Developing a Fragility Framework for Supply Chain and Outsourcing Engineering Services in UAE

وضع إطار الهشاشة لسلسلة التوريد والاستعانة بمصادر خارجية للخدمات الهندسية في الإمارات العربية المتحدة

by

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Abstract

This research analyzes the risk and fragility factors which are affecting the outsourcing services in the UAE market concentrating on the risk events and its impacts on fragility. Different organizations have different needs or factors that drive their decision related to outsourcing. The research aimed to analyze the risks which affect the implementation of outsourcing and to identify the characteristics to build a fragility framework for the outsourcing of engineering services. The analyses were carried out based on process, people, systems, and external factors and attempted to specify the risk events that influence on outsourcing fragility and develop the outsourcing fragility framework for engineering services enterprises. This framework can be utilized by the company decision-makers to manage fragility as well as deal with the various risk events, both pre and post outsourcing decisions. Results showing how main risk factors influence the risk and fragility and assist firms where to focus when outsourcing needs to be decided or improved to avoid threats, harm reputation or financial loss, etc.

The research findings showed that if companies can develop a strategy for outsourcing that addressed the limitation and challenges, the firms can get many benefits that come with outsourcing. Firms can save on time, get an enhanced quality of product, save cost, and gain performance enhancements that can provide the firms with the flexibility and capability to get better projects.

There is potential to researchers to find how to minimize the risks and fragility to improve the supply chain and firms to decide for outsourcing their services with higher quality and less cost. Researchers can focus for specific industry for more coherent analysis and find relation between fragility and resilience.

Abstract in Arabic

يحلل هذا البحث عوامل الخطر والهشاشة التي تؤثر على خدمات الاستعانة بمصادر خارجية في سوق الإمارات العربية المتحدة مع التركيز على المخاطر وتأثيراتها على الهشاشة. المنظمات المختلفة لديها احتياجات أو عوامل التي تدفع قراراتهم المتعلقة بالاستعانة بمصادر خارجية مختلفة. البحث يهدف إلى تحليل المخاطر التي تؤثر على تنفيذ الاستعانة بمصادر خارجية والتعرف على خصائص لبناء إطار هشاشة للاستعانة بمصادر خارجية من الخدمات الهندسية. وقد أجريت التحاليل على أسس اربعة تشملالعمليات، والناس، والنظم، والعوامل الخارجية وحاول البحث تحديد أحداث المخاطر التي تؤثر على هشاشة الاستعانة بمصادر خارجية و كذلك تطوير الإطار الخاصبالاستعانة بمصادر خارجية للشركات ما يتعلقبالخدمات الهندسية. هذا الإطار يمكن استخدامه من قبل صانعي القرار في الشركة لإدارة الهشاشة فضلا عن التعامل مع أحداث المخاطر المختلفة، سواء قبل وبعد قرارات الاستعانة بمصادر خارجية. النتائج تظهر عوامل الخطر الرئيسية كيف تؤثر على المخاطر والهشاشة وتساعد شركات أين التركيز عند الاستعانة بمصادر خارجية لبيان الاحتياجات أو تكون محسنة للتهديدات وتتجنب الضرر بسمعة الشركة أو خسارة مالية، الخ

وأظهرت نتائج البحوث أنه إذا كان يمكن للشركات وضع استراتيجية للاستعانة بمصادر خارجية التي تناولت الحد منها، والتحديات، ويمكن للشركات الحصول على العديد من المزايا التي تأتي مع الاستعانة بمصادر خارجية بالتالي يمكن للشركات توفير في الوقت المحدد، والحصول على تحسين نوعية المنتجات، وتوفير التكاليف، وكسب تحسينات الأداء التي يمكن أن توفر الشركات مع المرونة والقدرة على الحصول على أفضل المشاريع

هناك إمكانية للباحثين للعمل للعثور على كيفية تقليل المخاطر والهشاشة لتحسين سلسلة التوريد وللشركات لتعمل على التوجه لخدمات الاستعانة بمصادر خارجية مع أعلى جودة وأقل تكلفة. يمكن للباحثين التركيز على صناعة محددة لتحليل أكثر تماسكا وإيجاد العلاقة بين الهشاشة والمرونة

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Chapter I: Introduction

1.1 Research Background

This chapter outlines the introduction about the research and background of the research. There are details for the research aim and questions to be achieved at the end of the research. It also contains organization d the research and statement of the problem

Outsourcing Engineering services is considered one of the options which companies use it as one of their choices to serve their customers indirectly through specialized outsourcing corporations. Many factors make the companies to outsource like the cost, resources and control. At the same time there are attributes which influence companies' decision to outsource their services like fragility. Willcocks et al. (2011) stated that engineering outsourcing is highly observed in construction projects that primarily is reliant on the skills of the engineers as it involves intricate design works with lots of detailing. Due to shortage of qualified engineers, US firms are now taking to outsourcing of various kinds of structural design work in countries like China and India. Although these firms are benefited in terms of cost-savings, the major challenges emerged from lack of technological development in developing countries (Willcocks et al., 2011).

In the UAE outsourcing has been on rise. As noted by Malik (2018), according to Outsourcing Market Outlook 2016-2020 report, the country's outsourcing segment is growing at a fast pace with a value of approximately $976.1 million with an annual compound increase percentage of 11.2%. Besides, the author also noted that rise of small and medium sized enterprises are primarily turning towards outsourcing solutions to reduce overhead cost, increase efficiency, and focusing on the core activities (Malik, 2018).

Although there are driving factors for outsourcing, McIvor (2000) stated that often companies lack a strategic perspective towards outsourcing and is adopted with rather short-term goal (like cost) rather than long-term competitiveness. From this perspective, it is beneficial to see what attributes are influencing the outsourcing services considering the various risk events in the market of the UAE.

This research analyzes the factors which are affecting the outsourcing services in the UAE market concentrating on the risk events and its impacts on fragility. The research is structured in multiple chapters' form literature review, to the research methodology and have discussions for the findings from the distributed surveys and provides conclusions from the research and recommendation. The research introduces framework to be used by researchers and services decision makers in managing the fragility and its risk events when it is being outsourced or planned to be outsourced.

1.2 Problem statement

Referring to Bolumole et al, (2007); one purpose of confusion about different ways of implementing outsourced services was the absence of built up of framework systems for assessing associations' choices and their application and effect on coordination. A framework will assist to evaluate and examine the engineering corporate's decisions on the outsourced engineering services.

The UAE market will be analyzed for the engineering services being outsourced and like other markets there are challenges faced in engineering services outsourcing which would be controlled by developing framework to enhance the benefits and decisions when outsource services like logistics, IT, manufacturing, etc. This framework will be handled to get minimal fragility.

The framework addresses four critical aspects of business that includes people, process, system, and external factors. These aspects are termed as principal component and they further divided into factors. For instance, the people level factors include motivation, turnover, work environment, training, talent management and various others. On the other hand, process-level factors include inadequate contracts creation, management and compliance monitoring, inadequate supplier's service management, inadequate testing programs, data control, and others. System-level factors include data accuracy and integrity, system integration, inadequate management control, equipment performance, and the like. Finally, foreign exchange fluctuation, trade barriers, market uncertainty, political disturbances and the like are included under the external factors. In line with these the questions were framed and were analyzed quantitatively to identify the relative factor loading in the circumstances of outsourcing of engineering services. The study attempted to

distinguish the risk events that influence the fragility of outsourcing and develop the outsourcing fragility framework for engineering services enterprises. Firm decision-makers deal with various kinds of risks in implementing outsourcing in the business process. The fragility framework will help in assessing the risks and implement the outsourcing process to increase business efficiency in the engineering firms.

Each organization is interested to increase the profit and minimize risks impacting their business. This would be achieved in all project phases to manage, control and mitigate the risks. One of methods used is to subcontract the services to third party entities who are controlled in contracts to deliver the required services on behalf of the organization due to lack of skilled resources, tools, regulations, or even less operational cost. At the same time outsourcing services may have affected by multiple risk events which need to be managed properly else it will have negative consequences on the firm reputation and financials. As introduced in the statement of problem section in this research, framework is built to assist organization to manage the outsourced services and assist in the decision to outsource or not and even when being outsourced to manage the operations of the outsourced services.

1.3 Research Aims and Objectives

1.3.1 Research Aims

In this research which addresses developing a fragility framework for supply chain and outsourcing Engineering Services in UAE. The research aim is to determine the risk events which influence the fragility of outsourcing and develop the outsourcing fragility framework for engineering services enterprises

Although the existing studies have provided an understanding of the factors that drive outsourcing activities of the companies, it has not specifically considered the risk events. Moreover, in terms of engineering outsourcing, there is a general paucity of research and more so in throughout UAE. Therefore, this current study is conducted in UAE market with multiple organizations or industries adopting outsourced services and analyze the risk factors which are affecting the fragility focusing in engineering. This helps the organization where and when to take actions to reduce the fragility by providing the required resources and manage the systems in efficient and high-quality perspective.

1.3.2 Research Objectives

The research objectives are targeting four categories for each corporate operation to identify the outcome of the main objective; what are the characteristics to build a fragility framework for the outsourcing of engineering services? The following are these four categories of security factors involved for risks which includes process, people, systems and external factors

- For the process, the research will define what are the main characteristics for outsourced engineering services to build the required processes; what are the process risks affecting the outsourcing fragility; what are the processes' details needed to build the outsourcing fragility framework for engineering services

- For the people factor, research is focusing to know who the personnel are involved in outsourced engineering services; and what are the competencies required for people contributing in the outsourcing engineering services
- For the system factor, research will try to identify what are the systems contributing in outsourcing the engineering services
- Last objective to know what the external factors are affecting the outsourcing of engineering services

1.4 Structure of the Dissertation

This research includes multiple chapters described as follows

- Chapter one is the introduction which will include an overview about the research and the objectives and question aimed to be achieved.
- Chapter two will analyze all related literature researched and induced for similar topic and areas where criticizing the supporting components of this research.
- Chapter three will explore the research methodology being followed
- Chapter four, will explore the conducted surveys and analysis for the gathered feedback, in addition to discussion for the results.
- Chapter five has the recommendations based on the results and analysis conclusions.
- References and appendices are available to have reference for the sources for the official reference for the research citation and for more required details.

Chapter II: Literature Review

2.1 Introduction

The research literature is detailed for fragility and risks for UAE engineering services and supply chain. It also provides latest research done by researchers in outsourcing engineering services. The old researches deal with risks that affect the outsourcing and provides studies on the impact of risk and fragility on the services.

It highlights the actions done by companies to decide for outsourcing their services to third party supplier. There are articles explains the benefits for the outsourcing specially the engineering services. Some studies provide models and framework for outsourcing decisions. the literature review chapter list most of risks factors which affect services grouped under four major risk groups under people, systems, processes and external factors.

2.2 Terminology Definitions

There are main terminologies which are being used in the research that need to be clarified like Fragility, Risk, Supply Chain and Outsourcing.

According to Nassim Taleb ; the fragility can be identified as “what does not like volatility, and that what does not like volatility does not like randomness, uncertainty, disorder, errors, stressors, etc.” (Taleb 2014).

Based on this we can think of glass cup on a table is fragile object which you may worried about kids playing near the table? Or take precautions for labors in airport when be traveling with fragile items in your luggage.

According to Oxford dictionary, the term "Risk" interpreted to cases related to danger revelation. Aven et al., (2009) defined an individual or thing found as a threat or could be point of danger. Risk can be explained as a: "situation or event where something of human value (including humans themselves) is at stake and where the outcome is uncertain, or a term which refers to uncertainty about and severity of the events and consequences (or outcomes) of an activity with respect to something that humans value".

In his research about " Supply Chain Design and Analysis: Models and Methods", Beamon, (1998) identified the Supply Chain as " an integrated process wherein a number of various business entities (i.e., suppliers, manufacturers, distributors, and retailers) work together in an effort to: (1) acquire raw materials, (2) convert these raw materials into specified final products, and (3) deliver these final products to retailers". On the other hand, Chow and Heaver (1999) had identified the Supply Chain as a group of suppliers, retailers, manufacturers and distributors, as well as logistics and transportation service providers who are involved in delivering goods to consumers. Therefore, the chain consists both internal and external stakeholders of the firm.

In a study conducted by Adrian and Alexandru (2012), the researchers described the outsourcing concept stems from the term “outside resourcing” which refers to getting the required resources from outside. Then "outsourcing" had been used in economy to indicate the use of sources from outside the firm for business development instead of local available resources.

In his study " An introduction to outsourcing ", Ogburn (1994) summarized the definition of the "Outsourcing" as the transfer of business management to an outside provider, whereby the client and supplier sign the agreement which define the outsourced services; then the client provide the supplier with people, assets and other sources in order to enable the supplier to achieve the production of services which had been agreed in the contract. On the other hand, Raeissi, Sokhanvar, and Kakemam (2018) stated that outsourcing was a process whereby a firm assigns tasks to a third party to gain benefit in terms of cost and efficiency. The author also noted that the purpose of outsourcing is to improve access, quality, equity, and efficiency. On the other hand Ishizaka et al (2019) defined outsourcing from strategic management point of view that it is an agreement for business, internal or external (i.e. offshore) whereby a firm contract out their functions to other external supplier. In comparison to other definition, Ishizaka et al., (2019) highlighted that offshoring and outsourcing are two interrelated concept although they are not mutually inclusive. Mudambi and Venzin (2010) stated these two are increasingly being linked to firms’ outsourcing strategies.

There are as many definitions of outsourcing; that explore the process and goals of the process. But at its most basic outsourcing simply is the farming out of services to third party (Overb, 2007).

Outsourcing is utilizing of external resources strategically to perform various actions that were traditionally managed by the internal employees (Baily et al., 2008). However, Outsourcing has now been widely adopted as a strategic business method and has emerged as an accepted way of doing business in todays' organizations (Overby, 2007).

2.3 Benefits of Outsourcing

As stated by Hiwase (2016) the demand for outsourcing increased in multiple industries due to availability of pool of talented resources, also the improve on physical Infrastructure specially manufacturing capabilities, building an eco-system, investments in building domain knowledge, research & development, and growing manufacturing industry. In this regard, Fisher et al, (2008) stated that even outsourcing usage continues as a staffing strategy, it is crucial to get how the arena of management of human resources shifts are linked to this strategy. Outsourcing research in the behavior of the firm has verified individual level outcomes. The study revealed the various outsourcing-related challenges are faced by the HR professionals in the client organizations and the vendor or supplier as they look to attract, motivate, as well as retain talented employees and apply HR processes that would help to achieve organizational objectives. Therefore, before adopting an outsourcing business model, it is extremely important that the company properly evaluates the challenges associated with it and develop HR policies accordingly.

Other benefits related to outsourcing can be analyzed in terms of quality, cost and time to market that are main attributes for management of outsourcing (Zhu, 2016). A model is adopted theoretically to formulate the contracts of outsourcing for a supplier and a buyer where the buyer does not share internal variable cost information with the supplier. Optimum outsourcing deals are drawn where the results of quantitative exercise are given. Previous researchers have provided insights on managing the risks of outsourcing caused due to the Asymmetric Information in varied industries, like sensitive industries for cost, quality, and time-sensitive industry. As stated by Patil et al, (2014)for telecom operators, it is noticed that the basic set of parameters inducing the outsourcing decision is similar as other set for telecom industry. Recently, it is noticed that telecom operators extended this model by outsourcing multiple management like network infrastructure and other systems. However, the impact of outsourcing on cost is controversial. As noted by Globerman and Vining (2017) in outsourcing there is considerable cost involved in terms of goods expenditure along with the cost of governing the process of outsourcing and transactions. In

particular the authors noted that the complexity of product or activity, asset specificity, and contestability entails outsourcing governance cost for the firm. Moreover, Somjai (2017) also found that there are multiple unknown costs involved in the process of outsourcing especially when the transactions are carried out internationally. This also poses serious threats to the firms. Thus, it can be stated that while outsourcing is generally conceived as cost-effective, several hidden costs and governance costs may also potentially increase the expenditure for the firms.

Benefits of outsourcing can also be observed in terms of performance improvements (Lacity et al., 2009). In other words, additional support of staff from external sources can help running the process effectively and prevent any sort of delays in the project (Verneville, 2010). Performance improvements can also happen because the outsourced service provider provides equivalent or even better service to the client. (Barrar and Gervais, 2006; Mol, 2007). In addition short-term contract outsourcing can also provide flexibility. As observed by Ekeskär and Rudberg (2016) construction projects usually involves such short-term contracts with the logistics provider that provide the firms with greater flexibility and helps them to manage heavy machineries and equipment. Verneville (2010) noted that Ford Motors adopted such outsourcing strategy and reduced the number of regular employees to gain flexibility. By adopting outsourcing the firms are also better able to focus on their own main competencies and save investment in non-core functions and actions (Bragg, 2006; Verneville, 2010).

While various studies have found positive influence of outsourcing on the performance of the firms, there are considerable contradictory evidences as well. For instance, Joong-Kun Cho et al. (2008) undertook a study in computer and consumer electronic industry and found that outsourcing the logistics has a negative influence on the firms' performance. Similarly, Kenyon et al., (2016) found that product outsourcing has a considerable negative influence on the operational performance of the firms. In more specific, the authors noted that product outsourcing results in a reduced effectiveness of the operating equipment and has a negative influence on the on-time delivery. In terms of international outsourcing, Yu and Lindsay (2011) found mixed results. For instance, while global outsourcing got a positive influence on financial cost, quality, and efficiency, it get a negative influence on delivery and flexibility of the firm. However, the study

also noted that managerial actions play a moderating role between global outsourcing and the full performance of the organization. Such results are also there in the existing literature. Bengtsson (2008) conducted a study in the engineering manufacturing firm in Sweden, and noted that manufacturing process outsourcing does not have any positive e or negative influence on innovation capability and operating performance of the organization.

Willcocks et al., (2011) indicated that **t**he current development of the outsourcing domain has its effects for engineering management, and on the engineers who are involved in the development of the software or product development. According to the authors, nowadays, engineers are required to rearrange their development of the products and its operations to contain various outsourcing activities from their process of innovation that require them to specify the way innovation is undertaken internally or externally, the limits of product development and the way coordination is achieved at a global level. In this context, Sturgeon (2002) stated that innovation is one of the significant aspect especially in the complex product manufacturing industry and they outsource innovation process to the external sources due to the pressure of technology market development and rapid technological advancement. This has also resulted in vertical integration between the firms, outsourcing and other forms of network development for the purpose of product development (Arora et al., 2001; Langlois, 222; Howells et al., 2008).

On the contrary, Crawford et al.; (2011) indicated that engineering outsourcing is still at a nascent stage but is growing in popularity to gain capabilities and combative advantage. In this regard, Zirpoli and Becker (2011) stated that for any single firm, it is difficult to master all the skills and knowledge required for producing a complex product designs. It is because of this reason Christensen (2006) stated that outsourcing of designing is increasing that enables the firms to reap benefits by acquiring specialized techniques and knowledge from other supplier firms. Crawford et al; (2011) noted that corporates are now finding that by associating with firms with services for IT that are particularly experts in complex product design for engineering, they can enhance the firm competencies with the resources and skills that are not available internally. The authors noted that it can also lead to reduction in cost as utilizing such knowledgeable resources often becomes expensive. Sattineni (2008), in this regard, noted that especially in construction industry that

primarily is reliant on the structural engineers for all the projects often turn to outsourcing and off-shoring. The author conducted the study in the US and stated that although there are lot of detailed design works that is going on, but they lack in adequate skilled resources and are therefore, outsourcing their work to India. Patwardhan (2004), in this regard, noted that the US firms operating in have restructured their business model to fit in the off-shoring business model Architecture, Engineering and Construction (AEC) industry and are outsourcing their design works to India.

