Three-Phased Risk-Management Benchmark for Internationalization of Small and Medium-Sized Construction Companies

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ABSTRACT

Small and medium-sized construction companies (SMCCs) typically lack the international experience of their large counterparts. International construction projects often are more uncertain than domestic projects, which can pique SMCCs' interest or necessity for external benchmarks of best practices. This study aims to provide a three-phased risk-management benchmark framework for the internationalization of SMCCs. The first-phase benchmarking evaluates how well companies prepare to undertake business abroad and what capabilities they should improve upon based on comparative data from 41 SMCCs. The second-phase benchmarking provides risk information from 49 international subcontract projects that must be managed for SMCCs. In the last phase, the benchmark delivers subcontractor risk-response strategies through the analysis of 134 international-contractual cases. Additionally, the three illustrative cases show that the benchmark framework and metrics are quite helpful for decision-makers and SMCC practitioners in evaluating and responding to their international construction project risks.

1. Introduction

Considerable benchmark research efforts have contributed to the body of knowledge of project performance (Garnett and Pickrell, 2000; Luu et al., 2008; Yeung et al., 2013). Project performance benchmark subjects have gradually expanded from traditional quality measurement to productivity, safety, scheduling, environment, life-cycle management, and building information modeling (El-Mashaleh et al., 2010; Ahn et al., 2013; Iyer and Banerjee, 2016; Yun et al., 2016; Liu et al., 2017; Choi et al., 2020; Elsayegh and El-adaway, 2021; An et al., 2021). These benchmarks are both needed and required when users lack sufficient or proper internal references for evaluating project management performance (Barber, 2004). For example, integrated project delivery (IPD) has yet to be applied compared with such general project delivery as design-build or design-bid-build, so, many project owners and contractors cannot easily guarantee IPD's effectiveness and efficiency for the purpose of performance improvement. Thus, Hanna (2016) provides a benchmark for IPD performance metrics, which

explains when and how IPD delivery is superior to non-IPD delivery using benchmark information. Similarly, most SMCCs that are willing to engage in international construction projects have limited experience and access to best-practice data compared with large contractors (Oviedo-Haito et al., 2014). Such benchmark information as internationalization capability, country risk, localization, and subcontracting practices, therefore, can be useful for SMCCs in preparing for, selecting, and executing international construction projects.

Fundamentally, the international construction market encounters more uncertainties than the domestic market (Ofori, 2007; Deng et al., 2014; Viswanathan and Jha, 2020). Thus, many companies, especially SMCCs, have preferred to expand their domestic market share for stable revenue growth and profit rather than exploring abroad. However, as the domestic market growth in many developed countries is slowing and openness to international markets is expanding, SMCCs have gradually started doing business abroad (Jung et al., 2010; Lee et al., 2018). For example, Korean SMCCs have been by and large expanding their overseas

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Fig. 1. Subcontract Numbers and Award Amounts of Korean International SMCC

businesses except for recent years, as shown in Fig. 1 (ICAK, 2021). Even though the drop in oil prices and Covid 19 have reduced international bid winning, the number of Korean international SMCC projects in 2020 is still seven times higher than 20 years ago. Spanish and Australian subcontractors have also been expanding their business internationalization over the past several decades (London, 2010; Khan, 2017).

SMCCs have suffered various difficulties in executing projects in their efforts at internationalization, including a lack of market information, scarcity of skilled labor, culture differences, contract routine issues, and financial constraints (Stewart et al., 2003; Ribeiro and Fernandes, 2010). Thus, SMCCs have yielded a low level of average profit as compared with large construction contractors working on international projects (Jung et al., 2010). Despite these facts, there are limited risk-management studies for international SMCCs to assess their relevant project risks (Park et al., 2011; Oviedo-Haito et al., 2014; Lee et al., 2018).

This study aims to provide SMCCs with a phase-based risk-management benchmark framework and references for better performance on international subcontract projects. For the first phase, the researchers investigated 24 capability indicators from 41 international SMCCs to create internationalization capability benchmark references. Subcontractors inexperienced with international projects can use these benchmark references to judge their relative competence in the entry of international projects and evaluate which capability factors should be improved before going abroad. The second phase delivers project risk levels compared with other international subcontract projects, examining 77 project risk indicators from 49 international subcontract projects. Subcontractors less experienced with international work can use the comparative assessment of the project's risk before deciding on bid participation. The last phase provides subcontractors with actual practices corresponding to each risk indicator from the second phase. This phase collects the 134 contractual cases involved in international SMCCs and suggests apposite cases for

controlling key contractual risk factors. Thus, this three-phased benchmark framework supports SMCC's decision-makers and project managers in evaluating international business capabilities and project risks and responding with proactive contract management.

2. Research Background

2.1 Risk Management Difficulties of International SMCCs

An international construction project presents considerable risk compared to domestic construction projects, which can induce cost overruns and poor profit (Baloi and Price, 2003; Fidan et al., 2011; Chang et al., 2019). Thus, many researchers have studied risk factors or critical success factors to increase international project performance (Hastak and Shaked, 2000) and have derived international project risk at the country, market, and project levels. This risk breakdown structure is well organized but fails to consider different viewpoints between contractors and subcontractors. Han et al. (2007) suggested 64 risk factors that resulted in poor profit from 126 overseas construction projects. They investigated 20 large international contractors and indicated the gap in risk score between successful and failed international projects. Jha and Devaya (2008) derived 14 key risk factors in international projects conducted by top Indian construction companies and analyzed the influences on and dependence between each risk factor. Bu-Qammaz et al. (2009) also suggested 28 risk factors in a hierarchical risk breakdown structure from international contractors. Liu et al. (2018) considered 60 international construction risk factors by reviewing a wide scope of literature, evaluating the occurrence and magnitude of each risk factor through an investigation of 87 contractors and 17 subcontractors. Lastly, Siraj and Fayek (2019) identified a total of 571 risks through reviewing 130 academic articles that studied risk identification and classification in the construction industry,

