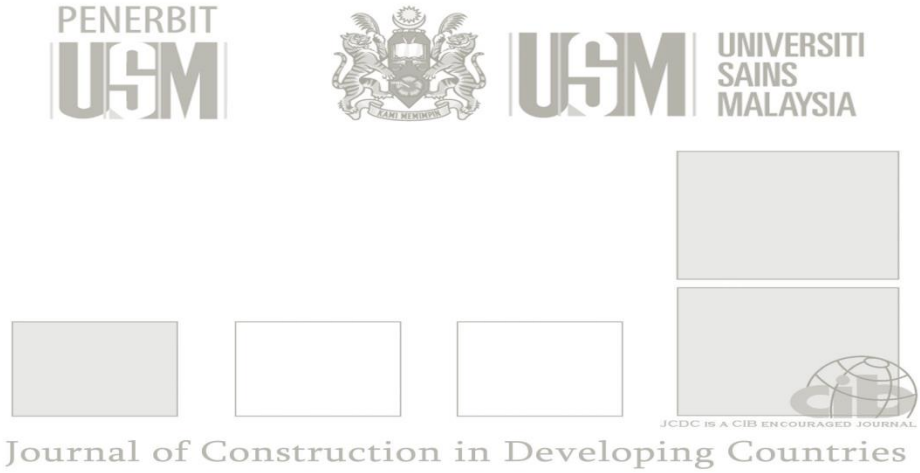

Manuscript Title	Determination of Contractor Strategies in Delivering Construction Projects in Oman
Authors	Ayisha Powmya, Nazirah Zainul Abidin and Nurul Sakina Mokhtar Azizi
Submitted Date	29-Dec-2021 (1st Submission)
Accepted Date	17-May-2022
DOI	https://doi.org/10.21315/jcdc-12-21-0203

Determination of Contractor Strategies in Delivering Construction Projects in Oman

Ayisha Powmya*, Nazirah Zainul Abidin*, Nurul Sakina Mokhtar Azizi

School of Housing, Building and Planning, University Sains Malaysia (USM), 11800, Pulau Pinang, Malaysia

* Corresponding author: ampowmya@gmail.com; nazirah_za@usm.my

Abstract:

Contractors are responsible to deliver construction projects as per contract. Past literature highlighted various implications of poor project delivery and as the ones who are responsible to deliver the project, contractors need to plan and strategise to ensure their projects are successfully delivered to the client. This paper focuses on identifying the strategies adopted by Omani main contractors to deliver construction projects successfully. Using 48 strategies identified through literature review, a survey has been conducted with 108 main contractors in Oman with top grade level of Oman Chamber of Commerce and Industry (OCCI) to investigate the significant strategies adapted ensuring successful project delivery. The top grade level contractor is on the focus of this research because they are involved as main contractors for construction projects in Oman. Using Factor Analysis technique, the 48 strategies have been reduced into 28 sub-strategies which are grouped into seven main strategies. The seven main strategies are: i) people and subcontractor management; ii)

technology and innovative solutions adoption; iii) quality, safety and environmental protection; iv) develop technical capability, monitor and control; v) organisational efficiency and financial stability; vi) legislative compliance; and vii) clients' satisfaction. This research revisits the successful strategy for project delivery and restructures them to suit the practices in Oman. The strategy can be emulated by contractors in the country, and perhaps other middle east countries, as a way to expedite better construction performance.

Keywords: Contractors, Project strategies, Oman, Project delivery, Construction project.

INTRODUCTION

The construction industry plays major role in every country's economic growth (Albino & Berardi, 2012; Hwang, Shan, & Lye, 2018). The success of construction projects generates income to project organisations such as the developers, contractors and consultant, as well as contribute to national growth (Zavadskas, Vilutienė, Turskis, & Šaparauskas, 2014). Unsuccessful project delivery, in return may have adverse impact to project organisation's reputation and affect the surrounding community (Oyegoke & Al Kiyumi, 2017). Failure to handover project to client on time with quality and within budget indicates unsuccessful project delivery. Contractors' role is critical in delivering projects successfully as they are responsible to plan and implement the construction work at site. While

managing construction project and successful delivery can bring competitive advantage to contractors, failure of a single project may cause serious damage to the contractors (Lu, Shen, & Yam, 2008). A tainted reputation is difficult to overcome and can easily outweigh successful past performance. Future work opportunities can be diminished as client may blacklist such contractors. Contractor's failure to achieve contractual obligations can cause contract termination, penalties, loss of profit or litigation with project parties (Oyegoke & Al Kiyumi, 2017). Contractor may be unable to bid for new projects and may be compelled to postpone other projects due to manpower and equipment constraints (Alnuaimi, Taha, Al Mohsin, & Al-Harthi, 2010). Thus, it is important for the contractors to strategise in ensuring continuous performance that meet their clients' expectation.

Project success is linked to the resources and management capability of organisations that implement it (Gudiene, Banaitis, Podvezko, & Banaitiene, 2014). In construction projects, the success of the project delivery rest heavily on the project contractors (Alzahrani & Emsley, 2013). They are the one responsible to transform design on papers into actual building. As such, they are expected to incorporate their skills and capability to manage, operate, monitor, control and execute the works with the resources they possessed, while ensuring the expectation from the clients and consultants are met and all the regulations are complied with. Adoption of appropriate strategies will not only ensure management of resources but also monitor and control project delivery process.

The Omani construction industry faces issues in project delivery due to absence of standard construction procedure manual or guidelines (Alnuaimi et al., 2010). Oyegoke & Al Kiyumi (2017) have identified that contractor's lack of experience and insufficient workers provision cause delay in Omani large projects. Lack of contractor's experience has led to inappropriate construction planning by them. Contractor's improper materials procurement plan with inaccurate lead time calculation causes material shortage in Omani construction project delivery (Islam & Khadem, 2013). They fail to make payment for the daily construction expenses due to their financial instability. Most of the time, construction workers and employees are forced to work overtime with inadequate salary resulting in productivity loss. Majority contractors and their workers are expatriates and exhibit poor understanding of cultural differences (Islam & Khadem, 2013). Most of these workers, including those who became the project supervisors, are unskilled and yet did not receive any proper training. Such incompetent supervisors are responsible for poor planning and poor coordination of construction projects in Oman. Thus, Omani contractors need to strategise to overcome these issues and deliver successful projects. While few studies have been conducted on construction projects in Oman, the contractors' strategies to deliver successful projects have been paid little attention in spite of the research by Alnuaimi & Mohsin (2013) which identified that contractors' poor performance has caused project delay which in turn impacted the national economy.

In view of these issues, this study aims to identify contractors' strategies to deliver successful project in Oman. Through systematic literature review focussing on contractor strategy and performance in delivering construction projects, a total of 48 strategies have been identified. Questionnaires were developed and tested in a pilot study before sending out to begin the survey. The respondents from the contractor firms were asked to rank the importance of these strategies using a Likert scale during the survey. Factor analysis was conducted to significantly group the strategies. The results are expected to fill the gap in project success factors research and provide useful information and practical guidance to contractors on project execution practices.