Although design outsourcing in engineering is increasing, Zirpoli and Becker (2011) noted that the firms that are outsourcing complex product designs to the supplier firms have faced various negative effects. The author stated that industry specificities often restricts the extent to which the products' design or architecture is modularized. For instance, Baldwin and Clark (2000) noted that electronic products such as computers have specific modular architectural requirement that limits the firms' innovation outsourcing activities. However, Rothstein (1998) noted that outsourcing has received importance in the engineering firms. The author noted engineers who work from a distant location, away from home office, are in greater need of support services. However, Rothstein (1998) also noted that there are various technical and security issues associated with outsourcing in engineering firms. Due to diverse standards, educational difference, and national background there are differences in technical safety standards.

Burdon and Bhalla (2005) studied outsourcing services in the Engineering and Facilities Management (EFM) that has recently shown significant growth. In this sector outsourcing activities include mechanical, structural, civil, electrical, and instrument maintenance (Burdon and Bhalla, 2005). The cost efficiency and quality of service primarily drives the intentions for outsourcing activities (Barthelemy and Dominique, 2004). In addition, other drivers include effectively responding to uncertainties for environmental side (D' Aveni et al., 1994), acquiring specialist knowledge (Quinn, 2000) and implementation of latest technologies (DiRomualdo et al., 1998). Kakabadse and Kakabadse (2002) also stated that after cost enhanced reliability, knowledge of best practice and improved quality are the primary considerations in EFM sector. In this regard, Burdon and Bhalla (2005) stated that compliance to quality standards is one of the most significant

aspects in EFM industry as it serves as the Key Performance Indicators (KPI). In addition, the authors noted flexibility, innovation and concentrate on the firms' core capabilities for the secondary benefits of outsourcing in EFM. However, the authors noted that the critical success factors in such outsourcing includes workforce management, relationship management, senior management involvement, and innovation management.

Bolumoleet al, (2007) had developed a framework which enables outsourcer clients to experiment the decisions for outsourcing the logistics. The framework indicates that the competitive firms around the globe are now looking for contract engineering services in order to meet their requirements. As noted by the author, this is particularly true for companies who have no in-house engineering or those who have extensive internal engineering functions. The client's decisions for outsourcing logistic services was focused on frame work that depends on cost, resource and Network based theories. The transaction cost-based part in firms to use external parties to reduce internal transaction and the costs of production. The resource part uses proper strategy when internal skills are not available. network of relationships is led by firms' strategies. every part gives partial beneficial framework for the logic of outsourcing the logistics. In South Africa, outsourcing of logistic services is a popular strategy for many industries. However, the alignment of the logistics services providers and the customer is not fully understood; customers adhere to strict to procurement policies, while logistic services providers aim to generate proper returns. So, customers and logistic services providers require assistance in structuring to logistic outsourcing arrangement to ensure the success of the transaction (Bloem, 2015).

In this regard, Ekeskär and Rudberg (2016) noted that in construction industry the products involve huge machineries and heavy equipment that are immobile and are primarily carried out by temporary organizations (Bakker, 2010) that also requires temporary supply chain and logistics (Vrijhoef, et al., 2000). It is because of this reason, 80% works that are done in construction industry involve third-party suppliers, vendors and subcontractors. A number of companies are therefore, now looking for third-party logistics provider to meet the requirements of large construction projects (Langley, 2015). Research conducted by Ekeskär and Rudberg (2016) revealed that such outsourcing can reap a number of useful benefits like better utilization of the

construction site and overcoming operational issues. However, the authors also stated that the barriers are observed primarily in terms of budget and time plans.

Although they are yielding benefits from this design outsourcing process in terms of cost and filling in the skill shortage, Sattineni (2008) revealed that they are also facing some challenges. For instance, the counterparts of these firms in India required training on some basic design elements that are considered as common knowledge in the US. Therefore, it incurred heavy cost on the construction company. However, Bolumole et al, (2007) found that the advantages for outsourcing for the firms as it can ensure greater speed of deployment, produce high quality results, lead to cost efficiencies and accumulation of vast knowledge and experience.

Apart from outsourcing activities in the third-world countries by the developing nations, there are also instances of outsourcing activities in the developing countries. A research done for software outsourcing by (Oza et al, 2006) found that trust was very fragile. In this regard, Sabherwal (1999) noted that trust is significant in development projects that are outsourced and is a critical factor to ensure the smooth operation and completion of the engagement. Oza et al, (2006) conducted a study among the vendors companies of the Indian software engineering firms and stated that providing suitable reference increases trust between the third-party and the client. In addition capabilities of the outsourced firm's representatives, and investment also play important role in building trust between the parties. Therefore, trust emerged as one of the significant factor that can potentially create challenges in outsourcing projects. Finally Cai et al., (2011) also identified a number of risks from an industrial engineering perspective. As noted by the authors, such risks involve loss of firms' core capabilities, lack of control over the producer services and controlling the external outsourced agents.

On other hand, a study was done on supply chain by Stonebraker et al, (2009) who worked for fragility and sustainability measurements. An"index for fragility" was developed to assist managers for supply chain to assess fragility and sustainability in terms of sources and cost. One of the issues faced the outsourcers is the stress at the work environment which leads to unhappy environment for the suppliers' employees. This is because of to multiple attributes like extended supply chain which leads the managers to have addition control on the processes and events (Iansiti

and Levin, 2004; Tebo, 2005; Misser, 2006). At the same time these factors have impact on the cost and threats on the control for the additional efforts to be given from management to minimize fragility.

A study conducted by Zhu et al., (2001)presented four stages steps of building a successful framework for outsourcing: plan, develop, implement and evaluate. As noted by the author, at the initial start, it should start with a well-drafted business plan that potentially identifies all the costs involved along with the consideration of efficiency by comparing the existing process and anticipating the outsourced functions. As discussed earlier, one of the important reasons is the cost to go for outsourcing decision (Barthelemy and Dominique, 2004). Therefore, this needs to be addressed at the first place. At the second stage of development, vendor agreement comes to play. As stated by Zhu et al., (2001) this stage should adequately assess the risks involved in the business relationship by both the parties. The third phase involves implementation and must be accompanied by a proper transition plan followed by the last stage of review, assessment and evaluation. Therefore, following McIvor (2000) it can be stated that outsourcing function must entail stringent assessment of the firms' internal capabilities as well as external capabilities and must benefit both the parties involved. However, Sharp et al., (2011) stated that an outsourcing framework is a holistic approach that analyzes business, information, as well as organizational perspective (HABIO). The HABIO framework is directed to assist organizational decision-makers by presenting a set of 'what-if' cases and scenarios. In terms of ERP outsourcing, Zandi (2013) stated that different level of ERP modules often creates challenges in outsourcing. Thus, the author focused on developing a bi-level outsourcing model that focuses on adequate modules and adequate process in ERP. Thus, there are different types of models and framework for managing outsourcing and each has its own characteristics and purpose.

Although there have been discussion on the topic of outsourcing and its associated risk, there have been very little effort in terms of a proper framework development (McIvor, 2000). Moreover, Momme and Hvolby (2002) stated that existing scholars and researchers although have highlighted the factors affecting outsourcing, they have not clearly highlighted on the model or framework that can be adopted to carry out various outsourcing activities and transfers. However,

Wasner (1999) stated that it is crucial to distinguish the transactions and processes tagged to outsourcing because in outsourcing the internally controlled systems become externally managed and thus the interdependency impacts the operational aspect of the firms. Thus, the present research will address this gap and develop a fragility framework to deal with the various kinds of risks related to outsourcing. Porter (1985) stated that it is important to analyze the decision for outsourcing from a value chain part. McIvor (2000) therefore, analyzed the organizations from value-chain point-of-view and stated that such analysis helps in understanding what functions are required to be added to increase the benefits of the enterprise. For instance, the author noted that in manufacturing industry it is important to analyze how the firm is handling logistics and material and what support activities they have. Furthermore, supply chain management (SCM) as conceived by Thunberg (2016) is a remedy for addressing the underlying issues faced by the construction industry. However failure to plan the supply chain along with the resources assigned in the value chain, and integrating the planning process in the supply chain, the construction projects does not lead to a success. In addition, as highlighted by Zhu et al., (2001) core corporate competencies are another major area of focus. It is crucial that the organization reorganizes their value chain in such a way that it is able to concentrate on core functions and develop competencies. Finally, as noted by McIvor (2000) it is also important for the firms to take account of the supplier base influence. According to the author, since firms nowadays are also outsourcing strategic functions (like complex design in engineering), they are forming collaborative relationship with the supplier firm that also has significant skill set and competencies. This creates dependency of the customer firm on the supplier firm which, in turn, makes the supply management a success. Based on this analysis, McIvor (2000) developed a practical framework to evaluate the decisions for outsourcing by the firms. This is depicted in the below figure.

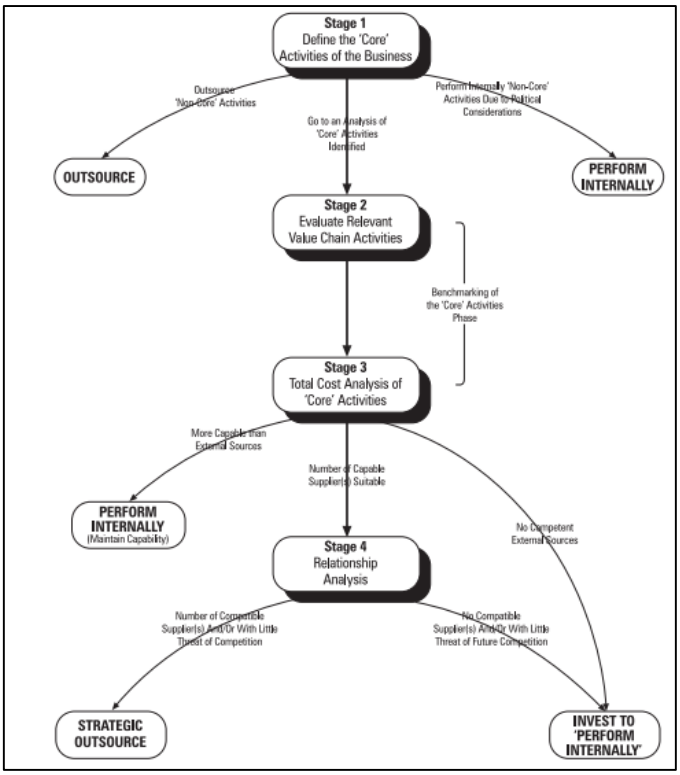

Figure 1: Framework for outsourcing decision

(McIvor, 2000)

Therefore, supply chain management emerges as the important consideration in the outsourcing decisions. Stonebraker et al.,(2009) indicated at an growing area for supply chain research focusing on fragility and sustainability, and developed a framework understand and measure it. And they concluded that if the supply chain was not sustainable in a long-term then it is fragile. A sustainable supply chain is seen as robust, while unsustainable supply chain is seen as fragile. As noted by Lee (2004 efficiency of the supply chain is not enough. Rather it must also address the issues of environmental costs that poses risks to the disruptions of supply chain (Stonebraker et al., 2009). This is more so due the increase in the in management of supply chain (Druckman, 2005). It is required by the management of the firms to pay particular attention on operations management, integration of the supply chain functions and activities, focus on supplier management, logistics and enhancing customer relationship (Kleindorfer et al., 2005). Therefore, the management of supply chain should clearly address the issues of disruption and prevent environmental risks to improve its fragility as well as cost.

While these authors provided a limited perspective on risks, Rost (2016) provided a detailed analysis on the risks and hazards on the outsourcing. The authors noted ignoring the importance of communication, inadequate governance system, lack of control over key information, inadequate leadership, and resistance on the internal organizational members pose considerable risk to outsourcings. In comparison to these factors, Zhu (2016) highlighted outsourcing risks related to quality, time to market reduction, and cost. If it is needed to enhance the quality the cost and market time increases and if market time needs to be reduced, then quality will reduce, and cost would increase.

Cullen and Will cock (2005) have determined the factors of developing successful outsourcing framework, and they have indicated the factors as following; the Termination item for the contract breach, the Flexibility and quick action for the changes, the Regulatory Risk; addressing competition or confidentially issues, Responsibility and payment obligations, A solid legal frame work, and Benchmarking item: The firm to have ability to change the price and compare with other suppliers. Apart from previous researches, Zambesi (2012) highlighted multiple attributes for managing outsourcing activities. These include relationship management, proper reporting and analysis, communication, documentation, risk management, contingency planning, dispute management, streamlining, and supplier audit. Considering these factors, the author developed a SMART framework that is flexible and provides for measurement of success. The framework according to Zambesi (2012) can help the management to measure outsourcing performance and helps addressing challenges at each stage.

As a results, it can be concluded that there are multiple of benefits incorporated with outsourcing in terms of performance improvements, cost reduction, competitive advantage, increasing knowledge base and speed of delivery. However, such benefits can only be reaped after careful considerations of the associated risks of outsourcing. Advantages can only be gained if one firm successfully able to eliminate or address such risks. Although a number of authors have attempted to provide a framework of outsourcing decision analysis, those are not comprehensive and does not clearly state on what conditions the firms should actually adopt outsourcing and what risks are associated in which condition. The existing research studies provides a general framework

for analysis and does not address the specific considerations for engineering. It also do not focus on addressing supply chain fragility and develop an analytical model to assess the potential disruption that the firms may face in managing global supply chain. The present research addresses this gap and highlights the various antecedents that affect the firms' decision of outsourcing a function. The following chapter will detail the methodological orientation of this research.

Chapter III: Research Methodology

3.1 Introduction

A detailed understanding of the methodological approach to the research topic is covered in this chapter. It highlights the design adopted for this research including procedures of data collection and analysis along with ethical responsibilities of the researcher. In addition to this the chapter also highlighted on the various system, people, process-related risks as well as external out of control risks to outsourcing, based on which the questionnaire was developed.

3.2 Design of the Research Survey

Referring to Saunders et al., (2012) the design of research is primarily based on the aim objectives of the study as well as the type of questions that the researcher seeks to address. The present research is primarily based on quantitative research design. Since, the study presents the list of major risk events that influence outsourcing fragility and develop a fragility framework and follows a quantitative approach which seems to be suitable for this research. It helped to analyze the factor loading of each of the people, process, systems and external factors and provide a comprehensive understanding on outsourcing fragility. The research questions also addressed these main categories of corporate function and attempted to analyze and identify the factors needed to be considered by the firms prior to their outsourcing decision.

3.3 Data Collection

Various kinds of methods for data collection like survey, interview, experiment, observation (Miller & Tsang, 2011). The selection of these methods are primarily attributed to the chosen research design and its purpose. As stated by Bryman, Bell & Harley (2018) survey method is most suitable when researcher attempts to collect quantitative data in relation to two or more than two variables. As highlighted earlier, this research is an exercise to identify the risk attributes which affect outsourcing processes. Moreover, from the existing literature four primary categories of systems, people, process and external risks were identified that affect outsourcing.

To understand the relative factor loading and the impact of these factors, quantitative data was most feasible. Therefore, a survey were formulated with a number of closed-ended questions related to the principal categories to understand the risk events that impact outsourcing services. The survey questionnaire was shared with the sample from a number of UAE firms who provided their feedback about their agreement and experience from getting services being outsourced to third party suppliers. The survey covered the companies which outsourced and others who need to outsource. The questions are formulated aiming minimum risk impact and at the end less fragility. Survey questions were built to check each risk expected to impact fragility.

3.4 Reliability and Validity

Since the survey was particularly designed for the cause of this study, assessing the validity and reliability of the research instrument was significant. In a quantitative research, according to Creswell and Plano Clark (2010), attempts to measure whether the scores received from the respondents are adequately indicating the construct of the variable that is being measured. In order to measure such internal consistencies a measurement using Cronbach's Alpha was carried out that attested the reliability and validity of the instrument of the research. In addition to Zikmund (2003) stated that it is important that the surveycan accurately capture the respondents' opinion and thus, should be flexible and sensitive to their responses. Following this, a scale called seven-point Likert was used for soliciting answers from the participants that captured the responses on a wide range. Thus, the shortcomings of dichotomous responses were avoided.

3.5 Data Analysis

The data analysis was conducted using SPSS through quantitative terms. Exploratory Analysis was enrolled based on several components for each of the categories. To understand the relative importance of these components factor loading was analyzed to make the fragility framework more stringent. Therefore, the data obtained from the respondents were analyzed objectively trying to deduce inferences from the responses.

3.6 Ethical Considerations

In any kind of academic research, ethical issues are most important. As stated by Easterby-Smith, Thorpe & Jackson (2015) the consent of the research participant is an important consideration to avoid ethical dilemmas. Similarly, Bryman & Bell (2012) also stated that it is extremely important to receive informed agreement from the participants to avoid any potential harm to the respondents because of the participation during the research process. Furthermore, the authors added that maintaining anonymity, confidentiality, and privacy of the respondents is important ethical consideration in research.

Following this, the researcher adhered to the ethical guidelines of academic research. The survey was conducted online which has required information about the survey like its objective, aim and objectives. It was mentioned that survey was enrolled solely for the academic purpose and the data provided by the respondents will be solely used for the purpose of this research. Moreover, anonymity and confidentiality of the respondents were maintained by masking their identity. No personal details like contact number, address was collected during this survey. Finally, the researcher-maintained honesty, transparency and integrity at all the stages of research and abided by the protocols of academic research.

The next section details the varied lists of risks related to outsourcing based on which the questionnaire was developed.

3.7 Risk Management

The risks related to outsourcing are considered the main shortage on the growth of business process for outsourcing, especially cross offshore outsourcing (Aron; Clemons; Reddi; 2005).

The study conducted by Cai et al., (2009) had classified the anticipated risk factors for outsourced services in a fishbone figure, the collected data was as following:

Table 1: Anticipated risk factors for outsourced services

(Cai et. al., 2009)

Management Risk	Disorder of Business process
	Lacking of effective producer services management
	Difference in Culture and unsatisfied communication
Relationship Risk	Lacking of effective incentive mechanism
	Insufficient Competition mechanism
Out- of control Risk	Service level agreement insufficient for execution
	Recurrent job examination shortage
	Insufficient vendor supervision
Strategic Risk	Outsourcing limit determination is indistinct
	Market maturity analysis insufficient
	Insufficient Key business identification
Transaction Risk	Inadequate of Contract clause
	Professional outsourcing team shortage

In the this research literature review for risk categories are categorized in terms of People , systems, process and external factors.

The following people and resources related risk events are grouped in the following details:

Table 2: Categories of people and resources related risk

Risk description	Literature reference
Inadequate supplier's incentive process	Cai et al., (2009) had classified the anticipated risk factors for outsourced services in a fishbone figure, where part of relationship risks it was found that Lacking of effective incentive mechanism is affecting the outsourced services in case agents are not being provided sufficient incentive.
Inadequate supplier's personnel qualifications, professionalism and technical knowledge	Cai et al., (2009) had classified the anticipated risk factors for outsourced services in a fishbone figure, where part of transaction risks it was found that Lacking of professional outsourcing team is affecting the outsourced services.

