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Exploring Capability Maturity Models and Relevant Practices as Solutions Addressing IT Service Offshoring Project Issues

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Exploring Capability Maturity Models and Relevant Practices as Solutions Addressing IT Service Offshoring Project Issues

by

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Abstract

Western countries' information technology and software intensive firms are increasingly producing software and IT services in developing countries. With this swift advancement in offshoring, there are many issues that can be investigated which will enable companies to maximize their benefits from offshoring. However, significant challenges can occur throughout the lifecycle of offshoring IT service projects that turn the potential benefits into losses. This research investigated CMM/CMMI best practices and their effects on managing and mitigating critical issues associated with offshore development.

Using a web-based survey, data was collected from 451 Information Technology and software development firms in the US. The survey instrument was validated by an expert panel which included practitioners and researchers. The survey population consisted of Information Technology and software engineering managers who work on offshore IT and software development projects. Statistical methods including Chi-Square and Cramer's V were used to test the research hypotheses.

The results of the analysis show that IT companies applying CMM/CMMI models have fewer issues associated with IT offshoring. When US IT companies utilize and incorporate different practices from TSP and People-CMM into CMMI-DEV/SVC and CMMI-ACQ, they have fewer offshoring issues related to language barriers and cultural differences.

The results of this research contribute to the existing body of knowledge on the offshoring of IT services from the client management perspective and provide practitioners with increased knowledge regarding IT offshoring decisions.

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Chapter 1: Introduction

Information Technology (IT) service offshoring describes the transfer of IT services to an offshore supplier in a near or far away country. The services themselves are partially or totally transferred (Carmel and Agrawal, 2002a, Hirschheim et al., 2005, Jahns et al., 2007, Mirani, 2006, Lacity and Rottman, 2008, Agrawal et al., 2003, Carmel and Agrawal, 2002b). IT offshoring is worthy of research because it has specific characteristics that distinguish it from the well-researched field of IT outsourcing. IT services and software development offshoring is becoming a dominant paradigm in the IT services and software development industry (Rottman and Lacity, 2008, Raffo and Setamanit, 2005).

Western countries' information technology and software intensive firms are attracted to offshoring in developing countries because of the promised benefits of: lower costs, faster delivery, the ability to focus their in-house IT staff on higher value work, access to supplier resources, capabilities and process improvement (Carmel and Beulen, 2005). Not all IT service and software development projects benefit from offshoring as half of the organizations that shifted processes offshore failed to realize the benefits they expected (Ferguson, 2004a, Ferguson et al., 2004, Lacity and Rottman, 2008, Lacity et al., 1996). The literature indicates that 20% of offshore software development contracts are cancelled in the first year, more than 25% of all offshore software development projects are cancelled outright before completion and 80% of offshore IT projects overrun their budgets (Kendall et al., 2007, Jørgensen, 2014, Ebert, 2013).

IT services and software development offshore projects pose substantial issues and challenges to the client companies in managing these projects (Ebert et al., 2008). In IT service offshoring, delivery occurs under the additional condition of distance between the service supplier and the client in terms of physical distance, time zone differences or cultural differences. Additionally, complexity increases due to the higher degree of geographical dispersion among team members (Holmström et al., 2008, Yalaho and Nahar, 2009, McIvor, 2000, Raffo and Setamanit, 2005). Therefore, there is a need to utilize different methods to effectively and efficiently mitigate the issues and challenges of offshoring.

A growing number of organizations are adopting the Software Engineering Institutes' (SEI) Capability Maturity Model (CMM) and Capability Maturity Model Integrate (CMMI) to improve their IT service and software development process. CMM/CMMI models were originally developed as methods for the objective evaluation of contractors in military software projects (outsourcing) (Humphrey, 2002, 2010b, Philips, 2011). The CMM/CMMI models are internationally adapted and have received great publicity in the software development industry (Biberoglu and Haddad, 2002). CMM/CMMI models became an industry standard based on industry best practices and features an industry standard appraisal methods (Olson, 2008, Dubey, 2003).

The literature reveals that CMM/CMMI has been well researched and proven to mitigate the issues and challenges of *outsourcing* IT services and software development projects (Ramasubbu et al., 2005, April et al., 2005, Lutteroth et al., 2007, Davis and

Mullaney, 2003, McHale, 2003, Paulk et al., 1993, Gibson et al., 2006, Garcia et al., 2006, Humphrey, 2005a, Sutherland et al., 2008, Jiang et al., 2004, Dion 1993, Gopal et al., 2002a, Evaristo et al., 2004, Humphrey et al., 1991, Adler et al., 2005, Goldenson and Gibson, 2003). However, there is limited research and investigation of CMM/CMMI best practices and how they mitigate the issues and challenges of *offshoring* of IT services and software development projects (Sengupta et al., 2006b, Lasser and Heiss, 2005, Prikladnicki et al., 2007, Ebert, 2007, Ebert et al., 2008, Gopal et al., 2002b). Therefore, this study examined the relationship between CMM/CMMI software process development and 1) the issues and challenges of offshoring IT services projects and 2) offshore IT services project performance outcomes.

This Chapter introduces the research. Section 1.1 presents the research background. Section 1.2 provides the objective of the study. Section 1.3 defines the research questions that are the focus of this study. Finally, section 1.4 provides the organization of the dissertation.

1.1 Research Background

Offshoring is the outsourcing or/and insourcing of information technology (IT) work to a third party supplier located on a different continent than the client (Rottman and Lacity, 2008). The globalization of resources has resulted in a dramatic increase in offshoring. Although client companies have offshored manufacturing services for decades, the practice of offshoring IT services is still maturing.

The offshoring of IT services (primarily in India) will conservatively represent 25% of the global US$ 1 trillion in 2014 (Kathpalia and Raman, 2014).

Gartner reported that the top five Indian IT vendors namely TCS, Cognizant, Infosys, Wipro and HCL Technologies grew 13.3 percent in 2012 to reach $34.3 billion in 2012, exceeding global IT services industry growth rate of 2 percent. The North American markets currently contribute to roughly 70% of the revenue of the Indian IT service companies (Kathpalia and Raman, 2014).

Academics have been studying domestic IT outsourcing since the early 1990s. The first published outputs from academic research appeared in 1991 and documented companies pursuing large-scale domestic IT outsourcing (Applegate and Montealegre, 1991, huber, 1993). However, the global software industry experienced exponential growth since the mid-1990s (Greenemeier, 2002, Correa, 1996, Patane and Jurison, 1994). Many companies used offshoring strategies hoping to reduce costs (Williamson, 1985). However, according to Lacity and Willcocks (2001, pp. xi-xiv) (Lacity and Willcocks, 2001), firms are recently citing new drivers for offshoring such as: 1) increased efficiency regarding faster delivery, 2) access to first class technical professionals, 3) the ability to expand software development capacity at minimal cost, 4) enhanced customer service quality, 5) reduced risks of late project completion and increasing costs, 6) enhanced flexibility and 7) increased competitive ability (Lacity and Willcocks, 2001). On the other hand, contrary to popular perceptions, many companies have had mixed or diverse results. Half of the organizations that shifted processes offshore failed to generate the financial benefits they expected (Ferguson, 2004a, Lacity and Willcocks, 2001, Lacity and Willcocks, 1998, Lacity et al., 1996) and 50% of the offshoring contracts by North American companies signed between 2001 and 2004 are likely to fail to meet goals, according the predictions of both Gartner and Boston Consulting Group (Aron and J.Singh, 2005). Gartner and Boston Consulting Group found that 50% of the offshoring contracts by North American companies fail to meet their expectations (Moe et al., 2013).

Although offshoring IT is technically possible because any work that can be digitized can be moved to an offshore supplier(s), there are many managerial challenges (Rottman and Lacity, 2008). One common complaint was that overall cost savings were less than anticipated due to the high transaction costs associated with finding suppliers, coordinating and monitoring the work done offshore (Ferguson, 2004b, Golder, 2004). Other common complaints were poor initial quality, late deliveries and personnel issues such as high supplier turnover that interfered with success (Lacity and Rottman, 2008).

IT services contain a range of activities such as: software application development (web design development, e-commerce projects), database administration, software customization, IT calling centers, IT help desk support, software maintenance (remote software maintenance, feature enhancement), operations and facility management (Lacity and Rottman, 2008). IT service offshoring may either be a one-time limited-duration project or a long-term relationship.

In the area of IT offshoring, academics are trying to understand how offshoring differs from domestic outsourcing. So far, researchers have found that offshoring poses additional challenges compared with domestic outsourcing (Rottman and Lacity, 2006). For example, offshoring is more challenging because of: time zone differences (Carmel, 2006), the need for more control (Chaudhury and Sabherwal, 2003, Choudhury and Sabherwal, 2003), cultural differences (Carmel and Tjia, 2005, Prikladnicki et al., 2003), defining requirements more rigorously (Chaudhury and Sabherwal, 2003, Gopal et al., 2003), the difficulties in managing dispersed teams (Oshri et al., 2008), and politically driven interests between the client and the service provider (Orlikowski, 2002). Researchers are also looking at offshoring at both the decision and relationship levels (Rivard and Aubert, 2007).

In the offshoring selection decision, many organizations use the candidate suppliers' Software Engineering Institute' Capability Maturity Model (CMM) and Capability Maturity Model Integration (CMMI) maturity level as part of the supplier selection criteria. Suppliers want to maximize their chances of winning business from companies that are pursuing offshoring services. Since CMMI maturity level ratings serve as a differentiator, these organizations want to position themselves among the elite. In CMMI terms, maturity level five indicates the world class possible performance.

Applying the CMMI model forces companies to commit to a number of instrumental procedures and assessments. Getting the CMMI accreditation is a great advantage for the client companies. It improves the quality of the products and services as well as improving the productivity of the companies by enhancing work procedures. Getting the CMMI accreditation also promotes and reinforces the company's capabilities to predict a project's schedule, achieve a higher return on investment and enhance the capability to manage challenges and issues associated with the outsourcing of IT services.

CMM/CMMI models including their respective practices have been well researched and they have proven to mitigate the issues and challenges of outsourcing IT services and software development projects (Ramasubbu et al., 2005, April et al., 2005, Lutteroth et al., 2007, Davis and Mullaney, 2003, McHale, 2003, Paulk et al., 1993, Gibson et al., 2006, Garcia et al., 2006, Humphrey, 2005a, Sutherland et al., 2008, Jiang et al., 2004, Dion 1993, Gopal et al., 2002a, Evaristo et al., 2004, Humphrey et al., 1991, Adler et al., 2005, Goldenson and Gibson, 2003, Hu et al., 2012, Kishore et al., 2012, Chang et al., 2012). Although these process improvement approaches were originally developed as methods for the objective evaluation of contractors for military software projects (outsourcing) and were not designed with offshoring development in mind, they are now widely adapted in both domestic and international firms and have received great publicity in the software development industry (Biberoglu and Haddad, 2002, Fitzgerald and O'Kane, 1999, Jiang et al., 2004, Amberg and Wiener, 2005, Dubey, 2003, Meyer, 2006, Gibson et al., 2006). However, there is limited research and investigation of CMM/CMMI best practices and how they mitigate the issues and challenges of offshoring of IT services and software development projects (Sengupta et al., 2006b, Lasser and Heiss, 2005, Prikladnicki et al., 2007, Ebert, 2007, Ebert et al., 2008, Gopal et al., 2002b, Nöhren and Heinzl, 2012).

The literature shows that organizations applying CMM/CMMI practices for their outsourced IT projects improve their ability to deliver on the agreed upon schedule, cost, and quality levels (Gibson et al., 2006, Sutherland et al., 2008, Dion 1993, Butler, 1995, Herbsleb and Goldenson, 1996b, Goldenson and Gibson, 2003, Chang et al., 2012, Kishore et al., 2012, Hu et al., 2012, Kronawitter et al., Kronawitter et al., 2013). However, there is limited research on CMM/CMMI practices and their effects on projects success factors of delivering on time, within budget and meeting the agreed upon quality in offshoring IT services and software development projects (Rottman and Lacity, 2008, Jiang et al., 2004, Nöhren and Heinzl, 2012, Mejia et al., 2013, Simões and Montoni, 2014).

This research investigated how the best practices of CMM/CMMI SEI frameworks can mitigate issues and challenges throughout the lifecycle of offshoring IT service projects from the client management perspective.

1.2 Research Objectives

Critical issues are the challenges that can happen throughout the lifecycle of offshoring IT service projects. This research investigated Software Engineering Institute' Capability Maturity Models and their best practices to manage and mitigate the offshoring issues throughout the lifecycle of IT service projects.

A field survey was developed, validated and tested in multiple ways:

1) A group of students from the Engineering and Technology Management Department (ETM) at Portland State who have experience in IT offshoring.

2) Two expert panels:

   A. Experts in CMM/CMMI models

   B. Experts in offshoring IT

3) Ten IT services companies

1.3 Research Questions

Q1: What is the impact of client firms adopting industry standards on the frequency of issues experienced by client firms when offshoring IT service projects?

Q2: What is the relationship between the maturity level achieved and the frequency of issues experienced by client firms when offshoring IT service projects?

Q3: What is the relationship between industry standard practices and the frequency of issues experienced by client firms when offshoring IT service projects?

Q4: What is the impact of adopting industry standards on the offshored projects' success?

This research answered questions through a theoretical and empirical study. The study focused on the offshoring of IT services projects from the client management perspective. Although the study was conducted among U.S. IT services companies, the results should be generalizable and applicable to other countries. The literature review indicates that offshoring for IT services does not change significantly from one country to another (Aron et al., 2008, Beaumont and Sohal, 2004, Bernroider, 2002, Bhalla et al., 2008, Burmistrov, 2006, Christiansen, 2007, Yalaho and Wu, 2002, Islam and Houmb, 2011, Yalaho, 2006, Sharma et al., 2008, Bahli and Rivard, 2005, Goo et al., 2009).

1.4 Organization of the Dissertation

This dissertation has seven chapters. The first chapter introduces the problem and questions, research objectives and the scope of the research. The second chapter presents the literature review. Chapter two is divided into nine sections: 1) definitions, 2) sourcing options, 3) IT service industry characteristics, 4) whole lifecycle of offshoring IT projects, 5) issues and challenging of offshoring, 6) project success factors, 7) CMM/CMMI models, 8) research gaps and 9) the summary of questions and hypothesis.

Chapter three describes the research design for the dissertation including the research model and the formulation of hypotheses. The development of the questionnaire and expert panel makeup is provided. Additionally, testing and validation of the tools along with sampling and mailing strategy are presented in this chapter.

The fourth chapter presents data collection including instrument design, instrument validation, instrument administration, and then discusses sampling and response rate.

Chapter five presents the data analysis and results. Chapter five begins by presenting general characteristics of the sample as well as reliability analysis. This chapter focuses on hypotheses testing and related results.

Chapter six presents a discussion of results of hypothesis testing and findings.

Chapter seven includes concluding remarks, including contributions to knowledge, future research and limitations.

The appendices included are: Appendix A, Survey instrument; Appendix B, Service Characteristics; Appendix C, Content Validation, Appendix D, Validation of research results; Appendix E, SEI information about their certified companies; Appendix F, Statistical detailed results.

Chapter 2: Literature Review

In section 2.1, definitions of sourcing options are presented and their respective concepts in literature are presented. Sourcing option descriptions are provided in section 2.2. Service industry characteristics and IT service characteristics are presented in section 2.3. Section 2.4 provides the whole lifecycle of offshoring IT projects. Section 2.5 lists issues and challenges of offshoring IT services and software development projects. Section 2.6 presents the project success factors. Section 2.7 presents the capability maturity models CMM/CMMI. Then, section 2.8 presents the research gaps. Lastly, section 2.9 presents a summary of gaps, questions and hypothesis.

2.1 Definitions of Sourcing Options

Outsourcing: is contracting out of goods or services that were previously produced internally to a domestic third party company (Lacity and Hirschheim, 1993b). The client organization and the supplier enter into a contractual agreement that defines the transferred services and/or goods (Insinga and Werle, 2000, Kern and Willcocks, 2000, Loh and Venkatraman, 1992). For IT outsourcing, the following definition was found: “turning over a firm’s computer operations, network operations, software development and maintenance, or other IT functions or services to a provider for a specified time, generally at least a few years” (Pfannenstein and Tsai, 2004).

Outsourcing may be called in-shoring: picking services within a country (Erber and Sayed-Ahmed, 2005); and best-shoring, picking the "best shore" based on various criteria

(Carmel, 2007). Business process outsourcing (BPO) refers to outsourcing arrangements when entire business functions (such as Finance & Accounting, Customer Service, etc.) are contracted out to a third party vendor (outsourced) (Halvey and Melby, 2007, Lacity et al., 1996).

Offshoring is the transfer of an organizational function to another country, regardless of whether the work is outsourced to third party company (vendor) or stays within the same company (Trent and Monczka, 2005, Bhalla et al., 2008, Carmel and Agrawal, 2002b, Kakabadse and Kakabadse, 2002). Whereas Carmel defined Offshoring as performing work for clients in one country using workers located in a different country, this work may be outsourced to an offshore third party provider, or conducted by wholly or partially owned offshore subsidiaries of the onshore parent company (Carmel and Abbott, 2006).

Outsourcing versus offshoring: Outsourcing requires contracting with a supplier, which may or may not involve offshoring, while offshoring is the transfer of a company's function to another country despite whether the work is outsourced or stays within the same company (in-sourced) (Bhalla et al., 2008, Insinga and Werle, 2000). Thus, a company can outsource without going offshore or can offshore without outsourcing (Bhalla et al., 2008).

Offshore outsourcing is defined as a situation where a company (a client) contracts out all or part of its goods or services to a third party company (vendor) who is located in a country other than where that company is headquartered and historically outside of where the product or service will be sold or consumed (Muhammad Ali et al., 2007, Kern and Willcocks, 2000). King defined offshore outsourcing of the software industry as "hiring coders who live overseas, usually in countries where the labor costs are much lower than in developed countries" (Insinga and Werle, 2000).

Near-shoring: Offshoring related concepts include near-shoring, which implies relocation of business processes to (classically) lower cost foreign locations, but in close geographical proximity (e.g., shifting United States-based business processes to Canada/Latin America) (Carmel and Abbott, 2006, Carmel, 1999, Carmel, 2007, Bock, 2008). Moreover, near-shoring, far-shoring and offshoring refer to the fact that some of the duties belonging to a software project are sourced out to a lower wage country (Aspray et al., 2006). The term off or near-shoring seems to be a matter of distance (Carmel and Abbott, 2006). Offshoring is associated with countries being "far away," referring to a distance of more than 1000 kilometers (e. 621 miles) or few hours flight away (Carmel and Abbott, 2006, Carmel, 2007). For example, from a European point of view, the term near-shoring is used for countries closer to their homeland such as Eastern Europe countries while China and India are considered offshoring (Carmel, 2007). Based on the literature, Table 1 lists most of the concepts related to forms of sourcing with their definitions.

Table 1: Forms of Outsource and Offshore Sourcing

Forms	Types	Description
In-sourcing	In-house (Lacity and Willcocks, 1998, Lacity et al., 2008, Metters, 2007)	The clients handle their own IT services and software development projects on their own premises in their home countries.
	Subsidiary (Lacity et al., 2008, Metters, 2007) Domestic captive (Lacity et al., 2008, Metters, 2007)	The client builds, owns, staffs, and operates facility in domestic locations in USA (Trent and Monczka, 2005, Carmel and Agrawal, 2002b).
	Captive service centers (Carmel and Beulen, 2005, Beulen et al., 2005)	Clients provide IT services from their own premises, employees, equipment, and facilities in domestic locations (Beulen et al., 2005).
	Types of Outsourcing	Description
Outsourcing	Outsourcing (Carmel and Agrawal, 2002b) IT outsourcing (Palvia, 1995)	Firms that outsource only domestically (Carmel and Agrawal, 2002b). An agreement in which one company hands over a part or all of their existing internal activity to another company through a contract (Hanna and Daim, 2009b). Contracting part or all of a firm's IT such as data processing, software, communication network, systems personnel or call centers to a third party vendor (Palvia, 1995).
	Outsourcing with domestic supplier (Lacity et al., 1996, Willcocks and Kern, 1998, Lacity et al., 2008) Outsourcing with multiple domestic suppliers (Lacity et al., 1996, Willcocks and Kern, 1998, Lacity et al., 2008, McFarlan and Nolan, 1995, Hoffmann, 1996) Outsourcing with in-state supplier (Lacity et al., 2008) On-shoring (Laplante et al., 2004)	Refers to a company contracting out of goods or services that were previously produced internally to a domestic third party company (Amiti and Wei, 2005, Lacity and Hirschheim, 1993b). The third party can be one or multiple domestic/national vendor or instate provider (McFarlan and Nolan, 1995, Hoffmann, 1996). Onshore represent outsourcing to domestic supplier (Laplante et al., 2004).
	Total outsourcing (Lacity and Willcocks, 1998) Complete outsourcing (Allen and Chandrashekar, 2000)	Contract out more than 80% of the work to an external domestic provider while retaining the management (Lacity and Willcocks, 1998). The transfer of the entire business functions from the outsourcing company to the outsourcing vendor (Allen and Chandrashekar, 2000).
	Total in-sourcing (Lacity and Willcocks, 1998) In-sourcing - contracting-in (Lacity et al., 1996) Fee-for-service contracts (Bhalla et al., 2008, Carmel and Agrawal, 2002b)	Execute work internally (Lacity and Willcocks, 1998). The delegation of operations or jobs from production within a business to an internal (but 'stand-alone') entity that specializes in that job (Lacity et al., 1996). In-sourcing is a business decision that is often made to maintain control of critical production or competencies. An alternate use of the term implies transferring jobs to within the country where the term is used, either by hiring local

		subcontractors or building a facility (Hirschheim and Lacity, 2000).
	Selective outsourcing – smart sourcing – right sourcing (Lacity and Willcocks, 1998) Business process outsourcing (BPO) (Halvey and Melby, 2007, Yang et al., 2007)	Outsource selected processes while still executing internally between 20% and 80%. The company may outsource to single or multiple vendors (Lacity and Willcocks, 1998). The biggest difference between outsourcing and BPO is that the BPO third party vendor providers control all issues related to business processes, human resources and technology (Yang et al., 2007).
Offshoring: Multinational company	Multinational company outsourcing Consultancy companies (Schwalbe, 2010) Multinational enterprises (MNEs)	Companies have their headquarters in high-wage countries open subsidiaries in low-wage countries to work on products and services for their domestic and global market. Companies also can have their headquarters in low-wage countries open subsidiaries in high-wage countries to serve the local market (Niosi and Tschang, 2009, Schwalbe, 2010).
	Value Centers (Trent and Monczka, 2005), Profit value centers (Venkatraman, 1997).	The customer owns and runs the facility as a profit center, offering services to other international companies (Trent and Monczka, 2005, Venkatraman, 1997).
	"Greenfield" subsidiaries (Niosi and Tschang, 2009)	A form of foreign direct investment where a parent company in a developing country starts a new venture in a developed foreign country from the ground up (Niosi and Tschang, 2009).
	Body-shopping (Majumdar et al., 2011)	On-shore temporary hiring from a multinational such as (Indian) firm. Onsite consultancy performed at clients' premises, involving software professionals who act as temporary employees of clients. For international clients, body-shopping keeps work within their home nations and premises. Clients' demand determines how much body-shopping is needed (Majumdar et al., 2011). Normally these services are provided by U.S. domestic subsidiaries of multinational companies (Lacity and Willcocks, 1995) .
	Types of off-shoring	Description
Off-shoring	Near-shore (Laplante et al., 2004) Far-shore/Offshore	Relocation of business processes to (classically) lower cost foreign locations, but in close geographical proximity (e.g., shifting United States-based business processes to Canada/Latin America) (Carmel and Abbott, 2006, Carmel, 1999, Carmel, 2007, Bock, 2008, Laplante et al., 2004). Near-shoring, far-shoring and offshoring refer to the fact that some of the duties belonging to software projects are sourced out to a lower-wage country (Aspray et al., 2006). Whether the term off or near-shoring seems to be a matter of distance (Carmel and Abbott, 2006). Offshoring is associated with countries being "far away," referring to a

		distance of more than 1000 kilometers (e. 621 miles) or few hours flight away (Carmel and Abbott, 2006, Carmel, 2007).
	Dedicated offshore outsourcing (Trent and Monczka, 2005, Carmel and Agrawal, 2002b, Palvia, 1995), Fully owned facility (Leiblein et al., 2002)	The offshore vendor owning the operation dedicated part of its facility to the customer (Trent and Monczka, 2005, Carmel and Agrawal, 2002b, Leiblein et al., 2002, Palvia, 1995).
	Built-operate-transfer (BOT) (Trent and Monczka, 2005, Carmel and Agrawal, 2002b, Colombo, 2003), Strategic alliances/ partnerships (Lacity and Willcocks, 1998)	BOT forms a hybrid between dedicated and captive facilities. The company forms a strategic alliance with an offshoring vendor to set-up and manage an offshore facility with an option to own the facility after the expiration of a specified period (Bhalla et al., 2008, Carmel and Agrawal, 2002b, Colombo, 2003).
	Offshore in-sourcing Captive model (Trent and Monczka, 2005), Wholly owned offshore Captive center (Carmel and Agrawal, 2002b). Subsidiary, Offshore in-sourcing, Global in-sourcing	The client builds, owns, staffs, and operates the offshore facility (Trent and Monczka, 2005, Carmel and Agrawal, 2002b). The company owns and establishes offshore IT centers where foreign technologies workers are employees of U.S. based companies and receive the same training, software tools, and development process guidelines as their western counterparts (Carmel and Agrawal, 2002b, Rao, 2004).
	Types of Offshore Outsourcing	Description
Offshore Outsourcing	Offshore outsourcing (Hanna and Daim, 2009b, Trent and Monczka, 2005, Michell and Fitzgerald, 1997) Global outsourcing International outsourcing (Carmel and Agrawal, 2002b, Amiti and Wei, 2005)	A contract or agreement with the vendor for his services. The company offshore outsources one or more project based on a contract(s) for a fixed cost and depending on identified deliverables and time schedules (Hanna and Daim, 2009b, Rivard and Aubert, 2007). The offshore vendor owns, builds, staffs and operates the facility on behalf of the customer (Trent and Monczka, 2005, Lacity and Willcocks, 1998, Michell and Fitzgerald, 1997).

2.2 Sourcing Options

There are four major types of sourcing options for U.S. IT services and software development projects: 1) in-sourcing, 2) outsourcing, 3) offshoring, 4) offshore outsourcing as shown in Table 1 and Figures 1 and 2.

SOURCING OPTIONS

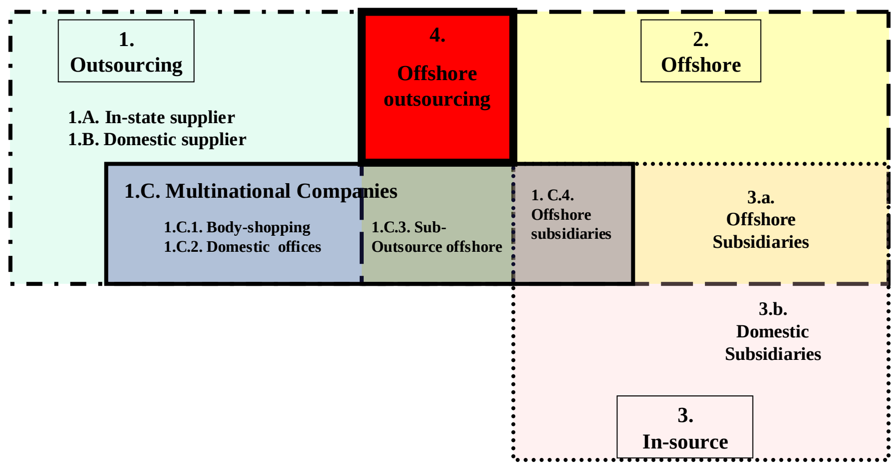


Figure 1: Sourcing Options

1. In-sourcing**:** Decision makers decide to keep the IT services and software production in house on their own premises and in their home countries. Clients may also decide to build and operate their own facilities in domestic locations in their own country as domestic subsidiaries (Trent and Monczka, 2005, Carmel and Agrawal, 2002b).

2. Outsourcing: Decision makers decide to contract out part or all of a firm's IT services and software development to a domestic third party vendor (Palvia, 1995). The third party can be one or multiple domestic/national vendors or an instate provider (McFarlan and Nolan, 1995, Hoffmann, 1996).

Outsourcing with multinational companies: Companies have their headquarters in high-wage countries open subsidiaries in low-wage countries to work on products and services for their domestic and global markets. Companies also can have their headquarters in low-wage countries and open subsidiaries in high-wage countries to serve their local market(s) (Niosi and Tschang, 2009, Schwalbe, 2010). For instance, some Indian enterprises set-up wholly owned facilities overseas to perform parts of the software development process. The most common practice is to perform systems analysis and design work at the customers' site while the rest of the development process is done from Indian and other locations of offshore development centers (Majumdar et al., 2011, Khan et al., 2003). Key Indian players are Tata Consultancy services (TCS), Wipro and Infosys as shown in Table 2.

Table 2: The Top 10 Multinational Companies Worldwide

Business Services	Software Development	Call Centers
1. Hewitt Association U.S. 2. ACS U.S. 3. Accenture U.S. 4. IBM U.S. 5. EDS U.S. 6. Hewlett-Packard U.S. 7. Wipro India 8. HCL Technology India 9. Tata Consultancy Services India 10. WNS Global Services India	1. Tata Consultancy Services India 2. Infosys Technology India 3. Wipro India 4. Accenture U.S. 5. IMB U.S. 6. Cognizant Technology Solutions U.S. 7. Satyam India 8. Patni Computer Systems Inida 9. EDS U.S. 10. CSC U.S.	1. Convergys U.S. 2. Wipro India 3. ICICI OneSource India 4. ClientLogic U.S. 5. 24/7 Customer India 6. SR.Teleperformance France 7. eTelecare International U.S. 8. SITEL U.S. 9. Teletech U.S. 10. CustomerCorp U.S.

Source: National Association of Software and IT Service Companies (NASSCOM) – India's software regulatory board – http://www.nasscom.org July 2002 (Gold, 2004). Business Week (2006) (Engardio, 2006).

Multinational companies such as Genpact, Accenture, IBM Services, Tata or any other offshoring multinational company (see Table 2) may dispatch teams to thoroughly investigate the workflow of an entire IT department. The team then helps build a new

IT platform, redesigns all processes, administers programs and acts as a virtual subsidiary. The contractor then disperses work among a global network of staff ranging from the U.S. to Asia and to Eastern Europe (Engardio, 2006).

In one example, Tata Consultancy Services TCS is part of the Tata Group. The TCS was founded in 1968 as a consulting service firm for the emerging IT industry. By 2006, TCS had expanded to become a global player with revenue over USD 2 billion with over 74,000 associates and 50 service delivery centers in 34 countries. TCS has developed a global delivery model in which projects are handled mainly by teams located remotely from clients, but are also often handled with small teams at the client's site. Usually, TCS's on-site and offshore teams conduct frequent interaction and collaboration with each other until a task is completed. TCS project teams based on-site, onshore, near-shore and offshore work together depending on the expertise and knowledge that reside within TCS's different locations. In an example from late 2005, Netherlands based ABN AMRO Bank announced a USD 1.2 billion outsourcing contract with five providers. Tata Consultancy Services was one of the five and provided support and application enhancement services. The outsourcing project of the ABN AMRO Bank TCS contract consisted of three arrangements across three continents. Each arrangement type has an on-site component at the client site and a remote component somewhere else (Oshri et al., 2008).

3. Offshoring in-sourcing**:** Occurs when an organization moves work from one location to another location on a different continent (Rottman and Lacity, 2008, Rottman and

Lacity, 2006). Researchers call it offshore in-sourcing and offshore subsidiaries (King, 2005).

4. Offshore outsourcing: Offshoring of IT Services and software development work to a third party supplier located on a different continent than the client (Rottman and Lacity, 2008, Rottman and Lacity, 2006). Offshore outsourcing and offshore in-sourcing are the focus of this research.

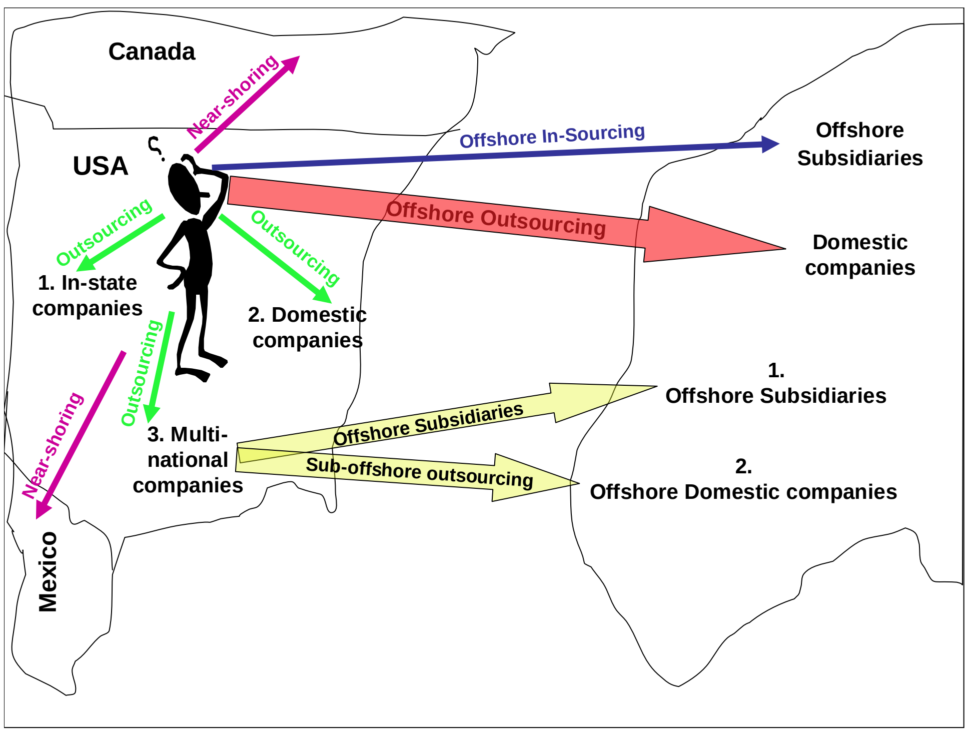


Figure 2: Outsourcing and Offshore Options

2.3 Service Industry Characteristics and IT Service Characteristics

A. Services are "activities, benefits or satisfactions which are offered for sale, or are provided in connection with the sale of goods" (Regan, 1963). Lovelock defined service as "a process or performance rather than a thing" (Lovelock, 1981). Most researchers regard services to be activities, deeds or processes, and interactions (Vargo and Lusch, 2004, Solomon et al., 1985, Lovelock, 1991). Hill defined services as “a change in the condition of a person, or a good belonging to some economic entity, bought as the result of the activity of some other economic entity, with the approval of the first person or economic entity” (Hill, 1977). This definition is accepted by the U.S. Government as the basis for defining service products in the new North American Product Classification System (NAPCS) (Chesbrough and Spohrer, 2006, Mohr and Russel, 2002).

To understand the differences between services and goods, four characteristics that describe the unique nature of services were first proposed in the early services marketing literature, are widely accepted by scholars and are consistently cited in the literature: intangibility, heterogeneity, inseparability and perishability (IHIP) (Regan, 1963, Rathmell, 1966, Shostack, 1977, Zeithaml, 1981, Zeithaml et al., 1985, Edvardsson et al., 2005).

Intangibility of Services: This is the basic difference between services and goods generally cited by authors (Rathmell, 1966, Shostack, 1977, Bateson, 1979, Berry, 1980, Lovelock, 1981, Rathmell, 1974). Since services are performances, rather than objects, they cannot be directly experienced, felt, tasted, touched and smelled as well as tested in the similar way in which goods can be sensed (Levitt, 1981).

Inseparability of Services: The simultaneous delivery and consumption of services which characterizes most services (Zeithaml, 1981, Bowen, 1990, Donnelly, 1976, Onkvisit, 1991, Wyckham, 1975). While goods are first produced, then sold and then consumed, services are sold first, then produced and consumed simultaneously such as a haircut and a doctor's visit (Regan, 1963).

Heterogeneity of Services (Non-standardization): As the service performance is delivered by different people and the performance of people can vary from day to day, therefore, heterogeneity is a significant problem for services with a high labor content, (Rathmell, 1966, Zeithaml et al., 1985, Carman and Langeard, 1980, Onkvisit, 1991). However, heterogeneity provides a degree of flexibility and customization of the service (Onkvisit, 1991). Thus, heterogeneity can be introduced as a benefit and a point of differentiation (Wyckham, 1975).

Perishability of Services (Cannot be inventoried): Services cannot be stored and carried forward to a future time period (Rathmell, 1966, Zeithaml et al., 1985, Donnelly, 1976).

B. Considerations on the characteristics of services:

Over the past 20 years, several types of customer service are offered through technology. The majority of these technology-delivered services are started and completed by the consumer and do not require any direct or indirect contact with the service provider (seller). The consumer starts the process using internet technology, completes the interaction without ever being in face-to-face or voice contact with an employee (Barnes et al., 1997). Examples include banking technology based self-service options such as ATMs and online banking services. Other examples include: automated airline ticketing, hotel reservations and room checkout, self-scanning at retail stores and home shopping using the internet. In the education sector, students register for university courses, collect their grades online and schools provide online classes where students and teacher interact virtually on the internet ((Dabholkar, 1997, Dabholkar, 1994).

A series of articles have brought to the forefront the idea of the market-space transaction as replacing the traditional marketplace transaction. The market-space is "a virtual realm where products and services exist as digital information and can be delivered through information based channels (Rayport and Sviokla, 1994, Rayport and Sviokla, 1995). Based on the evolution in the information technology, it is not necessary for buyer and a physical seller to be present to facilitate a successful transaction (Barnes et al., 1997). Providing service through technology is usually more cost-effective for the service provider. The technology is reliable and consistent in delivering service and it provides high levels of efficiency. It is available 24 hours a day, 7 days a week. The customer can access the service at any time, from any location and completely at his/her convenience. The level of service provided is consistent from location to location and incident to incident (Barnes et al., 1997).

Moreover, firms from all industries can customize their offerings by providing contact employees with cutting edge technological tools. This front office automation includes various tools such as: powerful databases, sales force automation, call center management, helpdesk applications, product and price configuration tools (Fisher, 1998). Appendix B provides considerations associated with the service characteristics of intangibility, heterogeneity, inseparability and perishability (IHIP).

C. Information Technology Services and Service Characteristics

IT services contain an array of activities such as: database administration, development and customization, calling centers, software development and maintenance and help desk support. Software development consists of three kinds of activities: 1) services designed to produce improved functionality by developing new custom applications, or changing or improving customized or packaged applications; 2) the integration, detailed design, and execution of management services to connect applications to each other and/or with existing IT infrastructure; 3) deployment services provided to support the implementation of new applications (Sadlowski, 1998). An IT service organization may maintain hardware configurations, handle software development, distribution, maintenance and run a computer center (Niessink and Vliet, 2000). Thus, IT services are offered by "operating, managing, installing, or maintaining the information technology of a customer or supporting the users of that technology" (Niessink and Vliet, 2000). Table 3 provides IT service characteristics in comparison to the service characteristics.

Table 3: IT Services Characteristics in Comparison to the Service Characteristics

Service characteristics	IT Services
Intangibility	• Most IT services are entangled with goods, where the choice of software and maintenance is linked to the computer such as specific operating system or software needs specific computer specifications in order to operate perfectly (Miozzo and Soete, 2001). • The production or development of many services is, in turn, dependent on inputs from the informational goods such as computers, communications infrastructure, neural networks, electronic circuits, microprocessors, and internet communications, logistic and route planning (Miozzo and Soete, 2001). • IBM, Digital, and other computer manufacturers have developed remote support centers to monitor and diagnose problems in computers operated by their customers (Rada, 1987).
Inseparability Of Production And Customer	• Services that were mainly controlled by geographical or time propinquity of production and consumption were mostly affected by the information technology infrastructure which increased the transportability of service activities (Soete, 1987). Therefore, IT made it possible for services to be produced in one place and consumed simultaneously in another, such as the software development and maintenance that can be executed in India or Russia and consumed in America or Europe (Muhammad Ali et al., 2007, Gopal et al., 2002a). • Software maintenance, database development and administration and the actual software maintenance are executed separate from the consumer (Niessink and Vliet, 2000). • Information technology services are partially, if not fully, "produced" separate from the consumer (Lovelock and Wirtz, 2004).
Heterogeneity (Non-standardization)	• The homogeneous perception of quality due to customer preference idiosyncrasies (or due to customization) can also benefit goods manufacturers. For instance, computer manufacturers (e.g., Dell and Apple) allow customers to specify their options at purchase time resulting in just-in-time manufacturing of heterogeneous goods that meet the customers' needs (Vargo and Lusch, 2004). • The infrastructure of IT such as: email, Internet, mobile telephony, IT service applications, and operating systems are standardized (Gummesson, 2007).
Perishability (Cannot be inventoried)	• "The claim that services cannot be stored is nonsense. Services are stored in systems, buildings, machine, knowledge, and people" (Gummesson et al., 2000). • Customers that participate in software developments by providing the requirement acquire knowledge which represents part of the stored service's value (Miozzo and Soete, 2001). • The ICT enabled codifying and transmitting knowledge as well as the ability to reuse and recombine that knowledge. The information is not consumed in the

	exchange but remains available for additional use or reuse by others (Romer, 1986).

The difference between products and services is not clear (Edvardsson et al., 2005, Gummesson, 2007, Baker, 2006, Gronroos, 2007, Grönroos, 2007). As Figure 3 shows, products and services can be entangled. For example, the restaurant meal, the product represented is the food itself, the physical environment and the services are essential to the customer. IT services contain both software development and software maintenance. It was argued that software development results in a product (operation system or financial or inventory system) that can be sold as a final product but still needs a computer to operate. At the same time, while the software maintenance results in service being delivered to the customer but it still needs the computer hardware in order to be able to execute the software maintenance (Niessink and Vliet, 2000).

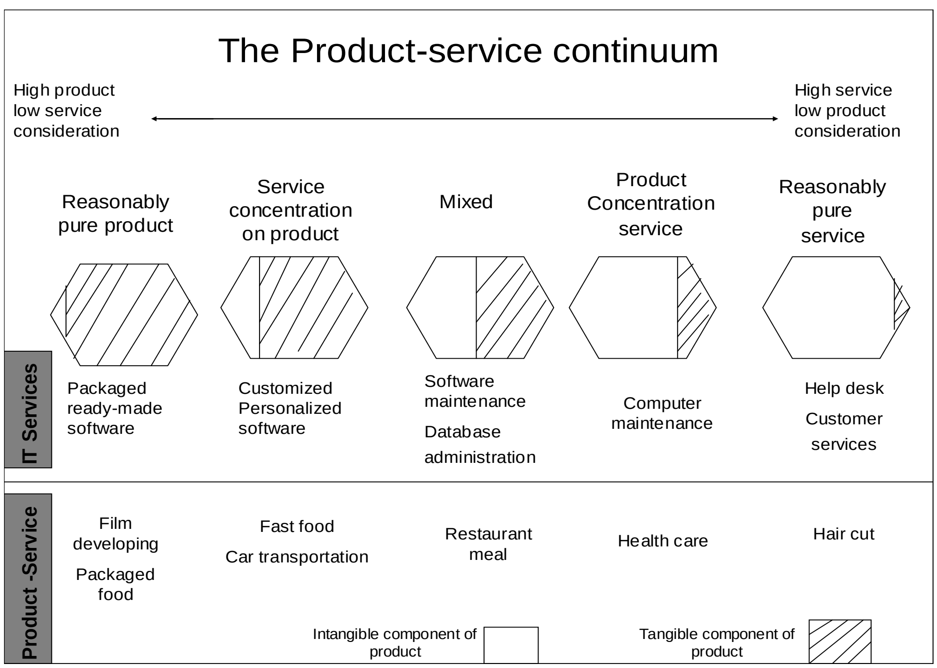


Figure 3: The product-service continuum

Source: (Berry and Parasuraman, 1991, Niessink and Vliet, 2000, Edvardsson et al., 2005)

2.4 Lifecycle of IT Service Offshoring Projects

The Lifecycle model is partitioning of the life of a product, service, project, work group, or set of work activities into phases(2010a). IT service and software development lifecycle is the implemented process for managing the development of the deliverable product. For software, the development lifecycle includes the following major phases: (1) translating user needs into software requirements, (2) transforming the software requirements into design, (3) implementing the design in code, (4) testing the code and (5) installing and checking out the software for operational use. These activities may overlap and may be applied iteratively or recursively (Kendall et al., 2007, 2010a).

The product lifecycle is the period of time, consisting of phases, that begins when a product or service is conceived and ends when the product or service is no longer available for use. Since an organization can be producing multiple products or services for multiple customers, one description of a product lifecycle may not be adequate. Therefore, the organization can define a set of approved product lifecycle models. These models are typically found in published literature and are likely to be tailored for use in an organization.

A product lifecycle could consist of the following phases: (1) concept and vision, (2) feasibility, (3) design/development, (4) production and (5) phase out (2010a, Kendall et al., 2007, Lutteroth et al., 2007).

Offshoring of IT services lifecycle considered for this research consists of the following six phases: 1) strategic analysis, 2) country selection, 3) supplier selection, 4) negotiating the contract, 5) execution of the transition plan, 6) evaluate results and taking corrective actions.

The following section 2.4.1 will review the previous prescriptive lifecycle models in the literature and explains the lifecycle considered for this research.

2.4.1 Review of Previous Lifecycle Models of Offshoring

Table 4: Lifecycle of Offshoring IT Service Projects in the Literature

Author (s)	Phase 1 Strategic Analysis	Phase 2 Country Selection	Phase 3 Supplier Selection	Phase 4 Negotiating the Contract	Phase 5 Execute the Transition Plan	Phase 6 Evaluate and Termination
Johnson (1997) (Johnson, 1997)	✓		✓		✓	
Lonsdale and Cox (1998) (Lonsdale and Cox, 1998)	✓	✓	✓			✓
Greaver II (1999) (Greaver-II, 1999)	✓		✓	✓		✓
Momme, (2002) (Momme, 2002)	✓			✓	✓	✓
Franceshini, Galetto, Pinnatelli, Veretto (2003) (Franceschini et al., 2003)	✓		✓	✓		✓
Yalaho, Wu, Nahar, Kakola (2004) (Yalaho et al., 2004)	✓	✓	✓	✓		✓
Yalaho, Nahar (2009) (Yalaho and Nahar, 2009)	✓	✓	✓	✓	✓	✓

From Table 4 above, several scientists provided offshoring IT project's lifecycles, but each presented limitations. Momme (2002) (Momme, 2002, Momme and Hvolby, 2002) developed a lifecycle model for outsourcing in the manufacturing industry. This framework is considered one of the important steps toward categorizing and defining the whole lifecycle of outsourcing. He viewed the phases from the operational point of view and listed them sequentially as: 1) competence analysis, 2) assessment and approval, 3) contract negotiation, 4) project execution and transfer, 5) managing the relationship and 6) contract termination. This lifecycle was developed building on the work of three research studies as in Table 5.

Table 5: Summary of Lifecycle Research Studies

Authors	Phases of outsourcing lifecycle
Johnson (1997) (Johnson, 1997)	1) strategic analysis, 2) identifying the best candidates, 3) defining the requirements, 4) selecting the suppliers, 5) transitioning the operations, 6) managing the relationship.
Lonsdale and Cox (1998) (Lonsdale and Cox, 1998)	1) assessment of the criticality of business activity, 2) assessment of the supply market, 3) selection of appropriate types of supplier relationship, 4) selection of supplier, 5) supplier management, 6) re-tender or return in-house.
Greaver II (1999) (Greaver-II, 1999)	1) planning initiatives, 2) exploring strategic implications, 3) analyzing cost/performance, 4) selecting providers, 5) negotiating terms, 6) transitioning resources, 7) managing relationships.

Source: Momme (2002) utilized to build on his outsourcing lifecycle

Momme's framework combined the phases of the whole lifecycle into strategic planning. This framework consists of a logical sequence of main actions with incorporated performance measures and the expected output for each of the phases. Momme's lifecycle emphasized all generic phases. However, this lifecycle has some limitations 1) Challenges and issues management as well as identification activities are not formally mentioned in Momme's lifecycle. 2) This lifecycle only addresses the outsourcing while offshoring is not particularly mentioned. 3) More importantly, Momme visualizes relationship management as a phase that comes after project execution and transfer. The argument here is that relationship management starts from the contract negotiation phase, goes through project implementation phase and then the contract may be renewed or terminated. Thus, it is an evolving activity that spans many other phases and is not a stand-alone phase.

Franceshini *et al.* (2003) (Franceschini et al., 2003) provided, in accordance with the principles of total quality management, a guideline for a structured outsourcing lifecycle. Different decision and analysis tools support this approach utilizing examples such as benchmarking techniques and multiple criteria decision-aiding methods. Their lifecycle consists of four major phases: 1) internal benchmarking, 2) external benchmarking analysis, 3) contract negotiation and 4) outsourcing management. Then, the phases are further divided in sequence of activities. For example, within the internal benchmarking analysis phase, the decision maker monitors processes, analyses efficiencies and determines what to outsource. The external benchmarking phase is focused on the relationship between the client and the service supplier, from the provider selection to strategic relationship management. The contract negotiation phase is the result of the preceding phase of analysis and decision. Lastly, the outsourcing management phase consists of the recognition of the designed outsourcing process. Their model is of great value once the outsourcing decision has been made because it can be used to monitor performance (Franceschini et al., 2003).

Another offshoring lifecycle model was developed by Yalaho *et al.* (2004) (Yalaho et al., 2004). The model was built on the model of Momme (2002) (Momme, 2002). The lifecycle involves seven distinctive phases. Even though the authors adapted the model of Momme (2002) (Momme, 2002) to make it suitable to the offshoring lifecycle, limitations exist in this study. Relationship management is considered a distinctive phase in the process of offshoring and begins after the project implementation. Thus, more research is still required in the offshoring lifecycle.

A conceptual maturity lifecycle model for IT outsourcing relationships was presented by Gottschalk and Solli-Saether (2006) (Gottschalk and Solli-Saether, 2006). They based their study on organizational theories and outsourcing practices and through it they identified three phases of maturity in outsourcing relationships: 1) cost phase, 2) resource phase and 3) partnership phase. They claimed that economic benefits are the first relationship focus, then access to competence is the concern and finally the main focus is development of norms and contract/alliance management. They suggested that a long term IT outsourcing relationship will change focus as it matures. This study is the theory based phase model and is exclusively dedicated to the maturity of outsourcing relationships and does not offer a complete description of how the offshoring lifecycle progress (Gottschalk and Solli-Saether, 2006).

In summary, reviewing the literature reveals that most of the existing offshoring lifecycle models are linear, where all phases of offshoring are plotted on one simple horizontal line as indicated in part 1 of Figure 1 (McIvor, 2000, Kern and Willcocks, 2000, Greaver-II, 1999, Yalaho et al., 2005, Yalaho et al., 2004, Yalaho, 2006, Johansson et al., 2003, Lonsdale and Cox, 1998, Bagchi and Virum, 1998, Fill and Visser, 2000, Pai and Basu, 2007, Bagachi and Virum, 1998). Empirical studies showed that this is not the case. For example, relationship management and risk management are evolving activities that span many other phases and are not standalone phases (Yalaho and Nahar, 2008, Lacity et al., 1996, Willcocks and Lacity, 1999, Beulen et al., 2005, Aron et al., 2008, Ellram et al., 2008, Aubert et al., 2005, Hanna and Daim, 2009b, Hanna and Daim, 2009a).

In this research, I am building on Momme (2002) (Momme, 2002), Yalaho (2004) (Yalaho et al., 2004) and (2009) (Yalaho and Nahar, 2009). The lifecycle of IT service offshoring projects and considered the following stages: 1) Strategic analysis phase, 2) Country selection phase, 3) Supplier selection phase, 4) Negotiating and signing the contract phase, 5) Project execution phase and 6) Evaluation and termination phase. Two phases spanned other phases: (1) the risk (issues) management phase and (2) the relationship management phase as in Figure 4.

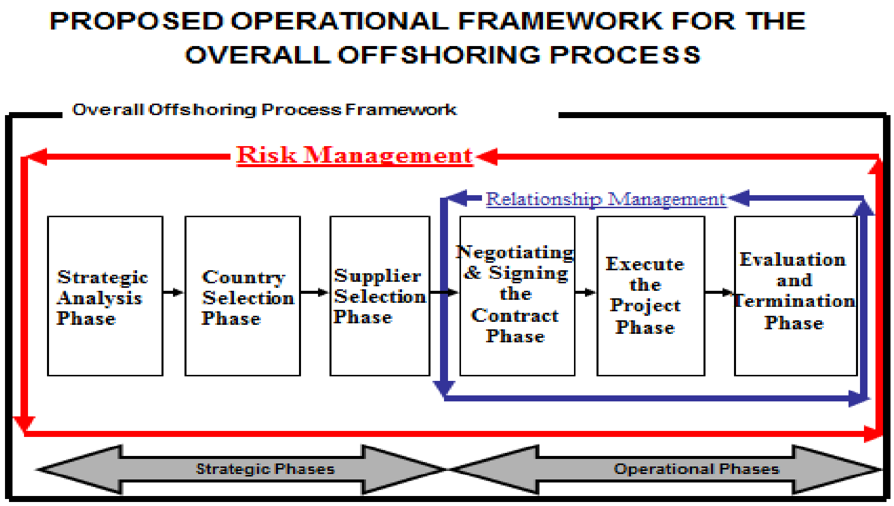


Figure 4: The Lifecycle of IT Service Offshoring Projects

Source: (Greaver-II, 1999, Momme, 2002, Yalaho et al., 2004, Momme and Hvolby, 2002, Bagachi and Virum, 1998)

2.5 Critical Issues and Challenges of IT Service Offshoring

Critical issues are the challenges that can happen throughout the lifecycle of offshoring IT service projects. This research investigated CMM/CMMI best practices to manage and mitigate these issues throughout the lifecycle of executed offshoring projects in the IT services industry.

One of the basic challenges of offshoring of IT services is the inability to communicate effectively across distances, cultures and time-zone differences (Sengupta et al., 2006b, Raffo and Setamanit, 2005). These issues were particularly acute in requirements management since it is one of the most collaborative intensive activities in IT services and specifically software development. Several studies reported difficulties in gaining a shared understanding of requirements and in managing requirement changes (Raffo and Setamanit, 2005, Overby, 2003).

Based on the literature review, this section identified issues and challenges associated with each phase of the lifecycle of IT service offshoring projects (Table 6).

Table 6: Lists Critical Issues of Each Phase of the Lifecycle of Offshoring IT projects

Phase	Issues	Description
Phase 1: Offshoring Strategic Analysis issues	Goals and objectives are unclearly defined	Are the client's objectives to reduce costs? Or, to access talents as well as their innovative (Leiblein et al., 2002). The lack of clearly defined objectives may lead to making the decision to offshore without complete information based on internal domestic costs and resources.
	Lack of top management support of the project	Offshore sourcing is all about decisions made by senior managers and how involved they are in each phase of the process. Most importantly, what skill set they own and how they are using it. Early involvement of top-level management can be fundamental in ensuring that all aspects of the offshored projects are monitored and improved where needed (Hanna and Daim, 2009b).
	Failure to see the broader perspective	Many client decision makers fail to see the broader perspective (Carmel and Tjia, 2005) of offshoring. The management responsibility also requires the awareness of cultural and legal differences and of risks associated with offshoring in general (Davey and Allgood, 2002).
	Selecting the wrong projects	Managers that do not carefully select which IT service activities to offshore might be the reason for the IT services offshoring projects to fail to produce the expected cost savings or other benefits (Barthelemy, 2001, Faraj and Sproull, 2000). Selecting a wrong IT service and software development project for offshoring has great consequences that are discussed in the offshoring literature (Kliem, 2004, Aron and J.Singh, 2005, Gonzalez et al., 2005).
	Lack of sufficient financial resources and unrealistic expectations	Lack of sufficient financial resources (or human) and unrealistic expectations (Londe, 2004, Dubie, 2008) of clients and suppliers can weaken or even fail the IT services and software development projects. In general, small and medium-sized companies have neither the financial nor the necessary human resources that big companies usually possess. Consequently, various projects were stopped due to lack of financial resources.
	Organization size (size barrier)	The size of the client firm relative to the service provider is an important variable in the offshoring situation and strongly increases client's bargaining power. For the offshoring service provider, reputation and size are also important variables (Yalaho and Nahar, 2008). As Dubie (2008)(Dubie, 2008) stated, "smaller companies, in particular may lack the resources to commit to an effective long-term offshoring strategy".
	Poorly developed and documented requirements.	The client often faces this type of problem in offshore software development. Specifications are erroneously written in the same way they are for developing software in-house. Offshore software development requires clear, very detailed written specifications. According to Overby (2003)(Overby, 2003), "The ability to write clear specifications is also critical to achieving offshore savings".

