
- Using the customer satisfaction and the project performance as KPI for the research group will help the chance of implementing the research in the construction industry

- Using prototype tests is the best way to validate the applicability of the theories and increase the value of research in point view of the industry professionals

For the Barriers factors, a Scale of five points (strongly agree, agree, not sure, disagree, and strongly disagree) was presented for each statement. The next step was that the respondents were asked to rate the impact of barriers factors that affect the implementation of research outcomes in the construction industry. The barriers factors were identified from the literature review (same factors that were used in Awalla , 2006) and from the personal experience. These barriers factors are:

1. Routine and bureaucratic barriers in supporting R&D at client system.
2. Universities do not have the knowledge or information that construction organizations need.
3. Construction Industry practitioners are not willing to change their set ways of operations.
4. Routine and bureaucratic barriers in universities
5. Lack of practical experience among faculty
6. Lack of information (expertise) on a specific fields offered by universities
7. There is no effort put into transforming the research finding for practitioners
8. Most researchers felt that it was not their responsibility to disseminate research.
9. There are no rewards for having research findings applied in practice
10. The University /Institution does not have research dissemination policies and strategy.

11. The University /Institution does not have an effective communication channels for research dissemination.
12. The University /Institution researches finding usefulness is not perceived
13. There is no tracking system for having research findings applied in practice in order to determine the impact of research.
14. Long retention time of researchers in universities.
15. Research is conducted by academics with no grounding in the real issues o f construction practice/teaching.
16. Lack of education in the importance of applied research
17. Lack cooperation with the researcher in providing the required and accurate data for research

Result and Discussion

A total of 37 surveys were received. About 25% were from the academic institutes and 75 % from the construction organizations. The background information collected about the respondents included the educational background, years of experience, level of experience of participants measured by the budgets of projects they participated in, and the Saudi governmental organization or ministry participants work in. Considering the educational background of respondents, 21.62% of respondents had doctorates, 18.92% had a master degree and 59.46% held a Bachelor degree. The experience level of the respondents are stated in table 13

Table (15)

Participants' years of experience

Years of experience	Percentages (%)
1-5	21.62
5-10	24.32
10-20	24.32
More than 20	29.73

The correlation values provided in table (16) suggest a very strong relationship between each question and the total of the questions, suggesting a very satisfactory level of construct validity. All the values were statistically significant at < 0.001 level. Noting that most of the values provided in the table were close to the integer 1 which represents the maximum possible value a relationship could be reached. Exploring the correlation values, the minimum correlation value was noticed in question 10 (0.809). These values express a strong relationship (generally a value of 0.70 or higher is considered to express a strong relationship) . A question was asked about the level of experience of participants measured by the budgets of projects they participated in as project managers or consultants. 51.35% of respondents worked in projects with more than 50 million Saudi Riyals (3.75 Riyal= 1 Dollar). 16.22% of respondents worked in projects with budgets between 20 to 50 million Riyal. 2.7% of respondents worked in projects with budgets between 5 to 10 million Riyal. Finally, 29.73% of respondents worked in projects with budgets less than 5 million Riyal.

Table (16)
The construct validity for the questions representing the proposed solution model's validity.

Question		r	sig
1	Having specialized research groups\centers at universities will help the construction professionals to perceive the research information and the expertise of universities' faculty members	0.977	< 0.001
2	Having specialize research groups\centers at universities will help to improve the construction management education for the students and junior researchers	0.904	< 0.001
3	Having specialize research groups\centers at universities will help to develop the communication between the industry professionals and researchers	0.935	< 0.001
4	Having specialized research groups\centers at universities will attracts the experts researchers from worldwide to participate and share the new ideas	0.965	< 0.001
5	Hiring research experts who have a successful performance measurement in theirs fields from implementing the research in the industry will help to bridge the gap between industry and academia	0.962	< 0.001
6	Identifying the boundaries of the research groups\centers will help to develop the expertise of the research groups\centers and increase the chance of collaboration between the academic and industry	0.926	< 0.001
7	Having a performance measurement to measure the impact of the research efforts will help to develop the collaboration between the academic and industry in implementing the research in the industry	0.961	< 0.001
8	Involving the industry professionals in organized workshop\presentations given by expert researchers who run the research centers will help to identify the real industry need.	0.927	< 0.001
9	Using the implementation results from pervious case studies in education sessions will help the construction professionals to perceive the impact of research and increase the chance of implementing the research	0.969	< 0.001
10	Inviting the champion individuals who control the changes in organization is important in order to implement the research in the industry	0.809	< 0.001
11	Involving the industry professionals in organized workshop\presentations will help them more to understand the theories and increase the chance of implementing the research	0.933	< 0.001
12	Using the customer satisfaction and the project performance as KPI for the research group will help the chance of implementing the research in the construction industry	0.931	< 0.001

Table (17)

Descriptive statistics for the questions representing the proposed solution model's validity

no.	question	%					mean	sd
		strongly agree	agree	Not sure	disagree	Strongly disagree		
1	Having specialized research groups\centers at universities will help the construction professionals to perceive the research information and the expertise of universities' faculty members	43.24	43.24	10.81	2.70	0.00	4.27	0.77
2	Having specialize research groups\centers at universities will help to improve the construction management education for the students and junior researchers	51.35	45.95	2.70	0.00	0.00	4.49	0.56
3	Having specialize research groups\centers at universities will help to develop the communication between the industry professionals and researchers	56.76	29.73	10.81	2.70	0.00	4.41	0.80
4	Having specialized research groups\centers at universities will attracts the experts researchers from worldwide to participate and share the new ideas	40.54	45.95	10.81	2.70	0.00	4.24	0.76
5	Hiring research experts who have a successful performance measurement in theirs fields from implementing the research in the industry will help to bridge the gap between industry and academia	51.35	35.14	10.81	2.70	0.00	4.35	0.79
6	Identifying the boundaries of the research groups\centers will help to develop the expertise of the research groups\centers and increase the chance of collaboration between the academic and industry	37.84	54.05	5.41	0.00	2.70	4.24	0.80

Table (17): Continued

no.	question	%					mean	sd
		strongly agree	agree	Not sure	disagree	Strongly disagree		
7	Having a performance measurement to measure the impact of the research efforts will help to develop the collaboration between the academic and industry in implementing the research in the industry	43.24	40.54	10.81	5.41	0.00	4.22	0.85
8	Involving the industry professionals in organized workshop\presentations given by expert researchers who run the research centers will help to identify the real industry need.	43.24	51.35	5.41	0.00	0.00	4.38	0.59
9	Using the implementation results from pervious case studies in education sessions will help the construction professionals to perceive the impact of research and increase the chance of implementing the research	45.95	43.24	8.11	0.00	2.70	4.30	0.85
10	Inviting the champion individuals who control the changes in organization is important in order to implement the research in the industry	27.03	64.86	8.11	0.00	0.00	4.19	0.57
11	Involving the industry professionals in organized workshop\presentations will help them more to understand the theories and increase the chance of implementing the research	56.76	32.43	8.11	0.00	2.70	4.41	0.86
12	Using the customer satisfaction and the project performance as KPI for the research group will help the chance of implementing the research in the construction industry	45.95	48.65	5.41	0.00	0.00	4.41	0.60