LITERATURE REVIEW

Oman Construction Industry

Oman is a developing country in which the construction industry is one of the promising sectors that contributes to the country's economy (Project Oman, 2020). As part of the government's strategy to diversify economy away from oil and gas, the construction sector in Oman has been buoyant over the last few years (The World Bank, 2019; Townsend, 2017). The construction industry in Oman has registered an average annual growth rate of 9.4% under the Eighth Five Year Development Plan 2010–2015 (Global Data, 2018). Continued growth is expected during the period 2018-2022 with approximately USD 180 billion worth of planned or on-going projects in Ninth Five Year Development Plan 2016 –

2020 (Malik & Mitchell, 2018). With 6,75,757 workers in the year 2017 for example, the industry has provided job opportunities for both Omanis and expatriates (Oxford Business Group (OBG), 2020). The Omani Government uses the industry as a "tool" to lower its unemployment rate. To cater to the growing population, government is spending heavily on social infrastructure including housing, education and health sector (Alpen Capital, 2015). This is also to attract private investment to the economy. Rapid urbanisation, a fast growing middle class and housing loans availability at low interest rate are driving Oman's housing sector construction activity (Alpen Capital, 2015). Although the industry has recorded a drop of 5.8% due to pandemic in 2020 (Al-Amri & Marey-perez, 2020), Mordor Intelligence (2020) forecasts a growth of 6% from 2019 to 2024. The industry is expected to grow in the future as it is pursuing its diversification plan 'Vision 2040'.

Contractor Roles in Construction Project Delivery

Contractor is one of the major players in the project team who is responsible for executing the construction project work until completion and handover to client (Rao, Kumar, & Kumar, 2018). They are customer-focused organisations that understand and fulfil the expectations of the client. Contractors are expected to complete projects within the timeframe provided for in the contract as delay may lead to penalties (Dvir, Raz, & Shenhar, 2003). Therefore, contractors are expected to make an effort to establish a comprehensive and specific schedule

before project commencement (Oyegoke & Al-Kiyumi, 2017). Aje et al. (2009) reported that contractor's monitoring and control procedure have an impact on the cost and time performance of construction project. Contractors are required to plan for materials and procure based on their usage at construction site to avoid work stoppage due to material shortage or unavailability (Osawaru et al., 2018). Contractor is responsible for site logistics and site management (Jaśkowski, Sobotka, & Czarnigowska, 2018). Main contractors need to monitor subcontractors to ensure that they meet the agreed budget, schedules and technical specifications (Bryde & Robinson, 2005). Contractors need to constantly liaise with consultants for clarification of project drawings. It is imperative for contractors to maintain harmony with consultants to achieve expectations of both clients and consultants during project delivery (Egemen & Mohamed, 2005). It is the contractor's responsibility to ensure quality of projects (Lou, Xu, & Wang, 2017) and safety of all personnel at the work site (Yong & Mustaffa, 2013). One of the major responsibilities of contractors in recent years is minimising environmental impact of construction activities at site (Alzahrani & Emsley, 2013). Overall, contractors are not only responsible for on-site activities including material procurement and environmental protection, they are also expected to manage site workers, subcontractors and liaise with relevant parties such as consultants, suppliers and local authority.

Construction Project Delivery Strategy

Manley, McFallan, & Kajewski (2009) define strategies as "the planned actions of firms to improve core competencies and facilitate outcome achievement". They represent a course of actions to fulfil the needs and expectations of stakeholders. The actions that bring success to a firm differ from country to country based on their operating environment, legislative requirements and policies (Yong & Mustaffa, 2012). In the context of construction firms, "strategies" are defined as planned actions to achieve its organisational goals such as to be competitive among other firms (Chew, Yan, & Cheah, 2008) or operate business globally (Choi, Cho, Han, Kwak, & Chih, 2018) or achieve improved business outcome (Manley et al., 2009) or to manage environmental issues of construction (Fergusson & Langford, 2006) in response to changing market environment. However, these prior studies focused on strategies at firm level that contributes to construction firm performance. It is widely acknowledged that contractor firms' capability is critical for successful execution of project. Thus, "construction project delivery strategy" is plans and actions by the contractor firms to bring them success in construction project delivery, within a changing market environment, to meet the needs and expectations of clients.

The study of strategies that contribute to project success is often considered as one of the important ways to deliver projects successfully (Gunduz & Yahya, 2015). These strategies which are related to company's personnel, resources, processes and management, if not taken care properly are likely to result in project failure (Farooquie & Farooquie, 2009). Shen, Lu, &

Yam (2006), investigated key contractor competitiveness indicators for success in different types of projects. They identified that effective quality policy and plan, technology capacity and plan, construction program, human resources, cost control system, effective organisation operation, plant and equipment resources, relationship with subcontractors and suppliers are critical for all types of project. Manley et al. (2009) investigated 23 business strategies of contractor firms for innovation performance. They identified employee strategies, technology strategies, knowledge strategies, relationship strategies and marketing strategies are significant for contractor companies. A study conducted by Yong & Mustaffa (2013) have identified five contractor strategies that contribute to project success in the Malaysian construction industry context. Their findings showed that control of subcontractors works, skilful workers, adequacy of design details and specifications, commitment and involvement to monitor the project progress are crucial for contractors. Kuwaiti, Ajmal, & Hussain's (2018) study focussed on Abdhabi's healthcare projects; they found that contractor's project management activities, financial capability, effective strategic planning, a competent project manager and multi-disciplinary/competent project team are essential for contractors to deliver successful projects. The implications of these studies are normally limited to the countries and the environment where these studies are conducted. It is important to conduct the investigation referring to Oman construction industry as the middle eastern social, political, economic and cultural aspects are quite

different from other region. The final list of contractor strategies to deliver successful project as identified from literatures is presented in Table 1.

Table 1. Contractor projects delivery strategies extracted from literatures

No.	Potential contractor strategies	References
1.	Provision of site workers according to the project and industry requirements	(Sambasivan & Soon, 2007); (Alzahrani & Emsley, 2013); (Yong & Mustaffa, 2013)
2.	Provision of good facilities for workers' comfortability	(Hwang, Zhu, & Ming, 2016)
3.	Appoint skilled and competent staff	(Kuwaiti et al., 2018); (Gunduz & Yahya, 2015); (Alzahrani & Emsley, 2013); (Pakseresht & Asgari, 2013)
4.	Outsourcing for specialised requirement	(Trejo, Patil, Anderson, & Cervantes, 2002)
5.	Practice reward and incentive system	(Zhao, Shen, & Zuo, 2009); (Gunduz & Yahya, 2015)
6.	Continuous plan for training and skills development	(Kuwaiti et al., 2018); (Gunduz & Yahya, 2015); (Tan, Xue, & Cheung, 2017)
7.	Stimulate good and healthy working culture and environment	(Zhao et al., 2009)
8.	Establish clear contractual responsibilities and liabilities with sub-contractors	(Kuwaiti et al., 2018); (Yong & Mustaffa, 2013); (Tan et al., 2017)
9.	Determine selection criteria for sub-contractor	(Sambasivan & Soon, 2007); (Pakseresht & Asgari, 2013)
10.	Maintaining continuous relationship with sub-contractors	(Tan et al., 2017); (Meng, 2012); (Manley et al., 2009)
11.	Conduct regular meeting with the consultants	(Pakseresht & Asgari, 2013);
12.	Develop trust and satisfaction on work progress	(Meng, 2012); (Wong, Cheung, & Ho, 2005)
13.	Advocate all the contractual terms to demonstrate professionalism	(Alzahrani & Emsley, 2013); (Hwang & Lim, 2013)
14.	Fulfilling client's requirement	(Kuwaiti et al., 2018); (Alzahrani & Emsley, 2013)
15.	Develop IT and technology capability	(Shen et al., 2006)
16.	Invest in new software and system	(Alzahrani & Emsley, 2013); (Wang et al., 2014); (Fang, Cho, Zhang, & Perez, 2016)
17.	Optimise automation and robotics	(Davies & Harty, 2013)
18.	Apply new technology, product or process	(Shen et al., 2018); (Davies & Harty, 2013)
19.	Appoint experienced technical staff	(Isik, Arditi, Dikmen, & Birgonul, 2009); (Aje, 2012)
20.	Select appropriate construction methods	(Isik et al., 2009); (Aje, 2012)
21.	Adherence to construction work schedule	(Gunduz & Yahya, 2015); (Alzahrani & Emsley, 2013); (Kim, Walewski, & Cho, 2016)
22.	Consistency in project monitoring procedure	(Kuwaiti et al., 2018); (Yang, Yu, & Zhu, 2020); (Yong & Mustaffa, 2013)