Non loyal supplier's personnel	Following Fisher et al, (2008), Performance on the client site creates complexities in supervisory, reporting, and other interpersonal relationships that may lead to problems including turnover, lack of loyalty, etc. Employees may develop loyalty to one or more client organizations instead of, commitment to their employer
Inadequate supplier personnel's performance	Following Fisher et al, (2008) Performance on the client site creates complexities in supervisory, reporting, and other interpersonal relationships that may lead to problems including turnover, lack of loyalty, etc.
High turnover of supplier's key personnel	Following Fisher et al, (2008) Performance on the client site creates complexities in supervisory, reporting, and other interpersonal relationships that may lead to problems including turnover, lack of loyalty, etc.
Low motivation of supplier's personnel	According to Fisher et al, (2008), challenges facing HR professionals in both the service provider and client organizations as they strive to attract, motivate, etc
Any history of fraud cases	Random variables impact operational losses due to fraud and corruption risks (McNeil, Frey &Embrechts 2015)
Unhappy working environment	Stonebraker et al, (2009) One of the issues faced the outsourcers is the stress at the work environment which leads to unhappy environment for the suppliers' employees.
Inadequate talent management and retention	According to Fisher et al. (2008) there are various HR challenges in outsourcing. As noted by the author often the core employees do not readily accept the outsource workers. Moreover, the job has to me designed to motivate the outsourced employees that creates further problem for the employees in the organization that adversely affect their job satisfaction. Such impacts as give rise to talent management and retention issues.
Inadequate technology management	Inadequate technological capability (Fan , et al., 2016)
Inadequate innovation management	As noted by Oshri and Kotlarsky (2011) in the context of outsourcing innovation management becomes one of the critical concern of the managers. The reason is the client firm is often unable to understand the nature of innovation desired by the vendor firm.
Inadequate technology training	This aspect is true in case of cross-border outsourcing and more specifically between the developing and developed nations. Often the inadequate technological expertise of the vendors affect the client firms product or services (Willcocks et al., 2011).

The following systems related risk events are grouped in the following details:

Table 3: Categories of systems related risk

Risk description	Literature reference
Inadequate control of shared resources serving multiple clients	As noted by Duncan (1998) knowledge is critical to any firm and the resources that a particular firm possesses marks its difference with the other firms. Therefore, there needs to be adequate control of the shared resources by the firms so that the vendor firm do not exploit expertise of the client firm.
Inadequate control management over engineering errors and omissions	Multiple strategies to be adopted to reduce design erors (Lopez R et al., 2010)
Inadequate equipment performance, capacity and high availability management	Operational Research and Disaster Operation Management assist in future directions (Morales, H , et al. 2015)
Inadequate executable service level agreements	Cai et al., (2009) had classified the anticipated risk factors for outsourced services in a fishbone figure, where part of out of control risks it was found that Lacking of executable service level agreement is affecting the outsourced services.
Immature business requirements' vision of organization	Have nondestructive method of implementation (Khosravi 2016)
Inadequate availability of power sources	application to power systems. (Zhu, Q. &Başar, T. 2011)
Inadequate availability of redundant power sources	application to power systems. (Zhu, Q. &Başar, T. 2011)
Immature performance estimation system	Cai et al., (2009) had classified the anticipated risk factors for outsourced services in a fishbone figure, where part of management risks it was found because lack of performance estimation system.
Inadequate supplier's systems/tools' maintenance, patching and performance management	Often in outsourcing there remains challenges with the suppliers' tools and systems and their inability to fulfill client patterns (Li et al., 2017). As noted by the authors this affect the client firm who often have to consider switching suppliers or developing new supplier channel.
Immature integration between supplier and Client counter systems	Technique to empower the integration of technology(Laue et al 2014).
Inadequate data reporting	Data available to be enough for reporting (Kim &Leem 2005)

Inadequate data accuracy and integrity	According to Xie (2017) data integrity and accuracy issues are common and relates to quality challenges in outsourcing. This also includes major concerns like data privacy and security in the context of database outsourcing (Li et al., 2017)
Inadequate feedback and feed forward	feedback systems are required (Chari, et al., 2012)
Inadequate inventory control	inventory policy is required. (Agrawal, et al., 2009)

The following process related risk events are grouped in the following details:

Table 4: Categories of process related risk

Risk description	**Literature reference**
Inadequate supplier's operational processes order	Cai et al., (2009) had classified the anticipated risk factors for outsourced services in a fishbone figure, where part of management risks it was found that Business process in disorder is affecting the outsourced services.
Inadequate supplier's service management	As noted by Malone C. O'D (2008) supplier management is one of the significant aspect in outsourcing and should be done through supplier segmentation. It is important to assess the level of service due in terms of quality
Inadequate performance review of recurring/routine jobs	Daily operational roles require review (Cui et al. 2016)
Inadequate supplier's supervisory processes	Cai et al., (2009)**,** had classified the anticipated risk factors for outsourced services in a fishbone figure, where part of out of control risks it was found that Vendor supervision is deficient is affecting the outsourced services.
Inadequate contracts creation, management and compliance monitoring	Cai et al., (2009)**,** had classified the anticipated risk factors for outsourced services in a fishbone figure, where part of transaction risks it was found that Contract clause is not perfect is affecting the outsourced services.
Failure of the supplier to transfer innovative technological capabilities	This aspect is similar to the challenges highlighted by Li et al., (2017). As noted by the authors often suppliers fail to meet the expectation of the clients due to poor technical capacities and limited technological knowledge.

Inadequate cost-benefit relationships	Aron et al.,(2005) have identified the risks affects client's expense.
Poor service delivery schedule, scope and/or execution	There are impact on the service from scheduling to completion (Patil, et al., 2014)
No or complicated physical accessibility to the services' facilities	Provide sustain access to the systems and it is facilities. (Zhu, Q. &Başar, T. 2011)
Inadequate supplier's processes governing the service	The process issues controlling the services has in impact on the outsourcing of the service (Hrbackova 2016)
Inadequate supplier's monitoring and control of contractual performance and regulations	As noted by Li et al. (2017) in the context of outsourcing, suppliers often do not follow the requirement of the buyer and fulfill the terms laid down in the contract. This sort of deviance is often noted in terms of quality, product specifications, work procedure, delivery promise and the suppliers often find loopholes in the contract to take advantage.
Inadequate supplier's business resumption, contingency testing and planning	Issues on planning and testing affect the service delivery (Kerzner 2017)
Inadequate testing programs measuring the supplier's interaction with the client and its customers	Risk impact due to measurements issues (Hartono et al. 2014)
Inadequate supplier's review and control of the client and its customers' complaints	Risk issues due to monitoring problems (Hartono et al. 2014)
Inadequacy of performance and operational review of supplier's personnel providing the service	Impact on performance of project human resources (Hartono et al. 2014)
Breaching supplier's service level agreement parameters	Impact on service when level of services is not acheived (Moeller 2007)
Poor supplier's supply chain	Supplier chain will be with high quality if criteria of selection are met and achieved (Boardman , et al., 2008)
Inadequate supplier's post-sales support	Minimize the risk to avoid after sales issues (Christopher, et al., 2004).
Inadequate communication/coordination between all service delivery stakeholders	Cai et al., (2009), had classified the anticipated risk factors for outsourced services in a fishbone figure, where part of management risks it was found that Culture difference and unsatisfactory communication is affecting the outsourced services.

Inadequate environmental vulnerability controls such as controls to handle in ordinary weather conditions, natural disasters or man-made threats, etc..	natural disasters and environmental conditions (Cutter, et al. 2008).
Delay of supplier's engineering deliverables (Equipment, software, ...)	Impact of delays of the deliverables from suppliers. Zhu, Q. &Başar, T. (2011)
Uncertainty of supplier's financials	Multiple indicators for financial uncertainty Stockhammer, E. &Grafl, L. (2010).
Inadequate data control	Low data control increases project problems Vanhoucke, M. (2012).

The following external factors related risk events are grouped in the following details:

Table 5: Categories of external factors related risk

Risk description	Literature reference
Inadequate suppliers' market competition	Cai et al., (2009)
Inadequate market maturity analysis	Cai et al., (2009)had classified the anticipated risk factors for outsourced services in a fishbone figure, where part of strategic risks it was found that Lacking of market maturity analysis is affecting the outsourced services.
Inadequate supplier's insurance coverage	Maintain the coverage forinsurance to improve the given service. (Leimberg, S., et al. (2002).)
Poor supplier's Infrastructure (Internet, telecom, roads, ports, and air infrastructures)	Good infrastructure will provide better service (Hiwase, Subhash 2016)
Credit fluctuation	Random variables impactlosses on a credit portfolio over fixed time intervals (McNeil, Frey &Embrechts 2015)
Political disturbances	Cook (2007) stated that volatile political atmosphere often pose risks to outsourcing. As noted by the author the regulatory and compliance issues impact the firms supply chain as well as delivery system.
Inflation rate increase	Impact of inflation rate increase on services (Pal & Mittal 2011)
Unclear market situation	Demand uncertainty in the market can drive outsourcing activities of the company (Bakhtiari and Breunig, 2014). As noted by the author, when the market is characterized by high level of uncertainty a firm must consider outsourcing to adjust capacity in the face of demand variation.
Uncertainty of currency rate	Holweg et al., (2011) currency fluctuation impacts sourcing. Changes in the political framework often leads to fluctuations in the rate of currency impacting on cost of the firms adopting to outsourcing or global sourcing.
Complexity of import duties	

Trade barriers	Niu et al., (2019) commented that various government regulations like tariffs and trade regulations also have significant impact on cross-border exchanges and outsourcing. For instance Bradley et al., (1998) stated international trade bills pose challenges for those firms who purchase products from the international market.
Losses due to foreign exchange fluctuation	Fluctuation of foreign exchange on services (Ihrig et al. 2010)
Interest rate risk	Impact of interest rate on service (Pal & Mittal 2011)
Inadequate compliance with echo-health obligations	Stonebraker et al, (2009) who worked for fragility and sustainability measurements including the echo health part of environmental impacts.

Chapter IV: Research Results Discussion

4.1 Introduction

This chapter outlines the results that were outlined by the survey instrument. Using Exploratory Factor Analysis, this research found the list of risk attributes which influence outsourcing of engineering services. First, this section outlines the demographic information of the research participants that were chosen purposively. Following which, this section detailing the reliability of the study instrument and then presents the results. The data manipulation was analyzed through SPSS. These results are then discussed within the theoretical background of the study.

4.2 Demographics

The research instrument was managed to a sample size (N) of 88 respondents in UAE. The sample size was chosen using non-probability sampling. 37% (n=33) of the participants have more than 10 years of work experience, 25% (n=22) of the respondents have between 6 to 10 years of work experience, 15.9% (n=14) of the respondents have between 3 to 5 years of work experience, and 21.6% (n=19) of the respondents have less than 3 years of work experience.

33% (n=29) of the respondents worked in the IT department, 21.6% (n=19) of the respondents worked in the Operations department, 20.5% (n=18) of the respondents worked in the Projects department, 4.5% (n=4) of the respondents worked in the Consulting and Security department each, 3.4% (n=3) of the respondents worked in the Corporate department, 2.3% (n=2) worked in the Legal department and PMO each, and 1.1% (n=1) worked in the Auto, Facilities, Information, Network, Presales, Professional, and Other departments each. Moreover, 26% (n=24) of the respondents' organization belonged to the IT industry, 21.6% (n=19) to the Engineering industry, 20.5% (n=18) belonged to the Telecommunications industry, 10.2% (n=9) worked in the industry of construction, 4.5% (n=4) worked in Public Sector, 2.3% (n=2) worked in the Energy and Financial industry each, and 1.1% (n=1) worked in the Auto, Education, Food and Beverages, Healthcare, Insurance, Manufacturing, Mining, Security, Services and Travel each.

Furthermore, 60.2% (n=53) of the respondents worked in organizations that had more than 300 employees, 30.7% (n=27) worked in organizations that had around 100 employees, and 9.1% (n=8) worked in organizations that had between 100 and 300 employees. In addition, 48.9% (n=43) of the respondents worked at the senior level, 26.1% (n=23) worked in the top management, 23.9% (n=21) worked at the middle level, and only 1.1% (n=1) worked at the entry level.

When asked to report the service that their respective organizations outsource to a third-party supplier, 30.7% (n=27) of the respondents reported IT services, 19.3% (n=17) reported Engineering and Consultancy services, 11.4% (n=10) reported Construction & Real Estate, Telecommunications, and multiple services each, 3.4% (n=3) reported Public services, 2.3% (n=2) returned financial services, and 1.1% (n=1) returned BSS/OSS, customer service, energy, hospital, marketing, physical, planning, and other services as outsourced services. In addition, 1.1% (n=1) reported none of their services being outsourced to third parties.

4.3 Analysis Reliability

To check if the measures had a good internal consistency, Cronbach's Alpha was carried out. The research instrument was categorized into four factors: people related, systems related, processes related, and externals factors that contribute to risk when outsourcing services. These factors were further categorized into sub-factors. For instance, people related factors were categorized into motivation, innovation and technology skills, and talent management. Systems related factors were characterised into operational risk, risk management, and out of control risk. Process related factors were grouped as transactional risk, operational risk, risk management, and project ad governance risks. Finally, external factors were categorized as relationship risk and strategic risk. The below table depicts that all measures had good internal consistency.

Table 6: Cronbach's Alpha test for internal consistency

Measures		Cronbach's Alpha
People	Motivation	0.869
	Technological and innovative skills	0.859
	Talent Management practices	0.840
Systems	System Operationalization	0.906
	Risk Management Practices	0.864
	Out of Control System Disruption	0.843
Process	Transactional disruptions	0.938
	Process Operationalization	0.886
	Process Risk Management practices	0.837
	Governances of processes	0.885
External	Third-party Relationship	0.945
	Macroeconomic factors	0.814

4.4 Analysis for Exploratory Factor

The questionnaire items were tested for the factorability. Other measure which is the Kaiser-Meyer-Olkin measure of sampling adequacy was carried out for each of the measures and it was 0.849 for people related factors, 0.881 for system related factors, 0.835 for process related factors, and 0.877 for external factors over the required value of 0.6. Similarly, other measure was used which is Bartlett's test of Sphericity was highly significant for people related factors ($\chi 2$ (66) = 617.1, $p<0.01$), for system relate factors ($\chi 2$ (91) = 915.5, $p<0.01$), for process related factors ($\chi 2$

(253) = 1903.2, p<0.01), and for external factors ($\chi 2$ (91) = 698.2, p<0.01). Following the above, factor analysis was considered to be a suitable analysis for the questionnaire items.

Principal component factor analysis was employed as the purpose was to get the underlying attributes which influenced the outsourcing of engineering services. For People-level factors, first three components from the Principal component analysis had an Eigenvalue greater than 1. More specifically, the motivation (component 1) had an eigenvalue of 5.85 and explained about 48.71% of the total variance, The Technological and innovative skills(component 2) had an eigenvalue of 1.62 and explained 13.52% of the variance and Talent Management practices (component 3) had an eigenvalue of 1.03 and explained 8.58% of the total variance. The below table outlines the factor loadings of each of the items on the components.

Table 7: Principal Component Analysis for People Factors

People-Level Factors	**Component**		
	1 (Motivation)	**2 (Technological and innovative skills)**	**3 (Talent Management practices)**
Q1.5. High turnover of supplier's key personnel	0.861		
Q1.6. Low motivation of supplier's personnel	0.828		
Q1.8. Unhappy working environment	0.712		
Q1.3. Non loyal supplier's personnel	0.683		
Q1.7. Any history of fraud cases	0.657		
Q1.4. Inadequate supplier personnel's performance	0.495		
Q1.11. Inadequate innovation management		0.857	

Q1.12. Inadequate technology training		0.85	
Q1.10. Inadequate technology management		0.835	
Q1.1. Inadequate supplier's incentive process			0.856
Q1.2. Inadequate supplier's personnel qualifications, professionalism and technical knowledge			0.803
Q1.9. Inadequate talent management and retention			0.653
Eigenvalue	5.85	1.62	1.03
Total Variance %	48.71	13.52	8.58

As it can be seen from the above table, high turnover rate, low employee motivation, unhappy work environment, history of fraud cases, and employee loyalty have a substantial loading as motivational factors that affect outsourcing of engineering services (>0.4). However, supplier personnel performance has moderate factor loading at just above 0.4. Furthermore, inadequate Technological and innovative skills as well as inadequate technology training also have substantial factor loadings (>0.4) as Technological and innovative skills factors influencing outsourcing of engineering services. Finally, supplier's incentive process, personnel qualifications, professionalism, and technical knowledge, as well as Talent Management practices and retention have high factor loadings asTalent Management practices factors impacting outsourcing of engineering services.

In addition, The component analysis with Varimax rotation was carried out for System level factors. For System-related factors, the first three components had eigenvalues greater than or equal to 1. In other words, TheSystem Operationalization (Component 1) had an eigenvalue of 7.98 and explained a total variance of 56.99%, Risk Management Practices (Component 2) had an

eigenvalue of 1.026 which explained a variance of 7.33%, while Out of Control System Disruption (Component 3) had an eigenvalue of 1 and explained a total of 7.14% of the variance.

The table below provides the factor loadings of each of the factors that comprised the three components.

Table 8: Principal Component Analysis for System Factors

	Component		
	1 (System Operationalization)	**2 (Risk Management Practices)**	**3 (Out of Control System Disruption)**
Q2.11. inadequate data reporting	0.838		
Q2.12. inadequate data accuracy and integrity	0.822		
Q2.8. immature performance estimation system	0.713		
Q2.13. inadequate feedback and feed forward	0.667		
Q2.10. immature integration between supplier and client counter systems	0.612		
Q2.1. inadequate control of shared resources serving multiple clients	0.459		
Q2.7. inadequate availability of redundant power sources		0.774	
Q2.6. inadequate availability of power sources		0.768	

Q2.5. Immature business requirements' vision of organization		0.695	
Q2.14. inadequate inventory control		0.622	
Q2.2. inadequate control management over engineering errors and omissions			0.775
Q2.9. inadequate supplier's systems/tools' maintenance, patching and performance management			0.758
Q2.3. inadequate equipment performance, capacity and high availability management			0.664
Q2.4. inadequate executable service level agreements			0.602
Eigenvalue	7.98	1.026	1.00
Total Variance %	56.99	7.33	7.14

From above table, all of the individual attributes had substantial factor loadings (>0.4) on System Operationalization factors, Risk Management Practices factors, and Out of Control System Disruption factors. However, control of shared resources serving multiple clients had a marginal factor loading of 0.46.

Similarly, The component analysis with Varimax rotation was carried out for Process factors and it was found that Transactional disruptions(Component 1) had an eigenvalue of 11.862 and explained 51.6% of the variance, Process Operationalization (Component 2) had an eigenvalue of 1.99 and explained 8.64% of the variance,Process Risk Management practices (Component 3) had an eigenvalue of 1.65 and explained 7.18% of the variance, and Governances of processes

(Component 4) had an eigenvalue of 1.32 and explained 5.74% of the variance. The below table outlines the factor loadings on each of the components.

Table 9: Principal Component Analysis for Process Factors

	Component			
	1 (Transactional disruptions)	**2 (Process Operationalization)**	**3 (Process Risk Management practices)**	**4 (Governances of processes)**
Q3.5. inadequate contracts creation, management and compliance monitoring	0.819			
Q3.2. inadequate supplier's service management	0.807			
Q3.4. inadequate supplier's supervisory processes	0.781			
Q3.13. inadequate testing programs for the supplier's interaction with client and its customers	0.754			
Q3.3. inadequate performance review of recurring/routine jobs	0.73			
Q3.15. inadequacy of performance and operational	0.704			

review for supplier's personnel providing the service				
Q3.14. inadequate supplier's review and control of client and its customers' complaints	0.614			
Q3.16. breaching supplier's service level agreement parameters	0.605			
Q3.23. inadequate data control	0.592			
Q3.19. inadequate communication/coordination between all service delivery stakeholders	0.512			
Q3.11. inadequate supplier's monitoring and control of contractual performance and regulations		0.81		
Q3.20. Inadequate environmental vulnerability controls such as controls to handle in ordinary weather events, natural disasters or man-made threats, etc…		0.781		
Q3.12. inadequate supplier's business resumption contingency testing and planning		0.742		

Q3.1. inadequate supplier's operational processes order		0.715		
Q3.7. inadequate cost-benefit relationship				
Q3.22. uncertainty of supplier's financials			0.824	
Q3.6. failure of the supplier to transfer innovative technological capabilities			0.738	
Q3.21. Delay of supplier's engineering deliverables (Equipment, software, …)			0.709	
Q3.18. inadequate supplier's post-sales support			0.464	
Q3.9. no or complicated physical accessibility to the services facilities				0.838
Q3.17. poor supplier's supply chain				0.766
Q3.10. inadequate supplier's processes governing the service				0.656
Q3.8. poor service delivery schedule, scope and/or execution				0.584
Eigenvalue	11.862	1.99	1.65	1.32
Total Variance %	51.6%	8.64%	7.18%	5.74%

From the above table, all of the individual attributes had substantial factor loadings as Transactional disruptions factors, Process Operationalization factors, Process Risk Management practices factors and Governances of processes factors.

