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Causes and Effects between an Enterprise Risk Management Framework and Firm Financial Performance for Energy Efficiency Services

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Enterprise Risk Management (ERM) is defined as processes of specifying risk management procedures that firms are facing systematically under integrated perceptions by assessing the events, probability, impacts, and relationship among all risk categories that threaten firm value and firm performance and controlling overall risk exposure under an appropriate and acceptable range in relation to policies and strategic objectives. The application of ERM increases the competitive advantage for businesses, achieves the goals and objectives of an organization, reduces earning variability, stabilizes firm performance, encourages employees, and maximizes firm value. This study takes a holistic view to investigate risk categories, contingent variables, and key aspects of risk management employed by an ERM system that should be able to improve firm financial performance for energy efficiency service companies (EESCs) in Thailand. This study received surveyed attitudes toward risk drivers in each category from 225 samples out of 609 top executives from 203 EESCs in 2017-2019 after Thailand had faced economic dire resulted from political disarray and natural disaster which affected EESCs' business and still lingered to these days as evident by the decline active numbers of registered EESCs. In view of current situation which possesses similarity of those days, those views and findings should be contemporary to be applied as a guidance for EESCs' risk management under such circumstances. The empirical evidence from the findings concluded that enterprise risk management insignificantly affected positive firm financial performance. The model fit corresponds to the empirical data and passes specified measured criteria (CMIN/DF = 0.874, GFI = 0.965, AGFI = 0.948, NFI = 0.915,

CFI = 1.000, and RMSEA = 0.000). As such, EESCs should address and focus on factors that render improvements in the ERM system by incorporating strategic risk, operation risk, financial risk, firm complexity, firm size, monitoring by the board of directors, effective risk management for strategy, operation, reporting, and compliance, in line with theories, to improve firm financial performance measured by ROE, ROA, and EPS.

Key words: *Successful enterprise risk management, contingent variables, successful firm financial performance, energy efficiency service companies in Thailand.*

Introduction

Global warming which currently is one of the world top most agenda needs highly mutual cooperation to abate. Energy efficiency service companies (EESCs) worldwide, including Thailand, have been nominated to as the key mechanism for success and the high success of energy efficiency needs sophisticated technologies, knowhow, and high investment. EESCs which have been well equipped with these three aspects have naturally being looked forward by energy efficiency authorities worldwide as the major contributors of the success. Nevertheless, till date, EESCs' achievement has not fulfilled the high expectation due to many problems, that EESCs encountered, that posed risks to EESCs' performance. Even though many governments worldwide, including Thailand, acknowledged problems and provided various supporting measures, they did not effectively minimize the risks as they tackled only consequent threats, not the root causes i.e. risk management that should be considered from the start which EESCs might overlooked. Under the aforementioned context, this study chooses the energy efficiency service industry in combination with Enterprise Risk Management theory to cover the missing parts in order to narrow the loopholes and to provide better benefits to EESCs' performance in Thailand and beyond.

Energy Efficiency Service Companies (EESCs) have been designated by Thailand for 20 years. The Energy Efficiency Plan (2015-2036) is one of the key vehicles to help achieve Thailand's ambitious goal of reducing energy intensity by one-third at the plan's year end. Despite its promising potential and various governmental support mechanisms, Thai EESCs with 5 years of official registered association under the government's blessing still struggle with barriers and risks. Some of these are universal and some are country specific, which impeded their future potential. This systematic study on exploring risks, causes and effects, and proper risk management solutions could be beneficial to EESCs, stakeholders, and interested parties.

***Energy efficiency service in Thailand*:** Energy efficiency service in Thailand is categorized into two groups: fee-based energy consultants and performance-based energy services

companies (ESCOs). The first group, the forerunner, was established first around 1992 and provided services on energy audit reports and the formulation of energy efficiency implementation plans for buildings and factories stipulated by the Energy Conservation Promotion Act, B.E. 2535 (1992). They registered under the Consulting Engineers Association of Thailand (http://www.ceat.or.th) and the Consultant Database Center, Ministry of Finance (https://www.consultant.pdmo.go.th). The second group reports to the Thai ESCO Association, the Federation of Thai Industries established in 2012 (http://www.thaiesco.org). The definition of EESCs differed by country; this study adopted the Thai context that states, a "A public or private entity who implements turnkey energy efficiency projects by taking all responsibilities in lieu of buildings or industries, covering design, construction, funding, installation, measurement and verification, saving guarantee, and compensation for unachieved saving.". EESCs practice 3 service models in general, i.e., Energy Contract (EC) or shared saving, Energy Performance Contract (EPC) or guaranteed saving, and Energy Supply Contract (ESC) (WEC, 2008, 2013), but in Thailand, some EESCs employed a leasing contract as an alternative option (ESCO Annual Report, 2013, 2014, 2015, 2016, & 2018). Energy Consultants and ESCOs sometimes worked as a synergic partner, as Energy Consultants performed the energy efficiency ground work such as primary energy auditing and feasibility study, which are risk undertakings for the ESCO should the ESCO implement them by themselves and depend on customer discretion that might lead to a decision to not proceed with further action, resulting in ESCOs' financial loss (Hansen, Langlois, & Bertoldi, 2009). In some cases, both parties shared information and staff for mutual benefit because some of the ESCOs are Energy Consultants' offshoots (noticeable from EESCs' shareholder lists, EESCs' audited financial statements, and ESCO Annual Report, 2013-2018). In light of such phenomena, this study assesses attitudes on EESCs' activities from both parties to obtain the full panoramic view.

Literature Review

Thailand has long recognized the importance of energy efficiency as evidenced by the legislation of the Energy Conservation Promotion Act, 1992 and an upper level proclamation in the new 2017 Constitution, Article 72. The country also issued the 20-year (2015-2036) Energy Efficiency Plan calling for the reduction of energy intensity by 30 percent or roughly 38,200 kilotons of oil equivalent accumulated energy savings. The plan designated EESCs as the key implementer of energy saving in the building and industrial sectors, whose combined potential investment was estimated at 0.15 trillion baht (approximately 5 billion U.S. dollars).

As EESCs were new to Thailand, they experienced both bright and gloomy circumstances. The government was aware of the difficulties of the young establishment and hence extended various supports to EESCs, such as government-sponsored legalization of the

ESCOs Association to help foster market trust, financial support on marketing activities (Achawangkool, 2011; Hansen et al., 2009) to enhance awareness, and the soft loan ESCO Revolving Fund to increase EESC financial access, etc. (http://www.efe.or.th). However, EESCs whose companies did not offer the full spectrum of energy efficiency services and were limited to EPC and leasing while facing service-alike competitors, such as energy consultants, experienced hindrances in market penetration that posed risks to their business (Langlois & Hansen, 2012; Vechakij, 2015) and currently approximately 85 percent of the registered ESCOs are still operative (ESCO Information Center, 2020). A literature review on Thai and selected countries' EE barriers was scrutinized and can illuminate risk drivers that Thai EESCs face, featuring both universal and country-specific problems.