Phase2: Offshore Country Selection	Legal requirements	This is concerned with the lack of understanding of employment laws and other legal requirements for an offshoring country (Aubert et al., 1996).
	Country risks	Country risks depend on the possibility of shifting local political, regulatory and economic conditions (Erber and Sayed-Ahmed, 2005).
	Political risks	For example, an escalation of the India/Pakistan Kashmiri conflict created an intensified awareness of political risks of doing business in India (Rao, 2004).
	Government laws and regulations	Because of the variety of regulations and legislations across countries, it is necessary to study the security environment of the country that the company intends to partner with (Ramanujan and Jane, 2006). Issues such as: technology transfers, intellectual property and copyrights, privacy laws, and trans-border data flows can seriously affect the offshoring relationship (Rao, 2004).
	Cultural issues	Working across cultures in offshoring software production is not a trouble-free process (Nicholson and Sahay, 2001). Specific cultures tend to have different ways of working and they can prove problematic when attempting cross border partnerships (Krishna et al., 2004).
	Telecommunications infrastructure level	Offshoring of software development may be constrained due to a lack of good telecommunications infrastructure (Carmel, 1999, Rao, 2004). As Prikladnicki et al. (2003)(Prikladnicki et al., 2003) stated, the telecommunications infrastructure is the foundation for all strategies. Collaborative technologies hold it all together. Jennex and Adelakun (2003)(Jennex and Adelakun, 2003) found a list of key attributes that contribute to success or failure, which include telecommunications infrastructure, technical skills of employees and the availability of current hardware and software.
Phase 3: Offshore Supplier Selection	Not matching with the right type of service provider	Michell and Fitzgerald (1997)(Michell and Fitzgerald, 1997) identified five types of service providers. They stated that there are some specific gaps between the service provider's provision and the client's expectations. They also stated that "vendors are clearly not all alike and, the vendor selection process must match not only 'hard' track record, financial stability, quality and capability requirements, but also understand the 'softer' issues of vendor vision, culture, background and human resource management issues".
	A lengthy and expensive service selection process	Although the service provider selection process can be lengthy and expensive, making a faster personal decision rather than a thorough commercial decision may lead to disastrous result.
	Culture of the supplier differences	Culture plays a role in both the quality of service delivery and the ease of service process management. Business culture practices and regulations are a significant barrier to offshoring (Stratman, 2008, Ellram et al., 2008). Major differences in norms and values cannot be harmonized since they develop from inherent differences in cultural background, education and working life.
	Language and communication of the supplier	Offshoring teams may suffer from communication problems if they fail to communicate such contextual information as workload, personal perspectives and other outside factors affecting their tasks. Virtual teams must communicate continuously, use active listening skills, keep the communication simple and clear, check often for understanding and ask for clarifications (Grosse, 2002). Oza et al.

		(2006)(Oza et al., 2006) found that cultural understanding and skills in the native language and communication skills of the client are essential for establishing initial trust in software offshoring relationships.
	Time-zone differences	Time zone differences make it very difficult to schedule meetings, as every time is inconvenient for someone. Time zones were reported to be a particular problem when there was a need for face-paced interactions and to get information to fix bugs during integration and during post-release technical bugs. In both cases, it is necessary to get information about how the code was written at the supplier site. This was very difficult and time consuming to get this information with emails and phone calls (Herbsleb et al., 2005a).
Phase 4: Offshore Contract Negotiation and	Problems of Contracting	Client-supplier arrangements are mostly about contracts, not relationships. According to Fitzgerald and Willcocks (1994) (Fitzgerald and Willcocks, 1994). Many things may go wrong in any large project and it is easy to lose money on fixed price contracts in case the work runs out of control or if the initial estimation was poorly conducted (Cramton and Webber, 2005).
	Difference in interpretation of project requirements	Differences in meaning of the same technical term and jargon used by both client and service provider teams are one important barrier (Yalaho and Nahar, 2008).
	Not getting the operational issues resolved in the contract before moving on to the legal aspects	A clear contract has two benefits. First, it clarifies 1) expectation - it makes feasible to avoid and fix the rising level of client's undocumented expectations, the (Conner, 1991). 2) cost control – the contract enables better determination of the appropriate level of services needed, 3) productivity – the contract provides a platform to both client and service provider to measure the productivity and service quality improvements. Second, the service provider uses the contract information to determine its costs and staff hiring requirements to meet those service levels.

	Length & type of the contract	It is important to remember that in contract negotiation each party tries to protect themselves as much as possible. The best way to do it is to use their own standard contract clauses. Offshore service providers often also have a standard contract that they offer officially to speed up the negotiation process. The problem with such contracts is that they favor the vendor and do not usually include any performance standards or penalty clauses (Tafti, 2005).
Phase 5: Execute the Project Plan for Offshoring	Poor execution plan specifically timing of transition to service provider	The transition period is perhaps the most expensive phase (Erber and Sayed-Ahmed, 2005). It takes from three months to three years (Overby, 2003), depending on the project size, to completely hand the work over to an offshore service provider. Offshoring implementation is where the relationship between the client and service provider is mainly executed. The manager from the client firm must be aware that resources will be required and no savings will be realized but rather significant expenses can occur during this period.
	Lack of supplier standardized working practices and methods	Successful offshoring project management, tools and strategies should integrate the suppliers' perspective by taking a 'cooperative norms' development approach. Yalaho et al. (2008) (Yalaho and Nahar, 2008) agreed on the fact that they should agree on procedures and standards of the offshore project management process.
	Transition risk and cost	Incompatible methodologies can significantly delay the offshoring of software development.
	Inadequate planning concerning IS and interfacing with the service provider	One source of failure in offshoring resides in the heterogeneity of the information systems of both client and the service provider.
	Not training the supplier on critical elements of the client's product line or service expectations.	The lack of domain knowledge is the biggest challenge faced by offshoring service providers. Domain knowledge is company specific, tacit by definition and resides most of the time on the client side. Hanna and Daim (2007) (Hanna and Daim, 2007b) stated that "client and vendor must have the right mix of competencies and know-how". However, to achieve success, the client firm must transfer domain specific knowledge to the service provider through training.
	Lack of detailed understanding of the project sent to offshore	Quite often, various client firms think that offshoring is the solution for all software development projects. Research has proven that it is one source of many failures of various systems development projects in the lack of understanding of the very nature of the project (Nicholson and Sundeep, 2004).
	Difficulties in gaining shared understanding of requirements between the client and the supplier	Several studies reported difficulty in gaining shared understanding of requirements due to communication, distance, cultures and time-zone differences. Thus, requirements were frequently misinterpreted with developers at one site often make incorrect assumptions about sub-systems being developed at other sites. These discrepancies remain hidden until integration when they are very expensive to fix (Evaristo et al., 2004, Sengupta et al., 2006b).
	Poor managing and tracking requirement changes of the client company	Sengupta reported that client and supplier teams were unable to hold effective discussions on requirements due to remoteness and time-zone differences that put a severe strain on offshoring IT projects (Sengupta et al., 2006b). Existing requirements management tools do not provide rich support for collaboration. Teams typically use tools only as a shared requirements repository and hold all

		discussions outside of the tool such as emails, chats or phone calls. This involves a significant amount of “context switch” as users have to continually move back and forth between requirements and communication environments. Moreover, it becomes difficult to track and preserve discussions on requirements that are spread across several media. Again, when the requirement changes, the information is often not spread to teams in a timely manner and gaps in understanding creep over time (Prikladnicki et al., 2003, Sengupta et al., 2006b, Prikladnicki et al., 2004).
	Unable to build trust between client and supplier employees	Trust between client and supplier teams lead to more open communications and a higher quality of decision making, risk taking and satisfaction (Sengupta et al., 2006b, Prikladnicki et al., 2004). As a result, a high performance team is associated with the presence of high trust levels within its team members.
	Unrealistic timeline	Having an unrealistic timeline for any of the steps of the offshore project can lead to unsatisfactory results (Yalaho and Nahar, 2008).
	Lack of a full communication plan between the client and the supplier	It is about the formal communication between the client and the supplier teams such as responsibilities, who is the focal point for communication, project manager, from both sides (client and supplier), reporting schedules, milestones etc.(Sengupta et al., 2006b). Not putting a full communication plan into effect including: escalation processes, regularly scheduled meetings, review periods, and employee communication. According to Pfeffer (1992)(Pfeffer, 1992), “Conflict is largely the result of misunderstanding, and if people only had more communication, more tolerance, and more patience, many (or all) social problems would disappear”.
	Inadequate informal and unplanned communication between the client and the supplier	Informal communication (Setamanit et al., 2007, Setamanit et al., 2006) (Raffo and Setamanit, 2005, Kraut and Streeter, 1995) 1) inadequate informal communication and 2) loss of communication richness. Distance, time-zone, language and cultural differences profoundly reduce the amount of informal communications. A reduction in the frequency of communication can lead to difficulty in collaborative work that may lead to longer development cycle times. Moreover, distance, time-zone differences, language and cultural differences have negative impacts on coordination and control effectiveness. It is no longer possible to coordinate by a quick phone call or by walking around the office. Informal and unplanned communication is particularly important in supporting cooperation in the software development processes (Curtis et al., 1988, Raffo and Setamanit, 2005, Kraut and Streeter, 1995). Nevertheless, distance greatly reduces the amount of informal communication (Allen, 1977, Raffo and Setamanit, 2005) which can lead to difficulty in cooperation and collaboration work and may lead to longer development cycle times (Raffo and Setamanit, 2005, Sengupta et al., 1006, Sengupta et al., 2006b).
	Loss of communication richness	Rich communication is required for tasks that need coordination and cooperation such as software development. However, distance and time zone difference between sites inhibits the use of rich media such as face to face communication, video conferencing etc. (synchronous communication) (Raffo and Setamanit, 2005, Carmel and Agarwal, 2001). This can contribute to lower productivity rates and lower quality, which can negatively affect negatively the development cycle time.

Phase 6: Evaluation and Termination of the Project	Unable to measure performance of the supplier	The client should indicate the measurement in the evaluation criteria (Yalaho and Nahar, 2008). It is common to measure the outcome in terms of user satisfaction as an indicator of product or service quality as well as financial (the cost of the project against the contract) or technical performance (Momme, 2002).
	Deliverables not according to contract.	The client needs to check the timelines, quality of the service and software projects against the contract.
	Payment methods are not flexible	The client should adopt flexible payment methods (Nahar et al., 2002).
	Unclear strategy for the use of information and communication technologies to support communication	Sakthivel (2007)(Sakthivel, 2007) stated that synchronous communication aided by telephones, conference calls, and chat facilities are not suitable for intensive or prolonged teamwork in offshore development, especially when members are separated by multiple time zones. Information communication technologies can be powerful if they are used strategically and effectively.
	Over expenditure/hidden costs that are incurred by client companies	Many IT executives interviewed reported that their overall savings were less than anticipated due to the high transaction costs associated with finding suppliers, coordinating, and monitoring work done offshore (Lacity and Rottman, 2008). Khan et al. (Khan et al., 2003) states that labor costs are up to 10 times lower but the transaction costs are much higher and less certain. These transaction costs can be up to 75% of the total costs of offshoring. Transaction costs include communication costs, travelling costs, costs of "poor" quality and extra testing. These transaction costs are sometimes considered as hidden costs (Khan et al., 2003).

2.5.1 Issues of IT Service offshoring Investigated in this Research

In offshore relationships, users and business analysts usually reside at the client side and technical analysts and developers tend to perform their work from offshore locations (Lacity and Rottman, 2008). Large geographic distances substantially accentuate the complexity of coordination in such global set-ups and demand strategies for working efficiently (Han et al., 2008). Some of the most common challenges faced in offshoring projects relate to: over-expenditure, hidden costs (Tafti, 2005, Barthelemy, 2001, Overby, 2003, Khan et al., 2003), communication problems, differences in project management practices, language barriers, time-zone differences, cultural differences, security and political issues and supplier site location (Carmel, 1999, Krishna et al., 2004) (Beulen et al., 2005, Cramton, 2001, Lawrence and Karr, 1996, Bhat et al., 2006).

Raffo *et al.* (Raffo and Setamanit, 2005) and Setamanit *et al.* (Setamanit et al., 2006, Setamanit et al., 2007) identified the issues that affect the performance of offshoring for software development projects. Issues were identified and placed into three groups: fundamental issues, strategic issues and organizational issues as listed in Table 7.

Table 7: Issues Affecting the Performance of Offshoring Software Development Projects

Fundamental Issues	Strategic Issues	Organizational Issues
• Communication issues 1. inadequate informal communication 2. loss of communication richness • Coordination and control issues • Cultural differences • Language differences • Time-zone differences	• Development site location • Product architecture • Development strategy 1. Module-based 2. Phase-based 3. Follow-the-sun • Distribution overhead • Distribution effort loss	Team formulation Team dynamics (building trust)

Source: (Raffo and Setamanit, 2005, Setamanit et al., 2006, Setamanit et al., 2007)

According to Raffo *et al.* (Raffo and Setamanit, 2005) and Setamanit *et al.* (Setamanit et al., 2006, Setamanit et al., 2007), fundamental issues are the impact from the characteristics of offshoring of software development projects. Thus, a project manager has little or no control over these issues. However, by using the right strategy and tool support, the project manager can mitigate the negative impacts of these issues. Communication issues could be caused by 1) inadequate informal communication and 2) loss of communication richness. Moreover, cultural and language differences are also identified as main challenges that affect the offshoring projects in many different ways. These include the effectiveness of communication and coordination, group decision making and team performance.

One of the most important global software development challenges is related to the requirements phase of software development (Prikladnicki et al., 2006). The requirements phase asks for a great deal of communication between the client team and supplier team (Sakthivel, 2005), and is particularly acute in offshoring teams (Na et al., 2007). Prikladnicki *et al.* (2003) (Prikladnicki et al., 2003) and Prikladnicki *et al.* (2006) (Prikladnicki et al., 2006) opt for face to face requirements elicitation, because functional business requirements can easily be misunderstood due to the organizational, distance, cultural and language differences (Na et al., 2007). In general, stable business requirements (Gopal et al., 2002a, Herbsleb and Grinter, 1999, Na et al., 2007, Boehm. et al., 2000) and the need for detailed requirements (Chrissis et al., 2006, Sengupta et al., 2006b) are required to overcome the difficulties of global software development. Also, the level of familiarity (precedent requirements) with similar requirements seems to have a positive impact on a project (Tiwana, 2004, Boehm. et al., 2000).

Building on the work of Raffo *et al.* (Carmel and Agarwal, 2001) and Setamanit *et al.* (Setamanit et al., 2006, Setamanit et al., 2007) and other researchers (Lacity and Rottman, 2008, Sengupta et al., 2006b, Greenemeier, 2002, Carmel and Tjia, 2005, Prikladnicki et al., 2003, Erber and Sayed-Ahmed, 2005, Na et al., 2007) in the area of issues and challenges of offshoring IT service projects, the most common issues and challenges were identified and compared to other sourcing options as shown in Table 8 below.

Table 8: Issues Level Associated with Each Sourcing Option

Issues/challenges	**Sourcing types**				
	In-sourcing		**Outsourcing**		**Offshoring**
	USA offices	Offshore subsidiaries	National vendors	Multinational companies	
Over expenditure due hidden costs incurred by the client (Lacity and Hirschheim, 1993a, Lacity and Willcocks, 1995)	Low	Low	Medium	High	*High*
Difference in interpretation of project requirements (Sengupta et al., 2006b)	Limited	Low	Medium	Medium	*High*
Poorly developed and documented requirements by the client firm	Limited	Low	Medium	Medium	*High*
Poor tracking and managing requirement changes (Sengupta et al., 2006b)	Limited	Low	Medium	Medium	*High*
Lack of a full communication plan (Setamanit et al., 2007, Setamanit et al., 2006) (Raffo and Setamanit, 2005, Kraut and Streeter, 1995)	Limited	Low	Medium	Medium	*High*
Communication and coordination problems (Sengupta et al., 2006b, Hanna and Daim, 2007a)	Limited	Low	High	High	*High*
Language barrier (Carmel, 1999, Krishna et al., 2004, Pai and Basu, 2007, Beulen et al., 2005)	Limited	High	Medium	Medium	*High*
Time-zone differences (Tafti, 2005, Carmel, 1999, Krishna et al., 2004, Vogel and Connolly, 2005, Pai and Basu, 2007, Beulen et al., 2005)	Limited	High	Low	Low	*High*
Cultural differences (Khan et al., 2003, Carmel, 1999, Krishna et al., 2004, Vogel and Connolly, 2005, Mohtashami et al., 2006, Beulen et al., 2005, Hanna and Daim, 2007a)	Limited	High	Medium	Medium	*High*
Incomplete and unclear contract (Hanna and Daim, 2007a)	N/A	N/A	Medium	Medium	*High*
Contract renegotiation and termination	N/A	N/A	Medium	Medium	*High*
Difference in project management practices	Limited	Low	Medium	Medium	*High*
Unable to measure performance of the supplier	Limited	Low	Medium	Medium	*High*
Supplier technical/ security & political issues (Vogel and Connolly, 2005, Khan et al., 2003, Barthelemy, 2001, Levina and Ross, 2003, Pai and Basu, 2007, Beulen et al., 2005, Hanna and Daim, 2007a)	Limited	Low	Low	Low	*High*
No previous experience of the supplier	N/A	N/A	Medium	Medium	*High*

Lack of supplier standardized working methods	N/A	N/A	Medium	Low	*High*
Poor execution plan, timing of transition to supplier (Tafti, 2005, Krishna et al., 2004)	Limited	Low	Medium	Medium	*High*

The main differences between "outsourcing" and "offshoring" of IT services and software development from a financial point of view are the labor costs and transaction costs (Qu and Brocklehurst, 2003, Lacity et al., 2008, Dibbern et al., 2008). When a company chooses to outsource its IT services, costs are mainly represented by labor costs that are relatively high while the transaction costs are relatively low. When offshoring is chosen, the labor costs are significantly lower and transaction costs are high. Khan Et al. (Khan et al., 2003) states that when companies offshore, labor costs are up to ten times lower than domestic outsourcing but the transaction costs are much higher and less certain than domestic outsourcing. These transaction costs can be up to 75% of the total costs of offshoring. Transaction costs include communication costs, travelling costs, costs of poor quality and extra testing among others. These transaction costs are sometimes considered as hidden costs (Khan et al., 2003). Therefore, in Table 8, offshoring has high degree of challenges on both over expenditure issues and hidden costs issues.

Outsourcing to domestic suppliers has the advantage of personnel speaking the same language and within the same cultural background. The downside is that local outsourcing (for western companies) is expensive due to labor costs (Lacity et al., 2008). Previous research addressed the issue of knowledge transfer due to cultural and language issues. Indeed, cultural and language issues exist with the domestic service providers, but the cultural, language, communication issues are much higher with the offshoring service providers (Beulen et al., 2005, Beulen and P., 2003, Bhalla et al., 2008).

Issues associated with outsourcing with multinational companies are considered medium degree and similar to outsourcing with domestic suppliers. The reason is that once the decision has been made to outsource with a multinational company, negotiation of the contract and the agreement is signed with the domestic offices of that multinational company (Khan et al., 2003, Majumdar et al., 2011, Kern, 1997). Thus, the domestic office holds legal responsibility for delivering the services according to the specifications in the contract ensuring that savings, service levels, and other outsourcing objectives are attained as stipulated in the contract (Kern, 1997). All communications between client and the international company will be through the specialized technical and legal personnel at the domestic office. Therefore, international companies will be treated the same as the outsourcing vendor with the exception of more expensive contracts to deliver high quality services (Oshri et al., 2008, Niosi and Tschang, 2009, Majumdar et al., 2011). Development of IT services and software costs vary substantially across nations because of labor costs. The cost of offshoring in India is the same regardless of the location of the client, but the labor costs of body-shopping to the US entails higher costs due to the higher wages paid (Niederman, 2004, Majumdar et al., 2011).

For example, Indian vendors such as WiPro and Tata consultancy (TCS) (see Table 2) have recognized the need for closer, personal, day-to-day relationships with major customers and have opened offices and increased staff in North America to provide them (King, 2005). In addition, due to political situations and natural disaster issues (King, 2006, King and Torkzadeh, 2008), many multinational companies are developing backup sites in places such as the Philippines and Canada where English fluency is common (King, 2005).

As IT services and software development have high degrees of interaction between the client and the service provider with more dynamic requirements, communication problems, cultural differences, language and time-zone differences create higher levels of challenges in offshoring compared with in-sourcing and outsourcing options (Beulen et al., 2005, Aspray et al., 2006) as indicated in Table 8.

Offshore subsidiaries are developed to overcome some of the problems with offshoring of IT services and software development to third party suppliers. Many firms have committed themselves to offshore in-sourcing strategy to obtain the advantages of low-cost professionals (Rao, 2004, Laplante et al., 2004). In this model, foreign technology workers are employees of U.S. based companies and receive the same training, software tools and development process guidelines as their western counterparts (Rao, 2004). The main difference between these workers and domestic employees is salary (Rao, 2004, King, 2005).

Researchers have found that offshoring of IT services and software development work poses considerably more challenges than domestic outsourcing as in Table 8. Offshoring is more challenging because of time-zone differences (Carmel and Abbott, 2006, Gokhale, 2007), the need for more controls (Choudhury and Sabherwal, 2003, Kotlarsky et al., 2008), distance and time-zone difference (Oshri et al., 2008, Gupta, 2002), cultural differences (Carmel and Tjia, 2005, Oza et al., 2006, Rao, 2004, Iacovou and Nakatsu, 2008, Smith and Mckeen, 2004), language problems (Beulen and P., 2003, Bhalla et al., 2008, Bock, 2008), having to define requirements more rigorously (Gopal et al., 2002a, Gopal et al., 2003), difficulties in managing dispersed teams (Oshri et al., 2008, Oza et al., 2006), security and political issues (Barthelemy, 2001, Khan et al., 2003, Vogel and Connolly, 2005) as in Table 8. Therefore, critical issues of offshoring of IT services and software development are the focus of this dissertation.

2.6 Project Success

Project success is the delivery of the agreed upon project scope, to the agreed quality measures and within the agreed upon timeframe and budget (Humphrey, 2005b). A project is defined in different ways in the literature. Reiss defined a project as “a human activity that achieves a clear objective against a time scale” (Reiss, 1995). Steiner (1969) (Steiner, 1969) defined a project as "an organization of people dedicated to a specific purpose or objective. Projects generally involve large, expensive, unique or high risk undertakings which have to be completed by a certain date, for a certain amount of money and within some expected level of performance (Williams, 1995). Ives

(2005) (Ives, 2005) defines project management as “the application of knowledge, skills, tools and techniques to project activities to meet project requirements”. The extent to which these requirements are met within the constraints of time, cost and performance (or quality) defines success.

However, other literature bounds the project a task that has to be completed within the famous three dimensions of time, cost and expected quality (McFarlan and Nolan, 1995). The following Figure 5 part A shows the triangular representation of a project.

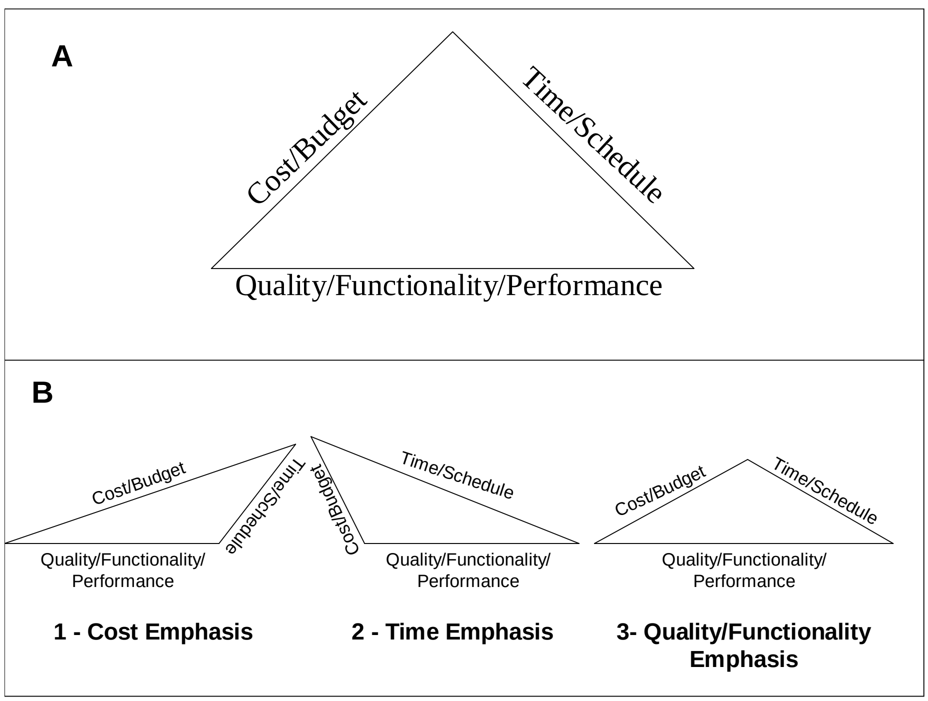


Figure 5: Project Main Components

Source: (Atkinson, 1999) (Alali and Pinto, 2009)

As Erickson and Ranganathan (2006) (Erickson and Ranganathan, 2006) and Grover Et al. (1996) (Grover et al., 1996) indicate, success can be understood and measured in multiple ways, including "the organization's satisfaction with the results of offshoring, an expectations fulfillment view (Lacity and Willcocks, 1998), a cost/benefit approach (Wang, 2002) , a psychological contract perspective on fulfilled obligations (Koh et al., 2004) and a strategic fit view of success (Lee et al., 2004, Erickson and Ranganathan, 2006).

Several studies measure success as the satisfaction of outcomes and sometimes calibrated by initial expectations (Balaji and Ahuja, 2005, Grover et al., 1996, Dahlberg and Nyrhinen, 2006, Wüllenweber et al., 2008). Dahlberg and Nyrhinen (2006) (Dahlberg and Nyrhinen, 2006), in their review of IT offshoring success definitions and measures, find that satisfaction with outcomes can be evaluated along four categories which are "strategic factors", "economic factors", "technological factors" and "social factors". Additionally, overall satisfaction forms a part of their success definition. Strategic, economic, technological and social outcome factors may also apply to projects but they are not applicable in all cases.

Success in project management used to be viewed from the perspective of meeting the three dimensions of project management that are illustrated in Figure 5 part A (meeting schedule, budget and performance). However, the relative importance among these three dimensions varies from one project to another. Some have cost or budget as the critical dimension, while others have time as the most important dimension for success (Alali and Pinto, 2009).

For example, the client organization has the need for (new) functionality to be developed in an (existing) application. Project success on this level is reflected primarily by meeting the goals of this functionality, as well as quality service levels, as addressed in Erickson et al. (2006) (Erickson and Ranganathan, 2006). Two other important objective factors according to Na Et al. (2007) (Na et al., 2007) are project budget and time schedule. A project is typically budgeted as well as time-limited and sticking to the budget within time are important parts of project success (Na et al., 2007, Jiang et al., 2004, Erickson and Ranganathan, 2006, Goldenson and Gibson, 2003). Figure 5 part B illustrates how the emphasis on each dimension affects project execution. In all three approaches, the project still has to meet all three criteria but one will be more critical than the others. However, a project is by definition an effort bound by “schedule”, “budget” and “quality” (Erickson and Ranganathan, 2006, Rottman and Lacity, 2008, Westner and Strahringer, 2010). Thus, in this research these dimensional factors were utilized for measuring offshore project success.

2.7 Industry Standards and Capability Maturity Models

Companies rely on teams of software analysts, programmers and engineers to develop new custom software, customize functionality, maintain applications and integrate disparate software to meet business needs.

The use of mature, stable software development discipline is proven to yield repeatable processes that translate into greatly reduced errors and reliable delivery against schedule and budget constraints. In the last decade, process improvement programs have become more and more prevalent. Some of the available options are:

- The People Capability Maturity Model (P-CMM);
- The Capability Maturity Model Integration (CMMI) for Development and Services (CMMI-DEV/SVC);
- The Capability Maturity Model Integration (CMMI) for Acquisition (CMMI-ACQ);
- Team Software Process (TSP-CMM);
- The 9001:2000 Quality Management Standard from the International Standards Organization;
- Six Sigma, a methodology for improvement (Bentley and Davis, 2010);
- Control Objectives for Information and related Technology (CobiT) (Campbell, 2005);
- IT Infrastructure Library (ITIL) (Sallé, 2004);
- Project Management Body of Knowledge (PMBOK), is a book which presents a set of standard terminology and guidelines for project management (von Wangenheim et al., 2010);
- ISO-9000, a series of standards, developed and published by the International Organization for Standardization (ISO), that define, establish, and maintain an effective quality assurance system for manufacturing and service industries (Poksinska et al., 2002);

- ISO-9000-3, standards developed to help software development organizations create quality assurance systems (Kehoe, 1996);
- eSCM-SP, the eSourcing Capability Model for Service Providers (eSCM-SP) is a "best practices" capability model with three purposes: (1) to give service providers guidance that will help them improve their capability across the sourcing life-cycle, (2) to provide clients with an objective means of evaluating the capability of service providers, and (3) to offer service providers a standard to use when differentiating themselves from competitors (Hyder et al., 2009);
- eSCM-CL, the eSourcing Capability Model for Client Organizations (eSCM-CL) is a "best practices" capability model that gives client organizations guidance in improving their capability throughout the sourcing life cycle (Hefley and Loesche, 2010).

Out of all the available options, three have moved to the top of the chain. The three leading programs: CMM/CMMI, ISO 9001:2000 and Six Sigma (Sengupta et al., 2006b, Persse, 2006). These recognized and proven quality programs are rising in popularity as more technology managers are looking for ways to help remove degrees of risk and uncertainty from their business equations and to introduce methods of predictability that better ensure success. Process improvement combines the foundation needed to understand process improvement theory with the best practices to help individuals implement process improvement initiatives in their organization.

This research investigated the Capability Maturity Model (CMM) and Capability Maturity Model Integration (CMMI) best practices from the Software Engineering Institute to manage and mitigate the issues and challenges of offshoring projects in the IT services industry.

Capability Maturity Models

The Capability Maturity Model (CMM) and Capability Maturity Model Integration (CMMI) are collections of best practices from leading engineering companies. They describe an evolutionary method for improving an organization from one that is ad hoc and immature to one that is disciplined and mature (April et al., 2005). The CMM/CMMI is internationally recognized and was developed by the Software Engineering Institute at Carnegie Mellon University.

Experience with CMM and CMMI demonstrates that outsourcing organizations appraised to higher levels of CMM or CMMI improve the ability to deliver the projects on schedule, cost, and agreed quality (Lutteroth et al., 2007). A number of governmental organizations worldwide have established CMMI maturity requirements. For example, the Danish Ministry of Science recently proposed regulations to require public organizations to request documentation of their supplier's maturity level (Sokmen, 2009).

In section 2.7.1 definitions will be listed, with the background of CMM/CMMI will be presented in section 2.7.2. Section 2.7.3 presents CMM/CMMI maturity models under investigation in this research and section 2.7.4 presents the maturity levels. Section 2.7.5 provides CMM/CMMI models and process areas associated with maturity levels. Section 2.7.6 presents strengths and weaknesses of CMM/CMMI models.

2.7.1 Definitions

- The Capability Maturity Model (CMM) and Capability Maturity Model Integration (CMMI) are collections of best practices from leading engineering companies. They provide models that companies can base their processes on (Philips, 2011). Capability Maturity Model: A model that contains the essential elements of effective processes for one or more areas of interest and describes an evolutionary improvement path from ad hoc, immature processes to disciplined, mature processes with improved quality and effectiveness (2010a).
- A process is a set of practices performed to achieve a given purpose; it may include tools, methods, materials, and/or people (2010a, Hefley and Curtis, 1998).
- A process area is satisfied when organizational processes cover all of the generic and specific goals and practices for that process area (Philips, 2011).
- A Process Area (PA) in CMMI, Key Process Area (KPA) in CMM: a cluster of related practices in an area that, when performed collectively, satisfy a set of goals considered important for making significant improvement in that area (Philips, 2011) (Hefley and Curtis, 1998).
- Practices in CMMI are actions to be performed to achieve the goals of a process area. Practices are the major building blocks in establishing the process maturity of an

organization (2010a, Philips, 2011). Key practices in CMM are the infrastructures and activities that contribute most to the effective implementation and institutionalization of a key process area (Hefley and Curtis, 1998).

- Specific goals and practices are specific to a process area. A specific goal applies to a process area and addresses the unique characteristics that describe what must be implemented to satisfy the process area (Philips, 2011).
- Generic goals and practices are a part of every process area. A specific practice is an activity that is considered important in achieving the associated specific goal (Philips, 2011).
- Bidirectional traceability: an association among two or more logical entities that is discernable in either direction (i.e., to and from an entity). Requirements traceability is a discernable association between requirements and related requirements, implementations, and verifications (2010a, Kendall et al., 2007).
- Institutionalization is defined in CMMI as “the ingrained way of doing business that an organization follows routinely as part of its corporate culture (Chrissis et al., 2006).” Others have described institutionalization as simply “this is the way we do things around here (Sutherland et al., 2008).” Note that Institutionalization is an organizational level concept that supports multiple projects. CMMI supports institutionalization through Generic Practices (GP) associated with all process areas (Chrissis et al., 2006, 2010a).
- Institutionalize a Managed Process is a performed process that is planned and executed in accordance with policy, employs skilled people having adequate

resources to produce controlled outputs, involves relevant stakeholders, is monitored, controlled and reviewed and is evaluated for adherence to its process description (2010a, 2010c). Table 9 defines some of the basic terms used in CMMI models.

Table 9: List of Definitions for Some of the Basic Terms Used in CMM/CMMI Models

CMMI Framework	The basic structure that organizes CMMI components including elements of current CMMI models as well as rules and methods for generating models, appraisal methods (including associated artifacts) and training materials (2010a)
Acquisition	The process of obtaining products or services through supplier agreements (2010a).
Contractual requirements	The result of the analysis and refinement of customer requirements into a set of requirements suitable to be included in one or more solicitation packages or supplier agreements (2010c)
Customer	The party responsible for accepting the product or for authorizing payment (2010c).
Development	To create a product or service system by deliberate effort. In some contexts, development can include the maintenance of the developed product (Philips, 2011).
Organizational maturity	The extent to which an organization has explicitly and consistently deployed processes that are documented, managed, measured, controlled and continually improved. Organizational maturity can be measured via appraisals (Philips, 2011, 2010a).
Organizational policy	A guiding principle typically established by senior management that is adopted by an organization to influence and determine decisions (2010b, 2010a).
Organization's business objectives	Senior management developed objectives designed to ensure an organization's continued existence and enhance its profitability, market share and other factors influencing the organization's success (2010b, 2010a).
Process	A set of interrelated activities which transform inputs into outputs to achieve a given purpose. A sequence of steps performed for a given purpose; for example, the software development process (2010b, 2010c, 2010a).
Process area	A cluster of related practices in an area that, when implemented collectively, satisfies a set of goals considered important for making improvement in that area (2010a, 2010c, 2010b).
Process description	A documented expression of a set of activities performed to achieve a given purpose. A process description provides an operational definition of the major components of a process. The description specifies, in a complete, precise, and verifiable manner, the requirements, design, behavior, or other characteristics of a process. It also can include procedures for determining whether these provisions have been satisfied. Process descriptions can be found at the activity, project, work group or organizational level (2010a, 2010c, 2010b).
Product component requirements	A complete specification of a product or service component including fit, form, function, performance and any other requirement (2010a, 2010c, 2010b).
Product lifecycle	The period of time, consisting of phases, that begins when a product or service is conceived and ends when the product or service is no longer available for use (2010a, 2010b). Since an organization can be producing multiple products or services for multiple customers, one description of a product lifecycle may not be adequate. Therefore,

	the organization can define a set of approved product lifecycle models. These models are typically found in published literature and are likely to be tailored for use in an organization. A product lifecycle could consist of the following phases: (1) concept and vision, (2) feasibility, (3) design/development, (4) production and (5) phase out (2010a, 2010c, 2010b).
Product requirements/ Software requirements specification (SRS)	A refinement of customer requirements into the developers' language, making implicit requirements into explicit derived requirements. A condition or capability that must be met by software needed by a user to solve a problem or achieve an objective (Kendall et al., 2007, 2010b). Documentation of the essential requirements (functions, performance, design constraints and attributes) of the software and its external interfaces(Kendall et al., 2007).
Project	A managed set of interrelated activities and resources, including people, that delivers one or more products or services to a customer or end user. A project has an intended beginning (i.e., project startup) and end. Projects typically operate according to a plan. Such a plan is frequently documented and specifies what is to be delivered or implemented, the resources and funds to be used, the work to be done and a schedule for doing the work. A project can be composed of projects (2010b).
Quality	The degree to which a set of inherent characteristics fulfills requirements. A planned and systematic pattern of actions necessary to provide adequate confidence that a product conforms to established technical requirements (Kendall et al., 2007).
Quantitative management / quantitatively managed	Managing a project or work group using statistical and other quantitative techniques to build an understanding of the performance or predicted performance of processes in comparison to the project's or work group's quality and process performance objectives, and identifying corrective action that may need to be taken (2010b).
Requirement	(1) A condition or capability needed by a user to solve a problem or achieve an objective. (2) A condition or capability that must be met or possessed by a product, service, product component or service component to satisfy a supplier agreement, standard, specification, or other formally imposed documents. (3) A documented representation of a condition or capability as in (1) or (2) (Kendall et al., 2007, 2010b).
Requirements management	The management of all requirements received by or generated by the project or work group, including both technical and non-technical requirements as well as those requirements levied on the project or work group by the organization (2010b).
Service agreement	A binding, written record of a promised exchange of value between a service provider and a customer. Service agreements can be fully negotiable, partially negotiable, or non-negotiable, and they can be drafted either by the service provider, the customer, or both, depending on the situation (2010c, 2010b).
Solicitation package	A collection of formal documents that includes a description of the desired form of response from a potential supplier, the relevant statement of work for the supplier, and required provisions in the supplier agreement (2010a).
Sub-practice	An informative model component that provides guidance for interpreting and implementing specific or generic practices. Sub-practices may be worded as if prescriptive, but they are actually meant only to provide ideas that can be useful for process improvement (2010a).
Sub-process	A process that is part of a larger process. The terms process, sub-process, and process element form a hierarchy with process as the highest, most general term, sub-processes below it and process element as the most specific. A sub-process can

	also be called a process element if it is not decomposed into further sub-processes (Kendall et al., 2007, 2010a).
Supplier	(1) An entity delivering products or performing services being acquired. (2) An individual, partnership, company, corporation, association, or other entity having an agreement with an acquirer for the design, development, manufacture, maintenance, modification or supply of items under the terms of an agreement(2010a).
Supplier agreement	A documented agreement between the acquirer and supplier (2010a).
Team	A group of people with complementary skills and expertise who work together to accomplish specified objectives. A team establishes and maintains a process that identifies roles, responsibilities, and interfaces; is sufficiently precise to enable the team to measure, manage, and improve their work performance and enables the team to make and defend their commitments (2010a).
Validation	Confirmation that the product or service, as provided (or as it will be provided), will fulfill its intended use. In other words, validation ensures that the company is building the right thing (2010a).
Verification	Confirmation that work products properly reflect the requirements specified for them (2010a).

2.7.2 Background of CMM/CMMI

The Capability Maturity Model (CMM) was originally developed in the 1980s by the U.S. Department of Defense (DOD) and Software Engineering Institute (SEI) at Carnegie Mellon University as a method for objective evaluation of contractors for military software projects. It has been continuously revised since then. CMM/CMMI is registered in the U.S. Patent and Trademark Office by Carnegie Mellon University (Paulk et al., 1993, 2010a, 2010b).

In 1997, development of CMM was superseded by Capability Maturity Model Integration (CMMI) (Chrissis et al., 2006). CMMI was developed by a group of experts from industry, government and the Software Engineering Institute (SEI) at Carnegie Mellon University. The main difference between CMM and CMMI is that the word "software" does not appear in definitions of CMMI. This generalization of improvement concepts makes CMMI extremely abstract. It is not as specific to software engineering as its predecessor, the Software CMM.

CMM/CMMI in software engineering and organizational development is a process improvement approach that provides organizations with the essential elements for effective process improvement. CMM/CMMI can be used to guide process improvement across a project, a division or an entire organization (2010b).

There are numerous instances of large, medium and small software systems suffering unexpected cost increases, schedule delays and even complete failure (2010b, Humphrey, 2005a, Ibbs and Kwak, 2000). As a consequence, the U.S. military and other organizations were looking for ways to rate the reliability of the software development work a contractor could offer. The original CMM and its successors CMMI were, and are still, used for many government projects.

The idea behind CMM/CMMI is that a high-quality process yields a high-quality product at the end. As a consequence, CMM/CMMI aims at providing objective measures for the quality of software development processes and strategies for their improvement. CMM/CMMI tries to define the key elements of an effective process and outlines how to improve suboptimal processes, i.e. the evolution from an “immature” process to a “mature, disciplined” one (2010c, 2010a). It describes key practices for meeting goals for cost, schedule, functionality and product quality.

A maturity model can be viewed as a set of structured levels that describe how well the behaviors, practices and processes of an organization can reliably and sustainably produce required outcomes. CMM/CMMI ranks software developing organizations according to a hierarchy of five maturity levels, with the first being the least mature and the fifth being the most mature. The five levels are: initial, managed, defined, quantitatively managed and optimizing as shown in Figure 6.

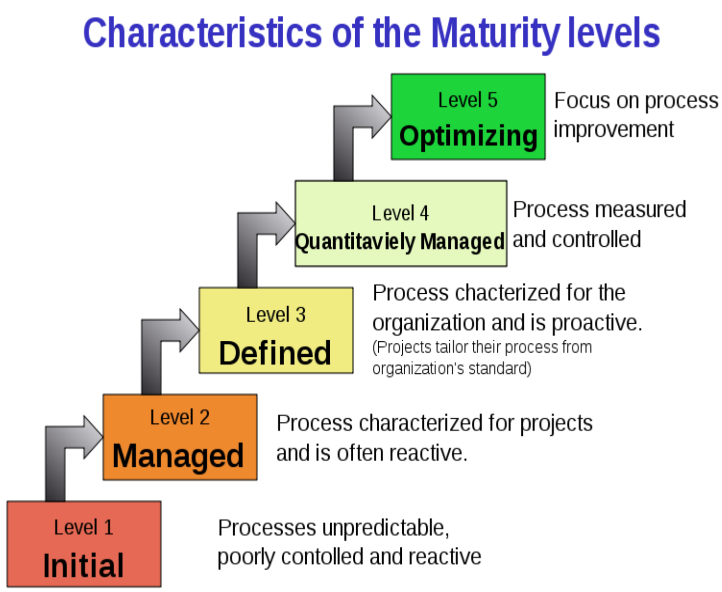


Figure 6: Characteristics of CMM/CMMI Maturity Levels

Source: (2010b, 2010a)

CMMI models provide guidance for developing or improving processes that meet the business goals of an organization. A CMMI model may also be used as a framework for appraising the process maturity of the organization (2006). CMMI provides a structured view of process improvement across an organization, not just the organizational parts concerned with software development. CMMI defines 25 key process areas to implement. For each process area, required goals, expected practices and recommended sub-practices are defined. In addition, a set of generic practices must be applied for all processes (2010a, 2010b).

There are two categories of goals and practices: generic and specific. Specific goals and practices are specific to a process area. Generic goals and practices are a part of every process area. A process area is satisfied when organizational processes cover all of the generic and specific goals and practices for that process area as in Figure 7 (2010c).

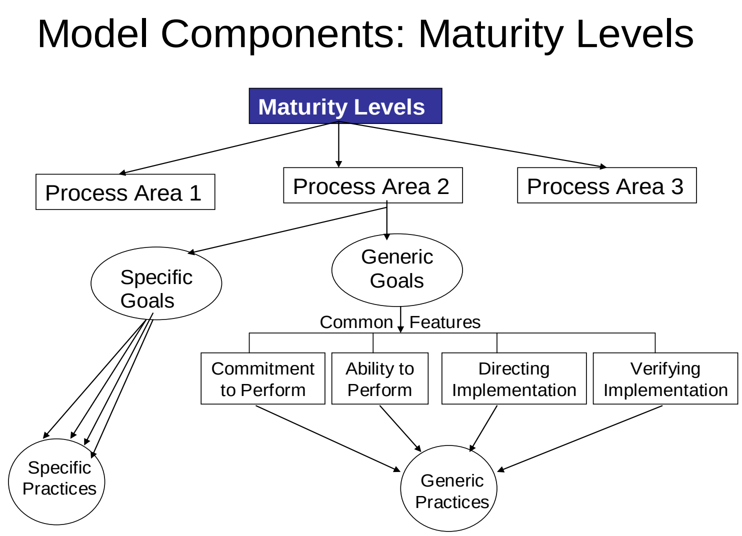


Figure 7: CMM/CMMI Model Component

Source: (2010a, 2010b, Sawyer, 2004)

A software developing organization ranked at a certain maturity level can improve over time and reach the next level of maturity. However, a new level has to be well established before the next level can be achieved, so it is not possible to skip levels. This is because each level builds on the preceding ones and adds features to the process rather than replacing them (2010b).

Institutionalization is an important concept in process improvement. When mentioned in the generic goal and generic practice descriptions, institutionalization implies that the process is ingrained in the way the work is performed and there is commitment and consistency to performing (i.e., executing) the process. An institutionalized process is more likely to be retained during times of stress.

However, when the requirements and objectives for the process change, however, the implementation of the process may also need to change to ensure that it remains effective. The generic practices describe activities that address these aspects of institutionalization. The degree of institutionalization is embodied in the generic goals and expressed in the names of the processes associated with each goal (2010a, 2010c).

2.7.3 CMM/CMMI Models

CMMI best practices are published in documents called models, each of which addresses a different area of interest: development, acquisition and services. CMMI now includes the concept of CMMI "constellations." A constellation is a set of CMMI components designed to meet the needs of a specific area of interest. A constellation can produce one or more related CMMI models as well as related appraisal and training materials. CMMI for Development is the first of these constellations. There are two other constellations, one for improving services and one for acquisition. Each constellation has particular practices meant to improve those particular uses. CMMI for Acquisition and CMMI for Services are now all at v1.3. In the original CMM for Software, the process areas were called "Key Process Areas" or KPAs.

The focus of this research is on the following CMM/CMMI models:

1) CMMI for Development/Services (CMMI-DEV, SVC)
2) CMMI for Acquisition (CMMI-ACQ)
3) CMM for People
4) CMM for Team Software Process (TSP)

In the following section, each CMM/CMMI model will be explained along with the process areas of each of the five maturity levels. A discussion of strength and weaknesses of CMM/CMMI model will be mentioned.

1. CMMI for Development/Services

CMMI for Development (CMMI-DEV), current version 1.3 was released in November 2010. It addresses product and service development processes within an organization and to external customers. The main difference between CMMI for Development and CMMI for Services is that in process area names, purpose statements, and throughout the text, in CMMI for Services, the notion of "project" has largely been replaced with the term "work". For example, in CMMI for Services, "Project Planning" becomes "Work Planning" and so forth. The rationale for that is the result of months of debate over the relevance and subsequent confusion over the concept of a "project" in the context of service work. While the concept of a "project" is appropriate for many types of services, it is quite inappropriate for most services and substituting the term "work" for "project" has effectively zero negative consequences in a service context. Therefore, in this research CMMI for Development and CMMI for Services will be considered the same. Moreover, in this research we are focusing on projects that have time schedule, budget, expected functionality and expected quality.

The CMMI-DEV model provides guidance for applying CMMI best practices in a development organization. Best practices in the model focus on activities for developing quality products and services to meet the needs of customers and end users. The CMMI-DEV model is a collection of development best practices from government and industry that is generated from the CMMI architecture and framework (2010b). It addresses practices that cover the product's lifecycle from conception through delivery and maintenance. The emphasis is on the work necessary to build and maintain the total product. CMMI-DEV contains 22 process areas. Of those process areas, 16 are core process areas shown in Figure 8 and Figure 12.

All CMMI-DEV model practices focus on the activities of the developer organization. Five process areas focus on practices specific to development: addressing requirements development, technical solution, product integration, verification and validation shown in Figure 8 and Figure 12.

Maturity Level	**Characteristics**	**Improvement Focus**	**Results**
5 Optimizing	Continuous improvement	Still human intensive process Maintain organization at optimizing level	**Productivity & Quality**
4 Managed	Measured process (quantitative basis for improvement)	Defect prevention Technology change management Process change management	
3 Defined	Process defined and institutionalized (qualitative basis for improvement)	Quantitative process management Software quality management	
2 Repeatable	Process still dependent on individuals (intuitive)	Organization process focus Organization process definition Peer reviews Training program Intergroup coordination Software product engineering Integrated software management	
1 Initial	Crisis-driven (ad hoc/chaotic)	Software project planning Software project tracking Software subcontract management Software quality assurance Software configuration management Requirements management	Risk

Figure 8: Five Maturity Levels of CMMI-DEV

Source: **(**Chrissis et al., 2006)

CMMI for Development is a reference model that covers activities for developing both products and services. Organizations from many industries such as aerospace, banking, computer hardware, software, defense, automobile manufacturing and telecommunications adopt CMMI for Development. CMMI for Development contains practices that cover project management, process management, systems engineering, hardware engineering, software engineering and other supporting processes used in development and maintenance (2010b, Babar et al., 2007).

2. CMMI for Acquisition

The latest version of CMMI for Acquisition (CMMI-ACQ) v.1.3 was released in November 2010. It includes acquisition best practices from government and industry for acquiring products and services. CMMI-ACQ addresses the growing trend in business and government for organizations to purchase or outsource required products and services as an alternative to in-house development or resource allocation.

Acquisition is "the process of obtaining products or services through a supplier agreement". This would include outsourcing where supplier agreements are established (2010a). All CMMI models, including CMMI-ACQ, rank software developing organizations according to a hierarchy of five maturity levels with the first being the least mature and the fifth being the most mature. The five levels are: initial, managed, defined, quantitatively managed and optimizing. CMMI-ACQ Level 1: Processes are usually ad hoc and chaotic. Level 2: The acquirer establishes agreements with suppliers supporting the projects and manages these agreements to ensure each supplier delivers on their commitments. The acquirer develops and manages customer and contractual requirements. Level 3: Acquirers use defined processes for managing projects and suppliers. They embed tenets of project management and acquisition best practices, such as integrated project management and acquisition technical management, into the standard process set as in Figure 9.

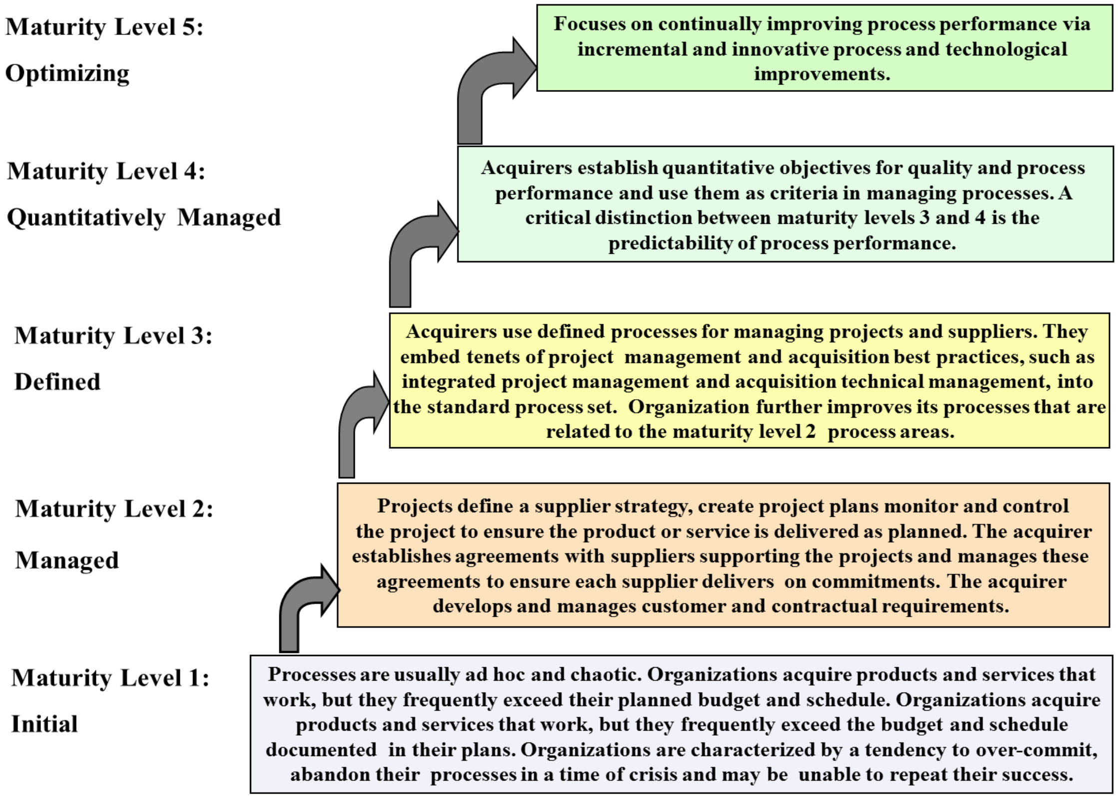


Figure 9: CMMI-ACQ Maturity Levels

Source: (2010a)

All CMMI-ACQ model practices focus on the activities of the client company that are specific for acquisition. Those activities and process areas include: agreement management, acquisition requirements development, acquisition technical management, acquisition validation, acquisition verification, solicitation and supplier agreement development, supplier sourcing, developing and awarding supplier agreements and managing the acquisition capabilities as in Figure 12 and Figure 9.

The CMMI-ACQ model is designed to influence the outcome of the acquisition process so that it delivers the right capabilities to users on schedule and at predictable costs through the disciplined application of efficient and effective acquisition processes. The main differences between CMMI-ACQ and CMMI-DEV and CMMI-SVC are listed in Table 10.

Table 10: Comparisons Between CMMI-ACQ and CMMI-DEV/SVC

CMMI-ACQ	CMMI-DEV, CMMI-SVC
For the acquirer (i.e., those who acquire, procure, or otherwise select and purchase products and services for business purposes, or those who outsource development and support)	For the product and service developer (i.e., those who develop or maintain products and services for business purposes)
Focus on the acquisition of products and services	Focus on the development and maintenance of products and services
Generic practices are covered only in the *Generic Goals and Generic Practices* section	Generic practices are covered both in the *Generic Goals and Generic Practices* section and at the end of each process are
Explicit coverage of services	Implicit coverage of services through the definition of the term "product," which covers both products and services
Contains an Acquisition process area category, but no Engineering category	Contains an Engineering process area category, but no Acquisition category
Stages Acquisition Requirements Development at maturity level 2	Stages Requirements Development at maturity level 3
Categorizes Requirements Management as a Project Management process area	Categorizes Requirements Management as an Engineering process area
Contains typical work products and typical supplier deliverables	Contains typical work products

Source: (2010a, 2010c, 2010b)

3. CMM for People

The People Capability Maturity Model (P-CMM) is a framework that helps organizations successfully address their critical people issues. The P-CMM utilizes the process maturity framework of the highly successful Capability Maturity Model for Software (SW-CMM) as a foundation for a model of best practices for managing and developing an organization's workforce. The Engineering Institute's (SEI) Capability Maturity Model (CMM) focuses primarily on the production aspects of software development. The People-Capability Maturity Model (P-CMM) complements this by explaining how people can best change their behaviors to fit the CMM approach (Sawyer, 2004).

Based on the best current practices in fields such as human resources knowledge management and organizational development, the People CMM guides organizations in improving their processes for managing and developing their workforces. The People-CMM helps organizations characterize the maturity of their workforce practices, establishes a program of continuous workforce development, sets priorities for improvement actions, integrates workforce development with process improvement and establishes a culture of excellence (Curtis et al., 2001, Curtis et al., 2010).

The People CMM consists of five maturity levels that establish successive foundations for continuously improving individual competencies, developing effective teams, motivating improved performance and shaping the workforce. Each maturity level is a well-defined evolutionary plateau that institutionalizes new capabilities for developing the organization's workforce. It describes an evolutionary improvement path from ad hoc, inconsistently performed practices to a mature, disciplined and continuously improving development of the knowledge, skills, and motivation of the workforce that enhances strategic business performance.

The People CMM applies the principles of the process maturity framework to the domain of workforce practices. Each of the People CMM's five maturity levels represents a different level of organizational capability for managing and developing the workforce. Each maturity level provides a layer in the foundation for continuous improvement and equips the organization with increasingly powerful tools for developing the capability of its workforce. The nature of the transformation imposed on the organization's workforce practices to achieve each level of maturity is depicted in Figure 10 (Curtis et al., 2001).

Initial Level typical characteristics are: inconsistency in performing practices, displacement of responsibility, ritualistic practices and emotionally detached workforce. When the company reaches the optimizing Level 5, the entire organization is focused on continual improvement. These improvements are made to the capability of individuals and workgroups, to the performance of competency based processes and to workforce practices and activities as in Figure 10.