23.	Apply effective cost and budgeting control	(Alzahrani & Emsley, 2013); (Hwang & Lim, 2013); (Yang et al., 2020); (Tan et al., 2017)
24.	Mitigation of delays and conflicts	(Yong & Mustaffa, 2013);
25.	Conduct risk management analysis	(Hwang & Lim, 2013); (Pakseresht & Asgari, 2013); (Kuwaiti et al., 2018)
26.	Provide competent site supervising team	(Hwang & Lim, 2013); (Yong & Mustaffa, 2013)
27.	Apply maintenance and operating procedure for handling construction plant and equipment	(Sambasivan & Soon, 2007); (Alzahrani & Emsley, 2013); (Doloi et al., 2011)
28.	Implement materials procurement plan	(Sambasivan & Soon, 2007)
29.	Implement logistic and supply chain management	(Kuwaiti et al., 2018)
30.	Implement environmental protection policy	(Acheamfour, Kissi, Adjei-Kumi, & Adinyira, 2020); (Alzahrani & Emsley, 2013)
31.	Implement waste management plan	(Alzahrani & Emsley, 2013)
32.	Implement pollution control	(Wang, Dulaimi, & Aguria, 2004)
33.	Implement health and safety plan	(Kuwaiti et al., 2018); (Tan et al., 2017); (Alzahrani & Emsley, 2013); (Manu et al., 2018)
34.	Provide health and safety supervisor on site	(Manu et al., 2018)
35.	Enclose construction site from public	(Dąbrowski, 2015)
36.	Implement IT system for construction site security	(Fang et al., 2016)
37.	Provide quality improvement through Quality Assurance and Quality Control program	(Yong & Mustaffa, 2013); (Alzahrani & Emsley, 2013); (Kuwaiti et al., 2018)
38.	Establish clear organizational structure and delegate authority	(Gunasekera & Chong, 2018)
39.	Minimise bureaucracy	(Islam & Khadem, 2013)
40.	Improve company image through membership of trade or specialist associations	(Alzahrani & Emsley, 2013)
41.	Submit required plans to authority for approval	(Windapo & Cattell, 2010)
42.	Comply to required rules, regulations and legislation	(Islam & Khadem, 2013); (Windapo & Cattell, 2010)
43.	Optimise technology as way to establish effective communication system	(Kuwaiti et al., 2018); (Gunduz & Yahya, 2015); (Alzahrani & Emsley, 2013)
44.	Manage information using proper documentation plan and technology	(Fortune & White, 2006)

45.	Adequate fund is arranged throughout the project	(Kuwaiti et al., 2018); (Gunduz & Yahya, 2015); (Alzahrani & Emsley, 2013); (Hwang & Lim, 2013)
46.	Minimise reliance on clients payment	(Iyer, Kumar, & Singh, 2020); (Alzahrani & Emsley, 2013);
47.	Forecast cash flow using software packages	(Alzahrani & Emsley, 2013); (Hwang & Lim, 2013)
48.	Invest in insurance policy to manage construction risks	(Odeyinka, 2000)

RESEARCH METHODOLOGY

Using systematic literature review, a total of 72 project delivery strategies have been identified. Similar meaning strategies are then grouped and those that only appear once are removed to ensure consistency in strategy elements, which left with only 48 strategies. A questionnaire was developed using these strategies and was piloted among three contractors in Oman construction industry and two Omani construction academicians to ensure relevancy and adequacy of questions. The feedback was generally helpful and indicated that the survey instrument was likely to work as planned. Some very minor changes, such as rephrasing questions to ensure clarity, were made to the survey questionnaire after the pilot study.

Questionnaires were then randomly distributed to 512 contractors registered under top grades such as International, Excellent and Grade 1 in Oman Chamber of Commerce and Industry (OCCI). This survey approached respondents with management position in the firm. The survey was conducted from 2nd November to 2nd December 2020 through email distribution of questionnaire. Respondents were asked to rate the importance of each strategies using a six-point Likert scale where ranking of 1 was "not important"

and 6 was "extremely important". By using the Likert scale, it required for respondents to make a statement rather than directing their response towards the mid-point choice, suggesting a neutral opinion. Despite reminders sent after the first email, only 119 responses were received representing a response rate of 23.2%. Past studies on contractors have shown that the number of responses between 100 – 110 is acceptable (Doloi, 2013; Kog & Yaman, 2016).

The demographic information of the participants and their company, which include work designation, educational qualification, place of work, and years of construction industry, company registration at OCCI, years of company establishment and number of projects completed by the company are shown in Table 2.

The respondents are either from top or middle management personnel. Majority of the respondents have either bachelor or master's degree which accounts for 50.9% and 38.9% respectively. About 2.8% of them are diploma holder, another 3.7% have professional certification and the remaining 3.7% have acquired other relevant qualifications within their area of expertise such as professional body memberships. Almost half of the respondents (50.9%) work at project site and the other half (49.1%) are based at company office. Majority of the respondents (45.4%) have extensive working experience in construction projects (more than 20 years). Another 20.4% of them have 16 to 20 years of experience, 25% of them have 11 to 15 years of experience and the rest 9.3% have worked at least 5 to 10 years. All respondents' companies are registered

with OCCI, at the top three registration level (International, Excellent and Grade 1). Majority of contractor firms (65.7%) have been established for more than 20 years. Only two (2) of the firms (1.9%) have been established for less than 5 years. About 84.3% of firms have completed more than 20 projects, while only 2.8% of firms have completed less than 5 projects. The data gathered was analysed using SPSS 25.0.

Table 2. Demographic information of the respondents

	Number	Percentage
Work Designation		
Top management personnel	20	18.5
Middle management personnel	88	81.5
Educational Qualification		
Diploma	3	2.8
Bachelor Degree	55	50.9
Master Degree	42	38.9
Professional Certification	4	3.7
Other	4	3.7
Place of work		
Company office	53	49.1
Construction project site	55	50.9
Years of experience in construction projects		
5 - 10	10	9.3
11 - 15	27	25
16 - 20	22	20.4
> 20	49	45.4
Company registration level at OCCI		
International	8	7.4
Excellent or Grade 1 with international operation	17	15.7
Excellent	74	68.5
Grade 1	9	8.3
Years of company establishment		
Less than 5 years	2	1.9
5-10 years	12	11.1
11-15 years	19	17.6
16-20 years	4	3.7
More than 20 years	71	65.7

Number of projects completed		
Less than 5	3	2.8
5-10	7	6.5
11-15	5	4.6
16-20	2	1.9
More than 20	91	84.3

THE FINDINGS

The aim of this study is to group the variables and identify the significant strategies of contractor firms to deliver successful projects. The survey data of 48 strategies were subjected to Factor Analysis (FA). The results are presented in Tables 3 to 5 and Figure 1. Initially, the data were tested for their reliability. The analysis results revealed that the overall degree of inter-correlation among the variables is observed to be sufficient as the correlation matrix revealed coefficients of above 0.3 and below 0.9. This range of coefficient is recommended by Field (2013). The KMO value (0.863) and Bartlett's test of sphericity (p=0.000) in Table 3 also confirmed that the data were appropriate for FA (Kaiser & Rice, 1974). Cronbach's Alpha of 0.968 shows an excellent internal consistency reliability of the items used.