This study employs enterprise risk management system to identify both internal and external crucial factors that affect the EESCs performance from proceeding business in the past. There are three concepts that underpin ERM i.e. 1) internal control (COSO, 2004), 2) corporate and auditing accountability, responsibility, and transparency (Sarbanes–Oxley Act of 2002), and 3) strategic planning (COSO, 2004). The objective of risk management is not to eliminate risk entirely, but to improve and enhance efficiency to the organization (Sheffi, 2005). The application of ERM is to increase competitive advantage to business (Akram, 2013; Kimbrough, 2006; Liu, 2011), to achieve goals and objectives of an organization (Espejo, Schuhmann, Schwaninger, & Bilello, 1996; Mintzberg, Ahlstrandm, & Lampel, 2005), to reduce earning variability, stabilize firm performance, to encourage employees (Lam, 2001), and to maximize firm value (Beasley, Pagach, & Warr, 2008; Hoyt & Liebenberg, 2011; Pagach & Warr, 2011). In addition, ERM focuses on how to integrate risk with performance by exploring how enterprise risk management practices support identification and assessment of risks that impact performance (COSO, 2017).

Enterprise Risk Management (ERM)

ERM can be viewed from two perspectives, i.e., academic (Bromiley, McShane, Nair, & Rustambekov, 2015; Mikes, 2009; Olson & Wu, 2010; Pagach & Warr, 2010; Romney & Steinbart, 2012, pp. 207) and organizations relating to business (CAS, 2019; COSO 2017; ISO 31000: 2018; RIMS, 2019; S&P 2008). Relying on the conclusion of Bromiley et al. (2015), Bromiley et al. (2014), Collier (2009), Markowitz (1952), and combining with previous perceptions and definitions regarding ERM, this study defines enterprise risk management (ERM) for EEs as "Processes of specifying risk management procedures that EEs are facing systematically under integrated perceptions by assessing events, probability, impacts, and relationships among all risk categories that threaten firm value and firm performance, and control overall risk exposure under an appropriate and acceptable range in relation to policy and strategic objectives.".

Enterprise Risks (ER)

This study investigates and focuses on events, risk drivers, or barriers that generated threats or negative impacts to the EEs industry in Thailand. Therefore, the definition of risk in this study is events with chances that threaten the achievement of success for proceeding EEs' business. (Cormican, 2014; Edwards & Bowen, 2005; Holton, 2004; ISO 31000: 2018; SEAI, 2013).

In the risk identification process, risk drivers are grouped under an organization chart and business activities (Rao & Goldsby, 2009), depending on appropriateness (AIRMIC, Alarm, IRM: 2010). In general, risk categories range from three to five risk classes for a firm (Panjer, 2006). From a literature review on risk classification for ERM, this study concludes that there are four major risk categories that can be grouped together as follows: *Strategic Risk (SR)* means events from external factors together with events from internal factors with a probability that undermines business growth or firm value detracting from the initial objectives or onset strategies. External factors are laws, regulations, economics, social market and customers' demand, technology and industry change, and competitors. Internal factors are project proceedings, business management, risk management, strategic pursuance after making decisions, lack of monitoring, and lack of responses or prevention in due course (AON, 2013; Bateman & Snell, 2012; Ben-Amar et al., 2014; CAS, 2019; Hitt, Duane, & Hoskisson, 2014; Jones, Santori, & Ingram, 2006; Lenckus 2006; Slywotzky & Drzik, 2005). *Operation Risk (OR)* means events with a probability of causing failures to internal working processes or insufficiency. The risk drivers of events come from internal operation, human resource management, use of technology or information technology, supply chain management, or operation management to comply with relevant regulations (CAS, 2019; Crouhy et al., 2014; Fan and Yuan, 2016; Gaudenzi, Confente, & Christopher 2015; Lam, 2000; Merna & Al.-Thani., 2008; Peccia, 2001; Wagner & Bode, 2008). *Financial Risk (FR)* means events with a probability of causing damages to business finances. The risk drivers or events are credit worthiness of the business, debtors' credit, and variability of market prices and economics, e.g., the exchange rate, commodity prices, interest rates, inflation, financial costs, liquidity of assets, or cash flow (CAS, 2019; Charles, 2004; Fan & Yuan, 2016; Gaudenzi et al. 2015; Jorion, 2007; Kloman, 2010). *Reputation Risk (RR)* means events with a probability of negatively affecting the reputation, attitude, perception, credit, and confidence toward business from the view of stakeholders, thus resulting in damage to the business in terms of revenue, business proceedings, supply chain, and acquisition of capital (Connell & Voola, 2007; Gatzert & Schmit, 2016; Gaultier-Gaillard, Louisot, & Rayner, 2009; Graham & Bansal, 2007; Keh & Xie, 2007; Scott & Walsham, 2005; Walsh, Mitchell, Jackson, & Beatty 2009; Walsh, Bartikowski, & Beatty 2012; Wang, Berens, & van Riel, 2012; Van den Bogaerd & Aerts, 2015).

This study concludes that both common and country-specific barriers and problems are based on criteria mentioned in at least 3 articles (except at least 1 in the case of Thailand) and found 37 risk drivers in total, illustrated in Table 1, used in the questionnaire for respondents to rate the impact on EESCs.

Table 1: Risk classification for the EESC industry from the literature review

ER	Risk drivers (EESCs' problems and barriers)	References
Strategic Risk (SR)		
SR1	Customers had limited insight into the energy efficiency technology and credit ability of EESCs' prior undertaking such as data originality, limitation, conditions, etc., which lead to concerns regarding EESCs' exploitation.	1,2,3,4,5,6,7,8
SR2	Customer top executives required a high return on investment projects for energy efficiency, or there is no policy on the latter.	1,2,3,4,5,7,8
SR3	Negative attitudes of customers' operation staff toward EESC employment due to fear of work interference or job uncertainty.	2,4,5
SR4	Small customers lacked interest in EESC employment due to limited financial resources, non-sizeable savings, and less financial attractiveness for energy efficiency projects.	2,4,5,6
SR5	Small customers did not have enough staff and knowledge to oversee and verify EESCs' performance.	2,8
SR6	EESCs' proposals were derived from a different basis. It is difficult for customers to compare, evaluate, and decide.	5,6,7,8
SR7	Customers collaborated under a moral obligation, while EESCs expected full collaboration under contract obligation.	1,2,3,4,5,6,7
SR8	High net worth customers had technical and financial competency and thus were likely to implement plans by themselves.	2,3,5
SR9	Customers required highly experienced third-party inspectors or consultants to ensure fairness in savings and costs.	1,2,3,4,5,6,7,8
SR10	Public policies on supporting EESCs lacked clarity and continuity.	1,2,3,4,5,6,7,8
SR11	Public fiscal tax and financial support were ambiguous and unanswerable to EESCs' needs.	1,2,3,5,6,7,8
SR12	Public procurement regulations awarded bidding on the lowest price basis, not on lifecycle cost.	1,2,3,4,5,6,7,8