In addition, similar analysis was carried out for External factors for which Third-party Relationship (component 1) had an eigenvalue of 7.78 and explained 55.61% of the variance and Macroeconomic factors (Component 2) had an eigenvalue of 1.77 and explained 12.65% of the variance. The below table represents the factor loadings for each of the factors.

Table 10: Principal Component Analysis for External Factors

	Component	
	1 (Third-party Relationship)	**2 (Macroeconomic factors)**
Q4.12. losses due to foreign exchange fluctuation	0.894	
Q4.10. complexity of import duties	0.888	
Q4.11. trade barriers	0.85	
Q4.9. uncertainty of currency rate	0.813	
Q4.13. interest rate risk	0.798	
Q4.7. Inflation rate increase	0.733	
Q4.8. unclear market situation	0.706	
Q4.14. inadequate compliance with echo-health obligations	0.643	
Q4.6. political disturbances	0.606	

Q4.2. inadequate market maturity analysis		0.847
Q4.3. inadequate supplier's insurance coverage		0.832
Q4.1. inadequate suppliers' market competition		0.729
Q4.5. credit fluctuation		0.628
Q4.4. poor supplier's Infrastructure (Internet, telecom, road, port, and air infrastructures)		0.616
Eigenvalue	7.78	1.77
Total Variance %	55.61	12.65

As is evident from the above table, all of the individual factors had a substantial factor loading of greater than 0.4 as Third-party Relationship factors and Macroeconomic factors.

The above analysis of the principal component analysis with Varimax rotation has outlined that the four stipulated factors of People, System, Process, and External do, in fact, have an influence on outsourcing of engineering services.

4.5 Analysis of Confirmatory Factor

In order to develop the fragility framework using Amos, Confirmatory Factor Analysis (CFA) was carried out. Details such as goodness of fit and other outputs pertaining to the CFA are outlined in Appendix 2.

The below figure shows the configuration of factors depending on the results of the exploratory factor analysis carried out earlier.

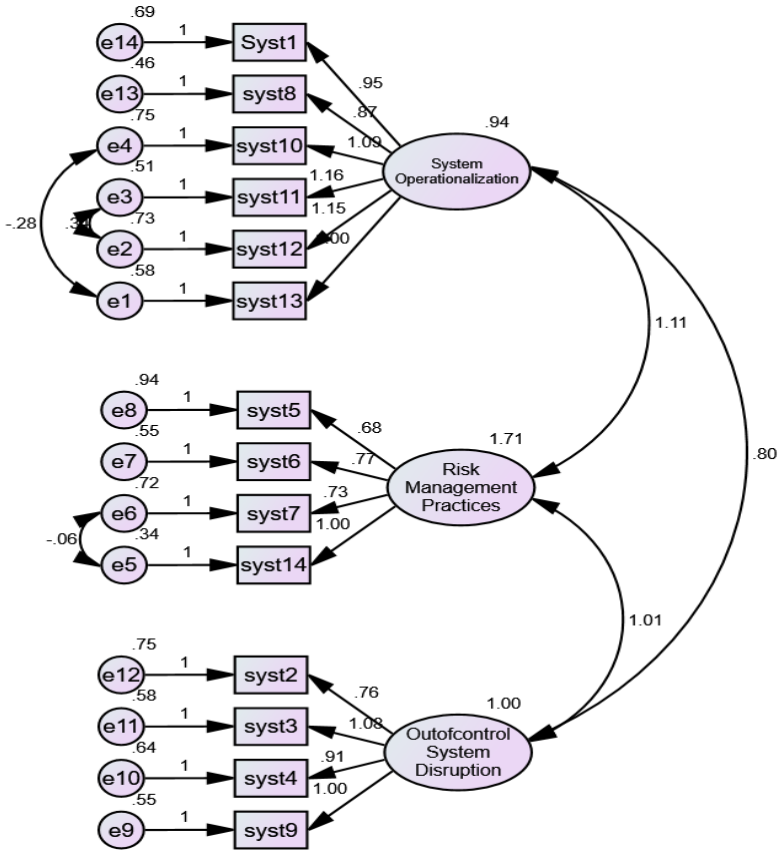

Figure 2 Structural model of SEM analysis for Systems Factors

The Root mean square error of approximation (RMSEA) was found to be 0.125 which is greater than 0.05 which indicates a poor fit for this model. In addition, the Goodness of Fit (GFI) and Adjusted Goodness of Fit Index (AGFI) are 0.810 and 0.719 which are below 0.9 which also represent a less than optimal fit. However the Chi-square minimum is significant at 167.002. The above figure depicts the regression weights.

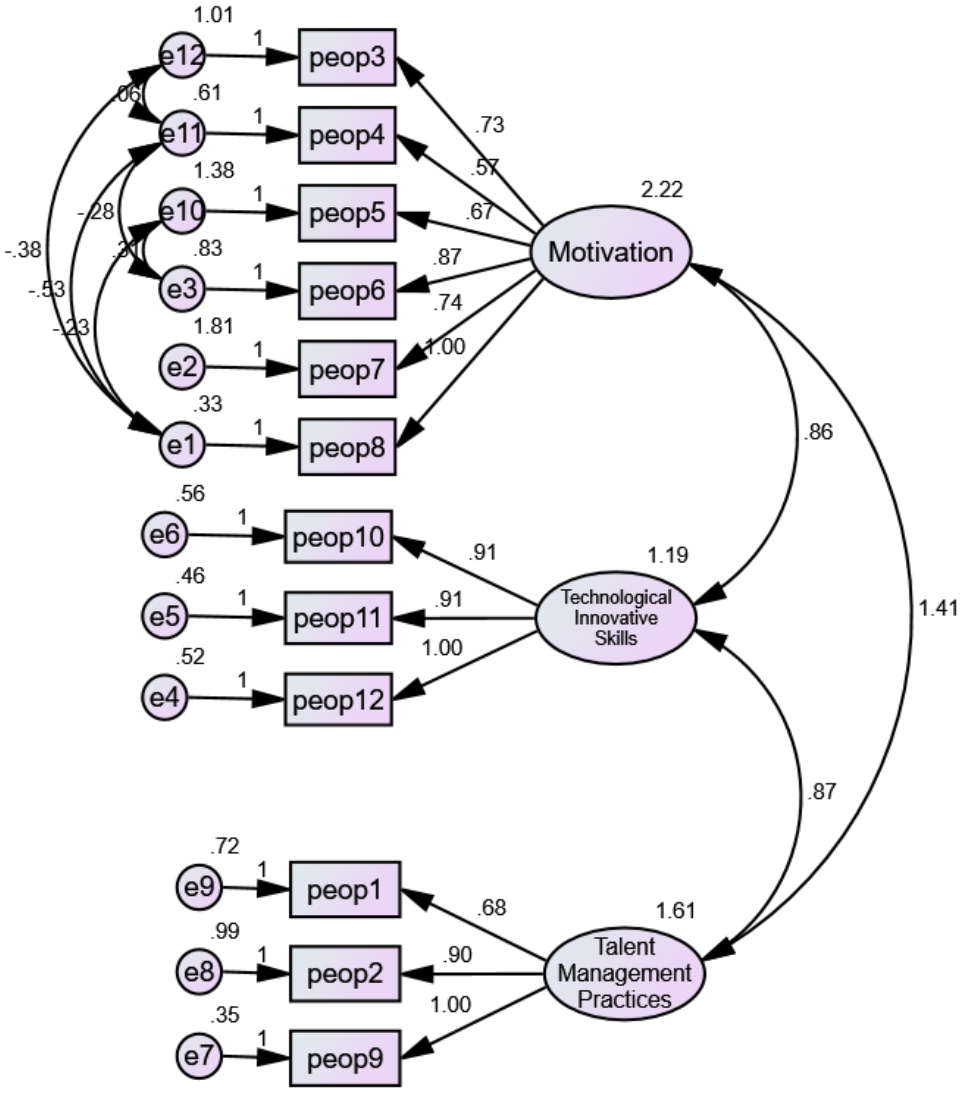

Figure 3, Structural model of SEM analysis for People Factors

The Root mean square error of approximation (RMSEA) was found to be 0.087 which is greater than 0.05 which indicates a poor fit for this model. In addition, the Goodness of Fit (GFI) and Adjusted Goodness of Fit Index (AGFI) are 0.886 and 0.802 which are below 0.9, but close to it which could represent a good fit. In addition, the Chi-square minimum is significant at 74.830. The above figure depicts the regression weights.

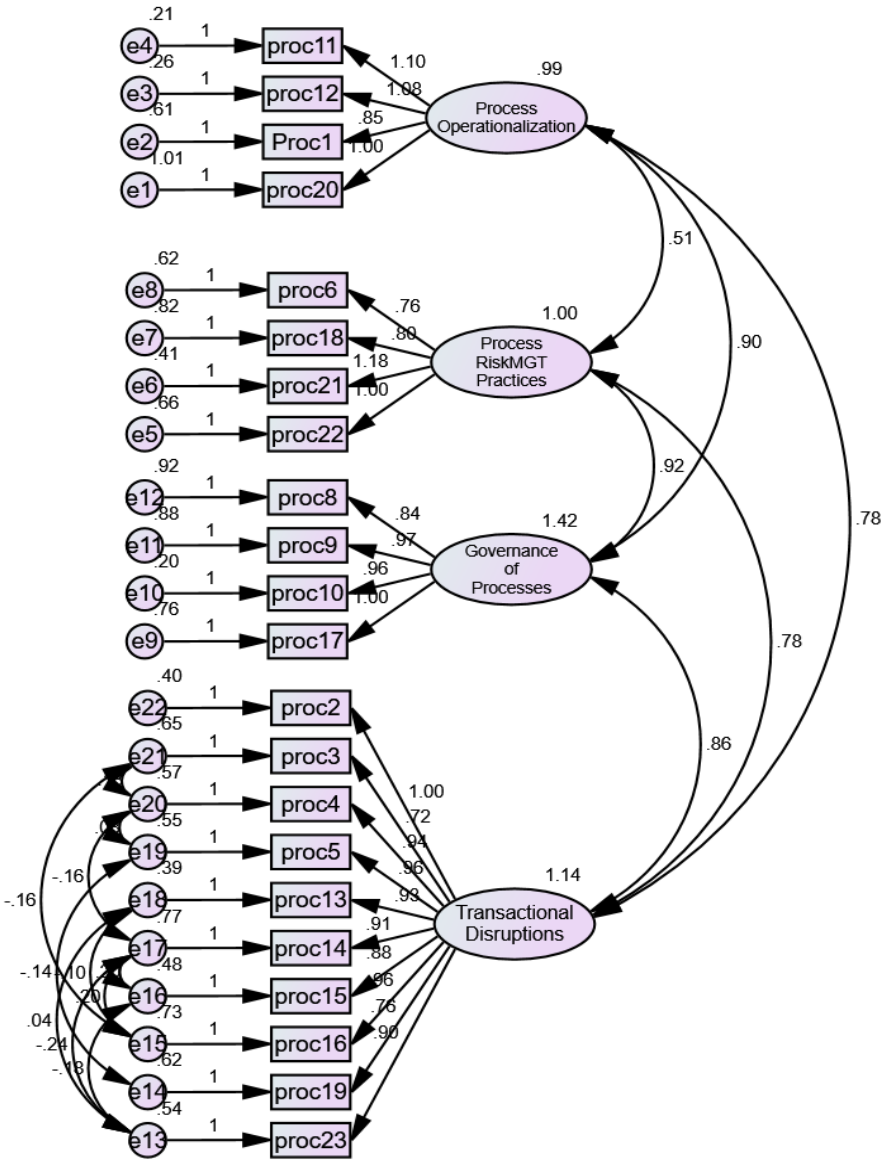

Figure 4: Structural model of SEM analysis for Process Factors

The Root mean square error of approximation (RMSEA) was found to be 0.156 which is greater than 0.05 which indicates a poor fit for this model. In addition, the GFI and AGFI are 0.674 and 0.570 which are below 0.9, but close to it which could represent a good fit. In addition, the Chi-square minimum is significant at 597.809. The above figure depicts the regression weights.

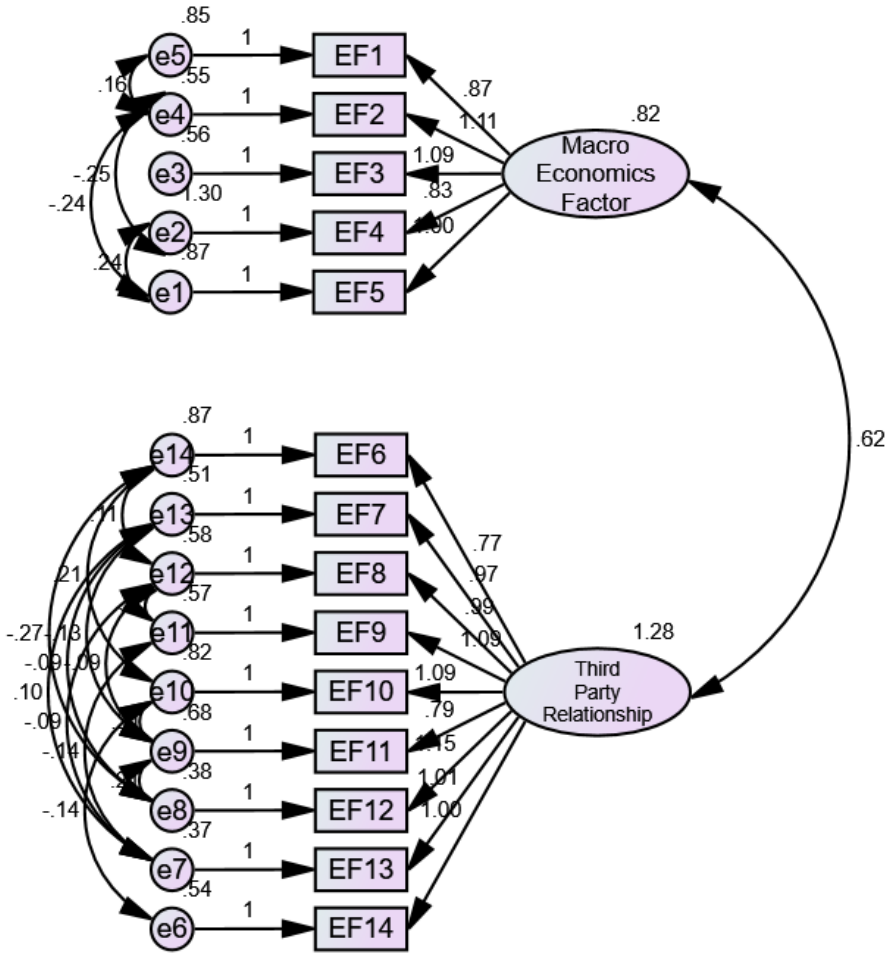

Figure 5: Structural model of SEM analysis for External Factors

RMSEA was found to be 0.126 which is greater than 0.05 which indicates a poor fit for this model. In addition, GFI and AGFI are 0.830 and 0.698 which are below 0.9, which represents a poor fit. However, the Chi-square minimum is significant at 140.118. The above figure depicts the regression weights. The following section will position the research against the theoretical framework that has been established.

4.6 Discussion

A survey was carried out with the questionnaire that was developed to gain insights into the factors which were influencing the outsourcing. For this a sample of 88 participants who are industry experts were used. KMO and Bartlett's Test of Sphericity was carried out and it was found that the sampling is adequate despite the short sample. Following this, Principal Component Analysis was carried out (Varimax rotation with Kaiser Normalization) to analyse if the proposed factors load together. The results have been outlined in the preceding sections and similar loading factors have been outlined in the tables presented. In addition, following this, confirmatory factor analysis or structured equation modeling was carried out for each of the factors and their sub factors. Primarily the model did not represent a good fit expect in the case of People level factors.

One of the core rationales behind this study is that while the demand for outsourcing is increasing (Hiwase, 2016), it is important to consider the factors that influence the outsourcing business model and brings challenges so that the organization is equipped to deal with them. For instance, Zirpoli and Becker (2011) have noted that when firms have outsourced complex product designs to design firms, they have faced several challenges. However, in the construction industry, since heavy machinery is involved and a large worker force is required which varies based on the project, creating temporary supply chain and logistics is crucial in order to cut long-terms costs (Vrijhoef and Koskela, 2000). However, personnel training issues are reported especially if the workforce is from a different cultural region to the host country. For instance, Sattineni (2008) has reported that skills shortage in terms of lower technical capabilities is seen when companies in the USA outsource their needs to companies in India due to the technical and cultural differences. The results of this study also provided support for people-level factors of motivation, innovation and technology skills and talent management. Furthermore, Gonzalez, Reyes et al. (2008) have also provided some people level potential risk factors to outsourcing to be the staff qualification of the supplier and the lack of inability to adapt to the technologies. This is in line with the results of this study as some of the factors identified having an influence on the outsourcing are related to training, inadequate skills, and limited technological knowledge. These factors were also echoed by Cai, Sanfa et al., (2009).

In terms of performance, people level factors have been found to have an influence by having limited motivation, loyalty, and having a high turnover rate (Fisher, Michael et al., 2008). This study found support for motivation level factors such as high turnover, low motivation, unsafe working environment, and prior history of fraud cases. Therefore, people related risk factors have been found to be influencing outsourcing of engineering services.

Moving onto System related risk factors, System Operationalization Risk, Risk Management Practices and Out of Control System Disruption risk were identified in this study as influencing outsourcing of engineering services. As outlined by Cai, Sanfa et al. (2009), inadequate executable service level agreements and other system mismatches between the host and the service provider firm are potential causes of outsourcing failure. This study provides empirical support for the above identified factors. From these three factors, System Operationalization risk factors had the greatest influence with 56.99% of variance followed by Risk Management Practices factors with 7.33% of the variance, and finally Out of Control System Disruption risk with 7.14% of the variance.

Furthermore, Process level factors are also crucial for understanding the risk factors influencing outsourcing of engineering services. This study used the following four sub-factors which make up the process level factors, Transactional disruptions factors, Process Operationalization factors, Process Risk Management practices factors and Governances of processes factors. Cullen and Willcock (2005) have outlined several process related risk factors such as breach of contract terms and conditions, resulting in breach, failure to respond quickly to any change that may be taking place, lack of appropriate framework for addressing confidentiality issues, and lack of a solid legal framework. In addition, Cai, Sanfa et al. (2009) had outlined that the lack of appropriate supplier's supervisory processes, inadequate contract management and compliance management, as well as insufficient rate of communication between the service delivery stakeholders as some of the process-level factors which induce the outsourcing of engineering services. Furthermore, Aron, Clemons and Reddi (2005) have noted that insufficient cost-benefit relationships between the supplier and the service provider are also some factors

which induce the outsourcing of engineering services. This research has found empirical evidence in support of the above-mentioned factors. In comparison to the four categories of Process level factors, Transactional risk factors explained more than 51% of the variance, followed by operational risk factors, risk management, and project & governance risks.

Finally, for External level factors, this study identified two factors: Relationship risk and Strategic risk. The results are in line with the study by Aron, Clemons, and Reddi (2005) who identified strategic factors as being a significant influencer of outsourcing of engineering services. The authors have identified strategic factors as being the advantage taken by the vendors of taking the full payment and providing a low-quality service. Furthermore, the vendor or service provider can replace the promised high caliber staff with poorly trained personnel. Finally, the service provider can invest in sub-standard software and equipment hence saving cost for themselves. Moreover, Cai, Sanfa et al. (2009) outlined relationship risk factors such as lack of effective communication, no mechanism for incentives, and an inadequate mechanism for competition. The study's results depict that there is a higher influence of relationship risk on the outsourcing of engineering services in comparison to the strategic risk with a variance of 55.6%.