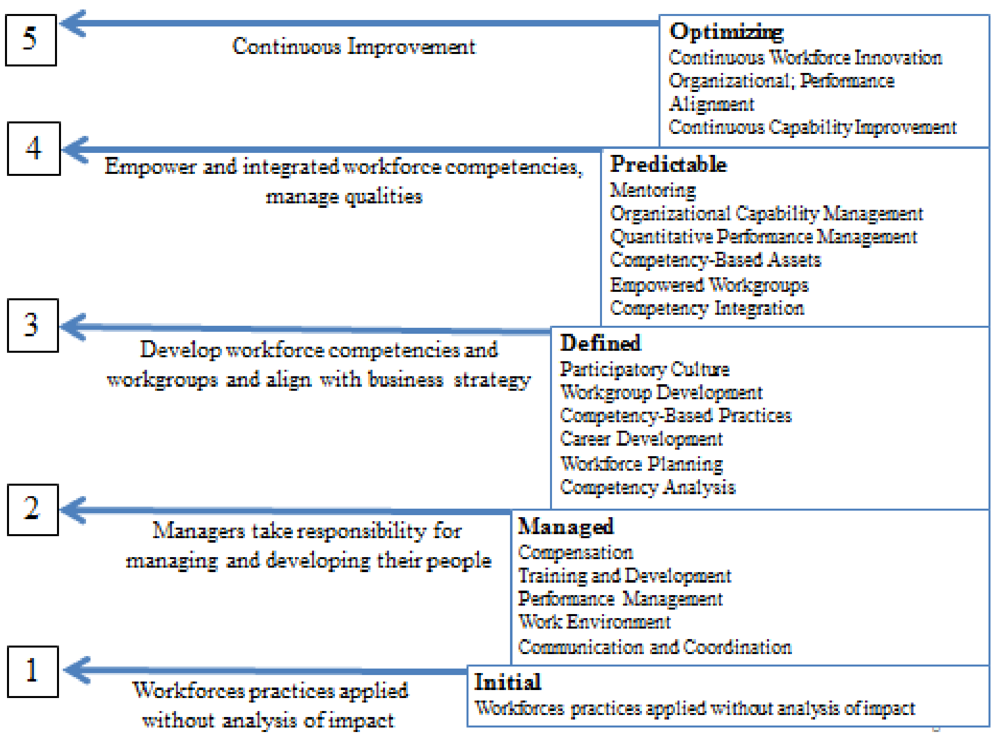


Figure 10: P-CMM maturity levels

Source: (Hefley and Curtis, 1998)

4. CMM for Team Software Process (TSP)

Team Software Process (TSP) guides engineering teams that are developing software-intensive products. Using TSP helps organizations establish a mature and disciplined engineering practice that produces secure, reliable software in less time and at lower costs. The primary goal of TSP is to create a team environment for establishing and maintaining a self-directed team while simultaneously supporting disciplined individual work as a base of Personal Software Process (PSP) framework (Humphrey, 2000b). A Self-directed team means that the team manages itself, plans and tracks their work, manages the quality of their work and works proactively to meet team goals (Humphrey, 2005b).

PSP and TSP were designed to support CMM/CMMI goals at the individual and project team levels respectively (McHale, 2003). The CMM/CMMI goals are to produce quality products on committed schedules for the lowest possible costs. CMM/CMMI improves the organization's capability and management focus. The scope of the TSP is the mainly the project, whereas the scope of the SW-CMM covers both the organization and the projects in an organization (Humphrey et al., 2003). TSP strongly supports the key practices of the SW-CMM and especially the project-level practices it targets (Humphrey et al., 2003).

TSP improves team performance, team and product focus. PSP improves individual skills, discipline as well as personal focus. The TSP can be used for all aspects of software development: requirements elicitation and definition, design, implementation, test and maintenance. The TSP can support multidisciplinary teams that range in size from two engineers to over a hundred engineers (Davis and Mullaney, 2003).

TSP has two principal components: team-building and team-working (Davis and Mullaney, 2003) as depicted in Figure 11. Team-building is a process that defines roles for each team member and sets up teamwork through TSP launch and periodical re-launch. Team-working is a process that deals with engineering processes and practices utilized by the team. TSP, in short, provides engineers and managers with a way that establishes and manages their team to produce the highest quality software on schedule and budget (Davis and Mullaney, 2003).

The primary elements of the TSP process are shown in Figure 11. Team members must know how to do disciplined work before they can participate on a TSP team. Training in the Personal Software Process (PSP) is required to provide engineers with the knowledge and skills to use the TSP. PSP training contains learning how to make detailed plans, gathering and using process data, developing earned value plans, using earned value to track a project, measuring and managing product quality and defining and using operational processes. Engineers must be trained in these skills before they can participate in TSP team building or follow the defined TSP process (Humphrey, 2000b, Humphrey, 2002).

> The objective of the PSP is to put software professionals in charge of their work and to make them feel personally responsible for the quality of the products they produce. The objectives of the TSP are to provide a team environment that supports

PSP work and to build and maintain a self-directed team. PSP and TSP are powerful tools that provide the necessary skills, discipline and commitment required for successful software projects (Davis and Mullaney, 2003).

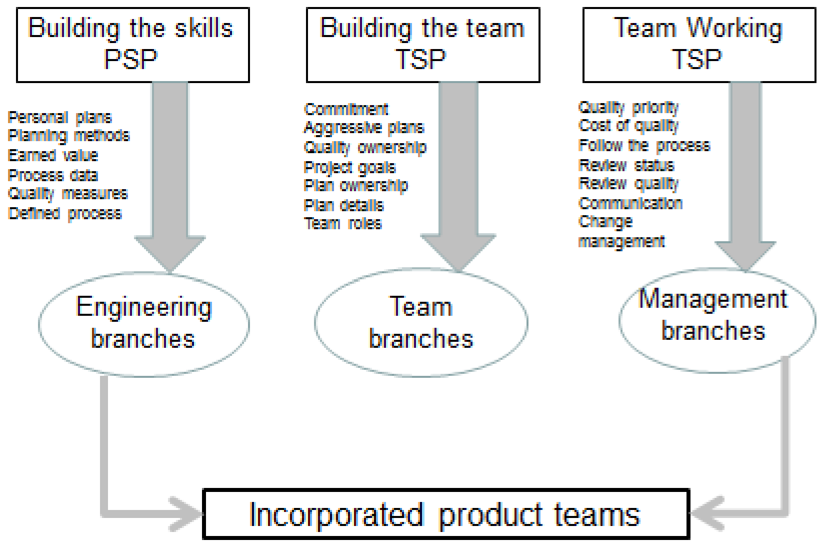


Figure 11: CMM for Team Software Process TSP

Source: (Humphrey, 2000a)

2.7.4 Maturity Levels (ML)

Maturity level is the degree of process improvement across a predefined set of process areas in which all goals in the set are attained. An organization cannot be certified in CMMI. Instead, an organization is appraised. Depending on the appraisal, the organization can be awarded a maturity level rating (1-5) or a capability level achievement profile.

Many organizations find value in measuring their progress by conducting an appraisal (2006). Appraisals are typically conducted for one or more of the following reasons:

1. To determine how well the organization's processes compare to CMMI best practices and to identify areas where improvements can be made.
2. To inform external customers and suppliers of how well the organization's processes compare to CMMI best practices.
3. To meet the contractual requirements of one or more customers (2006).

There are five maturity levels. However, maturity level ratings are awarded for levels 2 through 5. The process areas below and their maturity levels are listed for the CMMI for Development, Services and Acquisition and CMM for Software models. In the following, the five maturity levels are described in Figures 8 and 12.

Level - 1: Initial Level

At the Initial Level, an Organization does not provide a stable environment for developing and maintaining their IT processes. When an Organization lacks sound management practices, the benefits of good software engineering practices are undermined by reaction-driven commitments. In a crisis, projects typically abandon any planned procedures and revert to a code and fix methodology. Success depends on having exceptional people. The process capability at Level-1 is considered 'Ad Hoc' because the software development process constantly changes as the work progresses. Schedules, budgets, functionality and product quality are generally unpredictable.

Level - 2: Managed (Repeatable) Level

Level-2 Organizations have installed basic management controls. Establish policies for managing a software project and procedures to implement those policies. Planning and managing projects are based on experience with similar projects. Realistic project commitments are based upon the results observed on previous projects and on the requirements of the current project. Project managers track software costs, schedules and functionality. Problems in meeting commitments are identified when they arise. Software requirements and the work products developed to satisfy them are base-lined and their integrity is controlled.

The capability of Level-2 Organizations is summarized as 'Disciplined' because the ability to successfully repeat planning and tracking of earlier projects results in stability. To be certified at Level-2, organizations must improve the Process Areas (PAs) as depicted in Figures 6, 8, 9, 10 and Table 11.

Level - 3: Defined Level

The standard engineering and management processes for developing and maintaining software across an organization are documented, and these Processes are integrated as a whole. There is a group responsible for the Organization's software process activities like the standards development group. An organization-wide training program is implemented to ensure that the employees and the managers have the knowledge and skills required to fulfill their assigned roles.

The capability of a Level-3 Organization is summarized as 'Standard' and 'Consistent' because engineering and management activities are stable and repeatable. Product lines, Cost, Schedule and Functionality are well under control and quality is tracked. Process definition and deployment focus on the Process Areas (PAs) are depicted in Figures 6, 8, 9, 10 and Table 11.

Level - 4: Quantitatively Managed Level

A Level-4 Organization sets quantitative goals for both software products and processes. Productivity and quality are measured and included in an organization-wide database. Projects achieve control over their Products and Processes by narrowing the variation in their Process performance to fall within acceptable quantitative boundaries. The capability of Level-4 Organizations is summarized as 'Predictable' because the Process is measured and operates within measurable limits. The Process Areas (PAs) of Level-4 are listed in Figures 6, 8, 9, 10 and Table 11.

Level - 5: Optimizing Level

At Level-5, the entire Organization is focused on 'Continuous Process Improvement'. The Organization has the means to identify weaknesses and strengthen the Process proactively with the goal of preventing the occurrence of defects. Software

Project teams analyze defects to determine their root causes and lessons learned are disseminated to other Projects.

The capability of Level-5 Organizations is characterized as 'Continuously Improving', because projects strive to improve the process capability and process Performance. The Process Areas (PAs) of Level-5 are listed in Figures 6, 8, 9, 10 and Table 11.

2.7.5 CMM/CMMI Process Areas and Best Practices

In the current version of CMMI for DEVELOPMENT there are 22 Process Areas. The CMMI-DEV, CMMI-ACQ, CMMI-SVC and P-CMM share 16 "core" process areas or CMMI Foundation (CMF), CMMI for Development (CMMI-DEV) and for Services (CMMI-SVC) share the Supplier Agreement Management (SAM) process area. The CMMI for Acquisition (CMMI-ACQ) has a total of 21 (PAs) and People CMM has a total of 20 (PAs) as depicted in Figure 12 and Table 11.

CMM/CMMI Models and Process Areas

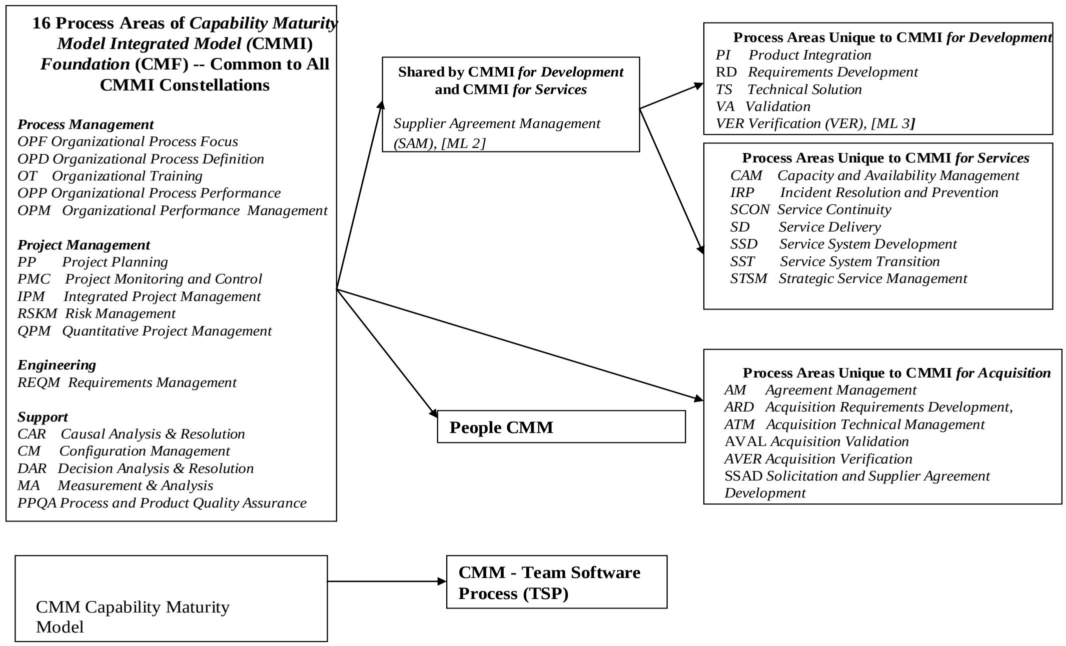


Figure 12: Process Areas associated with each of the CMM/CMMI models

Based on literature review, this research includes four CMM/CMMI models: 1) CMMI for Development, 2) CMMI for Acquisition, 3) People – CMM and 4) TSP – CMM. This research focused on Ten Process Areas from the CMM/CMMI Foundation (CMF) that are common to all CMM/CMMI models.

1) Project Planning (PP),
2) Project Monitoring and Control (PMC),
3) Organizational Process Definition (OPD),
4) Organizational Process Performance (OPP),
5) Quantitative Project Management (QPM),
6) Support, Process and Product Quality Assurance (PPQA),
7) Risk Management (RSKM),
8) Requirements Management (REQM),
9) Integrated Project Management (IPM),
10) Institutionalize a Management Process.

Four process areas were selected from CMMI for Acquisition (CMMI-ACQ):

1) Agreement Management (AM),
2) Solicitation and Supplier Agreement Development (SSAD),
3) Acquisition Technical Management (ATM),
4) Acquisition Requirement Development (ARD).

Supplier Agreement Management (SAM) was selected from CMMI for Development and Services. And, fourteen practices were selected from People-CMM and TSP as presented in Table 11.

Table 11: List the process areas and best practices utilized in this research

Process Area (PA)	Best Practices
(CMF) : From the 16 Process Areas of *Capability Maturity Model Integrated Model (*CMMI) *Foundation* (CMF) -- Common to All CMMI Constellations	
(CMF) Project Planning (PP) Maturity Level 2	PR1: A project plan is established and maintained as the basis for managing the project (CMMI ACQ, CMMI DEV, CMMI SVC, Project Management, Project Planning (PP), SP 2.8, ML2). PR2: Establish and maintain the overall project plan. (CMM ACQ, CMMI DEV, CMMI SVC, Project Management, Project Planning (PP), SP 1.7 ML2). PR3: Estimate the project's effort and cost for work products and tasks based on estimation rationale (CMMI ACQ, CMMI DEV, CMMI SVC, Project Management, Project Planning (PP), SP 1.4, ML2). PR4: Establish and maintain the project's budget and schedule, milestones, constraints, dependencies (CMMI ACQ, CMMI DEV, CMMI SVC, Project Management, Project Planning (PP), SP 2.1, ML2) PR57: Plan transition to operations and support (CMMI DEV, CMMI SVC, Project Management, project Planning (PP), SP 1.8, ML2).
(CMF) Project Monitoring and Control (PMC) Maturity Level 2	PR5: Monitor supplier project progress and performance (effort, and cost) as defined in the contract (CMMI ACQ, CMMI DEV, CMMI SVC, Project Management, Project Monitoring and Control (PMC), SP 1.5 ML2) PR44: Corrective actions are managed to closure when the project's performance or results deviate significantly from the plan (CMMI ACQ, CMMI DEV, CMMI SVC, Project Management, Project Monitoring and Control (PMC), SP 2, ML2) PR45: Periodically review the project's progress, performance, and issues (CMMI ACQ, CMMI DEV, CMMI SVC, Project Management, Project Monitoring and Control (PMC), SP 1.6 ML2). PR46: Review the project's accomplishments and results at selected project milestones (CMMI ACQ, CMMI DEV, CMMI SVC, Project Management, Project Monitoring and Control (PMC), SP 1.7, ML2). PR48: Actual project performance and progress are monitored against the project plan (CMMI ACQ, CMMI DEV, CMMI SVC, Project Management, Project Monitoring and Control (PMC), SP 1, ML2).

	PR58: Monitor transition to operations and support (CMMI ACQ, CMMI DEV, CMMI SVC, Project Management, Project Monitoring and Control (PMC), SP 1.8, ML2).
(CMF) Organizational Process Definition (OPD)Maturity Level 3	PR40: Establish and maintain a usable set of organizational process assets, work environment standards and rules and guidelines for teams (CMMI DEV, CMMI SVC, CMMI ACQ, Process Management, Organizational Process Definition (OPD), SP 1.1, SP 1.6, SP 1.7, ML 3).
(CMF) Organizational Process Performance (OPP) Maturity Level 4	PR41: Establish and maintain quantitative objectives to address quality and process performance, based on customer needs and business objectives (CMMI ACQ, CMMI DEV, CMMI SVC, Process Management, Organizational Process Performance (OPP), SP 1.1, ML4).
(CMF) Quantitative Project Management (QPM) Maturity Level 4	PR42: Manage the project using statistical and other quantitative techniques to determine whether or not the project's objectives for quality and process performance will be satisfied (CMMI ACQ, CMMI DEV, CMMI SVC, Project Management, Quantitative Project Management (QPM), SP 2.2 ML4). PR43: Perform root cause analysis of selected issues to address deficiencies in achieving the project's quality and process performance objectives (CMMI ACQ, CMMI DEV, CMMI SVC, Project Management, Quantitative Project Management (QPM), SP 2.3, ML4).
(CMF) Support, Process and Product Quality assurance (PPQA) Maturity Level 2	PR22: Communicate quality issues and ensure the resolution of noncompliance issues with the staff and managers (CMMI ACQ, CMMI DEV, CMMI SVC, Support, Process and Product Quality Assurance (PPQA), SP 2.1, ML2). PR47: Establish and maintain records of quality assurance activities (CMMI ACQ, CMMI DEV, CMMI SVC, Support, Process and Product Quality assurance (PPQA), SP 2.2, ML2).
(CMF) Risk Management (RSKM) Maturity Level 3	PR52: Evaluate and categorize each identified issue using defined risk categories, parameters and determine its relative priority (CMMI DEV, CMMI SVC, CMMI ACQ, Project Management, Risk Management (RSKM), SP 2.2, ML3).
(CMF) Requirements Management (REQM) Maturity Level 2	PR7: Develop an understanding between client and supplier on the meaning of requirements (CMMI DEV, CMMI SVC, CMMI ACQ, Project Management, Requirements Management (REQM), SP. 1.1, ML2) (TSP-CMM, Humphrey Nov. 2000, CMU/SEI-2000-TR-023 p.23). PR9: Obtain commitment to requirements from project participants (CMMI DEV, CMMI SVC, CMMI ACQ, Project Management, Requirements Management (REQM), SP. 1.2, ML2), (TSP-CMM Humphrey, Davis, McHale 2003, CMU/SEI-2002-TR-008, page 85). PR11: Maintain bidirectional traceability among requirements and work products (CMMI DEV, CMMI SVC, CMMI ACQ, Project Management, Requirements Management (REQM), SP. 1.4, ML2). PR12: Manage changes to requirements as they evolve during the project (CMMI DEV, CMMI SVC, CMMI ACQ, Project Management, Requirements Management (REQM), SP. 1.3, ML2). PR13: Ensure that project plans and work products remain aligned with requirements (CMMI DEV, CMMI SVC, CMMI ACQ, Project Management, Requirements Management (REQM), SP. 1.5, ML2).

(CMF) Integrated Project Management (IPM) Maturity Level 3	PR15: Establish and manage coordination and collaboration between the project and relevant stakeholders (Integrated Project Management (IPM), SP 2, ML3).
Institutionalize a Managed Process Generic goal and practices	PR55: Establish and maintain the plan for performing the process (CMMI DEV, CMMI SVC, CMMI ACQ, Institutionalize a Managed Process, GP 2.2).
CMMI for Acquisition	
CMMI-ACQ Agreement Management (AM) Maturity Level 2	PR6: Manage invoices submitted by the supplier (CMMI ACQ, Project management, Agreement Management (AM), SP 1.4, ML2). PR37: Select, monitor, and analyze supplier processes (CMMI ACQ, Project Management, Agreement Management (AM), SP 1.2, ML2). PR49: Ensure that the supplier agreement is satisfied before accepting the acquired product (CMMI ACQ, Project Management, Agreement Management (AM), SP 1.3, ML2). PR53: Select, monitor, and analyze supplier processes, (CMMI ACQ, Project Management, Agreement Management (AM), SP1.2, ML2).
CMMI-ACQ Solicitation and Supplier Agreement Development (SSAD) Maturity Level 2	PR30: Establish and maintain a mutual understanding of the contract with selected suppliers and end users based on acquisition needs and the suppliers' proposed approaches (CMMI ACQ, Project Management, Solicitation and Supplier Agreement Development (SSAD), SP 3.1, ML2). PR31R: Select suppliers based on an evaluation of their ability to meet specified requirements and established criteria (CMMI ACQ, Project Management, Solicitation and Supplier Agreement Development (SSAD), SP 2.3, ML2ML2). PR33: Establish and maintain a formal contract management plan (CMMI ACQ, Project Management, Solicitation and Supplier Agreement Development (SSAD), SP 3.2, ML2) PR35: Establish and maintain negotiation plans to use in completing a supplier agreement (CMMI ACQ, Project Management, Solicitation and Supplier Agreement Development (SSAD), SP 2.2, ML2). PR38R: Identify and qualify potential suppliers (CMMI ACQ, Project Management, Solicitation and Supplier Agreement Development (SSAD), SP 1.2, ML2). PR39R: Suppliers are selected using a formal evaluation (CMMI ACQ, Project Management, Solicitation and Supplier Agreement Development (SSAD), SP 2, ML2).
CMMI-ACQ Acquisition Technical Management (ATM) Maturity Level 3	PR50: Select supplier technical solutions to be analyzed and analysis methods to be used, (CMMI ACQ, Acquisition Engineering, Acquisition Technical Management (ATM), SP 1.1, ML 3). PR51: Conduct technical reviews with the supplier as defined in the supplier agreement (CMMI ACQ, Acquisition Engineering, Acquisition Technical Management (ATM), SP 1.3, ML 3). PR54: Supplier technical solutions are evaluated to confirm that contractual requirements continue to be met (CMMI ACQ, Acquisition Engineering, Acquisition Technical Management (ATM), SP 1, ML3).
CMMI–ACQ Acquisition Requirements	PR8: Validate requirements to ensure that the resulting product performs as intended in the end user's environment (CMMI ACQ, Project Management, Acquisition Requirements Development (ARD), SP 3.4, ML2). PR10R: Stakeholder needs, expectations, constraints, and interfaces are collected and translated into customer requirements (CMMI ACQ, Acquisition Engineering, Acquisition Requirements Development (ARD), SP1. ML2).

Development (ARD) Maturity Level 2	PR32: Customer requirements are refined and elaborated into contractual requirements (CMMI ACQ, Acquisition Engineering, Acquisition Requirements Development (ARD), SP 2, ML2). PR34: Establish and maintain contractual requirements that are based on client company requirements (CMMI ACQ, Acquisition Engineering, Acquisition Requirements Development (ARD), SP 2.1,ML2).
CMMI for Development and CMMI for Services	
Supplier Agreement Management (SAM) Maturity Level 2	PR36: Agreements with suppliers are satisfied by both the project and the supplier (CMMI DEV, CMMI SVC, Project Management, Supplier Agreement Management (SAM), SP 2, ML2) PR56: Determine the type of acquisition for each product or product component to be acquired (CMMI DEV, CMMI SVC, Project Management, Supplier Agreement Management (SAM), SP 1.1, ML2).
CMM TSP and People	
TSP-CMM	PR14: The Customer Interface Manager leads the team in estimating and documenting the impact of every requirements change and works with the Configuration Control Board (CCB) to get approval for changes to requirements (TSP-CMM, Humphrey Nov. 2000, CMU/SEI-2000-TR-023 p.24). PR16: Team members track actual results and performance against plans on a weekly basis. Team members track progress against individual plans on a daily basis (TSP-CMM, Humphrey Nov. 2000, CMU/SEI-2000-TR-023 p.36). PR17: A documented plan is used to communicate intergroup commitments and to coordinate and track the work performed (TSP-CMM, Humphrey Nov. 2000, CMU/SEI-2000-TR-023 p.87). PR18: Teams managers are responsible for coordination across all project teams (TSP-CMM Humphrey, Davis, McHale 2003, CMU/SEI-2002-TR-008, page 84). PR20: Representatives of the project's software engineering group work with representatives of the other engineering groups to monitor and coordinate technical activities and resolve technical issues (TSP-CMM, Humphrey Nov. 2000, CMU/SEI-2000-TR-023 p.87). PR21: Select team roles, including the role of Supplier Interface Manager, who is the liaison between the team and the supplier company representative, and is responsible for requirements change management (TSP-CMM, Humphrey Nov. 2000, CMU/SEI-2000-TR-023 p.23). PR26: Establish project teams and their responsibilities, authorities, and interrelationships (TSP-CMM Humphrey, Davis, McHale 2003, CMU/SEI-2002-TR-008, page 21). PR28: Teams managers are responsible to track and resolve intergroup issues (TSP-CMM Humphrey, Davis, McHale 2003, CMU/SEI-2002-TR-008, page 85).
People CMM Maturity Levels 2 and 3	PR19: Communication and Coordination practices are institutionalized to ensure they are performed as managed processes (P-CMM, Communication and Coordination process area, ML2 (Managed). PR23: The organization establishes and maintains a documented policy for conducting its Communication and Coordination activities (P-CMM, Communication and Coordination process area, ML2 (Managed). PR24: Ensure that the workforce has the skills to share information and coordinate their activities efficiently (P-CMM, Training and Development process area, ML2 (Managed).

	PR25: Establish a culture for openly sharing information and concerns across organizational levels and among team members (P-CMM, Participatory Culture process area, ML3 (Defined) PR27: Establish and maintain open and effective project teams' communication and coordination plan (P-CMM, Communication and Coordination process area, ML2 (Managed) PR29: To maintain effective workgroups, interpersonal problems are addressed quickly and meetings are managed to ensure that workgroup time is used most effectively (P-CMM, Communication and Coordination process area, ML2 (Managed)

Source: CMMI for Development, v1.3, Nov. 2010, CMMI for Services, v1.3, Nov. 2010, CMMI for Acquisition v1.3, Nov. 2010

2.7.6 CMM/CMMI Strengths and Weaknesses

A- CMM/CMMI Strengths

The Software Engineering Institute's CMM/CMMI are widely adopted and have received great publicity in the software development industry (Biberoglu and Haddad, 2002). CMM/CMMI became an industry standard based on industry best practices and has an industry standard appraisal method (Olson, 2008, Dubey, 2003).

Applying the CMMI model forces companies to commit to a number of instrumental procedures and assessments. Getting the CMMI accreditation is of a great advantage for both the clients and the employees of an organization. It improves the quality of the products and services as well as improving the productivity of the companies by enhancing work procedures. It also promotes and reinforces the company's capabilities to predict projects schedule and achieve higher return on investment and enhance the capability to manage risks.

Experience with CMM and CMMI demonstrates that outsourcing organizations appraised to higher levels of CMM or CMMI improve the ability to deliver projects on the agreed upon schedule, cost, and quality. Increasingly, the industry requires suppliers to be appraised to CMM or CMMI level 3 or higher (Lutteroth et al., 2007).

Supplier assessment is one of the fundamental tasks of offshoring management and requires formal procedures and methodologies (Webster et al., 1999). Capability maturity models CMM/CMMI instruct companies to establish and maintain supplier assessment rules/policies/standards. Determining the type of acquisition, selecting suppliers and establishing supplier agreements are the typical practices of Supplier Agreement Management (SAM) in CMM/CMMI (Chrissis et al., 2006, Vivatanavorasin et al., 2006).

The Software CMM Model (SW-CMM) has been used by software organizations around the world as a template for improving productivity, quality improvements, reducing costs, improving time to market and increasing customer satisfaction (Curtis et al., 2010).

Issues associated with outsourcing require the client company to be precise in terms of their requirements. Although English is used in case of offshoring to India, their English is not strong enough to communicate and consequently understand requirements appropriately (Prikladnicki and Audy, 2009). Therefore, offshore suppliers often rely heavily on Capability Maturity Model (CMM) or Capability Maturity Model Integrated (CMMI) processes to ensure that business requirements are properly documented (Adler et al., 2005, Rottman and Lacity, 2008). Based on more than 400 projects from 19 information sources, it was confirmed that investment in CMM programs leads to improved software development and maintenance (Harter et al., 2000).

CMMI tools minimize the risks of outsourcing projects of government and industrial companies (Harter et al., 2000). Research shows that it has proven to increase productivity and the quality of outsourced projects (Harter et al., 2000). Research studies have consistently shown results regarding improved productivity, increased quality and reductions in cycle time (Herbsleb and Grinter, 1999, Harter et al., 2000, Curtis et al., 2001, Curtis et al., 2010). CMMI for Acquisition (CMMI-ACQ) helps client companies improve relationships with their suppliers by assisting client companies improve their own processes.

Research based on case studies and interviews with experts support the People CMM approach as a key tool of managing an organization's total performance and evidence indicates that the People CMM improves teamwork, communication and knowledge levels (Vakaslahti, 1998). Since its release in 1995, thousands of copies of the People CMM have been distributed worldwide and were used by organizations small and large such as: IBM, Boeing, BAE Systems, Tata Consultancy Services, Ericsson, Lockheed Martin and QAI (India) Ltd.

The practices of Team Software Process (TSP) help create a team of software developers that can build a quality product on time, on budget and where the team is still functional after the product is built. According to Humphrey, the Team Software Process (TSP) is designed to build and manage quality software teams (Humphrey, 2002). The practices of Team Software Process (TSP) have proven effective for teams of up to about 100 members as well as for teams composed of multiple hardware, systems and software professionals. They have even worked for distributed teams from multiple geographic locations and organizations.

TSP can help organizations at all maturity levels. The sooner the TSP is introduced to the organization the better. Adopting the TSP also can greatly accelerate CMM-based process improvement. For example, SEI studies show that the mean time required for organizations to improve from maturity level 2 to level 3 is 22 months and that the mean time to improve from maturity level 3 to level 4 is 28 months. However, NAVAIR recently announced that its AV-8B Joint Systems Support Activity moved from maturity level 2 to level 4 in only 16 months instead of the expected 50. They attributed this rapid pace of improvement to the organization's prior introduction and adaptation of the TSP (Humphrey et al., 2003).

B - CMM/CMMI Weaknesses

The CMM/CMMI model requires a considerable amount of time, money and effort to implement and often requires a major shift in the culture and attitude in the organizations that decide to apply it (Brooks, 1987, Ibbs and Kwak, 2000, Jiang et al., 2004). One study found that the median time for an organization to move up one level of the five-level CMM/CMMI is between 21 and 37 months (Herbsleb et al., 1997b).

Over three-quarters of the organizations reported that implementing any Specific Practice (SP) activity took longer than expected. In addition, an organization's culture can be adversely impacted by adding a CMMI rigid bureaucracy and reducing the creativity or freedom of the developers (Jones, 1995).

Those participating in CMM/CMMI complained that it significantly increased their project overhead. Rottman and Lacity (Rottman and Lacity, 2008) reported that "on the smaller projects, the overhead costs of documenting some of the projects exceeded the value of the deliverables. The CMM/CMMI model and primer focus on "what" should be done not "how" it is done. Neither CMMI document prescribes specific implementation approaches.

Many critics accuse CMM of having excessive bureaucratic overhead and it is therefore often thought to be only suited for organizations that exhibit high degrees of bureaucracy such as in government agencies or large corporations. CMM/CMMI may influence an organization to focus on perfectly completed paperwork rather than on productive tasks like application development or sensitivity to client needs and the market. A highly-regulated process may stand in the way when entering a market with some kind of product that is more important than functionality and high quality (Lutteroth et al., 2007).

Several researchers have suggested that CMM/CMMI does not effectively deal with the social aspects of IT organizations. Johansen and Mathiassen (Johansen and Mathiassen, 1998) argue that CMM/CMMI needs a more managerial focus. Nielsen and

Nørbjerg (Iversen et al., 2002) argue that CMM needs to be supplemented with socially oriented theories in order to address organizational change issues and organizational politics. Aaen (Aaen et al., 2001) argue that the scale and complexity of the organizational change proposed by CMM necessitates a managerial rather than technical approach.

U.S. clients often complain that the requirement process is long and requires much more expensive iterations. This is because the U.S. clients often do not understand how the supplier will interpret the requirements. For example, some clients were surprised to learn that supplier teams did not understand the concept of a mortgage (Lacity and Rottman, 2008).

When there is a big difference of maturity level achieved between the client and supplier, such as when the supplier achieved level 5 and the client is operating at CMM/CMMI levels of 2 or below, the relationship may struggle with the issues experienced. Suppliers may have to help clients improve their CMM/CMMI processes, or be flexible by finding ways to fit into the client's requirements analysis process (Rottman and Lacity, 2008).

Notably, a great number of offshoring service providers seem to be applying CMM/CMMI. In India, all top-of-the-line service providers carry at least a CMM level 4 certification, whereas client companies that are offshoring often have problems reaching CMM level 3 (Amberg and Wiener, 2005). The consequential resulting differences in business processes of the outsourcing partners can lead to major complications within the realms of their interaction. A high level of quality in line with CMM/CMMI requires an acute amount of documentation as well as in-depth processes. If a company is not prepared for the procedures in accordance to CMM level 4 or 5, a great deal of time and expense will be involved in the coordination of the collaborative interface between the two partners (Dubey, 2003).

The practices of Team Software Process (TSP) have proven to improve team performance, team and product focus. Although these TSP methods should scale up to very large projects, the TSP has not yet been tried with projects over 100 members (Humphrey, 2002, Humphrey, 2005b).

2.8 Research Gaps

Existing literature and interviews with offshoring practitioners reveal that there has been relatively little investigation of CMM/CMMI best practices in offshoring projects, making this fertile ground for research (Sengupta et al., 1006, Ramasubbu et al., 2005, 2010b, Sokmen, 2009, Sengupta et al., 2006b).

The literature reveals that the issues and challenges associated with outsourcing and offshoring are well documented and investigated in both:

1- the *outsourcing* of IT services and software development projects (Sengupta et al., 2006b, King, 2005, Hall, 2003, Fill and Visser, 2000, Cio, 2002, Allen and Chandrashekar, 2000, Gold, 2004, Lonsdale and Cox, 1998, Franceschini et al., 2003, Tafti, 2005, Evaristo et al., 2004) and

2- the *offshoring* of IT services and software development projects (Paulish and Pichler, 2004, Pai and Basu, 2007, Perry et al., 2004, Prikladnicki et al., 2003, Prikladnicki et al., 2004, Prikladnicki et al., 2006, Rao, 2004, Robinson and Kalakota, 2004, Raffo and Setamanit, 2005, Overby, 2003, Setamanit et al., 2006, Setamanit et al., 2007, Tafti, 2005, Mohtashami et al., 2006, Yalaho and Nahar, 2008, Krishna et al., 2004, Sharma et al., 2008, Gurung and Prater, 2006, Carmel and Beulen, 2005, Willcocks et al., 2006, Herbsleb and Grinter, 1999, Bhat et al., 2006).

Popular process improvement approaches like Software Engineering Institute's Capability Maturity Model (CMM) and Capability Maturity Model Integration (CMMI) have been well researched and have proven to mitigate the issues and challenges of outsourcing IT services and software development projects (Ramasubbu et al., 2005, April et al., 2005, Lutteroth et al., 2007, Davis and Mullaney, 2003, McHale, 2003, Paulk et al., 1993, Gibson et al., 2006, Garcia et al., 2006, Humphrey, 2005a, Sutherland et al., 2008, Jiang et al., 2004, Dion 1993, Gopal et al., 2002a, Evaristo et al., 2004, Humphrey et al., 1991, Adler et al., 2005, Goldenson and Gibson, 2003).

Although these process improvement approaches were originally developed as methods for the objective evaluation of contractors for military software projects *(outsourcing)* and were not designed with *offshoring* development in mind, they are widely adapted and have received great publicity in the software development industry (Biberoglu and Haddad, 2002, Fitzgerald and O'Kane, 1999, Jiang et al., 2004, Amberg and Wiener, 2005, Dubey, 2003, Meyer, 2006, Gibson et al., 2006). However, the literature also shows that there is limited research and investigation of CMM/CMMI best practices and how they mitigate the issues and challenges of offshoring of IT services and software development projects (Sengupta et al., 2006b, Lasser and Heiss, 2005, Prikladnicki et al., 2007, Ebert, 2007, Ebert et al., 2008, Gopal et al., 2002b).

Gap 1: CMM/CMMI models and best practices, to mitigate the issues and challenges of offshoring IT services and software development projects, has not been adequately investigated and most evidence is anecdotal.

Research Questions:

Q1: What is the impact of client firms adopting CMM/CMMI industry standards on the frequency of issues experienced by client firms when offshoring IT service projects?

Q2: What is the relationship between the CMM/CMMI maturity level achieved and the frequency of issues experienced by client firms when offshoring IT service projects?

Q3: What is the relationship between performing CMM/CMMI industry standards practices and the frequency of issues experienced by client firms when offshoring IT service projects?

The literature shows that organizations applying CMM/CMMI best practices improved their ability to deliver on schedule, cost and agreed upon quality (Gibson et al., 2006, Sutherland et al., 2008, Dion 1993, Butler, 1995, Herbsleb and Goldenson, 1996b, Goldenson and Gibson, 2003). However, there is limited research and investigation on CMM/CMMI and its effects on offshored projects specifically with regards to delivering on time, within budget and agreed upon quality and functionality in IT service and software development (Rottman and Lacity, 2008, Jiang et al., 2004).

Moreover, the literature reveals that when offshoring IT services was examined, the focus was on the supplier side rather than the client side (Dibbern et al., 2008, Gopal et al., 2002a, Carmel, 2006, Carmel and Agarwal, 2001, Erber and Sayed-Ahmed, 2005, Vijayan, 2004, Pai and Basu, 2007, Carmel and Tjia, 2005, Nahar et al., 2002, Iacovou and Nakatsu, 2008).

Gap 2: CMM/CMMI models and best practices, to improve the ability to deliver on schedule, cost and expected quality of offshoring IT services and software development projects, has not been adequately investigated.

Research Question:

Q4: What is the impact of adopting and practicing CMM/CMMI industry standards on the offshored projects' performance outcomes?

Table 12 provides a summary of research gaps, objective, questions and hypothesis:

Table 12: Summary of research gaps, questions and hypothesis of the research

Gaps	Research Questions	Hypotheses
Literature reveals: 1) Limited research and investigation of Industrial standards practices and how they mitigate the issues and challenges of offshoring IT service and software development projects (Q1, Q2 and Q3).	Q1: What is the impact of client firms adopting CMM/CMMI industry standards on the frequency of issues experienced by client firms when offshoring IT service projects?	H1: There is a relationship between adopting CMM/CMMI Models and the IT offshoring.
	Q2: What is the relationship between the CMM/CMMI maturity level achieved and the frequency of issues experienced by client firms when offshoring IT service projects?	H2: There is a relationship between the CMM/CMMI maturity level achieved and the IT offshoring issues.
2) Limited research and investigation on industrial standard practices and their affects on the projects' success (Q4).	Q3: What is the relationship between performing CMM/CMMI industry standards practices and the frequency of issues experienced by client firms when offshoring IT service projects?	H3: There is a relationship between performing CMM/CMMI practices and the IT offshoring issues.
	Q4: What is the impact of adopting and practicing CMM/CMMI industry standards on the offshored projects' performance outcomes?	H4: There is a relationship between adopting and performing CMM/CMMI industrial standards and the offshored project performance outcomes.

Chapter 3: Research Design

The research hypotheses were derived from the research questions and are summarized in Table 12. The next section 3.1 in this chapter describes the research plan. Section 3.2 shows the integrated research model with each of the hypotheses labeled. Section 3.3 presents the formulation and defines the hypothesis.

3.1 Research Plan

Based on the literature review, the research questions and hypotheses were formed. The questionnaire was designed and two expert panels were formed: 1) CMM/CMMI IT service offshoring expert panel and 2) IT service offshoring expert panel with no CMM/CMMI experience. Testing and validation of the questionnaire was applied. Various iterations were performed to get the final version of the questionnaire. Data were collected, then the analysis phase started, followed by results, discussion and interpretation. Finally, the conclusion and future work as illustrated in Figure 13.

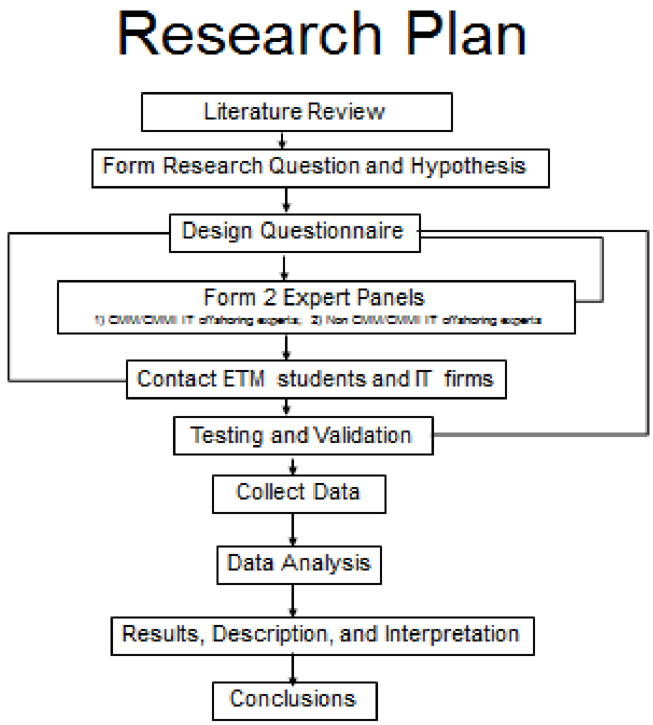


Figure 13: Research Plan

3.2 Research Model

This section explains the development of the research model for the offshoring of IT services and software development research model shown in Figure 14. This research investigated CMM/CMMI best practices to manage and mitigate these issues throughout the whole lifecycle of executed offshoring projects in the IT services industry. The client company is the unit of analysis.

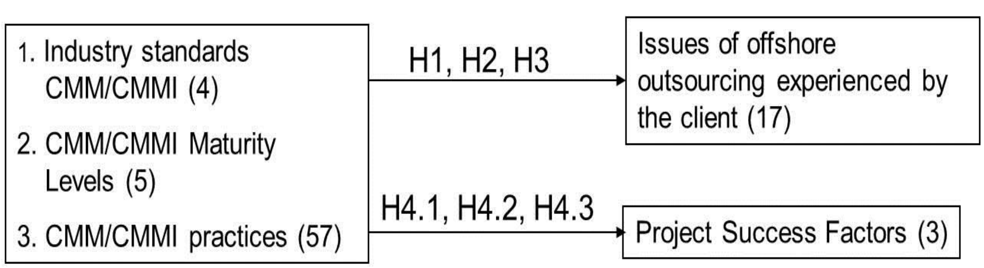


Figure 14: General Research Model

This research focused on four industry standards and their maturity levels to mitigate 17 IT offshoring issues:

1. Four CMM/CMMI models:
    i. CMMI-Development/Services
    ii. CMMI-Acquisition
    iii. People-CMM
    iv. Team Software Process (TSP)

2) Maturity levels
    i. CMMI-Development/Services (Five Maturity levels)
    ii. CMMI-Acquisition (Five Maturity levels)
    iii. People-CMM (Five Maturity levels)

3) Seventeen IT offshoring issues:
    1. Over expenditure or hidden costs incurred by the client
    2. Difference in interpretation of project requirements between the client and the supplier
    3. Poorly developed and documented requirements by the client company
    4. Poor tracking and managing requirement changes by the client company
    5. Lack of a full communication plan between the client and the supplier
    6. Communication and coordination problems between the client and the supplier
    7. Language barriers
    8. Time-zone differences between the client and the supplier
    9. Cultural differences between the client and the supplier
    10. Incomplete and unclear contract
    11. Early contract renegotiation and termination
    12. Difference in project management practices between the client and the supplier
    13. Unable to measure the performance of the supplier
    14. Supplier technical/security and political issues
    15. No previous experience of the supplier
    16. Absence or lack of supplier's standardized working methods
    17. Poor execution of the plan and timing of the transition to the supplier

4. Three project success factors (project performance outcome):
    1. Time/Schedule

2. Cost/Budget
3. Expected Quality

5. 57 CMM/CMMI best practices. Table 13 presents the expanded lists of issues/challenges of offshoring and CMM/CMMI best practices that are expected to mitigate these issues.

Both lists are expanded and were validated by two expert panels. 1) SEI CMMI experts reviewed the CMMI best practices list and advise as to which practices they believe to be the most important to mitigate offshoring issues. 2) IT service offshoring experts reviewed the issues list and advised which issues they believe are more important for offshoring projects.

Table 13: List of IT Offshoring Issues and CMM/CMMI Best Practices

Issues and challenges of offshoring	Industrial CMM/CMMI Best Practices
R1: Over expenditure due to hidden costs incurred by the client company	PR1: A project plan is established and maintained as the basis for managing the project (CMMI ACQ, CMMI DEV, CMMI SVC, Project Management, Project Planning (PP), SP 2.8, ML2). PR2: Establish and maintain the overall project plan. (CMMI DEV, CMMI SVC, Project Management, project Planning (PP), SP 1.7 ML2). PR3: Estimate the project's effort and cost for work products and tasks based on estimation rationale (CMMI ACQ, CMMI DEV, CMMI SVC, Project Management, Project Planning (PP), SP 1.4, ML2). PR4: Establish and maintain the project's budget and schedule, milestones, constraints, dependencies (CMMI ACQ, CMMI DEV, CMMI SVC, Project Management, Project Planning (PP), SP 2.1, ML2) PR5: Monitor supplier project progress and performance (effort, and cost) as defined in the contract (CMMI ACQ, CMMI DEV, CMMI SVC, Project Management, Project Monitoring and Control (PMC), SP 1.6, ML2) PR6: Manage invoices submitted by the supplier (CMMI ACQ, Project management, Agreement Management (AM), SP 1.4, ML2).
R2: Differences in interpretation of project requirements between the client and the supplier	PR7: Develop an understanding between client and supplier on the meaning of requirements (CMMI DEV, CMMI SVC, CMMI ACQ, Project Management, Requirements Management (REQM), SP. 1.1, ML2) (TSP-CMM, Humphrey Nov. 2000, CMU/SEI-2000-TR-023 p.23). PR8: Validate requirements to ensure that the resulting product performs as intended in the end user's environment (CMMI ACQ, Project Management, Acquisition Requirements Development (ARD), SP 3.4, ML2).

	PR9: Obtain commitment to requirements from project participants (CMMI DEV., CMMI SVC, CMMI ACQ, Project Management, Requirements Management (REQM), SP. 1.2, ML2), (TSP-CMM Humphrey, Davis, McHale 2003, CMU/SEI-2002-TR-008, page 85).
R3: Poorly developed and documented requirements by the client company	PR10R: Stakeholder needs, expectations, constraints, and interfaces are collected and translated into customer requirements (CMMI ACQ, Project Management, Acquisition Requirements Development (ARD), SP 1, ML2). PR11: Maintain bidirectional traceability among requirements and work products (CMMI DEV, CMMI SVC, CMMI ACQ, Project Management, Requirements Management (REQM), SP. 1.4, ML2).
R4: Poor tracking and managing requirement changes by the client company	PR12: Manage changes to requirements as they evolve during the project (CMMI DEV, CMMI SVC, CMMI ACQ, Project Management, Requirements Management (REQM), SP. 1.3, ML2). PR13: Ensure that project plans and work products remain aligned with requirements (CMMI DEV, CMMI SVC, CMMI ACQ, Project Management, Requirements Management (REQM), SP. 1.5, ML2). PR14: The Customer Interface Manager leads the team in estimating and documenting the impact of every requirements change and works with the Configuration Control Board (CCB) to get approval for changes to requirements (TSP-CMM, Humphrey Nov. 2000, CMU/SEI-2000-TR-023 p.24).
R5: Lack of a full communication plan between client and supplier	PR15: Establish and manage coordination and collaboration between the project and relevant stakeholders (CMMI DEV, CMMI SVC, CMMI ACQ, Integrated Project Management (IPM), SP 2, ML3). PR16: Teams members track actual results and performance against plans on a weekly basis. Team members track progress against individual plans on a daily basis (TSP-CMM, Humphrey Nov. 2000, CMU/SEI-2000-TR-023 p.36). PR17: A documented plan is used to communicate intergroup commitments and to coordinate and track the work performed (TSP-CMM, Humphrey Nov. 2000, CMU/SEI-2000-TR-023 p.87). PR18: Teams managers are responsible for coordination across all project teams (TSP-CMM Humphrey, Davis, McHale 2003, CMU/SEI-2002-TR-008, page 84). PR19: Communication and Coordination practices are institutionalized to ensure they are performed as managed processes (P-CMM, Communication and Coordination process area, ML2 (Managed).
R6:Communication and coordination problems between the client and the supplier	PR20: Representatives of the client project's software engineering group work with representatives of the supplier engineering groups to monitor and coordinate technical activities and resolve technical issues (TSP-CMM, Humphrey Nov. 2000, CMU/SEI-2000-TR-023 p.87). PR21: Select team roles, including the role of Supplier Interface Manager, who is the liaison between the team and the supplier company representative and is responsible for requirements change management (TSP-CMM, Humphrey Nov. 2000, CMU/SEI-2000-TR-023 p.23). PR22: Communicate quality issues and ensure the resolution of noncompliance issues with the staff and managers (CMMI ACQ, CMMI DEV, CMMI SVC, Support, Process and Product Quality Assurance (PPQA), SP 2.1, ML2). PR23: The organization establishes and maintains a documented policy for conducting its Communication and Coordination activities (P-CMM, Communication and Coordination process area, ML2 (Managed).

R7: Language barrier between the client and the supplier R8: Time-zone differences between the client and the supplier R9: Cultural differences between the client and the supplier	PR24: Ensure that the workforce has the skills to share information and coordinate their activities efficiently (P-CMM, Training and Development process area, ML2 (Managed). PR25: Establish a culture for openly sharing information and concerns across organizational levels and among team members (P-CMM, Participatory Culture process area, ML3 (Defined) PR26: Establish project teams establish and their responsibilities, authorities, and interrelationships (TSP-CMM Humphrey, Davis, McHale 2003, CMU/SEI-2002-TR-008, page 21). PR27: Establish and maintain open and effective project teams' communication and coordination plan (P-CMM, Communication and Coordination process area, ML2 (Managed) PR28: Teams' managers are responsible to track and resolve intergroup issues (TSP-CMM Humphrey, Davis, McHale 2003, CMU/SEI-2002-TR-008, page 85). PR29: To maintain effective workgroups, interpersonal problems are addressed quickly and meetings are managed to ensure that workgroup time is used most effectively (P-CMM, Communication and Coordination process area, ML2 (Managed).
R10: Incomplete and unclear contract	PR30: Establish and maintain a mutual understanding of the contract with selected suppliers and end users based on acquisition needs and the suppliers' proposed approaches (CMMI ACQ, Project Management, Solicitation and Supplier Agreement Development (SSAD), SP 3.1, ML2). PR31R: Stakeholder needs, expectations, constraints, and interfaces are collected and translated into customer requirements (CMMI ACQ, Acquisition Engineering, Acquisition Requirements Development (ARD), SP1. ML2). PR32: Customer requirements are refined and elaborated into contractual requirements (CMMI ACQ, Acquisition Engineering, Acquisition Requirements Development (ARD), SP 2, ML2). PR33: Establish and maintain a formal contract management plan (CMMI ACQ, Project Management, Solicitation and Supplier Agreement Development (SSAD), SP 3.2, ML2) PR34: Establish and maintain contractual requirements that are based on client company requirements (CMMI ACQ, Acquisition Engineering, Acquisition Requirements Development (ARD), SP 2.1,ML2)
R11: Contract renegotiation and termination	PR35: Establish and maintain negotiation plans to use in completing a supplier agreement (CMMI ACQ, Project Management, Solicitation and Supplier Agreement Development (SSAD), SP 2.2, ML2). PR36: Agreements with suppliers are satisfied by both the project and the supplier (CMMI DEV, CMMI SVC, Project Management, Supplier Agreement Management (SAM), SP 2, ML2)
R12: Difference in project management practices between the client and the supplier	PR31R: Select suppliers based on an evaluation of their ability to meet specified requirements and established criteria (CMMI ACQ, Project Management, Solicitation and Supplier Agreement Development (SSAD), SP 2.3, ML2ML2). PR37: Select, monitor, and analyze supplier processes (CMMI ACQ, Project Management, Agreement Management (AM), SP 1.2, ML2). PR38R: Identify and qualify potential suppliers (CMMI ACQ, Project Management, Solicitation and Supplier Agreement Development (SSAD), SP 1.2, ML2).

	PR39R: Suppliers are selected using a formal evaluation (CMMI ACQ, Project Management, Solicitation and Supplier Agreement Development (SSAD), SP 2, ML2). PR40: Establish and maintain a usable set of organizational process assets, work environment standards, and rules and guidelines for teams (CMMI DEV, CMMI SVC, CMMI ACQ, Process Management, Organizational Process Definition (OPD), SP 1.1, SP 1.6, SP 1.7, ML 3).
R13: Unable to measure performance of the supplier	PR41: Establish and maintain quantitative objectives to address quality and process performance, based on customer needs and business objectives (CMMI ACQ, CMMI DEV, CMMI SVC, Process Management, Organizational Process Performance (OPP), SP 1.1, ML4). PR42: Manage the project using statistical and other quantitative techniques to determine whether or not the project's objectives for quality and process performance will be satisfied (CMMI ACQ, CMMI DEV, CMMI SVC, Project Management, Quantitative Project Management (QPM), SP 2.2 ML4). PR43: Perform root cause analysis of selected issues to address deficiencies in achieving the project's quality and process performance objectives (CMMI ACQ, CMMI DEV, CMMI SVC, Project Management, Quantitative Project Management (QPM), SP 2.3, ML4). PR44: Corrective actions are managed to closure when the project's performance or results deviate significantly from the plan (CMMI ACQ, CMMI DEV, CMMI SVC, Project Management, Project Monitoring and Control (PMC), SP 2, ML2) PR45: Periodically review the project's progress, performance and issues (CMMI ACQ, CMMI DEV, CMMI SVC, Project Management, Project Monitoring and Control (PMC), SP 1.6, ML2). PR46: Review the project's accomplishments and results at selected project milestones (CMMI ACQ, CMMI DEV, CMMI SVC, Project Management, Project Monitoring and Control (PMC), SP 1.7, ML2). PR47: Establish and maintain records of quality assurance activities (CMMI ACQ, CMMI DEV, CMMI SVC, Support, Process and Product Quality assurance (PPQA), SP 2.2, ML2). PR48: Actual project performance and progress are monitored against the project plan (CMMI ACQ, CMMI DEV, CMMI SVC, Project Management, Project Monitoring and Control (PMC), SP 1, ML2). PR49: Ensure that the supplier agreement is satisfied before accepting the acquired product (CMMI ACQ, Project Management, Agreement Management (AM), SP 1.3, ML2).
R14: Supplier technical/security/political issues	PR50: Select supplier technical solutions to be analyzed and analysis methods to be used, (CMMI ACQ, Acquisition Engineering, Acquisition Technical Management (ATM), SP 1.1, ML 3). PR51: Conduct technical reviews with the supplier as defined in the supplier agreement (CMMI ACQ, Acquisition Engineering, Acquisition Technical Management (ATM), SP 1.3, ML 3). PR52: Evaluate and categorize each identified issue using defined risk categories and parameters, and determine its relative priority (CMMI DEV., CMMI SVC., CMMI ACQ, Project Management, Risk Management (RSKM), SP 2.2, ML 3).
R15: No previous experience of the supplier	PR31R: Select suppliers based on an evaluation of their ability to meet specified requirements and established criteria (CMMI ACQ, Project Management, Solicitation and Supplier Agreement Development (SSAD), SP 2.3, ML2ML2).

	PR38R: Identify and qualify potential suppliers (CMMI ACQ, Project Management, Solicitation and Supplier Agreement Development (SSAD), SP 1.2, ML2). PR39R: Suppliers are selected using a formal evaluation (CMMI ACQ, Project Management, Solicitation and Supplier Agreement Development (SSAD), SP 2, ML2).
R16: Lack of supplier standardized working methods	PR53: Select, monitor, and analyze supplier processes, (CMMI ACQ, Project Management, Agreement Management (AM), SP1.2, ML2). PR39R: Suppliers are selected using a formal evaluation (CMMI ACQ, Project Management, Solicitation and Supplier Agreement Development (SSAD), SP 2, ML2). PR31R: Select suppliers based on an evaluation of their ability to meet specified requirements and established criteria (CMMI ACQ, Acquisition Engineering, Solicitation and Supplier Agreement Development (SSAD), SP 2.3, ML2). PR54: Supplier technical solutions are evaluated to confirm that contractual requirements continue to be met (CMMI ACQ, Acquisition Engineering, Acquisition Technical Management (ATM), SP 1, ML3).
R17: Poor execution plan specifically timing and type of work transferred to the supplier	PR55: Establish and maintain the acquisition strategy (CMMI ACQ, Project management, Project Planning (PP), SP 1.1, ML2) PR56: Establish and maintain the plan for performing the process (CMMI DEV, CMMI SVC, CMMI ACQ, Institutionalize a Managed Process, GP 2.2). PR57: Determine the type of acquisition for each product or product component to be acquired (CMMI DEV, CMMI SVC, Project Management, Supplier Agreement Management (SAM), SP 1.1, ML2) PR58: Plan transition to operations and support (CMMI DEV, CMMI SVC, Project Management, project Planning (PP), SP 1.8, ML2). PR59**:** Monitor transition to operations and support (CMMI ACQ, CMMI DEV, CMMI SVC, Project Management, Project Monitoring and Control (PMC), SP 1.8, ML2).