SR13	New technologies with better efficiency and return emerged continuously. Hence, reaping the maximum benefits of projects was unlikely.	1,2,3,4,5,6,7
SR14	Trustworthy proven evidence based on continuous and long-time operation rarely existed, thus posing risks on saving evaluations and guarantees.	1,2,3,4,5,6,7
ER	**Risk drivers (EESCs' problems and barriers)**	**References**
Operation Risk (OR)		
OR1	EESCs' shortage of experienced technical staff rendered unimpressive outcomes.	1,3,4,5,6,7,8
OR2	Inadequate qualified staff to execute deals and monitor projects en masse, particularly in SMEs, which are numerous and costly.	2,4,6,8
OR3	EESCs' absence of unified and simplified measurement and verification standard rendered sophisticated and costly expeditions.	1,3,4,5,6,7,8
OR4	EESCs' disability on measurement and verification accuracy led to unacceptable results by customers.	1,2,3,4,5,6,7,8
OR5	Improper use and maintenance or equipment failure rendering lower than expected savings.	1,2,3,6,7,8
OR6	Discrepancies on guarantee issues between EESCs and technology suppliers.	1,3,6
OR7	EESCs' high reliance on external technologies resulted in high costs and complicated management structures.	3,8
OR8	EESCs difficulty in accessing customers' real energy usage information led to inaccurate and uncertain saving estimations.	1,2,3,4,5,6,8
Financial Risk (FR)		
FR1	Customers intentionally withheld payment to EESCs.	1,2,3,5,6,8
FR2	Long-term payment nature of energy projects was unattractive to customers and financial institutes.	1,2,3,4,5,8
FR3	EESCs needed long terms and large funding amounts, hence exposure to high and fluctuating cost changes, i.e., interest rates or bank guarantee fees.	1,4,5
FR4	Regulated or subsidized energy prices distorted saving and payback periods.	2,3,4,5,6,7
FR5	Accounting rules rendered compliance difficulties in book entry and tax management for obtaining tax privileges, i.e., capital expenditures (Board of Investment) or expenses	1,3,5

	(Department of Revenue).	
FR6	Financial institutes lending criteria are based on securities rather than project financing. Thus, ESCOs with limited collaterals faced difficulties in gaining credit lines.	1,2,3,4,5,6,8
FR7	EESCs with small registered capital hardly were qualified to bid on large-scale projects.	1,3,5,6,7,8
FR8	EESCs' operating cash flow was inadequate, and access to funding sources was limited.	1,2,3,4,6,7,8
ER	**Risk drivers (EESCs' problems and barriers)**	**References**
FR9	EESCs' excessive lead time in project and contract preparation caused extra unforeseen expenses.	3,4,5,7,8
FR10	EESCs' saving estimation error, or customers' energy consumptions, deviated from the baseline, and relocation or stopping operations was detrimental to financial performance.	1,2,3,4,5,6,7,8
FR11	EESCs' delayed project operation brought extra burden on expenses, project costs, and overhead costs later.	7,8
Reputation Risk (RR)		
RR1	Customers were unfamiliar with roles and the importance of EESCs in materializing significant energy saving.	1,2,3,4,5,6,7,8
RR2	Financial institutes possessed limited information and staff who understood EESCs' business and presumed EESCs to be a high-risk business.	1,2,3,4,5,6,7,8
RR3	EESCs' past performance record and reputation in view of customers were under par.	1,2,4,5,6,7
RR4	Failures of some EESCs in the past tarnished the EESC industry reputation.	2,3,5,6,7,8

World	Developing countries	EU	Russia	China	Thai
1. Hansen et al. (2009) 2. WEC (2008)	3. Ellis (2010) 4. T'Serclaes, (2010)	5. Marino, (2010)	6.Garbuzova, (2014),	7. Hu (2011)	8.Vechakij (2015)

Successful Enterprise Risk Management

A successful level of adoption of ERM can be measured by the Enterprise Risk Management Index (ERMI) that measures the effectiveness and efficiency of enterprise risk management (Gordon, Loeb, Tseng, & Chih-Yang., 2009; Li Nan, 2015; Panicker & Hiremath, 2016) by summing 4 measurable factors, as follows: *Strategy (S)* is measured by a sum of the firm market share acquisition and systematic risk (uncontrollable external factors) diversification compared with competitors in the same industry as they designate striving for top-level goals and missions. *Operation (O*) is measured by a sum of the total assets turnover ratio (Kiymaz, 2006) and the employee turnover ratio (Gordon et al., 2009) or the efficiency and effectiveness of a firm in generating output compared to resources input. (Banker, Datar, & Kaplan 1989). There are fewer risks of failures with higher efficiencies (Gordon et al., 2009). *Reporting (R)* measures the quality level of financial statement reliability (Lam, 2003) that reflects overall risk exposure that causes failures for business and is a sum of auditor opinions (Gordon et al., 2009; Li Nan, 2015; Panicker & Hiremath, 2016) and accounting manipulation (Defond & Jiambalvo, 1994; Defond & Subramanyam, 1998; Gordon et al., 2009; Jones, 1991). A firm reported to have a poor reliability of financial reporting also has poor performance, a high risk of failure, and decreased firm value (COSO 2004). *Compliance (C)* designates a successful level for a firm in decreasing the overall risk of failure and increasing performance and firm value by complying with applicable laws, regulations, agreements, or contract obligations and is a sum of the ratio between auditor's fees to net revenue and scaled by average total assets (Gordon et al., 2009; Li Nan, 2015; Panicker & Hiremath, 2016) and the ratio between net settlement gain (loss) to average total assets (Gordon et al., 2009; Li Nan, 2015; Panicker & Hiremath, 2016).