In line with the above discussion, it can be stated if firms can develop a strategy for outsourcing that addressed the limitation and challenges mentioned above, the firms can reap the many benefits that come with outsourcing. Firms can save on time, get an enhanced quality of product, save cost, and gain performance enhancements that can provide the firms with the flexibility and capability to get better projects. Furthermore, outsourcing also allows the firms to enhance their investment and save cost in their non-core activities.

This study used the principal component analysis with Varimax rotation on some of the factors that were identified from the literature as affecting the outsourcing of engineering services. Using exploratory analysis, this study was able to assign factor loadings on each of the potential factors and identify the most fundamental factor. Thus, each of the individual factors were analysed and discussed above in conformance with the theoretical underpinnings of this study. Therefore, this study has successfully developed an understanding of which factors have a potential influence on

outsourcing of engineering services. If the firms account for these challenges, then firms will be better able to obtain many benefits for outsourcing the services to external service providers. Finally, this is the first study of its kind to develop a fragility framework comprising of factors which impact the outsourcing of engineering services. Since these factors are generalised, they are applicable across all industries and sectors. Having said that, the following section concludes this research, provides recommendations to practitioners and to academic researchers as well as outlines the limitations of this research.

Chapter V: Conclusions and Recommendations

5.1 Conclusion

In the field of engineering, outsourcing is typically driven by the need to acquire capacity, specialist knowledge, improve efficiency, and quality of service. Moreover, cost reduction is also one of the primary considerations for firms while making outsourcing decisions. This is specifically true in case of the outsourcing relationships between the developed as well as developing nations. Developing nations are outsourcing a number of services to the low-cost service providers like India that help them to save money. Such decisions also relate to skill shortage and improving business flexibility.

The present study revealed that there are multiple ways of implementing outsourcing in business and different organizations have different needs or factors that drive their decision related to outsourcing. Keeping this in mind, the research aimed to analyze the factors that induce the implementation of outsourcing and to identify the characteristics to build a fragility framework for the outsourcing of engineering services. The analyses were carried out based on process, people, systems, and external factors and attempted to get the risk attributes which influence outsourcing fragility and develop the outsourcing fragility framework for engineering services enterprises. This framework can be utilized by the company decision-makers to manage fragility as well as deal with the various risk events, both pre and post outsourcing decisions.

The research was carried out in the UAE with multiple organizations from the chosen industries. A questionnaire was designed and implemented based on the abovementioned four principal factors that contained some sub-components. For instance, for analyzing the people-related factors the components were motivation, innovation, and technology skills and talent management. Each of these components was then measured on the basis of a number of items or questions. Since the questionnaire was developed for the sake of conducting this research, testing its validity and reliability was important. Cronbach's Alpha was carried out and it depicted strong

internal consistency for all the items measured by the research instrument. This strengthened the researcher's confidence in the outcome of the research.

The survey was carried out with 88 respondents working in the IT industry, Engineering industry, Telecommunications industry, Construction industry, Public Sector, Energy and Financial industry, Auto, Education, Food and Beverages, Healthcare, Insurance, Manufacturing, Mining, Security, Services and Travel Industry. Kaiser-Meyer-Olkin was carried out for each of the measures and revealed the adequacy of the sample. Similarly, Bartlett's test of Sphericity was found to be highly significant for people related factors, system-related factors, process-related factors as well as external factors. Finally, Principal component factor analysis was employed in order to identify the primary underlying factors that influenced the outsourcing of engineering services in the UAE.

People related factors emerged as one of the significant factors in terms of engineering outsourcing. High turnover rate, low employee motivation, unhappy work environment, history of fraud cases, and employee loyalty have a substantial loading as motivational factors that substantially impact on engineering service outsourcing. However, innovation and technology skills and talent management were also important dimensions to consider in terms of people-related factors. Following Kakabadse and Kakabadse (2002), it can also be stated that since knowledge of best practice and improved quality are the primary considerations in the EFM sector, it is also important to analyze the technological skills of the supplier which is the outsourced firm in order to reap the actual benefit out of it. For instance, as noted by Patwardhan (2004), the US engineering firms are outsourcing major design works to India due to skill shortage and are undergoing restructuration of their business model. However, such attempts are not fruitful because there are quality issues given the lack of technical capacities of the developing nations (Zirpoli and Becker, 2011). Thus, from this, it can be stated that prior analysis of the technological capacity of the outsourced service provider is one of the significant aspects. Lack of attention to such factors may lead to faulty manufacturing and impact the firms' image and reputation in the market. In such cases, training should be conducted with offshore suppliers or service providers to

help them understand the technical requirements. This approach can help address discrepancies in product manufacturing and deal with the risks.

Since the construction industry involves dealing with heavy machinery, manpower requirement is more compared to any other industries. Thus, it can be stated that it is important to consider the employee or people-related factors that impact the firms' outsourcing decisions. This also has received support from the existing literature that found that a shortage of skills often in countries like the USA often encourages firms to outsource their service (Sattineni, 2008). In this regard, it is crucial noting that there exist a number of risk factors like technical inefficiency and cultural differences. As noted by this present study, staff training, skill inadequacy, and limited technical expertise are the prime challenges in engineering outsourcing. These factors are also identified by Cai, Sanfa et al., (2009). Thus, it can be stated that people related factors are one of the important considerations for the firms before implementing their outsourcing decision.

In terms of System-related risk factors, Operational Risk, Risk Management and Out of Control risk were identified in this study as having a significant induce and impact on the outsourcing of engineering services. This finding was also significant as the existing literature revealed that inadequate executable service level agreements and other forms of system incongruities between the host and the supplier which is service provider firm can lead to failures of the outsourcing strategy of the firm. The study provides evidential support to this as it was found that operational risk factors had the greatest influence on the UAE firms' service outsourcing implementation followed by risk management factors, and out of control risk factors.

The various process-related risk factors were also identified by the study. As revealed by this study the Transactional disruptions risks have the maximum amount of impact, followed by Process Operationalization risk factors, Process Risk Management practices risk factors, and Governances of processes risks. Following the argument of Cullen and Willcock (2005), Cai, Sanfa et al. (2009) it can be stated that process-related risk can, therefore, include breach of contract terms, confidentiality issue, inadequate legal framework, lack of supervisory processes of

the supplier, compliance-related matters, and inadequate contract management. Such issues can potentially affect the relationship between the host firm as well as the parent firm involved in outsourcing decisions.

Apart from all the above-mentioned risk factors, external level factors like Third-party Relationship factors and Macroeconomic factors can pose serious challenges in engineering outsourcing decisions. As revealed by the study Third-party Relationship risk has a greater influence on the engineering outsourcing decisions compared to Macroeconomic risk factors. This can be compared to the study conducted by Aron, Clemons, and Reddi (2005) who found the greater influence of Macroeconomic risk factors on outsourcing services. As noted by the authors, such Macroeconomic risks are often found with the vendors who provide low-quality service after receiving the entire payment from the host company.

Following the research results, it can be stated that while outsourcing is a strategic decision, it has to be implemented after careful consideration of people, process, system as well as external factors. Disregarding such factors may increase the chances of business risk that can potentially affect the firms' profitability and growth. The present study significantly contributes towards developing an understanding and realization of the factors and attributes that can affect the engineering process outsourcing. In the area of research, the research is the first of its kind that attempted to develop a fragility framework based on the principal factor analysis for engineering services outsourcing. By adopting an exploratory research design the research was capable to highlight the relative importance of the sub-factors or the components that can potentially impact the process of outsourcing. The analyses carried out in this research is also corroborated with the existing studies and literature that provides similar evidence or otherwise. By considering these factors the firms can develop outsourcing strategy and successfully deal with the business risks and challenges and enhance their capabilities, knowledge and derive useful benefits in terms of cost-saving and greater flexibility.

5.2 Research and Study Findings

Although the present study has significantly contributed both practically as well as theoretically in this domain of research it has certain areas that can be improved.

- Working with small sample size of the study. Although the Kaiser-Meyer-Olkin measure indicates and shows the adequacy of the sample size to analyze the research aim and objectives, it may not be applicable for all the industries. Moreover, the study is induced to the UAE where the results may valid for the other countries or other countries may have different factors due to the culture, geographical, rules , etc.
- The study primarily focused on identifying the factors that may affect the engineering outsourcing process and highlighted on the factor loading. However, it does not clearly analyze what impact each of the factors has on the engineering outsourcing and whether the impact is positive or negative.

5.3 Recommendations

- The study, therefore, provided a detailed insight into the various factors that can be analyzed by the company decision-makers prior to their decision making related to outsourcing. With a detailed quantitative analysis, it presented the factor loading and highlighted the importance of the varied factors that can be analyzed to adopt an outsourcing strategy. However, it is recommended to note that each organization has a different political, cultural, and social context that shapes its business environment. A factor that is found to be relevant for one may not be so for the other. Thus, above all what is required is careful contextual analyses of these factors that impact the firms' business and outsourcing activities.
- While the fragility framework provides a tool for analysis, it is also important to develop corporate strategies to deal with the varied business risks related to outsourcing activities. Future studies can take all the principal factors discussed in this research and develop strategies for each to mitigate risks. These strategies can be implemented by the organizations in relation to their outsourcing strategy that will enhance their capability and improve business outcomes by saving costs and improving efficiencies.
- Future research can be conducted to focus on specific industries instead of multi industries to validate more coherent data and can explore the factors that influence engineering outsourcing across the border. Such studies can address the impact of cultural differences as well as the level of technological adequacy in outsourcing. These

researches can also be carried out in the EFM sector and analyze whether firms are able to raise their quality standards as well as improve cost.

- It is also important to see how the outsourcing process between the developing and developed countries impact the complex engineering product design. Such researches can also analyze the technological and skill adequacy of the outsourced firms that relate to the people related factors identified in this study.
- Another significant aspect in the area of research can entail a comprehensive analysis of all the people, process, system, as well as external factors and analyze the nature of its impact on the engineering process outsourcing. For instance, these studies can analyze how employee motivation can influence engineering outsourcing. In other words, it would be good to understand whether these sub-factors positively or negatively impact the outsourcing process. These researches can also analyze the impact of outsourcing on the company HR policy. Currently for the environment of business, it is important to knowand understand the firm's staffing strategy with the increase of outsourcing activities. Future studies can address these dimensions.
- In terms of engineering outsourcing across the border, future studies can also analyze the various transaction-related or system-related risks. In these lines, it can also be explored whether the performance of the organization is enhanced with the assistance from the outsourced service provider. These can be analyzed in terms of quality, cost, and filling up the skill requirement. However, cultural and linguistic differences can also be addressed that may have an influence on the relationship development between the host firm and the supplier which is the outsourced service provider. This can also be analyzed in terms of relationship risks as identified by this study.

- Future researchers can work to identify the relation between fragility and resilience and its coherence with risks for supply chain and outsourcing.

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Appendices

Appendix 1: Survey Questionnaire

Survey conducted by multiple participants in different industries in UAE and other countries.

Introduction

Dear Madame or Sir,

I am a student in British University in Dubai where I am preparing my MSC in Engineering Management. I would highly appreciate accepting this invitation to contribute to a survey I am conducting as part of my dissertation. The survey addresses the risk contribution on organization strategies and plans when these organizations outsource its services to third-party service providers.

The objective of this survey is to understand how risk management may or may not affect the outsourcing of services to a third-party entity. Concerted participants' inputs will be collectively analysed rather than on an individual basis to eventually provide the overall percentages. All Participants and their inputs are masked and anonymous to protect participants' identities and their input.

Should you have any inquiries, please do not hesitate to reach out to me at the below coordinates.

Kindly feel free to send the survey link to any relevant team members who you feel may productively contribute to this survey.

Appreciating your valuable time and busy schedules.

Thamer Ababneh
Cell: +971-50-1405659

email: 2016148108@student.buid.ac.ae

Section I: Contribution to Risk when Outsourcing Service

The following parameters are used to weigh the relevant contribution to Risk when outsourcing services and decisions to suppliers.

1.To what extend you agree that the following people related risk events stated below will contribute to the outsourced services of your organization managed by third party

Human Resources/Personnel's Related Risk	Agreement Level						
Parameter	Strongly Disagree	Disagree	Somewhat Disagree	Neither Agree nor Disagree	Somewhat Agree	Agree	Strongly Agree
1. Inadequate supplier's incentiv							

e process							
2. Inadequate supplier's personnel qualifications, professionalism and technical knowledge							
3. Non loyal supplier's personnel							
4. Inadequate supplier personnel's							

performance							
5. High turnover of supplier's key personnel							
6. Low motivation of supplier's personnel							
7. Any history of fraud cases							
8. Unhappy working environment							
9. Inadequate							

talent management and retention							
10. Inadequate technology management							
11. Inadequate innovation management							
12. Inadequate technology training							

The following parameters are used to weigh the relevant contribution to Risk when outsourcing services and decisions to suppliers.

2. To what extend you agree that the following Systems' related risk events stated below will contribute to the outsourced services of your organization managed by third party

Systems' Related Risk	Agreement Level						
Parameter	Strongly Disagree	Disagree	Somewhat Disagree	Neither Agree nor Disagree	Somewhat Agree	Agree	Strongly Agree
Inadequate control of shared resources serving							

multiple clients							
Inadequate control management over engineering errors and omissions							
Inadequate equipment performance, capacity and high availability management							
Inadequate executable service level agreements							
Immature business							

requirements' vision of organization							
Inadequate availability of power sources							
Inadequate availability of redundant power sources							
Immature performance estimation system							
Inadequate supplier's systems/tools' maintenance,							

patching and performance management							
Immature integration between supplier and Client counter systems							
Inadequate data reporting							
Inadequate data accuracy and integrity							
Inadequate feedback and feed forward							
Inadequate							

inventory control							

The following parameters are used to weigh the relevant contribution to Risk when outsourcing services and decisions to suppliers.

3. To what extend you agree that the following Processes' related risk events stated below will contribute to the outsourced services of your organization managed by third party

Processes' Related Risk	Agreement Level						
Parameter	Strongly Disagree	Disagree	Somewhat Disagree	Neither Agree nor Disagree	Somewhat Agree	Agree	Strongly Agree
Inadequate supplier's operational processes order							

Inadequate supplier's service management							
Inadequate performance review of recurring/routine jobs							
Inadequate supplier's supervisory processes							
Inadequate contracts creation, management and compliance monitoring							
Failure of the supplier to transfer innovative technological capabilities							
Inadequate cost-benefit relationships							
Poor service delivery schedule, scope and/or execution							

No or complicated physical accessibility to the services' facilities							
Inadequate supplier's processes governing the service							
Inadequate supplier's monitoring and control of contractual performance and regulations							
Inadequate supplier's business resumption, contingency testing and planning							
Inadequate testing programs measuring the supplier's interaction with the client and its customers							

Inadequate supplier's review and control of the client and its customers' complaints							
Inadequacy of performance and operational review of supplier's personnel providing the service							
Breaching supplier's service level agreement parameters							
Poor supplier's supply chain							
Inadequate supplier's post-sales support							
Inadequate communication/coordination between all service delivery stakeholders							

Inadequate environmental vulnerability controls such as controls to handle in ordinary weather conditions, natural disasters or man-made threats, etc..							
Delay of supplier's engineering deliverables (Equipment, software, ...)							
Uncertainty of supplier's financials							
Inadequate data control							

The following parameters are used to weigh the relevant contribution to Risk when outsourcing services and decisions to suppliers.

4. To what extend you agree that the following External Factors' related risk events stated below will contribute to the outsourced services of your organization managed by third party

External Factors' Related Risk	Agreement Level						
Parameter	Strongly Disagree	Disagree	Somewhat Disagree	Neither Agree nor Disagree	Somewhat Agree	Agree	Strongly Agree
Inadequate suppliers' market competition							
Inadequate market maturity analysis							

Inadequate supplier's insurance coverage							
Poor supplier's Infrastructure (Internet, telecom, roads, ports, and air infrastructures)							
Credit fluctuation							
Political disturbances							
Inflation rate increase							
Unclear market situation							
Uncertainty of							

currency rate							
Complexity of import duties							
Trade barriers							
Losses due to foreign exchange fluctuation							
Interest rate risk							
Inadequate compliance with echo-health obligations							

Section II: Demographics

This section addresses building the participants' demographics to link the final survey results to a clearly defined specimen of participants.

5. What is the location of your organization?
    - o UAE
    - o Other (please specify) ……

6. Please indicate how many years have you been working for your current organization?
    - o Less than 3 years
    - o 3-5 years
    - o 6-10 years
    - o More than 10 years

7. Please indicate your position's level in the organization?
    - o Entry Level
    - o Middle Level
    - o Senior Level
    - o Top Management

8. Please indicate what is your job function in the organization?
    - o Legal
    - o IT
    - o Finance
    - o Security
    - o Operations
    - o Other (please specify) ……

9. How many employees does your organization currently employ?
    - o 100 employees or less
    - o 101-300 employees
    - o More than 300 employees

10. To what vertical/industry does your organization belong?
    - o Engineering & Consultancy o Construction & Real Estate o Energy
    - o Insurance o Financial o Hospitality
    - o Public services o Telecommunication o Manufacturing