Table 3. KMO, Bartlett's Test and Cronbach's Alpha

Kaiser-Meyer-Olkin Measure of Sampling Adequacy.		.863
Bartlett's Test of Sphericity	Approx. Chi-Square	4475.434
	df	1128
	Sig.	.000
Cronbach's Alpha		0.968

Factor Extraction and Interpretation

The principal component analysis revealed seven components with eigenvalue greater than one, accounting for 74% of the variance. The factors grouping after varimax rotation is shown in Table 4. Items with loading exceeding 0.50 were only retained to interpret the factors as they are accepted to have enough relation to be grouped under a factor (Kazaz, Er, & Ozdemir, 2014). Based on the highest loading items of each factor and common theme of the variables, the 7 factors dubbed as strategies are labelled.

Table 4. Strategies to deliver conventional construction projects

Description of strategies	Factor loading	% of variance explained
1. People and subcontractor management		15.5
Appoint skilled and competent staff	0.689	
Outsourcing for specialised requirement	0.700	
Continuous plan for training and skills development	0.801	
Stimulate good and healthy working culture and environment	0.748	
Establish clear contractual responsibilities and liabilities with sub-contractors	0.724	
Determine selection criteria for sub-contractor	0.666	
Maintaining continuous relationship with sub-contractors	0.573	
2. Technology and innovative solutions adoption		13.8
Develop IT and technology capability	0.765	
Invest in new software and system	0.854	
Optimise automation and robotics	0.815	
Apply new technology, product or process	0.723	
Implement IT system for construction site security	0.752	
3. Quality, safety and Environmental protection		12.9
Implement environmental protection policy	0.844	
Implement waste management plan	0.851	
Implement pollution control	0.833	
Provide health and safety supervisor on site	0.634	
Provide quality improvement through Quality Assurance	0.565	
4. Develop technical capability, monitor and control		10.6

Appoint experienced technical staff	0.717	
Select appropriate construction methods	0.746	
Apply effective cost and budgeting control	0.723	
Mitigation of delays and conflicts	0.644	
5. Organisational efficiency and financial stability		8.3
Conduct risk management analysis	0.615	
Improve company image through membership of trade or specialist associations	0.786	
Minimise reliance on clients payment	0.696	
Forecast cash flow using software packages	0.548	
6. Legislative compliance		7.0
Submit required plans to authority for approval	0.891	
Comply with required rules, regulations and legislation	0.882	
7. Clients' Satisfaction		5.6
Advocate all the contractual terms to demonstrate professionalism	0.765	
Fulfilling client's requirement	0.726	

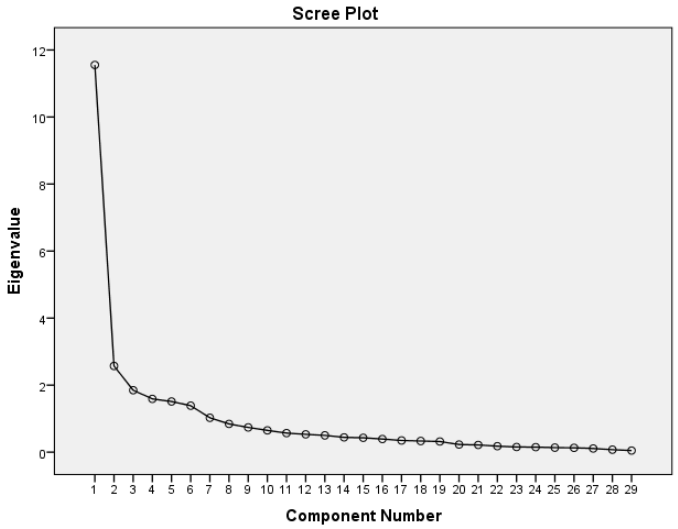

Figure 1. Scree plot

Strategy 1 consists of seven sub-strategies i.e. appoint skilled and competent staff, outsourcing for specialised requirement, continuous plan for training and skills development, stimulate good and healthy working culture and

environment, establish clear contractual responsibilities and liabilities with sub-contractors, determine selection criteria for sub-contractor and maintaining continuous relationship with sub-contractors.

Strategy 2 comprises of five sub-strategies i.e. develop IT and technology capability, invest in new software and system, optimise automation and robotics, apply new technology, product or process and implement IT system for construction site security.

Strategy 3 comprises of five sub-strategies i.e. implement environmental protection policy, implement waste management plan, implement pollution control, provide health and safety supervisor on site and provide quality improvement through Quality Assurance.

Strategy 4 comprises of four sub-strategies i.e. appoint experienced technical staff, select appropriate construction methods, apply effective cost and budgeting control and mitigation of delays and conflicts.

Strategy 5 comprises of four sub-strategies i.e. conduct risk management analysis, improve company image through membership of trade or specialist associations, minimise reliance on clients payment and forecast cash flow using software packages.

Strategy 6 comprises of two sub-strategies i.e. submit required plans to authority for approval and comply with required rules, regulations and legislation.

Strategy 7 comprises of two sub-strategies i.e. advocate all the contractual terms to demonstrate professionalism and fulfilling client's requirement.

Reliability and Validity

The reliability of the main-strategy dimensions were assessed with Cronbach Alpha values. Composite reliability (CR) and average variance extracted (AVE) values indicate validity of the strategy dimensions. The reliability and validity values are presented in Table 5. According to (Bagozzi & Yi, 1988), CR must be above 0.6 and AVE must be above 0.5 to establish convergent validity. The correlation of strategies should be lower than square root of AVE to demonstrate the discriminant validity (Hair, Black, Babin, & Anderson, 2018). All CR scores are above 0.70 and all AVEs are above 0.50 except the strategy five (AVE = 0.45). The square root of the AVE of all seven strategies greater than the levels of correlations involving that strategy confirms discriminant validity of all seven strategies. There is no issue to consider strategy five with AVE slightly below 0.5 while it exhibits discriminant validity (Sekar, Viswanathan, & Sambasivan, 2018).

Table 5.1 Cronbach's Alpha and correlation matrix

Strategies	Cronbach's Alpha	CR	AVE	1	2	3	4	5	6	7
1	0.893	0.87	0.50	**0.707**						
2	0.906	0.88	0.61	.453	**0.781**					
3	0.917	0.86	0.57	.612	.555	**0.755**				
4	0.858	0.80	0.50	.585	.520	.562	**0.707**			
5	0.736	0.76	0.45	.454	.457	.378	.471	**0.671**		
6	0.918	0.88	0.78	.432	.232	.367	.427	.255	**0.883**	
7	0.676	0.71	0.55	.415	.432	.434	.432	.424	.375	**0.741**

DISCUSSIONS

The literature review has identified a total of 48 strategies for contractors to deliver construction projects. The data collected from Omani contractors were subjected to FA to identify the main and sub-strategies. A total of seven main strategies were identified significant for Omani contractors to deliver successful projects.

People and Subcontractor Management

This survey has identified that 'people and subcontractor management' as the most important strategy with 15.5% of the total variance. People are important resource in any construction project. As such, their skills, competencies, and capability shall affect the performance of the projects. Lu et al. (2008) stated that contractors require competent people with strong knowledge and skills to execute project successfully. Under this first strategy, there are seven sub-strategies which can be divided into two main elements, in-house expertise and sub-contractors' relations. With regards to in-house expertise, the main contractors are aware of the need to appoint skilled and competent staff and where possible, outsource for specialised needs (Reichstein, Salter, & Gann, 2008; Wilkinson, Johnstone, & Townsend, 2012). Training has also been identified as one of the sub-strategies, as supported by (Kuwaiti et al., 2018) that indicates the necessity of training for skill development and to enable better achievement of project goals. In construction projects, main contractors enter a contract with

many sub-contractors. Main contractors are responsible to manage the sub-contractors, apart from their own staff. According to Yong & Mustaffa (2012), while competent subcontractors support the contractor to complete the project on time, inexperienced subcontractor can put the project at risk. Therefore, careful selection of the sub-contractors is needed for ensuring successful project delivery. This survey also acknowledged the need to maintain continuous relationship with the sub-contractors and to ensure the responsibility and liabilities of the sub-contractors are clearly defined. This finding supports the statement by Tan et al. (2017) which indicated that main contractors' competitiveness can be improved through their long-term business relationship with subcontractors. The importance of promoting good and healthy working environment in a project has also been identified as one of the sub-strategies. Zhao et al. (2009) stated that good and healthy working culture helps to develop loyalty of staff as it brings safe work environment for them.