Another question was asked to participants about the Saudi governmental organization or ministry they work in. 40.54% of respondents work in the ministry of education in Saudi Arabia. 18.92% of respondents work in the ministry of health. 16.7% of respondents work in the ministry of transportation in Saudi Arabia. 23.84 % of respondents work in the ministry of Municipal and Rural Affair in Saudi Arabia. The results of the second part of the survey considering the proposed model in this study are shown in table 14. In the first factor considering the respondents' perceptions about having specialized research groups or centers at universities will help the construction professionals to perceive the research information and the expertise of universities' faculty members. Most of the respondents (86.5%) either strongly agree or agree that the construction professionals will be helped to perceive the research information and the expertise of universities' faculty members once specialized research groups or centers at universities are created. The second element of the second part of the survey was about improving the education of the construction management departments for the students and junior researchers in the department. 97% of respondents either strongly agree or agree that having specialize research groups or centers at universities will help to improve the construction management education for the students and junior researchers.This element will help students and researchers to interact with industry professionals and apply their graduation projects or graduate studies researches in the industry. The third factor was about developing the communication between the industry professionals and researchers by having specialize research groups or centers at universities.The majority of the respondents (86.5%) agree or strongly agree that having specialize research groups or

centers at universities will help to develop the communication between the industry professionals and researchers. This is an important cause in implementing research in the industry practices as communication channels can be more effective through creating focused research centers that seeks industry professionals and create continuous communication with the needed industry professions.

In the fourth factor considering the respondents' perceptions about having specialized research groups or centers at universities will attracts the experts' worldwide researchers to participate and share the new ideas. 86.5% of respondents either strongly agree or agree that participation and sharing knowledge and new theories with worldwide researches will increase as they will be attracted to specialized research groups or centers at universities. The fifth cause was about bridging the gap between industry and academia through hiring research experts who have a successful performance measurement in theirs fields from implementing the research in the industry. The majority of the respondents (86.5%) strongly agree and agree that hiring research experts who have a successful performance measurement in theirs fields from implementing the research in the industry will help to bridge the gap between industry and academia.

The sixth question was asked about the effectiveness of identifying the boundaries of the research groups or centers will help to develop the expertise of the research groups to increase the chance of collaboration between the academic and industry. The majority of participants (92%) either strongly agree or agree that identifying the boundaries of the research groups or centers will help to develop the expertise of the research groups or centers and increase the chance of collaboration between the academic and industry. this

indicate that research groups should have a specific fields to work in as focusing on specific and focused areas of research will develop the expertise of the research groups and also increase the chance of collaboration between the academic and industry.

The seventh element was about the use of performance measurement to measure the impact of the research efforts. 84% of respondents either strongly agree or agree that having a performance measurement to measure the impact of the research efforts will help to develop the collaboration between the academic and industry in implementing the research in the industry. A similar and more detailed factor was answered by respondents as (94%) either strongly agree or agree that using the customer satisfaction metrics and the project performance as KPI for the research group will help the chance of implementing the research in the construction industry. These two elements are very important in showing the effectiveness of research in helping the industry practices to improve. Using the customer satisfaction metrics or performance measurement of the provided solutions is an effective way in showing how successful the solutions are. Another question was asked to respondents about using prototype tests is the best way to validate the applicability of the theories and increase the value of research in point view of the industry professionals. 94.5% of respondents either strongly agree or agree with the previous statement. Prototype tests can also be measured considering the performance KPIs and show the real results of the tests to the researchers and professionals.

Four factors in the survey were about having organized workshops or presentations that include both researchers and professionals. More than 94% of respondents either strongly agree or agree that involving the industry professionals in

organized workshop or presentations given by expert researchers who run the research centers will help to identify the real industry need. Furthermore, 89% of respondents either strongly agree or agree that involving the industry professionals in organized workshop\presentations will help them more to understand the theories and increase the chance of implementing the research. Moreover, 92% of respondents either strongly agree or agree that inviting the champion individuals who control the changes in organization is important in order to implement the research in the industry. Finally, 92% of respondents either strongly agree or agree that using the implementation results from pervious case studies in the education sessions will help the construction professionals to perceive the impact of research and increase the chance of implementing the research.

Overall, The results tell that solution no. 2 (Having specialize research groups\centers at universities will help to improve the construction management education for the students and junior researchers) has recorded the greatest mean (4.49) while solution no. 10 (Inviting the champion individuals who control the changes in organization is important in order to implement the research in the industry) has ranked the last order as it recorded the minimum mean (4.19) noting that even this solution has the least mean but its value is considered high reflecting that all the mentioned solutions satisfies a very strong agree by the sample targeted sample. All other values ranged between these two values. The Overall assessment of the proposed solutions was estimated by a mean of (51.89) noting that the mean value for the overall solutions ranges (12 – 60)

Barriers Factors that Affect the Implementation of Construction Management Research in the Saudi Construction

The results of Table (18) reflects the descriptive statistics for the factors (barriers) that affect the implementation of construction management research in the Saudi construction industry evaluated upon the point of view of the industry project professionals (four public organizations). The mean values tell that barrier no. 4 (There are no tracking system for having research findings applied in practice in order to determine the impact of research) was the most important barrier being rated as it recorded the greatest mean (4.10) while barrier no. 16 (Construction Industry practitioners are not willing to change their set ways of operations.) was the less important barrier being rated by the academic managers as it recorded the leastmean (3.23). The other barrier mean values ranged between these two values. The overall barriers estimation's mean value was (63.47) taking into account that this mean locates between (17 – 85) so the mean value being evaluated could be viewed as important

Table (18)
Descriptive statistics for the factors (barriers) from the point of view of the industry

no.	question	%					mean	sd
		strongly agree	agree	Not sure	disagree	Strongly disagree		
1	The University /Institution does not have an effective communication channels for research dissemination	30.0	43.3	26.7	0.0	0.0	4.03	0.76
2	There is no effort put into transforming the research finding for practitioners	20.0	63.3	10.0	0.0	6.7	3.90	0.96
3	lack of knowledge of the importance of research and development in increasing the performance of the construction sector	23.3	43.3	20.0	13.3	0.0	3.77	0.97
4	There are no tracking system for having research findings applied in practice in order to determine the impact of research	30.0	56.7	10.0	0.0	3.3	4.10	0.84
5	Lack of information (expertise) on a specific fields offered by universities	26.7	46.7	16.7	10.0	0.0	3.90	0.92
6	Most researchers felt that it was not their responsibility to disseminate research.	23.3	36.7	33.3	6.7	0.0	3.77	0.90
7	Research is conducted by academics with no grounding in the real issues o f construction practice/teaching	23.3	46.7	20.0	10.0	0.0	3.83	0.91