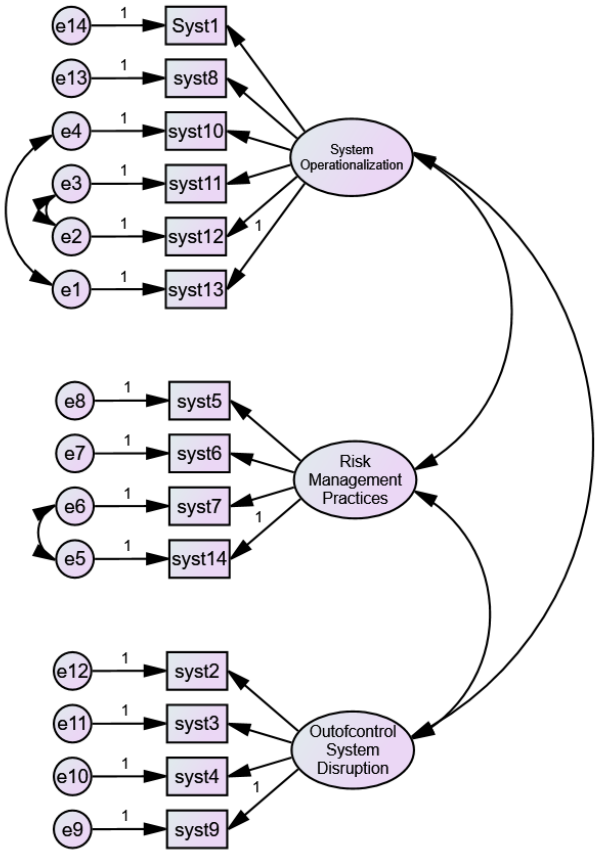
- IT o Other (please specify) ……

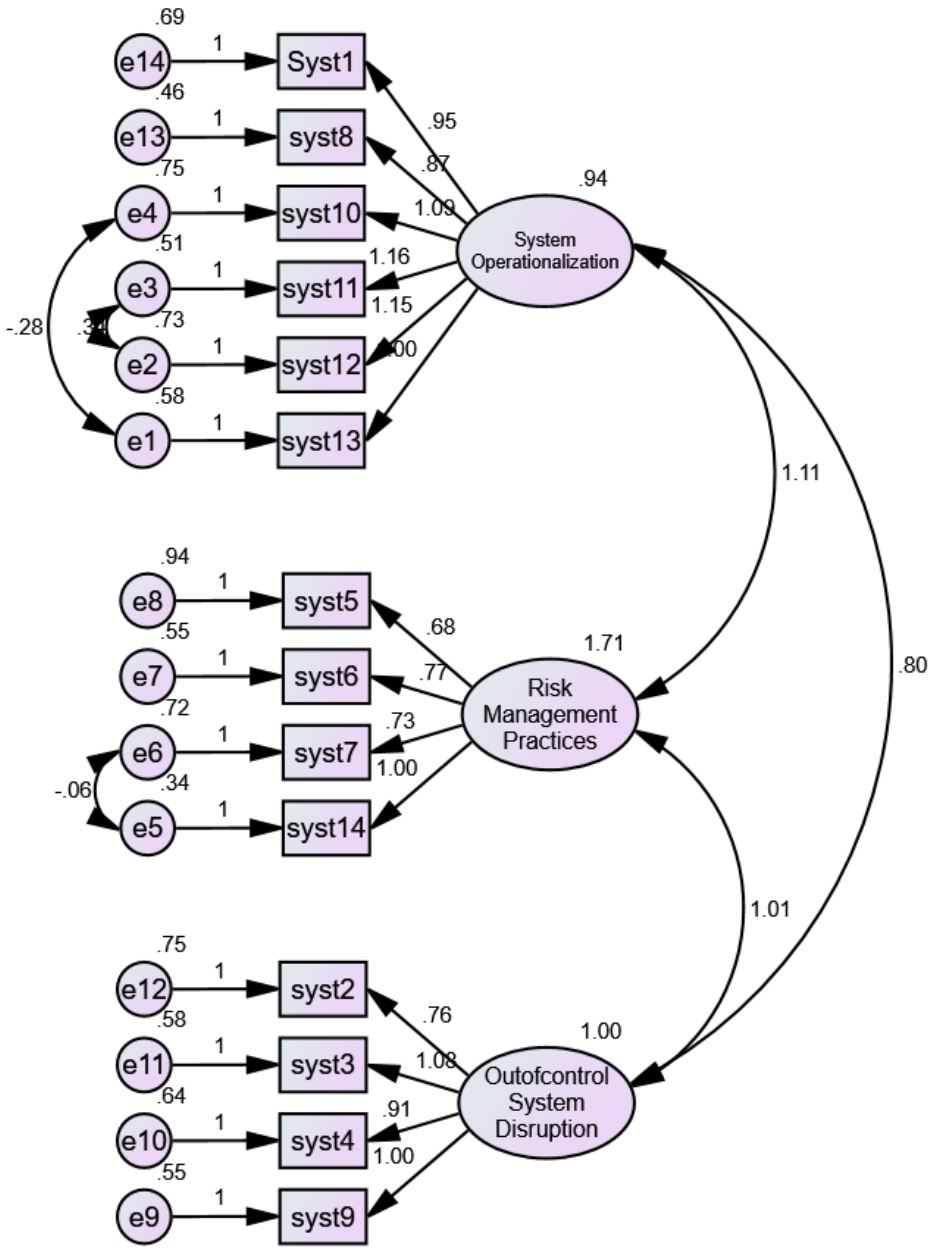
11. Which services does your organization outsource to third party supplier?
    - Engineering & Consultancy o Construction & Real estate o Energy
    - Insurance o Financial o Hospitality
    - Public services o Telecommunication o Manufacturing
    - IT o Other (please specify) ……

End of survey

Thank you for your valuable time and contribution.

Appendix 2: Results of the Structured Equation Modeling




.69
e14
1
Syst1
.46
e13
1
syst8
.75
e4
1
syst10
.51
e3
1
syst11
.73
e2
1
syst12
.58
e1
1
syst13
.95
.87
1.09
1.16
1.15
.94
System Operationalization
-.28
1.11
.80
.94
e8
1
syst5
.55
e7
1
syst6
.72
e6
1
syst7
.34
e5
1
syst14
-.06
.68
.77
.73
1.00
1.71
Risk Management Practices
1.01
.75
e12
1
syst2
.58
e11
1
syst3
.64
e10
1
syst4
.55
e9
1
syst9
.76
1.08
.91
1.00
1.00
Outofcontrol System Disruption

Number of variables in your model:	31
Number of observed variables:	14
Number of unobserved variables:	17
Number of exogenous variables:	17
Number of endogenous variables:	14

	Weights	Covariances	Variances	Means	Intercepts	Total
Fixed	17	0	0	0	0	17
Labeled	0	0	0	0	0	0
Unlabeled	11	6	17	0	0	34
Total	28	6	17	0	0	51

Number of distinct sample moments:	105
Number of distinct parameters to be estimated:	34
Degrees of freedom (105 - 34):	71

				Estimate	S.E.	C.R.	P	Label
system13	<---	System_Operationalization		1.000				
system12	<---	System_Operationalization		1.153	.144	8.034	***	
system11	<---	System_Operationalization		1.164	.134	8.689	***	
system10	<---	System_Operationalization		1.089	.167	6.535	***	
system14	<---	Risk_Management_Practices		1.000				
system7	<---	Risk_Management_Practices		.726	.089	8.152	***	
system6	<---	Risk_Management_Practices		.766	.080	9.573	***	
system5	<---	Risk_Management_Practices		.678	.093	7.317	***	
system9	<---	Outofcontrol_System_Disruption		1.000				
system4	<---	Outofcontrol_System_Disruption		.908	.123	7.376	***	
system3	<---	Outofcontrol_System_Disruption		1.083	.132	8.197	***	
system2	<---	Outofcontrol_System_Disruption		.755	.120	6.316	***	

			Estimate	S.E.	C.R.	P	Label
syst8	<---	System_Operationalization	.873	.111	7.869	***	
Syst1	<---	System_Operationalization	.947	.128	7.387	***	

			Estimate
syst13	<---	System_Operationalization	.787
syst12	<---	System_Operationalization	.796
syst11	<---	System_Operationalization	.845
syst10	<---	System_Operationalization	.774
syst14	<---	Risk_Management_Practices	.912
syst7	<---	Risk_Management_Practices	.745
syst6	<---	Risk_Management_Practices	.803
syst5	<---	Risk_Management_Practices	.676
syst9	<---	Outofcontrol_System_Disruption	.804
syst4	<---	Outofcontrol_System_Disruption	.750
syst3	<---	Outofcontrol_System_Disruption	.820
syst2	<---	Outofcontrol_System_Disruption	.659
syst8	<---	System_Operationalization	.780
Syst1	<---	System_Operationalization	.741

			Estimate	S.E.	C.R.	P	Label
Risk_Management_Practices	<-->	Outofcontrol_System_Disruption	1.015	.210	4.825	***	
System_Operationalization	<-->	Risk_Management_Practices	1.109	.216	5.145	***	
System_Operationalization	<-->	Outofcontrol_System_Disruption	.803	.171	4.708	***	
e2	<-->	e3	.345	.093	3.724	***	
e1	<-->	e4	-.281	.086	-3.274	.001	
e5	<-->	e6	-.060	.090	-.662	.508	

			Estimate
Risk_Management_Practices	<-->	Outofcontrol_System_Disruption	.774
System_Operationalization	<-->	Risk_Management_Practices	.873

			Estimate
System_Operationalization	<-->	Outofcontrol_System_Disruption	.825
e2	<-->	e3	.565
e1	<-->	e4	-.427
e5	<-->	e6	-.120

	Estimate	S.E.	C.R.	P	Label
System_Operationalization	.944	.221	4.272	***	
Risk_Management_Practices	1.711	.322	5.313	***	
Outofcontrol_System_Disruption	1.004	.231	4.338	***	
e1	.578	.105	5.529	***	
e2	.727	.128	5.698	***	
e3	.511	.096	5.354	***	
e4	.749	.134	5.608	***	
e5	.345	.110	3.148	.002	
e6	.723	.137	5.265	***	
e7	.554	.102	5.459	***	
e8	.936	.153	6.110	***	
e9	.547	.110	4.997	***	
e10	.642	.117	5.483	***	
e11	.576	.120	4.810	***	
e12	.745	.125	5.939	***	

	Estimate	S.E.	C.R.	P	Label
e13	.462	.079	5.853	***	
e14	.694	.115	6.018	***	

			M.I.	Par Change
e12	<-->	Risk_Management_Practices	4.074	-.158
e11	<-->	Risk_Management_Practices	4.020	.150
e11	<-->	System_Operationalization	4.981	-.114
e8	<-->	e11	10.207	.296
e8	<-->	e9	13.250	-.324
e6	<-->	System_Operationalization	7.066	-.143
e6	<-->	e7	5.238	.177
e5	<-->	Outofcontrol_System_Disruption	5.574	-.139
e5	<-->	System_Operationalization	7.750	.122
e5	<-->	e12	10.978	-.248
e4	<-->	e11	7.002	-.222
e4	<-->	e9	11.299	.271
e4	<-->	e7	9.952	-.245
e3	<-->	e6	4.793	.131
e2	<-->	e7	7.986	.172
e2	<-->	e6	5.943	-.170

	M.I.	Par Change

			M.I.	Par Change
syst3	<---	syst5	6.430	.179
syst3	<---	syst10	4.163	-.138
syst9	<---	syst5	7.314	-.184
syst9	<---	syst10	6.585	.167
syst6	<---	syst10	4.327	-.131
syst14	<---	syst2	7.613	-.199
syst10	<---	syst9	4.701	.169

Iteration		Negative eigenvalues	Condition #	Smallest eigenvalue	Diameter	F	NTries	Ratio
0	e	9		-1.277	9999.000	96 4.581	0	9999.000
1	e *	9		-1.012	2.611	56 0.818	20	.345

Iteration		Negative eigenvalues	Condition #	Smallest eigenvalue	Diameter	F	NTries	Ratio
2	e *	7		-.452	.543	419.223	6	.995
3	e	2		-.154	.667	293.423	5	.899
4	e	0	1065.495		.551	218.821	5	.804
5	e	0	549.054		.461	192.888	4	.000
6	e	0	392.813		.791	186.583	1	.207
7	e	0	295.469		.156	169.786	1	1.194
8	e	0	290.867		.083	167.140	1	1.129
9	e	0	295.191		.024	167.003	1	1.043
10	e	0	290.190		.002	167.002	1	1.004
11	e	0	290.168		.000	167.002	1	1.000

Model Fit Summary

CMIN

Model	NPAR	CMIN	DF	P	CMIN/DF
Default model	34	167.002	71	.000	2.352
Saturated model	105	.000	0		
Independence model	14	977.276	91	.000	10.739

RMR, GFI

Model	RMR	GFI	AGFI	PGFI
Default model	.094	.810	.719	.548
Saturated model	.000	1.000		
Independence model	.838	.207	.085	.179

Baseline Comparisons

Model	NFI Delta1	RFI rho1	IFI Delta2	TLI rho2	CFI
Default model	.829	.781	.894	.861	.892
Saturated model	1.000		1.000		1.000

Model	NFI Delta1	RFI rho1	IFI Delta2	TLI rho2	CFI
Independence model	.000	.000	.000	.000	.000

Parsimony-Adjusted Measures

Model	PRATIO	PNFI	PCFI
Default model	.780	.647	.696
Saturated model	.000	.000	.000
Independence model	1.000	.000	.000

NCP

Model	NCP	LO 90	HI 90
Default model	96.002	62.072	137.644
Saturated model	.000	.000	.000
Independence model	886.276	789.540	990.452

FMIN

Model	FMIN	F0	LO 90	HI 90
Default model	1.920	1.103	.713	1.582
Saturated model	.000	.000	.000	.000
Independence model	11.233	10.187	9.075	11.385

RMSEA

Model	RMSEA	LO 90	HI 90	PCLOSE
Default model	.125	.100	.149	.000
Independence model	.335	.316	.354	.000

AIC

Model	AIC	BCC	BIC	CAIC
Default model	235.002	249.169	319.231	353.231
Saturated model	210.000	253.750	470.120	575.120
Independence model	1005.276	1011.110	1039.959	1053.959

ECVI

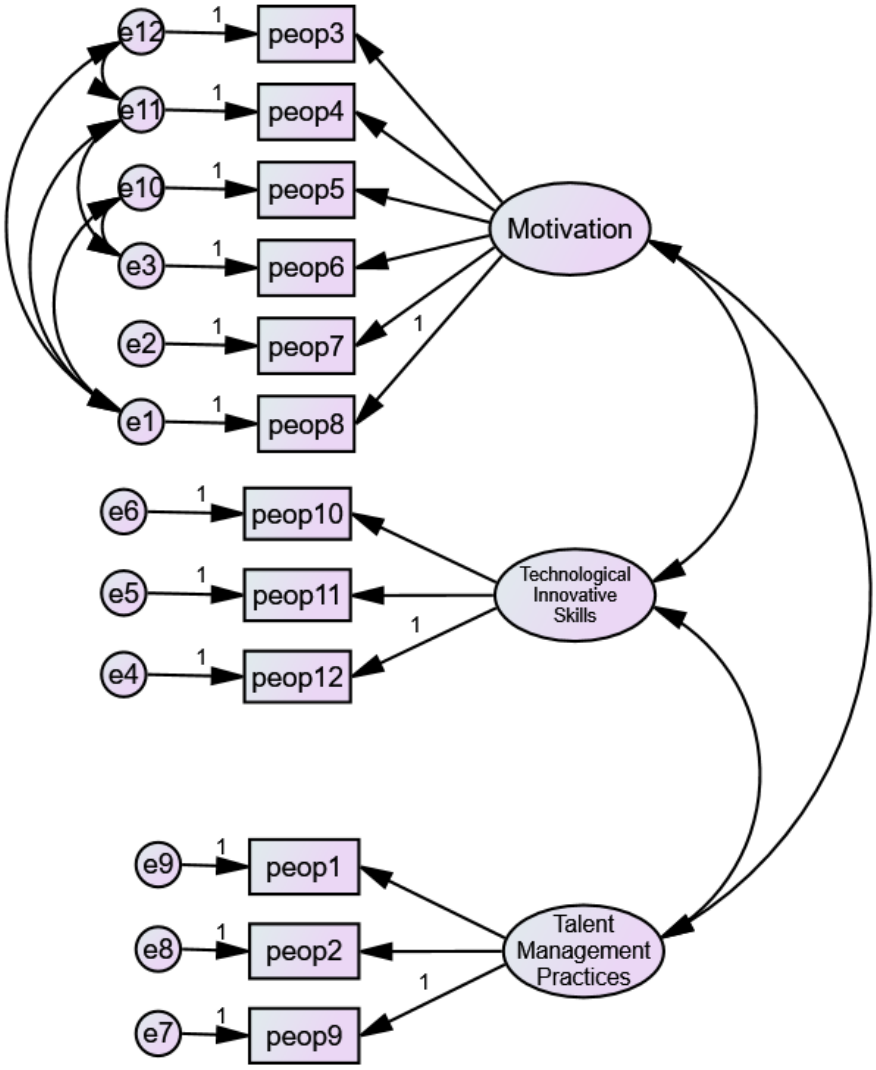
Model	ECVI	LO 90	HI 90	MECVI
Default model	2.701	2.311	3.180	2.864
Saturated model	2.414	2.414	2.414	2.917
Independence model	11.555	10.443	12.752	11.622

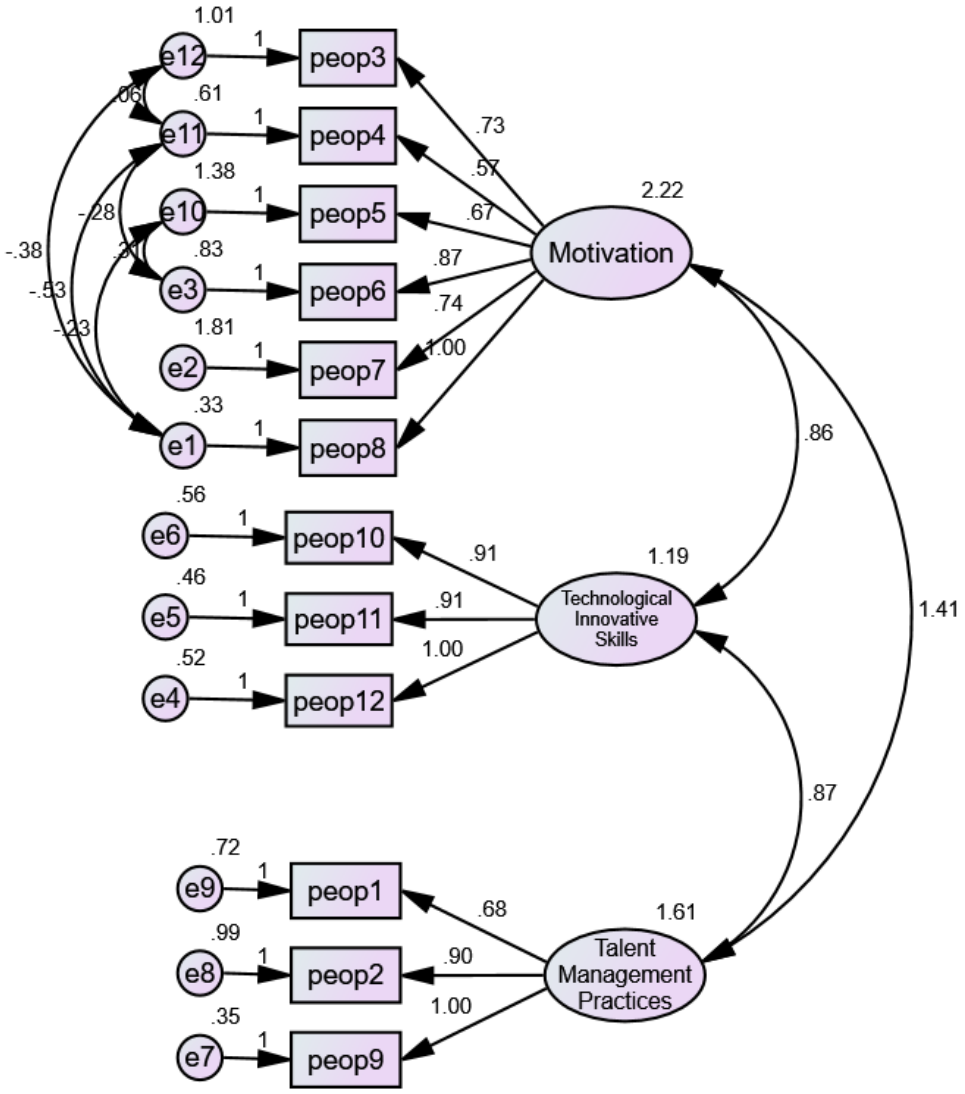
HOELTER

Model	HOELTER .05	HOELTER .01
Default model	48	53
Independence model	11	12

Minimization:	.016

Miscellaneous:	.172
Bootstrap:	.000
Total:	.188


e12
e11
e10
e3
e2
e1
peop3
peop4
peop5
peop6
peop7
peop8
Motivation
e6
e5
e4
peop10
peop11
peop12
Technological Innovative Skills
e9
e8
e7
peop1
peop2
peop9
Talent Management Practices
1


1.01
e12
1
peop3
.73
.06
.61
e11
1
peop4
.57
1.38
e10
1
peop5
.67
2.22
Motivation
-.28
-.38
.30
.83
e3
1
peop6
.87
-.53
.74
-.23
1.81
e2
1
peop7
1.00
.33
e1
1
peop8
.86
.56
e6
1
peop10
.91
1.19
.46
e5
1
peop11
.91
Technological
Innovative
Skills
1.41
1.00
.52
e4
1
peop12
.87
.72
e9
1
peop1
.68
1.61
.99
e8
1
peop2
.90
Talent
Management
Practices
1.00
.35
e7
1
peop9

Number of variables in your model:	27
Number of observed variables:	12
Number of unobserved variables:	15
Number of exogenous variables:	15
Number of endogenous variables:	12

	Weights	Covariances	Variances	Means	Intercepts	Total
Fixed	15	0	0	0	0	15
Labeled	0	0	0	0	0	0
Unlabeled	9	9	15	0	0	33
Total	24	9	15	0	0	48