Contingent Variables (COV)

Not only is an appropriate ERM system for a particular organization affected by causes of risks that are grouped into risk categories, but it also varies in contingent variables (or control variables) that influence the enterprise risk management framework to firm financial performance (COSO 2004; COSO, 2017; Gordon et al., 2009; Panicker & Hiremath, 2016). Therefore, contingent variables for an organization in this study means factors that influence the proper match between a successful ERM and firm financial performance. There are five common factors, as follows: *Environmental Uncertainty (EU)* creates difficulties for a firm in predicting future events outside companies, managing risks, generating earning, and creating firm value and is a sum of the Coefficient of Variation of Sales, the Coefficient of Variation of Capital Expenditures and R&D, and the Coefficient of Variation of Net Income before Taxes. *Industry Competition (CI)* reflects competition in gaining market share or sales, benefits from cost effectiveness, and risks of not maintaining profits above sustainable level when compared with rivals in the same industry and is calculated by one minus the Herfindahl-Hirsman Index (HHI) (measuring industry concentration in relation to market

shares). The higher the competition in an industry, the higher is the need to adopt an enterprise risk management system, and more risks towards earning volatility. (Gordon et al., 2009; Panicker & Hiremath, 2016; Sithipolvanichgul, 2016). *Firm Complexity (FC)* is determined by the numbers of business units and transactions that create difficulties and risks to management within the organization, integration of information, and excessive expenses for controlling and monitoring business units. (Doyle et al., 2007; Ge & McVay, 2005; Gordon et al., 2009; Panicker & Hiremath, 2016; Sithipolvanichgul, 2016). *Firm Size (FS)* involves organizational structure (organization theory) (Lawrence & Lorsch, 1967), design and use of management control systems (Haka, Gordon, & Pinches., 1985; Myers, Gordon, & Hamer 1991; Shields, 1995). A firm's larger size (the natural logarithm of total assets) is associated with a higher positive adoption for an enterprise risk management system (Beasley et al., 2008; Gordon et al., 2009; Hoyt & Liebenberg, 2011; Lin, Wen, & Yu, 2012). *Monitoring by Board of Directors (MBD)* indicates that active participation from the company's board of directors influences the effectiveness of enterprise risk management within an organization (COSO, 2017; Gordon et al., 2009; Sobel & Reding, 2004). The company's board of directors has an important role in encouraging the adoption of an enterprise risk management strategy (Kleffner, Lee, & McGannon, 2003). Therefore, the ratio between the numbers of directors to the natural logarithm of sales (MBD) is related positively to successful enterprise risk management (Gordon et al., 2009; Panicker & Hiremath, 2016).

Successful Firm Financial Performance (FFP)

ERM provides an integrated framework that involves objective achievement to an organization and maximizes firm value as well as shareholder value by setting strategies and objectives to obtain an optimal balance between growth and return goals and related risks, and efficiently and effectively uses resources to pursue the firm's objectives (Beasley et al, 2008; COSO, 2017; Hoyt & Liebenberg, 2011; ISO 31000:2018; Pagach & Warr, 2011). ERM helps to reduce overall risk exposure of a firm and thus leads to higher firm performance (Ellul & Yerramilli, 2013; Florio & Leoni, 2017), increases firm and shareholder value (Gordon, et al., 2009; Gupta, 2011; ISO 31000, 2018; Woon, Azizan, & Samad, 2010; Woon, et al., 2011), and has a positive impact on firm performance (Baxter, Bedard, Hoitash, & Yezegel 2013; Subramaniam et al., 2011; Vicky, et al., 2015).

In this study, FFP is based on an accounting-based measurement because almost all EESCs in Thailand are non-listed. In addition, accounting-based measurement considers internal operation profits generated by organizational resources, while market-based measurements are affected by external factors that are related most indirectly to firm management and cannot be observed directly. Therefore, Firm Financial Performance (FFP) is defined as a constructed variable that reflects financial performance and capital that relates to firm and

shareholder value that occur from employing enterprise risk management (Baxter et al., 2013; Bromiley, 1991; COSO, 2017; Ellul & Yerramilli, 2013; Florio & Leoni, 2017; Gordon et al., 2009; ISO 31000:2018; Laisasikorn & Rompho, 2014; Mirza & Javed, 2013; Nocco & Stulz, 2006; Santos & Brito, 2012; Zou & Hassan, 2015). Thee financial performance indicators are selected in this study as follows. *Return on Assets (ROA)*: This is the ratio between net profit and average total asset (Al-Matari, Al-Swidi, & Fadzil, 2014; Laisasikorn & Nopadol, 2014; Baxter et al., 2013; Mirza & Javed, 2013; Santos & Brito, 2012). *Return on Equity (ROE):* This is the ratio between firm net profit and common equity (Al-Matari et al., 2014; Laisasikorn & Rompho, 2014; Lin, Liao, & Chang, 2011; Santos & Brito, 2012). *Earning Per Share (EPS)*: This is the ratio between net profit and the number of common shares (Al-Manaseer, Al-Hindawi, Al-Dahiyat, & Sartawi 2012; Al-Matari et al., 2014; Junarsin 2011; Laisasikorn and Rompho, 2014; Lin, Liao, & Chang, 2011; Tsegba & Ezi-Herbert, 2011).

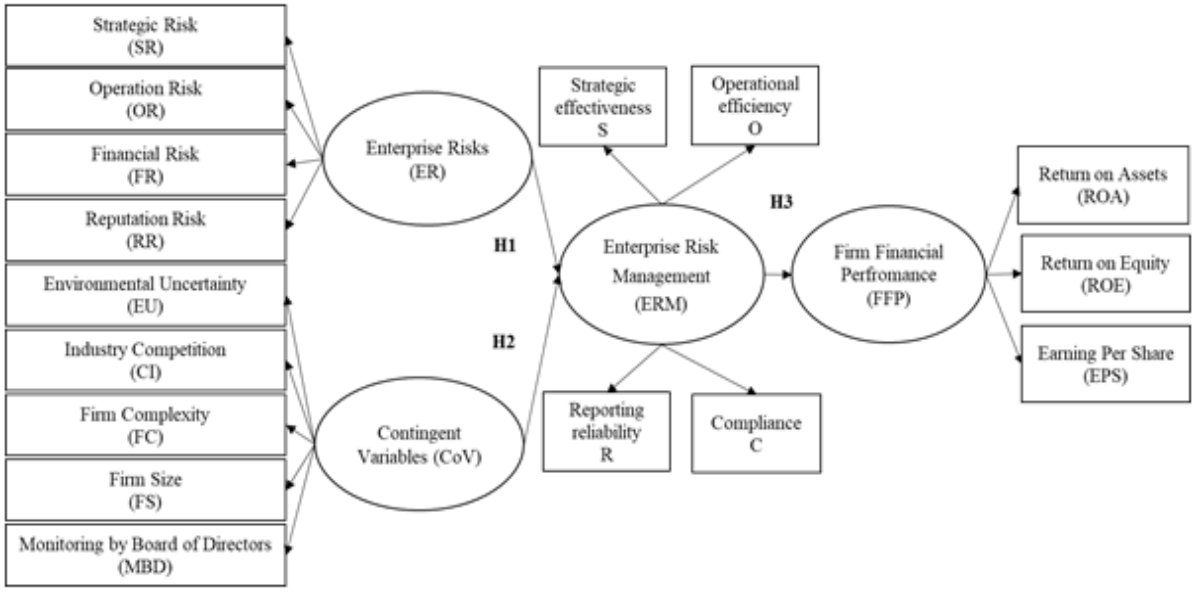
Hypotheses Development

To discover the relationship between the ERM and FFP found in the EESC industry in Thailand, this study uses a structural equation model to explore the results. The hypotheses are as follows:

H1: ER has a significant relationship with successful ERM.
H2: CoV has a significant relationship with successful ERM.
H3: ERM has a significant relationship with successful FFP.