3.3 Formulation and Defining the Hypotheses

The hypotheses were derived from the research questions (see Table 12 and Table 14). The first hypothesis aimed to test the relationship between adopting industrial standards and the frequency of issues experienced by the client firms when offshoring IT service projects. The second hypothesis is aimed at testing the relationship between the maturity level achieved and the frequency of issues experienced by client firm when offshoring IT service projects. The third hypothesis is intended to test the relationship between adopting industrial standards best practices and the frequency of issues experienced by client firms when offshoring IT service projects. The fourth hypothesis is testing the impacts of adopting industrial standards on the offshoring projects' success.

Table 14: Research Questions and the Detailed Hypotheses

Research Questions	Hypotheses
Research Question 1: What is the impact of client firms adopting industry standards on the frequency of issues experienced by client firms when offshoring IT service projects?	H1.1 There is a relationship between adopting CMMI-DEV/SVC and the IT offshoring issues. H1.2 There is a relationship between adopting CMMI-ACQ and the IT offshoring issues. H1.3 There is a relationship between adopting P-CMM and the IT offshoring issues. H1.4 There is a relationship between adopting TSP-CMM and the IT offshoring issues.
Research Question 2: What is the relationship between the maturity level achieved and the frequency of issues experienced by client firms when offshoring IT service projects?	H2.1: There is a relationship between the CMMI-DEV/SVC maturity level achieved and the IT offshoring issues. H2.2: There is a relationship between the CMMI-ACQ maturity level achieved and the IT offshoring issues. H2.3: There is a relationship between CMM-people maturity level achieved and the IT offshoring issues experienced by the client firm.
Research Question 3: What is the relationship between industry standards practices and the frequency of issues experienced by client firms when offshoring IT service projects?	H3.1: There is a relationship between PR1to PR6 practices and R1 issue. H3.2: There is a relationship between PR7 to PR9 practices and R2 Issue. H3.3: There is a relationship between PR10, and PR11 practices and R3 issue. H3.4: There is a relationship between PR12 to PR14 practices and R4 issue. H3.5: There is a relationship between PR15 to PR19 practices and R5 issue. H3.6: There is a relationship between PR20 to PR23 practices and R6 issue. H3.7: There is a relationship between PR24 to PR29 practices and R7. R8 and R9 issues. H3.8: There is a relationship between PR30, to PR34 practices and R10 issue. H3.9: There is a relationship between PR35 and PR36 practices and R11 issue. H3.10: There is a relationship between PR31, PR37, PR38, PR39 and PR40 practices and R12 issue. H3.11: There is a relationship between PR41to PR49 practices and R13 issue. H3.12: There is a relationship between PR50 to PR52 practices and R14 Issue. H3.13: There is a relationship between PR31, PR38, PR39 practices and R15 issue. H3.14: There is a relationship between PR31, PR37, PR39, PR53 practices and R16 issue. H3.15: There is a relationship between PR54 to PR58 practices and R5 issue.
Research Question 4:	H4.1: There is a relationship between adopting industrial standards on the offshored projects' performance outcomes.

What is the impact of adopting industry standards on the offshored projects' performance outcomes?	H4.2: There is a relationship between the maturity level achieved and the offshored projects' performance outcomes. H4.3: There is a relationship between industry standards practices and the offshored projects' performance outcomes.

Internet-based surveys (email, web survey) are becoming increasingly popular because they are believed to be faster, better, cheaper and easier to conduct than surveys using more-traditional telephone or mail methods (Reynolds et al., 2006, Sue and Ritter, 2007, Schonlau et al., 2002). Internet surveys may be preferable to mail or telephone surveys when a list of e-mail addresses for the target population is available as they eliminate the need for mail or phone invitations to potential respondents. Internet surveys also are well-suited for larger survey efforts and for some target populations that are difficult to reach by traditional survey methods (Reynolds et al., 2006, Sue and Ritter, 2007, Schonlau et al., 2002). People such as major corporate executives are difficult to reach in any method other than the email (web) survey (Cooper and Pamela, 2008, Cooper and Schindler, 2006)**.**

A standard survey instrument (Cooper and Pamela, 2008, Cooper and Schindler, 2006, Graziano and Raulin, 2006, Zikmund and Zihmund, 1999) will help to collect data for analysis utilizing Chi-square for testing the hypotheses (Hair et al., 1992, Hair et al., 1995, Dillon and Goldstein, 1984, Johnson and Wichern, 1992).

This chapter describes the data collection activities, which include instrument design section 4.1. Instrument validation is provided in section 4.2. Section 4.3 shows the instrument administration, sampling and response rate. The survey instrument used in this research was a structured questionnaire. Invitations to participants in a web-based survey were sent out by email with a link to the survey (follow-up 2 through 4). Due to a low response rate with emails, additional contacts for the same companies list were obtained.

4.1 Instrument Design

For this research three instruments were designed:

1. Model development – Construct Validation: a web-based survey questionnaire that was administered to the expert panel to minimize the number of issues (from 17 to 10), and to minimize the number of practices from (57 to 40) to increase the response rate of the questionnaire.
2. Content Validation:

    A. Web-based survey questionnaire was administered to the expert panel to validate the survey that will be emailed to IT and software development managers;

    B. Web-based survey questionnaire that was administered to managers at the IT and software companies.

3. Web-based survey questionnaire that was administered to IT offshoring managers.

4.1.1 Survey Layout and Usability

The development of the survey instrument has multiple phases:

1. Creating the questions based on research questions and the literature review, questions by SEI High Maturity Workshop (2011).
2. Developing the style of the questions and creation of item scales.
3. Modifying the questions after the expert panel evaluation.
4. Modifying the questionnaire via preliminary tests through ten IT companies and Graduate students from ETM department.

The web-based survey instrument included three components:

1) Introduction page: This page included the consent form along with instructions for taking the survey.
2) The survey questions: This page included ten survey questions and an optional contact information section. The complete survey can be found in Appendix A of this document.
3) Termination page: A short message notifying the respondent that the survey was successfully submitted and thanking them for participating.

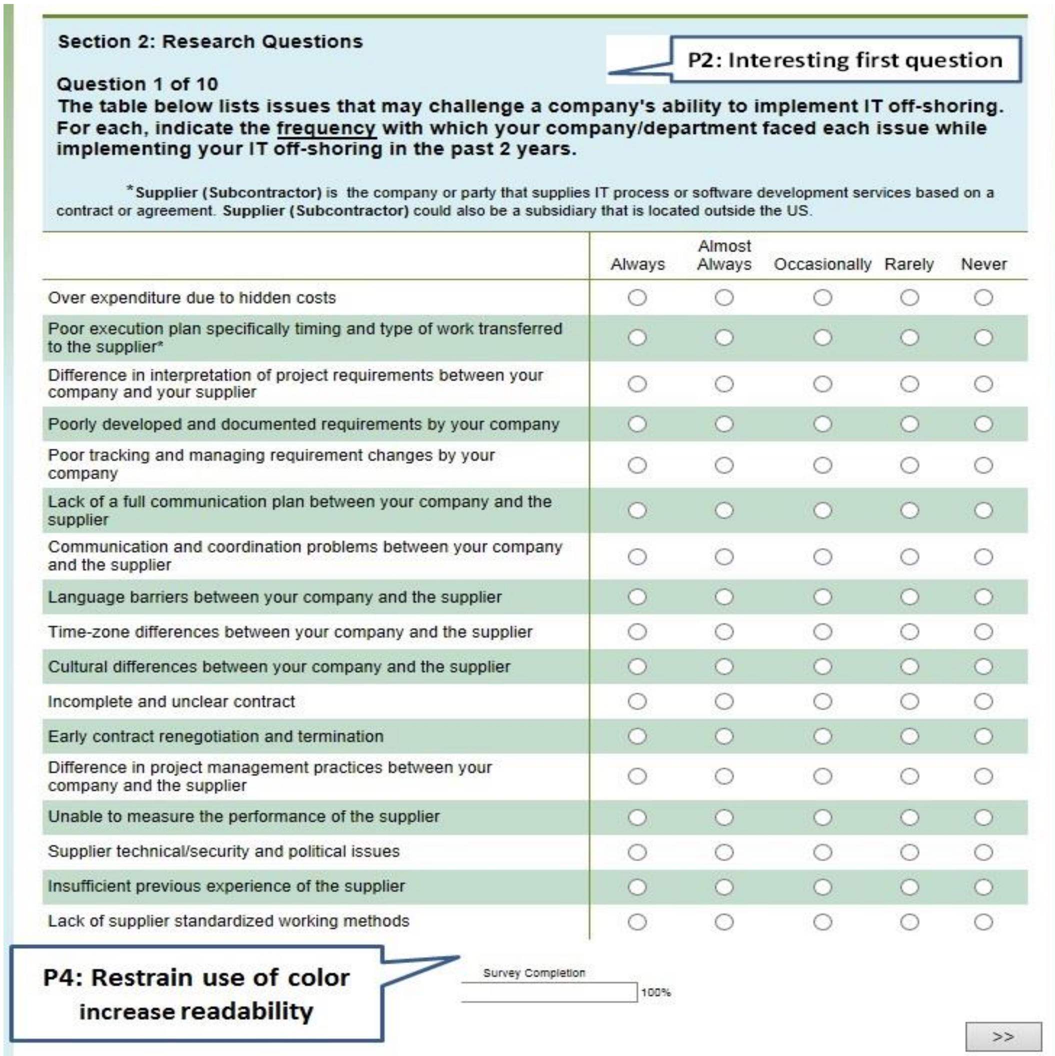
To help reduce errors associated with sampling, coverage, measurement, and non-response in the survey, Dillman, Smyth and Christian identify eight principles for designing web-based survey (Dillman et al., 2009) (Dillman and Bowker, 2001) (Dillman, 2000, Dillman et al.). Yet, attention to these principles is also critical in enhancing the usability of a survey. Table 15 lists the principles used for design the web-survey. Marked up shots of the IT manager's survey,

Figure 15 and Figure 16, clarify the manner in which these principles were integrated into the design.

Table 15: Web-Survey Goals Adapted from Dillman

Principles	Description
P1	Introduce survey with a pleasant welcome screen and instructions.
P2	Choose for the first question an item that would be interesting to most respondents.
P3	Present questions in a way similar to paper based self-administered questions.
P4	Restrain use of color to increase readability.
P5	Avoid differences in questions' visual appearance.
P6	Provide specific instructions and clarifications as needed for each question.
P7	Do not require respondents to provide an answer for each question before answering any subsequent question.
P8	Avoid open-ended questions.

Source: (Dillman and Bowker, 2001, Dillman, 2000, Dillman et al.).



Section 2: Research Questions

P2: Interesting first question

Question 1 of 10

The table below lists issues that may challenge a company's ability to implement IT off-shoring. For each, indicate the frequency with which your company/department faced each issue while implementing your IT off-shoring in the past 2 years.

*Supplier (Subcontractor) is the company or party that supplies IT process or software development services based on a contract or agreement. Supplier (Subcontractor) could also be a subsidiary that is located outside the US.

	Always	Almost Always	Occasionally	Rarely	Never
Over expenditure due to hidden costs	○	○	○	○	○
Poor execution plan specifically timing and type of work transferred to the supplier*	○	○	○	○	○
Difference in interpretation of project requirements between your company and your supplier	○	○	○	○	○
Poorly developed and documented requirements by your company	○	○	○	○	○
Poor tracking and managing requirement changes by your company	○	○	○	○	○
Lack of a full communication plan between your company and the supplier	○	○	○	○	○
Communication and coordination problems between your company and the supplier	○	○	○	○	○
Language barriers between your company and the supplier	○	○	○	○	○
Time-zone differences between your company and the supplier	○	○	○	○	○
Cultural differences between your company and the supplier	○	○	○	○	○
Incomplete and unclear contract	○	○	○	○	○
Early contract renegotiation and termination	○	○	○	○	○
Difference in project management practices between your company and the supplier	○	○	○	○	○
Unable to measure the performance of the supplier	○	○	○	○	○
Supplier technical/security and political issues	○	○	○	○	○
Insufficient previous experience of the supplier	○	○	○	○	○
Lack of supplier standardized working methods	○	○	○	○	○

P4: Restrain use of color increase readability

Survey Completion

100%

>>

Figure 15: Survey First Research Question Page

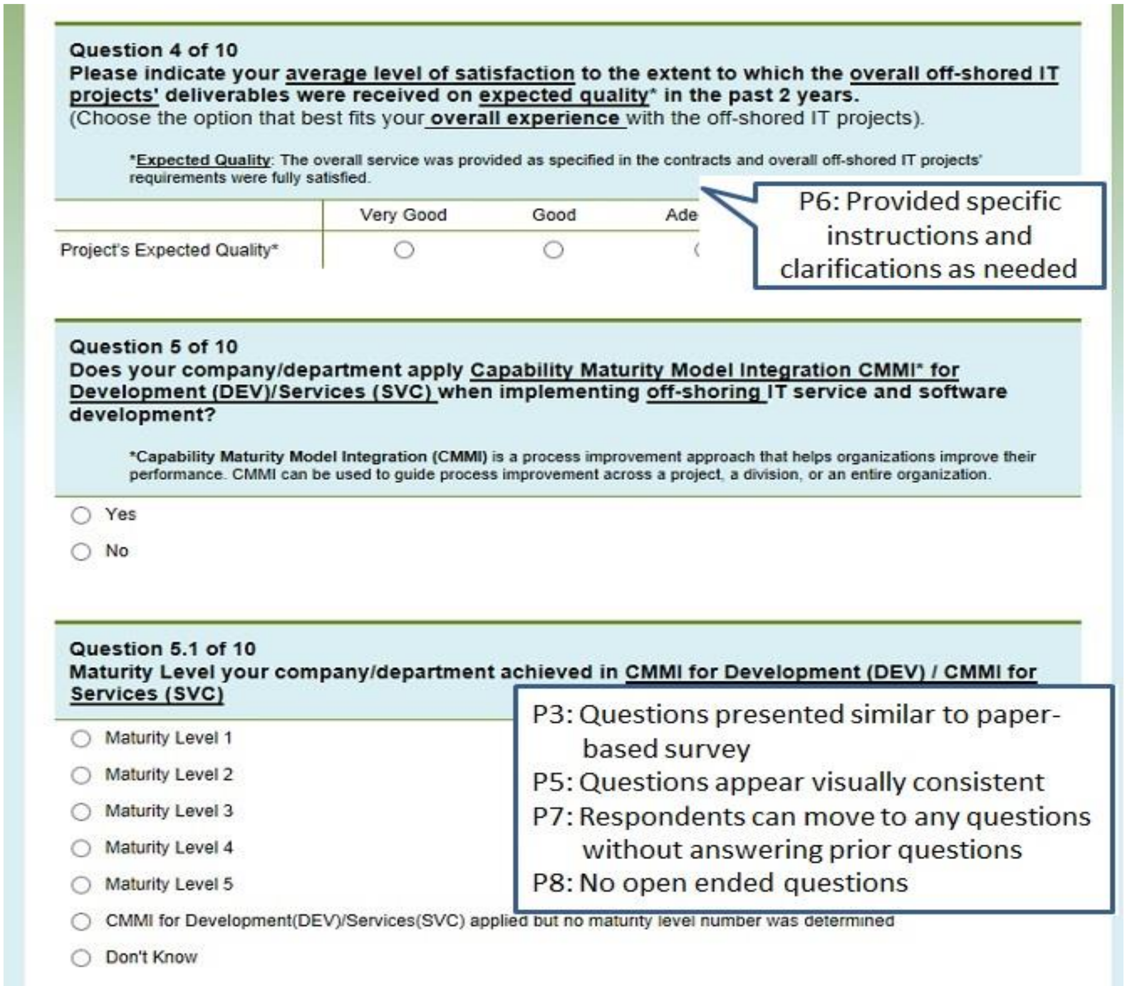


Figure 16: Survey Questions 4 and 5 Page

The questionnaire (see Appendix A) consisted of two parts: the first part was general questions and the second part was research questions. All questions addressed the hypotheses that were stated earlier in Tables 12 and 14 above. All questions used a numeric response scale. This scale, commonly referred to as a Likert scale (Cooper and Schindler, 2006), is most applicable where evaluative responses are to be arrayed on a single dimension and when the measurement is assumed to be at the interval level. It is most efficient where several items are all to be rated on the same dimension. A five ordered response level was used as shown in Table 16.

The first part of the questionnaire is about background information and will be used for statistical purposes (questions 1-6). Question 4 of this section confirmed if the company conducts offshoring and, if the answer is no, then the rest of the questionnaire would not be tested since this company would lack the required experience needed for this research. Question 6 of this section investigated the number of offshoring projects in the past two years.

The second part of the questionnaire consisted of ten questions targeting the hypotheses of the research. Question 1 tests the issues and challenges of offshoring IT services projects, the five-point Likert scale and Chi-square analysis were utilized.

Question 2 asked the respondents to indicate the level of their satisfaction with the performance of their offshore outsourced projects regarding time schedule. A five point Likert scale will be used, the last three scales represent the negative performance (About 20% more than planned, 50% more than planned time and double or more of the planned time) the first two options represent the goal achieved (Earlier than planned time and On-time) scenarios. A Chi-square analysis was used on this question.

Question 3 asked the respondents to indicate the level of their satisfaction with the performance of their offshore outsourced projects regarding cost/budget**.** A five point Likert scale will be used, the first two options represent the goal achieved (Less than estimated budget and On-budget as estimated) scenarios and the last three scales represent the negative performance (More than 10% of estimated budget, More than 20% of the estimated budget and More than 50% of the estimated budget). A five point Likert scale will be used. A Chi-square analysis was used on this question.

Question 4 asked respondents to indicate the level of their satisfaction with the performance of their offshore outsourced projects regarding expected quality. A Chi square analysis was used on this question. A Five point Likert scale (1: Very Good, 2: Good, 3: Adequate, 4: Poor, 5: Bad) was used as shown in Table 16.

Questions 5, 6 and 7 consist of two sections as shown in Figure 17:

Question 5 first asked the respondents if they Apply CMMI for Development

a) If yes, present the second question, if their company is rated and what maturity level they have achieved (sections 5.1) then ask question 6.
b) If no, move to question the following question (question 6).

Then, question 6 asked the respondents if they apply CMMI for Acquisition

a) If yes, present the second question, if their company is rated and what maturity level they have achieved (sections 6.1), then present question 7.
b) If no, move to ask the following question (question 7).

Question 7 is presented, first to ask the respondents if they apply People-CMM

a) If yes, present the second question, if their company is rated and what maturity level they have achieved (sections 7.1), then present question 7.
b) If no, move to ask the following question (question 8).

The last question in the group is question 8 that asked the respondents if they apply TSP-CMM. The respondent will answer either yes or no. Then Question 9 is presented.

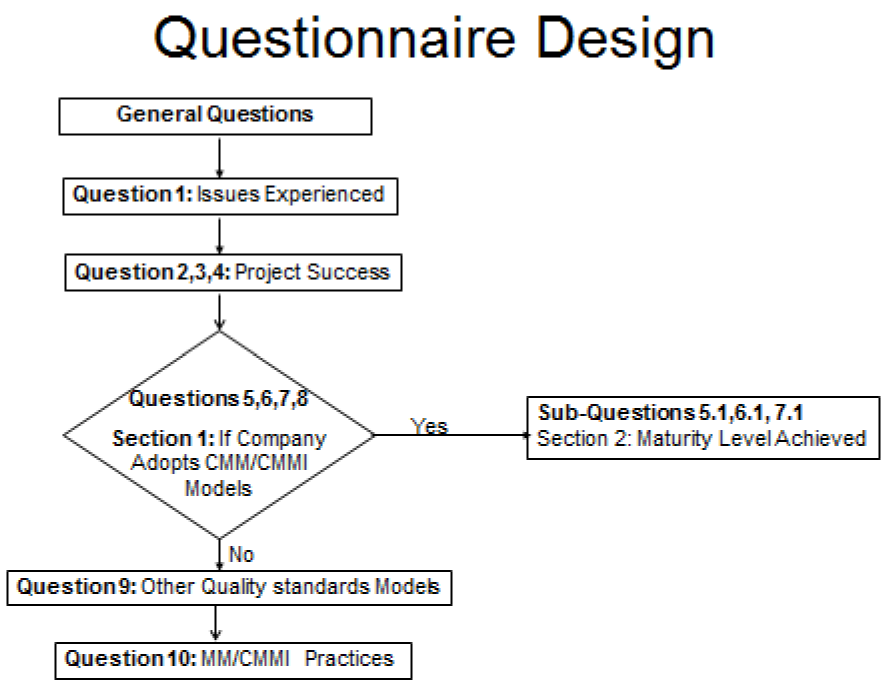


Figure 17: Questionnaire Design

For questions 5, 6, 7, 8 and sub-sections 5.1, 6.1, 7.1, a Chi-square test was applied to test the relationship between adopting industrial standards and the frequency of issues experienced. Data was collected and categorized into two groups: 1) companies that adopt industry standards and 2) other companies that did not adopt industry standards.

Question 9 asked the respondents if they apply other quality standards models such as ISO-9000, ISO-900-3, eSCM-CL, eSCM-SP, Project Management Body of Knowledge (PMPOK) and others. This question was added based on the recommendation by members of the expert panel (see instrument design section). Data collected from companies that apply other than CMM/CMMI practices such as ISO-9000, ISO-9000-3, eSCM-CL, eSCM-SP or Project Management Body of Knowledge (PMBOK), was excluded from the analyses, this way their results did not affect our data analysis.

Question 10 asked the respondents to indicate the frequency their companies apply the industry standards practices when they offshoring their IT services projects, a Chi-square test will be applied. A five point Likert scale was used as shown in Table 16.

Table 16: Research Questions, Hypotheses and Questionnaire Questions

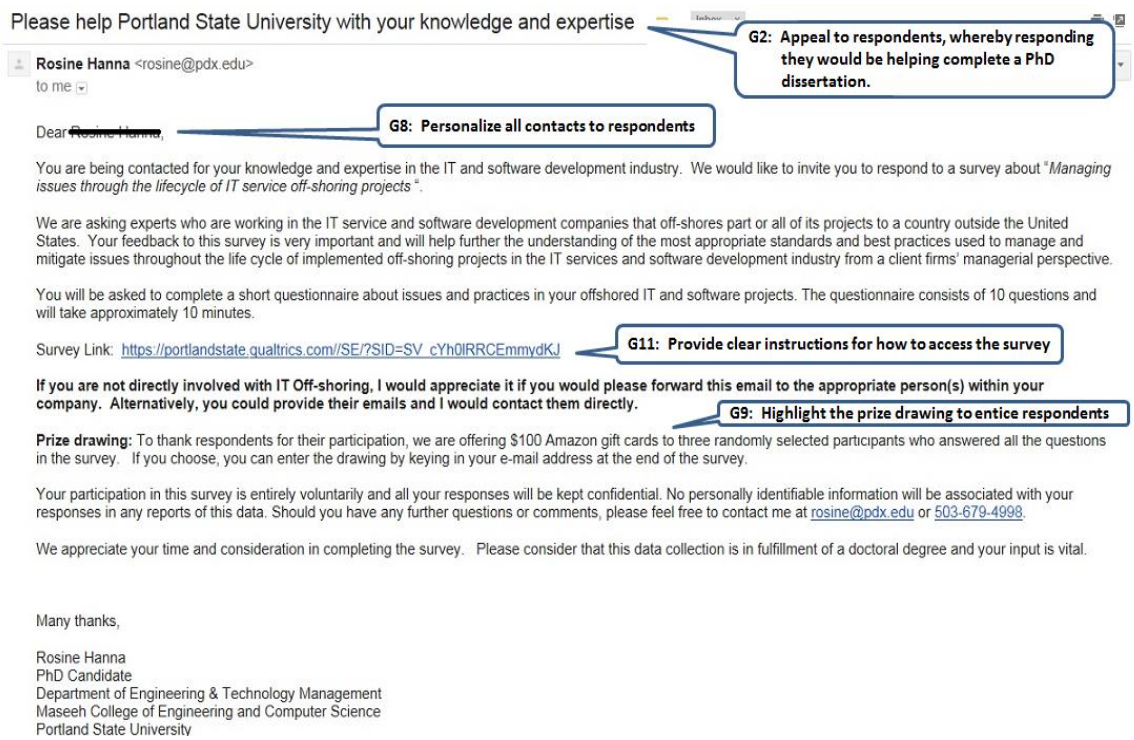
Research Q/H	Questionnaire questions	Scales and method
RQ1/H1	Questionnaire Question 1 is about issues and challenges experienced by client companies when offshoring IT services projects	Five-point Likert scale. Chi-square and cross-tabulation analysis was performed, significance level α =0.05 and Bonferroni correction equation was applied. The strength of the relation was tested with Cramer's V, the closer the value to 1:00 the stronger the relationship.
RQ2/H2	Questionnaire Questions 5,6,7 and 8 section 1 is about applying industrial standards. Questionnaire 2 section 2 is about the maturity level achieved	Respondents answer either Yes or No. Chi-square and cross-tabulation analysis was performed, significance level α =0.05 was applied and Bonferroni correction equation was applied, answers were categorized into 2 groups: 1) for companies that apply industrial standards 2) companies that does not apply industrial standards, then applied Chi- Square test that detected whether there is a significant association between two categorical variables. The strength of the relation was tested with Cramer's V, the closer the value to 1:00 the stronger the relationship
RQ3/H3	Questionnaire Question 10 is about industrial standards practices.	Five-point Likert scale. Chi-square was used to test hypotheses, and Bonferroni correction equation was applied The strength of the relation was tested with Cramer's V, the closer the value to 1:00 the stronger the relationship
RQ4/H4	Questionnaire Questions 2,3 and 4 about projects success factors when offshoring IT services	Five-point Likert scale is used for answers. Chi-square was used to test hypotheses and Bonferroni correction equation was applied. The strength of the relation was tested with Cramer's V, the closer the value to 1:00 the stronger the relationship

4.1.2 Delivery Method: Email

The sample population was emailed, inviting them to participate in an online survey by clicking on a link in the invitation email. As listed in Table 17, the invitation email layout was designed using best-practice goals from Dillman's publications (Dillman et al., 2009, Dillman and Bowker, 2001, Dillman, 2000). Figure 18, Figure 19 and Figure 20 highlight the manner in which these goals were incorporated into layout.

Table 17: Email invitation design goals adapted from Dillman

Goal	Description
G1	Create an integrated look and feel between the email invitation letter and the web survey.
G2	Appeal to respondents, whereby responding they would be helping complete a PhD dissertation.
G3	Carefully select the Sender Name and Address and the Subject Line Text for email communication to ensure that Emails are not flagged as Spam.
G4	Emphasize that the survey is short and will not be time consuming.
G5	Highlight that the request is from an academic institution, rather than, from a marketing business firm.
G6	Have the survey web address jump out when viewing the email.
G7	Emphasize the survey is anonymous.
G8	Personalize all contacts to respondents.
G9	Highlight the prize drawing to entice respondents.
G10	Carefully and strategically time all contacts with the population in mind.
G11	Provide clear instructions for how to access the survey.
G12	Use multiple contacts and vary the message across them.
G13	Provide contact information in case there is a need for recipients to contact researcher.


Please help Portland State University with your knowledge and expertise

G2: Appeal to respondents, whereby responding they would be helping complete a PhD dissertation.

Rosine Hanna <rosine@pdx.edu>
to me

Dear [redacted],

G8: Personalize all contacts to respondents

You are being contacted for your knowledge and expertise in the IT and software development industry. We would like to invite you to respond to a survey about "*Managing issues through the lifecycle of IT service off-shoring projects*".

We are asking experts who are working in the IT service and software development companies that off-shores part or all of its projects to a country outside the United States. Your feedback to this survey is very important and will help further the understanding of the most appropriate standards and best practices used to manage and mitigate issues throughout the life cycle of implemented off-shoring projects in the IT services and software development industry from a client firms' managerial perspective.

You will be asked to complete a short questionnaire about issues and practices in your offshored IT and software projects. The questionnaire consists of 10 questions and will take approximately 10 minutes.

Survey Link: https://portlandstate.qualtrics.com//SE/?SID=SV_cYh0lRRCEmmydKJ

G11: Provide clear instructions for how to access the survey

If you are not directly involved with IT Off-shoring, I would appreciate it if you would please forward this email to the appropriate person(s) within your company. Alternatively, you could provide their emails and I would contact them directly.

G9: Highlight the prize drawing to entice respondents

Prize drawing: To thank respondents for their participation, we are offering $100 Amazon gift cards to three randomly selected participants who answered all the questions in the survey. If you choose, you can enter the drawing by keying in your e-mail address at the end of the survey.

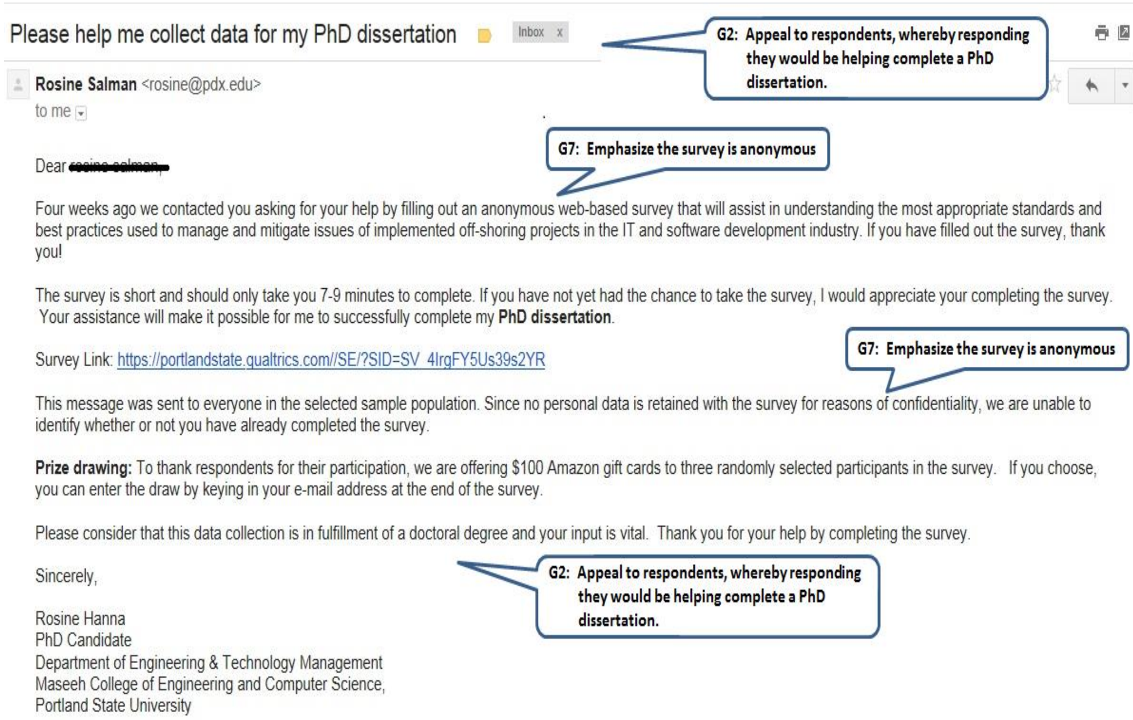
Your participation in this survey is entirely voluntarily and all your responses will be kept confidential. No personally identifiable information will be associated with your responses in any reports of this data. Should you have any further questions or comments, please feel free to contact me at rosine@pdx.edu or 503-679-4998.

We appreciate your time and consideration in completing the survey. Please consider that this data collection is in fulfillment of a doctoral degree and your input is vital.

Many thanks,

Rosine Hanna
PhD Candidate
Department of Engineering & Technology Management
Maseeh College of Engineering and Computer Science
Portland State University

Figure 18: Invitation Email



Please help me collect data for my PhD dissertation Inbox x

Rosine Salman <rosine@pdx.edu>
to me

Dear [redacted]

Four weeks ago we contacted you asking for your help by filling out an anonymous web-based survey that will assist in understanding the most appropriate standards and best practices used to manage and mitigate issues of implemented off-shoring projects in the IT and software development industry. If you have filled out the survey, thank you!

The survey is short and should only take you 7-9 minutes to complete. If you have not yet had the chance to take the survey, I would appreciate your completing the survey. Your assistance will make it possible for me to successfully complete my **PhD dissertation**.

Survey Link: https://portlandstate.qualtrics.com//SE/?SID=SV_4IrgFY5Us39s2YR

This message was sent to everyone in the selected sample population. Since no personal data is retained with the survey for reasons of confidentiality, we are unable to identify whether or not you have already completed the survey.

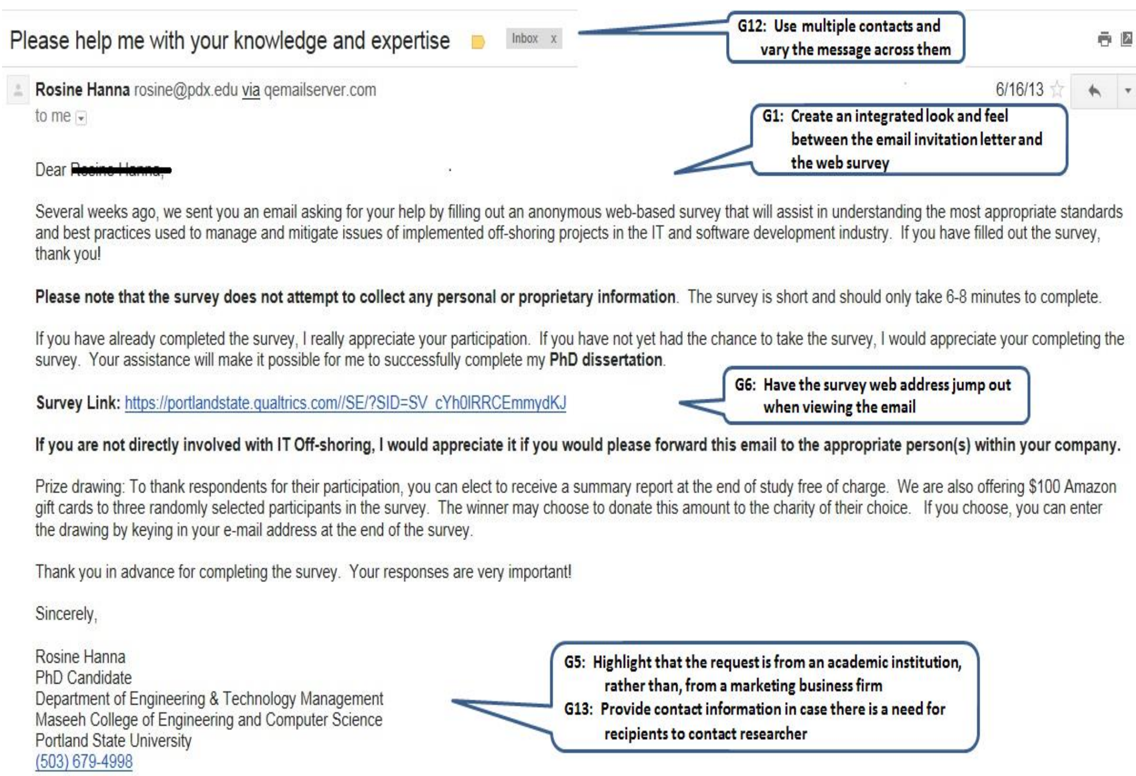
Prize drawing: To thank respondents for their participation, we are offering $100 Amazon gift cards to three randomly selected participants in the survey. If you choose, you can enter the draw by keying in your e-mail address at the end of the survey.

Please consider that this data collection is in fulfillment of a doctoral degree and your input is vital. Thank you for your help by completing the survey.

Sincerely,

Rosine Hanna
PhD Candidate
Department of Engineering & Technology Management
Maseeh College of Engineering and Computer Science,
Portland State University

Figure 19: Second Follow-up Email Invitation



Please help me with your knowledge and expertise Inbox x

Rosine Hanna rosine@pdx.edu via qemailserver.com 6/16/13
to me

Dear [redacted]

Several weeks ago, we sent you an email asking for your help by filling out an anonymous web-based survey that will assist in understanding the most appropriate standards and best practices used to manage and mitigate issues of implemented off-shoring projects in the IT and software development industry. If you have filled out the survey, thank you!

Please note that the survey does not attempt to collect any personal or proprietary information. The survey is short and should only take 6-8 minutes to complete.

If you have already completed the survey, I really appreciate your participation. If you have not yet had the chance to take the survey, I would appreciate your completing the survey. Your assistance will make it possible for me to successfully complete my **PhD dissertation**.

Survey Link: https://portlandstate.qualtrics.com//SE/?SID=SV_cYh0lRRCEmmydKJ

If you are not directly involved with IT Off-shoring, I would appreciate it if you would please forward this email to the appropriate person(s) within your company.

Prize drawing: To thank respondents for their participation, you can elect to receive a summary report at the end of study free of charge. We are also offering $100 Amazon gift cards to three randomly selected participants in the survey. The winner may choose to donate this amount to the charity of their choice. If you choose, you can enter the drawing by keying in your e-mail address at the end of the survey.

Thank you in advance for completing the survey. Your responses are very important!

Sincerely,

Rosine Hanna
PhD Candidate
Department of Engineering & Technology Management
Maseeh College of Engineering and Computer Science
Portland State University
(503) 679-4998

Figure 20: Third Follow-up Reminder Email

4.2 Instrument Validation

In this survey research, prior to survey administration, the survey went through Model Development and Construct Validation with the expert panel. The experts were asked to: A) Review a CMMI best practices list which I had prepared and advice as to which practices the expert panel believe to be the most important in mitigating offshoring issues and challenges; B) Review the list of offshoring issues, challenges and advise which issues they believe to be the most important for offshoring project. This Phase was done in three steps.

In survey research, prior to survey administration, the instrument must go through content validation. This is done by asking experts to make a judgment about survey items: 1) how well a survey item represents the intention of the intended measurement; 2) how easy is it for the intended target population to answer the survey item. The survey instrument went through Content Validation in six steps resulting in nine survey revisions over a nine month period. Table 18 lists the steps for both Phase 1 and Phase 2

4.2.1 Instrument Validation Plan

The instrument used in the research was validated in nine steps, three steps in phase 1 and six steps in phase 2 of the validation, resulting in ten survey revisions over a nine month period. Figure 21 depicts the validation plan and Table 18 lists the steps and the proceeding sections describe the steps in detail.

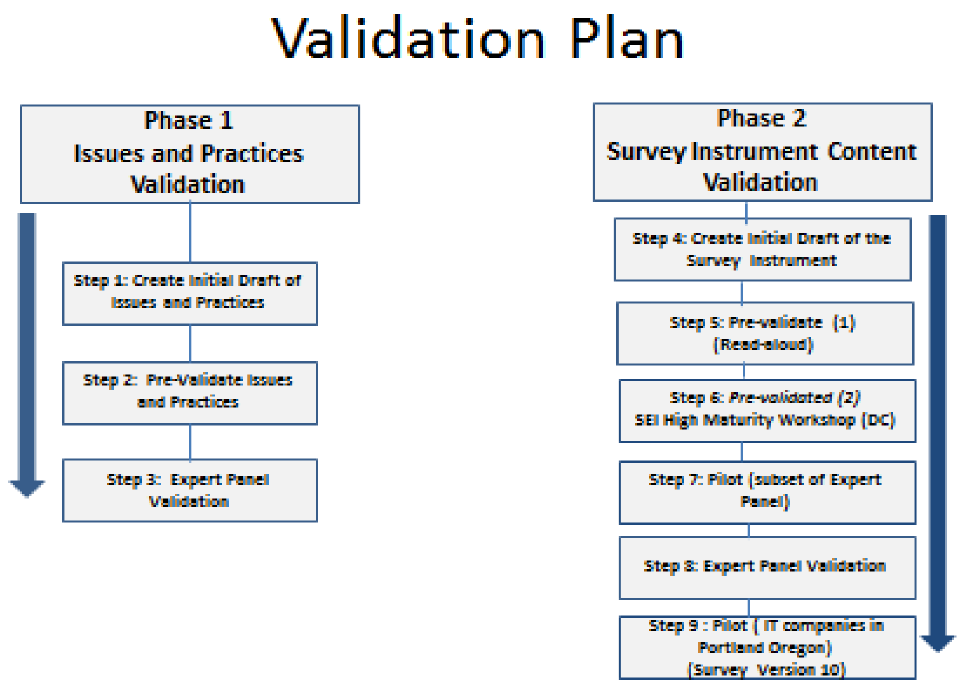


Figure 21: Validation Plan

Table 18: Represents Survey Instrument Validation and Timeline

Step	Description	Resulting Survey Version
Model Development – Survey Instrument Construct Validation		
Step 1: Create initial draft of issues and practices of offshoring IT services	Initial version of issues and practices was created based on existing literature and Software Engineering Institute publications and brainstorming with the dissertation committee.	Initial list of issues and practices
Step 2: Pre-validate	Initial draft was 1) read-aloud, 2) tested by committee members and	Version 1 – 3 of issues and practices. Version 3 was distributed into 3 surveys each contained 17 issues and 21 practices. 3a, 3b and 3c.
Step 3: Expert Panel Validation	Version 3 of the list was incorporated into a web-based validation survey and was administered to an expert panel of 21 members	Expert panel found all issues and practices to be important. The decision was to keep all issues and practices but distribute the practices in two surveys instead of one and send each survey to 6000 IT companies. Version 4a and 4b of issues and practices

Survey Instrument Development and Content Validation		
Step 4: Create Initial Draft	Initial version of web survey was created based on existing surveys from literature and brainstorming with the dissertation committee.	Initial version of the online survey (1a and 1b)
Step 5: Pre-validate (Read-aloud)	The initial draft was tested using PhD students at the department by administrating the read aloud method.	version 2(a, b) through 3(a ,b)
Step 6: Pre-validated (2)	The survey was reviewed by experts at the SEI High Maturity Workshop (Washington, D.C., September 2011)	Version 4(a, b)
Step 6: Pilot (ETM PhD Students)	Survey version 4 was administered to a group of PhD students at the department.	version 5(a, b) and 7(a, b)
Step 7: Pilot (subset of Expert Panel)	Version 8 of the survey was verified with subset of expert panel who have IT managerial experience and worked in IT offering companies; using the walkthrough method through one-on-one (face-to-face) or email discussion.	version 8 (a, b)
Step 8: Expert Panel Validation	Version 7a and 7b of the survey was incorporated into a web-based validation survey and was administered to an expert panel of 21 members.	The decision was to distribute the practices on 4 questionnaires instead of and distribute each questionnaire to 4000 IT companies. Version 9 (a, b, c, d).
Step 9: Pilot (IT companies in Portland, Oregon)	Version 9 (a, b, c, d) was sent out to (12 IT companies in Portland) to pilot testing the survey.	Version 10 (a, b, c, d)

4.2.2 Expert Panel

Two Expert Panels were formed to help with the validation of the survey instrument, clarify, interpret and validate the research results: (1) SEI CMM/CMMI expert panel and (2) IT services offshoring expert panel.

The expert panels composed of experts from several sectors of the IT services industry. They were asked to (1) Construct validate the survey instrument by revising the survey instrument to minimize the number of issues and practices according to their importance; (2) Content validate the survey instrument and (3) then, validate and clarify the results attained through the field study. They were selected using the following criteria:

- Expertise in the decision making process for offshoring of U.S. IT services and software development by selecting them from multiple sectors and industries.
- Objective viewpoint in a group to compensate for individual biases on the outcome.
- Ensure the absence of evident conflicts among the panel members by selecting the members from organizations that do not have conflicts among them.

Initially, 37 candidates were contacted with an invitation. Following Don Dillman's books: "Internet and Mixed Mode Survey" (Dillman et al., 2009), "How to Conduct Your Own Survey" (Salant and Dillman, 1994), and "Mail and Internet surveys" (Dillman, 2000). An invitation letter was sent to the 37 candidates as shown in Figure 22.

Hello,

My name is Rosine Hanna and I am a PhD candidate at the Department of Engineering & Technology Management (ETM), Maseeh College of Engineering and Computer Science, Portland State University. My research is part of doctoral degree requirements in Engineering and Technology Management titled: *Managing issues through the lifecycle of IT service off-shoring projects*.

Western countries' information technology and software intensive firms are increasingly producing software and IT services in developing countries. With this swift advancement in off-shoring, there are many issues that can be investigated to enable companies to maximize their benefit from off-shoring. However, significant challenges can happen throughout the lifecycle of off-shoring IT service projects which turn the potential benefits into losses. This research investigates CMM/CMMI best practices and their effect on managing and mitigating critical issues associated with off-shore development.

I would like to invite you to be on my expert panel for my PhD dissertation research. Professor David Raffo of Portland State University (with joint appointments in the Business Administration, Engineering, and Computer Science) recommended you based upon your knowledge and expertise. The expert panel members will be asked to provide feedback in two phases.

Phase one:
A. Review a CMMI best practices list which I have prepared and advise as to which practices you believe to be the most important in mitigating off-shoring issues and challenges.
B. Review the list of off-shoring issues and challenges and advise which issues you believe to be the most important for off-shoring projects.

Providing this feedback should take between 10 and 15 minutes to complete.

Phase two:
Respond to a construction validation survey (9 questions). This phase will be sent out for your review 1-2 weeks after the results of phase one have been analyzed and incorporated into the construct validation instrument.

This review should take approximately 20-30 minutes to complete.

At the end of the research, you will receive a copy of the report and results of the research.

Your acceptance and participation in this research panel is very important and greatly appreciated as it adds not only to the completion of my doctoral dissertation but also to the body of knowledge in this growing area of off-shoring IT services.

Best regards,

Rosine Hanna

Figure 22: Sample of Expert Panel Invitation Email

Twenty two candidates agreed to be panel members. Twelve of which were CMM/CMMI experts IT services and ten were IT offshoring experts. Seventeen experts participated in Phase 2 of the validation.

The experts listed in Table 19 were the main evaluators of the validity of the survey instrument.

Table 19: Expert Panel

Title		Education	Institution	Experience	Location
1	Process Director, Senior Member of the Technical Staff	PhD	IT Services and Software Development Company (CMM/CMMI)	15 years of IT industry	Wayne, NJ
2	Senior Member of the Technical Staff	PhD	Software Engineering Institute (CMM/CMMI)	10 years of academia, 40 years of IT Industry	Pittsburgh, PA
3	Faculty (Professor) in IT and Software Engineering		Software Engineering Institute (CMM/CMMI)	10 years of academia, 6 years of IT industry	Pittsburgh, PA
4	1), Director of ITSqc. LLC.	PhD	IT and Software Engineering University (CMM/CMMI)	15 years of academia, 10 years in the IT industry	Pittsburgh, PA
5	Senior Member of Technical Staff	PhD	University (CMM/CMMI)	20 years of academia, 10 years of IT industry	Pittsburgh, PA
6	Chief Scientist and Partner	PhD	Software Engineering Research (CMM/CMMI)	5 years of academia, 20 years of IT industry	Deutschland, Ireland
7	Senior Lecturer in Computer Science	PhD	University (CMM/CMMI)	20 years of academia, 7 years of Industry	United Kingdom
8	CEO	PhD	Quality Standard Solutions Company (CMM/CMMI)	Over 30 years of IT industry	San Diego, CA
9	Present	PhD	Process standard Company Inc., (CMM/CMMI)	13 years of academia, 15 years of IT industry	Rockville, MD
10	Associate Professor at Department of Information Technology	PhD	University (CMM/CMMI)	30 years of academia, 10 years in the IT industry	Washington, DC
11	Director, Process Management	PhD	IT and Software Engineering Company (CMM/CMMI)	Over 30 years of IT industry	Redondo Beach, CA
12	Engineering Fellow	PhD	IT and Software Engineering Company (CMM/CMMI)	Over 24 years of IT industry	Melbourne, FL
13	Business Development Manager	MS	IT and Software Engineering Company (Non CMM/CMMI)	17 years of IT industry	Portland, OR
14	Professor, Information Technology Dept.	PhD	University (Non CMM/CMMI)	Over 20 years of academia	Washington, DC
15	Corporate Research	PhD	IT and Software Engineering Company (Non CMM/CMMI)	Over 30 years of IT industry	Princeton, NJ
16	Associate Professor of IT and Software Development	PhD	University (Non CMM/CMMI)	10 years of academia, 5 years of IT industry	Canada

17	Professor of IT and Software Development	PhD	University (Non CMM/CMMI)	10 years of academia	Deutschland
18	Researcher and Scientist	PhD	Labs Research	8 years of academia, 15 years of IT industry	Basking Ridge, NJ
19	Fellow and Associate Professor	PhD	University (Non CMM/CMMI)	10 years of academia	United Kingdom
20	Project Manager and Lecturer of Technology	PhD	University (Non CMM/CMMI)	15 years of academia, 15 years of IT industry	Helsinki, Finland
21	Senior Lecturer, Department of Computer Science and Information Systems	PhD	Software Engineering Research Centre	20 years of academia	Ireland
22	Research Staff Member	PhD	IT Company Research Center	9 years of IT industry	USA and India

4.2.3 Model Development – Construct Validation

There are three main steps for the survey instrument construct validation.

4.2.3.1 Step 1: Create the initial Draft of Issues and Practices

As a first step of construct validation, a literature review was conducted to gather evidence from studies using similar types of instruments. Among others, a similar study surveyed IT managers in Irvine California where the topic was offshore software development with issues such as obstacles, performance and practices (Dedrick et al., 2009). The actual survey instrument was obtained through the Publishing Journal. Table 20 lists example surveys that were used as references in this study.

Table 20: Example Surveys that were used as References in this Study

Sponsor	Title	Date
University of California, Irvine	Offshore Software Development: Survey Results (Dedrick et al., 2009)	2009
IBM Research	A Research Agenda for Distributed Software Development (Sengupta et al., 2006a)	2006
San Jose State University, USA	Risks, benefits, and challenges in global IT outsourcing: Perspectives and practices (Dhar and Balakrishnan, 2006)	2006
Software Engineering Institute, Carnegie Mellon University Pittsburgh, PA	An empirical study of global software development: distance and speed (Herbsleb et al., 2005b)	2005
MIT Sloan School of Business	Software Development Worldwide (Cusumano et al., 2003)	2003
Software Engineering Institute, Carnegie Mellon University Pittsburgh, PA	Software quality and the capability maturity model (Herbsleb et al., 1997a)	1997
Software Engineering Institute, Carnegie Mellon University Pittsburgh, PA	A systematic survey of CMM experience and results (Herbsleb and Goldenson, 1996a).	1996
IEEE Transactions on Software Engineering	Components of software development risk: How to address them? A project manager survey. (Ropponen and Lyytinen, 2000)	2000

4.2.3.2 Step 2: Pre-Validate Offshoring IT service survey

Once a preliminary version of the survey was completed, it was converted to an online survey. The survey tool was provided by Qualtrics, as online survey vendor, and sponsored by Portland State University: www.qualtrics.com.

The survey was comprised of questions about the importance of the issues experienced when offshoring IT services and regarding the importance of industry best practices used to mitigate these issues.

The survey was activated and PhD students from the Department of Engineering and Technology Management were recruited to participate in a read-aloud review of the survey. In the read-aloud method, common in usability studies, the subject is asked to perform a series of instructions. The subject is requested to speak aloud their thoughts and feelings as they go about completing the assigned tasks.

Below are examples of feedback and the resulting modifications from the read aloud activity:

Recruited participant: "What do you mean with offshoring?"

Modification: Added definition of offshoring to clarify survey item. "What is this for?"

Modification: Added instruction to explain survey element"

Recruited participant: "The list of practices 57 is too long; experts will not have the time to review all of them – why don't you distribute them on two or three surveys instead of one"

Modification: Because we had 17 issues and 57 practices to track, we decided to distribute the practices over three questionnaires. The intent was to increase the response rate from the expert panel.

4.2.3.3 Step 3: Expert Panel Validates Offshoring IT Services Issues and Practices

During this most critical model development and construct validation step, the expert panel was contacted to:

1) Review a CMMI best practices list which I have prepared and advise as to which practices the expert panel believes to be the most important in mitigating offshoring issues and challenges;

2) Review the list of offshoring issues, challenges and advise which issues they believe to be the most important for offshoring project.

4.2.3.4 Results and Summary of Model Development and Survey Instrument Construct Validation

This Model Development and construct validation were done in three steps. The instrument contained 17 issues and 57 practices.

Because we had 17 issues and 57 practices to track, we decided to distribute the practices over three questionnaires. The intent was to increase the response rate from the expert panel. Providing this feedback, the survey was expected to take between ten and fifteen minutes to complete.

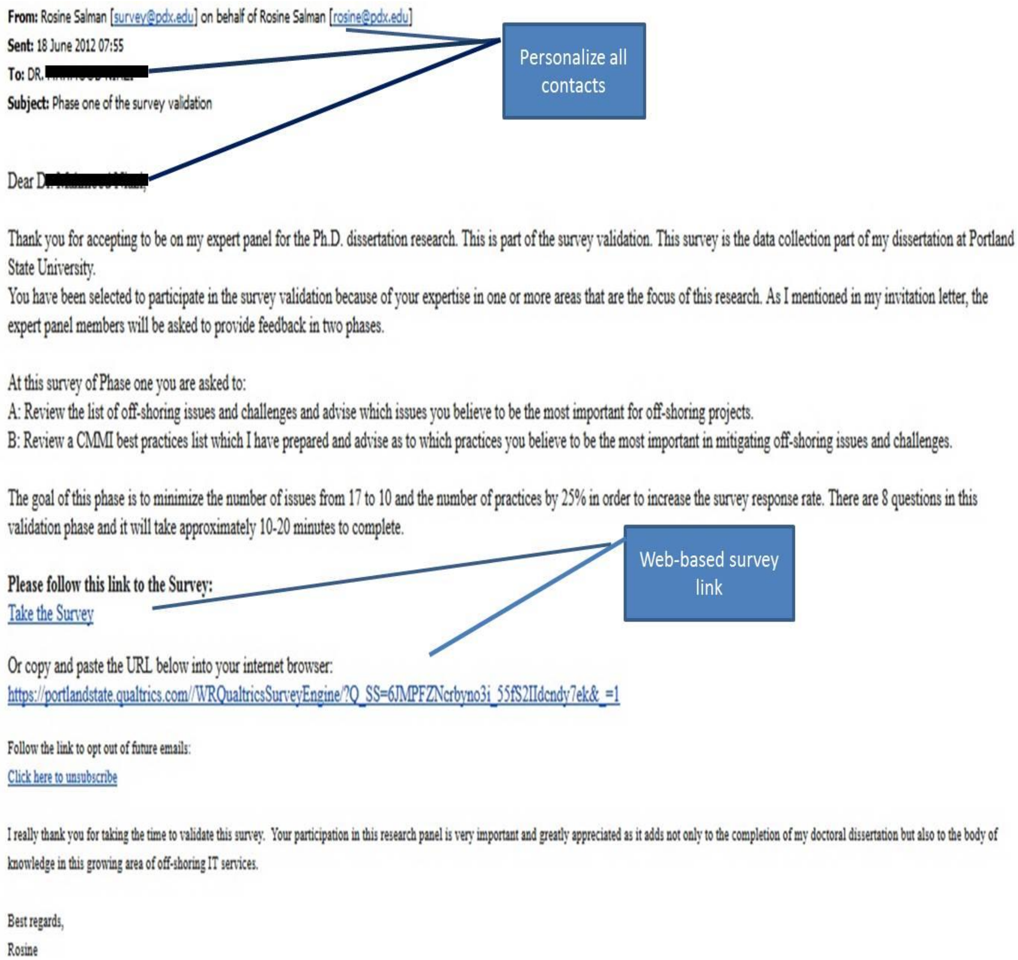
As for the practices, we have 57 practices and they were distributed as in Table 21.

Table 21: Issues and Practices Distributed to the Expert Panel for Construct Validation

7 Expert Panel 4 CMM/CMMI experts and 3 IT offshoring services experts	7 Expert panel 4 CMM/CMMI experts and 3 IT offshoring service non CMM/CMMI experts	7 Expert panel 3 CMM/CMMI experts and 4 non CMM/CMMI experts
Questionnaire 1: contains 17 issues and 21 practices	Questionnaire 2: contains 17 issues and 22 practices	Questionnaire 3: contains 17 issues and 21 practices
Q1 and Q2 17 Issues Q3 contains 6 practices Q4 contains 3 practices Q10 contains 5 practices Q14 contains 3 practices Q17 contains 4 practices	Q1 and Q2 17 Issues Q5 contains 2 practices Q7 contains 5 practices Q8 contains 4 practices Q9 contains 6 practices Q11 contains 2 practices Q15 contains 3 practices	Q1 and Q2 17 Issues Q6 contains 3 practices Q12 contains 6 practices Q13 contains 9 practices Q16 contains 4 practices

Invitations to the construct validation were sent via email to 21 expert panel members and validation activity was conducted using a web-based survey. Using multiple follow-ups contacts, this step took five weeks to complete. 21 experts started and completed the survey.

The expert panel was provided a link to a web-based survey. Figure 23 shows the email page.



From: Rosine Salman [survey@pdx.edu] on behalf of Rosine Salman [rosine@pdx.edu]
Sent: 18 June 2012 07:55
To: DR.[redacted]
Subject: Phase one of the survey validation

Dear D[redacted]

Thank you for accepting to be on my expert panel for the Ph.D. dissertation research. This is part of the survey validation. This survey is the data collection part of my dissertation at Portland State University.
You have been selected to participate in the survey validation because of your expertise in one or more areas that are the focus of this research. As I mentioned in my invitation letter, the expert panel members will be asked to provide feedback in two phases.

At this survey of Phase one you are asked to:
A: Review the list of off-shoring issues and challenges and advise which issues you believe to be the most important for off-shoring projects.
B: Review a CMMI best practices list which I have prepared and advise as to which practices you believe to be the most important in mitigating off-shoring issues and challenges.