Number of distinct sample moments:	78
Number of distinct parameters to be estimated:	33
Degrees of freedom (78 - 33):	45

				Estimate	S.E.	C.R.	P	Label
people8	<---	Motivation		1.000				
people7	<---	Motivation		.742	.109	6.828	***	
people6	<---	Motivation		.870	.091	9.571	***	
people12	<---	Technological_Innovative_Skills		1.000				
people11	<---	Technological_Innovative_Skills		.914	.111	8.239	***	
people10	<---	Technological_Innovative_Skills		.906	.114	7.952	***	
people9	<---	Talent_Management_Practices		1.000				
people2	<---	Talent_Management_Practices		.905	.110	8.224	***	
people1	<---	Talent_Management_Practices		.681	.090	7.564	***	
people5	<---	Motivation		.672	.111	6.047	***	
people4	<---	Motivation		.565	.094	5.984	***	
people3	<---	Motivation		.733	.106	6.885	***	

			Estimate
peop8	<---	Motivation	.933
peop7	<---	Motivation	.635
peop6	<---	Motivation	.818
peop12	<---	Technological_Innovative_Skills	.834
peop11	<---	Technological_Innovative_Skills	.827
peop10	<---	Technological_Innovative_Skills	.797
peop9	<---	Talent_Management_Practices	.906
peop2	<---	Talent_Management_Practices	.756
peop1	<---	Talent_Management_Practices	.712
peop5	<---	Motivation	.649
peop4	<---	Motivation	.733
peop3	<---	Motivation	.735

			Estimate	S.E.	C.R.	P	Label
Motivation	<-->	Talent_Management_Practices	1.407	.275	5.120	***	
Motivation	<-->	Technological_Innovative_Skills	.863	.219	3.950	***	
Technological_Innovative_Skills	<-->	Talent_Management_Practices	.869	.205	4.231	***	
e11	<-->	e12	.062	.135	.457	.648	
e1	<-->	e10	-.226	.149	-1.515	.130	
e1	<-->	e11	-.529	.131	-4.047	***	
e1	<-->	e12	-.375	.131	-2.853	.004	
e3	<-->	e10	.309	.170	1.820	.069	
e3	<-->	e11	-.284	.110	-2.589	.010	

			Estimate
Motivation	<-->	Talent_Management_Practices	.746
Motivation	<-->	Technological_Innovative_Skills	.531
Technological_Innovative_Skills	<-->	Talent_Management_Practices	.628

			Estimate
e11	<-->	e12	.079
e1	<-->	e10	-.334
e1	<-->	e11	-1.176
e1	<-->	e12	-.648
e3	<-->	e10	.290
e3	<-->	e11	-.399

	Estimate	S.E.	C.R.	P	Label
Motivation	2.217	.412	5.381	***	
Technological_Innovative_Skills	1.191	.265	4.495	***	
Talent_Management_Practices	1.605	.311	5.160	***	
e1	.332	.160	2.079	.038	
e2	1.805	.275	6.556	***	
e3	.829	.161	5.143	***	
e4	.520	.124	4.203	***	
e5	.459	.106	4.328	***	
e6	.562	.117	4.795	***	
e7	.349	.121	2.887	.004	
e8	.988	.181	5.468	***	
e9	.723	.126	5.748	***	
e10	1.377	.248	5.553	***	

	Estimate	S.E.	C.R.	P	Label
e11	.610	.140	4.369	***	
e12	1.011	.203	4.969	***	

	e12	e11	e10	e3	e1
e12	1.011				
e11	.062	.610			
e10	.000	.000	1.377		
e3	.000	-.284	.309	.829	
e1	-.375	-.529	-.226	.000	.332

			M.I.	Par Change
e6	<-->	e10	6.658	.263
e6	<-->	e7	4.831	.163
e5	<-->	e10	6.990	-.252
e2	<-->	e8	5.368	.352

	M.I.	Par Change

			M.I.	Par Change
peop10	<---	peop5	4.605	.127
peop11	<---	peop5	9.527	-.171

Iteration		Negative eigenvalues	Condition #	Smallest eigenvalue	Diameter	F	N Tries	Ratio
0		e 11		-1.161	9999.000	653.837	0	9999.000
1		e 10		-.318	1.818	373.546	20	.497
2		e 6		-.244	.517	277.290	6	.946
3	*	e 1		-.553	.880	193.932	5	.537
4		e 0	490.440		.613	108.259	5	.752
5		e 0	305.417		.435	85.049	2	.000
6		e 0	135.016		.174	76.279	1	1.166
7		e 0	98.655		.049	74.917	1	1.139

Iteration		Negative eigenvalues	Condition #	Smallest eigenvalue	Diameter	F	N Tries	Ratio
8	e	0	90.564		.014	74.831	1	1.052
9	e	0	91.858		.001	74.830	1	1.005
10	e	0	91.462		.000	74.830	1	1.000

Model Fit Summary

CMIN

Model	NPAR	CMIN	DF	P	CMIN/DF
Default model	33	74.830	45	.003	1.663
Saturated model	78	.000	0		
Independence model	12	653.399	66	.000	9.900

RMR, GFI

Model	RMR	GFI	AGFI	PGFI
Default model	.105	.886	.802	.511
Saturated model	.000	1.000		
Independence model	.872	.303	.176	.256

Baseline Comparisons

Model	NFI Delta1	RFI rho1	IFI Delta2	TLI rho2	CFI
Default model	.885	.832	.951	.926	.949
Saturated model	1.000		1.000		1.000
Independence model	.000	.000	.000	.000	.000

Parsimony-Adjusted Measures

Model	PRATIO	PNFI	PCFI
Default model	.682	.604	.647
Saturated model	.000	.000	.000
Independence model	1.000	.000	.000

NCP

Model	NCP	LO 90	HI 90
Default model	29.830	9.889	57.658
Saturated model	.000	.000	.000
Independence model	587.399	509.147	673.104

FMIN

Model	FMIN	F0	LO 90	HI 90
Default model	.860	.343	.114	.663
Saturated model	.000	.000	.000	.000
Independence model	7.510	6.752	5.852	7.737

RMSEA

Model	RMSEA	LO 90	HI 90	PCLOSE
Default model	.087	.050	.121	.049
Independence model	.320	.298	.342	.000

AIC

Model	AIC	BCC	BIC	CAIC
Default model	140.830	152.425	222.582	255.582
Saturated model	156.000	183.405	349.232	427.232
Independence model	677.399	681.615	707.127	719.127

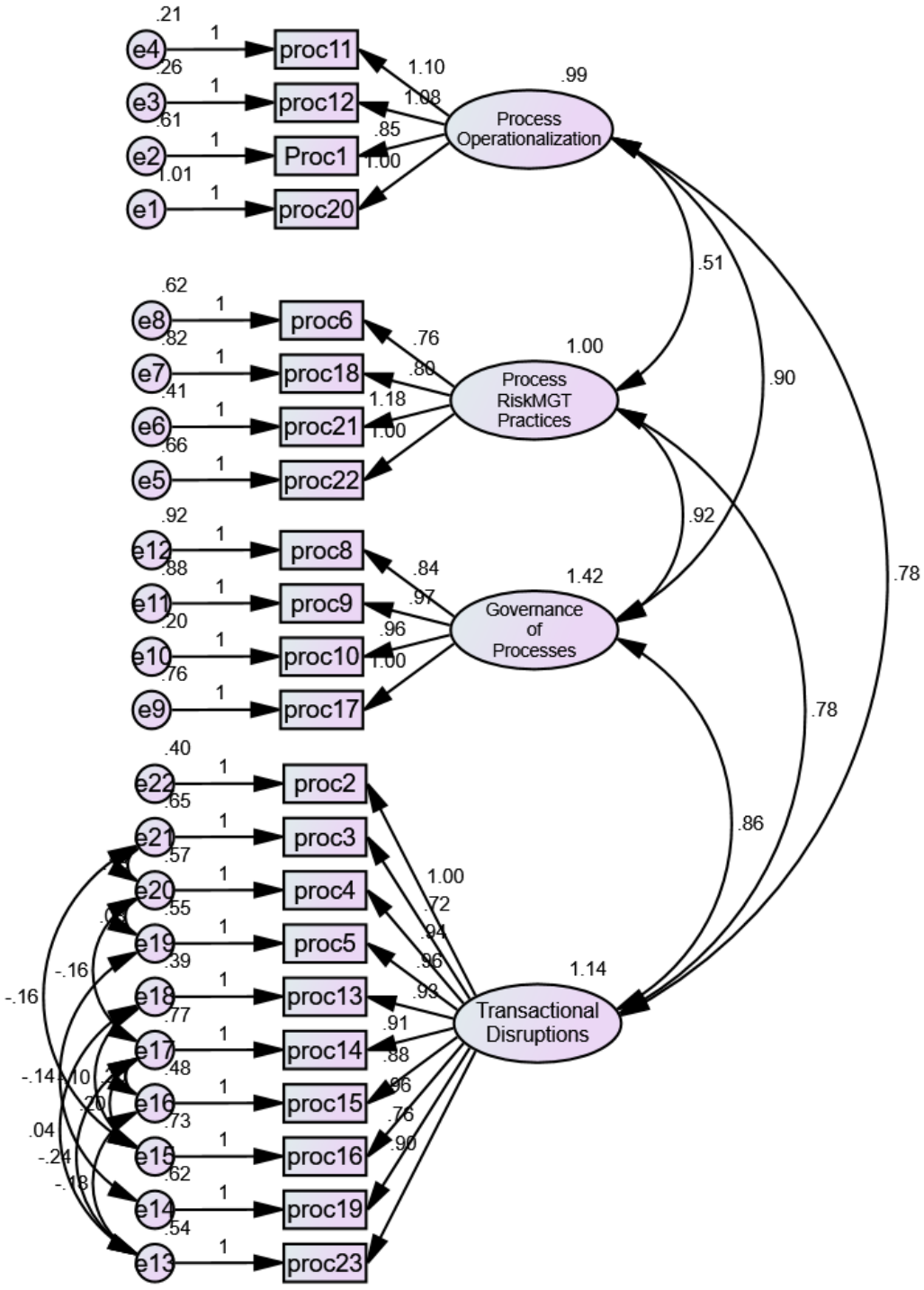
ECVI

Model	ECVI	LO 90	HI 90	MECVI
Default model	1.619	1.390	1.939	1.752
Saturated model	1.793	1.793	1.793	2.108
Independence model	7.786	6.887	8.771	7.835

HOELTER

Model	HOELTER .05	HOELTER .01
Default model	72	82
Independence model	12	13

Minimization:	.016
Miscellaneous:	.155
Bootstrap:	.000
Total:	.171


Process Operationalization
Process RiskMGT Practices
Governance of Processes
Transactional Disruptions
proc11
proc12
Proc1
proc20
proc6
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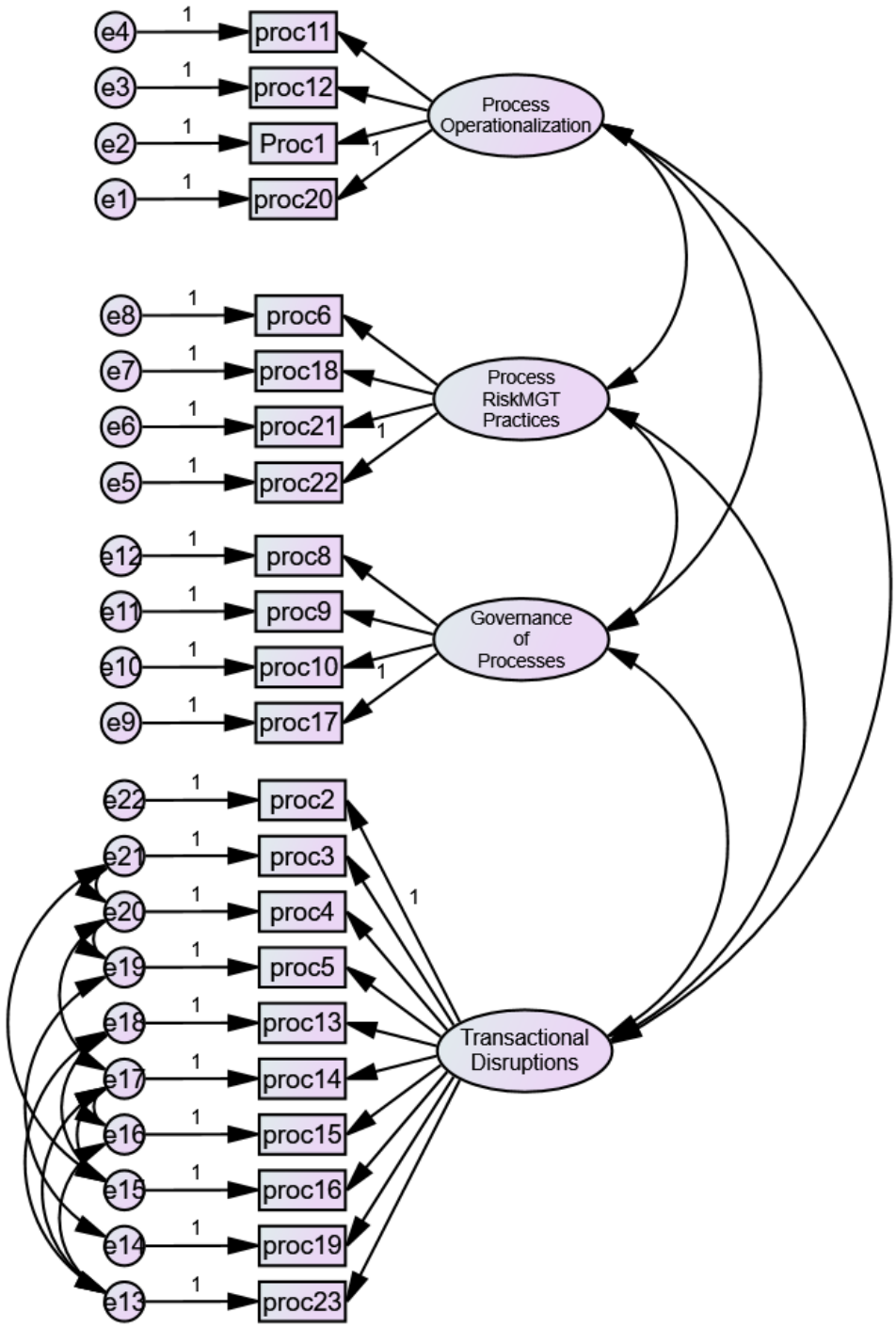


5.3.1.1

Number of variables in your model: 48

Number of observed variables:	22
Number of unobserved variables:	26
Number of exogenous variables:	26
Number of endogenous variables:	22

	Weights	Covariances	Variances	Means	Intercepts	Total
Fixed	26	0	0	0	0	26
Labeled	0	0	0	0	0	0
Unlabeled	18	17	26	0	0	61
Total	44	17	26	0	0	87

Number of distinct sample moments:	253
Number of distinct parameters to be estimated:	61
Degrees of freedom (253 - 61):	192

				Estimate	S.E.	C.R.	P	Label
proc20	<--	Process_Operationalization		1.000				
Proc1	<--	Process_Operationalization		.851	.130	6.548	***	
proc12	<--	Process_Operationalization		1.076	.135	7.949	***	
proc11	<--	Process_Operationalization		1.101	.136	8.102	***	
proc22	<--	Process_RiskMGT_Practices		1.000				
proc21	<--	Process_RiskMGT_Practices		1.177	.138	8.513	***	
proc18	<--	Process_RiskMGT_Practices		.797	.128	6.209	***	
proc6	<--	Process_RiskMGT_Practices		.763	.116	6.576	***	
proc17	<--	Governance_of_Processes		1.000				
proc10	<--	Governance_of_Processes		.957	.092	10.414	***	
proc9	<--	Governance_of_Processes		.971	.119	8.161	***	
proc8	<--	Governance_of_Processes		.844	.114	7.420	***	

				Estimate	S.E.	C.R.	P	Label
proc23	<--	Transactional_Disruptions		.896	.097	9.233	***	
proc19	<--	Transactional_Disruptions		.763	.095	8.024	***	
proc16	<--	Transactional_Disruptions		.962	.109	8.826	***	
proc15	<--	Transactional_Disruptions		.877	.092	9.495	***	
proc14	<--	Transactional_Disruptions		.909	.109	8.307	***	
proc13	<--	Transactional_Disruptions		.930	.090	10.380	***	
proc5	<--	Transactional_Disruptions		.964	.100	9.681	***	
proc4	<--	Transactional_Disruptions		.940	.100	9.421	***	
proc3	<--	Transactional_Disruptions		.719	.095	7.553	***	
proc2	<--	Transactional_Disruptions		1.000				
Process_Operationalization	<-->	Process_RiskMGT_Practices		.510	.148	3.438	***	
Process_Operationalization	<-->	Governance_of_Processes		.898	.206	4.357	***	
Process_Operationalization	<-->	Transactional_Disruptions		.775	.176	4.413	***	
Process_RiskMGT_Practices	<-->	Governance_of_Processes		.918	.203	4.530	***	
Process_RiskMGT_Practices	<-->	Transactional_Disruptions		.775	.171	4.538	***	
Governance_of_Processes	<-->	Transactional_Disruptions		.855	.192	4.464	***	
e13	<-->	e17		-.245	.073	-3.335	***	
e13	<-->	e16		-.180	.063	-2.872	.004	
e13	<-->	e18		.037	.061	.609	.542	

			Estimate	S.E.	C.R.	P	Label
e14	<-->	e19	-.136	.067	-2.025	.043	
e15	<-->	e17	.202	.087	2.320	.020	
e15	<-->	e18	-.105	.060	-1.750	.080	
e15	<-->	e21	-.156	.073	-2.146	.032	
e16	<-->	e17	.205	.072	2.864	.004	
e17	<-->	e20	-.161	.065	-2.500	.012	
e19	<-->	e20	.081	.065	1.257	.209	
e20	<-->	e21	.131	.071	1.858	.063	

	Estimate	S.E.	C.R.	P	Label
Process_Operationalization	.986	.268	3.683	***	
Process_RiskMGT_Practices	.997	.241	4.137	***	
Governance_of_Processes	1.424	.319	4.468	***	
Transactional_Disruptions	1.139	.228	5.000	***	
e1	1.008	.164	6.132	***	
e2	.608	.101	6.037	***	
e3	.265	.060	4.385	***	
e4	.210	.056	3.744	***	
e5	.661	.122	5.396	***	
e6	.414	.105	3.937	***	
e7	.822	.137	5.997	***	

	Estimate	S.E.	C.R.	P	Label
e8	.625	.106	5.870	***	
e9	.763	.135	5.633	***	
e10	.195	.060	3.236	.001	
e11	.880	.151	5.818	***	
e12	.924	.153	6.046	***	
e13	.539	.093	5.800	***	
e14	.615	.099	6.228	***	
e15	.731	.121	6.042	***	
e16	.485	.082	5.914	***	
e17	.770	.123	6.242	***	
e18	.390	.071	5.502	***	
e19	.552	.094	5.901	***	
e20	.572	.096	5.982	***	
e21	.646	.103	6.278	***	
e22	.398	.070	5.698	***	

			M.I.	Par Change
e22	<-->	Process_RiskMGT_Practices	6.194	-.123
e19	<-->	e21	4.852	.136
e18	<-->	e21	5.155	.121
e16	<-->	Governance_of_Processes	9.881	.163
e16	<-->	Process_RiskMGT_Practices	6.794	-.127
e15	<-->	Governance_of_Processes	5.648	.147
e15	<-->	Process_Operationalization	8.492	-.158
e14	<-->	e20	5.954	-.147
e13	<-->	Transactional_Disruptions	8.019	-.143