further classifying risks into 11 categories and presenting the top 10 common risks of each category. As the research mentioned above shows, international project risks have been studied for large contractors but not for SMCCs, and international projects by SMCCs have a different risk perspective from international projects undertaken by large contractors. First, SMCCs are small organizations with weak financial stability and have not necessarily acquired internationally experienced resources. Financially, they cannot usually afford to invest in the long-term investigations necessary for localization without the guarantee of winning awards. These insufficiencies lead to difficulty in identifying and managing country-oriented project risk, including such local issues as working and contract practices, supply chain structure, regulation, and so on (Jung et al., 2010). Thus, they must check their ability to react to country-oriented risk and their financial resiliency before doing business in a foreign country. Second, subcontract risk is somewhat different from prime-contract risk. Owner-oriented risk, such as design error and site handover delay, is lower for subcontractors than prime contractors, whereas field construction-oriented risk, such as low productivity and material procurement, might be larger for a subcontractor than for a prime contractor. In addition, subcontracting risks can be reduced or multiplied depending on the relationship between the prime contractor and subcontractor and the prime contractor's capability and experience (Oviedo-Haito et al., 2014). Last, SMCCs have fewer internal project references to evaluate the project risk compared with large contractors. Recently, many large contractors have conducted international construction projects, which enables them to accumulate lessons-learned knowledge. They can build their internal benchmark information for selecting bad projects, evaluating risk levels, and managing contract conflicts, which are helpful for managing international project risk (Liu et al., 2018). SMCCs lack internal track records, so they need to acquire external benchmark information to better manage risk.

2.2 Benchmarking Approach in Risk Management

There are many areas of risk management, such as risk identification, assessment, and mitigation (Jepson et al., 2020), and many strategies to address them: risk registers, structured checklists, brainstorming, the Crawford Slip method, and influence diagrams, among others (Chapman, 2001; Raz and Michael, 2001; Lyons and Skitmore, 2004). As for risk evaluation, the probability impact (PI) assessment, Monte Carlo Simulation (MCS), artificial hierarchy process (AHP), multi-regressions, discriminant analysis, and fuzzy analysis have been applied for project risk management (Hsueh et al., 2007; Han et al., 2008; Zayed et al., 2008; Cioffi and Khamooshi, 2009; Lazzerini and Mkrtchyan, 2011). However, many researchers have criticized these kinds of quantitative risk management, which are rarely used in actual projects (Raz and Michael, 2001; Wood and Ellis, 2003; Laryea and Hughes, 2008; Taroun, 2014; Yoo et al., 2017). Practitioners in the industry trust their experience and intuition more than statistical analysis or complex models, asserting that simple numbers and single judgments derived from an academic model cannot explain a

whole risk situation and level of severity. They prefer to assess the risk situation themselves, after reviewing all the available information and knowledge, such as internal historical data, external data references, expert advice, and their own experience. Therefore, if practitioners have enough information and experience, they do not adhere to the various available academic approaches. However, construction companies often do not have enough local experts and local practice information for an international construction project. In the case of SMCCs, these shortages are more serious. Thus, a benchmarking approach might be useful to international practitioners because it does not directly judge a risk decision but focuses on providing a helpful reference for rational decisions.

Benchmarking measures performance outcomes of completed projects, which enables a company to continually improve its own competitiveness and sustainability by comparing with competing companies (Yun and Jung, 2017). Benchmarking in construction typically measures key performance indicators such as cost, schedule, productivity, changes, safety, and competition (Yun et al., 2016). For example, the Construction Industry Institute (CII) operates the Benchmarking and Metrics (BM&M) program that provides norms for best practices of a construction project (CII, 2021). A user can assess an individual project performance based on the norms which consist of mean, median, and quartile cutoffs of similar projects' performances (Lee et al., 2005).

Benchmarking is an effective tool for improvement in project management. It allows a company to understand the current state of a project and to have confidence in expected outcomes by reducing uncertainty based on data-driven analysis (RICS, 2020). Moreover, benchmarking enables industrial practitioners to adopt innovative strategies and solutions to tackle construction-related problems (Olawumi and Chan, 2019). Appropriate risk-management indicators and sufficient external benchmark data would support SMCCs to evaluate and respond to international project risk.

3. Research Methodology

3.1 Benchmark Framework

This study attempts to derive a three-phased risk-management benchmark framework for international SMCCs. First, the authors gathered previous studies and developed an initial benchmark framework draft. Over three meetings, 20 experts (thirteen from the industry, seven from academia) with an average of 19.8 years of experience in international construction participated in the review of the risk-management benchmark framework. At the first meeting, the benchmarking framework was approached in two phases: internationalization of company capability and project risk. Although most experts were satisfied overall with the framework, several experts strongly suggested that benchmarking internationalization capability and project risk alone was not enough and that providing risk response information was important for improving international risk management. Therefore, a contract risk benchmark was developed and added as the third phase.

Fig. 2. Risk-Management Benchmark Framework for International SMCC

These framework and benchmark indicators were developed more in the second and third expert meetings. Finally, the three-phased risk-management benchmark framework for international SMCCs was developed as shown in Fig. 2.

The first and second phases are comprised of three steps: risk assessment, risk benchmark, and risk response. First, the company or project information is input, and the indicators are measured. Second, the result of the company or project risk assessment is compared with benchmark data and the priority indicator that should be improved for international SMCCs is derived. The third phase provides various examples of contract risk resolutions that correspond to project risks identified in the second phase.