Table (18): Continued

no.	question	%					mean	sd
		strongly agree	agree	Not sure	disagree	Strongly disagree		
8	Routine and bureaucratic barriers in supporting R&D at client system	13.3	43.3	36.7	3.3	3.3	3.60	0.89
9	Lack of practical experience among faculty	30.0	40.0	16.7	13.3	0.0	3.87	1.01
10	lack of cooperate with the researcher from the construction organizations in providing the required data	13.3	53.3	20.0	3.3	10.0	3.57	1.10
11	Lack of strategy in determining the scope of research published in universities	13.3	53.3	30.0	0.0	3.3	3.73	0.83
12	The University /Institution does not have research dissemination policies and strategy.	26.7	33.3	33.3	6.7	0.0	3.80	0.92
13	Universities do not have the knowledge or information that construction organizations need.	23.3	53.3	10.0	0.0	13.3	3.73	1.23
14	There are no rewards for having research findings applied in practice	16.7	40.0	33.3	6.7	3.3	3.60	0.97

Table (18): Continued

no.	question	%					mean	sd
		strongly agree	agree	Not sure	disagree	Strongly disagree		
15	Routine and bureaucratic barriers in Universities	10.0	53.3	9.7	6.7	3.3	3.60	0.89
16	Construction Industry practitioners are not willing to change their set ways of operations.	16.7	40.0	6.7	23.3	13.3	3.23	1.36
17	Long retention time of researchers in universities	5.00	50.0	30.0	6.7	6.7	3.43	0.97
	Total barriers estimation						63.47	15.43

Table (19)

Descriptive statistics for the factors (barriers) from the point of view of the academic

no.	question	%					mean	sd
		strongly agree	agree	Not sure	disagree	Strongly disagree		
1	The University /Institution does not have an effective communication channels for research dissemination	57.1	42.9	0.0	0.0	0.0	4.57	0.53
2	There is no effort put into transforming the research finding for practitioners	57.1	28.6	14.3	0.0	0.0	4.43	0.79
3	lack of knowledge of the importance of research and development in increasing the performance of the construction sector	71.4	14.3	14.3	0.0	0.0	4.57	0.79
4	There are no tracking system for having research findings applied in practice in order to determine the impact of research	14.3	28.6	28.6	14.3	14.3	3.14	1.35
5	Lack of information (expertise) on a specific fields offered by universities	28.6	57.1	14.3	0.0	0.0	3.86	1.35
6	Most researchers felt that it was not their responsibility to disseminate research.	28.6	71.4	0.0	0.0	0.0	4.29	0.49
7	Research is conducted by academics with no grounding in the real issues o f construction practice/teaching	57.1	14.3	28.6	0.0	0.0	4.00	1.41
8	Routine and bureaucratic barriers in supporting R&D at client system	85.7	14.3	0.0	0.0	0.0	4.86	0.38

Table (19)

no.	question	%					mean	sd
		strongly agree	agree	Not sure	disagree	Strongly disagree		
9	Lack of practical experience among faculty	14.3	57.1	28.6	0.0	0.0	3.57	1.13
10	lack of cooperate with the researcher from the construction organizations in providing the required data	71.4	28.6	0.0	0.0	0.0	4.71	0.49
11	Lack of strategy in determining the scope of research published in universities	42.9	28.6	28.6	0.0	0.0	3.86	1.35
12	The University /Institution does not have research dissemination policies and strategy.	14.3	28.6	0.0	42.9	14.6	2.86	1.46
13	Universities do not have the knowledge or information that construction organizations need.	14.3	14.3	0.0	42.9	28.6	2.43	1.51
14	There are no rewards for having research findings applied in practice	14.3	28.6	42.9	14.3	0.0	3.43	0.98
15	Routine and bureaucratic barriers in Universities	14.3	57.1	0.0	0.0	28.6	3.29	1.60
16	Construction Industry practitioners are not willing to change their set ways of operations.	57.1	28.6	0.0	0.0	14.3	4.14	1.46
17	Long retention time of researchers in universities	28.6	14.3	0.0	57.1	0.0	3.14	1.46
	Total barriers estimation						65.1	16.5

Table (19) provides the results of the descriptive statistics for the factors (barriers) that affect the implementation of construction management research in the Saudi construction industry evaluated upon the point of view of the academic lecturers (from three Saudi universities). The mean values tell that barrier no. 8 (Routine and bureaucratic barriers in supporting R&D at client system) was the most important barrier being rated as it recorded the greatest mean (4.86) while barrier no. 13 (Universities do not have the knowledge or information that construction organizations need.) was the less important barrier being rated by the academic managers as it recorded the leastmean (2.43). The other barrier mean values ranged between these two values. The overall barriers estimation's mean value was (65.14) taking into account that this mean locates between (17 – 85) so the mean value being evaluated could be viewed as important.

Table (20)

Descriptive statistics for the factors (barriers) from the point of view of both the academic managers and the industry professionals (n=37)

no.	question	%					mean	sd
		strongly agree	agree	Not sure	disagree	Strongly disagree		
1	The University /Institution does not have an effective communication channels for research dissemination	35.1	43.2	21.6	0.0	0.0	4.14	0.75
2	There is no effort put into transforming the research finding for practitioners	27.0	56.8	10.8	0.0	5.4	4.00	0.94
3	lack of knowledge of the importance of research and development in increasing the performance of the construction sector	32.4	37.8	18.9	10.8	0.0	3.92	0.98
4	There are no tracking system for having research findings applied in practice in order to determine the impact of research	27.0	51.4	13.5	2.7	5.4	3.92	1.01
5	Lack of information (expertise) on a specific fields offered by universities	27.0	48.6	13.5	8.1	2.7	3.89	0.99
6	Most researchers felt that it was not their responsibility to disseminate research.	24.3	43.2	27.0	5.4	0.0	3.86	0.86
7	Research is conducted by academics with no grounding in the real issues o f construction practice/teaching	29.7	40.5	16.2	13.5	0.0	3.86	1.00

Table (20) Continued

no.	question	%					mean	sd
		strongly agree	agree	Not sure	disagree	Strongly disagree		
8	Routine and bureaucratic barriers in supporting R&D at client system	27.0	37.8	29.7	2.7	2.7	3.84	0.96
9	Lack of practical experience among faculty	27.0	43.2	13.5	16.2	0.0	3.81	1.02
10	lack of cooperate with the researcher from the construction organizations in providing the required data	24.3	48.6	16.2	2.7	8.1	3.78	1.11
11	Lack of strategy in determining the scope of research published in universities	18.9	48.6	24.3	5.4	2.7	3.76	0.93
12	The University /Institution does not have research dissemination policies and strategy.	24.3	32.4	27.0	13.5	2.7	3.62	1.09
13	Universities do not have the knowledge or information that construction organizations need.	21.6	45.9	8.1	8.1	16.2	3.49	1.37
14	There are no rewards for having research findings applied in practice	16.2	37.8	35.1	8.1	2.7	3.57	0.96
15	Routine and bureaucratic barriers in Universities	10.8	54.1	21.6	5.4	8.1	3.54	1.04
16	Construction Industry practitioners are not willing to change their set ways of operations.	24.3	37.8	5.4	18.9	13.5	3.41	1.40
17	Long retention time of researchers in universities	10.8	43.2	24.3	16.2	5.4	3.38	1.06
	Total barriers estimation						63.78	15.42

Inspecting the results provided in Table (20), which show the descriptive statistics for the factors (barriers) that affect the implementation of construction management research in the Saudi construction industry evaluated upon the common point of view of both the academic lecturers and the industry project professionals. The mean values tell that barrier no. 1 (The University /Institution does not have an effective communication channels for research dissemination) was the most important barrier being rated as it recorded the greatest mean (4.14) while barrier no. 17 (Long retention time of researchers in universities.) was the less important barrier being rated by the common point of view as it recorded the leastmean (3.38). The other barrier mean values ranged between these two values. The overall barriers estimation's mean value was (63.78) taking into account that this mean locates between (17 – 85) so the mean value being evaluated could be viewed as important.