The goal of this phase is to minimize the number of issues from 17 to 10 and the number of practices by 25% in order to increase the survey response rate. There are 8 questions in this validation phase and it will take approximately 10-20 minutes to complete.

Please follow this link to the Survey:
Take the Survey

Or copy and paste the URL below into your internet browser:
https://portlandstate.qualtrics.com//WRQualtricsSurveyEngine/?Q_SS=6JMPFZNcrbyno3i_55fS2IIdcndy7ek&_=1

Follow the link to opt out of future emails:
Click here to unsubscribe

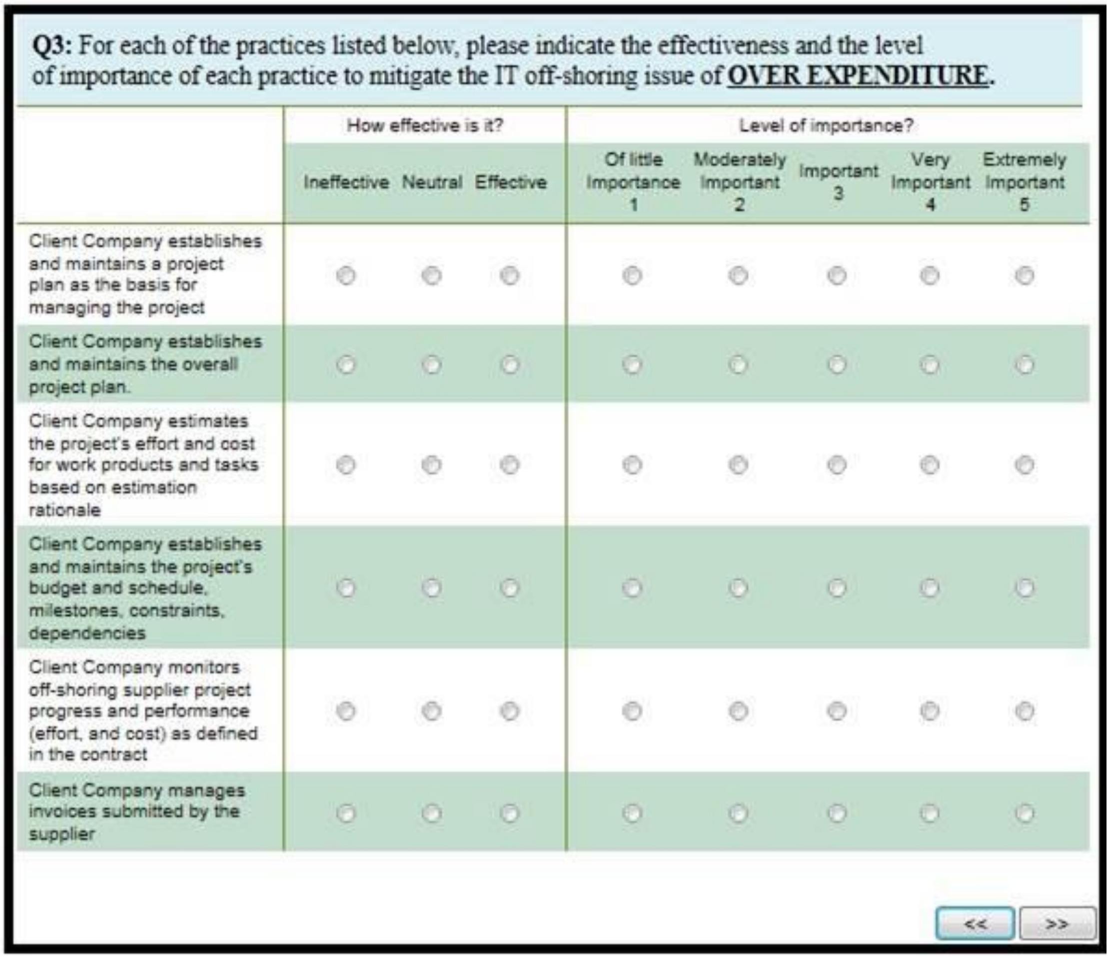
I really thank you for taking the time to validate this survey. Your participation in this research panel is very important and greatly appreciated as it adds not only to the completion of my doctoral dissertation but also to the body of knowledge in this growing area of off-shoring IT services.

Best regards,
Rosine

Figure 23: Email Sent to the Expert Panel for the Survey Construct Validation

For the purpose of construct validation, the experts were expected to (1) review a CMMI best practices list which I prepared and advise as to which practices the expert panel believes to be the most important in mitigating offshoring issues and challenges as in Figure

24, (2) Review the list of offshoring issues, challenges and advise as to which issues they believe to be the most important for offshoring projects as in Figure 25.



Q3: For each of the practices listed below, please indicate the effectiveness and the level of importance of each practice to mitigate the IT off-shoring issue of **OVER EXPENDITURE**.

	How effective is it?			Level of importance?				
	Ineffective	Neutral	Effective	Of little Importance 1	Moderately Important 2	Important 3	Very Important 4	Extremely Important 5
Client Company establishes and maintains a project plan as the basis for managing the project	○	○	○	○	○	○	○	○
Client Company establishes and maintains the overall project plan.	○	○	○	○	○	○	○	○
Client Company estimates the project's effort and cost for work products and tasks based on estimation rationale	○	○	○	○	○	○	○	○
Client Company establishes and maintains the project's budget and schedule, milestones, constraints, dependencies	○	○	○	○	○	○	○	○
Client Company monitors off-shoring supplier project progress and performance (effort, and cost) as defined in the contract	○	○	○	○	○	○	○	○
Client Company manages invoices submitted by the supplier	○	○	○	○	○	○	○	○

<< >>

Figure 24: Example of Level of Effectiveness and Importance of Practices

Q1: How important is each issue when off-shoring IT services?

	Not at all Important	Somewhat Unimportant	Neutral	Somewhat Important	Extremely Important
Over expenditure due to hidden costs incurred by the client company	○	○	○	○	○
Difference in interpretation of project requirements between the client and the supplier	○	○	○	○	○
Poorly developed and documented requirements by the client company	○	○	○	○	○
Poor tracking and managing requirement changes by the client company	○	○	○	○	○
Lack of a full communication plan between the client and the supplier	○	○	○	○	○
Communication and coordination problems between the client and the supplier	○	○	○	○	○
Language barriers	○	○	○	○	○
Time-zone differences between the client and the supplier	○	○	○	○	○
Cultural differences between the client and the supplier	○	○	○	○	○
Incomplete and unclear contract	○	○	○	○	○
Contract renegotiation and termination	○	○	○	○	○
Difference in project management practices between the client and the supplier	○	○	○	○	○
Unable to measure performance of the supplier	○	○	○	○	○
Supplier technical/security and political issues	○	○	○	○	○
No previous experience of the supplier	○	○	○	○	○
Lack of supplier standardized working methods	○	○	○	○	○
Poor execution plan specifically timing and type of work transferred to the supplier	○	○	○	○	○

Q2: Optional: In your opinion, is there anything missing from the issues listed above? Or do you have any additional feedback on any of these issues? Please provide it in the comment box below.

Figure 25: Example of Importance of Issues

The results of phase one were clear and indicated that the expert panel found all issues to be important where the minimum average was 3.48 of 5 points on the Likert scale. On the issue of *Time Zone difference*, thirteen experts voted between 4 and 5 “somewhat important” and “extremely important” as depicted in Table 22.

Table 22: Results of Construct Validation of the Importance of Issues of IT Offshoring

Experts	Over expenditure	Difference in interpretation of project requirements	Poorly developed and documented requirements	Poor tracking & managing requirement changes	Lack of a full communication plan	Communication and coordination problems	Language barriers	Time-zone differences	Cultural differences	Incomplete and unclear contract	Contract renegotiation and termination	Difference in project management practices	Unable to measure performance	Supplier technical/security and political issues	No previous experience of the supplier	Lack of supplier standardized working methods	Poor execution plan
Expert 1	4	4	3	3	5	5	3	4	4	3	3	4	3	4	4	2	3
Expert 2	2	5	4	4	3	3	3	4	3	5	4	4	4	4	5	5	4
Expert 3	5	4	4	4	5	5	5	4	5	5	5	4	5	4	5	4	5
Expert 4	2	4	4	2	3	4	5	5	5	3	3	2	3	3	3	3	3
Expert 5	5	5	4	4	4	5	4	4	4	3	3	4	4	3	5	4	4
Expert 6	4	4	4	5	3	3	3	3	4	4	3	5	5	3	4	4	3
Expert 7	4	5	5	5	5	4	4	2	4	4	3	4	4	4	4	4	4
Expert 8	4	5	5	5	3	4	3	2	3	4	4	5	5	4	5	5	5
Expert 9	4	5	4	4	4	5	4	4	4	3	3	4	4	3	4	4	4
Expert 10	3	4	5	5	4	4	4	3	3	4	2	3	3	3	5	4	5
Expert 11	5	5	4	4	4	4	2	2	2	5	5	4	5	5	4	4	5
Expert 12	3	5	5	5	4	5	4	3	4	5	4	4	5	5	5	4	4
Expert 13	1	5	3	4	3	3	3	4	5	4	4	1	3	3	4	3	4
Expert 14	3	5	4	5	5	5	4	4	4	5	4	4	4	4	4	3	4
Expert 15	5	5	4	4	5	4	3	3	3	4	2	2	4	2	4	5	2
Expert 16	3	3	5	5	3	5	3	5	5	5	3	4	5	4	5	4	5
Expert 17	5	5	5	5	5	5	4	4	4	5	4	4	4	4	4	4	5
Expert 18	5	4	5	4	5	5	4	4	5	4	4	3	4	4	5	3	2
Expert 19	5	5	5	5	5	5	5	4	4	5	4	4	5	5	5	5	5
Expert 20	5	5	5	5	5	5	3	4	5	4	4	4	5	3	5	5	5
Expert 21	5	5	5	5	4	5	3	1	1	4	3	2	3	2	4	2	4
Average	3.9	4.6	4.4	4.4	4.1	4.4	3.6	3.5	3.9	4.2	3.5	3.5	4.1	3.6	4.4	3.9	4
Number of 4 & 5s	14	21	19	19	15	18	11	13	15	17	11	15	16	12	20	15	16

The expert panel also found that all 57 practices to be important as in Table 23 with most of the practices were found to be above 2.5 out of 3 points on the Likert scale. Therefore, after a meeting with committee members, the decision was to keep all issues and practices but distribute the practices in four surveys instead of one and send each survey to 3000 IT companies.

Table 23: Expert panel evaluation for the importance of the 57 practices

Issue 1	OVER EXPENDITURE					
#	Question	Ineffective	Neutral	Effective	Responses	Mean
1	Client Company establishes and maintains a project plan as the basis for managing the project	0	3	4	7	2.57
2	Client Company establishes and maintains the overall project plan.	0	5	2	7	2.29
3	Client Company estimates the project's effort and cost for work products and tasks based on estimation rationale	0	3	4	7	2.57
4	Client Company establishes and maintains the project's budget and schedule, milestones, constraints, dependencies	0	2	5	7	2.71
5	Client Company monitors offshoring supplier project progress and performance (effort, and cost) as defined in the contract	1	1	5	7	2.57
6	Client Company manages invoices submitted by the supplier	0	2	5	7	2.71
Issue 2	DIFFERENCES IN INTERPRETATION OF PROJECT REQUIREMENTS BETWEEN THE CLIENT AND THE SUPPLIER					
#	Question	Ineffective	Neutral	Effective	Responses	Mean
7	Client Company develops an understanding with offshoring supplier on the meaning of requirements	0	1	6	7	2.86
8	Client Company validates requirements to ensure that the resulting product performs as intended in the end user's environment	0	1	6	7	2.86
9	Client Company obtains commitment to requirements from project participants	0	2	5	7	2.71
Issue 3	POORLY DEVELOPED AND DOCUMENTED REQUIREMENTS BY THE CLIENT COMPANY					
#	Question	Ineffective	Neutral	Effective	Responses	Mean
10	Client Company stakeholder needs, expectations, constraints and interfaces are	0	1	6	7	2.86

	collected and translated into customer requirements					
11	Client Company maintains bidirectional traceability among requirements and work products	0	2	5	7	2.71
Issue 4	POOR TRACKING AND MANAGING REQUIREMENT CHANGES BY CLIENT COMPANY					
#	Question	Ineffective	Neutral	Effective	Responses	Mean
12	Client Company manages changes to requirements as they evolve during the project.	0	1	6	7	2.86
13	Client Company ensures that project plans and work products remain aligned with requirements	0	1	6	7	2.86
14	Client Company's Customer Interface Manager leads the team in estimating and documenting the impact of every change in requirement and works with the Configuration Control Board (CCB) to get approval for changes to those requirements	1	1	5	7	2.57
Issue 5	LACK OF A FULL COMMUNICATION PLAN BETWEEN THE CLIENT AND THE SUPPLIER					
#	Question	Ineffective	Neutral	Effective	Responses	Mean
15	Client Company establishes and manages the coordination and collaboration between the project and relevant stakeholders	0	1	6	7	2.86
16	Client Company's team members track actual results and performance against plans on a weekly basis. Team members track progress against individual plans on a daily basis.	0	2	5	7	2.71
17	Client Company develops a documented plan to be used to communicate inter-group commitments and to coordinate and track the work performed.	0	3	4	7	2.57
18	Client Company team managers are responsible for the coordination across all project teams	0	3	4	7	2.57
19	Client company communication and coordination practices are institutionalized to ensure they are performed as managed processes	1	2	4	7	2.43
Issue 6	COMMUNICATION AND COORDINATION PROBLEMS BETWEEN THE CLIENT AND THE SUPPLIER					
#	Question	Ineffective	Neutral	Effective	Responses	Mean
20	Representatives of the client company project's software engineering group work with representatives of the supplier engineering groups to monitor and coordinate technical activities and resolve technical issues	0	2	5	7	2.71

21	Client Company selects team roles, including the role of Supplier Interface Manager, who is the liaison between the team and the supplier company representative, and is responsible for requirements change management	1	2	4	7	2.43
22	Client Company communicates quality issues and ensures the resolution of noncompliance issues with the staff and managers	0	2	5	7	2.71
23	Client Company establishes and maintains a documented policy for conducting its Communication and Coordination activities	2	2	3	7	2.14
Issues 7,8 &9	7) LANGUAGE BARRIERS 8) TIME-ZONE DIFFERENCES 9) CULTURAL DIFFERENCES BETWEEN THE CLIENT AND THE SUPPLIER					
#	Question	Ineffective	Neutral	Effective	Responses	Mean
24	Client Company ensures that the workforce has the skills to share information and coordinate their activities efficiently	0	1	6	7	2.86
25	Client Company establishes a culture for openly sharing information and concerns across organizational levels as well as among team members	0	1	6	7	2.86
26	Client Company establishes project teams as well as their responsibilities, authorities and interrelationships	1	1	5	7	2.57
27	Client Company establishes and maintains open and effective project teams' communication and coordination plan	0	2	5	7	2.71
28	Client Company team managers are responsible to track and resolve inter-group issues	0	2	5	7	2.71
29	Client Company maintains effective work-groups, interpersonal problems are addressed quickly and meetings are managed to ensure that work-group time is used most effectively	0	2	5	7	2.71
Issue 10	INCOMPLETE AND UNCLEAR CONTRACT					
#	Question	Ineffective	Neutral	Effective	Responses	Mean
30	Client Company establishes and maintains a mutual understanding of the contract with selected suppliers and end users based on acquisition needs and the suppliers' proposed approaches	0	1	6	7	2.86
31	Client Company stakeholder needs, expectations, constraints and interfaces are collected and translated into customer requirements.	0	1	6	7	2.86
32	Client Company requirements are refined and elaborated into contractual requirements.	0	1	6	7	2.86
33	Client Company establishes and maintains a formal contract management plan.	0	2	5	7	2.71
34	Client Company establishes and maintains contractual requirements.	0	1	6	7	2.86

#	Question	Ineffective	Neutral	Effective	Responses	Mean
Issue 12	INSUFFICIENT PREVIOUS EXPERIENCE OF THE SUPPLIER					
#	Question	Ineffective	Neutral	Effective	Responses	Mean
35	Client Company selects suppliers based on an evaluation of their ability to meet specified requirements and established criteria	0	1	6	7	2.86
36	Client Company identifies and qualifies potential suppliers	0	2	5	7	2.71
37	Client Company selects suppliers using a formal evaluation	0	3	4	7	2.57
Issue 13	POOR EXECUTION PLAN SPECIFICALLY TIMING AND TYPE OF WORK TRANSFERRED TO THE SUPPLIER					
#	Question	Ineffective	Neutral	Effective	Responses	Mean
38	Client Company establishes and maintains the offshoring strategy	0	2	5	7	2.71
39	Client Company establishes and maintains the plan for performing the offshoring	1	1	5	7	2.57
40	Client Company determines the type of acquisition for each product or product component to be offshored	0	1	6	7	2.86
41	Client Company Plan transition to operations	0	2	5	7	2.71
Issue 14	SUPPLIER TECHNICAL/SECURITY /POLITICAL ISSUES					
#	Question	Ineffective	Neutral	Effective	Responses	Mean
42	Client Company selects supplier technical solutions to be analyzed and analysis methods to be used.	2	2	3	7	2.14
43	Client Company conducts technical reviews with the supplier as defined in the supplier agreement.	0	2	5	7	2.71
44	Client Company evaluates and categorizes each identified issue using defined risk categories and parameters and determines its relative priority.	0	2	5	7	2.71
Issue 15	EARLY CONTRACT RENEGOTIATION AND TERMINATION					
#	Question	Ineffective	Neutral	Effective	Responses	Mean
45	Client Company establishes and maintains negotiation plans to use in completing a supplier agreement.	0	3	4	7	2.57
46	Client Company insures that agreements with suppliers are satisfied by both the project and the supplier.	1	2	4	7	2.43
Issue 16	DIFFERENCE IN PROJECT MANAGEMENT PRACTICES BETWEEN THE CLIENT AND THE SUPPLIER					
#	Question	Ineffective	Neutral	Effective	Responses	Mean
47	Client Company stakeholder needs, expectations, constraints and interfaces are collected and translated into customer requirements.	0	1	6	7	2.86
48	Client Company selects suppliers based on an evaluation of their ability to meet specified requirements and established criteria	0	3	4	7	2.57

#	Question	Ineffective	Neutral	Effective	Responses	Mean
49	Client Company identifies and qualifies potential suppliers	0	2	5	7	2.71
50	Client Company selects, monitors, and analyzes supplier processes	0	4	3	7	2.43
Issue 17	UNABLE TO MEASURE PERFORMANCE OF THE SUPPLIER					
#	Question	Ineffective	Neutral	Effective	Responses	Mean
51	Client Company establishes and maintains quantitative objectives to address quality and process performance, based on customer needs and business objectives.	0	2	5	7	2.71
52	Client Company manages the project using statistical and other quantitative techniques to determine whether or not the project's objectives for quality and process performance will be satisfied.	0	3	4	7	2.57
53	Client Company performs root cause analysis of selected issues to address deficiencies in achieving the project's quality and process performance objectives.	1	0	6	7	2.71
54	Client Company manages corrective actions to closure when the project's performance or results deviate significantly from the plan	0	1	6	7	2.86
55	Client Company periodically reviews the project's progress, performance and issues experienced.	1	0	6	7	2.71
56	Client Company reviews the project's accomplishments and results at selected project milestones.	1	1	5	7	2.57
57	Client Company establishes and maintains records of quality assurance activities.	1	1	5	7	2.57

4.2.4 Survey Instrument Content Survey Validation

The instrument used in the research was content validated in six steps as in Table 18 and Figure 21 above, resulting in nine survey revisions over a nine month period. In the survey research, prior to survey administration, the instrument must go through a content validation. This is done by asking experts to make a judgment about the survey items: (1) How well a survey item represents the intention of the intended measurement;

(2) How easy is it for the intended target population to answer the survey item. Figure 26 shows an example of questions for intention and ease of answering. Responses are based on a 5-point Likert scale.

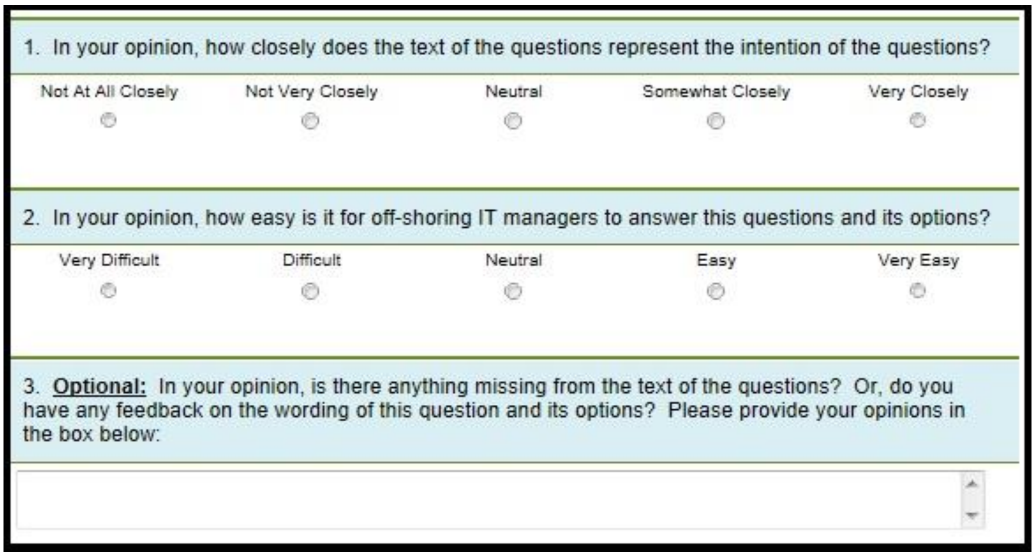


Figure 26: Content Validation Questions for Intention and Ease of Use

4.2.4.1   Content Validation: Step 4: Create Initial Draft of the Survey Instrument

As a first step of content validation of the survey instrument, a literature review was conducted to gather evidence from studies using similar types of instruments. The actual survey instrument was obtained through publishing journals. Table 23 above lists example surveys that were used for reference in this study.

4.2.4.2 Content Validation: Step 5: Pre-validate (1)

The survey was activated and nine PhD students from the Department of Engineering and Technology Management were recruited to participate in a read-aloud review of the survey. In the read-aloud method, common in usability studies, the subject is asked to perform a series of instructions. The subject is requested to speak aloud their thoughts and feelings as they go about completing the assigned tasks. A researcher is seated next to the participant and observed the interaction of the participant with the survey. The researcher may make additional notes that were not mentioned by the participant that would be helpful in improving the survey.

Below are examples of feedback and the resulting modification from the read-aloud activity:

"What do you mean with this item?"

Modification: Added explanation to clarify survey item.

Recruited participant: "What is this for?"

Modification: Added instruction to explain survey element"

4.2.4.3 Content Validation: Step 6: Pre-validate (2)

Then, the initial survey was presented to researchers and IT specialists at the SEI High Maturity Workshop (Washington, D.C., September 2011). The concept of the study was presented to them along with asking some of them to review the expanded list of risks and CMMI practices that would mitigate those risks. Table 24 lists the comments from the SEI researchers and the answers provided.

Initial list of questions for SEI CMM/CMMI colleagues:

1. Are we missing any major issues that are experienced by the client firm on offshoring projects?
2. Are we missing any CMMI practices that you believe would mitigate the issue?
3. Any comments you have regarding study construction?
4. Any people/organizations you recommend be included in the survey or interviews?

Table 24: Lists the Comments from the SEI Workshop and the Answers Provided

No.	Questions/Comments	Answers/ Modifications
1	You need to clarify who is applying the CMMI. Is it the client organization or the software service provider? Also, it may be that the client firm's development group is following CMMI, but the contracting organization is not. How are you handling that?	The study is focuses on the client organization. I added the client company to the practices.
2	The Cutter consortium wrote a famous article that lists offshore outsourcing risks. You should be sure to include that set of risks.	The issues of Cutter consortium article matches the list of issues of offshoring IT services in this study.
3	We understand that you are interested in what practices in the CMMI could be associated with mitigating each risk. Have you considered practices from ISO 9000? From PIM-BOK?	The focus of the research is CMM/CMMI best practices because it focuses on software development and it is widely adapted and has received great publicity in the software development industry and used by many companies. There are other industry standards such as ISO-9000 but for this research we wanted to limit our set of practices to CMMI to get a reasonable size of questionnaire.
4	Have you listed the security of data and a company's IP as part of the risks associated with offshore outsourcing. That is the main reason most DoD contractors do not offshore outsource.	In issue number 14 (R14: Supplier technical/security/political issues), I mentioned the security and political issues of the offshore outsourcing supplier. However, CMMI was developed to aid the U.S. Department of Defense in evaluating the capability of software contractors as part of awarding contracts which is only outsourcing to same country suppliers. Thus, in the CMMI for acquisition and CMMI for Development there are no specific practices to check the supplier security and political issues. Yet, these issues are critical for offshore outsourcing. The main objective of this research is to know if an organization adheres to the CMMI, does it mitigate the risks associated with offshore outsourcing.
5	What is the sample frame of companies that you will survey? Client firms? Service providers? End customers? Those who apply the CMMI and those who	The sample companies include client companies that apply CMM/CMMI and those who don't. The companies that don't apply CMM/CMMI will be the (control group) to compare their results in mitigating offshore outsourcing issues and

	don't? This is a critical issue that will affect the validity of your work.	challenges with the companies that apply the CMM/CMMI practices.
6	What will you do if you survey a company that does not use the CMMI but uses ISO 9000 or PIM-BOK instead? Will that skew your results? In other words, a company that participates in a process improvement model other than the CMMI will be advanced and perhaps actually participate in advanced practices so they will do well. How will you control for that?	I added question 9 for ISO and PMBOK (when I ask about the industrial standards applied by the client company). Data collected from companies that apply other than CMM/CMMI practices such as ISO-9000, ISO-9000-3, eSCM-CL, SSCM-SP or Project Management Body of Knowledge (PMBOK) will be excluded from the analyses, this way their results will not affect our data analysis.
7	How many companies will you survey?	The target sample will be 12000 companies, therefore, the web survey will be sent to 12000 client companies.
8	CMMI ACQ has a unique practice associated with establishing and maintaining an acquisition strategy. Have you included this?	Yes, it is included in issue number 17 (R17: Poor execution plan specifically timing and type of work transferred to the supplier) practice number 55 (PR55: Establish and maintain the acquisition strategy (CMMI ACQ, Project management, Project Planning (PP), SP 1.1, ML2)
9	Be sure to use good survey software	I am using Qualtrics that is supported by Portland State University.

The results of phase one were clear and indicated that the expert panel found all issues and practices to be important. Therefore, after a meeting with committee members, the decision was to keep all issues and practices but distribute the practices in four surveys instead of one and send each survey to 3000 IT companies as illustrated in Table 25.

Content validation survey (10 questions). This review was expected to take approximately 20-30 minutes to complete. Phase Two started on October 1 and ended on October 28th 2012.

Table 25: Number of Expert Panel and Number of Practices for Each of the Two Surveys

11 Expert Panel 6 CMM/CMMI expert and 5 non CMM/CMMI expert	**10 Expert panel 5 CMM/CMMI experts and 5 non CMM/CMMI experts**
Questionnaire 1: contains 17 issues and 29 practices	Questionnaire 2: contains 17 issues and 28 practices

4.2.4.4 Content Validation: Step 7: Pilot (PhD Experienced Students)

Step seven of the content validation was pilot tested with PhD experienced students. Respondents were asked to respond to the survey. The intention of the test deployment of a web survey to a group of respondents and test the back-end system, ensuring that data was being collected and stored electronically in the desired format. Feedback on content was not the goal of this step and respondents were specifically notified as such.

Twenty PhD students from the Engineering and Technology Department at Portland State University were recruited. They were shown a copy of the eventual survey that IT and software development managers would take and asked to answer all of the questions. At the end, a large text-based comment box asked for their overall comments and feedback regarding the survey in which they just participated. Twenty started and fifteen completed it to the end. Table 26 provides some examples of feedback and resulting modifications from the pilot step.

Table 26: Feedback and Resulting Modifications from the Pilot Step

No.	Participants' comments	Modifications
1	Question 3 in general questions "What Number of employees" it is currently allowing multiple answers!	Changed question layout to radio button format (single answer)
2	Why to put "* Required" questions 3 and 4?	Removed the word "Required" from all the questions
3	Why do you have the word "offshore" after each functional area in question 5	Removed the word "offshore" from the all answer options in this question
4	Question 1 option 5 "Poor tracking and … by "the" your company and … "remove "the before your company	Removed
5	Introduction of Question 1 is too long	Shorten the question
6	Question 4 "it is better to put a definition" for quality	Definition is added
7	If question 5 is "no", then question 6 does not apply. I can suggest to add in question 5 a note such as: "if the answer is no, please skip question 6"	Added Qualtrics "skip logic" to questions 5, 6, and 7 - when a person answers No it automatically skip the "level question" to the following question.
8	Size of font differs from question to question	Checked all fonts – unified them
9	I could add a State option that is not a State – how can you make sure that it is validated??	Added Qualtrics validation for US State to the State option

4.2.4.5 Content Validation: Step 7: Pilot (Subset of Expert Panel)

Version 7 of the survey was verified with a subset of expert panel members who had IT managerial experience and worked in IT offshoring companies. This was done using the walkthrough method, through a one-on-one (face-to-face) or email discussion.

4.2.4.6 Content Validation: Step 8: Expert Panel Validation

During this most critical validation step, the expert panel was contacted to content validate the survey questions for (1) relevance and (2) ease of answering. Invitations were emailed to start the content validation phase. The content validation was conducted using a web-based survey. With multiple follow-ups, this step took six weeks to complete. Of the total twenty one expert panel members who accepted the invitation, twenty one started the survey and sixteen completed it.

The expert panel was provided a link to a web-based survey. Figure 27 shows the invitation email with the link to the web-based link for the survey validation and Figure 28 shows the introduction page. Both show the instructions as to the nature of the activity and what was expected.

Rosine Salman 3:58 PM (0 minutes ago)

to [redacted]

Dear [redacted]

Thank you for your feedback on phase one of my survey validation. Your feedback was extremely important to my research as well as to the field of IT service offshoring and enhanced the survey instrument.

This phase two is part of the construct validation survey for a survey of IT off-shoring. As you know, this survey is the data collection part of my dissertation at Portland State University.

The construct validation survey will be conducted by walking you through each question in the survey by providing figures depicting the questions of the survey and by asking you two questions about each survey question: 1) How closely does the text of each question and its options represent the intention of the question?, 2) How easy is it for off-shoring IT managers to answer each question? If you think a question(s) can be improved at each step, you will have the opportunity to write in your comments.

There are 10 questions in the survey and 24 questions in the validation of the survey. This review should take approximately 20-30 minutes to complete.

Please Take the Survey

Or copy and paste the URL below into your internet browser:
https://portlandstate.qualtrics.com//WRQualtricsSurveyEngine/?Q_SS=ebKTqkmOj2R4kdf_0TWlbpFWKf1Kzdj&_=1

Upon the conclusion of this phase of the survey construct validation activity, I will compile the survey instrument before sending it out. The survey will target a random sample of companies inthe United States that: are of varying size, are among the 12,000 companies that off-shore IT services, consist of companies that do/do not participate in the SEI CMM/CMMI. Lastly, the survey tests the IT offshore practices from the client-firm management perspective.

At the end of the research, you will receive a copy of the report and the results of the research.

I would appreciate it if you could respond by October 28, 2012. If I have not received your responses by that date, I will send you a reminder.

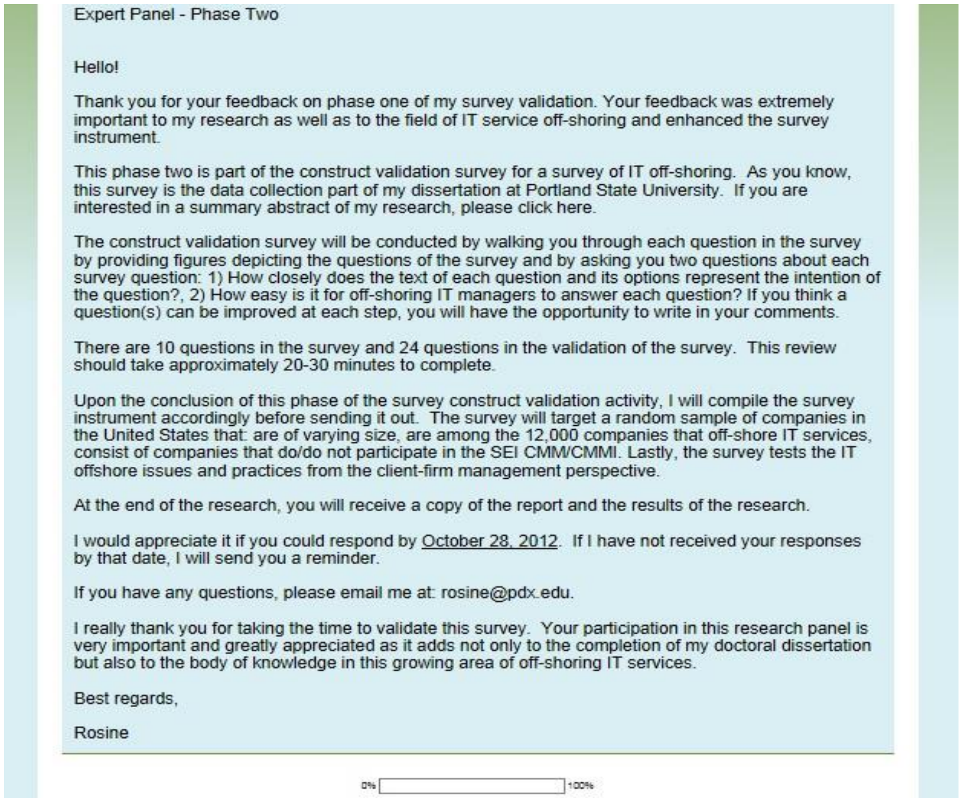
If you have any questions, please email me at: rosine@pdx.edu.

I really thank you for taking the time to validate this survey. Your participation in this research expert panel is very important and greatly appreciated as it adds not only to the completion of my doctoral dissertation but also to the body of knowledge in this growing area of off-shoring IT services.

Best regards,

Rosine

Figure 27: Survey Validation Email Invitation



Expert Panel - Phase Two

Hello!

Thank you for your feedback on phase one of my survey validation. Your feedback was extremely important to my research as well as to the field of IT service off-shoring and enhanced the survey instrument.

This phase two is part of the construct validation survey for a survey of IT off-shoring. As you know, this survey is the data collection part of my dissertation at Portland State University. If you are interested in a summary abstract of my research, please click here.

The construct validation survey will be conducted by walking you through each question in the survey by providing figures depicting the questions of the survey and by asking you two questions about each survey question: 1) How closely does the text of each question and its options represent the intention of the question?, 2) How easy is it for off-shoring IT managers to answer each question? If you think a question(s) can be improved at each step, you will have the opportunity to write in your comments.

There are 10 questions in the survey and 24 questions in the validation of the survey. This review should take approximately 20-30 minutes to complete.

Upon the conclusion of this phase of the survey construct validation activity, I will compile the survey instrument accordingly before sending it out. The survey will target a random sample of companies in the United States that: are of varying size, are among the 12,000 companies that off-shore IT services, consist of companies that do/do not participate in the SEI CMM/CMMI. Lastly, the survey tests the IT offshore issues and practices from the client-firm management perspective.

At the end of the research, you will receive a copy of the report and the results of the research.

I would appreciate it if you could respond by October 28, 2012. If I have not received your responses by that date, I will send you a reminder.

If you have any questions, please email me at: rosine@pdx.edu.

I really thank you for taking the time to validate this survey. Your participation in this research panel is very important and greatly appreciated as it adds not only to the completion of my doctoral dissertation but also to the body of knowledge in this growing area of off-shoring IT services.

Best regards,

Rosine

0% 100%

Figure 28: Survey Instrument Validation Introduction Page

The questions from the IT offshoring survey were presented to the expert panel one-by-one (one per page). For each question, the experts were provided with a textual definition of the intention, along with any relevant background information. A screen capture from the IT offshoring survey, showing the question and response, was also presented. Then the experts were asked to answer three questions. First, score how well the question captured the intention on a scale of 1 to 5 where 1 is "Not At All Closely" and 5 is "Very Closely". Second, score how easy it would be for the IT managers to answer the particular question on a scale of 1 to 5 where 1 is "Very Difficult" and 5 is "Very Easy". Third, is an optional opportunity for additional feedback for each question. Figure 29 presents a screen capture of an example question and how these steps were provided and integrated.

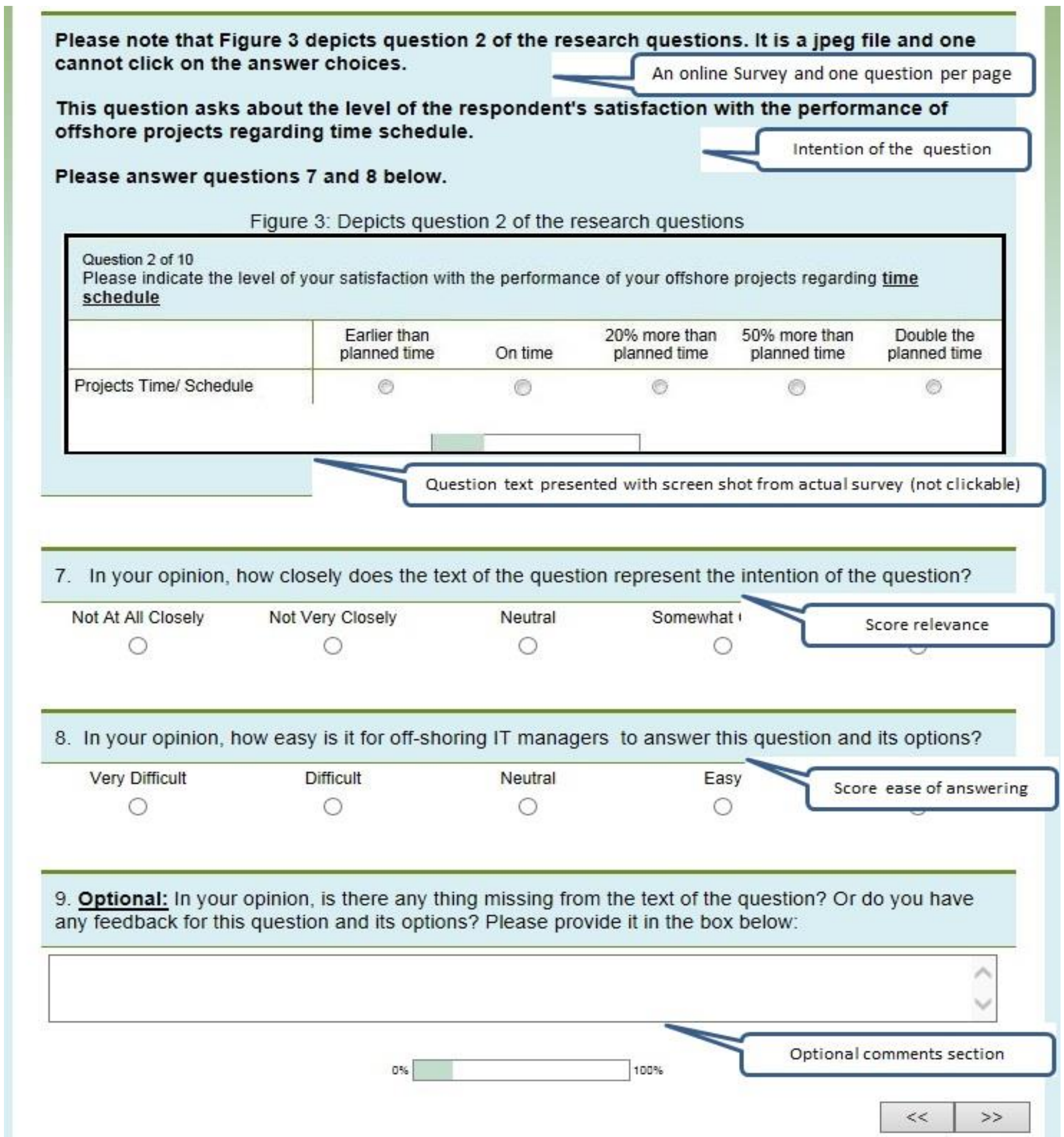


Figure 29: Example Question from the Online Validation Survey

Relevance; how well the question captures the intention of the question and ease of answering were scored on a 5-point Likert scale:

Relevance: 1: Not at all Closely; 2: Not Very Closely; 3: Neutral; 4: Somewhat Closely; 5: Very Closely.

Ease of Answering: 1: Very Difficult; 2: Difficult; 3: Neutral; 4: Easy; 5: Very Easy

After incorporating the feedback from the expert panel, the goal was to have all of the survey questions score above a 4: Somewhat closely for relevance and 4: Easy for ease of answering. Achieving these goals would help demonstrate that the survey was well designed, suited for the research objective and easy to fill out.

As shown in Table 27, the validation results were encouraging. The average intention score was 4.34 out of 5 and the average ease of answering was 3.91 out of 5. Consistent with the goal to have both indicators score above a 4-point, ease of answering for question 1 (3.63), Question 2 (3.63), Question 3 (3.69), Question 4 (3.19), Question 6 (3.88) and question 10 (3.25), were specifically identified for modification and improvement.

Table 27: Content Validation Results

Question	Intention Mean	Standard Deviation	Ease of Answering Mean	Standard Deviation
General Questions	4.56	0.89	4.31	0.79
Q1	4.56	0.81	3.63	1.02
Q2	4.06	1.12	3.63	1.20
Q3	4.13	1.15	3.69	1.30
Q4	4.13	0.81	3.19	1.17
Q5	4.06	1.18	4.00	1.26
Q6	4.25	1.00	3.88	1.31
Q7	4.44	1.03	4.13	1.26
Q8	4.31	1.01	4.19	1.05
Q9	4.00	1.32	4.00	1.15
Q10	4.63	0.50	3.25	1.44
End of Survey Questions	5.00	0.00	5	0.00
Average	4.34		3.91	

As mentioned earlier, in addition to scoring for intention and ease of answering, each question provided the experts with an optional comment box. The expert panel responses produced 15 full pages of comments. For each optional comment, each time 6 to 14 experts provided comments. Appendix C provides a list of the comments received and the action taken for each comment. Figures 30 to 35 reflect modified questions 1 to 4, 6 and 10 as well as how the comments were addressed and actions taken to improve their score.

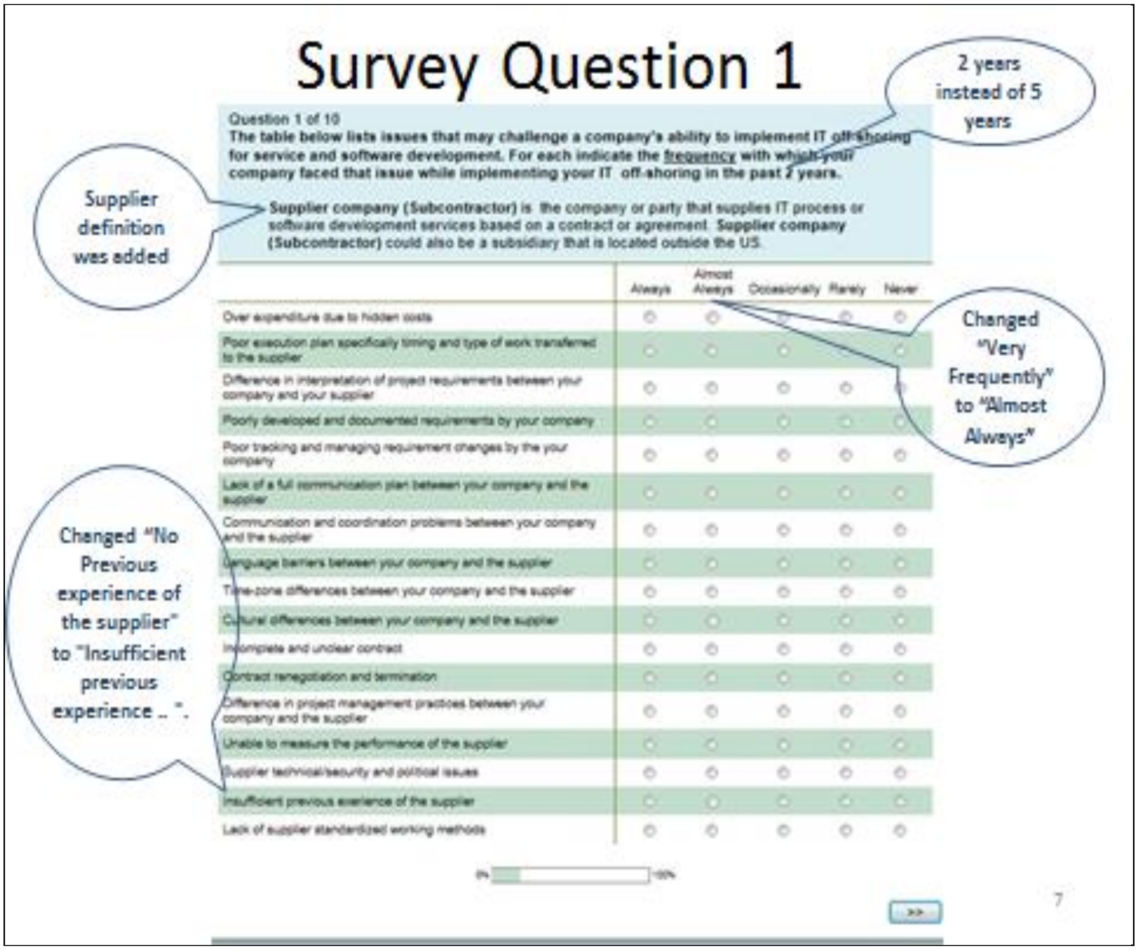


Figure 30: Survey Question 1 and the Modifications Applied

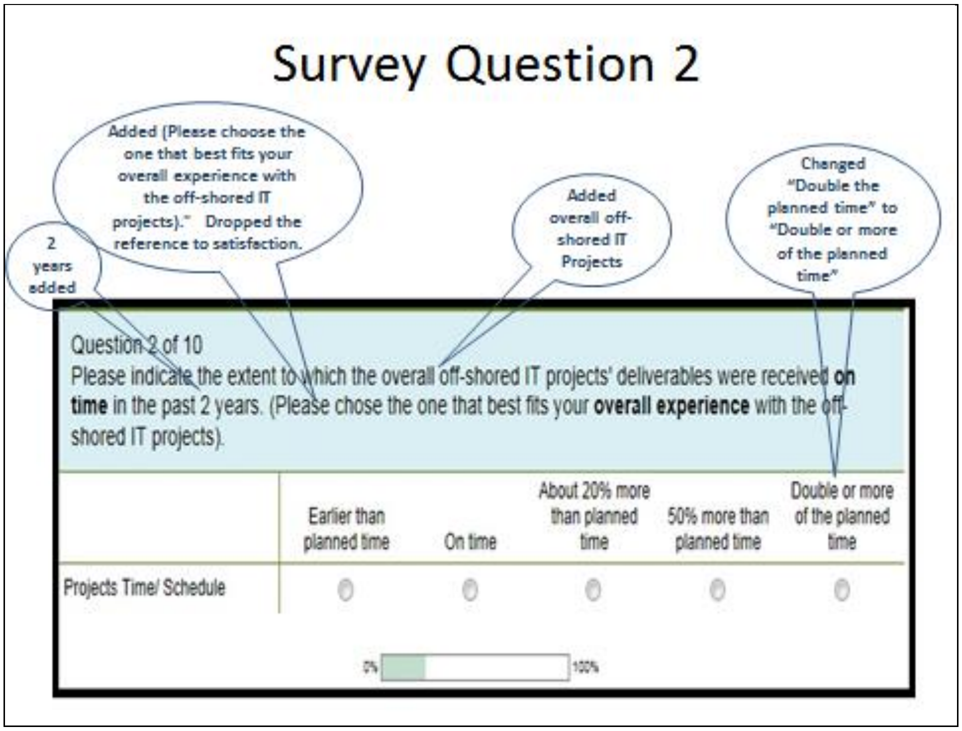


Figure 31: Survey Question 2 and the Modifications Applied

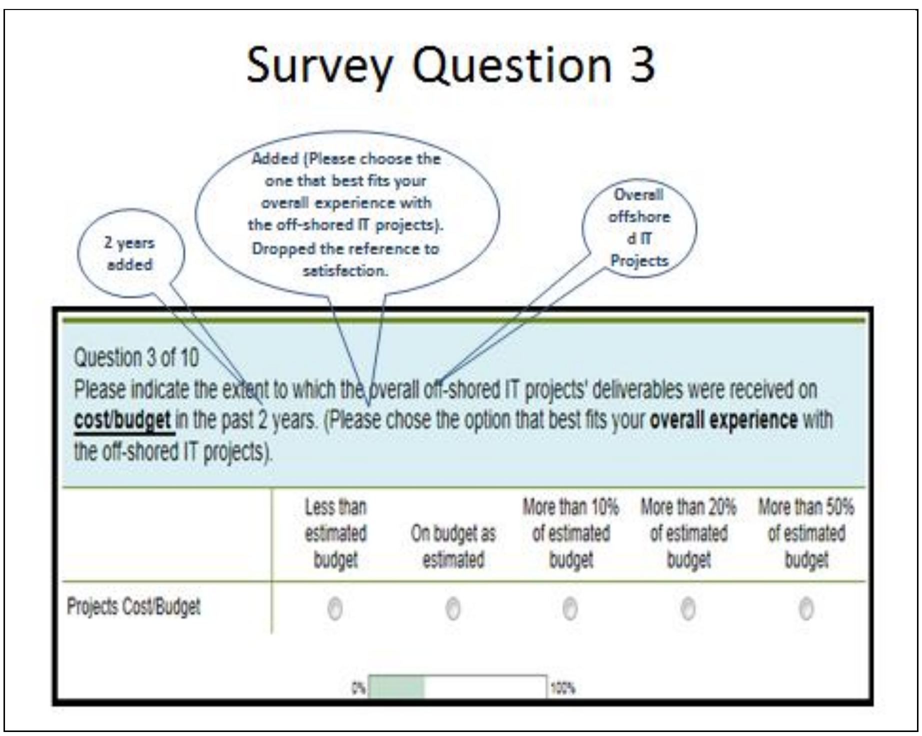


Figure 32: Survey Question 3 and the Modifications Applied

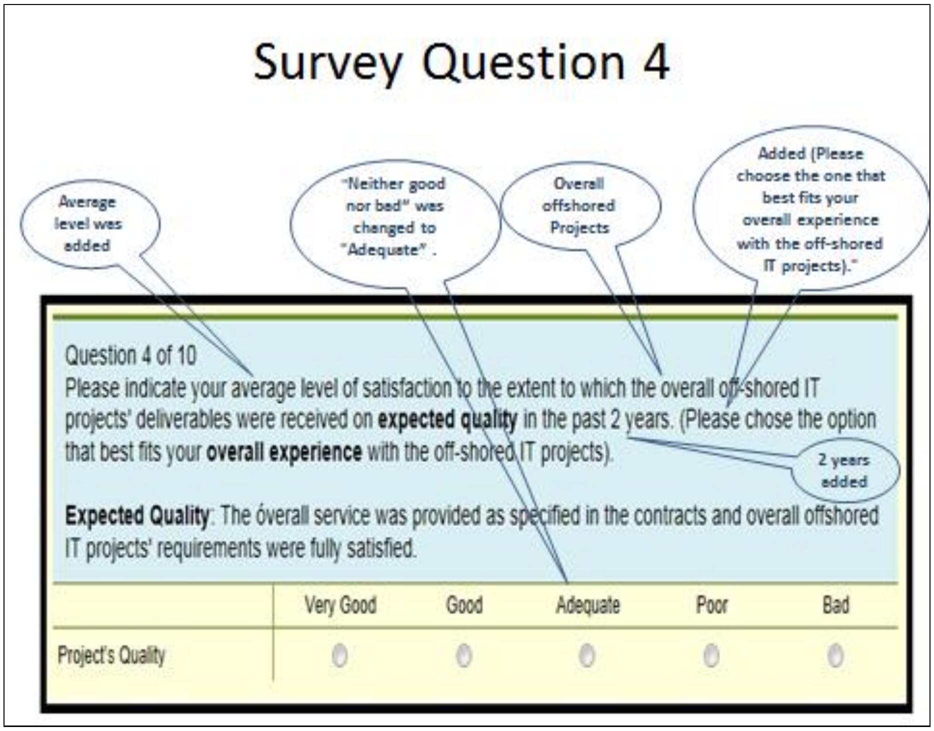


Figure 33: Survey Question 4 and the Modifications Applied

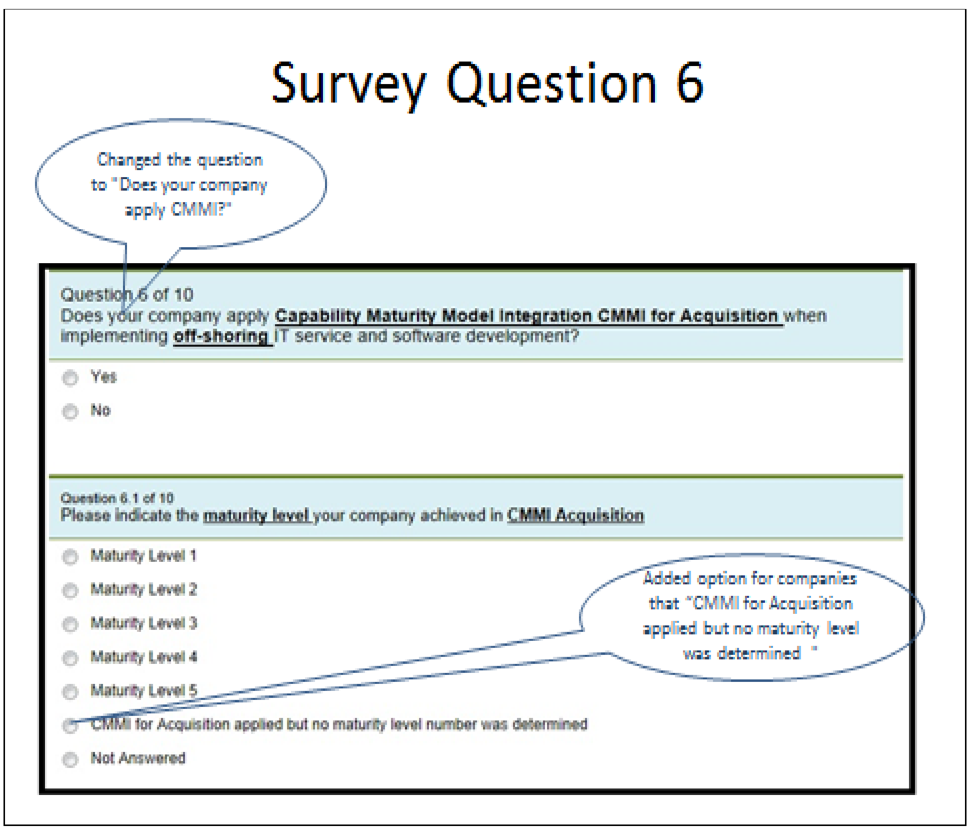


Figure 34: Survey Question 6 and the Modifications Applied

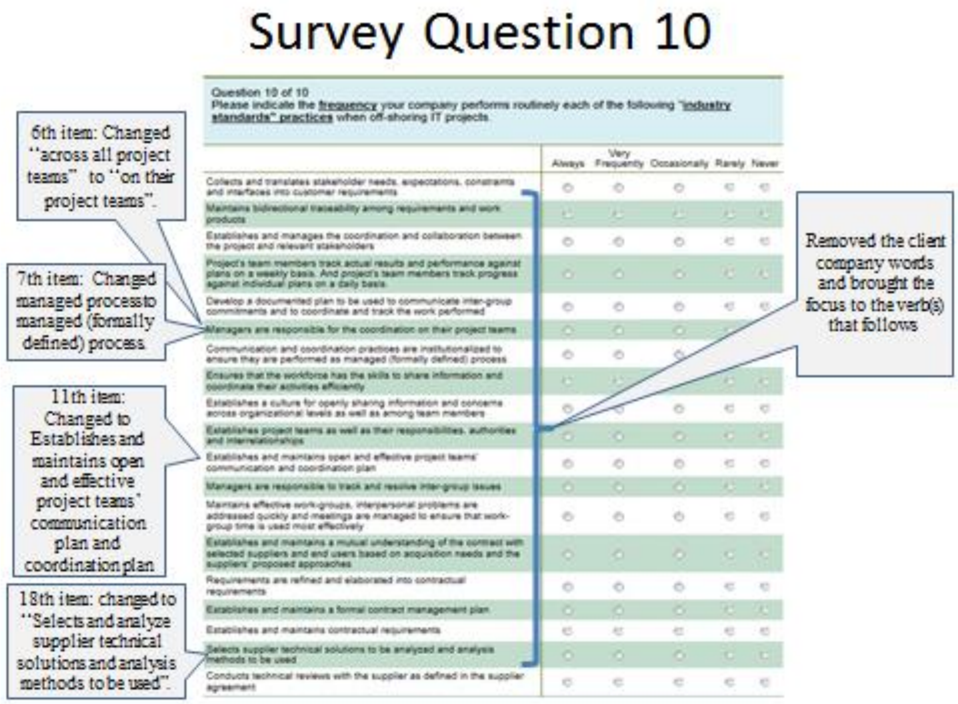


Figure 35: Survey Question 10 and the Modifications Applied

4.2.4.7 Content Validation: Step 9: Final Pilot (IT and Software Development Companies)

After receiving the expert panel comments, a tenth and final version of the survey was created and distributed among four surveys. Each of the four surveys contained the same first nine questions and the tenth question concerning the 57 practices was distributed among the four survey questionnaires as indicated in Figure 36.