3.2 Internationalization Capability Benchmark Metrics

Table 1 shows four performance metrics for internationalization capability: construction, international business, international human resources (HR), and financial. Each performance metric has several subordinate indicators. The indicators of internationalization capability have been identified from previous research and expert interviews. First, from twenty research papers, four indicators and 32 measurements were derived as indicators related to the performance of international construction or SMCC. Next, four indicators and 23 measurements were selected from six experts in the second expert meeting.

3.2.1 Construction Performance

Construction performance metrics are used to evaluate the technical capability of an international construction project. These metrics are measured by schedule delays, cost overruns, overseas equipment, defect rates, and incident rates. Managing schedule delays and cost overruns is a fundamental competency for construction companies (Alaghbari et al., 2007). In this study, schedule delays and cost overruns were measured as the average performance value over the last three years. Overseas equipment availability is also an important capability factor; often, necessary equipment is not supplied in local markets (Patel and Vyas,

2011). The defect rate, incident rate, and claim occurrence are measurements for quality management capability.

3.2.2 International Business Performance

International business performance expresses how well a company has fulfilled international projects in the past. The construction industry is evaluated empirically based on its performance (Fong and Choi, 2009). This study selected and followed such empirical performance factors as market diversification, product diversification, international revenue ratio, award competitiveness, international network, and client satisfaction as part of its overall parameters. Market diversification and product diversification indicate the number of countries and the number of international projects a company has performed. Diversification is an important factor in enhancing stability in the localization or overseas expansion strategy of construction companies (Han et al., 2010), and the international revenue ratio is found by calculating the percentage the total revenue that is generated by international work. Award competitiveness is the number of wins compared with the number of bid proposals, and the international network shows how robustly and effectively the company has built an overseas network with the owner or general contractor. Finally, client satisfaction indicates the owner's or general contractor's level of satisfaction with past projects and is considered an important factor in the evaluation of the company (Chan and Chan, 2004; Costa et al., 2006; Lu et al., 2010).

3.2.3 International HR Performance

For better internationalization, the level and number of internationally experienced and skilled experts are crucial. International HR performance is measured by an international expert ratio, staff training for an international project, technical HR competitiveness, estimate of HR competitiveness, employee productivity, and the average length of continuous service. The international expert ratio indicates the percentage of international projects of experienced employees in a company. Technical and estimated

Table 1. Benchmark Metrics of Internationalization Capability

Performance Metrics	Definition	Unit	Reference
Construction Performance			
Schedule delay	Delayed schedule / Planned schedule (in recent 3 years)	%	Kagioglou et al. (2001), Takim and Akintoye (2002), Thomas et al. (2002), Xiao and Proverbs (2003), Bassioni et al. (2004), Beatham et al. (2004), Chan and Chan (2004), Robinson et al. (2005), Costa et al. (2006), Nudurupati et al. (2007), Yu et al. (2007), Luu et al. (2008), Lu et al. (2010), Radujković et al. (2010), Sun et al. (2012)
Cost overrun	Actual cost / Planned cost (in recent 3 years)	%	
Oversea equipment	The number of own oversea equipment	Number	
Defect rate	Rework cost / Planned cost (in recent 3 years)	%	
Incident rate	The number of incidents/The number of projects	%	
Claim (Dispute) occurrence	Claim (Dispute) occurrence number (in recent 3 years)	Number	
International Business Performance			
Market diversification	The number of entered countries	Number	Kagioglou et al. (2001), Takim and Akintoye (2002), Thomas et al. (2002), Xiao and Proverbs (2003), Bassioni et al. (2004), Beatham et al. (2004), Chan and Chan (2004), Robinson et al. (2005), Costa et al. (2006), Nudurupati et al. (2007), Yiu et al. (2007), Yu et al. (2007), Luu et al. (2008), Han et al. (2010), Jung et al. (2010), Lu et al. (2010), Radujković et al. (2010), Sun et al. (2012)
Product diversification	The number of completed product types	Number	
International revenue ratio	International sales / Total sales	%	
Award competitiveness	The number of winning awards / The number of bid proposals	%	
International network	Networking building performance with owner or general contractor	Likert scales	
Client satisfaction	Satisfaction of owner or general contractor	Likert scales	
International HR performance			
International expert ratio	International project experienced employee / Total employee	%	Takim and Akintoye (2002), Thomas et al. (2002), Sexton and Barrett (2003), Beatham et al. (2004), Costa et al. (2006), Nudurupati et al. (2007), Yiu et al. (2007), Yu et al. (2007), Luu et al. (2008), Radujković et al. (2010), Sun et al. (2012)
Staff training for international project	Satisfaction of staff training for international projects	Likert scales	
Technical HR competitiveness	The number of technical experts / Total employee	%	
Estimate HR competitiveness	The number of estimate experts / Total employee	%	
Employee productivity	Total revenue / Total employee	1,000 \$	
Average of continuous service	Average of continuous service per employee	Year	
Financial Performance			
Current ratio	Current assets / Current liabilities	%	Kagioglou et al. (2001), Robinson et al. (2005), Nudurupati et al. (2007), Yu et al. (2007), Luu et al. (2008), Han et al. (2010), Lu et al. (2010), Sun et al. (2012), Jang et al. (2019)
Debt ratio	Total debts / Total assets	%	
Return on revenues	Operating income / Revenue	%	
Revenue growth rate	Current year's revenue/Previous year's revenue	%	
Operating income growth rate	Current year's operating income / Previous year's operating income	%	

HR competitiveness are considered, as both measurements are important aspects of an international project (Nguyen and Hadikusumo, 2017). Staff training for an international project is also important given its impact on future growth potential (Tabassi and Bakar, 2009). Employee productivity refers to the revenue generated per employee. The average of continuous service is calculated by the total length of employee service to a company divided by the total number of employees. This measurement shows the stability of the retention rate expert because it costs to educate and familiarize newly recruited employees (Tabassi and Bakar, 2009).