Table (21)
The construct validity for the questions expressing factors (barriers) that affect the implementation of construction management research in the Saudi construction industry (n=37)

Barriers Factor		r	sig
1	The University /Institution does not have an effective communication channels for research dissemination	0.854	< 0.001
2	There is no effort put into transforming the research finding for practitioners	0.877	< 0.001
3	lack of knowledge of the importance of research and development in increasing the performance of the construction sector	0.912	< 0.001
4	There are no tracking system for having research findings applied in practice in order to determine the impact of research	0.821	< 0.001
5	Lack of information (expertise) on a specific fields offered by universities	0.923	< 0.001
6	Most researchers felt that it was not their responsibility to disseminate research.	0.880	< 0.001
7	Research is conducted by academics with no grounding in the real issues o f construction practice/teaching	0.940	< 0.001
8	Routine and bureaucratic barriers in supporting R&D at client system	0.774	< 0.001
9	Lack of practical experience among faculty	0.938	< 0.001
10	lack of cooperate with the researcher from the construction organizations in providing the required data	0.852	< 0.001
11	Lack of strategy in determining the scope of research published in universities	0.906	< 0.001
12	The University /Institution does not have research dissemination policies and strategy.	0.847	< 0.001
13	Universities do not have the knowledge or information that construction organizations need.	0.828	< 0.001
14	There are no rewards for having research findings applied in practice	0.944	< 0.001
15	Routine and bureaucratic barriers in Universities	0.900	< 0.001
16	Construction Industry practitioners are not willing to change their set ways of operations.	0.913	< 0.001
17	Long retention time of researchers in universities	0.891	< 0.001

The correlation values provided in table (21) suggest a very strong relationship between each question and the total of the questions representing barriers, suggesting a very satisfactory level of construct validity. All the values were statistically significant at < 0.001 level. Noting that most of the values provided in the table were close to the integer 1 which represents the maximum possible value a relationship could be reached. Exploring the correlation values, the minimum correlation value was noticed in question 8 (0.774). These values express a strong relationship (generally a value of 0.70 or higher is considered to express a strong relationship). Also, the value of the internal consistency provided in table (22) suggest a very meaningful reliability.

Table (22)

Cronback alpha reliability for factors (barriers) that affect the implementation of construction management research in the Saudi construction industry (n=37)

No. of questions	value
17	0.980

Overall, the results of rating the barriers factors by participants are shown in table 18, 19, 20. An in depth analysis of the previous results is shown in table 23. The top five barriers factors according to the academic researcher are:

- Routine and bureaucratic barriers in supporting R&D at client system
- Lack of cooperate with the researcher from the construction organizations in providing the required data

- The University /Institution does not have an effective communication channels for research dissemination
- Lack of knowledge of the importance of research and development in increasing the performance of the construction sector
- There is no effort put into transforming the research finding for practitioners.

On the other hand, the top five barriers factors according to construction practitioners are:

- There is no tracking system for having research findings applied in practice in order to determine the impact of research.
- The University /Institution does not have an effective communication channels for research dissemination.
- There is no effort put into transforming the research finding for practitioners.
- Lack of information (expertise) on a specific fields offered by universities.
- Lack of practical experience among faculty

It is clearly seen that there are some factors that both academic researchers and construction practitioners have an agreement on the high impact such as "The University /Institution does not have an effective communication channels for research dissemination" and " There is no effort put into transforming the research finding for practitioners". The proposed solution will assure that the creation of research group/centers will to overcome these issues since it will help to develop the communication channel between the two sectors.

Table 23

Comparison between academic participant's views and professional industry's views.

Barriers Factors	Academic Ranking	Practitioners Ranking	Total Ranking
The University /Institution does not have an effective communication channels for research dissemination	3	2	1
There is no effort put into transforming the research finding for practitioners	5	3	2
Lack of knowledge of the importance of research and development in increasing the performance of the construction sector	4	8	3
There are no tracking system for having research findings applied in practice in order to determine the impact of research	15	1	4
Lack of information (expertise) on a specific fields offered by universities	10	4	5
Most researchers felt that it was not their responsibility to disseminate research.	6	9	6
Research is conducted by academics with no grounding in the real issues o f construction practice/teaching	8	6	7

Table 23.Continued

Barriers Factors	Academic Ranking	Practitioners Ranking	Total Ranking
Routine and bureaucratic barriers in supporting R&D at client system	1	12	8
Lack of practical experience among faculty	11	5	9
Lack of cooperate with the researcher from the construction organizations in providing the required data	2	15	10
Lack of strategy in determining the scope of research published in universities	9	10	11
The University /Institution does not have research dissemination policies and strategy.	16	7	12
Universities do not have the knowledge or information that construction organizations need.	17	11	15
There are no rewards for having research findings applied in practice	12	14	13
Routine and bureaucratic barriers in Universities	13	13	14
Construction Industry practitioners are not willing to change their set ways of operations.	7	17	16
Long retention time of researchers in universities	14	16	17

CHAPTER 6

IMPLEMENTATION PLAN: INTRDUCING BEST VALUE APPROACH TO SAUDI CONSTRUCTION INDUSTRY

It was suggested by the Performance Based Studies Research Group (PBSRG) at Arizona State University that one of the key reasons that brought about issues in the construction industry was the prevailing traditional research methodology. In the existing academic research, there isn't any structure suitable for introducing change. Hence, it is highly dependent on literature studies and surveys of the views of industry participants to recognize the performance factors and issues prevalent in the construction industry. There is hardly any action research that examines the validity of their perceptions in actual life industry tests. New concepts can be validated by carrying out action research with the help of recurring industry tests. Hence, the PBSRG has continuously collaborated with the construction industry to evaluate their proposals. The research comprises of (Rivera, 2014):

- +1,915 projects that cost $6.3 billion, where the BV environment was utilized (PBSRG, 2015).
- One of the biggest contractor developers in Malaysia (functioning in a more underdeveloped culture) utilizes the best value PIPS and IMT concepts to have more efficient operations.
- 50 diverse clients (public & private) have taken part in the testing.
- 483 Presentations, 8,600 Attendees from the U.S., Asia/Australia, Europe, and Africa

- 175 refereed conference and journal papers pertaining to the growth of IMT, PIPS/PIRMS, and research tests.
- Carried out research testing in 31 states in the US and 6 other countries.