Technology and Innovative Solutions Adoption

The results also showed that 'technology and innovative solutions adoption' is another significant strategy with 13.8% of the total variance. Large and challenging projects are dealt with adaptation to new technologies and innovative methods of construction. Contractors are required to acquire appropriate technologies and develop capability for their implementation. While Zhao et al. (2009) reported that advanced technologies' adoption by

Chinese contractors increased their capability to tackle complex projects in international market, Islam & Khadem (2013) identified that low level of technology available in Omani market caused project delay. Contractor's investment in new software and system would help site personnel's unnecessary visits to the firm office. This is supported by Mahmoud, Mehmet, Clevenger, & Fanning (2015) who stated that application of software packages such as BIM in projects results in decreased project schedule due to low request for information. In addition, automation with robotics is also a strategy identified in this study. According to Kurien, Kim, Kopsida, & Brilakis (2018), the use of automation with robotics in construction projects increases productivity and reduces the risk for workers during work in hazardous environment. Kim, Chi, & Wang (2015) also reported that automation with robotics can help managers to quickly and accurately identify quality issues and manage them. This survey identified the need to apply modern construction technology, product, and process to reduce rework and improve productivity. Contractors who apply new technology and process achieve enhanced work efficiency and better quality of finished product (Agenbag & Amoah, 2021). In agreement with previous studies by Fang et al. (2016), the survey results reveal that latest IT systems for site security helps decision makers to locate workers and materials to improve project execution productivity.

Quality, Safety and Environmental Protection

The third important strategy is 'quality, safety and environmental protection' with 12.9% of the total variance. This strategy has five sub-strategies related to three key areas such as quality assurance, health and safety of workers and environmental protection. In this study, quality assurance has been identified as an important sub-strategy. Contractors ensure quality of project through the workmanship quality and conformance to specifications. Alzahrani & Emsley's (2013) research shows that contractors' investment in quality policy is important to deliver quality project. Implementation of an effective quality assurance program can ensure smooth handing over of construction project to client (Kuwaiti et al., 2018). Secondly, the survey results show that health and safety has paramount importance in construction site. It is the contractor's responsibility to ensure health and safety of all workers by providing health and safety supervisor on site. The importance of safety and health for project success have been reported by Sekar et al. (2018) where safety is the criteria additional to time, cost and quality. Acheamfour, Kissi, & Adjei-kumi (2019) also acknowledged that contractors are required to be safety and health conscious as it improves quality of work and productivity. The third key area related to environmental protection indicates that environmental consideration has significance in project success. This aspect started to gain significance in project success attainment due to their life cycle benefits (Acheamfour et al., 2020). Environmental protection has now become a global construction industry challenge. According to Alzahrani & Emsley (2013), construction processes

without considerations of environmental hazards and degradation consequently lead to many environmental problems such as pollution and global warming. The survey results demonstrate that waste management plan implementation is an important sub-strategy. The study conducted by Azeem, Ullah, Thaheem, & Qayyum (2020) had similar findings. They indicated that contractors implement various on-site techniques for waste reduction to achieve better project performance (Azeem et al., 2020). Environmental protection policy implementation is another sub-strategy that is supported by Alzahrani & Emsley (2013), as they highlighted that the policy implementation ensures environmental regulations compliance. The study shows that implementation of pollution control by contractors is an essential sub-strategy. This finding is consistent with Chen, Ong, & Hsu (2016) who asserted that pollution prevention helps contractors in cost reduction.

Develop Technical Capability, Monitor and Control

The results also showed that 'develop technical capability, monitor and control' is a significant strategy of contractors with 10.6% of the total variance. Contractor's technical competence to perform specialised work is one of the most important factors for successful project delivery. Several past studies concurred that high technical capabilities of a contractor indicate his abilities to deliver the project with quality on time and within budget (Acheamfour et al., 2020; Aje, 2012). This study indicates that selection of appropriate construction

methods is an important sub-strategy. The research by Tsai, Lin, Lee, Chang, & Hsu (2013) shows that appropriate construction method selection is critical to contractors to manage delivery of modern complex construction projects. Contractor's regular monitoring and accurate change control process during implementation of planned activities helps project delivery. This is acknowledged by Davies & Harty (2013) as consistent project monitoring helps managers to make decisions on corrective measures and reschedule the construction program to ensure project delivery as planned. Another sub-strategy is to apply effective cost and budgeting control. Previous study by Lu et al. (2008) has addressed the importance of cost controlling. Another research by Yong & Mustaffa (2013) shows that poor monitoring and control will lead to project delay and cost overrun. This research also indicates that mitigation of delays and conflicts is also an important sub-strategy. Conflicts in construction project delivery process not only delay the project but also affect the quality (Ariffin & Sutrisna, 2010). Previous study by Sambasivan & Soon (2007) revealed the need to minimise delays as it leads to cost overrun and disputes during the course of project delivery.

Organisational Efficiency and Financial Stability

This research highlights 'organisational efficiency and financial stability' as another main strategy with 8.3% variance. This strategy consists of four sub-strategies that are divided into two elements as, organisational efficiency and

financial stability. For organisational efficiency, the survey showed that contractors must identify potential sources of risks and take necessary steps to manage those risks. Past research has reported that risk identification and management is crucial for contractors to meet the time, cost and quality targets (Hwang & Lim, 2013). Another sub-strategy is to improve company image through membership of trade or specialist associations. Contractor's reputation is usually derived from their past performance. However, it is necessary for contractors to improve reputation through membership in trade or specialist associations (Alzahrani & Emsley, 2013). Reputation gives an indication regarding contractor's ability to perform in projects (Kog & Yaman, 2016) though it is subjective. Under financial stability, minimal reliance on client payment is highlighted as an important sub-strategy. In their research, Sambasivan & Soon (2007) found that contractors must ensure their sound financial resources for project delivery while Hartmann (2006) stated that poor financial resources can cause delay and quality issues. Another sub-strategy is cash flow forecast using software packages that is supported by Alzahrani & Emsley (2013) as poor cash flow forecasting is the major reasons for construction contractor's failures in project delivery.

Legislative Compliance

In any construction industry in the world, compliance to legislations and law is prudent and necessary. It is what ensures the durability, stability and safety of

the buildings and its occupants. Thus, it is unsurprising that Oman contractors also view that 'legislative compliance' is another main strategy to deliver conventional projects which accounted for 7% of the total variance. Standards and regulatory controls are essential for construction as these construction activities play major role in environmental health, economy, and social welfare. Under this strategy, submission of required plans to authority for approval is one of the sub-strategies. Past research by Islam & Khadem (2013) showed that contractors' submission of drawings and plans to concerned authorities to obtain their approval to proceed determined their productivity which in turn helped project delivery. Another sub-strategy is to comply with required rules, regulations, and legislation of the country. It is mandatory for contractors to comply with the established technical standards and requirements of the country to ensure health, safety, environmental protection, social welfare, and economic stability. According to Windapo & Cattell (2010), compliance to the rules and regulations of the country would ensure smooth handing over of the project.

Clients' Satisfaction

The final main strategy identified from the survey is 'clients' satisfaction' with 5.6% of the total variance. The main responsibility of the contractor is to deliver construction project according to the clients' requirements. One of the two important sub-strategies is 'advocate all the contractual terms to demonstrate

professionalism'. This is acknowledged by Alzahrani & Emsley (2013) that, winning trust of the client through professionalism and adherence to contractual terms increases possibility of successful project delivery. Hwang & Lim (2013) reported that failure to manage the contractual obligations causes project delay due to conflicts. One more sub-strategy is fulfilling clients' requirements to ensure project delivery. Contractor has to fulfill various requirements of client including compliance to the client's schedule, budget and quality. Dikmen & Birgönül (2003) also asserted that contractors need to maximise client's satisfaction by fulfilling their requirements.