3.2.4 Financial Performance

Financial performance is a necessary indicator to evaluate company

performance in any industry. In particular, financial stability is essential for SMCCs because they are prone to bankruptcy due to their lack of financial leverage (Westhead et al., 2001; Lu et al., 2010; Jang et al., 2019). This indicator is measured by a company's current ratio, debt ratio, return on sales, sales growth rate, and operating income growth rate. These measurements are generally used to assess a company's financial position. The current ratio and debt ratio are calculated by current assets of current liabilities and total debts of total assets, respectively. Return on sales is the ratio used to evaluate a company's operational efficiency. Sales growth rate and operating income growth rate indicate the amount of growth compared with the previous year.

3.3 International Project Risk-Assessment Benchmark Metrics

Table 2 shows the benchmark indicator for subcontracting project risk. The indicators and corresponding measurements have been

identified from previous research. Sixteen research papers concerning international construction project risk and subcontracting risk were reviewed. Consequently, in this study, a total of twelve indicators and 68 measurements have been identified and

Table 2. Benchmark Metrics of Subcontracting Project Risk

Risk Metrics	Measurement	Reference
Country Perspective		
Political	Civil war/terror/regime change, Corruption and collusion, Change in laws, Imperfect institution	Han et al. (2007), Jha and Devaya (2008), Bu-Qammaz et al. (2009), Zhao et al. (2013), Yildiz et al. (2014), El-Sayegh and Mansour (2015), Hwang et al. (2017), Jung and Han (2017), Yoo et al. (2017), Li et al. (2020)
Economic	Currency uncertainty, Interest rate uncertainty	Jha and Devaya (2008), Ng and Tang (2008), Zhao et al. (2013), Hwang et al. (2017), Jung and Han (2017), Yoo et al. (2017), Li et al. (2020)
Social & Infra	Cultural difference, Civil complaints, Poor living environment, Social legitimacy for projects	Han et al. (2007), Bu-Qammaz et al. (2009), Zhao et al. (2013), El-Sayegh and Mansour (2015), Hwang et al. (2017), Jung and Han (2017), Tan et al. (2017), Yoo et al. (2017), Li et al. (2020)
Project Perspective		
Owner	Management capability of owner, Design accuracy provided by owner, Insufficient specification provided by owner, Unstable financing resources of owner, Administrative approval and licensing delays, Informal request by owner	Han et al. (2007), Jha and Devaya (2008), Bu-Qammaz et al. (2009), Ling et al. (2009), Zhao et al. (2013), Yildiz et al. (2014), El-Sayegh and Mansour (2015), Hwang et al. (2017), Jung and Han (2017)
Contract	Insufficient period for bid preparation, Insufficient period for completion, Unreasonable local contents, Unfavorable retained earning transfer, Unfavorable tax and tariff treaty, Unfavorable inflation compensation, Unfavorable security clause, Unfavorable payment condition, Unfavorable liquidated damage, Unfavorable payment currency, Unfavorable claim and arbitration	Packham et al. (2003), Han et al. (2007), Eom et al. (2008), Jha and Devaya (2008), Ng and Tang (2008), Bu-Qammaz et al. (2009), Ling et al. (2009), Zhao et al. (2013), Yildiz et al. (2014), El-Sayegh and Mansour (2015), Hwang et al. (2017), Jung and Han (2017), Tan et al. (2017)
Resource	Staff supply difficulty from host country, Material supply difficulty from host country, Equipment supply difficulty from host country	Jha and Devaya (2008), Bu-Qammaz et al. (2009), Yildiz et al. (2014), El-Sayegh and Mansour (2015), Hwang et al. (2017), Jung and Han (2017), Yoo et al. (2017), Li et al. (2020)
Physical	Unfavorable geographical accessibility, Poor infra & logistics condition, Geological uncertainty, Weather and climate uncertainty	Han et al. (2007), Bu-Qammaz et al. (2009), Zhao et al. (2013), Yildiz et al. (2014), El-Sayegh and Mansour (2015), Hwang et al. (2017), Jung and Han (2017), Yoo et al. (2017), Li et al. (2020)
Contractor	Unclear work scope, Unclear payment condition, Unclear retention money, Poor collaboration, Work practice and routine difference, Poor language risk, Contractor's construction ability	Packham et al. (2003), Han et al. (2007), Eom et al. (2008), Jha and Devaya (2008), Ng and Tang (2008), Bu-Qammaz et al. (2009), Ling et al. (2009), Zhao et al. (2013), Yildiz et al. (2014), El-Sayegh and Mansour (2015), Hwang et al. (2017), Jung and Han (2017), Tan et al. (2017)
Capability Perspective		
Organizational	Leadership of project manager, Headquarters' support level, P.E and Ph.D. retention level, Collaboration and flexibility, Communication capability, Labor management capability	Han et al. (2007), Jha and Devaya (2008), Ng and Tang (2008), Ling et al. (2009), Yildiz et al. (2014), Hwang et al. (2017), Jung and Han (2017)
Construction management	Cost management capability, Schedule management capability, Quality management capability, Resource management capability, Labor training capability, Claim management capability, Contract management capability, Document management capability, IT based project management capability, Safety management capability, Environment management capability	Han et al. (2007), Eom et al. (2008), Jha and Devaya (2008), Ng and Tang (2008), Bu-Qammaz et al. (2009), Ling et al. (2009), Zhao et al. (2013), Yildiz et al. (2014), El-Sayegh and Mansour (2015), Hwang et al. (2017), Jung and Han (2017), Yoo et al. (2017)
Localization	Local network capability, Information acquisition capability, Host country's experience of project manager, Overall localized level	Han et al. (2007), Yildiz et al. (2014), Jung and Han (2017)
Technical	Construction method experience, Inadequate understanding of standards, Rework due to errors and defects, Lack of experienced labor, New construction method capability	Packham et al. (2003), Han et al. (2007), Eom et al. (2008), Ng and Tang (2008), Yildiz et al. (2014), El-Sayegh and Mansour (2015), Jung and Han (2017)

evaluated using a five-point Likert Scale. A brief description of each indicator is presented below.