Conceptual Framework

Figure 1. Conceptual model



There are two major reasons for the absence of direct relationships between ER and FFP as well as CoV and FFP in the conceptual model. Firstly, many studies that can be traced back for the past 20 years are barely found references to support both direct relationships. Secondly, the non-inclusion of both direct relationships are from the true economic point of view, rather than including them from the statistical point of view, in that enterprise risks and contingent variables are able to indirectly affect the firm financial performance through business management and risk responses by human, not by themselves.

Research Methodology

The questionnaire for this study employs a quantitative approach constructed to measure variables by adopting relevant literature and research materials on four latent variables, which are ER (risk drivers), ERM, CoV, and FFP.

Population, Sample, and Data Collection

The questionnaire was posted to a population of 609 people from 203 EESCs, responsible for three areas of firm risk management and firm performance, which were the 1) chief executive officers (CEO)/managing directors (MD), 2) chief financial officers (CFO)/accounting or financial managers, and 3) chief operating managers/project/technical managers working in energy service firms, registered with the Institute of Industrial Energy, and energy consultant firms with Rating A and registered with the Ministry of Finance in

Thailand. The data were prepared and collected from 2017 to 2019. The number of returned questionnaires with completed data was 225, representing a 36.94% response rate. The fairly high response rate is due to recognition and intimacy with energy service companies and energy consultant companies; the researcher had the privilege of using energy service firms' meeting venues as a platform to explain and distribute questionnaires and to use the researcher's company staff to collect responses. As for energy consultant firms, the researcher networked with the energy consultant association in which the researcher's company is a member. Therefore, the data and information provided by respondents were more or less closely relevant to real operations in the EESCs industry. The 225 response sample size is considered appropriate for this study under the following criteria: 1) Rule of r: r =p/k, where p = manifest variables, k = constructed variables (Herbert et al., 1995). If r = 2, n >= 400; if r = 3, n >= 200; if r = 4, n >= 100; if r = 12, n >= 50. In this study, p = 16 and k = 4, so p/k = 4, and the standard sample size should be higher than 100. 2) The standard sample size for the Structural Equation Model with (1) equal or less than 5 latent variables, (2) Communality equal to 0.6 or above, and (3) each latent variable with at least 3 measured variables should be at least 100 or above (Hair, Black, Babin, & Anderson, 2010).

Measured Variables

Enterprise Risks (ER) contain four groups of risk categories, which are SR, OR, FR, and RR. Each risk category includes relevant risk drivers as question items in the questionnaire. Respondents were asked to rate each question on a 5-point Likert scale, as is used and illustrated most often by COSO 2004, ranked from the highest impact to the least impact as a risk driver , (5: Highest impact, 4: Moderate high impact, 3: Moderate impact, 2: Moderate low impact, and 1: Lowest impact). The questionnaire was tested for content validity based on the index of item-objective congruence (IOC) scored by 5 experts in the energy service business sector. Any questions with values under 0.6 were excluded (Rovinelli and Hambleton, 1997). The reliability of the questionnaire also was tested with 37 sample respondents representing similar characteristics to those of the target groups. The Cronbach's alpha coefficient of reliability of 0.89 was above the accepted level of 0.7 (Bearden et al., 1989).

Data for ERM (4 measured variables, i.e., S, O, R, and C), CoV (5 measured variables, EU, CI, FC, FS, and MBD), and FFP (3 indicators, ROE, ROA, and EPS) can be obtained from company information and audited financial statements, available from http://corpus.bol.co.th and provided by Business Online PCL., and available from questionnaires, companies' websites, or websites from institutes where EEs are registered. Each indicator was averaged over the past 3 years, standardized, and scored on a 5-point Likert scale as is most often used and illustrated by COSO 2004. A higher rating for ERM, CoV, and FFP indicates higher

effectiveness in achieving ERM goals, having a higher need for ERM and more variability in firm financial performance, and healthier firm financial performance, respectively.

Audited financial statements for 3 years were selected, as they were the most recent available data for most non-listed private firms during the period that this study was conducted.

Data Analysis

Data analysis has two phases, as follows:
1. Data analysis of convergent validity, reliability, discriminant validity, and correlation coefficient between pairs of measured variables.
2. Data analysis of Confirmatory Factor Analysis (CFA) and verification of the goodness of fit by the p-value of Chi-square, CMIN/DF, goodness fit index (GFI), adjusted goodness of fit index (AGFI), normed fit index (NFI), comparative fit index (CFI), standardized root mean square residual (SRMR), and root mean squared error approximation (RMSEA).

Results and Statistical Analysis

The demographic characteristics of the questionnaire samples are shown in Table 2. A total of 225 respondents out of a population of 609 EEs in Thailand were in chief executive officer/managing director (39.11%), chief operating/engineering/technical/project officer/manager (38.22%), and chief financial/accounting officer/manager (22.67%) levels. The majority of the 225 respondents were males (77.78%), with ages ranging from 25 to over 55 years old, and the majority of ages ranged between 36-45 years old (52.89%). Most respondents held a master's degree (55.11%), followed by a bachelor's degree (44.44%), and had work experience with the current companies for a range of 5-10 (32.44%) and 11-15 (32.00%) years.

The empirical data was processed and analyzed by the AMOS program through the SEM approach, as shown in Table 3, Table 4, Table 5, Table 6, Table 7, Table 8, and Figure 2.

Table 2: Statistical data of questionnaire respondents

Respondents' general information	**No.**	**Percent**
Current position in company		
Chief executive officer/managing director	88	39.11%
Chief financial/accounting officer/manager	51	22.67%
Chief operating/engineering/technical/project officer/manager	86	38.22%
Total	225	100.00%
Sex		
Male	175	77.78%
Female	50	22.22%
Total	225	100.00%

Respondents' general information	**No.**	**Percent**
Age (years)		
< 25	0	0.00%
25-35	7	3.11%
36-45	119	52.89%
46-55	67	29.78%
> 55	32	14.22%
Total	225	100.00%
Education		
Bachelor's	100	44.44%
Master's	124	55.11%
Doctorate	1	0.44%
Total	225	100.00%
Work experience with current company (years)		
< 5	11	4.89%
5-10	73	32.44%
11-15	72	32.00%
16-20	50	22.22%
> 20	19	8.44%
Total	225	100.00%

Table 3 shows descriptive statistical data, i.e., the mean, standard deviation, skewness, and kurtosis, for all measured variables. Most impacts of risk drivers in the EEs industry are between moderate and moderate high. All skewness and kurtosis parameters are in acceptable limits of ±2 (Field, 2000, 2009; Gravetter & Wallnau, 2014; Trochim & Donnelly, 2006), indicating that the normal distribution assumption is still valid for SEM.