CONCLUSIONS

The aim of this study is to identify and group the significant strategies of contractor firms to deliver successful projects in Oman. A detailed literature review identified a total of 48 contractor strategies. These strategies were analysed by employing factor analysis approach. A total of seven main strategies and 29 sub-strategies adopted by the Oman main contractors to deliver projects have been identified. The seven strategies are: 1) people and subcontractor management (seven sub-strategies); 2) technology and innovative solutions adoption (five sub-strategies); 3) quality, safety and environmental protection (five sub-strategies); 4) develop technical capability, monitor and control (four sub-strategies); 5) organisational efficiency and

financial stability (four sub-strategies); 6) legislative compliance (two sub-strategies); and 7) clients' satisfaction (two sub-strategies).

. This research unveiled the delivery strategy that has benefited the main contractors. As main contractors, they are the decision makers in ensuring projects are executed properly and in timely manner. Due to complexity at site, they need to ensure every aspect of project delivery is catered for efficiently. Thus, having holistic strategies would be advantageous throughout the whole project execution. In Oman, the conventional construction still dominates the industry, however, the government is moving towards more modern and sustainable construction. This instigates changes to the current practice. By establishing strategies that have been successfully applied, more contractors can emulate the practices to increase the project performance. These strategies can also be adapted to answer the government's call for better construction industry. This research is currently focused on main contractor with top grade level of OCCI working on conventional projects only. This also indicates that the projects they are involved with are considered as large projects. Lower grade or smaller projects may adopt similar strategies or they may have different strategies to cater for smaller project budgets. More mega projects and green certifiable projects are also taking hold in Oman. Although the delivery strategy adopted by the conventional projects are most likely appropriate for mega or green projects, there could be additional or newer aspects that the contractor need to be aware off to ensure successful delivery.

Thus, this opens avenue for further research on delivery strategy to cater for this more challenging construction projects.

REFERENCES

Acheamfour, V. K., Kissi, E., & Adjei-kumi, T. (2019). Ascertaining the impact of contractors pre-qualification criteria on project success criteria. *Engineering, Construction and Architectural Management*. https://doi.org/10.1108/ECAM-03-2018-0110

Acheamfour, V. K., Kissi, E., Adjei-Kumi, T., & Adinyira, E. (2020). Review of empirical arguments on contractor pre-qualification criteria. *Journal of Engineering, Design and Technology*, *18*(1), 70–83. https://doi.org/10.1108/JEDT-03-2019-0067

Agenbag, H., & Amoah, C. (2021). The impact of modern construction technology on the workforce in the construction industry. In *IOP Conf. Series: Earth and Environmental Science 654*. https://doi.org/10.1088/1755-1315/654/1/012001

Aje, I. (2012). The impact of contractors' prequalification on construction project delivery in Nigeria. *Engineering, Construction and Architectural Management*, *19*(2), 159–172. https://doi.org/10.1108/09699981211206098

Aje, O. I., Odusami, K. T., & Ogunsemi, D. R. (2009). The impact of contractors' management capability on cost and time performance of construction

projects in Nigeria. *Journal of Financial Management of Property and Construction*, *14*(2), 171–187. https://doi.org/10.1108/13664380910977619

Al-Amri, T., & Marey-perez, M. (2020). Impact of Covid-19 on Oman's Construction industry. *Technium Social Sciences Journal*, *9*(July), 661–670. https://doi.org/10.47577/tssj.v9i1.1021

Albino, V., & Berardi, U. (2012). Green buildings and organizational changes in Italian case studies. *Business Strategy and the Environment*, *21*(6), 387–400. https://doi.org/10.1002/bse.1728

Alnuaimi, A. S., & Al-Mohsin, M. A. (2013). Causes of Delay in Completion of Construction Projects in Oman. *International Conference on Innovations in Engineering and Technology (ICIET'2013) Dec. 25-26, 2013 Bangkok*, *99231200*, 267–270. https://doi.org/10.15242/IIE.E1213590

Alnuaimi, A. S., Taha, R. A., Al Mohsin, M., & Al-Harthi, A. S. (2010). Causes, effects, benefits, and remedies of change orders on public construction projects in Oman. *Journal of Construction Engineering and Management*, *136*(5), 615–622. https://doi.org/10.1061/(ASCE)CO.1943-7862.0000154

Alpen Capital. (2015). *GCC Construction Industry*. Retrieved from http://www.alpencapital.com/downloads/GCC_Construction_Industry_Report_June_2015.pdf

Alzahrani, J. I., & Emsley, M. W. (2013). The impact of contractors' attributes on construction project success: A post construction evaluation. *International*

Journal of Project Management, *31*, 313–322. https://doi.org/10.1016/j.ijproman.2012.06.006

Ariffin, L. H. T., & Sutrisna, M. (2010). Developing a Framework to Minimize the Occurrence of Construction Conflict and Disputes in Different Procurement Strategies: An Initial Review of Literature. In *In: Egbu, C. (Ed) Procs 26th Annual ARCOM Conference, 6-8 September 2010, Leeds, UK, Association of Researchers in Construction Management,* (pp. 1059–1068).

Azeem, M., Ullah, F., Thaheem, M. J., & Qayyum, S. (2020). Competitiveness in the construction industry: A contractor's perspective on barriers to improving the construction industry performance. *Journal of Construction Engineering, Management & Innovation*, *3*(3), 193–219. https://doi.org/10.31462/jcemi.2020.03193219

Bagozzi, R. P., & Yi, Y. (1988). On the evaluation of structural equation models. *Journal of the Academy of Marketing Science*, *16*(1), 74–94. https://doi.org/10.1007/BF02723327

Bryde, D. J., & Robinson, L. (2005). Client versus contractor perspectives on project success criteria. *International Journal of Project Management*, *23*, 622–629. https://doi.org/10.1016/j.ijproman.2005.05.003

Chen, P.-H., Ong, C.-F., & Hsu, S.-C. (2016). The linkages between internationalization and environmental strategies of multinational construction firms. *Journal of Cleaner Production*, *116*, 207–216. https://doi.org/10.1016/j.jclepro.2015.12.105

Chew, D. a. S., Yan, S., & Cheah, C. Y. J. (2008). Core capability and competitive

strategy for construction SMEs in China. *Chinese Management Studies*, *2*(3), 203–214. https://doi.org/10.1108/17506140810895898

Choi, S., Cho, I., Han, S. H., Kwak, Y. H., & Chih, Y.-Y. (2018). Dynamic Capabilities of Project-Based Organization in Global Operations. *Journal of Management in Engineering*, *34*(5), 1–12. https://doi.org/10.1061/(ASCE)ME.1943-5479.0000621

Dąbrowski, A. (2015). An investigation and analysis of safety issues in Polish small construction plants. *International Journal of Occupational Safety and Ergonomics*, *21*(4), 498–511. https://doi.org/10.1080/10803548.2015.1085206

Davies, R., & Harty, C. (2013). Implementing ' Site BIM ': A case study of ICT innovation on a large hospital project. *Automation in Construction*, *30*, 15–24. https://doi.org/10.1016/j.autcon.2012.11.024

Dikmen, I., & Birgönül, M. T. (2003). Strategic Perspective of Turkish Construction Companies. *Journal of Management in Engineering*, *19*(1), 33–40. https://doi.org/10.1061/(ASCE)0742-597X(2003)19:1(33)