3.3.1 Country Risk

Country risk has been regarded as the most important risk for an international project (Ling et al., 2009; Zhao et al., 2013; Yildiz et al., 2014; El-Sayegh and Mansour, 2015; Yoo et al., 2017; Li et al., 2020; Zhu et al., 2021). This study divided country risk into political, economic, social, and infrastructure risk. Political risk arises from an act by the government of the host country that could negatively affect project performance. It is widely considered in previous research as one of the most significant project risk metrics (Yildiz et al., 2014; Yoo et al., 2017). This research evaluates the political risk using four measurements: civil war/terror/regime change; corruption and collusion; change in law; and imperfect institution. The macro-economic condition has a huge impact on the overall construction industry and could affect subcontractor profit performance regardless of their capability (Zhao et al., 2013; Yoo et al., 2017; Kim et al., 2019). This research includes currency uncertainty and interest-rate uncertainty as measurements of economic risk. Also, social factors, such as differences in culture and language among partners or stakeholders, could disrupt interaction and communication, which could negatively affect project performance (Bu-Qammar et al., 2009; Jung and Han, 2017; Yoo et al., 2017; Li et al., 2020). This research includes cultural differences, civil complaints, poor living environment, and social legitimacy for projects as measurements.

3.3.2 Project Condition Risk

Country risk is not easily managed through contract or organizational capability, whereas project condition risk can be controlled through such capabilities. This study comprises the following project risks: owner, contract, resource, physical, and contractor. Owner risk is related to the project management capability of the owner. Many previous types of research have stated that project implementation and performance could be impeded or promoted according to the owner's experience and capability (El-Sayegh and Mansour, 2015; Hwang et al., 2017). This research evaluates owner risk using the owner's management capability, the design accuracy they provided, whether specifications provided by the owner are insufficient, the owner's financing stability, administrative approval and licensing delays, and informal requests by the owner.

Contract risk entails the terms and clauses of the contract that could be made against project performance. Especially for an SMCC, which has little experience in international projects and host countries, contracts are carefully checked and could adversely affect project performance (Ling et al., 2009). This research uses twelve measurements to evaluate contract risk.

Resource risk involves the likelihood of procuring the necessary labor, materials, and equipment with sufficient quality to implement the project. It is not easy, perhaps, to procure these resources for an international project, according to the host country (Jha and Devaya, 2008; El-Sayegh and Mansour, 2015; Yoo et al., 2017;

Li et al., 2020). This research evaluates the difficulties encountered with staff, materials, and equipment supplies of resources from the host country.

Physical risk includes unfavorable geographical accessibility, poor infra- and logistics conditions, geological uncertainty, and weather and climate uncertainty. Project implementation could be disturbed without investigation and countermeasures, which should be done at the initial stage of the project (Bu-Qammar et al., 2009; Yildiz et al., 2014; Yoo et al., 2017). Many previous research studies have stated the importance of capability and the relationship of the project partner (Packham et al., 2003; Ling et al., 2009). This study evaluates the lack of clarity in work scope; payment conditions; money retention; poor collaboration, work practices, and routine differences; poor language risk; and contractor's construction ability for contractor risk.

3.3.3 Capability Risk

The first phase deals with a company's capability, but the second phase focuses on the project organization's capability, which is comprised of organizational, management, localization, and technical factors. Organizational risk involves internal organizational structure and subcontractor resources. This research includes the project manager's leadership, headquarters' support level, P.E. and Ph.D. retention levels, collaboration and flexibility, communication capability, and labor management capability for organizational risk. Management risk is about the overall project management capability of the subcontractor. Lack of management capability could cause problems with project implementation, such as duration, cost, and quality (Ng and Tang, 2008; Yildiz et al., 2014; Yoo et al., 2017). This research includes eleven measurements to evaluate the management capability of the subcontractor. Localizing efforts within the host country is important for international construction projects, and can be created through localization to acquire information and implement the project (Han et al., 2007; Yildiz et al., 2014). This research has measured the local network capability, information acquisition capability, experience of the host country's project manager, and an overall localized level to evaluate the localization risk. If the subcontractor has a technical problem with the company that carries out the construction work directly, it could seriously affect overall project performance. Five measurements have been used to evaluate the technical risk: construction method experience; inadequate understanding of standards; rework due to errors and defects; lack of experienced labor; and new construction method capability (Yildiz et al., 2014; El-Sayegh and Mansour, 2015; Yoo et al., 2017).

3.4 Data Collection and Quantification

This study collected benchmark data from the internationally experienced experts working at SMCCs in Korea. For the collection of capability benchmark data, survey questionnaires were distributed to 236 SMCCs, and 41 responses were compiled. Thus, the response rate was 17.4%. The average international revenue over three years was M\$ 19.5, and the average international revenue portion of the firms' total revenue was 33.4%. For a

collection of subcontracting project risk data, survey questionnaires were distributed to 241 subcontractors' international projects, and 49 responses were received. The average cost of the projects was M\$ 468, and the average project duration was 20 months. Twenty-four projects suffered cost overruns, 15 of which recorded a cost overrun rate higher than 30%. Sixteen projects also experienced delays in contractual schedules.

Each benchmark data has a different scale. Thus, quantification of these different scale metric measurements is required to properly evaluate and compare them with various project types and characteristics (Yun et al., 2016). The quantification process consists of the following three steps: 1) Normalizing measurements using mean and standard deviation, 2) Weighting of each measurement, 3) Ranking of each normalized measurement value.