Table 3: Descriptive statistical data of the measured variables

Variables	Mean	Std. Deviation	Skewness	Kurtosis	Remarks
Enterprise Risks (ER)					
Strategic Risk (SR)	4.02	0.65	-0.39	-0.57	Moderate High
Operation Risk (OR)	3.98	0.77	-0.55	-0.44	Moderate High
Financial Risk (FR)	4.23	0.86	-1.23	1.07	Moderate High
Reputation Risk (RR)	4.05	0.85	-1.00	0.44	Moderate High
Contingent Variables (CoV)					
Environment Uncertainty (EU)	2.68	1.58	0.28	-1.48	Moderate
Industry Competition (CI)	3.88	1.45	-0.53	-1.74	Moderate High
Firm Complexity (FC)	3.20	0.62	0.06	-0.11	Moderate
Firm Size (FS)	3.96	0.86	-0.57	0.15	Moderate High
Monitoring by Board of Director (MBD)	3.60	0.61	-0.27	-0.15	Moderate High
Enterprise Risk Management (ERM)					
Strategy (S)	3.36	0.98	-0.29	-0.17	Moderate
Operation (O)	3.42	1.07	-0.39	-0.40	Moderate
Reporting (R)	4.14	0.82	-0.58	-0.50	Moderate High
Compliance (C)	3.61	0.61	-0.49	1.22	Moderate High
Firm Financial Performance (FFP)					
Return on Assets (ROA)	3.25	0.74	0.11	-0.32	Moderate
Return on Equity (ROE)	3.13	0.77	0.08	-0.35	Moderate
Earning Per Share (EPS)	3.16	0.49	0.34	0.54	Moderate

Table 4: Pearson Product Moment Correlation Coefficient (PPMC) between pairs of measured variables

Variables	SR	OR	FR	RR	EU	CI	FC	FS	MBD	S	O	R	C	ROA	ROE	EPS
SR	1															
OR	.482**	1														
FR	.453**	.407**	1													
RR	0.114	0.060	0.070	1												
EU	-0.024	0.044	0.107	0.062	1											
CI	-0.013	-0.067	0.014	.364**	0.086	1										
FC	-0.055	-0.045	0.004	0.019	-.151*	-0.071	1									
FS	-0.102	-0.060	-0.040	0.007	-0.111	-0.053	.373**	1								
MBD	-0.063	-0.108	-0.009	-0.072	-0.084	-0.085	.301**	.444**	1							
S	-.173**	-.169*	-.195**	-0.065	-.143*	-0.044	.203**	.243**	.158*	1						
O	-0.058	-0.079	-.180**	0.033	-0.097	0.001	.199**	.195**	.190**	.568**	1					
R	-0.097	-0.068	-0.115	0.036	-0.092	-0.046	.218**	.163*	0.128	.446**	.464**	1				
C	-0.117	-0.125	-0.119	0.064	-0.044	-0.008	.185**	0.080	0.080	.315**	.252**	.196**	1			
ROA	-0.042	-0.040	-0.024	-0.052	-0.008	-0.026	0.093	.176**	0.114	0.044	.158*	0.077	-0.060	1		
ROE	-0.113	-0.103	-0.064	0.050	-0.040	0.022	-0.018	0.109	0.121	0.096	.149*	.158*	-0.039	.599**	1	
EPS	0.009	-0.044	-0.095	-0.006	-0.044	-0.010	-0.064	0.087	0.006	0.057	0.105	0.068	-0.013	.406**	.348**	1

**. Correlation is significant at the 0.01 level (2-tailed).

*. Correlation is significant at the 0.05 level (2-tailed).

In Table 4, the Pearson product moment correlation coefficients between pairs of measured variables are between -0.195 and 0.599 and are not higher than a limit of 0.90 (Hair, Anderson, Tatham, & Black 1998; Hinkle, 1998, p. 118). Therefore, multicollinearity is not a problem for the SEM model. Twenty-seven pairs of correlations between measured variables are statistically significant at a level of 0.01, and eight pairs of correlations are statistically significant at a level of 0.05, totaling 35 pairs of correlations that exhibit statistical significance.

Table 5: Model fit check summary

Criteria Indices	Criteria	Value before adjusting model	Value after adjusting model	Results	References
p-value of Chi-squre	> 0.05	0.219	0.748	Consistent/pass	Hair et al., 2010
Relative Chi-square: (c^2/df)	< 2.00	1.107	0.874	Consistent/pass	Ullman, 2001; Carmines & McIver, 1981
Goodness of Fit Index: GFI	> 0.90	0.944	0.965	Consistent/pass	Hair et al., 2010
Adjusted Goodness of Fit Index: AGFI	≥ 0.90	0.923	0.948	Consistent/pass	Schumacker & Lomax, 2004
Norm Fit Index: NFI	> 0.90	0.841	0.915	Consistent/pass	Bollen, 1989; Bentler & Bonet, 1980
Comparative Fit Index: CFI	≥ 0.95	0.981	1.000	Consistent/pass	Hair et al., 2010
SRMR	≤ 0.08	0.053	0.044	Consistent/pass	Hair et al., 2010
RMSEA	< 0.08	0.022	0.000	Consistent/pass	Hair et al., 2010
Cronbach's Alpha	≥ 0.07	0.950	0.961	Consistent/pass	Tavakol & Dennick, 2011

***Model Fit Analysis*:** Figure 2 illustrates the SEM model after adjusting the model to fit the consistency of the models to the empirical data. The tested model fit indices are summarized in Figure 2 and Table 5 and show that the model corresponds to empirical data and passes the specified measured criteria.