Doloi, H. (2013). Cost overruns and failure in project management: understanding the roles of key stakeholders in construction projects. *Journal of Construction Engineering and Management*, *139*, 267–279. https://doi.org/10.1061/(ASCE)CO.1943-7862

Doloi, Hemanta, Iyer, K. C., & Sawhney, A. (2011). Structural equation model for assessing impacts of contractor's performance on project success. *International Journal of Project Management*, *29*, 687–695. https://doi.org/10.1016/j.ijproman.2010.05.007

Dvir, D., Raz, T., & Shenhar, A. J. (2003). An empirical analysis of the relationship between project planning and project success. *International Journal of Project Management*, *21*(2), 89–95. https://doi.org/10.1016/S0263-7863(02)00012-1

Egemen, M., & Mohamed, A. N. (2005). Different approaches of clients and consultants to contractors' qualification and selection. *Journal of Civil Engineering and Management*, *11*(4), 267–276. https://doi.org/10.1080/13923730.2005.9636357

Fang, Y., Cho, Y. K., Zhang, S., & Perez, E. (2016). Case study of BIM and cloud–enabled real-time RFID indoor localization for construction management applications. *Journal of Construction Engineering & Management*, *142*(7), 05016003–1. https://doi.org/10.1061/(ASCE)CO.1943-7862.0001125

Farooquie, P., & Farooquie, J. A. (2009). Project planning and performance: an empirical study. *International Journal of Project Organisation and Management*, *1*(4), 408–421. https://doi.org/10.1504/IJPOM.2009.029109

Fergusson, H., & Langford, D. A. (2006). Strategies for managing environmental issues in construction organizations. *Engineering, Construction and Architectural Management*, *13*(2), 171–185.

https://doi.org/10.1108/09699980610659625

Field, A. (2018). *Discovering Statistics using IBM SPSS Statistics* (5th Ed.). California: Sage Publications, Thousand Oaks.

Fortune, J., & White, D. (2006). Framing of project critical success factors by a systems model. *International Journal of Project Management*, *24*(1), 53–65. https://doi.org/10.1016/j.ijproman.2005.07.004

Global Data. (2018). *Construction in Oman – key trends and opportunities to 2022*. Retrieved from https://store.globaldata.com/report/gd-cn0393mr--construction-in-oman-key-trends-and-opportunities-to-2022/

Gudiene, N., Banaitis, A., Podvezko, V., & Banaitiene, N. (2014). Identification and evaluation of the critical success factors for construction projects in Lithuania: AHP approach. *Journal of Civil Engineering and Management*, *20*(3), 350–359. https://doi.org/10.3846/13923730.2014.914082

Gunasekera, V. S., & Chong, S. C. (2018). Knowledge management for construction organisations: a research agenda. *Kybernetes*, *47*(9), 1778–1800. https://doi.org/10.1108/K-10-2017-0378

Gunduz, M., & Yahya, A. M. A. (2015). Analysis of project success factors in construction industry. *Technological and Economic Development of Economy*, *24*(1), 67–80. https://doi.org/10.3846/20294913.2015.1074129

Hair, J. F., Black, W. C., Babin, B. J., & Anderson, R. E. (2018). *Multivariate Data Analysis* (8th Ed.). Cengage Learning India Pvt. Ltd.

Hartmann, A. (2006). The context of innovation management in construction

firms. *Construction Management and Economics*, *24*(6), 567–578. https://doi.org/10.1080/01446190600790629

Hwang, B.-G., & Lim, E.-S. J. (2013). Critical Success Factors for Key Project Players and Objectives: Case Study of Singapore. *Journal of Construction Engineering and Management*, *139*, 204–215. https://doi.org/10.1061/(ASCE)CO.1943-7862

Hwang, B.-G., Shan, M., & Lye, J.-M. (2018). Adoption of sustainable construction for small contractors : major barriers and best solutions. *Clean Technologies and Environmental Policy*, *20*, 2223–2237. https://doi.org/10.1007/s10098-018-1598-z

Hwang, B., Zhu, L., & Ming, J. T. T. (2016). Factors affecting productivity in green building construction projects: the case of Singapore. *Journal of Management in Engineering*, *33*(3). https://doi.org/10.1061/(ASCE)ME.1943-5479.0000499.

Isik, Z., Arditi, D., Dikmen, I., & Birgonul, M. T. (2009). Impact of corporate strengths/weaknesses on project management competencies. *International Journal of Project Management*, *27*(6), 629–637. https://doi.org/10.1016/j.ijproman.2008.10.002

Islam, M. A., & Khadem, M. M. R. K. (2013). Productivity determinants in Oman construction industry. *International Journal of Productivity and Quality Management*, *12*(4), 426. https://doi.org/10.1504/IJPQM.2013.056736

Iyer, K. C., Kumar, R., & Singh, S. P. (2020). Understanding the role of contractor

capability in risk management: a comparative case study of two similar projects. *Construction Management and Economics*, *38*(3), 223–238. https://doi.org/10.1080/01446193.2019.1590614

Jaśkowski, P., Sobotka, A., & Czarnigowska, A. (2018). Decision model for planning material supply channels in construction. *Automation in Construction*, *90*, 235–242. https://doi.org/10.1016/j.autcon.2018.02.026

Kaiser, H. F., & Rice, J. (1974). Little jiffy, Mark IV. *Educational and Psychological Measurement*, *34*(1), 111–117.

Kim, K., Walewski, J., & Cho, Y. K. (2016). Multiobjective Construction Schedule Optimization Using Modified Niched Pareto Genetic Algorithm. *Journal of Management in Engineering*, *32*(2), 1–12. https://doi.org/10.1061/(ASCE)ME.1943-5479.0000374

Kim, M. J., Chi, H., & Wang, X. (2015). Automation and robotics in construction and civil engineering. *Journal of Intelligent and Robotic Systems*, *79*, 347–350. https://doi.org/10.1007/s10846-015-0252-9

Kog, F., & Yaman, H. (2016). A multi agent systems based contractor pre-qualification model. *Engineering, Construction and Architectural Management*, *23*(6), 709–726. https://doi.org/10.1108/ECAM-01-2016-0013

Kurien, M., Kim, M., Kopsida, M., & Brilakis, I. (2018). Real-time simulation of construction workers using combined human body and hand tracking for robotic construction worker system. *Automation in Construction*, *86*, 125–137. https://doi.org/10.1016/j.autcon.2017.11.005

Kuwaiti, E. Al, Ajmal, M. M., & Hussain, M. (2018). Determining success factors in Abu Dhabi health care construction projects: customer and contractor perspectives. *International Journal of Construction Management*, *18*(5), 430–445. https://doi.org/10.1080/15623599.2017.1333401

Lou, J., Xu, J., & Wang, K. (2017). Study on construction quality control of urban complex project based on BIM. *Procedia Engineering*, *174*, 668–676. https://doi.org/10.1016/j.proeng.2017.01.215

Lu, W., Shen, L., & Yam, M. C. H. (2008). Critical success factors for competitiveness of contractors: China study. *Journal of Construction Engineering and Management*, *134*(12), 972–982. https://doi.org/10.1061/(ASCE)0733-9364(2008)134:12(972)

Mahmoud, H. O., Mehmet, E., Clevenger, C. M., & Fanning, B. (2015). Implementing BIM on infrastructure: Comparison of two bridge construction projects. *Practice Periodical on Structural Design and Construction*, *20*(4), 1–8. https://doi.org/10.1061/(ASCE)SC.1943-5576.0000239

Malik, M. J., & Mitchell, H. (2018). *Construction and projects in Oman: overview*. Retrieved from https://www.amjoman.com/wp-content/uploads/2019/01/Construction-and-projects-in-Oman-overview.pdf