In the first step, mean and standard deviation were calculated for each measurement. Because many capability measurements are absolute metrics, such as construction and business performance, they require normalization. Another reason for normalization is to provide more useful and explicit information to compare different benchmark indicators. Based on these mean and standard deviations for each measurement, the equation for standardization is equal to Eq. (1), where Z_{ij} denotes the normalized measurement of given scores (x_{ij}) in j th measurement of the i th SMCC, x_{ij} denotes each scores of j th measurement of the i th SMCC, $\bar{x}_j$ denotes the

mean of j th measurement, and σ_j denotes the standard deviation of j th measurement:

$$Z_{ij} = \frac{x_{ij} - \bar{x}_j}{\sigma_j} \quad (1)$$

Since each indicator has different numbers and types of unit measurements, the value of the normalization score is in the range of zero to one hundred before the addition of the measurements. The equation for converting the normalized measurement to the range of zero to one hundred is Eq. (2), where 1.67 is one sigma deviation in normal distribution and X_{ij} is the benchmark score that has the range of zero to one hundred:

$$X_{ij} = 1.67 \times Z_{ij} + 50 \quad (2)$$

The benchmark score of each indicator should be weighted because each company and project has a different context and situation; this benchmark evaluation can be modified according to the user's estimation of the severity of each situation. Finally, the benchmark rankings are calculated to show the priority of each benchmarking score.

4. International Contract Management Benchmark

This study provides contractual risk-management benchmark

Table 3. International Contract Risk Management Cases

Indicator		Case description	Num. of cases
Country Perspective	Political	Change in law related to tax	2
		Change in law related to working hour	2
		Change of government support policy	1
	Economic	Unstable currency	6
		Change of macroeconomic condition	1
		Soaring escalation	1
	Social and Infra	Local contents	4
		Cultural differences	2
		Difference of labor regulation	1
		Work permit and minimum wage rate	1
Project Perspective	Owner	Delay in payment by employer	5
		Unreasonable interference by employer	4
		Rejection of change order approval by employer	3
		Excessive quality requirements by employer	3
		Delay in approval process by employer	2
		Delay in material supply by employer	2
		Insufficient design document provided by employer	2
		Negligence of local employer's authority	2
		Delay in co-financing by employer	1
		Improper engineer selection	1
		Impossibility of balance payment after project suspension	1
		Insertion of the clause that rejects the excessive change order	1
		Non-payment of compensation related to delay in site preparation	1
		Unfavorable decision making by multiple employers	1
		Unreasonable requirement of agent-fee by employer	1

Table 3. (continued)

Indicator		Case description	Num. of cases
Project Perspective	Prime Contractor	Bankruptcy of contractor	1
		Improper returning of retention money	1
		Improper payment by contractor	1
		Delay in payment that exceeds a bill of quantity (BOQ)	1
		Inconsistency of contractual contractor and substantive contractor	1
		Lump-sum subcontract by employer's request	1
	Sub-Contract	Unfavorable interpretation for unclear contract terms and clauses	2
		Contract conditions that transfer risk to subcontractor	2
		Abuse of cost-plus fee contract by owner	2
		Mismatch between contract currency and payment currency	2
		Additional cost due to delay in issuing a certificate of completion	1
		Lapse of the right to claim by the missed deadline for notification	1
		Omitted terms and clauses that changed verbally	1
		Unable to claim due to imperfect project scheduling	1
		Failure of special equipment procurement in host country	2
		Failure of material procurement in host country	1
	Resource	Loss due to careless material management	1
		Omission of material and equipment during shipping	1
		Penalty by equipment export restriction of host country	1
		Re-procurement of broken equipment	1
		Restriction of material procurement to a single pipeline	1
		Negligence of decline in productivity due to weather condition	4
	Physical	Mismatching of geological condition with the provided document	3
		Responsibility of risk event related to weather condition	3
		Imperfect planning without considering weather condition	1
Capability Perspective	Organizational	Insufficient decision making process	2
		Solidarity with partners	2
		Different work practice between partners	1
		Lack of communication between project participants	1
	Construction Management	Delay in procurement of a large equipment	6
		Difference in the interpretation of the escalation clauses with client	5
		Difference in contract interpretation between client and contractor	2
		Delay in unloading equipment	2
		A clause that limits the excessive change order	2
		Insufficient contract management capability	1
		Non-application of the verbal contract to contract document	1
		Non-application of the changed clauses to contract document	1
		Omission of agreed terms and clauses at contract document	1
		Suspension of construction work due to delay in site preparation	1
		Unstable financial background of contractor	1
		Incomplete planning related to the local environment	3
	Localization	Insufficient negotiation capability of a local partner	1
		Effort of contractor in localization	1
		Failure to get the approval of change order from employer	3
	Technical	Rejection of new construction technique application by engineer	3
		Rejection of material that satisfying the specification by engineer	3
		Difficulty in satisfaction of quality requirements	2
		Taking responsibility for mistake of nominated subcontractor	1

information for risk-response management. The contract management benchmark provides 134 contractual cases, which are categorized into nine sub-groups and 73 topics as shown in Table 3. Nine sub-groups were the same as 2nd phase risk benchmarking; if the 2nd benchmark shows that some metrics are poor, the user can refer to the corresponding benchmark cases. Some topics have several cases, and other topics only one. These cases were gathered through interviews and reports by the six international contract experts, who have on average 25 years of experience on international projects. All cases do not include the name of the owner, prime-contractor and subcontractor because of confidentiality compliance. These also do not include specific numbers like price, volume, and date, depending on the individual cases. Some cases just include the name of country or product type.