No. of firms 3000	Survey 1	Issues	Unable to measure performance	Difference in interpretation of project requirements	Contract renegotiation and termination	<u>Total practices</u>	Total
		17	9	3	2	14	31

No. of firms 3000	Survey 2	Issues	Poor execution plan	Language barriers, Time-zone differences, Cultural differences	Communication and coordination problems	<u>Total practices</u>	Total
		17	4	6	4	14	31

No. of firms 3000	Survey 3	Issues	Over expenditure	Supplier technical/security and political issues	Lack of a full communication plan	<u>Total practices</u>	Total
		17	6	3	5	14	31

No. of firms 3000	Survey 4	Issues	No previous experience of the supplier	Difference in project management practices	Lack of supplier standardized working methods	Incomplete and unclear contract	Poorly developed and documented requirements	Poor tracking & managing requirement changes	Total practices	Total
		17	3	5	4	5	2	3		
Repeated practices			31R+38R+39R	31R + 37R + 38R + 39R	37R+ 39R + 31R	10R	10R	Non		
Total without the repeated practices			0	5	1	4	2	3	15	32

Figure 36: Distribution of Practices into Four Surveys

After applying the modifications of the expert panel, twelve IT companies were invited and accepted to participate in the survey. Ten IT companies' managers started and finished the survey validation. Characteristics of the IT companies and titles of respondents are listed in Table 28 below.

Table 28: Lists the Characteristics of the IT Companies and Titles of Respondents

Company	**Size (No of Emp.)**	**Manager Title**	**Location**	**Survey**
Company 1	1-20 Employees	CEO	Oregon	Survey 1
Company 2	50-100 Employees	CTO	California	Survey 2
Company 3	101-250 Employees	Project Manager	Oregon	Survey 3
Company 4	250-500 Employees	Software Manager	Oregon	Survey 4
Company 5	500-1000 Employee	Project Manager	Oregon	Survey 1
Company 6	1000+ Employees	Software Engineering Manager	Oregon	Survey 2
Company 7	50-100 Employees	Engineering Manager	California	Survey 3
Company 8	250-500 Employees	Information Technology Manager	Oregon	Survey 4
Company 9	101-250 Employees	CTO	California	Survey 1
Company 10	500-1000 Employees	Software Manager	Oregon	Survey 2
Company 11	1000+ Employees	IT Manager	Oregon	Survey 3
Company 12	1-20 Employees	CEO	Oregon	Survey 4

In this phase, each question was presented to the respondents to answer it (one per page). Then the respondents were asked to answer two questions: (1) how easy it was to answer the particular question on a scale of 1 to 5 and (2) provide any additional feedback (optional). Figure 37 shows a screen of an example question and how these steps were integrated.

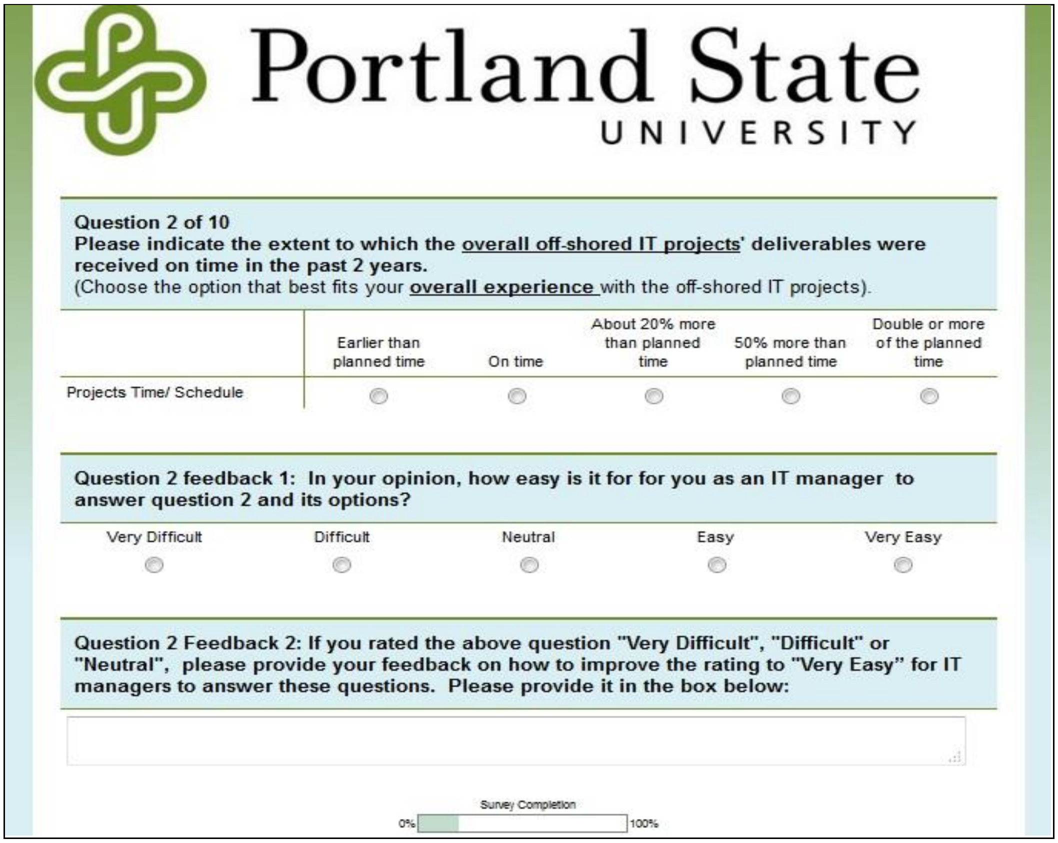


Figure 37: A Screen-shot of an Example Question of the Pilot Test of Questionnaire

The data collected at this step was used to insure that the data was collected as designed and the logic of the questions was also as designed. After incorporating the feedback from the managers in ten IT companies, the goal was to have all of the survey questions (specifically questions 1, 2, 3, 4, 6, and 10) score above 4 “Easy” for ease of answering to enhance the previous low score and make sure that the modifications had improved the survey ease of answering. Table 29 shows that all questions had a score of 4 and above.

Table 29: Results of Content Validation of Pilot Test with IT Companies

Question	Ease of Answering Mean	Standard Deviation
General Questions	4.31	0.79
Q1	4.50	0.89
Q2	4.31	0.80
Q3	4.25	1.00
Q4	4.00	1.32
Q5	4.00	1.26
Q6	4.44	1.03
Q7	4.13	1.26
Q8	4.19	1.05
Q9	4.00	1.15
Q10	4.13	0.81
Average	4.27	

4.3 Instrument Administration

4.3.1 Targeted Population

The unit of analysis in this research is "the company" and the key informant is a senior executive and middle management involved in decision making of IT and Software offshored projects (e.g. President, CEO, General Manager, Project Manager, Software Engineering Manager, Engineering Manager, CTO, Operation Manager and Quality Manager Etc.). The rational scope described section 4.3.2 illustrates IT and Software companies in the USA as the population of interest.

4.3.2 Sampling Frame

The Kompass database was used to build the database of target 12,000 IT companies (www.Us.kompass.com). A single contact per company was provided. The offer is to provide one email contact per company. Kompass offers complete coverage of ALL businesses in the U.S. and Canada as well as coverage of the most significant international firms.

One can search by more than 35 individual criteria including: industry, company name, geography, product category, SIC or NAICS, company size, annual sales, job function, job title and more.

North American Industry Classification System (NAICS) is the standard used by Federal statistical agencies in classifying business establishments for the purpose of collecting, analyzing, and publishing statistical data related to the U.S. business economy.

NAICS was developed under the auspices of the Office of Management and Budget (OMB) and adopted in 1997 to replace the Standard Industrial Classification (SIC) system.

The focus of this research is on NAICS CODES 541511, 541512, and 511210 that focus on Software development and IT companies as listed in Figure 38. Using Kompass, Location (USA), NAICS and the size of the company were the criteria to select companies.

2002	2007	2012	Corresponding Index
NAICS	NAICS	NAICS	Entries
541511	541511	541511	Applications software programming services, custom computer
541511	541511	541511	Computer program or software development, custom
541511	541511	541511	Computer programming services, custom
2002	2007	2012	Corresponding Index
NAICS	NAICS	NAICS	Entries
541512	541512	541512	Computer-aided design systems integration design services
541512	541512	541512	Computer-aided engineering systems integration design services
2002	2007	2012	Corresponding Index
Corresponding Index			
Entries			
511210	511210	511210	Applications software, computer, packaged
511210	511210	511210	Computer software publishers, packaged
511210	511210	511210	Computer software publishing and reproduction

Figure 38: NAICS CODES for Software Development and IT Firms

12,000 companies were randomly selected and downloaded from the Kompass database with different sizes: 1-100 employees, 101-500 employees and 501 and more employees. The companies were from all US states and represented in three regions (Central, West and East) as in Table 30.

Table 30: 12,000 companies from Kompass database distributed on size and location

		1-100 Emp.	101-500 Emp.	500 + Emp.	Total
Original number of companies contacted	Central	1085	640	279	2004
	East	3268	896	768	4932
	West	3258	821	985	6936
	Total	7611	2357	2032	12000

In order to minimize the number of the practices and increase the response rate, the survey was distributed over four surveys. To ensure that the 12,000 companies were randomly distributed among the four surveys, the 12,000 companies were collected into one spreadsheet, sorted according to their sizes and locations (States) and then they were distributed over four surveys. A new column was created and listed survey 1, survey 2, survey 3 and survey 4. This step was repeated for all companies. Survey 1 companies were gathered into one spreadsheet and all other companies were gathered according to their survey number. Figure 39 shows this step.

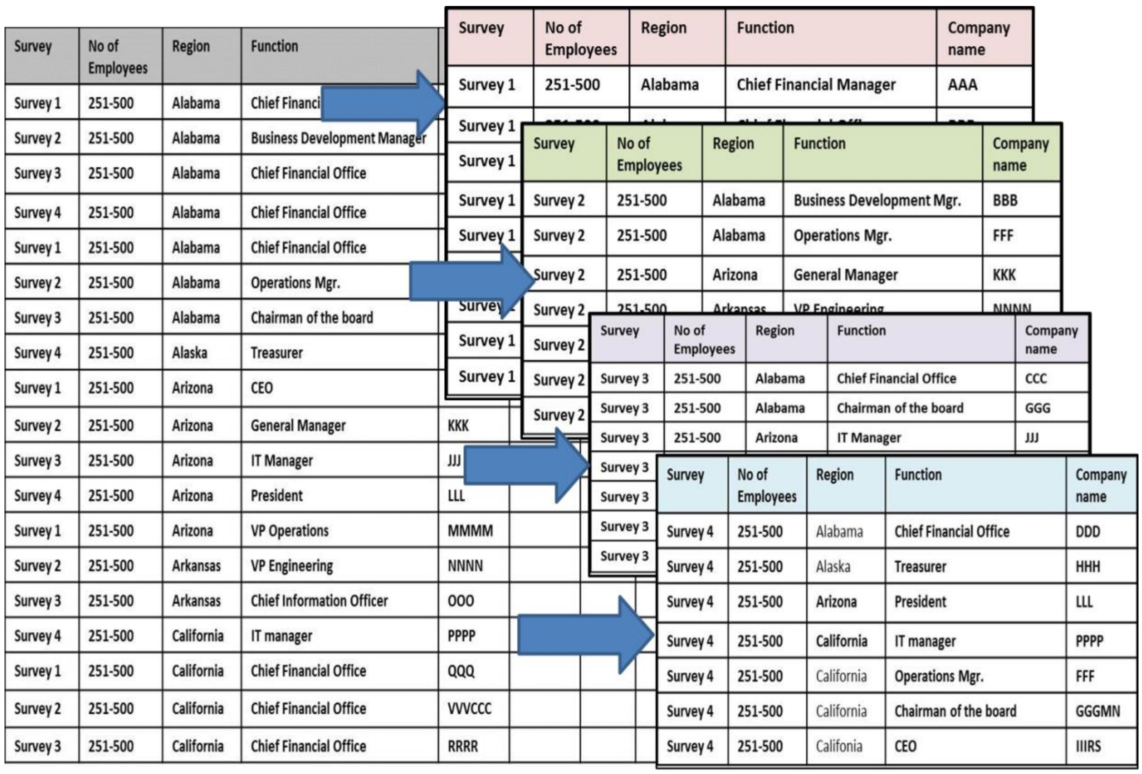


Figure 39: Randomly distributing the 12,000 IT Company into four surveys

Previous researchers have reported low response rates in similar research involving survey respondents. Thus, it was expected that low response rates would be present in this research as well.

Figures 40 and 41 illustrate the sampling frame for each follow up. At the conclusion of the third follow-up emails using the Qualtrics software, 236 email failures (2%) were generated for the following reasons: emails no longer active, emails no longer available or invalid emails. An additional 2734 invitees (22%) were asked to be removed for the following reasons: they were federal government contractors and could not participate in any survey (1265), they were IT and software engineer staffing companies (913), they were wholesalers/retailers for IT and software development (378), or they declined to take the survey and had asked to be removed from the mailing list without mentioning any reason (178).

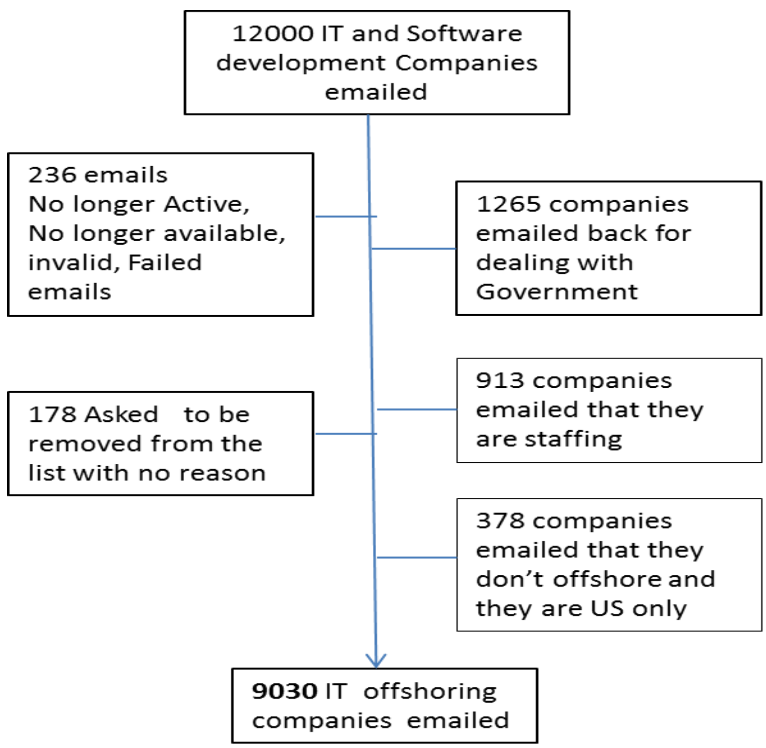


Figure 40: Number of IT Companies Reached

Companies asked to be removed from the email list	Initial Invitation	1st Reminder	2nd Reminder	3rd reminder	Total	%
Companies dealing with Government agencies	556	310	250	149	1265	10%
Staffing for IT Jobs	428	290	143	52	913	8%
Wholesalers, Retailers	153	121	65	39	378	3%
Emails returned	128	47	33	28	236	2%
Asked to be removed from the list	68	42	39	29	178	1%
Total companies removed from the email list	1333	810	530	297	2970	24%
Effective Sample Size					9030	76%

Figure 41: Final Number of IT Companies Sample Frame

The researcher wanted to make sure that there was no mistake with selecting the IT companies due to the large numbers of emails received from companies that deal with the Government/Federal Government, Staffing firms and wholesale companies. Therefore, 3000 randomly selected companies where tested. Using the Kompass data base, we checked “Business Activities” and “Other Products and Services” categories in each company’s profile. Figure 42 shows an example of Government Contactor Company that provides services for the federal government and thus cannot offshore and/or could not participate in the survey.

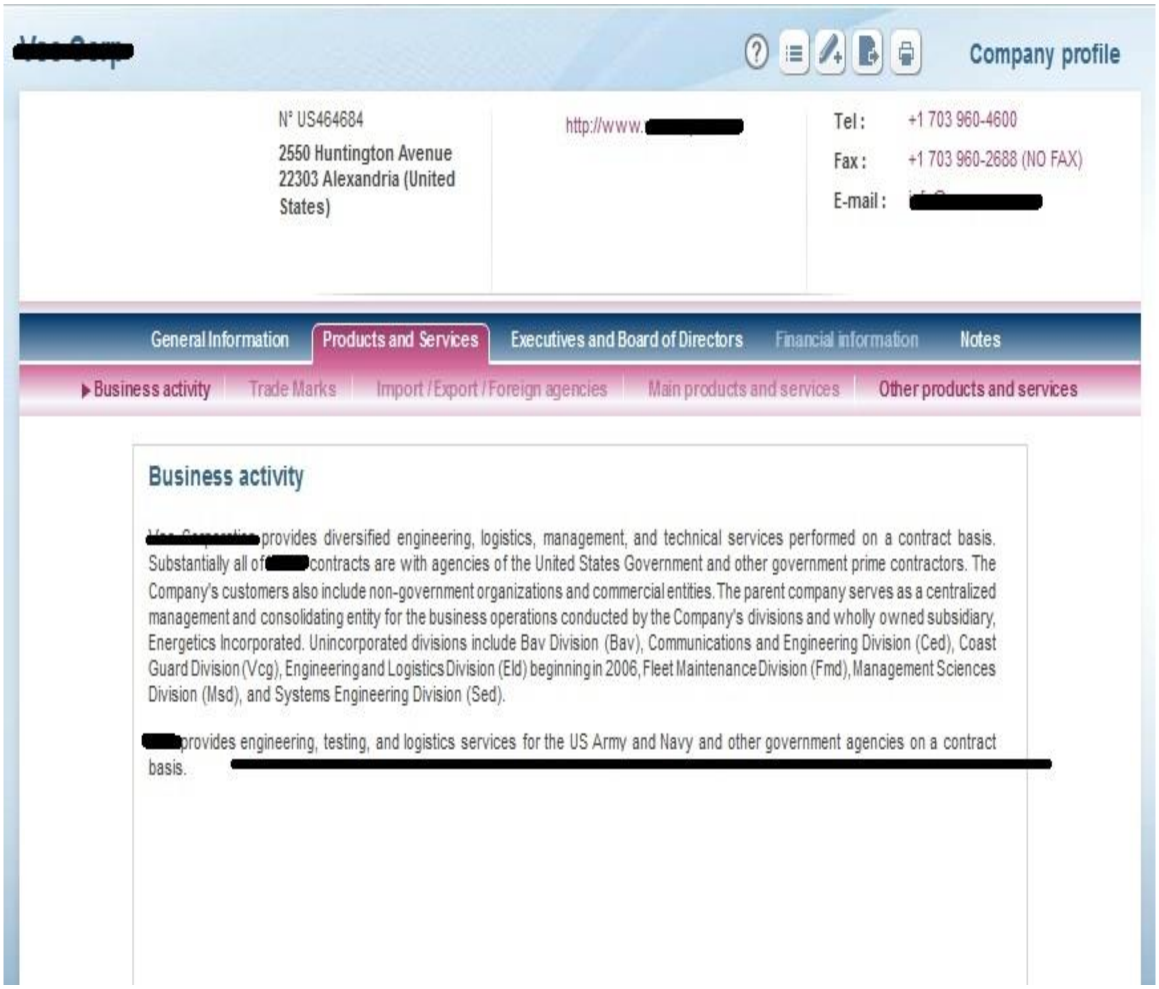


Figure 42: An Example of Government Contactor Company

From 3,000 companies tested, 25% were companies dealing with government agencies and could not participate in the survey. 12% were IT staffing companies and 3% were wholesalers or retailers.

Thus, the results received were considered acceptable and 9,030 companies were considered for this survey.

From the 12,000 randomly selected companies, there were many contacts for managers who were not involved in IT decisions such as: Chief Financial Officer, Treasurer, VP HR, Chairman of the Board, Marketing Director and Administration Manager etc. Therefore, 4,000 new contact names and emails were generated from the 12,000 randomly selected Kompass database to increase the response rate.

The following email style for each company provided by the Kompass database one email for each company such as: firstname-lastname@companyname.com, lastname@companyname.com, or firstname.lastnamefistletter@ companyname.com etc. was used to generate the additional contacts.

The researcher used the Kompass database (one email contact per company) and searched for additional management personnel through the website of each company name. Using the list of executives, the researcher generated the names of IT executives and put the email that matched the company's style and added to the list of 12,000 contacts available as illustrated by Figure 43.

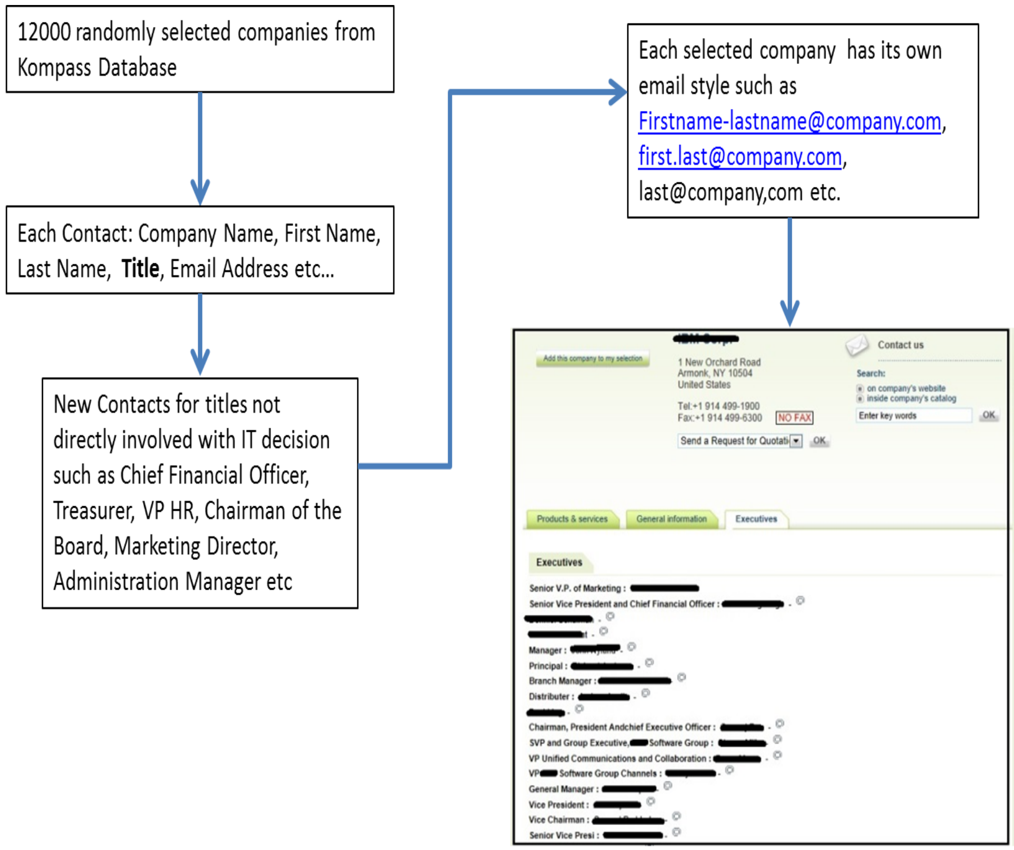


Figure 43: Strategy Used to Add 4000 Contact Names to Increase the Response Rate

4.3.3 Sampling Administration

The survey invitations were emailed with three follow-ups: The initial invitation was sent on Thursday February 29th early morning at 12:05am. The time of the release was chosen based on Dillman's recommendation on web-survey implementations that "*Email invitations are most successful if they are delivered to recipient's' inboxes early in the morning*" (Dillman et al., 2009). In one study, it was found that people who received their invitation emails first thing in the morning were significantly more likely to reply than those who received it midday (Trouteaud, 2004). Thus, the timing of sending the emails is crucial and the researcher should consider when sample members are most likely to check their email and be free from other commitments and then attempt to have email invitations distributed to their in-boxes just prior to this time (Dillman et al., 2009).

In this research, twelve IT managers were asked about their best time to check their email and thus had the tendency to reply. Ten out of twelve said early morning between 7am and 9am. Therefore, the invitation email was sent between 12am and 3am of February 29, 2013 so that respondents would receive it first thing in the morning.

After sending the initial invitation, many emails were received with concerns that their jobs involved sensitive data, were of a proprietary and confidential nature and could not respond to this survey. Based on these comments, a bold text sentence was added to the first reminder email "Please note that the survey does not attempt to collect any personal or proprietary information". After sending the first reminder, the response rate increased from 10% after the initial invitation to 22%.

Then, another email was received from a CEO of a software company mentioning that "When I saw your email four weeks ago, I was interested but when I saw the $100 gift card offer, it certainly took my interest off". Although the gift token was recommended by Dilllman, a sentence was added to the second reminder "To thank respondents for their participation, you can elect to receive a summary report at the end of study free of charge. We are also offering $100 Amazon gift cards to three randomly selected participants in the survey. The winner may choose to donate this amount to the charity of their choice." This increased the response rate from 31% to 37%. The invitation letter and the three reminders are listed in Appendix D.

The survey letter indicated that the survey would take six to eight minutes to complete. An analysis of timestamps from Qualtrics.com revealed that the average compilation time was 9.20 minutes and the median time was 5.12 minutes. Figure 44 provides breakdown of the survey responses over time.

At the conclusion of data collection, 316 valid responses were considered for this research, 558 responses were received, 451 completed responses, 371 responses offshored their IT projects and 55 responses were excluded from the analyses for companies used other quality assurance models. In this manner, their results will not affect our data analysis. Table 31 shows data collected from the four survey questionnaires and Table 32 lists the collected responses based on region and size of the company (number of employees).

Table 31: Responses Collected from Four Survey Questionnaires

Survey	**Started**	**Completed**	**Offshored**	**Valid for this research**
1	143	114	91	77
2	142	116	94	81
3	123	106	93	75
4	143	115	93	83
Total	558	451	371	316

Table 32: Collected responses based on region and size of the company

Region	**1-100 Emp.**	**101-500 Emp.**	**500+ Emp.**
Central	46	23	11
East	144	43	34
West	133	38	46

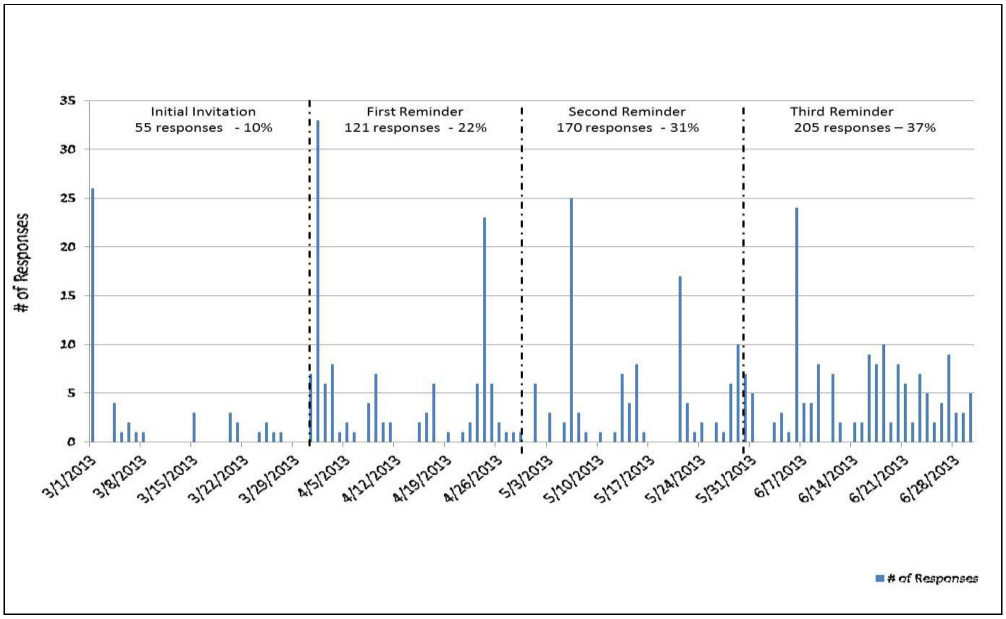


Figure 44: Survey Responses Over Time

4.3.4 Response Rate

The Response Rate (RR) for this survey is as follows:

Initial Invitation: **RR = $\frac{55}{9030}$ = 0.61%**

First Reminder: **RR = $\frac{121}{9030}$ = 1.34%**

Second Reminder: **RR = $\frac{170}{9030}$ = 1.88%**

Third Reminder: **RR = $\frac{205}{9030}$ = 2.27%**

Combined: **RR = $\frac{558}{9,030}$ = 6.14%**

Researchers recommend 100 to 200 responses for complex models (Hulland et al., 1996, Roscoe and Byars, 1971). Additionally, this response rate is consistent with a typical PhD Dissertation response rate of 5% to 8% as shown in Table 33. Email addresses were used to reach the target population. Email had advantages over phone call and included:

geographic flexibility, time convenience for respondent, elimination of interview bias and low cost compared to other methods.

Table 33: Previous PhD Dissertations and Achieved Response Rate

Study	Sample size	Response Rate
Daim Dissertation - 1998 (Daim, 1998)	1,987 electronics manufacturing Companies	226 responses = 11.4%
Nima A. Behkami 2012 (Behkami, 2012)	1,820 clinics	146 responses = 8%
Iwan Sudrajat 2007 (Iwan, 2007, Sudrajat, 2008)	1,917 US Electronics companies	99 responses = 5.1%
Trent Randolph Tucker 2011 (Tucker, 2011)	13,705 Manufacturing companies in Canada	227 responses =1.66%
This survey 2013	9,030 IT and Software Developing Companies in the US	551 responses = 6.10%

In this research, based on Dillman's tailored design method, care was taken to create respondent trust, increase rewards, and reduce the cost of being a respondent through the following techniques:

- Rewards: monetary incentives, offer summary of results at the end of the study.
- Make questions interesting.
- Insure confidentiality and anonymity.
- Build trust with respondents: Portland State sponsorship, follow-ups to make completion appear crucial to the research, personalize the emails with name, address and phone number of sender (researcher) and reply spontaneously to all emails with respondents' inquiries. Personalize all contacts to respondents.

- Strategically time all contacts.

- To help respondents open the message: Carefully select the sender name, address and subject line for email communication such as: 1) "From" field shows the sender's professional university address (rosine@pdx.edu); 2) "Subject" field for invitation email "Please help Portland State University with your knowledge and expertise" and follow up emails "Please help me with your knowledge and expertise" and "Please help me collect data for my PhD dissertation".
- Procedure with bounced, undelivered or out of office emails.

At this point, a note about proposed sample size is necessary. At the beginning of the research it was hoped that a 10% response rate would be achieved. However, the combined response rate of initial invitation and three reminders was below the threshold at 6.14%. The proposal included a mitigation plan in case a 10% response rate was not achieved. This included taking one or more of the following actions:

Action 1: Replaced 4,000 non IT managers' contacts with IT managers from the same list of companies provided by the Kompass database.

In the selection process for the IT companies, the researcher could ask for one email contact of senior management from each company and it depended on the available email contact in the data base when the request took place. Therefore, the original email contact list provided by Kompass data base contained 4,000 non IT managers such as

Treasurer, VP HR, Admin, Chairman of the Board, Chief Financial Officer, Sales Director, Partner, Marketing Director, VP Finance and Admin. Manager etc.

To increase the response rate from the IT managers, each email style provided by Kompass for each company was applied to the names of IT managers that were listed in the company's website and it had a positive outcome.

Action 2: Distribute the 57 practices into four surveys to increase response rate

The survey contained 17 issues and 57 practices. It was originally planned to have one survey containing the 17 issues and 57 practices. Based on feedback from the expert panel and discussion with committee members later, it was decided to distribute the 57 practices into four surveys to increase the response rate and it had a positive outcome.

Action 3: Additional Follow-ups to increase response rate

Originally it was planned to conduct the research with three follow-ups (including initial invitation). However, a fourth follow-up was conducted to increase response rate and it had a positive outcome.

Action 4: Contacted Software Engineering Institute (SEI)

To ensure that my list of companies included CMM/CMMI appraised companies, I contacted SEI's administration and asked if they could provide a list of their appraised companies (only company names). Their response was that the SEI receives numerous requests from users to reveal the identity and/or maturity level of organizations. As a federally funded research and development center, the SEI was not able to release any information about an appraised organization's identity or its maturity level. The SEI treats all appraisal information as private property and it is kept confidential within the SEI. An appraisal's results are owned by the appraisal sponsor and the sponsor may publicize this information at their discretion.

However, the SEI provided a link to a current list of companies who have completed appraisals the applying CMMI Models. These companies had provided SEI with written authorization for this release of information and are available on their SEI Web site.

Since written authorization must be received from the sponsor of each appraisal posted, there are companies that are using CMMI that are not on this list. Consequently, this list cannot be perceived as an indicator of all or an exact count of organizations in the world that are using SEI models or appraisal methods. www.sei.cmu.edu/cmmi/casestudies/profiles/pdfs/upload/2011MarCMMI.pdf.

https://sas.cmmiinstitute.com/pars/ and https://sas.cmmiinstitute.com/pars/pars.aspx

These links provides a filter for CMM/CMMI models, maturity level, year and country. Then, the list will provide the names of the companies, maturity level, model, and appraisal and expiration date.

The SEI list was used to ensure that companies listed in the SEI are available in our database list of 12,000 IT and software development companies. Appendix E provides a copy of the email received from SEI and a copy of the filter and list provided by SEI.

4.3.5 Respondent Profile

The completed surveys indicated that a typical respondent could be described as senior IT manager who had implemented IT offshoring and experienced issues with performing some level of practices to mitigate these issues. They also could have applied one or more of CMM/CMMI methods or models when offshoring their IT projects. The companies they represent could be described as all sizes of US IT and software development companies. Section 5.1 provides more details about the respondent profile.

4.3.6 Survey Response Representativeness – Goodness-to-Fit

For this study, 12,000 IT companies were initially contacted and 2970 of these asked to be removed from the list or were rejected. This brought the total companies contacted to 9,030. Out of 9,030 companies, a total of 551 responses were received. This corresponds to a 6.14 percent response rate. Out of these returned surveys, 451 had valid data.

Although Cook et. al. (2000) discusses response rates in terms of election polls, they note that "the representativeness of our sample is much more important than the response rate we obtain" (Cook et al., 2000). The main question "Is the sample data from the survey representative of the data from the population being studied?"

Table 34 compares between the observed data (actual survey data received from respondents) and the expected data based on the Kompass directory (sampling frame) across two demographic dimensions: (1) Size of the company (Number of Employees) and (2) Geographic region. Exploring the number of respondents from different segments and comparing them to the expected numbers using Goodness to fit chi square test yielded no significant differences (chi square = 2.33 df. = 8).

Table 34: Comparison of Segment Profile with the Sample of U.S. IT Companies

	Observed Number	Observed %	Expected %	Expected Number
Central 1-100 Emp	46	8.90%	9.04%	*47*
Central 101-500 Emp	23	4.44%	5.34%	*28*
Central 500+ Emp	11	2.12%	2.32%	*12*
East 1-100 Emp	144	27.79%	27.23%	*141*
East 101-500 Emp	*43*	8.30%	7.47%	*39*
East 500+ Emp	*34*	6.56%	6.40%	*33*
West 1-100 Emp	*133*	25.67%	27.15%	*141*
West 101-500 Emp	*38*	7.33%	6.84%	*35*
West 500+ Emp	*46*	8.89%	8.21%	*42*
Total	*518*	100.00%	100.00%	*518*
*551 - 33(missing) = 518				

4.3.7 Nonresponse Error: Wave Analysis

"Response bias is the effect of non-response on survey estimates" (Trent and Monczka, 2005) (Creswell et al., 2005). Wave analysis is one of the methods of evaluating response bias. The proposition being that "persons who respond in later waves are assumed to have responded ”because of the increased stimulus and are expected to be similar to non-respondents” (Armstrong and Overton, 1977).

ANOVA analysis was performed on the data; there was no statistically significant difference between respondents among the four follow-ups. The mean of measurement items from respondents in each of the four follow-ups was compared at ($p<0.05$) for five important variables measured in the survey: Offshoring Issues: 1) *Over expenditures*; 2) *Poor execution plan specifically timing and type of work transferred to the supplier*. Projects Success Factors: A) *Time/ Schedule*, B) *Cost/Budget*, C) *Expected Quality*. Table 18 through Table 22 summarizes the ANOVA statistical analysis.

Table 35: Offshoring Issues: Over Expenditures

ANOVA

Over Expenditure

	Sum of Squares	df	Mean Square	F	Sig.
Between Groups	11.837	3	3.946	1.879	.133
Within Groups	669.965	319	2.100		
Total	681.802	322			

Table 36: Offshoring Issues: Poor Execution Plan

ANOVA

Poor Execution Plan

	Sum of Squares	df	Mean Square	F	Sig.
Between Groups	8.542	3	2.847	1.440	.231
Within Groups	616.825	312	1.977		
Total	625.367	315			

Table 37: Project Success Factors: Time/Schedule

ANOVA

Project Success Factors: Time/Schedule

	Sum of Squares	df	Mean Square	F	Sig.
Between Groups	5.979	3	1.993	1.117	.342
Within Groups	556.730	312	1.784		
Total	562.709	315			

Table 38: Project Success Factors: Cost/Budget

ANOVA

Project Success Factors: Cost/Budget

	Sum of Squares	df	Mean Square	F	Sig.
Between Groups	10.584	3	3.528	1.842	.139
Within Groups	595.499	311	1.915		
Total	606.083	314			

Table 39: Project Success Factors: Expected Quality

ANOVA

Project Success Factors: Expected Quality

	Sum of Squares	df	Mean Square	F	Sig.
Between Groups	13.903	3	4.634	2.073	.104
Within Groups	695.240	311	2.235		
Total	709.143	314			

4.3.8 Nonresponse Error: Item Nonresponse

316 responses were considered for this research, 558 responses were received, 451 completed responses, 371 responses offshored their IT projects and 55 responses were excluded from the analyses. These 55 companies used other quality assurance models, this way their results will not affect our data analysis.

There were no survey responses missing measurement items which were part of the proposed hypotheses. This is due to the fact that all related questions were required to answer (the force-to-answer feature of Qualtrics was applied). There are no incomplete or abandoned survey responses that were used which would have meant missing data. Table 40 shows the breakdown by survey question.

Table 40: The Breakdown of Responses by Survey Question

	Validation Type	# of Records	Missing	% of Total
General Information (Company Name)	Optional	451	0	0%
General Information (State)	Required	451	0	0%
Offshore (Yes/No)	Required	451	0	0% (Yes 83%, No 17%)
Issues of offshoring	Required	316	0	0%
Project Success factors	Required	316	0	0%
CMM/CMMI	Required	316	0	0%
Maturity Level	Required	316	0	0%
Best Practices	Required	316	0	0%
General Information (Offshore Outsource – Contract out)	Optional	316	10	2.4%
General Information (Own Subsidiary)	Optional	316	10	2.4%
General Information (Functional Area)	Optional	316	8	1.9%
General Information (Number of Project offshored)	Optional	316	8	1.9%
Contact Information (Name)	Optional	316	109	34%
Contact Information (Email Address)	Optional	316	109	34%

4.3.9 Post-survey adjustments

There is no missing data relevant to the hypothesis and no post-survey adjustments are necessary.

4.3.10 Reliability and Validity

The general concept of validity has been traditionally defined as "the degree to which a test measures what it claims, or purports, to be measuring" (Brown, 1996, Field, 2005). There are three basic types of Validity: Content, Construct and Criterion related (Brown, 1996, Field, 2005). Content validity measures the degree to which the content of the items sufficiently represents all relevant items under study (Rourke and Anderson, 2004). The expert panel was utilized to improve content validity. The purpose of the questionnaire was explained and they were given the questions. They were asked to make comments on the questions. Based on their comments, changes were made. Their ratings of each question were gathered and used to construct validity (Rourke and Anderson, 2004).

Construct validity refers to whether a scale or test measures the construct adequately. It answers the question, “What accounts for the variance in the measure?” and attempts to identify the underlying constructs being measured and determine how well the tool represents them. Expert panel data was also used to confirm construct validity. The experts were given the purpose of each question along with the question text. They were asked to validate each question by rating the relevance and ease of answering each question.

Table 41 presents the reliability and validity analysis plan. Internal consistency was used to measure the reliability. Content validity, construct validity and criterion related validity were assessed to confirm the validity.

Table 41: Reliability and Validity Analysis Plan

Analysis Type	**Reliability (Table 15)**	**Validity**		
Approach	Internal Consistency	Content	Construct	Criterion Related
When	After the survey is conducted	Before the survey is conducted	Before the survey is conducted	After the survey is conducted
Application	Examines if the items in a survey assess one, and only one dimension.	Measures the degree to which the content of the items sufficiently represents all relevant items under study.	Whether a scale or test measures the construct adequately. Attempts to identify the underlying constructs being measured and determine how well the tool represents them.	Whether responses are systematically related to other criteria that indicate that the respondent is competent in a criteria area.
How tested	Cronbach's Alpha "Alpha" of 0.6-0.7 indicates acceptable reliability, and 0.8 or higher indicates good reliability	Ask Expert(s) to make a judgment that the survey items reflect the universe of items in the topic being measured	The experts will be given the purpose of each question along with the question text. They will be asked to validate each question by rating the relevance and ease of answering each question.	Correlate questionnaire responses with the outcomes with some other measure that is already valid that asses the same set of attributes - if they are truly valid or not. Then, the results will be present on the Expert panel for judgment.

Reliability

Chronbach's alpha is used to test for internal consistency and reliability of the scale items (survey instrument). The variables in this study had a Chronbach's alpha coefficient of greater than 0.7, indicating that the factors have a good level of internal reliability (Pallant, 2010) as shown in Table 42.

Table 42: Reliability Results

Factor Name	Factor Code	Number of Items	Chronbach's Alpha
Issues of Offshoring		17	.973
Project Success Factors	Time/ Schedule, Cost/Budget Expected Quality	3	.960
Quality Standards	CMMI for Development CMMI for Acquisition People CMM TSP	4	.856
Quality Standards Levels		3	.773
Practices		57	.843

Validity

Validity is the property of a research instrument that indicates that it measures what it is supposed to measure. Criterion-related validity measures the extent to which the predictor is sufficient in capturing the significant aspects of the criterion. The easiest and simplest technique of determining if a questionnaire can be used in a valid fashion in making general statements is to correlate questionnaire responses with the outcomes of the statements - if they are truly valid or not. Then, the results were presented to members from the expert panel to confirm similar results in their companies.

First, the expert panel received a document summarizing the research and the focus of the research questions and hypothesis. The results were presented in two sections: 1) six findings and 2) to explain the statistical results, eight possible hypothetical scenarios were developed based on the company background and the targeted goal. The invitation email and the document emailed to the expert panel can be found in Appendix D.

The results validation with the expert panel was conducted through phone meetings with each phone meeting lasting 30-45 minutes.

Below are examples of feedback and the resulting from validation activity:

Researcher: Based on your experience, do you agree with the finding 1 "Applying CMM/CMMI models have fewer issues associated with IT offshoring"?

Validator: *Yes, it makes sense for me*.

Researcher: Do you agree with finding 2 "Achieving higher maturity levels of CMM/CMMI resulted in fewer issues associated with IT offshoring"?

Validator: *Yes, this is very true, the higher the level the better results company realizes*.

Researcher: Do you agree with finding 3 "Applying CMM/CMMI models and routinely performing industry practices resulted in fewer issues associated with IT offshoring"?

Validator: *Yes, this is significant. From my experience, performing CMMI practices are very important to achieve the desired results*.

Researcher: Do you agree with finding 4 "Applying CMM/CMMI models and routinely performing industry practices resulted in better project performance outcomes"?

Validator: *What are the project performance outcomes?*

Researcher: Project time/schedule, cost/budget and expected quality.

Validator: *Yes, this makes sense for me. Seems good.*

Researcher: Do you agree with finding 5 "Utilizing and incorporating different practices from TSP and People into CMMI-DEV/SVC and CMMI-ACQ resulting in fewer offshoring issues of language barriers and cultural differences?"

Validator: *Yes, it makes sense! I agree, especially TSP because it focuses on teams interactions in software development. As for People-CMM, it was made for human resource training and contains practices that targets cultural issues.*

Researcher: Do you agree with finding 6 "Adopting and practicing CMM/CMMI models did not mitigate the offshoring issues of: 1) Time-zone difference between the client company and the supplier company and 2) Supplier Security and Political Issues"?

Validator: *Yes! These models were done for outsourcing. I expect project management planning and data management had more practices for these issues!*

Here the researcher clarifies that to explain the statistical results, eight possible hypothetical scenarios were developed based on the company background and the targeted goal.

Researcher: Do you agree with the following practices to mitigate over expenditure due to hidden costs incurred by the client company:

- “A project plan is established and maintained as the basis for managing the project (CMMI ACQ, CMMI DEV, CMMI SVC, ML2)
- Establish and maintain the overall project plan. (CMMI DEV, CMMI SVC, ML2)
- Estimate the project’s effort and cost for work products and tasks based on estimation rationale (CMMI ACQ, CMMI DEV, CMMI SVC, ML2)
- Establish and maintain the project’s budget and schedule, milestones, constraints and dependencies (CMMI ACQ, CMMI DEV, CMMI SVC, ML2)
- Monitor supplier project progress and performance (effort, and cost) as defined in the contract (CMMI ACQ, CMMI DEV, CMMI SVC, ML2)
- Manage invoices submitted by the supplier (CMMI ACQ, ML2)”

Validator: *Yes! This makes sense for me! I agree!*

Researcher: Do you agree with the following practices used to mitigate the issue of poor execution plans: timing and type of work transferred to the supplier:

- Establish and maintain the acquisition strategy (CMMI ACQ, ML2)
- Establish and maintain the plan for performing the process (CMMI DEV, CMMI SVC, CMMI ACQ, ML2)
- Determine the type of acquisition for each product or product component to be acquired (CMMI DEV, CMMI SVC, ML2)
- Plan transition to operations and support (CMMI DEV, CMMI SVC, ML2)
- Monitor transition to operations and support (CMMI ACQ, CMMI DEV, CMMI SVC, and ML2)?

Validator: *Yes! I agree! Seems good.*

Researcher: Do you agree with the following practices used to manage the issue of poorly developed and documented requirements by the client company:

- Stakeholder needs, expectations, constraints and interfaces are collected and translated into customer requirements (CMMI ACQ, ML2)
- Maintain bidirectional traceability among requirements and work products (CMMI DEV, CMMI SVC, CMMI ACQ, ML2)

Validator: *I expected more documentation in CMMI practices for these issues! Did you ask the surveyed managers if they are using other models? Or, if this is the only model?*

Researcher: Yes, we asked about other models such as ISO-9000, ISO-9000-3, eSCM-CL, eSCM-SP, PMBOK and if they are using other Models.

Validator: *The companies might not use other models but they might have used other practices that worked for them over the time. Did you ask them specifically about other practices? Or, how important was each practice to mitigate the specified issue?*

Researcher: No, we did not ask about other practices or about the importance of each practice. This is a quantitative survey instrument and the response rate was one of the researcher's main concerns. To add more questions, this would increase the survey questions and decrease the response rate. However, the researcher noticed that some companies replied to the question about other quality models applied "homemade methodology" and these companies experienced fewer issues with regard to Time-Zone and Supplier Politics and Security issues. This will be an interesting qualitative future research to investigate what practices these companies do to mitigate these issues.

Chapter 5: Results

In this chapter, the results of the data analysis are discussed, starting with respondent profile, descriptive statistics and testing the hypotheses.

5.1 Respondent Profile

316 valid responses were considered for this research, 558 responses were received, 451 completed responses, 371 responses offshored their IT projects and 55 responses were excluded from the analyses for companies used other quality assurance models. In this manner, their results will not affect our data analysis.

Table 43 lists the top three most frequent responses for each category in the survey. California (19.2%) and New York (12.89%) were the most frequent respondents. In terms of regions, the East region (42.9%) and West region (40.8%) were the most frequent respondents. Regarding the size of the company's responding, 21-100 employees (37.7%) and 1-20 employees (23.2%) were the most frequent respondents.

Of the total responses, 75% offshored their IT project while 25% did not offshore their IT projects. 88% of the IT offshoring companies contracted out their IT project while 50% owned their own subsidiaries. In terms of functional area of respondents, CTO (28.6%), CEO (22%) and Software Engineering Manager (20%) were the most frequent respondents. 30.6% of the total responses offshored 6-15 IT projects in the past 2 years.

Of the total of offshoring companies, 29.6% applied Capability Maturity Model Integration (CMMI) for Development/Services, while 28.5% applied CMMI for

Acquisition. Moreover, 24.4% of the offshoring companies applied Team Software Process. 14% applied People CMM and 30% of the total responses did not apply any of the quality standard models.

Of the five Maturity Levels achieved, 29.5% of the companies applied CMMI for Development/Services achieved level 3 and 28.9% of the companies applied CMMI for Acquisition achieved level 4.

Of the three project success factors, for project time/schedule 50% of the IT offshoring companies reported about “50% or more than planned time” or “double or more of the planned time”. However, for cost/budget 27.8% of the IT offshoring companies reported “more than 50% of the estimated budget”. 23% of the IT offshoring companies simply reported “bad” for the expected quality of the IT offshored projects.

Table 43: Demographic overview

Characteristic	Most Frequent	2nd Most Frequent	3rd Most Frequent
General Questions n=451			
Company Location by the State	California (19.4%)	New York (12.7%)	Texas (7.6%)
Company Location by the Region	East (41.1%)	West (42.1%)	Central (16.8 %)
Company Size (number of employees in 5 groups - Questionnaire)	21-100 Employees (35.1)%	1-20 Employees (22.2%)	101-500 Employees (21.3)%
Company Size (number of employees in 3 groups)	1-100 Employees (60.8)	101-500 Employees (21.4%)	More than 500 Employees (17.8%)
Does your company Offshore	Yes (74.9%)	No (25.1%)	0
Company Offshoring IT Projects by Contracting (n=316)	Yes (88.2%)	No (11.8%)	0
Company Offshoring IT Projects by Owning Subsidiaries (n=316)	Yes (50%)	No (50%)	0
Respondent Functional Area (n=316)	Chief Technology Officer + Chief Information Technology + Information Systems Manager (28.6%)	CEO/General Manager (22%)	Software Engineering Manager (20.4%)
Number of IT Projects offshored in the past 2 years (n=316)	6-15 IT Projects (30.6%)	1-5 IT Projects (15.5%)	16-25 Projects (14.0%)
CMMI/CMM and other quality methods used n=316			
CMMI for Development/Services	No (70.6%)	Yes (29.4%)	0
CMMI for Acquisition	No (71.5%)	Yes (28.5)	0
People CMM	No (84.8%)	Yes (15.2%)	0
TSP	No (80.5%)	Yes (19.5%)	0
No Models Applied	30%	0	0
Others (n=55)	PMBOK (30%)	ISO-9000-3 (26%)	ISO-9000 (22%)
Maturity Level Achieved			
CMMI for Development/Services Maturity Level	Level 3 (29.5%) n=88	Level 5 (26.1%) n=88	Level 4 (18.2%) n=88
CMMI for Acquisition Maturity Level	Level 4 (28.9%) n=82	Level 3 (20.5%) Level 5 (20.5%) n=82	Level 1 (18.1%) N=82
People CMM Maturity Level	Level 3 (36.5%) n=37	Level 5 (21.6%) n=37	Level 2 (16.6%) n=37
Project Success Factors (n=316)			
Time/Schedule	Double or more of the planned time (25%)	On time (24.4%)	About 20% more than planned time (22.7%)
Cost/Budget	More than 50% of estimated budget (32.8%)	On Budget (25.8%)	More than 10% of estimated budget (20%)
Expected Quality	Bad (23%)	Good (22%)	Adequate (18%)

Figure 45 shows the respondents adopting CMM/CMMI models. For example, the area numbered 1 represents companies that participated in CMMI-DEV/SVC only; the area numbered 5 represents companies that applied both CMMI-DEV/SVC and CMMI-ACQ. Area numbered 6 signifies companies that applied CMMI-DEV/SVC and TSP. This research focused on companies that applied CMMI-DEV alone, CMMI-ACQ alone, People-CMM alone and TSP alone.

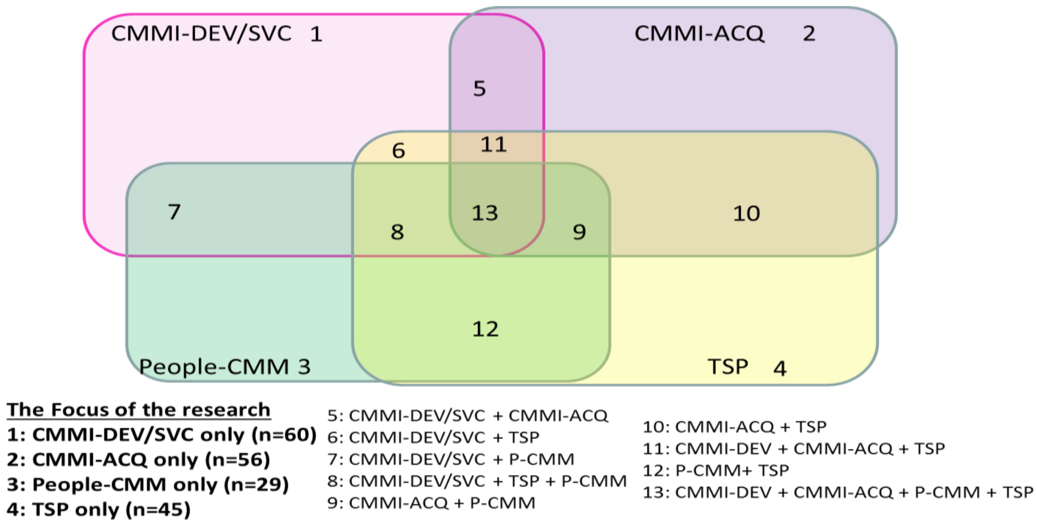


Figure 45: CMM/CMMI Responses

Figure 46 illustrates the total number of responses that included the non-CMM/CMMI models (n=451). 19% applied CMMI-DEV/SVC, 18% applied CMM-ACQ. 18% of the companies did not adopt any quality standard models. 10% of the companies adopted TSP and PMBOK, and 9% adopted ISO-9000-3. Other models applied (2%): Agile, Lean Agile, ITIL, ISO-9001-2008, their own methods (internal systems, in-home methods, home-grown, home-made, home-grown standards).

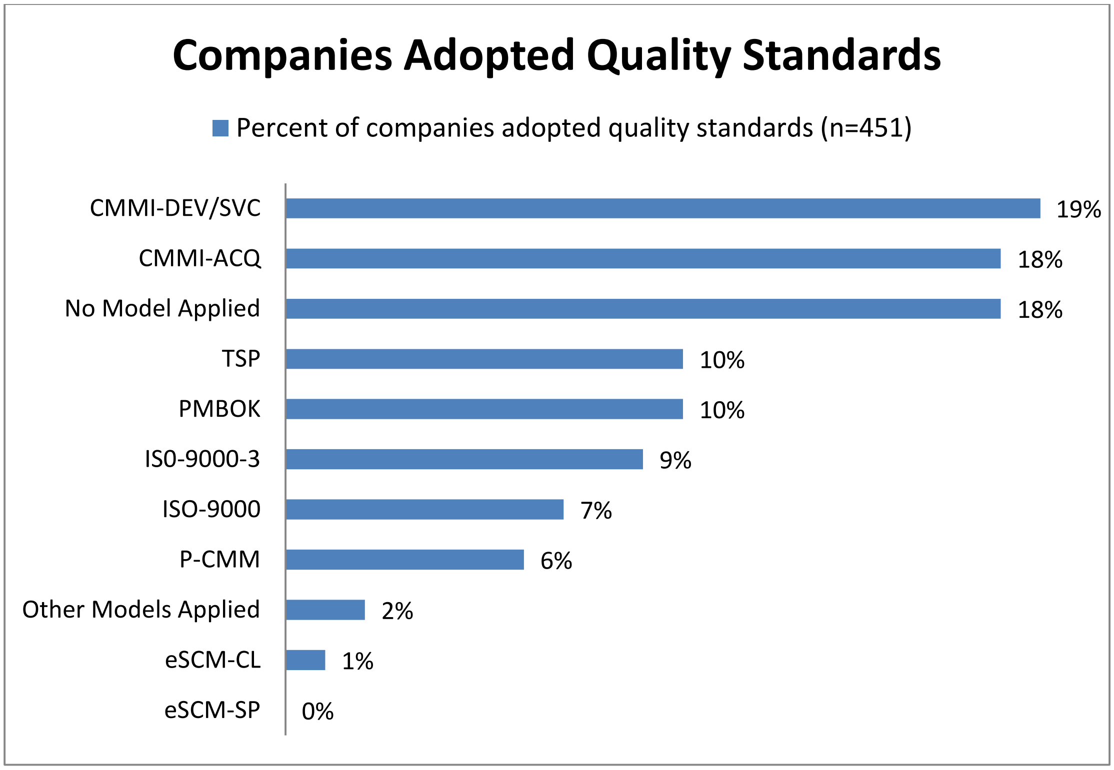


Figure 46: Percentage of Responses of Companies Adopting Quality Standards Models

5.1.1 Profile IT Offshoring Issues

Table 44 lists the respondent statistics for the 17 issues of IT offshoring. Issues were labeled as being experienced always, almost always, occasionally, rarely or never. Although all of the issues were experienced (Always or Almost Always) by at least 35% of companies, *Time Zone Differences*, *Cultural differences*, *Language Barriers problems and Supplier technical/security and political issues* were most frequently experienced in the past two years.