The conventional literature search method was not utilized by the originator of the Performance Based Studies Research Group to recognize the issues in the construction industry. It is presumed that the issue was prevalent since the industry participants did not comprehend what was going on [did not possess the performance information and did not comprehend that the client or non-professional should not direct the expert vendors] and that the action research outcome demonstrated with the help of dominant performance information, the practicality of the situation and the degree of performance. The researcher then tried to determine the worth of the professional vendor's services by using a transparent system that assessed various solutions' performance information. The multi-criteria decision making model, that is the Displaced Ideal Model [DIM], was employed by the researcher, to find out the worth and degree of experience possessed by all competitors. It was then recognized through the action research testing regarding the ideal worth of the vendor [best value for the least cost]. Through this test, the precedence for the PBSRG research method was established [decrease bias/personal perspective, using performance information, decreased decision-making and observation of the solution]. It was presumed by the PBSRG that their success would be an outcome of a preponderance of test outcomes, continuous action research testing and the optimization of construction industry procedures and publication within the industry. This method is

recognized in this research as a method that was different from the conventional validation through peer review.

A new corporate model was required by PBSRG's research methodology. The new funding model is the need of time owing to constant improvement of successful concepts, frequent action research tests besides the development of leading and simple logic. Regarding government grants, no competition was made by PBSRG management (Rivera, 2014). The clients from construction industry had funded the research grants who had demonstrated great concerns in the practical implementation of the upcoming model. The research work carried out by PBSRG was only confined to their scope of expertise. Construction industry partners gravitated to the research due to the following dominant results (Rivera, 2014):

1. The reduction of project cost from 5 to 30%.
2. The reduction in procurement duration and transactions by all parties by 50%.
3. The increase in expert vendor profit.
4. Expert vendor project time and deviation cost of less than 1%.
5. The minimization of client management and direction by 90%.

Besides industrial standards, the impact and speed of action research testing has been uplifted because of the PBSRG's competence to incorporate the prototype testing, the theoretical development and implementation of the best value technology.

As it is shown in Fig 7, this approach ensured rapid impact and continual conceptual development in the delivery of services in the construction industry. Theoretical development immediately impacts the implementation of the technology.

The validation of the developed concepts would not be by academic research peer review in journal publications, but by action research test results and sustainability of the research effort.

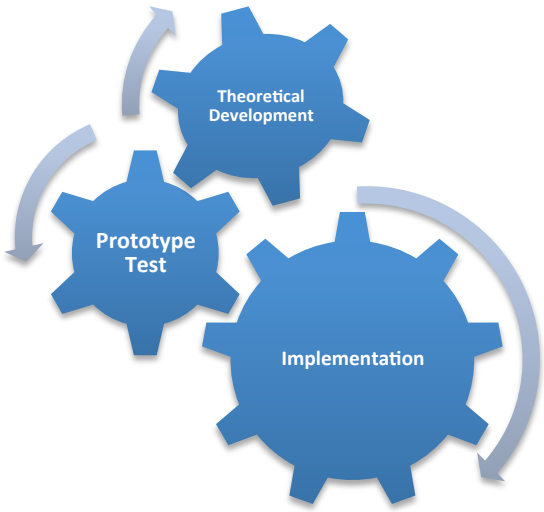


Figure 7: PBSRG Research Model

If the research efforts do not lead to industry implementation, the action research objective of improving the industry performance is not validated. The PBSRG action research result requirement was simplicity, clearly identifying where industry participants were not following the developed processes. The IMT (Information Measurement Theory) was believed to be the theoretical result of the PBSRG research.

Theoretical Development (IMT, BV PIPS/PIRMS)

The theoretical development of the BV technology took a totally different approach than any research effort. The following assumptions are made:

1. Logic must start from a foundation of natural laws and not industry technical knowledge.
2. The logic must be non-technical in nature.
3. No concepts for solutions will be taken from industry participants or experts. The assumption was that the problem of the performance of the delivery of services has been poor for so long, the industry's traditional approaches were not optimal and even flawed.
4. The solution must be simple (non-complex). The assumption of the researchers is that complexity is created by non-experts, and can never lead to improvement of the industry performance.

The PBSRG action research result requirement was simplicity, clearly identifying where industry participants were not following the developed processes. The theoretical result of the PBSRG research was the Information Measurement Theory (IMT), the Kashiwagi Solution Model (KSM), the Construction Industry Structure (CIS), the Performance Based Procurement System (PIPS) and the Performance Information Risk Management System (PIRMS). The IMT consists of the following concepts (see Figure 8):

- All natural laws that explain the change from one state to another exist at all times.
- All event start from unique initial conditions and unique end with unique final conditions.
- These unique initial and final conditions are always related.

- All events have only one outcome.
- Randomness does not exist.
- The expert understands the initial conditions, predicts the final conditions, and monitors the performance from the beginning to the end.
- The expert minimizes their scope and utilizes transparency to minimize risk that they do not control.
- The expert does quality control and risk management, and the owner/buyer does quality assurance (ensures that the expert contractor is doing their quality control and risk management).

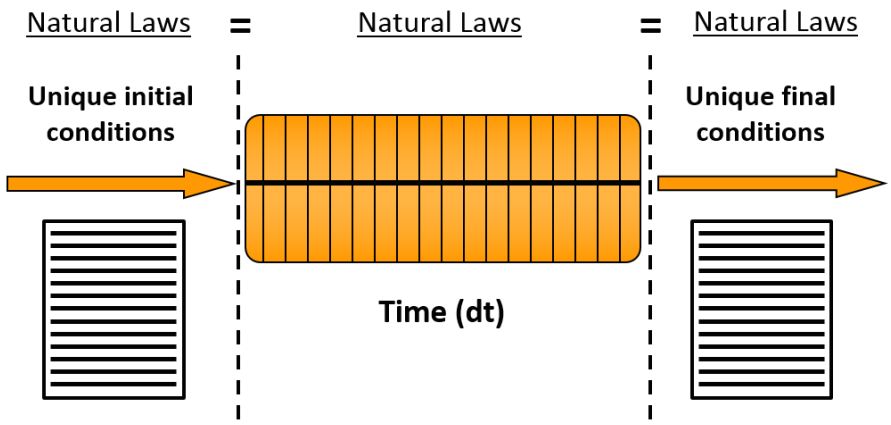


Figure 8: Event Chart (Kashiwagi, 2014)

By applying the IMT concepts in action research, the following became obvious:

- Expertise can be utilized to lower project cost and increase project quality.
- When the buyers manage and direct the expert vendor, the expertise of the vendor will not be utilized, the value of the expertise will decrease and the cost will increase.

- When the expectation of a buyer is created, and expertise is not utilized, the project risk is increased.
- Project risk is the difference between expectation and reality that is set by the initial conditions.
- A transparent environment assists expert and not expert vendors perform.
- Transparency minimizes decision-making and confusion.