5. Illustrative Case Applications

These illustrative case applications aim to express the practical validation of this risk-management benchmark framework. Among the collected benchmark information, this study selected three international SMCCs and their subcontracting projects as shown in Table 4. Each case has a different capability and risk situation. SMCC A has a high internalization capability that enables them

to deal with a higher risk level of a subcontracting project. SMCCs B and C have a weak level of internalization capability, implying that they can manage with a moderate- or low-risk level of subcontracting projects, respectively. These different contexts show how they can utilize this risk-management benchmark framework according to their unique situation.

5.1 Internationalization Capability Benchmark

Each SMCC had a different internationalization capability. Each company was required to assess and review which factors were considered comparatively weak and how much these risk factors needed to be improved. Fig. 3 and Table 5 show high benchmarking internationalization capability. SMCC A was a highly internationalized subcontractor that had earned 25% international revenue of total revenue over the past three years, which was the highest international revenue ratio among the three firms. They recorded ranking first in cost and schedule management performance as shown in Table 5. In addition, they experienced the use of many types of products in various countries, even though they recorded the smallest revenue among the three cases. Of the 41 benchmark companies, this firm ranked 2nd in the total internationalization capability score and yielded a higher profit in many projects. However, this company needed to improve several financial issues as shown in Table 5. For example,

Table 4. Samples Profiles

	SMCC A	SMCC B	SMCC C
3yrs revenue (M\$)	61	909	315
3yrs international revenue (M\$)	16	106	32
3yrs debit ratio (%)	30.8	86.3	184.6
Employer number	153	396	100
Entered countries	Saudi Arabia, Vietnam, Bangladesh	Singapore, Malaysia, Hong Kong, Qatar, Kuwait	Saudi Arabia, UAE, Algeria
Case country	Saudi Arabia	Vietnam	Algeria
Case product	Power plant	Road	Building
Contract type	Lump-sum	Unit-price	Cost-plus fee

Fig. 3. Metric Distribution of Internationalization Capability

Table 5. Benchmark Metric Details of Internationalization Capability

Benchmark Indicator	SMCC A		SMCC B		SMCC C	
	Score	Rank	Score	Rank	Score	Rank
Construction Performance						
Schedule delay	59.8	1	44.6	36	41.6	39
Cost overrun	67.0	1	44.0	33	44.0	33
Oversea equipment	46.4	33	72.7	3	51.3	8
Defect rate	62.8	1	38.6	36	26.5	39
Incident rate	51.9	8	55.9	7	24.2	40
Claim (Dispute) occurrence	64.4	1	0.1	41	31.9	36
Average	58.7	3	42.5	40	36.6	41
International Business Performance						
Market diversification	96.3	1	43.9	28	57.0	7
Product diversification	86.9	1	41.2	30	50.4	8
International revenue ratio	48.8	26	49.9	23	47.2	28
Award competitiveness	47.0	27	38.2	35	61.2	5
International network	74.7	1	21.1	36	47.9	13
Client satisfaction	64.7	1	9.0	40	36.9	25
Average	69.7	2	33.9	40	50.1	22
International HR Performance						
International expert ratio	51.0	10	55.0	8	61.5	5
Staff training	52.5	9	52.5	9	29.5	30
Technical HR competitiveness	51.3	15	47.3	35	43.3	36
Estimate HR competitiveness	47.6	22	41.0	38	43.0	31
Employee productivity	51.7	11	53.8	9	26.2	40
Average of continuous service	50.8	14	57.5	8	57.5	8
Average	50.8	16	51.2	15	43.5	38
Financial Performance						
Current ratio	48.0	26	55.4	5	44.7	31
Debt ratio	53.9	18	52.3	12	56.3	3
Return on sales	46.9	9	46.4	33	46.3	35
Sales growth rate	49.5	30	23.2	38	64.6	7
Operating income growth rate	46.2	29	43.7	40	46.1	31
Average	48.9	31	44.2	37	51.6	12
Total Capability Score	57.0	2	42.9	40	45.4	38

they were short of working capital and were earning a low growth rate compared to other companies.

SMCC B ranked 40th in the internationalization capability score, even though they earned larger revenues and were thought of as being one of the strong leading subcontractors in the domestic market. This firm has attempted to do overseas business in several countries but frequently failed to win bid awards or made a loss in many projects. Nevertheless, this company continued to seek large subcontracting project awards because they wanted to overcome their low revenue growth rate in the domestic market. Hence, they needed to benchmark which capabilities were weak and how much they would have to improve for better performance levels. As shown in Table 5, this firm achieved poor performance in almost every indicator compared to other SMCCs, which

means that they had to consider not going abroad before entirely improving their internationalization capability or selecting only risk-free projects.

SMCC C had a similar level of capability with SMCC B. They also ranked very poorly in construction, international business, international human resource, and financial performance. One of the interesting points, however, was that SMCCs B and C had different internationalization strategies for realizing better capability. SMCC C could recognize that they were relatively noncompetitive in the areas of construction performance and international human resource performance. So, they were used to selecting low-risk international projects and tended to secure good profit performance, which is explained in more detail in the next section.