Of the total responses, 72 % of companies experienced *Time Zone Differences* “A*lways*” or “A*lmost always*” in the past two years when offshoring their IT projects, while 60% of the companies experienced *Cultural Differences* issues “A*lways*” or “A*lmost* *always*". Whereas, 54% of the companies experienced *Language Barrier* issues "A*lways*" or "A*lmost always*" with their supplier employees.

Table 44: Lists Respondent Statistics for the 17 Issues of IT Offshoring

	Responses (%) (n=316)					Statistics				Total
	Always	Almost Always	Occasionally	Rarely	Never	Min	Max	Mean	Std. Dev.	
Over expenditure	25.3%	14.2%	22.5%	22.5%	15.5%	1	5	2.886	1.41	316
Poor Execution Plan	27.2%	16.5%	20.9%	21.5%	13.9%	1	5	2.785	1.41	316
Difference in Interpretation of project requirements	22.5%	20.3%	19.0%	24.7%	13.6%	1	5	2.867	1.37	316
Poorly developed and documented requirements	22.5%	16.5%	24.1%	26.6%	10.4%	1	5	2.861	1.32	316
Poor tracing and managing requirements	23.4%	15.8%	19.6%	27.2%	13.9%	1	5	2.924	1.39	316
Lack of full communication plan	26%	15%	14%	35%	10%	1	5	2.946	1.39	316
Communication and coordination problems	25%	14.2%	18.7%	30.4%	11.7%	1	5	2.896	1.38	316
Language barriers	34.8%	19%	19.9%	17.4%	8.9%	1	5	2.465	1.35	316
Time Zone differences	52.5%	19.6%	14.9%	6.6%	6.3%	1	5	1.946	1.23	316
Cultural differences	35.1%	24.4%	14.9%	16.1%	9.5%	1	5	2.405	1.36	316
Incomplete and unclear contract	24.1%	10.1%	14.2%	32%	19.6%	1	5	3.130	1.47	316
Early contract renegotiation	22.2%	12.8%	9.3%	29.7%	26.6%	1	5	3.294	1.50	316
Difference in project management practices	24.1%	15.5%	17.4%	24.4%	18.7%	1	5	2.981	1.45	316
Unable to measure the performance of the supplier	25.3%	13.9%	19.9%	24.7%	16.1%	1	5	2.924	1.43	316
Supplier technical/security and political issues	40.5%	12.3%	11.1%	22.2%	13.9%	1	5	2.566	1.53	316
Insufficient previous experience of the supplier	24.1%	13%	14.9%	29.1%	19%	1	5	3.060	1.46	316
Lack of standardized working methods of the supplier	22.5%	16.5%	12.3%	32%	16.8%	1	5	3.16	1.38	316

5.1.2 Profile of IT Projects Success Factors

1 - Time/Schedule

Table 45 and Table 46 list the respondent statistics by project success factors of Time/Schedule. Companies either experience *earlier than planned time/schedule, on time, 20% more than planned time, 50% more than planned time or double or more of the planned time* to complete the IT offshored projects.

Of the total respondents, 84 (26%) reported *double or more of the planned time* to implement their offshored IT projects. 72 (23.1%) reported *on time*, 70 (22.2%) took *About 20% more than planned time, 55* (17.4%) *50% more than planned time,* and 35 (11.1%) *Earlier than planned time* to implement their offshored IT projects in the past two years.

Table 45: Project: Time/Schedule

Project Success Factor: Time/Schedule		
Answer	**Response**	**%**
Earlier than planned time	35	11.1%
On time	72	23.1%
About 20% more than planned time	70	22.2%
50% more than planned time	55	17.4%
Double or more of the planned time	84	26.2%
Total	316	100%

Table 46: Project Time/Schedule Statistics

Statistics	**Value**
Min Value (Earlier than planned time)	1
Max Value (Double or more of the planned time)	5
Mean	3.152
Variance	1.786
Standard Deviation	1.3366
Total Responses	316

2 – Cost/Budget

Table 47 and Table 48 list the respondent statistics by project success factors of Cost/Budget. Companies either experience *Less than estimated budget, On budget as estimated, More than 10% of estimated budget, More than 20% of estimated budget or More than 50% of estimated budget* to implement the IT offshored projects.

Of the total responses, 89 (28%) reported implementing their IT offshored projects using *More than 50% of estimated budget*; 82 (25%) *On budget as estimated*; 63 (20%) using *More than 10% of estimated budget*; 53 (17%) *More than 20% of estimated budget* and 29 (9.7%) *Less than estimated budget.*

Table 47: Project: Cost/Budget

Project Success Factor: Cost/Budget		
Answer	**Response**	**%**
Double or more of the planned time	29	9.7%
On budget as estimated	82	25.3%
More than 10% of estimated budget	63	20%
More than 20% of estimated budget	53	17%
More than 50% of estimated budget	89	28%
Total	316	100%

Table 48: Project: Cost/Budget Statistics

Statistics	**Value**
Min Value (Double or more of the planned time)	1
Max Value (More than 50% of estimated budget)	5
Mean	3.278
Variance	1.840
Standard Deviation	1.3563
Total Responses	316

3 – Expected Quality

Table 49 and Table 50 list the respondent statistics by project success factors of Expected Quality. Companies either experience Very Good, Good, Adequate, Poor or Bad expected quality when they implement the IT offshored projects.

Of the total responses, 73 (23%) reported bad quality, 69 (22%) reported Good for expected quality, 66 (20%) Very Good expected quality, 57 (18%) Adequate expected quality and 50 (15.8%) Poor quality achieved.

Table 49: Project: Expected Quality

Project Success Factor: Expected Quality		
Answer	**Response**	**%**
Very Good	66	20.9%
Good	69	22%
Adequate	57	18%
Poor	50	15.8%
Bad	74	23.3%
Total	316	100%

Table 50: Project: Expected Quality Statistics

Statistics	**Value**
Min Value (Very Good)	1
Max Value (Bad)	5
Mean	2.981
Variance	2.146
Standard Deviation	1.4648
Total Responses	316

5.1.3 Quality Standards: CMM/CMMI

1 - CMMI for Development/Services

Tables 51 and Table 52 list the respondent statistics for CMMI for Development/Services.

Of the total responses, 93 (30%) applied CMMI for Development/Services and 223 (70%) did not apply CMMI for Development/Services.

Table 51: CMMI for Development/Services

CMMI for Development/Services		
Answer	**Response**	**%**
Yes	93	29.4%
No	223	70.6%
Total	316	100%

Table 52: CMMI for Development/Services Statistical

Statistics	**Value**
Min Value (Yes)	1
Max Value (No)	2
Mean	1.706
Variance	.208
Standard Deviation	.4565
Total Responses	316

Figure 47 shows the percentage of companies that adopted CMMI-ACQ alone (64%), companies that adopted both CMMI-ACQ and CMMI-DEV/SVC (22%), companies that adopted both CMMI-ACQ and TSP (8%).

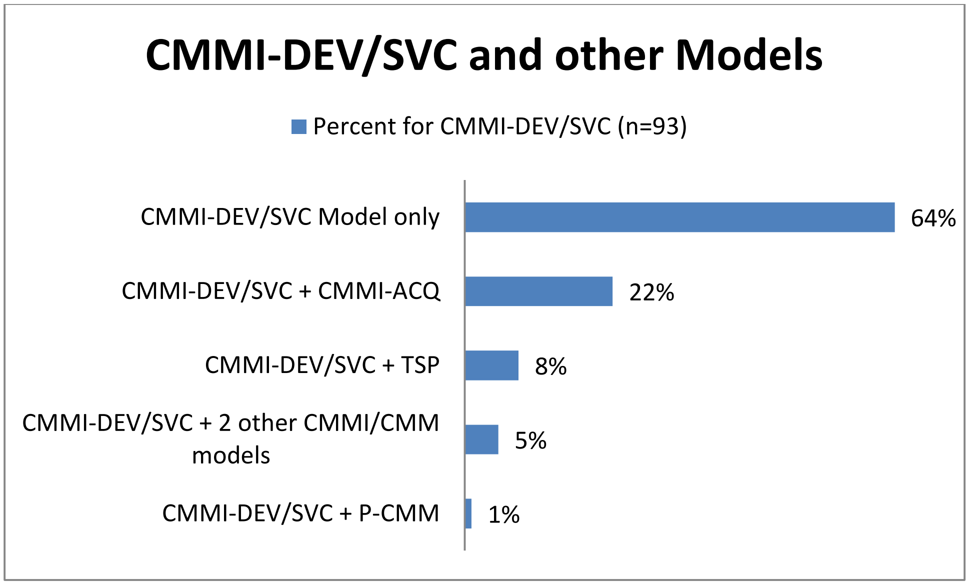


Figure 47: Distribution of Responses of Companies that adopted CMMI-DEV/SVC

2 – CMMI for Acquisition

Table 53 and Table 54 list the respondent statistics for CMMI for Acquisition. Of the total responses, 90 (28.5%) applied CMMI for Acquisition and 226 (71.5%) did not apply CMMI for Acquisition.

Table 53: CMMI for Acquisition

CMMI for Acquisition		
Answer	**Response**	**%**
Yes	90	28.5%
No	226	71.5%
Total	316	100%

Table 54: CMMI for Acquisition Statistics

Statistics	**Value**
Min Value (Yes)	1
Max Value (No)	2
Mean	1.715
Variance	.204
Standard Deviation	.4520
Total Responses	316

Figure 48 shows the percentage of companies that adopted CMMI-ACQ alone (62%), companies that adopted both CMMI-ACQ and CMMI-DEV/SVC (24%), companies that adopted both CMMI-ACQ and TSP (8%).

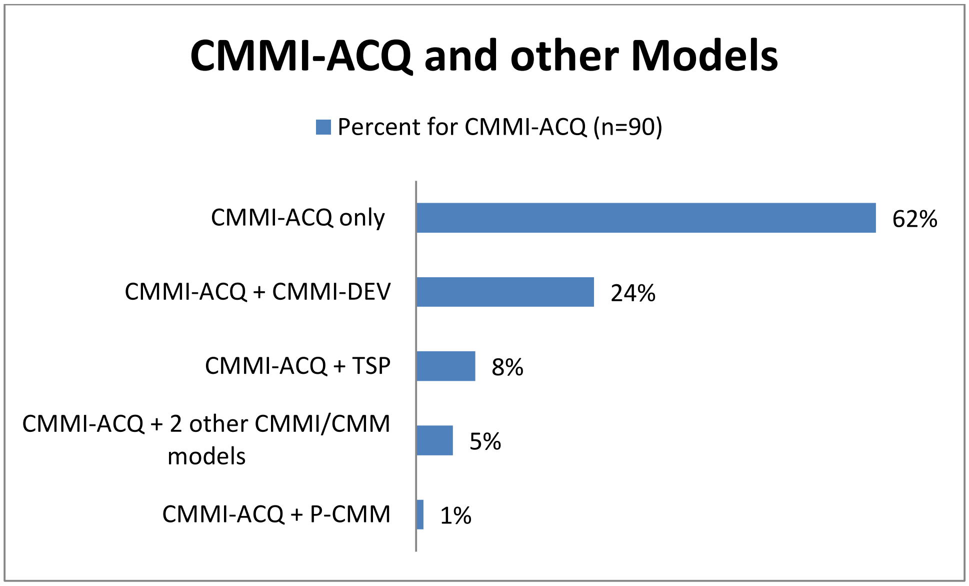


Figure 48: Distribution of responses of companies that adopted CMMI-ACQ

3 - People for CMM

Table 55 and Table 56 list the respondent statistics for People for CMM. Of the total responses, 48 (15%) applied People-CMM and 268 (85%) did not apply it.

Table 55: People CMM

CMMI for Development/Services		
Answer	**Response**	**%**
Yes	49	15.2%
No	267	84.8%
Total	316	100%

Table 56: People CMM Statistics

Statistics	Value
Min Value (Yes)	1
Max Value (No)	2
Mean	1.848
Variance	.129
Standard Deviation	.3595
Total Responses	316

Figure 49 shows the percentage of companies that adopted P-CMM alone (60%), companies that adopted both P-CMM and TSP (22%), companies that adopted both P-CMM and other CMM/CMM models (10%), companies that adopted both P-CMM and CMMI-ACQ (4%) and companies that adopted both P-CMM and CMMI-DEV/SVC.

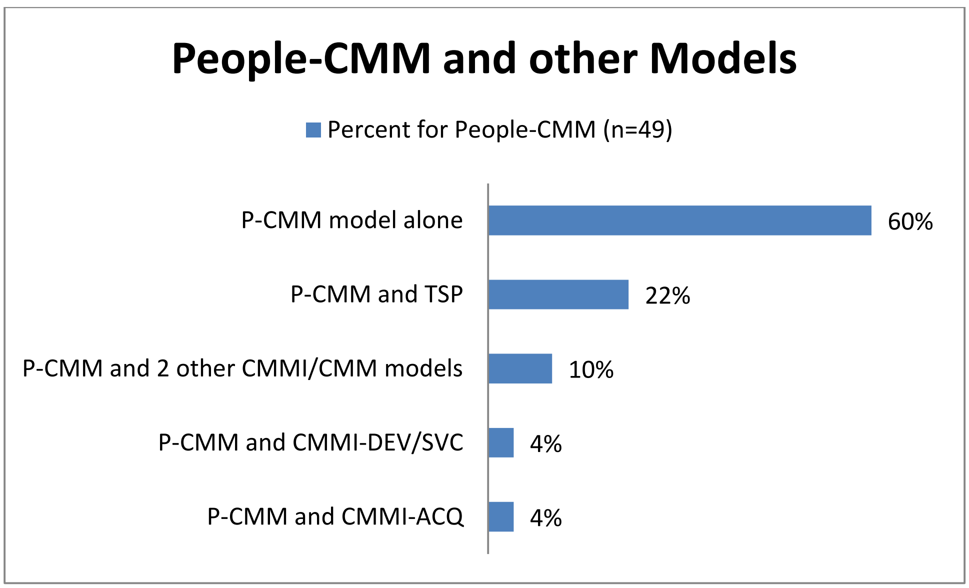


Figure 49: Distribution of responses of companies that adopted P-CMM

4 – Team Software Process (TSP)

Table 57 and Table 58 list the respondent statistics for TSP. Of the total responses, 77 (24.4%) applied Team Software Process (TSP) and 239 (75.6%) did not apply it.

Table 57: TSP

CMMI for Team Software Process (TSP)		
Answer	**Response**	**%**
Yes	77	24.4%
No	239	75.6%
Total	316	100%

Table 58: TSP Statistics

Statistics	**Value**
Min Value(Yes)	1
Max Value (No)	2
Mean	1.756
Variance	.185
Standard Deviation	.4300
Total Responses	316

Figure 50 shows the percentage of companies that adopted TSP alone (58%), companies that adopted both TSP and P-CMM (14%), companies that adopted both TSP and CMMI-ACQ (12%), companies that adopted both TSP and CMMI-DEV/SVC and Companies that adopted TSP and 2 or more other CMM/CMMI models.

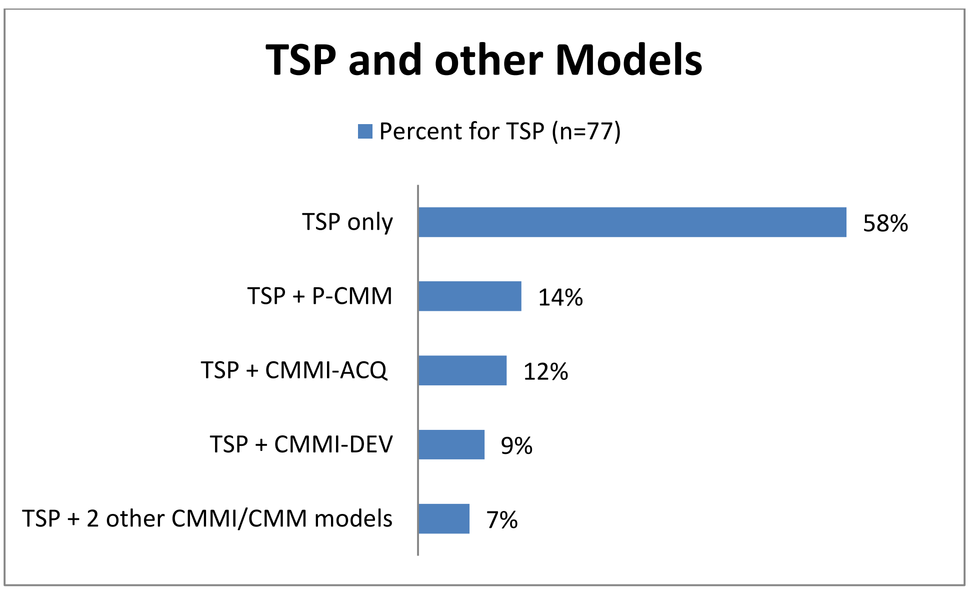


Figure 50: Distribution of Responses of Companies Adopted TSP

5.1.4 Maturity Level

CMMI for Development/Services, CMMI for Acquisition and People for CMM

Table 59 lists the respondent statistics for maturity level for (1) CMMI for Development/Services, (2) CMMI for Acquisition and People for CMM.

Of the total responses for CMMI for Development maturity level achieved, 26 (30%) achieved maturity level 3, 23 (26%) achieved maturity level 5, 16 (18%) achieved maturity level 4, 12 (14%) achieved maturity level 1 and 11 (13%) achieved maturity level 2.

Whereas, for CMMI for Acquisition, 24 (29%) achieved maturity level 4, 17 (21%) achieved both maturity levels 3 and 5, 15 (18%) achieved maturity level 1.

As for People-CMM, 13 (36%) achieved maturity level 3, 8 (22%) archived maturity level 5 and 6 (17%) achieved maturity level 2.

Table 59: Maturity Levels and Statistics

Maturity levels	CMMI for Development/Services		CMMI for Acquisition		People CMM	
	Responses	%	Responses	%	Responses	%
Maturity Level 1	12	13.6%	15	18.1%	5	13.9%
Maturity Level 2	11	12.5%	10	12%	6	16.7%
Maturity Level 3	26	29.5%	17	20.5%	13	36.1%
Maturity Level 4	16	18.2%	24	28.9%	4	11.1%
Maturity Level 5	23	26.1%	17	20.5%	8	22.2.7%
CMMI applied but no maturity level number was determined	2		5		9	
Don't Know	3		2		4	
Statistics						
Min Value	1		2		2	
Max Value	7		7		7	
Mean	3.307		3.217		3.111	
Variance	1.824		2.928		1.759	
Std Deviation	1.3507		1.3885		1.3262	
Total Responses	93		90		49	

5.1.5 Industry Standards Practices

Tables 60, 61, 62 and 63 lists the respondent statistics for industry standards practices collected from surveys 1, 2, 3 and 4 respectively.

Of the total responses for survey 1, 23 (19.5%) reported practicing "1-R6-1: Establishes and maintains quantitative objectives to address quantitative objectives to address quality and process performance" "Always", 20 (25.6%) responded reported performing this practice "Very Frequently", 11 (14%) reported "Occasionally", and 12 (15%) reported for each "Rarely" and "Never".

Table 60: Respondent Statistics by Industry Standards Practices for Survey 1

Survey 1	Responses (%)					Statistics				Total
Practices - Survey 1	Always	Very Frequently	Occasionally	Rarely	Never	Min	Max	Mean	Std. Dev.	
1-R6-1-Establishes and maintains quantitative objectives to address quality	23 29.5%	20 25.6%	11 14.1%	12 15.4%	12 15.4%	1	5	2.61	1.44	78
1-R6-2 -Manages the project using statistical techniques	28 35.9%	13 16.7%	12 15.4%	15 19.2%	10 12.8%	1	5	2.56	1.46	78
1-R6-3 -Performs root cause analysis of issues	26 33.3%	13 16.7%	16 20.5%	13 16.7%	10 12.82%	1	5	2.59	1.43	78
1-R6-4- Manages corrective actions to closure	26 33.3%	19 24.4%	15 19.2%	6 7.7%	12 15.4%	1	5	2.47	1.42	78
1-R6-5- Periodically reviews the project's progress	39 50%	16 20.5%	7 9%	8 10.3%	8 10.3%	1	5	2.10	1.39	78
1-R6-6--Reviews project's accomplishments	35 44.9%	16 20.5%	10 12.8%	8 10.3%	9 11.5%	1	5	2.23	1.41	78
1-R6-7--Establishes and maintains records of quality	33 42.3%	12 15.4%	11 14.1%	16 20.5%	6 7.7%	1	5	2.36	1.40	78
1-R6-8- Monitors actual project performance	36 46.2%	13 16.7%	14 17.9%	8 10.3%	7 9%	1	5	2.19	1.36	78
1-R6-9 -Ensures that supplier agreement is satisfied	30 38.5%	15 19.2%	14 17.9%	9 11.5%	10 12.8%	1	5	2.41	1.43	78
1-R2-10- Develops an understanding on meaning of requirements	36 46.2%	19 24.4%	9 11.5%	7 9.0%	7 9%	1	5	2.10	1.33	78
1-R2-11- Validates requirements to ensure end product performs	36 46.2%	19 24.4%	10 12.8%	4 5.1%	9 11.5%	1	5	2.12	1.36	78
1-R2-12- Obtains commitment to requirements from all participants	35 44.9%	18 23.1%	10 12.8%	8 10.3%	7 9%	1	5	2.15	1.34	78
1-R2-13- -Establishes and maintains negotiation plans	35 44.9%	10 12.8%	8 10.3%	17 21.8%	8 10.3%	1	5	2.40	1.49	78
1-R2-14 -Ensures agreements with suppliers are satisfied	38 48.7%	13 16.7%	9 11.5%	12 15.4%	6 7.7%	1	5	2.17	1.38	78

Of the total responses for survey 2, 16 (19.8%) reported practicing “1-R7-1: Establishes and maintains the offshoring strategy plan ” “Always”, 24 (29.6%) responded reported performing this practice “Very Frequently”, 11 (5.6%) reported “Occasionally”, 19 (25%) reported for “Rarely” and 11 (19.7) reported “Never” as in Table 61.

Table 61: Respondent Statistics by Industry Standards Practices for Survey 2

Survey 2	Responses (%)					Statistics				Total
Practices - Survey 2	Always	Very Frequently	Occasionally	Rarely	Never	Min	Max	Mean	Std. Dev.	
2-R7-1 -Establishes and maintains offshoring strategy	16 19.8%	24 29.6%	11 5.6%	19 25.4%	11 19.7%	1	5	2.82	1.361	81
2-R7-2- Establishes and maintains the plan	20 24.7%	20 24.7%	14 17.3%	15 18.5%	12 14.8%	1	5	2.74	1.403	81
2-R7-3- Determines type of acquisition for product	14 18.3%	21 23.9%	21 19.7%	12 23.9%	13 14.1%	1	5	2.86	1.321	81
2-R7-4- Plan transition to operations precisely timing	13 16.9%	24 25.4%	15 15.5%	21 38%	8 4.2%	1	5	2.84	1.260	81
2-R9-5-Ensures that workforce has skills to share information	27 33.3%	19 23.5%	7 8.6%	18 22.2%	10 12.3%	1	5	2.57	1.457	81
2-R9-6 -Establishes a culture for openly sharing information	23 28.4%	21 25.9%	15 18.5%	12 14.8%	10 12.3%	1	5	2.57	1.369	81
2-R9-7- Establishes project teams and responsibilities	31 38.3%	13 16%	18 22.2%	10 12.3%	9 11.1%	1	5	2.42	1.395	81
2-R9-8- Establishes effective communication	30 37%	13 16 %	16 19.8%	12 14.8%	10 12.3%	1	5	2.49	1.433	81
2-R9-9- Managers are responsible to track and resolve inter-group issues	32 39.5%	13 16%	11 13.6%	11 13.6%	14 17.3%	1	5	2.53	1.542	81
2-R9-10- Maintains effective work-groups, interpersonal problems are addressed	23 28.4%	17 21%	15 18.5%	17 21%	9 11%	1	5	2.65	1.380	81
2-R5-11-Representatives of client company project’s SE group work with supplier	29 35.8%	20 24.7%	9 11.1%	15 18.5%	8 9.9%	1	5	2.42	1.395	81
2-R5-12- Selects team roles	26 32.1%	20 24.7%	9 11.1%	13 16%	13 16%	1	5	2.59	1.481	81
2-R5-13- Communicates quality issues	33 40.7%	11 13.6%	10 12.3%	18 22.2%	9 11.1%	1	5	2.49	1.484	81
2-R5-14- Establishes and maintains a documented policy for Communication	30 37%	14 17.3%	10 12.3%	16 19.8%	11 13.6%	1	5	2.56	1.492	81

Of the total responses for survey 3, 37 (48.7%) reported practicing “3-R1-1: Establishes and maintains a project plan as the basis for managing the project” “Always”, 13 (17%) responded reported performing this practice “Very Frequently”, 4 (5.3%) reported “Occasionally”, and 14 (18.4%) reported for “Rarely” and 8 (10.5) reported “Never” as in Table 62.

Table 62: Respondent Statistics by Industry Standards Practices for Survey 3

Survey 3	Responses (%)					Statistics				Total
Practices - Survey 3	Always	Very Frequ-ently	Occasionally	Rarely	Never	Min	Max	Mean	Std. Dev.	
3-R1-1- Establishes and maintains a project plan	37 48.7%	13 17.1%	4 5.3%	14 18.4%	8 10.5%	1	5	2.25	1.480	76
3-R1-2- Establishes and maintain overall project plan	34 44.7%	12 15.8%	8 10.5%	12 15.8%	10 13.2%	1	5	2.37	1.504	76
3-R1-3- Estimates project’s effort and cost for work	29 38.2%	19 25 %	6 7.9 %	11 14.5%	11 14.5%	1	5	2.42	1.481	76
3-R1-4- Establishes and maintains project’s budget	36 47.4%	15 19.7%	4 5.3%	8 10.5%	13 17.1%	1	5	2.30	1.558	76
3-R1-5- Monitors offshoring supplier project progress	33 43.4%	12 15.8%	8 10.5%	10 13.2%	13 17.1%	1	5	2.45	1.561	76
3-R1-6- Manages invoices submitted by the supplier	36 47.4%	12 15.8%	4 5.3 %	12 15.8%	12 15.8%	1	5	2.37	1.574	76
3-R13-7- Selects supplier technical solutions analyzed	28 36.8%	19 25%	7 9.2%	14 18.4%	8 10.5%	1	5	2.41	1.416	76
3-R13-8- Conducts technical reviews with the supplier	31 40.8%	13 17.1%	8 10.5%	9 11.8%	15 19.7%	1	5	2.53	1.587	76
3-R13-9- Evaluates and categorizes identified issue	32 42.1%	10 13.2%	9 11.8%	8 10.5%	17 22.4%	1	5	2.58	1.635	76
3-R8-10- Establishes and manages the coordination	35 46.1%	13 17.1%	6 7.9%	9 11.8%	13 17.1%	1	5	2.37	1.565	76
3-R8-11- Project’s team members track actual results	34 40%	10 14.7%	9 2.7%	13 22.7%	10 20%	1	5	2.41	1.516	76
3-R8-12- Develops documented plan to communicate commitments	32 42.1%	14 18.4%	7 9.2%	6 7.9	17 22.4%	1	5	2.50	1.621	76
3-R8-13- Managers are responsible for coordination	38 50%	9 11.8%	7 9.2%	13 17.1%	9 11.8%	1	5	2.29	1.513	76
3-R8-14--Communication practices are institutionalized	30 39.5%	12 15.8%	9 12%	15 19.7%	10 13.2%	1	5	2.51	1.501	76

Of the total responses for survey 4, 25 (30.5%) reported “Always” for performing practice “4-R17-1: Evaluates supplier technical solutions (designs) to confirm that contractual requirements continue to be met”, 15 (18.3%) responded reported performing this practice “Very Frequently”, 18 22%) reported “Occasionally”, 13 (15.9%) reported for “Rarely” and 11 respondents (13.4) reported “Never” as in Table 63.

Table 63: Respondent Statistics by Industry Standards Practices for Survey 4

Survey 4	Responses (%)					Statistics				Total
Practices - Survey 4	Always	Very Freque-ntly	Occasionally	Rarely	Never	Min	Max	Mean	Std. Dev.	
4-R17-1- Evaluates supplier technical solutions to confirm requirements to be met	25 30.5%	15 18.3%	18 22%	13 15.9%	11 13.4%	1	5	2.63	1.410	82
4-2- Selects suppliers based on evaluation of ability to meet specified requirements	25 30.5%	18 22 %	13 16 %	15 18.3%	11 13.4%	1	5	2.62	1.429	82
4-3- Identifies and qualifies potential suppliers	24 29.3%	16 19.5%	16 19.5%	14 17.1%	12 14.6%	1	5	2.68	1.431	82
4-4- Selects, monitors, and analyzes supplier processes	23 28%	14 17.1%	17 20.7%	16 19.5%	12 14.6%	1	5	2.76	1.428	82
4-5- Selects suppliers using a formal evaluation	24 29.3%	13 15.9%	18 22%	15 18.3%	12 14.6%	1	5	2.73	1.432	82
4-R15-6- Establishes and maintains a usable set of organizational processes	29 35.4%	17 20.7%	14 17%	18 22%	4 4.9%	1	5	2.40	1.304	82
4-R12-7- Establishes and maintains a mutual understanding of contract	23 28%	19 23.2%	17 21%	12 14.6%	11 13.4%	1	5	2.62	1.385	82
4-8-Requirements are refined and elaborated into contractual requirements	25 30.5%	16 19.5%	19 23 %	11 13.4%	11 13.4%	1	5	2.60	1.395	82
4-9- Establishes and maintains a formal contract management plan	24 29.3%	19 23.2%	13 16 %	13 15.9%	13 15.9%	1	5	2.66	1.451	82
4-10-Establishes and maintains contractual requirements	26 31.7%	17 20.7%	14 17%	13 15.9%	12 14.6%	1	5	2.61	1.447	82
4-11- Collects and translates stakeholder needs, expectations into customer requirements	29 35.4%	21 25.6%	11 13.4%	10 12.2%	11 13.4%	1	5	2.43	1.423	82
4-12- Maintains bidirectional traceability among requirement	26 31.7%	18 22%	13 15.9%	12 14.6%	13 15.9%	1	5	2.61	1.464	82

4-13- Manages changes to requirements as they evolve during project	33 40.2%	16 19.5%	8 9.8%	16 19.5%	9 11%	1	5	2.42	1.457	82
4-14--Ensures project plans and work products remain aligned with requirements	27 32.9%	18 22%	15 18 %	13 15.9%	9 11%	1	5	2.50	1.381	82
4-15- Customer Interface Manager leads in documenting change in requirement	24 29.3%	14 17.1%	10 12%	16 19.5%	18 22%	1	5	2.88	1.559	82

5.2 Testing Hypotheses

In this section, I investigated the relationship between (1) industry standards CMM/CMMI, (2) CMM/CMMI Maturity levels and (3) CMM/CMMI practices and issues of offshoring IT projects. Then, I investigated the relationship between (1) industry standards CMM/CMMI, (2) CMM/CMMI Maturity levels and (3) CMM/CMMI practices and project success factors as shown in Figure 51**.**

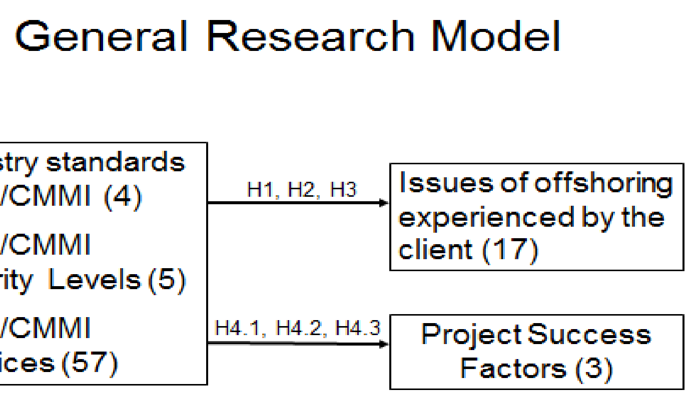


Figure 51: Research Model

Hypotheses Testing

316 valid responses considered for this research, 558 responses were received, 451 completed responses, 371 responses offshored their IT projects and 55 responses were excluded from the analyses for companies that used other quality assurance models. This way, the results from the 55 responses will not affect our data analysis. In the end, 316 valid responses were considered for this research.

Chi-square analysis was used for testing the hypotheses. A Chi-square test with significance level $\alpha = 0.05$ was applied on Question 1 answers that were categorized into two groups: 1) for companies that followed the hypothesis stages and 2) other answers, then applied a Chi- Square test that detects whether there is a significant association between two categorical variables. The Chi-square test is particularly useful in tests involving nominal data since our data is grouped in two or more nominal categories such as “yes –no”, less-frequent, frequent, more frequent, more-important, less important, and 1, 2, 3 (Cooper and Schindler, 2006).

5.2.1 Cramer’s V Test

The strength of the relation was tested with Cramer’s V where values vary between 0.00 and 1:00. The closer to 1:00 the stronger the relationship, while the closer to 0.00 the weaker the relationship. SPSS software was utilized for analyzing the responses.

Tests of statistical significance such as Chi-square do not measure the strength of association between variables. They can only show if such an association does exist. Measures of association reflect both the strength and nature of the relationship in one single summary statistic. Among the tests available, Cramer's V is considered to be the most versatile for nominal and ordinal data with categorical variables are usually interpreted in the following way (Widmalm et al., 1995, Kotrlik et al., 2011, Parker and Rea, 1997, Allen, 1993, Wilkin and Smith, 1987):

- 0.00 and under 0.10 Negligible association
- 0.10 and under 0.20 Weak association
- 0.20 and under 0.40 Moderate association
- 0.40 and under 0.60 Relatively strong association
- 0.60 and under 0.80 Strong association
- 0.80 to 1.0 Very strong association

5.2.2 Bonferroni Correction

The Bonferroni correction was used to control the Type I error rate or the probability of rejecting a null hypothesis that is actually true. In the worst-case scenario, these error rates can be additive, so that if we do 20 tests, each at the 5% level of significance, our probability of committing a Type I error can approach 100% and virtually guaranteeing that we would claim to find a significant result that is not really significant. Future researchers, attempting to reproduce the results, would likely be unable to find the same items being significant (Holm, 1979, Schumacher et al., 2005, Greene et al., 1990, Parhi et al.).

There are less conservative methods that can be applied in regression and ANOVA settings, but Bonferroni is used when doing a series of Chi-square tests (Rice, 1989, Devlin and Roeder, 1999). Table 64 shows the Bonferroni correction value applied to each of the research hypothesis tests.

Table 64: Research Hypotheses and Bonferroni Correction Values Applied

Hypothesis	Description	Bonferroni correction applied
Hypothesis 1	Test the relationship between: • Applying CMMI-DEV/SVC and 17 issues • Applying CMMI-ACQ and 17 issues • Applying P-CMM and 17 issues • Applying TSP and 17 issues	P= 0.05 P =0.05/68 (17 issues *4 models) P = 0.0007462
Hypothesis 2	Test the relationship between: CMMI-DEV/SVC maturity level achieved and 17 issues CMMI-ACQ maturity level achieved and 17 issues P-CMM maturity level achieved and 17 issues	P=0.05 P =0.05/51 (17 issues *3 Models with maturity levels) P = 0.000980392
Hypothesis 3	Test the relationship between 17 issues and the practices	P=0.05 P = 0.05/64= 0.0007812
Hypothesis 4.1	Test the relationship between: • Applying CMMI-DEV/SVC and 3 Project success factors • Applying CMMI-ACQ and 3 Project success factors • Applying P-CMM and 3 Project success factors • Applying TSP and 3 Project success factors	P= 0.05 P=0.05/12 (3 project factors *4 Models) P = 0.0041667
Hypothesis 4.2	Test the relationship between: • CMMI-DEV/SVC maturity level achieved and 3 Project success factors • CMMI-ACQ maturity level achieved and 3 Project success factors • P-CMM maturity level achieved and 3 Project success factors	P=0.05 P =0.05/9 (3 project factors *3 Models with maturity levels) P = 0.005555556
Hypothesis 4.3	Test the relationship between 17 issues and the 3 Project success factors	P=0.05/171 (57 practices *3 project factors) P = 0.0002923

5.2.3 Recoding the Answers

The number of participants on different questions had imbalanced group sizes, which may pose a challenge to the subsequent statistical analysis on group differences due to small cell sizes. Thus, the respondent's answers were recoded as shown in Table 65 to obtain relatively larger cell sizes (Ribbens et al., 2008, Bloemer et al., 2002, Al-Senaidi et al., 2009, Keiningham et al., 2007, Grigorian, 2010, Honkala et al., 2006)

Table 65: Respondents' Answers Recoding

Question 1 - 5 Categories	Recode1 - 3 categories	Recode 2 - 2 categories
1 Always	1) Always + Almost Always	1) Always + Almost Always + Occasionally
2 Almost Always		
3 Occasionally	2) Occasionally	
4 Rarely	3) Rarely + Never	2) Rarely + Never
5 Never		
Question 2 5 Categories	**Recode1 3 categories**	**Recode 2 2 categories**
1 Earlier than planned	1) Earlier than planned time + On time	1) Earlier than planned time + On time
2 On time		
3 About 20% more than planned time	2) About 20% more than planned time	2) About 20% more than planned time + 50% more than planned time + Double or more of the planned time
4 50% more than planned time	3) 50% more than planned time + Double or more of the planned time	
5 Double or more of the planned time		
Question 3 5 Categories	**Recode1 3 categories**	**Recode 2 2 categories**
1 Less than estimated budget	1) Less than estimated budget + On budget as estimated	1) Less than estimated budget + On budget as estimated
2 On budget as estimated		
3 More than 10% of estimated budget	2) More than 10% of estimated budget	2) More than 10% of estimated budget + More than 20% of estimated budget + More than 50% of estimated budget
4 More than 20% of estimated budget	3) More than 20% of estimated budget + More than 50% of estimated budget	
5 More than 50% of estimated budget		
Question 4 5 Categories	**Recode1 3 categories**	**Recode 2 2 categories**
1 Very Good	1) Very Good + Good	1) Very Good + Good
2 Good		
3 Adequate	2) Adequate	2) Adequate + Poor + Bad
4 Poor	3) Poor + Bad	
5 Bad		
Questions 5.1, 6.1, 7.1 5 Categories	**Recode1 3 categories**	**Recode 2 2 categories**
1 Maturity Level 1	1) ML 1 + ML 2	1) ML 1 + ML 2
2 Maturity Level 2		
3 Maturity Level 3	2) ML 3	2) ML 3 + ML 4 + ML5
4 Maturity Level 4	3) ML 4 + ML 5	
5 Maturity Level 5		

Question 10 5 Categories	Recode1 3 categories	Recode 2 2 categories
1 Always 2 Very Frequently	1) Always + Very Frequently	1) Always + Very Frequently
3 Occasionally	2) Occasionally	2) Occasionally + Rarely + Never
4 Rarely 5 Never	3) Rarely + Never	

5.2.4 Testing Hypotheses

All statistical results are provided and covered in the following chapter 6 of the Hypotheses Test Results and Discussion due to the volume of the results. Detailed statistical results are provided in Appendix F.

Chapter 6: Hypotheses Test Results and Discussion

This section summarizes the status for each hypothesis. First, I will discuss adopting CMM/CMMI models and IT offshoring issues. The second section of this chapter will discuss the CMM/CMMI maturity level achieved and IT offshoring issues. The third section will discuss the CMM/CMMI practices and IT offshoring issues. The last section will discuss adopting CMM/CMMI models and performing their practices and the project success factors.

6.1 Adopting CMM/CMMI models and IT offshoring issues

A growing number of organizations are adopting the Software Engineering Institutes' (SEI) Capability Maturity Model (CMM) and Capability Maturity Model Integrate (CMMI) to improve their IT service and software development process. CMM/CMMI became an industry standard based on industry best practices and features an industry standard appraisal methods (Olson, 2008, Dubey, 2003). This research examined four CMM/CMMI models: 1) CMMI for Development/Services; 2) CMMI for Acquisition; 3) People-CMM; Team Software Process (TSP). Little is known regarding how adopting CMM/CMMI influences the frequency of IT offshoring issues experienced by the client companies. This research investigated CMM/CMMI best practices and their effect on managing and mitigating critical issues associated with offshore development.

Based on the statistical analysis in Appendix F, the research showed that adopting CMM/CMMI models and best practices is associated with managing and mitigating critical issue associated with IT offshored development. The following sections will summarize the results and the status for each of the hypotheses.

6.1.1 CMMI for Development/Services and IT offshoring issues

Table 66 shows a summary of the status of hypothesis 1.1 that investigates the relationship between adopting CMMI for Development/Services model and the frequency of IT offshoring issues experienced.

H1.1 There is a relationship between adopting CMMI for Development/Services model and the IT offshoring issues.

Table 66: Summary of H1.1 adopting CMMI for DEV/SVC and offshoring issues

Hypothesis 1.1 **There is a relationship between adopting CMMI-DEV/SVC and**		*Status Significantly Associated	Strength of Association
H1.1.1	Over expenditure issue.	Yes	0.610
H1.1.2	Poor execution plan specifically timing and type of work transferred to the supplier issue.	Yes	0.707
H1.1.3	Difference in interpretation of project requirements between Client company and the supplier.	Yes	0.659
H1.1.4	Poorly developed and documented requirements by the client company.	Yes	0.685
H1.1.5	Poor tracking and managing requirement changes by the client company.	Yes	0.681
H1.1.6	Lack of a full communication plan between the client company and the supplier company.	Yes	0.641
H1.1.7	Communication and coordination problems between the client company and the supplier company.	Yes	0.703
H1.1.8	Language barriers between the client company and the supplier.	No	0
H1.1.9	Time-zone differences between the client company and the supplier.	No	0
H1.1.10	Cultural differences between the client company and the supplier.	No	0
H1.1.11	Incomplete and unclear contract.	Yes	0.617
H1.1.12	Early contract renegotiation and termination.	Yes	0.589
H1.1.13	Difference in project management practices between your company and the supplier.	Yes	0.639
H1.1.14	Client company unable to measure the performance of the supplier.	Yes	0.672
H1.1.15	Supplier technical/security and political issues.	No	0
H1.1.16	Insufficient previous experience of the supplier.	Yes	0.645
H1.1.17	Lack of supplier standardized working methods.	Yes	0.626
*P=.05/68 = 0.0007352 (Bonferroni Adjustment)			

The analysis showed that firms that adopted CMMI for Development/Services reported fewer issues with IT offshoring. The analysis showed a significantly associated relationship between thirteen issues (77%) and adopting CMMI for DEV/SVC industrial standards (p=0.0007352). The majority of the following relationships indicated strong association with Cramer's V above 0.60:

1. Over expenditure due to hidden costs
2. Poor execution plan specifically timing and type of work transferred to the supplier company
3. Difference in interpretation of project requirements between the client company and the supplier
4. Poorly developed and documented requirements by the client company
5. Poor tracking and managing requirement changes by the client company

6. Lack of a full communication plan between the client company and the supplier company
7. Communication and coordination problems between the client company and the supplier company
8. Incomplete and unclear contract
9. Early contract renegotiation and termination
10. Difference in project management practices between client company and the supplier company
11. Client company unable to measure the performance of the supplier
12. Insufficient previous experience of the supplier
13. Lack of supplier standardized working methods

However, the analysis did not show a significant relationship between adopting CMMI for Development/Services and:

1. Language barriers between the client company and the supplier company
2. Time-zone differences between the client company and the supplier company
3. Cultural differences between the client company and the supplier company
4. Supplier technical/security and political issues

Therefore, this may suggest, consistent with literature, that IT services and software development offshoring projects pose substantial issues and challenges to the client companies in managing these projects (Ebert et al., 2008). In IT service offshoring, delivery occurs under the additional condition of distance between the service supplier and the client in terms of physical distance, time zone differences or cultural differences. Additionally, complexity increases due to the higher degree of geographical dispersion among team members (Holmström et al., 2008, Yalaho and Nahar, 2009, McIvor, 2000, Raffo and Setamanit, 2005). Therefore, there is a need to utilize different methods to effectively and efficiently mitigate the issues and challenges of offshoring.

6.1.2 CMMI for Acquisition and IT offshoring issues

Table 67 shows a summary of the status of hypothesis 1.2 investigating the relationship between adopting CMMI for Acquisition and the frequency of IT offshoring issues experienced.

H1.2 There is a relationship between adopting CMMI for Acquisition model and the IT offshoring issues.

Table 67: **Summary of H1.2 Adopting CMMI for Acquisition and Offshoring Issues**

Hypothesis 1.2 **There is a relationship between adopting CMMI for Acquisition and**		*Status Significantly Associated	Strength of Association
H1.2.1	Over expenditure issue.	Yes	0.769
H1.2.2	Frequency of poor execution plan	Yes	0.609
H1.2.3	Difference in interpretation of project requirements	Yes	0.542
H1.2.4	Poorly developed and documented requirements	Yes	0.532
H1.2.5	Poor tracking and managing requirement changes	Yes	0.566
H1.2.6	Lack of a full communication plan	Yes	0.545
H1.2.7	Communication and coordination problems	Yes	0.613
H1.2.8	Language barriers	No	0
H1.2.9	Time-zone differences	No	0
H1.2.10	Cultural differences	No	0
H1.2.11	Incomplete and unclear contract issue.	Yes	0.498
H1.2.12	Early contract renegotiation and termination issue.	Yes	0.642
H1.2.13	Difference in project management practices	Yes	0.474
H1.2.14	Unable to measure the performance of the supplier issue.	Yes	0.584
H1.2.15	Supplier security and political issues.	No	0
H1.2.16	Insufficient previous experience of the supplier issue.	Yes	0.624
H1.2.17	Lack of supplier standardized working methods issue.	Yes	0.645
*P=.05/68 = 0.0007352 (Bonferroni's Adjustment)			

The analysis showed that firms that adopted CMM for Acquisition reported fewer issue with IT offshoring. Applying the Bonferroni correction, the analysis showed a significantly associated relationship (p=0.0007352) between adopting CMMI for Acquisition industrial standards and thirteen issues (77%). The majority of the following relationships indicated strong association with Cramer's V above 0.60:

1) Over expenditure due to hidden costs
2) Poor execution plan specifically timing and type of work transferred to the supplier company
3) Difference in interpretation of project requirements between the client company and the supplier
4) Poorly developed and documented requirements by the client company
5) Poor tracking and managing requirement changes by the client company
6) Lack of a full communication plan between the client company and the supplier company
7) Communication and coordination problems between the client company and the supplier company
8) Incomplete and unclear contract
9) Early contract renegotiation and termination
10) Difference in project management practices between Client Company and the supplier company
11) Client company unable to measure the performance of the supplier
12) Insufficient previous experience of the supplier
13) Lack of supplier standardized working methods

However, the analysis did not show a significantly associated relationship between adopting CMMI for Acquisition and four IT offshoring issues:

1. Language barriers between the client company and the supplier company
2. Time-zone differences between the client company and the supplier company
3. Cultural differences between the client company and the supplier company
4. Supplier technical/security and political issues

Therefore, this may suggest, consistent with literature, that IT services and software development offshoring projects pose substantial issues and challenges to the client companies in managing these projects (Ebert et al., 2008). In IT service offshoring, delivery occurs under the additional condition of distance between the service supplier and the client in terms of physical distance, time zone differences or cultural differences. Additionally, complexity increases due to the higher degree of geographical dispersion among team members (Holmström et al., 2008, Yalaho and Nahar, 2009, McIvor, 2000, Raffo and Setamanit, 2005). Therefore, there is a need to utilize different methods to effectively and efficiently mitigate the issues and challenges of offshoring.

6.1.3 People-CMM and IT offshoring issues

Table 68 shows a summary of the status of hypothesis 1.3 that investigates the relationship between adopting People-CMM and the frequency of IT offshoring issues experienced.

H1.3 There is a relationship between adopting People-CMM model and the IT offshoring issues.

Table 68: Summary of H1.3 adopting People-CMM and IT Offshoring Issues

Hypothesis 1.3 There is a relationship between adopting People-CMM and		*Status Significantly Associated	Strength of Association
H1.3.1	Over expenditure issue.	No	0
H1.3.2	Poor execution plan	Yes	.307
H1.3.3	Difference in interpretation of project requirements.	Yes	.427
H1.3.4	Poorly developed and documented requirements by client company.	Yes	.382
H1.3.5	Poor tracking and managing requirement changes.	Yes	.342
H1.3.6	Lack of a full communication plan.	Yes	.499
H1.3.7	Communication and coordination problems.	Yes	.453
H1.3.8	Language barriers between the client and supplier.	Yes	.387
H1.3.9	Time-zone differences between the client company and the supplier.	No	0
H1.3.10	Cultural differences between the client company and the supplier	Yes	.413
H1.3.11	Incomplete and unclear contract issue.	Yes	.335
H1.3.12	Early contract renegotiation and termination issue.	No	0
H1.3.13	Difference in project management practices.	No	0
H1.3.14	Unable to measure the performance of the supplier.	No	0
H1.3.15	Supplier technical/security and political issues.	No	0
H1.3.16	Insufficient previous experience of the supplier issue.	Yes	.314
H1.3.17	Lack of supplier standardized working methods issue.	Yes	.296
*P=.05/68 = 0.0007352 (Bonferroni’s Adjustment)			

After applying the Bonferroni correction, the analysis showed a significantly associated relationship (p=0.0007352) between adopting People-CMM industrial standards and eleven issues (65%), the majority of the following relationships indicated strong association with Cramer's V above 0.60:

1. Poor execution plan specifically timing and type of work transferred to the supplier company
2. Difference in interpretation of project requirements between the client company and the supplier
3. Poorly developed and documented requirements by the client company
4. Poor tracking and managing requirement changes by the client company
5. Lack of a full communication plan between the client company and the supplier company
6. Communication and coordination problems between the client company and the supplier company
7. Language barriers between the client company and the supplier company
8. Cultural differences between the client company and the supplier company
9. Incomplete and unclear contract
10. Insufficient previous experience of the supplier
11. Lack of supplier standardized working methods

However, the analysis did not show a significantly associated relationship between adopting People-CMM and six offshoring issues:

1. Over expenditure due to hidden costs
2. Time-zone differences between the client company and the supplier company
3. Early contract renegotiation and termination
4. Difference in project management practices between client company and the supplier company
5. Client company unable to measure the performance of the supplier
6. Supplier Technical/Security and Political issues

6.1.4 Adopting Team Software Process (TSP) and IT offshoring issues

Table 69 shows a summary of the status of hypothesis 1.4 that investigated the relationship between adopting Team Software Process and the frequency of IT offshoring issues experienced.

H1.4 There is a relationship between adopting TSP model and the IT offshoring issues.

Table 69: Summary of H1.3 Adopting (TSP) and IT Offshoring Issues

Hypothesis 1.4 **There is a relationship between adopting TSP and**		***Status** Significantly Associated	Strength of Association
H1.4.1	Over expenditure.	No	0
H1.4.2	Poor execution plan.	Yes	0.304
H1.4.3	Difference in interpretation of project requirements.	Yes	0.384
H1.4.4	Poorly developed and documented requirements.	Yes	0.304
H1.4.5	Poor tracking and managing requirement changes.	Yes	0.324
H1.4.6	Lack of a full communication plan.	Yes	0.464
H1.4.7	Communication and coordination problems.	Yes	0.424
H1.4.8	Language barriers	Yes	0.517
H1.4.9	Time-zone differences	No	0
H1.4.10	Cultural differences	Yes	0.492
H1.4.11	Incomplete and unclear contract issue.	Yes	0.303
H1.4.12	Early contract renegotiation and termination issue.	Yes	0.304
H1.4.13	Difference in project management practices.	No	0
H1.4.14	Unable to measure the performance of the supplier issue.	No	0
H1.4.15	Supplier security and political issues.	No	0
H1.4.16	Insufficient previous experience of the supplier issue.	No	0
H1.4.17	Lack of supplier standardized working methods issue.	No	0
*P=.05/68 = 0.0007352 (Bonferroni's Adjustment)			

The analysis showed a significantly associated relationship (p=0.0007352) between adopting the Team Software Process (TSP) industrial standards and ten issues (60%):

1. Poor execution plan specifically timing and type of work transferred to the supplier company
2. Poorly developed and documented requirements by the client company
3. Poor tracking and managing requirement changes by the client company
4. Difference in interpretation of project requirements between the client company and the supplier
5. Lack of a full communication plan between the client company and the supplier company

6. Communication and coordination problems between the client company and the supplier company
7. Language barriers between the client company and the supplier company
8. Cultural differences between the client company and the supplier company
9. Incomplete and unclear contract
10. Early contract renegotiation and termination

However, the analysis did not show a significant relationship between adopting People-CMM and seven (40%) offshoring issues:

1. Over expenditure due to hidden costs
2. Time-zone differences between the client company and the supplier company
3. Difference in project management practices between client company and the supplier company
4. Client company unable to measure the performance of the supplier
5. Lack of supplier standardized working methods
6. Supplier technical/security and political issues
7. Insufficient previous experience of the supplier

6.2 CMM/CMMI Maturity Level Achieved and IT Offshoring Issues

Based on the statistical analysis in Appendix F, the research showed that achieving higher maturity levels of CMMI is associated with managing and mitigating critical issues associated with IT offshored development.

6.2.1 CMMI-DEV/SVC maturity level achieved and IT offshoring issues

H2.1: There is a relationship between the CMMI-DEV/SVC maturity level achieved and the issues experienced by the client firm.

Table 70: H2.1-CMMI-DEV/SVC Maturity Level Achieved and IT Offshoring Issues

Hypothesis 2.1 There is a relationship between CMMI-DEV/SVC ML achieved and		*Status Significantly Associated	Strength of Association
H2.1.1	Over expenditure issue.	Yes	0.769
H2.1.2	Poor execution plan specifically timing.	Yes	0.609
H2.1.3	Difference in interpretation of project requirements.	Yes	0.542
H2.1.4	Poorly developed and documented requirements.	Yes	0.532
H2.1.5	Poor tracking and managing requirement changes.	Yes	0.566
H2.1.6	Lack of a full communication plan.	Yes	0.545
H2.1.7	Communication and coordination problems.	Yes	0.613
H2.1.8	Language barriers between client and supplier.	No	0
H2.1.9	Time-zone differences.	No	0
H2.1.10	Cultural differences.	No	0
H2.1.11	Incomplete and unclear contract issue.	Yes	0.498
H2.1.12	Early contract renegotiation and termination issue.	Yes	0.642
H2.1.13	Difference in project management practices.	Yes	0.474
H2.1.14	Unable to measure the performance of supplier.	Yes	0.584
H2.1.15	Supplier technical/security and political issues.	No	0
H2.1.16	Insufficient previous experience of supplier.	Yes	0.624
H2.1.17	Lack of supplier standardized working methods.	Yes	0.645
*P=.05/51 (17*3) = 0.00098039 (Bonferroni's Adjustment)			

Table 70 shows a summary of the status of hypothesis 2.1 investigating the relationship between adopting CMMI for Development/Services maturity level achieved and the frequency of IT offshoring issues experienced. The analysis showed a significant relationship between CMMI for DEV/SVC maturity level achieved and thirteen issues (77%). The majority of the following relationships indicated a strong association with Cramer's V above 0.60:

1. Over expenditure due to hidden costs
2. Poor execution plan specifically timing and type of work transferred to the supplier company
3. Difference in interpretation of project requirements between the client company and the supplier
4. Poorly developed and documented requirements by the client company
5. Poor tracking and managing requirement changes by the client company
6. Lack of a full communication plan between the client company and the supplier company
7. Communication and coordination problems between the client company and the supplier company

8. Incomplete and unclear contract
9. Early contract renegotiation and termination
10. Difference in project management practices between client company and the supplier company
11. Client company unable to measure the performance of the supplier
12. Insufficient previous experience of the supplier
13. Lack of supplier standardized working methods

The analysis showed that when IT offshoring companies achieved a higher maturity level they reported less frequent IT offshoring issues experienced (77%). The results are consistent with the literature, that experience with CMM and CMMI demonstrates that companies appraised to higher levels of CMM or CMMI experience less frequent issues. Increasingly, the industry requires suppliers to be appraised to CMM or CMMI level 3 or higher (Lutteroth et al., 2007).

However, the analysis did not show a significant relationship between adopting CMMI for Development/Services and:

1. Language barriers between the client company and the supplier company
2. Time-zone differences between the client company and the supplier company
3. Cultural differences between the client company and the supplier company
4. Supplier technical/security and political issues

Therefore, this may suggest, consistent with literature, that IT services and software development offshoring projects pose substantial issues and challenges to the client companies in managing these projects (Ebert et al., 2008). In IT service offshoring, language differences, time zone differences and/or cultural differences. Additionally, complexity increases due to the higher degree of geographical dispersion among team members and supplier political and security issues increases (Holmström et al., 2008, Yalaho and Nahar, 2009, McIvor, 2000, Raffo and Setamanit, 2005). Therefore, there is a need to utilize different methods to effectively and efficiently mitigate the issues and challenges of offshoring.

6.2.2 CMMI-ACQ maturity level achieved and IT offshoring issues

H2.2: There is a relationship between the CMMI-ACQ maturity level achieved and the IT offshoring issues.