The theoretical development of IMT led to the development of the Construction IndustryStructure (CIS). The CIS is a visual of the construction industry and identifies that poor performance is created by the use of direction and control by non-experts. The understanding of IMT and the CIS led to the Best Value Approach and technology (Figure 9 and 10). Various clients prototype tested the Performance Information Procurement System (PIPS) and then over a longer period of time a couple of clients attempted to implement the system into their organization. Figure 5 shows the three phases of the PIPS and Figure 9 shows the submittals and the process in more detail. The simultaneous development of the theoretical development, prototype tests and the implementation of Best Value into the buyer's structure has made the PBSRG research of great value to those who are seeking to improve their construction performance.

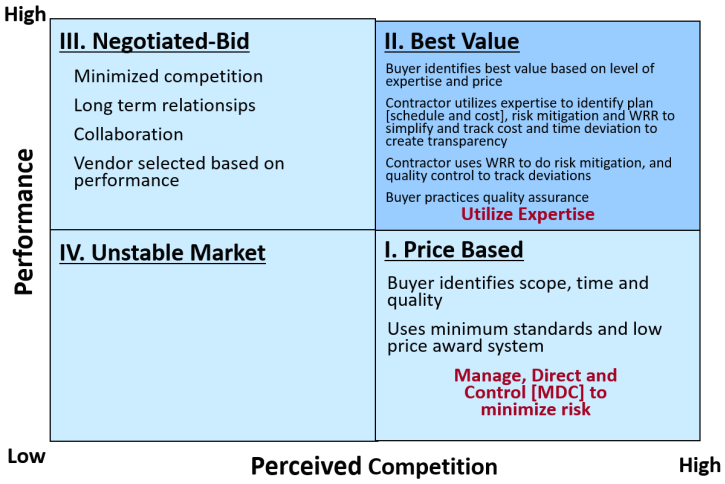


Figure 9: Construction Industry Structure (Kashiwagi, 2014).

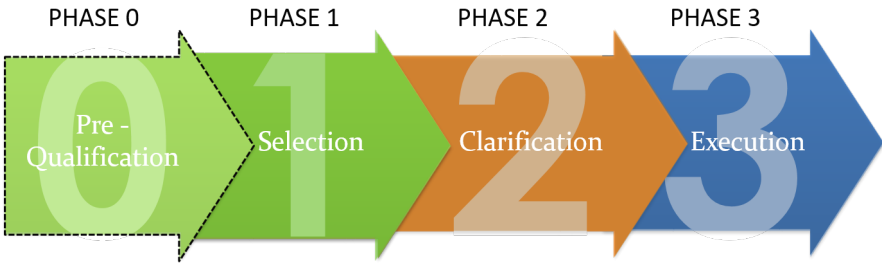


Figure 10: Performance Information Procurement System (Kashiwagi, 2014)

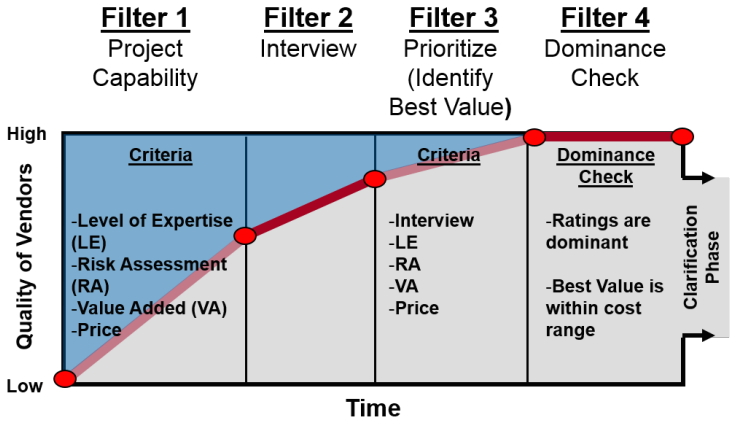


Figure 11: PIPS Filters (Kashiwagi, 2014)

Potential Solution for Saudi Construction Industry

The construction industry structure (CIS) provides an insight into the present structure of the Saudi Arabian construction industry. The following identified characteristics of the Saudi construction industry from the literature review presented in table 6 propose that it occupies the price-based environment:

- Change orders, time extensions, cost overrun, and stakeholder's dissatisfaction.
- No accountability for deviations (blaming environment).
- More detailed specifications given to the contractors in bidding stage.
- Need for decision-making. This practice is not efficient and causes risks.
- Award to the lowest price using minimum specifications.
- Lack of contractor preplanning before contract award.
- Lack of local skilled contractor base in critical subcontractor areas.

PBSRG has identified the similar problems in the construction industries in Finland, the

Netherland, Botswana, Canada, and United States and Malaysia. Tests conducted by PBSRG have minimized project cost and time deviations, increased customer satisfaction, increased vendor's profits and minimized project costs. Therefore, the authors wanted to create a group of researchers and setup an implementation plan in order to proliferate the "Best Value" Technology into Saudi Arabia construction industry.

Implementation Plan

The author set up a plan for implementing the successful PBSRG research efforts and the Best Value in Saudi Arabia to have impact on Saudi construction industry. The plan will contain the following objectives:

- Create a Saudi Arabian academic research program called Saudi research group (PBSRG-SRG) under PBSRG mentoring.
    - Learn the expertise of PBSRG in conducting the Best Value research.
    - Learn the theoretical development concept of PBSRG model and its implication.
    - Learn the PBSRG research approach that have improved the construction industry practice and improved its performance.
    - Obtain Master of Science (MS) degrees and Doctorate (PhD) degrees, writing theses and dissertations in the Best Value (BV) research program. Those students will learn the PBSRG approach and conduct research with

the aim of implementing the BV research and development in Saudi Arabia.

    - Create a database of construction industry performance for worldwide construction industry including Saudi Arabia.

- Educate the Saudi academic research units and government agencies by giving them presentations about Best Value Approach.
- Run tests in Saudi Arabia with visionary government owners and vendors.

As it is mention earlier, it is realized that the challenges in doing research and development in Saudi Arabia with the country being rapidly transformed from a nomadic culture and thinking to a proactive, modern day society. The key to assisting the Saudi research and development effort was to partner or joint venture with the Saudi universities, and slowly change the research model. It is important to realize that PBSRG is not a traditional research and development group.

Creating Research Group

As it is mentioned earlier, the first step in the proposed model is to establish a research group that can be a connection channel between the industry and academia. Under the mentorship of PBSRG, a Saudi Research Group (SRG) has been formed. SRG members have been mentored and educated. SRG members have successfully presented the PBSRG efforts to both academic organizations and the construction industry in Saudi Arabia and have gained interests in implementing the PBSRG Best Value technology in

Saudi Arabia. The following list includes a brief summary of their accomplishments to date:

- The group started in 2013 with the first PhD student (the author of this dissertation)
- They have obtained 6 scholarships from different Saudi universities and government agencies since 2014.
- SRG has developed a database of 300 references on worldwide construction industry performance
- Mentored weekly by BV PIPS experts in the research approach, the theoretical logic and research testing.
- Learning from other PBSRG research groups such as Dutch Best Value participants and the Leadership Society of Arizona.
- Identified a potential test of applying innovative concepts with a client in Saudi Arabian construction industry and will start in the fall of 2017.