Figure 2. SEM results after adjusting the factor loading and modification indices (MI)

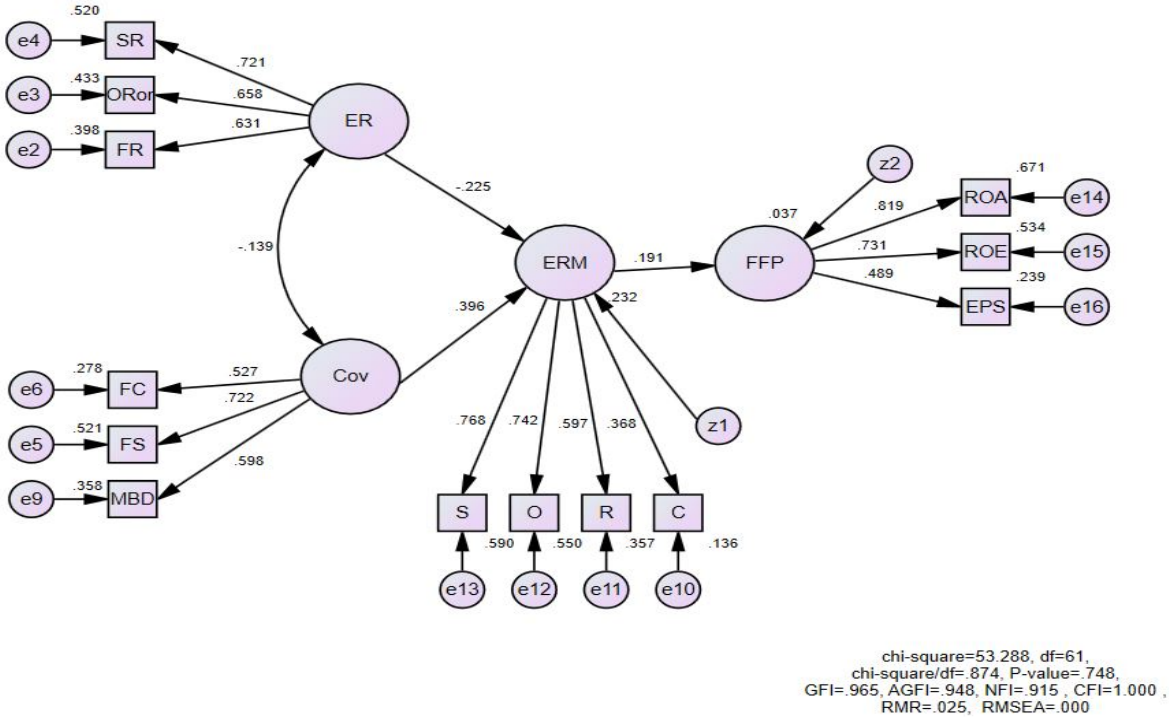


Table 6 shows the latent variables and their corresponding indicators. Enterprise Risks (ER) comprises three measured variables. Each indicator is statistically significant at a level of .01. The best indicator is Strategic Risk (SR) (factor loading = 0.721), and then Operation Risk (OR) (factor loading = 0.658), and Financial Risk (FR) (factor loading = 0.631).

Contingent Variables (CV) comprises three measured variables. Each indicator is statistically significant at a level of .01. The best indicator is Firm Size (FS) (factor loading = 0.722), then Monitoring by Board of Directors (MBD) (factor loading = 0.598), and Firm Complexity (FC) (factor loading = 0.527).

Enterprise Risk Management (ERM) comprises four measured variables. Each indicator is statistically significant at a level of .01. The best indicator is Strategy (S) (factor loading = 0.768), then Operation (O) (factor loading = 0.742), Reporting (R) (factor loading = 0.597), and Compliance (C) (factor loading = 0.368).

Firm Financial Performance (FFP) comprises three measured variables. Each indicator is statistically significant at a level of .01. The best indicator is Return on Asset (ROA) (factor loading = 0.819), then Return on Equity (ROE) (factor loading = 0.731), and Earning Per Share (EPS) (factor loading = 0.489).

Table 6: Convergent validity and reliability for latent variables

Latent Variables	Measured Variables	Factor Loading	S.E.	Critical Ratio	p-value	R^2	Composite Reliability	Average Variance Extracted
Enterprise Risks (ER)	Strategic Risk (SR)	0.721	0.135	6.407	***	0.520	0.806	0.581
	Operation Risk (OR	0.658	0.145	6.425	***	0.433		
	Financial Risk (FR)	0.631				0.398		
Contingent Variables (CV)	Firm Complexity (FC)	0.527	0.102	5.171	***	0.278	0.798	0.574
	Firm Size (FS)	0.722				0.521		
	Monitoring by Board of Directors (MBD)	0.598	0.103	5.670	***	0.358		
Enterprise Risk Management (ERM)	Strategy (S)	0.768	0.690	4.881	***	0.590	0.788	0.498
	Operation (O)	0.742	0.759	4.694	***	0.551		
	Reporting (R)	0.597	0.486	4.487	***	0.356		
	Compliance (C)	0.368				0.135		
Firm Financial Performance (FFP)	Return on Asset (ROA)	0.819				0.671	0.868	0.696
	Return on Equity (ROE)	0.731	0.143	6.480	***	0.534		
	Earning Per Share (EPS)	0.489	0.068	5.881	***	0.239		

Criteria: *** p-value < 0.001, Critical Ratio > 1.96, R^2 > 0.5, Composite Reliability > 0.7, AVE > 0.5 (Hair et al., 2010)

Table 7: Discriminant Validity

Latent Variables	Mean	SD	Shapiro-Wilk	Pearson's Correlations vs Sqrt(AVE) (in main diagonal)			
				ER	CoV	ERM	FFP
ER	4.081	0.902	0.000	0.762			
CoV	3.590	0.770	0.000	-0.086	0.758		
ERM	3.629	0.937	0.001	-.215**	.308**	0.706	
FFP	3.179	0.677	0.000	-0.092	.132*	.133*	0.834

**. Correlation is significant at the 0.01 level (2-tailed).

*. Correlation is significant at the 0.05 level (2-tailed).

Each latent variable has an insignificant Shapiro-Wilk value, which means that each passes the normality test, and it also passes the discriminant validity test because all pairs of Pearson's correlation coefficients between latent variables are less than the square root of the extracted average variance (shown in the main diagonal).

Table 8: Hypothesis test results

Hypothesis		Estimated coefficient	S.E.	C.R.	p-value	Results
H1: Enterprise Risks (ER) has a significant relationship with successful Enterprise Risk Management (ERM).	ER --> ERM	-0.225	0.041	-2.259	0.024*	Supported
H2: Contingent Variables (CoV) hhas a significant relationship with successful Enterprise Risk Management (ERM).	CoV --> ERM	0.396	0.046	3.108	0.002**	Supported
H3: The Enterprise Risk Management (ERM)has a significant relationship with successful Firm Financial Performance (FFP).	ERM --> FFP	0.191	0.257	2.016	0.044*	Not supported

***p-value < 0.001; **p-value < 0.01; *p-value < 0.05; C.R. > 1.96

The three hypothesis results are detailed in Table 8, and the explanations are as follows:

H1: ER has a direct negative effect on ERM, supported;
H2: CoV has a significant positive relationship with a successful ERM, supported;
H3: A successful ERM has an insignificant relationship with Firm Financial Performance (FFP), not supported. Even though the p-value is 0.044, which is slightly lower than the significant value of 0.05, the standardized regression weight is merely 0.191. Therefore, this study concludes that ERM has an insignificant relationship with FFP.