			M.I.	Par Change
e13	<-->	Governance_of_Processes	14.836	-.213
e13	<-->	Process_RiskMGT_Practices	15.121	.202
e13	<-->	Process_Operationalization	16.713	.198
e13	<-->	e21	4.431	-.122
e12	<-->	Process_RiskMGT_Practices	5.365	.170
e12	<-->	Process_Operationalization	12.570	-.242
e12	<-->	e21	7.825	.230
e12	<-->	e17	8.614	-.229
e12	<-->	e15	13.772	.315
e11	<-->	e19	7.552	.219
e11	<-->	e13	22.675	-.359
e10	<-->	Process_Operationalization	4.372	.083
e10	<-->	e22	5.628	.103
e10	<-->	e21	5.521	-.116
e10	<-->	e16	12.868	.153
e9	<-->	Transactional_Disruptions	8.834	-.200
e8	<-->	Process_Operationalization	4.434	.120
e7	<-->	Transactional_Disruptions	4.915	.150
e7	<-->	Process_RiskMGT_Practices	4.284	-.141
e7	<-->	e17	5.418	.172
e6	<-->	Governance_of_Processes	5.896	.146
e6	<-->	Process_Operationalization	13.460	-.198
e6	<-->	e14	4.802	-.148
e6	<-->	e9	6.657	.205
e5	<-->	Governance_of_Processes	6.623	-.176
e5	<-->	Process_Operationalization	5.422	.141
e5	<-->	e17	4.556	-.147
e5	<-->	e16	6.931	-.166
e5	<-->	e14	4.518	.160
e4	<-->	e20	8.156	-.126
e4	<-->	e14	4.391	.103
e4	<-->	e13	5.689	.105
e4	<-->	e6	7.754	-.137
e4	<-->	e5	5.961	.134
e3	<-->	e21	10.425	.162
e3	<-->	e19	6.955	.129
e2	<-->	e22	4.426	.123
e2	<-->	e20	9.116	.187
e2	<-->	e10	5.383	.121
e1	<-->	Transactional_Disruptions	6.415	-.189

			M.I.	Par Change
e1	<-->	Process_RiskMGT_Practices	12.213	.266
e1	<-->	e22	8.057	-.213
e1	<-->	e19	4.244	-.172
e1	<-->	e14	6.438	.224
e1	<-->	e9	17.547	.436
e1	<-->	e8	10.689	.302

	M.I.	Par Change

			M.I.	Par Change
proc2	<---	proc6	4.203	-.135
proc14	<---	proc18	4.567	.138
proc15	<---	proc10	5.868	.141
proc16	<---	proc8	10.508	.197
proc16	<---	proc22	4.774	.144
proc19	<---	proc20	4.787	.132
proc23	<---	proc9	8.746	-.151
proc8	<---	Process_RiskMGT_Practices	5.826	.273
proc8	<---	Process_Operationalization	4.447	-.235
proc8	<---	proc3	4.377	.202
proc8	<---	proc18	5.325	.205
proc8	<---	proc21	5.824	.193
proc8	<---	proc22	4.237	.171
proc8	<---	proc11	5.608	-.214
proc8	<---	Proc1	6.946	-.246
proc8	<---	proc20	6.618	-.195
proc9	<---	proc23	12.895	-.316
proc10	<---	Process_Operationalization	4.421	.140
proc10	<---	proc2	4.738	.113
proc10	<---	proc15	8.238	.158
proc10	<---	proc11	5.983	.132
proc10	<---	Proc1	9.043	.168
proc17	<---	proc2	4.908	-.179
proc17	<---	proc13	4.335	-.178
proc17	<---	proc19	5.118	-.201
proc17	<---	proc23	5.451	-.194
proc17	<---	proc20	6.443	.180
proc6	<---	proc20	9.283	.192
proc18	<---	Transactional_Disruptions	5.112	.219
proc18	<---	Process_Operationalization	5.785	.254
proc18	<---	proc3	5.435	.212
proc18	<---	proc14	8.495	.226

			M.I.	Par Change
proc18	<---	proc19	7.847	.251
proc18	<---	proc23	4.158	.171
proc18	<---	proc11	5.165	.194
proc18	<---	proc12	4.889	.189
proc18	<---	proc20	4.064	.145
proc21	<---	Process_Operationalization	6.903	-.233
proc21	<---	proc19	4.894	-.167
proc21	<---	proc11	10.199	-.230
proc21	<---	proc12	6.733	-.186
proc21	<---	Proc1	4.546	-.158
proc22	<---	proc15	5.198	-.185
proc22	<---	proc23	5.163	.179
proc11	<---	proc4	5.289	-.114
proc12	<---	proc3	6.078	.145
proc20	<---	proc17	8.540	.220
proc20	<---	proc6	11.641	.346
proc20	<---	proc21	4.207	.170

Iteration		Negative eigenvalues	Condition #	Smallest eigenvalue	Diameter	F	N Tries	Ratio
0	e	17		-1.778	9999.000	1955.719	0	9999.000
1	* e	21		-.592	3.512	1392.812	20	.212
2	* e	15		-.291	.751	1198.388	6	.822
3	* e	5		-.214	1.308	987.783	5	.559
4	e	1		-.027	1.029	724.042	5	.954
5	e	0	2809.949		.453	639.890	5	1.031
6	e	0	427.942		.944	611.270	1	.987
7	e	0	476.291		.241	599.470	1	1.171
8	e	0	556.000		.081	597.897	1	1.130
9	e	0	554.735		.016	597.809	1	1.049

Iteration		Negative eigenvalues	Condition #	Smallest eigenvalue	Diameter	F	NTries	Ratio
10	e	0	556.913		.001	597.809	1	1.005
11	e	0	556.909		.000	597.809	1	1.000

Model Fit Summary

CMIN

Model	NPAR	CMIN	DF	P	CMIN/DF
Default model	61	597.809	192	.000	3.114
Saturated model	253	.000	0		
Independence model	22	2005.622	231	.000	8.682

RMR, GFI

Model	RMR	GFI	AGFI	PGFI
Default model	.141	.674	.570	.512
Saturated model	.000	1.000		
Independence model	.770	.155	.075	.142

Baseline Comparisons

Model	NFI Delta1	RFI rho1	IFI Delta2	TLI rho2	CFI
Default model	.702	.641	.776	.725	.771
Saturated model	1.000		1.000		1.000
Independence model	.000	.000	.000	.000	.000

Parsimony-Adjusted Measures

Model	PRATIO	PNFI	PCFI
Default model	.831	.583	.641
Saturated model	.000	.000	.000
Independence model	1.000	.000	.000

NCP

Model	NCP	LO 90	HI 90
Default model	405.809	335.885	483.347
Saturated model	.000	.000	.000
Independence model	1774.622	1635.265	1921.398

FMIN

Model	FMIN	F0	LO 90	HI 90
Default model	6.871	4.664	3.861	5.556

Model	FMIN	F0	LO 90	HI 90
Saturated model	.000	.000	.000	.000
Independence model	23.053	20.398	18.796	22.085

RMSEA

Model	RMSEA	LO 90	HI 90	PCLOSE
Default model	.156	.142	.170	.000
Independence model	.297	.285	.309	.000

AIC

Model	AIC	BCC	BIC	CAIC
Default model	719.809	763.652	870.926	931.926
Saturated model	506.000	687.844	1132.766	1385.766
Independence model	2049.622	2065.435	2104.123	2126.123

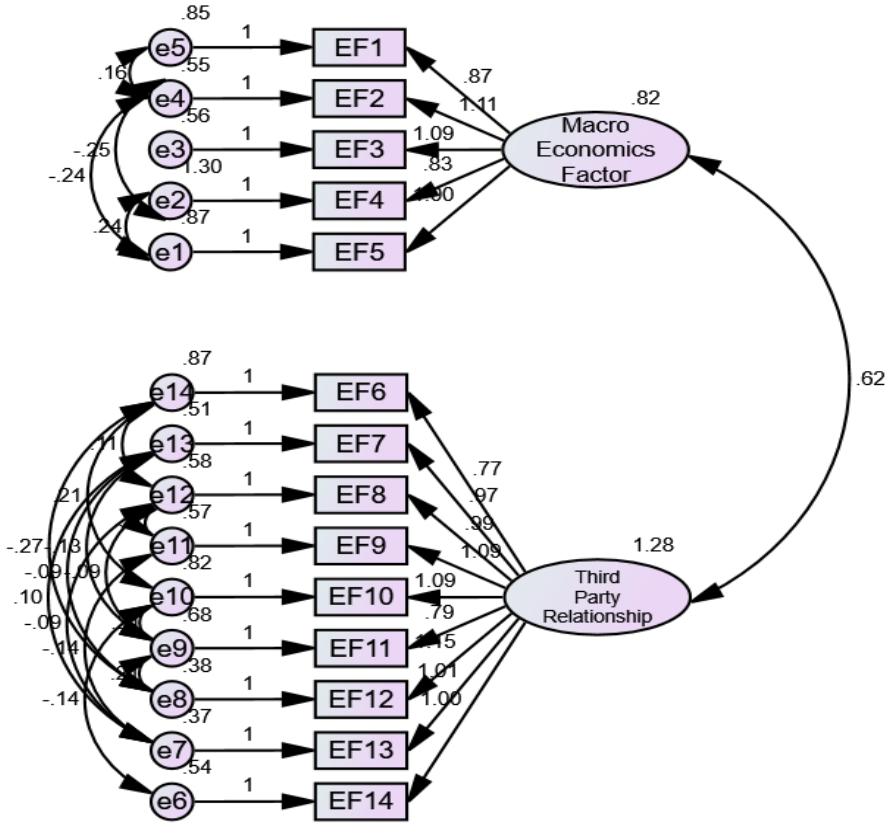
ECVI

Model	ECVI	LO 90	HI 90	MECVI
Default model	8.274	7.470	9.165	8.778
Saturated model	5.816	5.816	5.816	7.906
Independence model	23.559	21.957	25.246	23.741

HOELTER

Model	HOELTER .05	HOELTER .01
Default model	33	36
Independence model	12	13

Minimization:	.016
Miscellaneous:	.348
Bootstrap:	.000
Total:	.364



Number of variables in your model:	30
Number of observed variables:	14
Number of unobserved variables:	16
Number of exogenous variables:	16
Number of endogenous variables:	14

	Weights	Covariances	Variances	Means	Intercepts	Total
Fixed	16	0	0	0	0	16
Labeled	0	0	0	0	0	0
Unlabeled	12	18	16	0	0	46
Total	28	18	16	0	0	62

Number of distinct sample moments:	105
Number of distinct parameters to be estimated:	46
Degrees of freedom (105 - 46):	59

				Estimate	S.E.	C.R.	P	Label
EF5	<--	Macro_Economics_Factor		1.000				
EF4	<--	Macro_Economics_Factor		.828	.167	4.948	***	
EF3	<--	Macro_Economics_Factor		1.091	.190	5.757	***	
EF2	<--	Macro_Economics_Factor		1.108	.206	5.387	***	
EF1	<--	Macro_Economics_Factor		.873	.174	5.017	***	
EF14	<--	Third_Party_Relationship		1.000				
EF13	<--	Third_Party_Relationship		1.007	.094	10.715	***	
EF12	<--	Third_Party_Relationship		1.148	.102	11.231	***	
EF11	<--	Third_Party_Relationship		.790	.099	8.011	***	
EF10	<--	Third_Party_Relationship		1.092	.130	8.422	***	
EF9	<--	Third_Party_Relationship		1.088	.107	10.162	***	
EF8	<--	Third_Party_Relationship		.993	.103	9.621	***	
EF7	<--	Third_Party_Relationship		.969	.100	9.718	***	
EF6	<--	Third_Party_Relationship		.768	.107	7.186	***	

			Estimate	S.E.	C.R.	P	Label
Macro_Economics_Factor	<-->	Third_Party_Relationship	.622	.162	3.842	***	
e1	<-->	e2	.238	.152	1.570	.116	
e1	<-->	e4	-.238	.114	-2.086	.037	
e2	<-->	e4	-.250	.123	-2.043	.041	
e4	<-->	e5	.162	.132	1.226	.220	
e6	<-->	e10	-.144	.073	-1.974	.048	
e7	<-->	e11	-.138	.058	-2.400	.016	
e7	<-->	e12	-.095	.055	-1.739	.082	
e7	<-->	e13	.096	.068	1.408	.159	
e8	<-->	e9	.207	.066	3.144	.002	
e8	<-->	e13	-.087	.055	-1.580	.114	
e8	<-->	e14	-.273	.067	-4.076	***	
e9	<-->	e10	.212	.077	2.742	.006	
e9	<-->	e12	-.091	.061	-1.478	.139	
e9	<-->	e13	-.129	.063	-2.049	.041	
e10	<-->	e14	.210	.094	2.237	.025	
e11	<-->	e12	.101	.071	1.431	.152	
e12	<-->	e14	.109	.079	1.382	.167	

	Estimate	S.E.	C.R.	P	Label
Macro_Economics_Factor	.820	.250	3.280	.001	

	Estimate	S.E.	C.R.	P	Label
Third_Party_Relationship	1.278	.266	4.807	***	
e1	.872	.178	4.904	***	
e2	1.296	.226	5.725	***	
e3	.565	.136	4.157	***	
e4	.546	.168	3.256	.001	
e5	.851	.158	5.371	***	
e6	.537	.091	5.935	***	
e7	.368	.072	5.097	***	
e8	.384	.073	5.228	***	
e9	.675	.108	6.259	***	
e10	.824	.136	6.054	***	
e11	.567	.100	5.669	***	
e12	.580	.101	5.751	***	
e13	.509	.095	5.336	***	
e14	.872	.138	6.325	***	

			M.I.	Par Change
e10	<-->	Macro_Economics_Factor	4.772	-.157
e8	<-->	Macro_Economics_Factor	4.941	-.104
e7	<-->	Macro_Economics_Factor	7.050	.139
e5	<-->	e8	5.747	.126
e3	<-->	e14	5.276	-.165
e3	<-->	e8	18.887	-.214
e3	<-->	e7	8.723	.163
e3	<-->	e6	4.842	.151
e2	<-->	e13	5.093	-.190
e1	<-->	Third_Party_Relationship	5.403	.231
e1	<-->	e14	8.579	.245

	M.I.	Par Change

			M.I.	Par Change
EF6	<---	EF5	7.674	.182
EF12	<---	EF3	12.996	-.170
EF13	<---	Macro_Economics_Factor	4.041	.154
EF13	<---	EF2	5.351	.121
EF13	<---	EF3	9.589	.163
EF2	<---	EF11	5.696	-.175
EF3	<---	EF12	4.026	-.126
EF5	<---	EF6	10.960	.273

			M.I.	Par Change
EF5	<---	EF9	4.357	.152
EF5	<---	EF10	4.046	.138
EF5	<---	EF11	5.547	.204

Iteration		Negative eigenvalues	Condition #	Smallest eigenvalue	Diameter	F	NTries	Ratio
0	e	17		-2.060	9999.000	1018.798	0	9999.000
1	e *	17		-.942	2.548	585.412	20	.272
2	e *	7		-.204	.829	379.944	5	.921
3	e	4		-.181	.238	323.957	6	.921
4	e	2		-.127	.588	232.490	6	.893
5	e *	0	1298.982		.689	169.436	5	.852
6	e	1		-.411	.957	169.252	3	.000
7	e	0	583.172		.214	150.163	6	1.126
8	e	0	403.018		.530	142.195	1	1.009
9	e	0	605.167		.119	140.196	1	1.095
10	e	0	638.710		.025	140.118	1	1.039
11	e	0	642.300		.002	140.118	1	1.004
12	e	0	640.606	0	.00	140.118	1	1.000

Model Fit Summary

CMIN

Model	NPAR	CMIN	DF	P	CMIN/DF
Default model	46	140.118	59	.000	2.375
Saturated model	105	.000	0		
Independence model	14	1060.827	91	.000	11.657

RMR, GFI

Model	RMR	GFI	AGFI	PGFI
Default model	.144	.830	.698	.466
Saturated model	.000	1.000		
Independence model	.887	.217	.096	.188

Baseline Comparisons

Model	NFI Delta1	RFI rho1	IFI Delta2	TLI rho2	CFI
Default model	.868	.796	.919	.871	.916
Saturated model	1.000		1.000		1.000
Independence model	.000	.000	.000	.000	.000

Parsimony-Adjusted Measures

Model	PRATIO	PNFI	PCFI
Default model	.648	.563	.594
Saturated model	.000	.000	.000
Independence model	1.000	.000	.000

NCP

Model	NCP	LO 90	HI 90
Default model	81.118	50.305	119.638
Saturated model	.000	.000	.000
Independence model	969.827	868.682	1078.404

FMIN

Model	FMIN	F0	LO 90	HI 90
Default model	1.611	.932	.578	1.375
Saturated model	.000	.000	.000	.000
Independence model	12.193	11.147	9.985	12.395

RMSEA

Model	RMSEA	LO 90	HI 90	PCLOSE
Default model	.126	.099	.153	.000
Independence model	.350	.331	.369	.000

AIC

Model	AIC	BCC	BIC	CAIC
Default model	232.118	251.285	346.076	392.076
Saturated model	210.000	253.750	470.120	575.120
Independence model	1088.827	1094.660	1123.510	1137.510

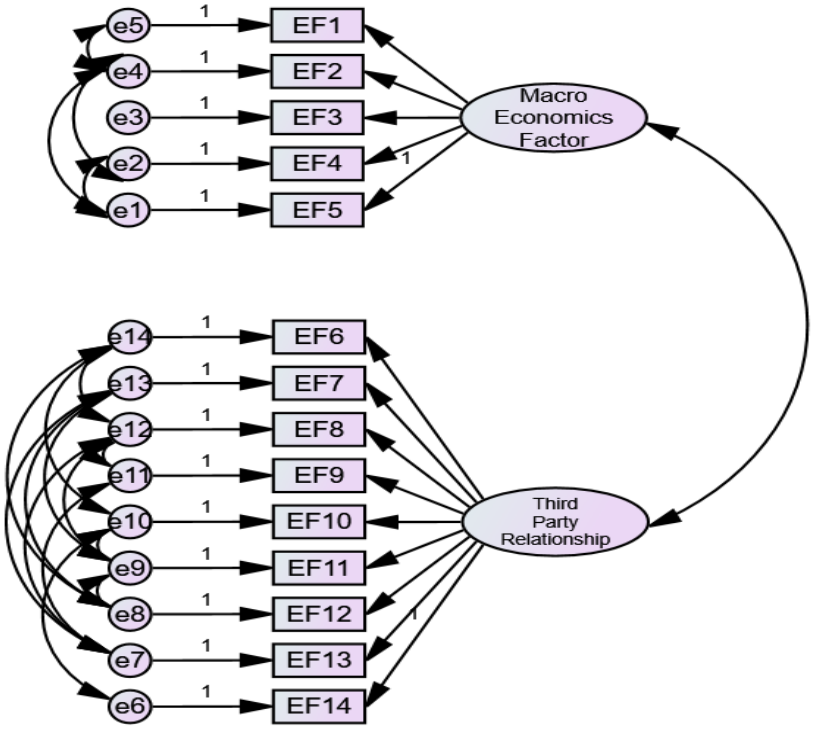
ECVI

Model	ECVI	LO 90	HI 90	MECVI
Default model	2.668	2.314	3.111	2.888
Saturated model	2.414	2.414	2.414	2.917
Independence model	12.515	11.353	13.763	12.582

HOELTER

Model	HOELTER .05	HOELTER .01
Default model	49	55
Independence model	10	11

Minimization:	.032
Miscellaneous:	.192
Bootstrap:	.000
Total:	.224


e5
e4
e3
e2
e1
EF1
EF2
EF3
EF4
EF5
Macro Economics Factor
e14
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e12
e11
e10
e9
e8
e7
e6
EF6
EF7
EF8
EF9
EF10
EF11
EF12
EF13
EF14
Third Party Relationship
1