Education

The second step in the proposed model is education. The construction professionals must be engaged in the early phases of conducting research in order to understand their needs and issues. The given roadmap model in this study proposed that having a research center that has a successful implementation metrics will help to attract the attention of the industry professionals. Also the proposed solution uses the education workshop as a tool to bring both construction professionals and academia to one place to

discuss the theories and its ability to be implemented to solve industry issues. These two steps will help the implementation of research efforts in order to bridge the gap between the academic and practice. The PBSRG-SRG has introduced the research center expertise metrics to the construction professional group from a public organization in Saudi Arabia. One of the public organizations in Saudi Arabia was interested in attending an education workshop. This industry group is facing issues to improve the contractor classification system performance in order to identify the capability of the contractor to do the work. The industry group used to hire consultants from the private sector to do the work. However, after perceiving the value of a research group's expertise, they turned to academic research to see if there was anything being developed that could meet their objectives. As it is shown in the work agenda below, the industry group was involved in a workshop to discuss their issues and the theories that are proposed by the research group. The workshop was held at Arizona State University, at the Del Webb School of Construction in October 2015. The industry group was 7 people including the top management.

Implementation

The last phase in the proposed model is the implementation phase. This step is extremely important since it will transform all efforts that were given in the education workshops to the implementation phase. Several meetings will be needed to identify the implementation plan. Both research experts and the industry professionals should attend these meetings and carefully understand how the solution will be implemented, identify the responsibility of each individual who will be involved in the implementation phase,

identify the risks that may affect the performance of the projects and how these risks will be mitigated. The outcome from the education phase for the given case study, Contractor Classification System, was that the industry group from Saudi Arabia agreed to utilize the research group expertise and work with academic experts to implement the theories in their case. Currently, both the industry professionals from the Saudi organization (Contractors' Classification Agency) and the research group are discussing the implementation plan. Detailed information about this case study is not provided in this dissertation since the aim of this study is to implement the proposed model to bridge the gap between the research work and practice. Another research project will be conducted in the future to discuss the implementation phase and provide the results for the given case study through publishing the results of implementing the new theories in the case of the Contractors' Classification System in Saudi Arabia.

[Education workshop for Saudi organization visit]

October 2, 2015

8:00 am – 5:00 pm

Meeting called by [Saudi Research Group]

8:30 am – 9:00 am	**Welcome and Breakfast**	[CAVC 329]
9:00 am – 11:00 am	**Overview on PBSRG/BV Approach** Speaker: Prof. Dean Kashiwagi	[CAVC 329]
11:00 am – 11:15 am	**Overview on Saudi Research Group** Speaker: Yasir Alhammadi	[CAVC 329]
11:15 am – 11:45 am	**Ministry of Saudi Municipal & Rural Affairs** Speaker: Guest	[CAVC 329
11:45 am – 12:00 pm	**Discussion**	[CAVC 329]
12:00 pm – 2:00 pm	**Prayer/ Lunch break** **Lunch (1:30 – 2:00)**	[CAVC 401]
2:00 pm – 4:00 pm	**Vendor performance metrics system** Speaker: Prof. Dean Kashiwagi	[CAVC 401]
4:00 pm – 5:00 pm	**Tour in Arizona State University**	ASU campus

CHAPTER 7

CONCLUSION & RECOMMENDATION

CONCLUSION

The Saudi Arabian construction industry has suffered from non-performance and inefficiencies for the past 30 years. Saudi Arabian research efforts have minimal impact to improve the poor performance. It was observed during conducting this research that there is a high spending on research and development in both universities and public organizations. This dissertation aimed to evaluate the impact of construction management impact in Saudi construction industry, and to investigate obstacles that hinder the diffusion of implementing the research outcomes in the construction sector in order to develop a suitable framework to bridge the gap between academic research and practice, using the experience of other organizations that have a successful experience in developing the impact of construction management research in the construction industry. In order to achieve the aim of research, the following objectives were set up

Objective 1: Evaluate the impact of construction management research in Saudi construction industry

An attempt has been made to find effective research efforts and the best practices in the Saudi construction industry that incorporate the theoretical studies and industry practices through which the industry performance can be enhanced. By surveying the researchers and industry professionals, a questionnaire has been developed. According to the findings, both research methods, the literature review and the survey, have the same

results indicating that the theoretical research work and the industry practice in the Saudi construction industry SCI operate independently and without collaboration or cooperation between the two. As a result, the SCI practice is not considerably affected by the academic research work. It has been learned that the majority of research publications keep a record of existing industry practices. This includes what industry practitioners recognize and observe and their different proposals based on consent of opinions. The prototype testing of concepts are run by very few academic researchers. Moreover, a considerable gap has been found between the academic research publication and the SCI practice according to the survey results. In the response session, it was agreed that the transformations must be made to the current R&D efforts in SCI.

Objective 2: Develop a framework to bridge the gap between the research and practice

This study suggests that the kingdom's economic productivity could be enhanced and the synergy between the two sectors would be developed by changing a mind-set in both the public and private sector with regards to R&D co-operation/collaboration. Research centers, where participants are drawn from the industry, could help to bridge this gap between the SCI and academic research. The aforementioned steps must be ensured to support the future research and development approach:

- Theoretical development research.
- Prototype Testing
- Implementation testing.

- Performance metrics must be kept on the action research results.

The proposed implementation model is comprised of three main phases: establishing research centers that have the scope of specific expertise, holding educational workshops that aim to educate the construction practitioners and exchange the expertise between the industry professionals and academia about the research value and identify the real issues that the industry faces, and finally, the implementation phase and documentation of the results. In the delivery of services across the construction industry, persistent conceptual development and rapid impact is ensured by this future based approach. The implementation of the proposed solutions and recommendations in the studies is extremely important in order to validate the results. Therefore, the academic research peer review would not endorse the authentication of the developed concepts, but it would be supported by sustainability of the research effort and action research test results. The model uses customer satisfaction and projects performance that utilize the research group expertise as key performance indicators.

Objective 3: validating the proposed model

The new research model was validated by exposing it to academic researchers who have experience in conducting research and the industry professionals who have experience in managing construction projects. The results revealed that there is an agreement in the importance of having a research centers that can help to bridge the gap between the academic researchers and practice. Both sectors will benefit from the implementation of the proposed model since the academic researchers and practitioners

will work as a team to develop the performance of the construction industry. The outcome will be several case studies that can be used in the education workshops and let the students learn from the real issues that will face them after graduation. Another benefit will be that the universities will have another source of funding instead of only relying on government funding. This point is important since it aligns with the Saudi vision 2030, which aims to increase the sources of funding for universities. Also, the proposed model meets the requirements that were presented in the 9th national plan by the Saudi Ministry of Planning.