Discussion

From the sample data, most factors (measured variables) found in EESCs in Thailand corresponded to theoretical factors, as determinants of the ERM system, i.e., SR, OR, FR, FC, FS, MBD, effective risk management for strategies, operation, reporting, and compliance, in line with theories, and firm financial performance can be indicated by ROE, ROA, and EPS, in an integrated picture. From documentary review to support findings of this study, the latest ESCO Annual Report (2018) still identified strategic risk on EESCs business i.e. third-party inspectors or consultants to ensure fairness in savings and costs (SR9) (pp. 73), operation risk i.e. unified and simplified measurement and verification (M&V) standards (OR1) (pp. 2, 73), and financial risk i.e. substantial registered capital (FR7), banks' credit lines and banks' guarantees (FR6) (pp. 74).

The proper match between ER, ERM, and CoV for EESCs to accomplish enterprise risk management mainly occurred through reducing strategic risk, increasing firm size, and

having effective strategies for managing the firm. The possible explanations of excluded factors, i.e., Reputation Risk, Environment Uncertainty, and Industry Competition, of the ERM system that did not relate the ERM system to firm financial performance in the structural equation model are as follows:

Enterprise Risks

Reputation Risk: Some of these previous risk drivers in Thailand (Vechakij, 2015) and in other countries were not factors that related the ERM system to firm financial performance. Perhaps various government support, physical and financial, more or less diverted these reputational risks away from respondents (ESCO Annual Report, 2013-2018). The impact of overall risk drivers in this group is somehow different from the literature described by Ellis (2010); Garbuzova & Madlener (2012, 2013, 2014, 2016); Hansen et al. (2009); Hu & Zhou (2011); SEAI (2013); T'Serclaes (2010); and WEC (2008); Vechakij (2015).

Contingent Variables

Environment Uncertainty (EU) and Industry Competition (CI): The common factor that Environment Uncertainty (EU) and Industry Competition (CI) use in the calculation shares is firms' sales, as well as Compliance (C) (with the concept of the auditor fee). Therefore, Compliance (C) also shows a factor loading of 0.368, which is the lowest value among the measured variables of ERM. The explanation is that competition among EEs and energy consultants was not fierce as the market size has been large, evidenced by revenue from sample data that was not sizable at less than USD 7 million per annum on average, or 1.4% of the total potential investment, and EEs needed a unifying collaboration to gain market trust and the government's support (ESCO Annual Report 2013-2018). Although energy consultants took some of the EEs' market share, their threats were minimal. In reality, they are somewhat synergic partners, not rivals, as consultants are engaged in the ground work, i.e., energy auditing and feasibility studies that are a high risk to EESCs if the EESCs would perform them independently, in addition to being subject to customers' discretion on further implementation (Hansen et al., 2009). In addition, Thailand had suffered from political turmoil before; EESCs therefore were subject to similar difficult situations, thus exhibiting a poor linkage between ERM and firm financial performance (Quon, Zeghal, & Maingot. 2012) and a disintegration of determinant factors (EU, CI, and C) from the ERM system, relating to firms' sales since then. The importance of these contingent variables is different from the literature described by Chenhall (2006), Gordon et al. (2009), Liebenberg and Hoyt (2003), Luft and Shields (2003), Panicker and Hiremath (2016), Sithipolvanichgul (2016), Tymon, Stout, and Shaw (1998).

The Relationship between Enterprise Risk Management and Firm Financial Performance

The influence from enterprise risk management on firm financial performance was insignificant and positive. This result is similar to the result of Laisasikorn and Rompho (2014), who studied listed companies in Thailand, and opposite to studies of Florio and Leoni (2017), Gordon et al. (2009), Mirza and Javed (2013), Sithipolvanichgul (2016), Yang, Ishtiaq, and Anwar (2018), Zou and Hassan (2015). The possible reasons the researcher's noticed is that the implementation of enterprise risk management by EEs was in the very early stages and was superficial. The result thus exhibits a low positive influence of ERM on firm financial performance similar to the reasons provided by Agustina and Baroroh (2016); the adoption of ERM by Indonesian Banks was by regulations and was not pursued seriously. Thailand political turmoil and natural disaster during that surveyed period could be contingent variables that could deteriorate the effectiveness of the ERM to improve firm financial performance. This is similar to the situation during the financial and economic crisis in Canada as studied by Quon et al. (2012) who used samples from listed companies in the Toronto Stock Exchange (TSX) from 2006-2009, when the firms' earnings were very volatile.

This study clearly exhibits that critical EESCs' risks attach to internal and external issues are Strategic Risk (SR), Operation Risk (OR), and Financial Risk (FR) which need tandem operation to mitigate those risks altogether. Under those contexts, this study recommends the following solutions 1) internal issues: EESCs should review and update their business strategies, renovate practices i.e. M&V protocol, as well as strengthen manpower to upkeep disruptive technologies and conform to new normal, 2) external issues: a fiduciary(ies) and trustworthy independent third party(ies) should be set up to facilitate, mediate, and assure fair deal and payment between EESCs and their stakeholders.

Conclusion

Based on 225 respondent sample data and empirical evidence available from Thailand energy services surveyed during 2017-2019, this paper explored factors of the ERM system that linked the relationship between ERM and firm financial performance in an encapsulated picture, and the findings confirm that ERM can be measured by strategic risk, operation risk, and financial risk. CoV can be measured by firm complexity, firm size, and monitoring by the board of directors; effective risk management can be measured by strategy, operation, reporting, and compliance, in line with previous theories; and firm financial performance can be indicated by ROE, ROA, and EPS. However, the missing factors from the ERM system, different from other ERM literature, are reputation risk, environment uncertainty, and industry competition. The finding reveals that the level of ERM's influence on firm financial

performance is positively trivial and that there is room for the ERM to be introduced in EESCs.

Limitation and Directions for Future Research

This study's limitations are as follows. First, results obtained during surveyed period had been affected by political turmoil and natural disaster occurred before, which did not favor EESCs' financial performance. This resulted in the ineffectiveness of the ERM, and this is not generalizable to other longer periods. Second, the state of EESCs was not at full capacity, so the results may deviate from findings in the literature that are based on different maturity, environments, and culture. Third, selected variables may be viewed and used differently from other studies, i.e., risk drivers, risk categories, contingent variables, and performance due to interpretation, service activities, accounting standards, and available data, e.g., market-based performance.

The results should be considered as an initiative under particular circumstances, rather than a confirmation for business as usual, however it could provide useful guidance for EESCs to appropriately adapted for risk management under similar environment. To improve the results of this study, a comprehensive study should be completed in due time when irregularity is mitigated, new government regulation enforcement has been invigorated, and the EESCs' population has grown larger. Further study on the prediction and confirmatory factor analysis model can complement these findings.

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