Fig. 4. Metric Distribution of International Project Risk Assessment

5.2 International Project Risk-Assessment Benchmark

Each international project has a different risk level. Each SMCC has to review how much the given project is risky and what risk has to be responded to in advance. In addition, each SMCC has to select the appropriate project, considering whether or not they have enough capability to manage its given risk level. SMCC A had a strong internationalization capability, but SMCC B and C had a relatively weak internationalization capability, as mentioned in the previous section. SMCC A selected the medium-high risk project positioned in the second quarter as shown in Fig. 4. SMCC A evaluated contractor risk, contract risk, and owner risk as higher levels. As they have experienced many other projects in the same country of the given project and had been in a relationship with the contractor for 15 years, they comprehended this kind of risk situation as acceptable. Accordingly, they knew how they had responded to these risks in the past and they signed lump-sum contracts yielding a high profit. The benchmark metrics of Table 6 also suggest that, for better performance, SMCC A needed to improve construction management and localization capability in this targeted project. By contrast, SMCC B chose a very high-risk project even though they did not have enough internationalization capability; country and project risk was also very high, and they had a poor relationship with the contractor. Moreover, the contractor had difficulty in controlling project risks and to make a profit, which impacted the profit of SMCC B. The risks related to technical and organizational capability ranked first. If they had these kinds of benchmark references, they could compare their risk level with other projects and might not have selected this type of project. SMCC C executed a project with a lower level-of-risk score, recognizing that they did not have a strong internationalization capability. So, they selected a low-risk project as shown in Table 6 and signed under the condition of a cost-plus fee contract. They also had a good relationship with the prime contractor for more than six years. These kinds of positive situations enabled SMCC C to execute the given project successfully and to earn a profit.

Table 6. Benchmark Metric Details of International Subcontracting Project Risk

Benchmark Indicator	Project A by SMCC A		Project B by SMCC B		Project C by SMCC C	
	Score	Rank	Score	Rank	Score	Rank
Country						
Political	42.5	18	42.5	18	42.5	18
Economic	38.9	21	69.3	3	38.9	21
Social & Infra	46.0	16	62.5	9	40.4	22
Average	42.5	27	58.1	8	40.6	28
Project						
Owner	57.9	9	79.4	3	40.1	22
Contract	61.3	7	50.9	16	40.5	24
Resource	42.1	19	60.9	6	42.1	19
Physical	41.5	18	56.4	8	34.1	32
Contractor	91.2	2	56.3	8	40.9	20
Average	58.8	9	60.8	7	39.5	29
Capability						
Organizational	41.6	17	99.9	1	34.9	32
Construction management	74.5	3	92.4	1	41.9	21
Localization	58.8	8	79.4	2	38.3	19
Technical	50.1	11	99.9	1	42.2	22
Average	56.3	9	97.8	1	39.3	30
Total Risk Score	52.5	13	72.2	1	39.8	31

5.3 International Contract Management Benchmark

Each SMCC could obtain contract management cases in the third phase benchmark corresponding to the high-risk metric in Table 6. SMCC A evaluated that prime contractor risk and construction management risk were high. SMCC A could benchmark the 29 cases from these two risk sub-groups. In comparison, SMCC B confirmed that their project risk was very high in Table 6. In particular, technical risk, organizational risk, construction management risk, localization risk, owner risk, and economic risk were evaluated as high. SMCC B could obtain the 85 cases

corresponding to these five high-risk groups from Table 3.

For example, SMCC B could benchmark the two cases of “rejection of material satisfying the specification by engineer” in the technical risk sub-group. One case indicated that a contract condition to sand material requests only the required quality but not the sand source. So, the subcontractor submitted the approval document of river sand with a method statement that improved the quality of river sand. However, the engineer declined the river sand regardless of the improvement method and insisted on only approving mountain sand. Therefore, the subcontractor suffered losses by purchasing expensive mountain sand far from the construction site. However, in this case, if the subcontractor had raised the claim, the subcontractor might have won. They did not know about this contract practice. Another similar case was that the subcontractor knew this kind of material source issue and they suggested the provisional sum to the contractor: “if the mountain sand cannot be obtained within OO km, the river sand with the qualified test can be used or the mountain sand can be utilized with the additional payment”. This suggestion was accepted by the contractor.

Another example was the case of an unstable currency in the economic risk group for SMCC B. A Korean subcontractor contracted with the local prime contractor with a 100% local currency payment. This subcontractor planned that 80% of their expenditure was local currency. So, they underestimated this currency risk. However, the financial crisis happened in 2009, which significantly decreased the value of the local currency. Moreover, the subcontractor used a USD loan for construction cash flow, which impacted the significant loss. So, this case suggests that, if possible, the payment of local currency ratio should be similar to the expenditure of local currency and the construction loan had better be derived from the same currency ratio.

6. Conclusions

This study attempts to provide a risk-management benchmark framework and practical information to international SMCCs. This benchmark approach to project risk management is the first such trial to the best of the authors’ knowledge. This study should be valuable for the following reasons: First, international SMCCs usually have limited project experience in a foreign country, so they need to obtain and compare external project references for their own decision-making and risk management. Second, this study provides three-phased benchmark references for different situations. Chief Executive Officers (CEOs) and executive management can consider the results to determine whether they should go abroad or check their competitiveness level. Project professionals can review project risk levels when they prepare a proposal or subcontract. Additionally, project professionals can develop risk response strategies based on the contract cases related to high-risk score metrics. Third, this study attempts to provide a qualitative benchmark reference, which is a new approach in benchmark research. If the number of cases

increases, best practices considering various cases could be very useful for references and developing risk-response strategies.

This study illustrates the validation of this benchmarking framework using three actual companies and projects. High-capability subcontractors can control high-risk projects, but for low-capability subcontractors, it is not easy to manage high-risk projects. These examples show which organizational capability and project risk factors must be improved. Moreover, these high-risk items can be prepared through the link with the contract-management benchmark reference. This framework does not define the weight of metric indicators because all companies and projects have different situations and preferences. So, the users can improve the benchmark accuracy using a customized weight of metric indicators.

Even though this framework has many strengths, as mentioned above, this study has several limitations. First, this framework must increase the number of benchmark data. Approximately 50 companies and projects are insufficient to generalize benchmark metric depending on delivery and product types. More cases are necessary to explain more complex and different contract situations. Second, the second phase uses the Likert Scale. Although this measuring method is popular, the practitioners might feel that the input and results look too subjective. Therefore, using an absolute or descriptive scale for the next updated framework is recommended.

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