Objective 4: Identify the barriers that affect the implementation of construction management research in Saudi construction industry

Several barrier factors were identified from the literature review. These factors were introduced to the academic researchers and practitioners to identify the level of impact in implementing the research outcomes in construction industry. The respondents were given 17 barrier factors and asked to rate them in terms of their impacts in the implementation of researches in the practice. The results revealed that the three top factors are:

- The University does not have an effective communication channels for research dissemination
- There is no effort put into transforming the research finding for practitioners
- Lack of knowledge of the importance of research and development in increasing the performance of the construction sector

Objective 5: Proposed Implementation plan and review the result from the implementation

This dissertation provides an implementation plan for the proposed model. The plan includes:

- Establishing a research group that is mentored by an expert research center, PBSRG, that has a successful history in bridging the gap between academic research and practice.
- Holding educational workshops to educate the Saudi academic research units and government agencies by giving them presentations about Best Value Approach.
- Run tests, when possible, in Saudi Arabia with visionary government owners and vendors

The result from the implementation of the research model showed the applicability of the solution. The first year resulted in one case study that will utilize the expertise of the research group PBSRG.

Research Contribution

The researcher is a construction management faculty member in one of the Saudi universities. He desires to add value to the university systems and the construction industry in order to bridge the gap between the academia and construction industry. According to the literature review, this study is the first research that discusses the impact of construction management studies that were published in the Saudi construction industry. Also, this research provides a new model and approach to bride the gap between

academia and construction industry in Saudi Arabia. The result of this study will help both decision makers at universities and public organization to change their mindset on their views on R&D since cooperation is required to create collaboration between the two sectors and improve the competitiveness of the country's economy.

Some of the information presented in this research has also been published in different conferences and journals (Alhammadi, 2015 & Alhammadi 2016 (a) & Alhammadi 2016(b)) .

Recommendations

The following recommendations are suggested

- Universities should rethink in how to utilize the research outcomes that are conducted by faculties members and develop a strategic and polices to increase the value of these researches
- Another recommendation is that Universities should develop the communication channels with the construction professionals in order to increase the numbers of funding resources
- Using the proposed research roadmap will improve the education by share the students understand the real issues that they will face after their graduation.
- Training course should be given to educate the industry and researchers about the importance of research and development.

- Best Value Approach is recommended to the Saudi construction industry to overcome the performance issues

Recommendations for Future studies

The following questions are proposed for the future studies:

- How to design an effective workshop that helps both academic researchers and industry professionals to achieve their objectives.
- How to develop an effective implementation plan that can achieve the objectives of the projects
- For other industries such as IT, what is the status of research and development between the industry and academic institutes?
- How to develop the research and development at public organizations systems?

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APPENDIX A

SURVEY 1: ASSESSMENT OF THE RESEARCH AND DEVELOPMENT IN THE SAUDI CONSTRUCTION INDUSTRY

Q: Based on your experience, please rate the following statements using the scale below:

Question	Strongly Agree	Agree	Not Sure	Disagree	Strongly Disagree
Most of the construction projects in Saudi Arabia have performance issues (Delay or Cost overruns, Quality or Safety issues					
Most of the research publications in SCI have not helped to improve the SCI performance					
The research centers (Public/ Private) that have interest in Construction industry have helped the SCI to improve					
The role of Saudi universities to improve the SCI performance is effective					
Most of the proposed solutions\ recommendations in publications are theoretical based and not tested in the real construction projects					
There is a collaboration between universities and government agencies to find solutions for real issues in construction projects					
There is a collaboration between universities and private agencies to find solutions for real issues in construction projects					
Overall, There is a big gap in the collaboration between the Saudi research centers and SCI to improve the Saudi construction performance					
There is a real need to change the R&D in SCI					

APPENDIX B

SURVEY 2: SUCCESSFUL FACTORS TO BRIDGE THE GAP BETWEEN RESEARCH AND PRACTICE

Q: Based on your experience, please rate the following statements using the scale below:

Proposed Solutions: Successful factors	**Strongly agree**	**Agree**	**Not sure**	**Disagree**	**Strongly disagree**
Having a performance measurement to measure the impact of the research efforts will help to develop the collaboration between the academic and industry in implementing the research in the industry					
Involving the industry professionals in organized workshop\presentations given by expert researchers who run the research centers will help to identify the real industry need.					
Using the implementation results from pervious case studies in education sessions will help the construction professionals to perceive the impact of research and increase the chance of implementing the research					
Inviting the champion individuals who control the changes in organization is important in order to implement the research in the industry					
Involving the industry professionals in organized workshop\presentations will help them more to understand the theories and increase the chance of implementing the research					
Using the customer satisfaction and the project performance as KPI for the research group will help the chance of implementing the research in the construction industry					
Using prototype tests is the best way to validate the applicability of the theories and increase the value of research in point view of the industry professionals					

Proposed Solutions: Successful factors	**Strongly agree**	**Agree**	**Not sure**	**Disagree**	**Strongly disagree**
Having specialized research groups\centers at universities will help the construction professionals to perceive the research information and the expertise of universities' faculty members					
Having specialize research groups\centers at universities will help to improve the construction management education for the students and junior researchers					
Having specialize research groups\centers at universities will help to develop the communication between the industry professionals and researchers					
Having specialized research groups\centers at universities will attracts the experts researchers from worldwide to participate and share the new ideas					
Hiring research experts who have a successful performance measurement in theirs fields from implementing the research in the industry will help to bridge the gap between industry and academia					
Identifying the boundaries of the research groups\centers will help to develop the expertise of the research groups\centers and increase the chance of collaboration between the academic and industry					

APPENDIX C

SURVEY 3: BARRIERS FACTORS THAT AFEECT THE IMPLEMENTATION OF RESEARCH IN THE CONSTRUCTION INDUSTRY

Q: Based on your experience, please rate the following statements using the scale below:

Barriers Factors	Strongly Agree	Agree	Not Sure	Disagree	Strongly disagree
The University /Institution does not have an effective communication channels for research dissemination					
There is no effort put into transforming the research finding for practitioners					
Lack of knowledge of the importance of research and development in increasing the performance of the construction sector					
There are no tracking system for having research findings applied in practice in order to determine the impact of research					
Lack of information (expertise) on a specific fields offered by universities					
Most researchers felt that it was not their responsibility to disseminate research.					
Research is conducted by academics with no grounding in the real issues of construction practice/teaching					
Routine and bureaucratic barriers in supporting R&D at client system					
Lack of practical experience among faculty					
Lack of cooperation with the researcher from the construction organizations in providing the required data					

Barriers Factors	Strongly Agree	Agree	Not Sure	Disagree	Strongly disagree
Lack of strategy in determining the scope of research published in universities					
The University /Institution does not have research dissemination policies and strategy.					
Universities do not have the knowledge or information that construction organizations need.					
There are no rewards for having research findings applied in practice					
Routine and bureaucratic barriers in Universities					
Construction Industry practitioners are not willing to change their set ways of operations.					
Long retention time of researchers in universities					