Manley, K., McFallan, S., & Kajewski, S. (2009). Relationship between construction firm strategies and innovation outcomes. *Journal of Construction Engineering and Management*, *135*(8), 764–771. https://doi.org/10.1061/(ASCE)CO.1943-7862.0000030

Manu, P., Mahamadu, A. M., Phung, V. M., Nguyen, T. T., Ath, C., Heng, A. Y. T., & Kit, S. C. (2018). Health and safety management practices of contractors in South East Asia: A multi country study of Cambodia, Vietnam, and Malaysia. *Safety Science*, *107*, 188–201. https://doi.org/10.1016/j.ssci.2017.07.007

Meng, X. (2012). The effect of relationship management on project performance in construction. *International Journal of Project Management.*, *30*(2), 188–198. https://doi.org/https://doi.org/10.1016/j.ijproman.2011.04.002

Mordor Intelligence. (2020). Oman Construction Market | Growth, Trends and Forecast (2019 - 2024). Retrieved March 24, 2020, from https://www.mordorintelligence.com/industry-reports/oman-construction-market

Odeyinka, H. A. (2000). An evaluation of the use of insurance in managing construction risks. *Construction Management and Economics*, *18*(5), 519–524. https://doi.org/10.1080/014461900407329

Osawaru, F., Amusan, L., Awotinde, O., Akanya, C., Asiyanbola, O., & Akinbo, F. (2018). Planning materials supply for construction works. In *IOP Conf. Series: Earth and Environmental Science, 2nd International Conference on Science and Sustainable Development* (Vol. 173, pp. 1–7).

Oxford Business Group (OBG). (2020). Oman's construction activity ramps up amid government initiatives. Retrieved February 14, 2020, from https://oxfordbusinessgroup.com/overview/building-excitement-activity-sector-picks-after-slow-2017-aided-higher-oil-prices-and-government

Oyegoke, A. S., & Al Kiyumi, N. (2017). The causes, impacts and mitigations of delay in megaprojects in the Sultanate of Oman. *Journal of Financial Management of Property and Construction*, *22*(3), 286–302. https://doi.org/10.1108/JFMPC-11-2016-0052

Pakseresht, A., & Asgari, G. (2013). Determining the critical success factors in construction projects: AHP approach. *Interdisciplinary Journal of Contemporary Research in Business*, *4*(8), 383–393.

Project Oman. (2020). Oman's construction market snapshot. Retrieved February 15, 2020, from http://www.project-oman.com/market-insights

Rao, M. V. K., Kumar, V. S. S., & Kumar, P. R. (2018). Optimal contractor selection in construction industry: The fuzzy way. *Journal of The Institution of Engineers (India): Series A*, *99*(1), 67–78. https://doi.org/10.1007/s40030-018-0271-1

Reichstein, T., Salter, A. J., & Gann, D. M. (2008). Break on through: Sources and determinants of product and process innovation among UK construction firms. *Industry and Innovation*, *15*(6), 601–625. https://doi.org/10.1080/13662710802565198

Sambasivan, M., & Soon, Y. W. (2007). Causes and effects of delays in Malaysian construction industry. *International Journal of Project Management*, *25*, 517–526. https://doi.org/10.1016/j.ijproman.2006.11.007

Sekar, G., Viswanathan, K., & Sambasivan, M. (2018). Effects of project-related and organizational-related factors on five dimensions of project performance: A study across the construction sectors in Malaysia.

Engineering Management Journal, *30*(4), 247–261. https://doi.org/10.1080/10429247.2018.1485000

Shen, L., Lu, W., & Yam, M. C. H. (2006). Contractor key competitiveness indicators: A China study. *Journal of Construction Engineering & Management*, *132*(4), 416–424. https://doi.org/10.1061/(ASCE)0733-9634(2006)132:4(416)

Shen, W., Tang, W., Siripanan, A., Lei, Z., Duffield, C., & Hui, F. K. P. (2018). Understanding the green technical capabilities and barriers to green guildings in developing countries: A case study of Thailand. *Sustainability*, *10*, 3585. https://doi.org/10.3390/su10103585

Tan, Y., Xue, B., & Cheung, Y. T. (2017). Relationships between main contractors and subcontractors and their impacts on main contractor competitiveness: An empirical study in Hong Kong. *Journal of Construction Engineering and Management*, *143*(7), 1–11. https://doi.org/10.1061/(ASCE)CO.1943-7862.0001311.

The World Bank. (2019). *Oman's Economic Update — October 2019*. Retrieved from https://www.worldbank.org/en/country/gcc/publication/oman-economic-update-october-2019

Townsend, S. (2017). Oman to get boost from expat property law. *Arabian Business*.

Trejo, D., Patil, S., Anderson, S., & Cervantes, E. (2002). Framework for competency and capability assessment for resource allocation. *Journal of*

Management in Engineering, *18*, 44–49. https://doi.org/10.1061/(ASCE)0742-597X(2002)18:1(44)

Tsai, W.-H. H., Lin, S.-J. J., Lee, Y.-F. F., Chang, Y.-C. C., & Hsu, J.-L. L. (2013). Construction method selection for green building projects to improve environmental sustainability by using an MCDM approach. *Journal of Environmental Planning and Management*, *56*(10), 1487–1510. https://doi.org/10.1080/09640568.2012.731385

Wang, J., Sun, W., Shou, W., Wang, X., Wu, C., Yan, H. C., & Cenfei, L. (2014). Integrating BIM and LiDAR for real-time construction quality control. *Journal of Intelligent and Robotic Systems*, *79*(3–4), 1–16. https://doi.org/10.1007/s10846-014-0116-8

Wang, S. Q., Dulaimi, M. F., & Aguria, M. Y. (2004). Risk management framework for construction projects in developing countries. *Construction Management and Economics*, *22*(3), 237–252. https://doi.org/10.1080/0144619032000124689

Wilkinson, A., Johnstone, S., & Townsend, K. (2012). Changing patterns of human resource management in construction. *Construction Management and Economics*, *30*(7), 507–512. https://doi.org/10.1080/01446193.2012.711562

Windapo, A., & Cattell, K. (2010). A study of building contractors' compliance with national building regulations in Cape Town. In *COBRA 2010 - Construction, Building and Real Estate Research Conference of the Royal Institution of Chartered Surveyors*.

Wong, P. S. P., Cheung, S. O., & Ho, P. K. M. (2005). Contractor as trust initiator in construction partnering — prisoner's dilemma perspective. *Journal of Construction Engineering and Management*, *131*, 1045–1053. https://doi.org/10.1061/(ASCE)0733-9364(2005)131:10(1045)

Yang, X., Yu, M., & Zhu, F. (2020). Impact of project planning on knowledge integration in construction projects. *Journal of Construction Engineering and Management*, *146*(7). https://doi.org/10.1061/(ASCE)CO.1943-7862.0001852

Yong, Y. C., & Mustaffa, N. E. (2012). Analysis of factors critical to construction project success in Malaysia. *Engineering, Construction and Architectural Management*, *19*(5), 543–556. https://doi.org/10.1108/09699981211259612

Yong, Y. C., & Mustaffa, N. E. (2013). Critical success factors for Malaysian construction projects: An empirical assessment. *Construction Management and Economics*, *31*(9), 959–978. https://doi.org/10.1080/01446193.2013.828843

Zavadskas, E. K., Vilutienė, T., Turskis, Z., & Šaparauskas, J. (2014). Multi-criteria analysis of projects' performance in construction. *Journal of Construction, Archives of Civil and Mechanical Engineering*, *14*(1), 114–121. https://doi.org/10.1016/j.acme.2013.07.006

Zhao, Z. Y., Shen, L. Y., & Zuo, J. (2009). Performance and strategy of chinese contractors in the international market. *Journal of Construction Engineering and Management*, *135*(2), 108–118. https://doi.org/10.1061/(ASCE)0733-9364(2009)135:2(108)