Table 71: H2.2 -CMMI-ACQ Maturity Level (ML) Achieved and IT Offshoring Issues

Hypothesis 2.2 **There is a relationship between adopting CMMI-ACQ ML achieved and**		*Status Significantly Associated	Strength of Association
H2.2.1	Over expenditure issue.	Yes	0.769
H2.2.2	Poor execution plan.	Yes	0.609
H2.2.3	Difference in interpretation of project requirements.	Yes	0.542
H2.2.4	Poorly developed and documented requirements.	Yes	0.532
H2.2.5	Poor tracking and managing requirement changes.	Yes	0.566
H2.2.6	Lack of a full communication plan.	Yes	0.545
H2.2.7	Communication and coordination problems.	Yes	0.613
H2.2.8	Language barriers between client company and supplier.	No	0
H2.2.9	Time-zone differences.	No	0
H2.2.10	Cultural differences.	No	0
H2.2.11	Incomplete and unclear contract issue.	Yes	0.498
H2.2.12	Early contract renegotiation and termination.	Yes	0.642
H2.2.13	Difference in project management.	Yes	0.474
H2.2.14	Unable to measure performance of supplier.	Yes	0.584
H2.2.15	Supplier technical/security and political issues.	No	0
H2.2.16	Insufficient previous experience of the supplier issue.	Yes	0.502
H2.2.17	Lack of supplier standardized working methods.	Yes	0.498
*P=.05/51 (17*3) = 0.00098039 (Bonferroni's Adjustment)			

Table 71 shows a summary of the status of hypothesis 2.1 investigating the relationship between adopting CMMI for Acquisition maturity level achieved and the frequency of IT offshoring issues experienced.

The analysis showed a significant relationship between CMMI for Acquisition maturity level achieved and thirteen issues (77%), the majority of the following relationships indicated relatively strong association with Cramer's V above 0.40:

1. Over expenditure due to hidden costs
2. Poor execution plan specifically timing and type of work transferred to the supplier company
3. Difference in interpretation of project requirements between the client company and the supplier
4. Poorly developed and documented requirements by the client company
5. Poor tracking and managing requirement changes by the client company
6. Lack of a full communication plan between the client company and the supplier company
7. Communication and coordination problems between the client company and the supplier company
8. Incomplete and unclear contract
9. Early contract renegotiation and termination
10. Difference in project management practices between client company and the supplier company
11. Client company unable to measure the performance of the supplier
12. Insufficient previous experience of the supplier
13. Lack of supplier standardized working methods

The analysis showed that when IT offshoring companies achieved a higher maturity level, they reported fewer IT offshoring issues experienced (77%). However, the analysis did not show a significant relationship between adopting CMMI for Development/Services and:

1. Language barriers between the client company and the supplier company
2. Time-zone differences between the client company and the supplier company
3. Cultural differences between the client company and the supplier company
4. Supplier technical/security and political issues

Therefore, this may suggest, consistent with literature, that IT services and software development offshoring projects pose substantial issues and challenges to the client companies in managing these projects (Ebert et al., 2008) (Holmström et al., 2008, Yalaho and Nahar, 2009, McIvor, 2000, Raffo and Setamanit, 2005). Therefore, there is a need to utilize different methods to effectively and efficiently mitigate the issues and challenges of offshoring.

6.2.3 People-CMM maturity level achieved and IT offshoring issues

H2.3: There is a relationship between CMM-people maturity level achieved and the IT offshoring issues.

Table 72: H2.3 - People-CMM Maturity Level Achieved and IT Offshoring Issues

Hypothesis 2.3 **There is a relationship between adopting People-CMM ML achieved and the**		**Status Significantly Associated
H2.3.1	Over expenditure issue.	No
H2.3.2	Poor execution plan.	*No
H2.3.3	Difference in interpretation of project requirements.	*No
H2.3.4	Poorly developed and documented requirements by the client company issue.	*No
H2.3.5	Poor tracking and managing requirement changes by client company issue.	*No
H2.3.6	Lack of a full communication plan issue.	*No
H2.3.7	Communication and coordination problems.	*No
H2.3.8	Language barriers between the client company and the supplier issue.	*No
H2.3.9	Time-zone differences.	*No
H2.3.10	Cultural differences.	*No
H2.3.11	Incomplete and unclear contract issue.	*No
H2.3.12	Contract renegotiation and termination issue.	*No
H2.3.13	Difference in project management practices between client and supplier.	No
H2.3.14	Unable to measure the performance of the supplier issue.	*No
H2.3.15	Supplier technical/security and political issues.	*No
H2.3.16	Insufficient previous experience of the supplier issue.	*No
H2.3.17	Lack of supplier standardized working methods.	*No
*Results may differ with more data (small sample 36 valid cases) **P=.05/51 (17*3) = 0.00098039 (Bonferroni's Adjustment)		

Table 72 shows a summary of the status of hypothesis 2.3 investigating the relationship between adopting CMMI for People-CMM maturity level achieved and the frequency of IT offshoring issues experienced.

The analysis did not show a significant relationship between CMMI for People-CMM maturity level achieved and IT offshoring issues. However, it was not possible to find a significant relationship between the maturity level achieved and issues experienced when applying People-CMM. There can be various explanations for the lack of statistical significance and I will discuss 2 of them:

1) Of the total responses, only 14.7% companies considered practicing People-CMM.
2) Of the 14.7% companies, 2% of the companies reported “CMMI applied but no maturity level number was determined” option and 1.7% of the companies did not know their maturity level. This lowered the People-CMM maturity level responses to 11%.

For hypothesis 2.3, the results may differ with more data collected. This is due to a small sample (36) of valid cases.

6.3 CMM/CMMI practices and IT offshoring issues

Table 73 shows a summary of the status of hypothesis 3 investigating the relationship between adopting CMM/CMMI industry standards best practices and the frequency of IT offshoring issues experienced.

The investigation showed that the more frequently the IT offshoring company routinely performed the CMM/CMMI industry standard practices they reported fewer IT offshoring issues. The analysis showed a significant relationship between CMM/CMMI industry standards practices and the IT offshoring issues (92%).

Table 73: Results of the practices and IT offshoring issues

Hypothesis	Issues and CMM/CMMI Practices	*Status Significantly Associated	Strength of Association
H3.1	Issue 1: OVER EXPENDITURE and CMM/CMMI Practices PR1 to PR6		
H3.1.1	PR1: Establishes and maintains a project plan as the basis for managing the project	Yes	0.611
H3.1.2	PR2: Establishes and maintains the overall project plan.	Yes	0.692
H3.1.3	PR3: Estimates the project's effort and cost for work products and tasks based on estimation rationale	Yes	0.651
H3.1.4	PR4: Establishes and maintains the project's budget and schedule, milestones, constraints, dependencies	Yes	0.591
H3.1.5	PR5: Monitors offshoring supplier project progress and performance (effort, and cost) as defined in the contract	Yes	0.606
H3.1.6	PR6: Manages invoices submitted by the supplier	Yes	0.541
H3.2	Issue 2: DIFFERENCES IN INTERPRETATION OF PROJECT REQUIREMENTS BETWEEN THE CLIENT AND THE SUPPLIER and CMM/CMMI Practices PR7 to PR9		Strength of Association
H3.2.1	PR7: Develops an understanding with offshoring supplier on the meaning of requirement	Yes	0.451
H3.2.2	PR8: Validates requirements to ensure that the resulting product performs as intended in the end user's environment	Yes	0.525
H3.2.3	PR9:Obtains commitment to requirements from project participants	Yes	0.446
H3.3	Issue 3: POORLY DEVELOPED AND DOCUMENTED REQUIREMENTS BY THE CLIENT COMPANY and CMM/CMMI Practices PR10 and PR11		Strength of Association
H3.3.1	PR10: Stakeholder needs, expectations, constraints and interfaces are collected and translated into customer requirements	Yes	0.561
H3.3.2	PR11: Maintains bidirectional traceability among requirements and work products	Yes	0.651
H3.4	Issue 4: POOR TRACKING AND MANAGING REQUIREMENT CHANGES BY CLIENT COMPANY and PR12 to PR14		Strength of Association
H3.4.1	PR12: Manages changes to requirements as they evolve during the project.	Yes	0.640
H3.4.2	PR13: Ensures that project plans and work products remain aligned with requirements	Yes	0.614
H3.4.3	PR14: Customer Interface Manager leads the team in estimating and documenting the impact of every change in requirement and works with the Configuration Control Board (CCB) to get approval for changes to those requirements	Yes	0.657
H3.5	Issue 5: LACK OF A FULL COMMUNICATION PLAN BETWEEN THE CLIENT AND THE SUPPLIER and PR15 to PR19		Strength of Association
H3.5.1	PR15: Establishes and manages the coordination and collaboration between the project and relevant stakeholders	Yes	0.655

H3.5.2	PR16: Team members track actual results and performance against plans on a weekly basis. Team members track progress against individual plans on a daily basis.	Yes	0.693
H3.5.3	PR17: Develops a documented plan to be used to communicate group commitments and to coordinate and track work performed.	Yes	0.646
H3.5.4	PR18: Team managers are responsible for coordination across all project teams	Yes	0.677
H3.5.5	PR19: Communication and coordination practices are institutionalized to ensure are performed as managed processes	Yes	0.635
H3.6	Issue 6: COMMUNICATION AND COORDINATION PROBLEMS BETWEEN THE CLIENT AND THE SUPPLIER and CMM/CMMI Practices PR20 to PR23		Strength of Association
H3.6.1	PR20: Representatives of the client company project's software engineering group work with representatives of the supplier engineering groups to monitor and coordinate technical activities and resolve technical issues	Yes	0.515
H3.6.2	PR21: Selects team roles, including the role of Supplier Interface Manager, who is the liaison between the team and the supplier company representative, and is responsible for requirements change management	Yes	0.411
H3.6.3	PR22: Communicates quality issues and ensures the resolution of noncompliance issues with the staff and managers	Yes	0.601
H3.6.4	PR23: Establishes and maintains a documented policy for conducting its Communication and Coordination activities	Yes	0.549
H3.7	Issues: 7) LANGUAGE BARRIERS 8) TIME-ZONE DIFFERENCES 9) CULTURAL DIFFERENCES BETWEEN THE CLIENT AND THE SUPPLIER and CMM/CMMI Practices PR24 to PR29		Strength of Association
H3.7.1a-c	PR24: Client Company ensures that the workforce has the skills to share information and coordinate their activities efficiently	Yes Language + Cultural	.458 Language .411 -Cultural
H3.7.2a-c	PR25: Client Company establishes a culture for openly sharing information and concerns across organizational levels as well as among team members	Yes (Language , Cultural)	.400 - Language .395 -Cultural
H3.7.3a-c	PR26: Client Company establishes project teams as well as their responsibilities, authorities and interrelationships	Yes (Language , Cultural)	.438 - Language .447 -Cultural
H3.7.4a-c	PR27: Client Company establishes and maintains open and effective project teams' communication and coordination plan	Yes (Language , Cultural)	.455 Language .465 -Cultural
H3.7.5a-c	PR28: Client Company team managers are responsible to track and resolve inter-group issues	Yes (Language , Cultural)	.422 Language .326 -Cultural
H3.7.6a-c	PR29: Maintains effective work-groups, interpersonal problems are addressed quickly and meetings are managed to ensure that work-group time is used most effectively	Yes (Language , Cultural)	.402 Language .367- Cultural
H3.8	Issue 10: INCOMPLETE AND UNCLEAR CONTRACT and CMM/CMMI Practices PR30 to PR34		
H3.8.1	PR30: Establishes and maintains a mutual understanding of the contract with selected suppliers and end users.	Yes	0.660

H3.8.2	PR31: Stakeholder needs, expectations, constraints and interfaces are collected and translated into customer requirements.	Yes	0.581
H3.8.3	PR32: Requirements are refined and elaborated into contractual requirements.	Yes	0.537
H3.8.4	PR33: Establishes and maintains formal contract management plan	Yes	0.539
H3.8.5	PR34: Establishes and maintains contractual requirements.	Yes	0.490
H3.9	Issue 11: EARLY CONTRACT RENEGOTIATION AND TERMINATION and CMM/CMMI Practices PR35 and PR36		
H3.9.1	PR35: Establishes and maintains negotiation plans to use in completing a supplier agreement.	Yes	0.453
H3.9.2	PR36: Insures that agreements with suppliers are satisfied by both the project and the supplier.	Yes	0.566
H3.10	Issue 12: INSUFFICIENT PREVIOUS EXPERIENCE OF THE SUPPLIER and CMM/CMMI Practices PR37 to PR39		Strength of Association
H3.10.1	PR37: Selects suppliers based on an evaluation of their ability to meet specified requirements and established criteria	Yes	0.520
H3.10.2	PR38: Client Company identifies and qualifies potential suppliers	Yes	0.537
H3.10.3	PR39: Selects suppliers using a formal evaluation	Yes	0.655
H3.11	Issue 13: UNABLE TO MEASURE PERFORMANCE OF THE SUPPLIER and CMM/CMMI Practices PR40 to PR48		Strength of Association
H3.11.1	PR40: Establishes and maintains quantitative objectives to address quality and process performance, based on customer needs and business objectives.	Yes	0.486
H3.11.2	PR41: Manages the project using statistical and other quantitative techniques to determine whether or not the project's objectives for quality and process performance will be satisfied.	Yes	0.507
H3.11.3	PR42: Performs root cause analysis of selected issues to address deficiencies in achieving the project's quality and process performance objectives.	Yes	0.470
H3.11.4	PR43: Manages corrective actions to closure when the project's performance or results deviate significantly from the plan	Yes	0.520
H3.11.5	PR44: Periodically reviews the project's progress, performance and issues experienced.	Yes	0.537
H3.11.6	PR45: Reviews the project's accomplishments and results at selected project milestones.	Yes	0.489
H3.11.7	PR46: Establishes and maintains records of quality assurance activities.	Yes	0.580
H3.11.8	PR47: Monitors the actual project performance and progress against the project plan	Yes	0452
H3.11.9	PR48: Ensures that the supplier agreement is satisfied before accepting the acquired product	Yes	0.465
H3.12	Issue 14: SUPPLIER TECHNICAL/SECURITY /POLITICAL ISSUES and CMM/CMMI Practices PR49 to PR51		Strength of Association
H3.12.1	PR49: Selects supplier technical solutions to be analyzed and analysis methods to be used.	Yes	0.400
H3.12.2	PR50: Conducts technical reviews with the supplier as defined in the supplier agreement.	Yes	0.446
H3.12.3	PR51: Evaluates and categorizes each identified issue using defined risk categories and determines its relative priority.	Yes	0.305

H3.13	Issue 15: DIFFERENCE IN PROJECT MANAGEMENT PRACTICES BETWEEN THE CLIENT AND THE SUPPLIER and the CMM/CMMI Practices PR52 to PR56		Strength of Association
H3.13.1	PR52: Selects suppliers based on an evaluation of their ability to meet specified requirements and established criteria	Yes	0.491
H3.13.2	PR53: Identifies and qualifies potential suppliers	Yes	0.547
H3.13.3	PR54: Selects, monitors, and analyzes supplier processes	Yes	0.607
H3.13.4	PR55: Selects suppliers using a formal evaluation	Yes	0.607
H3.13.5	PR56: Establishes and maintains a usable set of organizational process assets, work environment standards, rules for teams	Yes	0.538
H3.14	Issue 16: POOR EXECUTION PLAN SPECIFICALLY TIMING AND TYPE OF WORK TRANSFERRED TO THE SUPPLIER and CMM/CMMI Practices PR57 to PR60		Strength of Association
H3.14.1	PR57: Establishes and maintains the offshoring strategy	Yes	0.507
H3.14.2	PR58: Establishes and maintains plan for performing offshoring	Yes	0.507
H3.14.3	PR59: Determines the type of acquisition for each product	Yes	0.476
H3.14.4	PR60: Plan transition to operations	Yes	0.443
H3.15	Issue 17: LACK OF SUPPLIER STANDARIZED WORKING METHODS and CMM/CMMI Practices PR61 to PR64		Strength of Association
H3.15.1	PR61: Evaluates supplier technical solutions (designs) to confirm that contractual requirements continue to be met	Yes	0.634
H3.15.2	PR62: Selects suppliers based on an evaluation of their ability to meet specified requirements and established criteria	Yes	0.614
H3.15.3	PR63: Selects, monitors, and analyzes supplier processes	Yes	0.658
H3.15.4	PR64: Selects suppliers using a formal evaluation	Yes	0.707
*P=.05/64 = 0.00078125 (Bonferroni's Adjustment)			

- Issue 1: Over expenditure due to hidden costs issue. The analysis showed a significant relationship between CMM/CMMI industry standards practices PR1 to PR6 and the IT offshoring issue of over expenditure (100%). Cramer's V above .60 indicates a strong association between applying PR1 to PR5 and the issue of over expenditure as shown in Table 73. In contrast, PR 5 indicates relatively strong association with over expenditure with Cramer's V =.541.
- Issue 2: Difference in interpretation of project requirements between the client company and the supplier issue. The analysis showed a significant relationship between CMM/CMMI industry standards practices PR7 to PR9 and the IT

offshoring issue 2 (100%). Cramer's V above .40 indicates a relatively strong association between applying PR1 to PR5 and the issue of this issue shown in Table 73.

- Issue 3: Poorly developed and documented requirements by the client company issue. The analysis showed a significant relationship between CMM/CMMI industry standards practices PR10 to PR11 and ITI offshoring issue 3 the IT offshoring issue 4 (100%). There is a strong association between PR11 and with Cramer's V=0.651.
- Issue 4: Poor tracking and managing requirement changes by the client company issue. The analysis showed a significant relationship between CMM/CMMI industry standards practices PR12 to PR14 and the IT offshoring issue 4 (100%). Cramer's V above .60 indicates a strong association between applying PR12 to PR14 and this issue.
- Issue 5: Lack of a full communication plan between the client company and the supplier company issue. The analysis showed a significant relationship between CMM/CMMI industry standards practices PR15 to PR19 and the IT offshoring issue 5 (100%). Cramer's V above .60 indicates a strong association between applying PR15 to PR19 and this issue shown in Table 73.
- Issue 6: Communication and coordination problems between the client company and the supplier company issue. The analysis showed a significant relationship between CMM/CMMI industry standards practices PR20 to PR 23 and the IT offshoring issues 7 (100%). Cramer's V above .40 indicates a relatively strong

association between applying PR20, PR21 and PR23 and this issue. PR22 showed a strong association with this issue and Cramer's V=0.601.

- Issue 7: Language barriers between the client company and the supplier company issue. The analysis showed a significant relationship between CMM/CMMI industry standards practices PR24 to PR29 and the IT offshoring issue 7 (100%). Cramer's V above .40 indicates a relatively strong association between applying PR24 to PR29 and this issue.
- However, for issue 8: Time-zone differences between the client company and the supplier company issue. The analysis did not show a significant relationship between CMM/CMMI industry standards practices PR24 to PR29 and the IT offshoring issue 8.
- Issue 9: Cultural differences between the client company and the supplier company issue. The analysis showed a significant relationship between CMM/CMMI industry standards practices PR24 to PR29 and the IT offshoring issue 9 (100%). Cramer's V above .40 indicates a relatively strong association between applying PR24 to PR29 and this issue.
- Issue 10: Incomplete and unclear contract issue. The analysis showed a significant relationship between CMM/CMMI industry standards practices PR30 to PR34 and the IT offshoring issue 10 (100%). Cramer's V above .40 indicates a relatively strong association between applying PR31to PR34 and this issue. PR30 showed a strong association with this issues and Cramer's V=0.660.

- Issue 11: Early contract renegotiation and termination issue. The analysis showed a significant relationship between CMM/CMMI industry standards practices PR35 and PR36 and the IT offshoring issue 11 (100%). Cramer's V above .40 indicates a relatively strong association between applying PR35 to PR36 and this issue.
- Issue 12: Insufficient previous experience of the supplier issue. The analysis showed a significant relationship between CMM/CMMI industry standards practices PR37 to PR39 and the IT offshoring issue 12 (100%). Cramer's V above .40 indicates a relatively strong association between applying PR37 to PR38 and this issue. PR39 has a strong association with this issue and Cramer's V=0.655.
- Issue 13: Client Company unable to measure the performance of the supplier issue. The analysis showed a significant relationship between CMM/CMMI industry standards practices PR40 to PR48 and this issue (100%). Cramer's V above .40 indicates a relatively strong association between applying PR40 to PR48 and this issue.
- Issue 14: Supplier technical/security and political issues 14. The analysis showed a significant relationship between CMM/CMMI industry standards practices PR49 to PR51 and the IT offshoring issue 14 (100%). Cramer's V above 0.40 indicates a relatively strong association between applying PR49 to PR50 and this issue. However, PR51 has a moderate association with this issue and Cramer's V=0.305.
- Although the practices PR49 to PR51 showed a significant association with the issue of Supplier technical/security and political issues. Practicing it did not mitigate the issue completely. This might be because there are no practices

targeting the security and political issues. Further investigation is needed for different sets of practices and methods needed to manage and mitigate the offshoring issues of Supplier Security and Political issues.

- Issue 15: Difference in project management practices between Client Company and the supplier company issue. The analysis showed a significant relationship between CMM/CMMI industry standards practices PR52 to PR56 and this issue (100%). Cramer's V above .40 indicates a relatively strong association between applying PR52, PR53 and PR56 and this issue. However, PR54 andPR55 show a strong association with this issue and Cramer's V above 0.60.
- Issue 16: Poor execution plan specifically timing and type of work transferred to the supplier company issue. The analysis showed a significant relationship between CMM/CMMI industry standards practices PR57 to PR60 and this IT offshoring issue (100%). Cramer's V above .40 indicates a relatively strong association between applying PR57 to PR60 and this issue shown in Table 73.
- Issue 17: Lack of supplier standardized working methods issue. The analysis showed a significant relationship between CMM/CMMI industry standards practices PR61 to PR64 and this IT offshoring issue (100%). Cramer's V above .60 indicates a strong association between applying PR61 to PR64 and this issue shown in Table 73.

6.4 CMM/CMMI and projects success factors (performance outcomes)

H4.1: There is a relationship between adopting industrial standards and the offshored projects success factors (performance outcomes).

H4.2: There is a relationship between maturity levels achieved and the offshored projects' success factors (performance outcomes).

H4.3: There is a relationship between performing industry standards practices and the offshored projects' success factors (performance outcomes).

6.4.1 Adopting CMM/CMMI models and project success factors

Table 74 shows a summary of the status of hypothesis 4.1 investigating the relationship between adopting each of CMM/CMMI and the IT offshored project's success factors.

H4.1: There is a relationship between adopting industrial standards and the offshored projects success factors (performance outcomes).

Table 73: Results of Adopting CMM/CMMI Models and Project's Success Factors

Hypothesis 4.1		*Status Significantly Associated	Strength of Association
There is a relationship between adopting CMMI-DEV/SVC industrial standards and the			
H4.1.1	Offshored projects' outcomes of Time/Schedule.	Yes	0.721
H4.1.2	Offshored projects' outcomes of Cost/Budget.	Yes	0.714
H4.1.3	Offshored projects' outcomes of Expected Quality.	Yes	0.665
There is a relationship between adopting CMMI-ACQ industrial standards and the			
H4.1.4	Offshored projects' outcomes of Time/Schedule.	Yes	0.699
H4.1.5	Offshored projects' outcomes of Cost/Budget.	Yes	0.706
H4.1.6	Offshored project's outcomes of Expected Quality.	Yes	0.671
There is a relationship between adopting People-CMM industrial standards and the			
H4.1.7	Offshored projects' outcomes of Time/Schedule.	Yes	0.361
H4.1.8	Offshored projects' outcomes of Cost/Budget.	Yes	0.351
H4.1.9	Offshored projects' outcomes of Expected Quality.	Yes	0.377
There is a relationship between adopting TSP industrial standards and the			
H4.1.10	Offshored projects' performance outcomes of Time/Schedule.	Yes	0.394
H4.1.11	Offshored projects' performance outcomes of Cost/Budget.	Yes	0.373
H4.1.12	Offshored projects' performance outcomes of Expected Quality.	Yes	0.432
*P=0.05/12 =0041666 (Bonferroni's Adjustment)			

The analysis showed a significant relationship between adopting each of the four CMM/CMMI models under investigation (DEV/SVC, CMMI for ACQ, People-CMM and TSP) and the projects' success factors: (1) Time/Schedule, (2) Budget and (3) Expected Quality (100%).

Cramer's V above 0.60 indicates a strong association between applying CMMI-DEV/SVC and CMMI-ACQ and the projects' success factors: (1) Time/Schedule, (2) Budget, (3) Expected Quality. Cramer's V above 0.40 states that a relatively strong association between People-CMM and TSP with projects' success factors.

The investigation indicated that IT offshoring companies that adopted any of the CMM/CMMI models (CMMI for DEV/SVC, CMMI for ACQ, People-CMM and TSP) reported better results on their offshored projects on three factors: (1) Time/Schedule, (2) Cost/Budget and (3) Expected Quality.

This is consistent with the literature, that CMM/CMMI models instruct companies to establish and maintain supplier assessment rules/policies/standards and determining the type of acquisition, selecting suppliers and establishing supplier agreements (Chrissis et al., 2006, Vivatanavorasin et al., 2006). These models have been used by software organizations around the world as templates for: improving productivity, quality, reducing costs, time to market and increasing customer satisfaction (Curtis et al., 2010).

Issues associated with offshoring require the client company to be precise in terms of their requirements. Therefore, offshore suppliers often rely heavily on Capability Maturity Model (CMM) or Capability Maturity Model Integrated (CMMI) processes to ensure that business requirements are properly documented (Adler et al., 2005, Rottman and Lacity, 2008). Based on more than 400 projects from 19 information sources, it was confirmed that investment in CMM/CMMI programs leads to improved software development and maintenance (Harter et al., 2000).

6.4.2 CMM/CMMI maturity level achieved and project success factors

Table 75 shows a summary of the status of hypothesis 4.2 investigating the relationship between CMM/CMMI maturity level achieved and the project success factors of (1) Time/Schedule, (2) Cost/Budget and (3) Expected Quality.

H4.2: There is a relationship between maturity levels achieved and the offshored projects' success factors (performance outcomes).

Table 74: Results of CMM/CMMI Maturity Level Achieved and Project Success Factors

Hypothesis 4.2		Status Significantly Associated	Strength of association
There is a relationship between CMMI- DEV/SVC maturity level achieved and			
H4.2.1	Offshored project's performance outcomes of Time/Schedule.	Yes	0.647
H4.2.2	Offshored projects 'performance outcomes of Cost/Budget.	Yes	0.695
H4.2.3	Offshored projects 'performance of Expected Quality.	Yes	0.647
There is a relationship between CMMI-ACQ maturity level achieved and			
H4.2.4	Offshored project's performance outcomes of Time/Schedule.	Yes	0.689
H4.2.5	Offshored project's performance outcomes of Cost/Budget.	Yes	0.613
H4.2.6	Offshored project's performance outcomes of Expected Quality.	Yes	0.665
There is a relationship between People-CMM maturity level achieved and			
H4.2.7	Offshored project's performance outcomes of Time/Schedule.	*No	0
H4.2.8	Offshored project's performance outcomes of Cost/Budget.	*No	0
H4.2.9	Offshored project's performance outcomes of Expected Quality.	*No	0
*Results may change with more data collected (small sample n=36) * P=0.05/9 =0.0055555 (Bonferroni's Adjustment)			

The analysis showed a significant relationship between CMMI for DEV/SVC and CMMI for ACQ maturity level achieved and the projects' success factors: (1) Time/Schedule, (2) Cost/Budget and (3) Expected Quality (100%).

Cramer's V above 0.60 indicates a strong association between CMMI-DEV/SVC and CMMI-ACQ maturity models and the projects' success factors: (1) Time/Schedule, (2) Cost/Budget and (3) Expected Quality as shown in Table 75.

The analysis showed that companies that achieved higher maturity levels of 3 and above reported better results on their offshored projects in terms of (1) Time/Schedule, (2) Cost/Budget and (3) Expected Quality. This is consistent with literature that showed experience with CMM and CMMI demonstrates that outsourcing organizations appraised to higher levels of CMM or CMMI improved their ability to deliver projects on the agreed upon schedule, cost and quality. Increasingly, the industry requires suppliers to be appraised to CMM or CMMI level 3 or higher (Lutteroth et al., 2007).

However, the analysis did not show a significant relationship between People-CMM maturity level and project success factors. This might be due to the small sample size of n= 36. The results might be different with more data collected.

6.4.3 CMM/CMMI practices and project success factors

Table 76 shows a summary of the status of hypothesis 4.3 investigating the relationship between performing CMM/CMMI industry standards practices and the project success factors of (1) Time/Schedule, (2) Cost/Budget and (3) Expected Quality.

Table 75: Results of CMM//CMMI Practices and Project's Success Factors

Hypothesis	CMM/CMMI Practices	Time/ Schedule	Cost/ Budget	Expected Quality
		*Status Significantly Associated / Cramer's V		
H4.3.1	PR1: Establishes and maintains a project plan as the basis for managing the project	Yes/ 0.599	Yes / 0.566	Yes / 0.666
H4.3.2	PR2: Establishes and maintains the overall project plan.	Yes/ 0.670	Yes/.634	Yes0.754
H4.3.3	PR3: Estimates the project's cost for work products and tasks based on estimation rationale	Yes/ 0.634	Yes/ 0.600	Yes/ 0.709
H4.3.4	PR4: Establishes and maintains the project's budget and schedule, milestones, dependencies	Yes/ 0.581	Yes/ 0.550	Yes/ 0.644
H4.3.5	PR5: Monitors offshoring supplier project progress and performance as defined in contract	Yes/ 0.689	Yes/ 0.652	Yes/ 0.669
H4.3.6	PR6: Manages invoices submitted by the supplier	Yes/ .634	Yes/ 0.600	Yes/ 0.600
H4.3.7	PR7: Develops an understanding with offshoring supplier on the meaning of requirement	Yes/ 0.479	Yes/ 0.421	Yes/ 0.481
H4.3.8	PR8:Validates requirements to ensure that resulting product performs as intended in end user's environment	Yes/ 0.497	Yes/ 0.497	Yes/ 0.502
H4.3.9	PR9: Obtains commitment to requirements from project participants	Yes/ 0.421	No	Yes/ 0.432
H4.3.10	PR10: Stakeholder needs, expectations, constraints and are collected and translated into customer requirements	Yes/ 0.592	Yes/ 0.539	Yes/ 0.673
H4.3.11	PR11: Maintains bidirectional traceability among requirements and work products	Yes/ 0.585	Yes/ 0.534	Yes/ 0.584
H4.3.12	PR12: Manages changes to requirements as they evolve during the project.	Yes/ 0.607	Yes/ 0.555	Yes/ 0.590
H4.3.13	PR13: Ensures that project plans and work products remain aligned with requirements	Yes/ 0.671	Yes/ 0.568	Yes/ 0.564
H4.3.14	PR14: Customer Interface Manager leads the team in estimating and documenting the impact of every change in requirement and works with the Configuration Control Board (CCB) to get approval for changes to those requirements	Yes/ 0.694	Yes/ 0.591	Yes/ 0.657
H4.3.15	PR15: Establishes and manages the coordination and collaboration between the project and relevant stakeholders	Yes/ 0.634	Yes/ 0.600	Yes/ 0.709
H4.3.16	PR16: Team members track actual results and performance against plans on a weekly basis.	Yes/ 0.599	Yes/ 0.560	Yes/ 0.746
H4.3.17	PR17: Develops a documented plan to be used to communicate inter-group commitments and to coordinate and track the work performed.	Yes/ 0.616	Yes/ 0.579	Yes/ 0.754
H4.3.18	PR18: Managers are responsible for the coordination across all project teams	Yes/ 0.652	Yes/ 0.617	Yes /0.731
H4.3.19	PR19: Client company communication and coordination practices are institutionalized to ensure they are performed as managed processes	Yes/ 0.693	Yes/ 0.652	Yes/ 0.688

H4.3.20	PR20: Representatives of the client company project's software engineering group work with representatives of the supplier engineering groups to monitor and coordinate technical activities and resolve technical issues	Yes/ 0.485	No	Yes/ 0.464
H4.3.21	PR21: Selects team roles, including the role of Supplier Interface Manager, who is the liaison between the team and the supplier company representative, and is responsible for requirements change management	Yes/ 0.475	No	Yes/ 0.405
H4.3.22	PR22: Communicates quality issues and ensures the resolution of noncompliance issues with the staff and managers	Yes/ 0.505	Yes/ 0. 413	Yes/ 0.543
H4.3.23	PR23: Establishes and maintains a documented policy for conducting its Communication and Coordination activities	Yes/ 0.452	No	Yes/ 0.438
H4.3.24	PR24: Ensures that workforce has skills to share information and their activities efficiently	Yes/ 0.421	No	Yes/ 0.405
H4.3.25	PR25: Establishes a culture for openly sharing information and concerns across organizational levels as well as among team members	Yes/ 0.452	No	Yes/ 0.491
H4.3.26	PR26: Establishes project teams as well as their responsibilities, authorities and interrelationships	Yes/ 0.398	No	Yes/ 0.491
H4.3.27	PR27: Establishes and maintains open and effective project teams' communication and coordination plan	Yes/ 0.414	No	Yes/ 0.455
H4.3.28	PR28: Managers are responsible to track and resolve inter-group issues.	Yes/ 0.436	No	No
H4.3.29	PR29: Maintains effective work-groups, interpersonal problems are addressed quickly to ensure that work-group time is used most effectively.	Yes/ 0.463	Yes/ 0.418	Yes/ 0.454
H4.3.30	PR30: Establishes and maintains a mutual understanding of contract with selected suppliers and based on acquisition needs.	Yes/ 0.620	Yes/ 0.569	Yes/ 0.623
H4.3.31	PR31: Requirements are refined and elaborated into contractual requirements.	Yes/ 0.536	Yes/ 0.587	Yes/ 0.594
H4.3.32	PR32: Establishes and maintains a formal contract management plan.	Yes/ 0.551	Yes/ 0.551	Yes/ 0.554
H4.3.33	PR33: Establishes and maintains contractual requirements.	Yes/ 0.551	Yes/ 0.500	Yes/ 0.504
H4.3.34	PR34: Establishes and maintains negotiation plans to use in completing a supplier agreement.	Yes/ 0.421	No	Yes/ 0.432
H4.3.35	PR35: Insures that agreements with suppliers are satisfied by both the project and the supplier.	Yes/ 0.569	Yes/ 0.514	Yes/ 0.529
H4.3.36	PR36: Selects suppliers based on an evaluation of their ability to meet specified requirements and criteria	Yes/ 0.551	No	Yes/ 0.554
H4.3.37	PR37: Identifies and qualifies potential suppliers	Yes/0.554	Yes/ 0.503	Yes/ 0.565
H4.3.38	PR38: Selects suppliers using a formal evaluation	Yes/ 0.611	Yes/ 0.559	Yes/ 0.580
H4.3.39	PR39: Establishes and maintains quantitative objectives to address quality and process performance, based on customer needs and business objectives.	Yes/ 0.458	Yes/ 0.458	Yes/ 0.522
H4.3.40	PR40: Manages the project using statistical quantitative techniques to determine whether the project's objectives for quality performance will be satisfied.	Yes/ 0.477	No	Yes/ 0.487

H4.3.41	PR41: Performs root cause analysis of selected issues to address deficiencies in achieving the project's quality and process performance objectives.	Yes/ 0.497	Yes/ 0.401	Yes/ 0.502
H4.3.42	PR42: Manages corrective actions to closure when project's performance deviate significantly from plan	Yes/ 0.469	Yes/ 0.407	Yes/ 0.459
H4.3.43	PR43: Periodically reviews the project's progress, performance and issues experienced.	Yes/ 0.435	Yes/ 0.365	Yes/ 0.483
H4.3.44	PR44: Reviews the project's accomplishments and results at selected project milestones.	Yes/ 0.452	No	Yes/ 0.439
H4.3.45	PR45: Establishes and maintains records of quality assurance activities.	Yes/ 0.537	Yes/ 0.479	Yes/ 0.538
H4.3.46	PR46: Monitors the actual project performance and progress against the project plan	Yes/ 0.418	No	No
H4.3.47	PR47: Ensures that the supplier agreement is satisfied before accepting the acquired product	Yes/ 0.426	Yes/ 0.371	Yes/ 0.419
H4.3.48	PR48: Selects supplier technical solutions to be analyzed and analysis methods to be used.	Yes/ 0.652	Yes/ 0.617	Yes/ 0.677
H4.3.49	PR49: Conducts technical reviews with the supplier as defined in the supplier agreement.	Yes/ 0.708	Yes/ 0.670	Yes/ 0.746
H4.3.50	PR50: Evaluates and categorizes each identified issue using defined risk categories and parameters and determines its relative priority.	Yes/ 0.747	Yes/ 0.707	Yes/ 0.741
H4.3.51	PR51: Establishes and maintains a usable set of organizational process assets, work environment standards, rules and guidelines for teams	Yes/ 0.552	Yes/ 0.500	Yes/ 0.545
H4.3.52	PR52: Establishes and maintains the offshoring strategy	Yes/ 0.516	Yes/0.473	Yes/ 0.506
H4.3.53	PR53: Establishes and maintains the plan for performing the offshoring	Yes/ 0.570	Yes/ 0.473	Yes/ 0.506
H4.3.54	PR54: Determines the type of acquisition for each product or product component to be offshored	Yes/ 0.496	Yes/ 0.501	Yes/ 0.546
H4.3.55	PR55: Plan transition to operations specifically timing and type of work transferred to the supplier	Yes/ 0.568	Yes/ 0.412	Yes/ 0.561
H4.3.56	PR56: Evaluates supplier technical solutions to confirm that contractual requirements continue to be met	Yes/ 0.554	Yes/ 0.452	Yes/ 0.565
H4.3.57	PR57: Selects, monitors and analyzes supplier processes	Yes/0.611	Yes/0.559	Yes/0.580
* P=0.05/171 (57*3) =0.0002923 (Bonferroni's Adjustment)				

After applying the Bonferroni correction p=0.0002923, the analysis showed a significant relationship between performing CMM/CMMI industry standards practices (100% of the practices were significantly associated) and the project success factor of Time/Schedule. The majority of the relationships between CMM/CMMI practices and

Time/Schedule indicated either strong association with Cramer's V above 0.60 or relatively strong association with Cramer's V above 0.40.

The analysis indicated a significantly associated relationship between performing CMM/CMMI industry standard practices (77% of the practices) and the project success factor of Cost/Budget with the Bonferroni correction p=0.0002923. The majority of the relationships between CMM/CMMI practices and Cost/Budget indicated either a strong association with Cramer's V above 0.60 or a relatively strong association with Cramer's V above 0.40.

Moreover, the analysis showed a significantly associated relationship between performing CMM/CMMI industry standard practices (97% of the practices) and the project success factor of Expected Quality with applying the Bonferroni correction p=0.0002923. The majority of the relationships between CMM/CMMI practices and Expected Quality indicated either a strong association with Cramer's V above 0.60 or a relatively strong association with Cramer's V above 0.40.

This is consistent with the literature, that CMM/CMMI practices have been used by software organizations around the world as templates for: improving productivity, improving quality, reducing costs, improving time to market and increasing customer satisfaction (Chrissis et al., 2006, Vivatanavorasin et al., 2006). Research studies have consistently shown results regarding improved productivity, increased quality and reductions in cycle time (Herbsleb and Grinter, 1999, Harter et al., 2000, Curtis et al., 2001, Curtis et al., 2010).

Chapter 7: Conclusions, Contributions, Limitations and Future Research

This chapter provides an interpretation of the research results and discussions found in chapters 5 and 6. It is divided into conclusions, contributions, limitations and future research.

7.1 Conclusions

IT service and software development offshoring is becoming a dominant paradigm in the IT service and software development industry (Rottman and Lacity, 2008, Raffo and Setamanit, 2005). The literature indicates that 20% of offshoring software development contracts are cancelled in the first year, more than 25% of all offshored software development projects are cancelled outright before completion and 80% of offshoring IT projects overrun their budgets (Kendall et al., 2007).

IT services and software development offshoring projects pose significant issues and challenges to the client companies in managing these projects (Ebert et al., 2008). In IT service offshoring, delivery occurs under the additional conditions of distance between the service supplier and the client in terms of physical distance, language barriers, time zone differences or cultural differences, security and political issues of supplier. Additionally, the complexity of the IT offshoring projects increase due to the higher degree of geographical dispersion among team members (Holmström et al., 2008, Yalaho and Nahar, 2009, McIvor, 2000, Raffo and Setamanit, 2005). Therefore, there is a need to utilize different methods to effectively and efficiently mitigate the issues and challenges of offshore outsourcing.

A growing number of organizations are using the Software Engineering Institutes' (ESI) Capability Maturity Model (CMM) and Capability Maturity Model Integrate (CMMI) to improve their IT service and software development process. The CMM/CMMI standards are adopted internationally and have received great publicity in the software development industry (Biberoglu and Haddad, 2002). There is limited research and investigation of CMM/CMMI best practices and how they mitigate the issues and challenges of *offshoring* of IT services and software development projects (Sengupta et al., 2006b, Lasser and Heiss, 2005, Prikladnicki et al., 2007, Ebert, 2007, Ebert et al., 2008, Gopal et al., 2002b). This empirical study examined the relationship between CMM/CMMI software process development and 1) the issues and challenges of offshoring IT services projects and 2) offshoring IT services project performance outcomes of (1) Time/Schedule, (2) Cost/Budget and (3) Expected Quality.

7.1.1 Conclusion of adopting CMM/CMMI models and IT offshoring issues

Table 77 shows a summary of the status of hypothesis 1 that investigated the relationship between adopting CMM/CMMI models and the frequency of IT offshoring issues.

Table 76: Summary of Results of Four CMM/CMMI Models and IT Offshoring Issues

Hypothesis 1	*Status /Cramer's V			
Issues	H1.1 Adopting CMMI for DEV/SVC Significantly Associated	H1.2 Adopting CMMI for ACQ Significantly Associated	H1.3 Adopting People-CMM Significantly Associated	H1.4 Adopting TSP – CMM Significantly Associated
Over expenditure due to hidden costs	Yes/.610	Yes/.769	No	No
Poor execution plan	Yes/.707	Yes/.609	Yes/.307	No
Difference in interpretation of project requirements	Yes/.659	Yes/.542	Yes/.427	Yes/.384
Poorly developed and documented requirements	Yes/.685	Yes/.532	Yes/.382	Yes/.304
Poor tracking and managing requirement changes	Yes/.681	Yes/.566	Yes/.342	Yes/.324
Lack of a full communication plan	Yes/.641	Yes/.545	Yes/.499	Yes/.464
Communication and coordination problems	Yes/.703	Yes/.613	Yes/.453	Yes/.424
Language barriers	No	No	Yes/.387	Yes/.517
Time-zone differences	No	No	No	No
Cultural differences	No	No	Yes/.413	Yes/.492
Incomplete and unclear contract	Yes/.617	Yes/.498	Yes/.335	Yes/ .320
Early contract renegotiation and termination	Yes/.589	Yes/.642	No	No
Difference in project management practices	Yes/.639	Yes/.474	No	No
Unable to measure performance of supplier	Yes/.672	Yes/.584	No	No
Supplier technical/security and political issues	No	No	No	No
Insufficient previous experience of supplier	Yes/.645	Yes/.624	Yes/.314	Yes/.310
Lack of supplier standardized working methods	Yes/.626	Yes/.645	Yes/.296	No
*P=0.05/68 (17*4) = 0.0007352 (Bonferroni's Adjustment)				

The analysis of hypothesis 1 showed a statistically associated relationship between adopting CMMI for DEV/SVC and CMMI for ACQ models and IT offshoring issues (77%).

However, the results did not show a significant relationship with 25% of the IT offshoring issues of Language Barriers, Time-zone Differences, Cultural Differences and Supplier Political and Security issues.

Therefore, this may suggest, consistent with the literature, that IT services and software development offshoring projects pose significant issues and challenges to the client companies in managing these projects (Ebert et al., 2008). In IT service offshoring, delivery occurs under the additional condition of distance between the service supplier and the client in terms of physical distance, time zone differences or cultural differences. Additionally, complexity increases due to the higher degree of geographical dispersion among team members (Holmström et al., 2008, Yalaho and Nahar, 2009, McIvor, 2000, Raffo and Setamanit, 2005). Therefore, there is a need to utilize different methods to effectively and efficiently mitigate the issues and challenges of offshoring.

By contrast, Hypotheses 1.3 and 1.4 analyses showed surprising results. There was a statistically association relationship between adopting People-CMM and TSP and language barriers and cultural differences between the client company and the supplier company as in Table 77. Whereas, these two issues did not show a significance when adopting CMMI for DEV/SVC and CMMI for ACQ that are mostly adopted by IT offshoring companies as shown in Table 77. This may suggest that there is a need to utilize and incorporate different practices from TSP and People along with CMMI for DEV/SVC and CMMI for ACQ to effectively and efficiently mitigate the issues of Language Barriers and Cultural Differences.

Companies that adopted CMM/CMMI models did not manage the issues of (1) Time-zone differences between the client company and the supplier company issue and (2) Supplier Technical/Security and Political issues. This may suggest that a different set of practices and methods are required in the CMM/CMMI models to mitigate these issues as shown in Table 77.

Finding 1: US IT companies applying CMM/CMMI models have fewer issues associated with IT offshoring.

Finding 2: When US IT companies utilize and incorporate different practices from TSP and People-CMM into CMMI-DEV/SVC and CMMI-ACQ, they have fewer offshoring issues related to language barriers and cultural differences.

Finding 3: US IT companies applying CMM/CMMI models did not mitigate the offshoring issues of: 1) Time-zone difference between the client company and the supplier company and 2) Supplier Security and Political Issues.

7.1.2 Conclusion of CMM/CMMI maturity level achieved and IT offshoring issues

Table 77: Summary of Results of H2 Maturity Level Achieved and IT offshoring issues

Hypothesis 2 **There is a relationship between CMMI maturity level achieved and the**		CMMI-DEV /SVC ML Achieved *Status Significantly Associated	CMMI-ACQ ML Achieved *Status Significantly Associated
H2.1.1	Over expenditure issue.	Yes	Yes
H2.1.2	Poor execution plan.	Yes	Yes
H2.1.3	Difference in interpretation of project requirements.	Yes	Yes
H2.1.4	Poorly developed and documented requirements.	Yes	Yes
H2.1.5	Poor tracking and managing requirement changes.	Yes	Yes
H2.1.6	Lack of a full communication plan.	Yes	Yes
H2.1.7	Communication and coordination problems.	Yes	Yes
H2.1.8	Language barriers.	No	No
H2.1.9	Time-zone differences.	No	No
H2.1.10	Cultural differences.	No	No
H2.1.11	Incomplete and unclear contract issue.	Yes	Yes
H2.1.12	Contract renegotiation and termination issue.	Yes	Yes
H2.1.13	Difference in project management practices.	Yes	Yes
H2.1.14	Unable to measure the performance of the supplier.	Yes	Yes
H2.1.15	Supplier technical/security and political issues.	No	No
H2.1.16	Insufficient previous experience of the supplier issue.	Yes	Yes
H2.1.17	Lack of supplier standardized working methods.	Yes	Yes
*P=.05/51 (17*3) = 0.000980392 (Bonferroni's Adjustment)			

The analysis of hypothesis 2 showed a statistical significance between adopting CMMI for DEV/SVC and CMMI for ACQ maturity levels achieved and IT offshoring issues (77%) as shown in Table 77.

Therefore, this may suggest, consistent with IT outsourcing literature, that IT services and software development offshoring projects pose substantial issues and challenges to the client companies in managing these projects (Ebert et al., 2008). Experience with CMM and CMMI demonstrates that outsourcing organizations appraised to higher levels of CMM or CMMI improve the ability to deliver projects on the agreed upon schedule, cost, and quality. Increasingly, the industry requires suppliers to be appraised to CMM or CMMI level 3 or higher (Lutteroth et al., 2007).

Finding 4: US IT companies achieving higher maturity levels of CMMI have fewer issues associated with IT offshoring compared with lower maturity levels.

7.1.3 Conclusion of performing CMM/CMMI practices and IT offshoring issues

The investigation showed that the more frequently the IT offshoring company routinely performed the CMM/CMMI industry standard practices they reported fewer issue with IT offshoring issues. The analysis showed a significant relationship between CMM/CMMI industry standards practices and the IT offshoring issues (92%) as shown in Table 73.

Finding 5: US IT companies routinely performing industry practices have fewer issues associated with IT offshoring.

7.1.4 CMM/CMMI and projects success factors (project performance outcomes)

1 - Adopting CMM/CMMI models and project success factors

The analysis showed a significantly associated relationship between adopting each of the four CMM/CMMI models under investigation (DEV/SVC, CMMI for ACQ, People-CMM and TSP) and the projects' success factors: (1) Time/Schedule, (2) Budget and (3) Expected Quality (100%) as shown in Table 74.

2 - CMM/CMMI maturity level achieved and project success factors

The analysis showed a significant relationship between CMMI for DEV/SVC and CMMI for ACQ maturity level achieved and the projects' success factors: (1) Time/Schedule, (2) Cost/Budget and (3) Expected Quality (100%) as shown in Table 75.

3 - Performing CMM/CMMI practices and project success factors

The analysis showed a significantly associated relationship between performing CMM/CMMI industry standards practices (100% of the practices were significantly associated) and the project success factor of Time/Schedule. The analysis also indicated a significantly associated relationship between performing CMM/CMMI industry standard practices (77% of the practices) and the project success factor of Cost/Budget. Moreover, the analysis showed a significantly associated relationship between performing CMM/CMMI industry standard practices (97% of the practices) and the project success factor of Expected Quality as shown in Table 76.

This is consistent with the literature, that CMM/CMMI practices have been used by software organizations around the world as templates for improving productivity, quality, reduce costs, time to market and increasing customer satisfaction (Chrissis et al., 2006, Vivatanavorasin et al., 2006). Research studies have consistently shown results regarding improved productivity, increased quality and reductions in cycle time (Herbsleb and Grinter, 1999, Harter et al., 2000, Curtis et al., 2001, Curtis et al., 2010).

Finding 6: US IT companies applying CMM/CMMI models and routinely performing their industry practices have better project outcomes regarding (1) Time/Schedule, (2) Cost/Budget and (3) Expected Quality.

Hypothetical Scenarios

To explain the statistical results presented in chapters 5 and 6, eight possible hypothetical scenarios are developed based on the company background and the targeted goal. Adopting CMM/CMMI models and performing multiple CMM/CMMI practices may help in mitigating the IT offshoring issues.

Table 78 presents eight hypothetical cases. Each scenario provides the offshoring type (offshore outsourcing or offshore insourcing) and the practices and maturity level for each practice that a specific type of company might want to use in order to attain its targeted results.

For example, a US IT client company may have management problems with a goal of mitigating the issues of inability to measure supplier performance. These companies, regardless of their size and offshoring strategy, routinely perform the following practices and achieve the maturity levels in order to attain their goals:

1. Establish and maintain quantitative objectives to address quality and process performance based on customer needs and business objectives (CMMI-DEV/SVC, CMMI-ACQ- Maturity Level 4).

2. Manage the project using statistical and other quantitative techniques to determine whether or not the project's objectives for quality and process performance will be satisfied (CMMI-DEV/SVC, CMMI-ACQ-Maturity Level 4).
3. Performs root cause analysis of selected issues to address deficiencies in achieving the project's quality and process performance objectives (CMMI-DEV/SVC, CMMI-ACQ- Maturity Level 4).
4. Manage corrective actions to closure when the project's performance or results deviate significantly from the plan (CMMI-DEV/SVC, CMMI-ACQ-Maturity Level 2).
5. Periodically review the project's progress, performance and issues experienced (CMMI-DEV/SVC, CMMI-ACQ-Maturity Level 2). .
6. Review the project's accomplishments and results at selected project milestones (CMMI-DEV/SVC, CMMI-ACQ-Maturity Level 2).
7. Establish and maintain records of quality assurance activities (CMMI-DEV/SVC, CMMI-ACQ-Maturity Level 2).
8. Monitor the actual project performance and progress against the project plan (CMMI-DEV/SVC, CMMI-ACQ-Maturity Level 2).
9. Ensure that the supplier agreement is satisfied before accepting the acquired product (CMMI-DEV/SVC, CMMI-ACQ-Maturity Level 2).

These companies can either adopt CMMI-DEV/SVC or CMMI-ACQ and will achieve their goal of mitigating the issue of inability to measure supplier performance when they achieve maturity level 2. However, companies will not perform the first three practices until they achieve maturity level 4. Thus, companies will realize better results when achieving maturity level 4.

In the case of US IT offshoring companies with Cultural and/or Language problems, regardless of their size or type of offshoring, these client companies need to apply People-CMM and/or TSP for mitigation and perform the following practices:

- Ensuring that the workforce has the skills to share information and coordinate their activities efficiently (P-CMMI – Maturity Level 2)
- Establish a culture for openly sharing information and concerns across organizational levels as well as among team members (P-CMM – Maturity Level 3)
- Establish and maintains open and effective project teams' communication and coordination plan (P-CMM – Maturity Level 2)
- Maintain effective work groups, ensure that interpersonal problems are addressed quickly and meetings are managed to ensure that work group time is used most effectively (P-CMM – Maturity Level 2)
- Establish project teams as well as their responsibilities, authorities and interrelationships (TSP)
- Team's managers are responsible to track and resolve intergroup issues (TSP)

This is the major contribution of this study. Based on the results obtained from the statistical analyses, the decision maker can identify the CMM/CMMI models and practices which will most likely contribute to his/her company's goals.

Table 78: Hypothetical Scenarios

Company	Goal	Industrial CMM/CMMI Best Practices and maturity level
1: US IT offshoring client companies that want to mitigate management problems when offshoring	Mitigate over expenditure due to hidden costs incurred by the client company	• A project plan is established and maintained as the basis for managing the project (CMMI ACQ, CMMI DEV, CMMI SVC, ML2). • Establish and maintain the overall project plan. (CMMI DEV, CMMI SVC, ML2). • Estimate the project's effort and cost for work products and tasks based on estimation rationale (CMMI ACQ, CMMI DEV, CMMI SVC, ML2). • Establish and maintain the project's budget and schedule, milestones, constraints, dependencies (CMMI ACQ, CMMI DEV, CMMI SVC, ML2) • Monitor supplier project progress and performance (effort, and cost) as defined in the contract (CMMI ACQ, CMMI DEV, CMMI SVC, ML2) • Manage invoices submitted by the supplier (CMMI ACQ, ML2).
	Mitigating the poor execution plans: timing and type of work transferred to the supplier	• Establish and maintain the acquisition strategy (CMMI ACQ, ML2) • Establish and maintain the plan for performing the process (CMMI DEV, CMMI SVC, CMMI ACQ, ML2). • Determine the type of acquisition for each product or product component to be acquired (CMMI DEV, CMMI SVC, ML2) • Plan transition to operations and support (CMMI DEV, CMMI SVC, ML2). • Monitor transition to operations and support (CMMI ACQ, CMMI DEV, CMMI SVC, and ML2).
	Mitigating the inability to measure supplier performance	• Establish and maintain quantitative objectives to address quality and process performance, based on customer needs and business objectives (CMMI ACQ, CMMI DEV, CMMI SVC, and ML4). • Manage the project using statistical and other quantitative techniques to determine whether or not the project's objectives for quality and process performance will be satisfied (CMMI ACQ, CMMI DEV, CMMI SVC, ML4). • Perform root cause analysis of selected issues to address deficiencies in achieving the project's quality and process performance objectives (CMMI ACQ, CMMI DEV, CMMI SVC, ML4). • Corrective actions are managed to closure when the project's performance or results deviate significantly from the plan (CMMI ACQ, CMMI DEV, CMMI SVC, ML2) • Periodically review the project's progress, performance and issues (CMMI ACQ, CMMI DEV, CMMI SVC, ML2). • Review the project's accomplishments and results at selected project milestones (CMMI ACQ, CMMI DEV, CMMI SVC, ML2). • Establish and maintain records of quality assurance activities (CMMI ACQ, CMMI DEV, CMMI SVC, ML2). • Actual project performance and progress are monitored against the project plan (CMMI ACQ, CMMI DEV, CMMI SVC, ML2).

		• Ensure that the supplier agreement is satisfied before accepting the acquired product (CMMI ACQ, ML2).
2. US IT offshoring client companies with requirements management problems	Mitigating the differences in interpretation of project requirements between client and supplier	• Develop an understanding between client and supplier on the meaning of requirements (CMMI DEV, CMMI SVC, CMMI ACQ, ML2) (TSP-CMM) • Validate requirements to ensure that the resulting product performs as intended in the end user's environment (CMMI ACQ, ML2). • Obtain commitment to requirements from project participants (CMMI DEV, CMMI SVC, CMMI ACQ, ML2), (TSP-CMM).
	Managing the of poorly developed and documented requirements	• Stakeholder needs, expectations, constraints, and interfaces are collected and translated into customer requirements (CMMI ACQ, ML2). • Maintain bidirectional traceability among requirements and work products (CMMI DEV, CMMI SVC, CMMI ACQ, ML2).
	Mitigating the poor tracking and managing requirement changes	• Manage changes to requirements as they evolve during the project (CMMI DEV, CMMI SVC, CMMI ACQ, ML2). • Ensure that project plans and work products remain aligned with requirements (CMMI DEV, CMMI SVC, CMMI ACQ, ML2). • The Customer Interface Manager leads the team in estimating and documenting the impact of every requirements change and works with the Configuration Control Board (CCB) to get approval for changes to requirements (TSP-CMM).
3. US IT Offshoring client companies with communication problems	Managing the lack of a full communication plan between client and supplier	• Establish and manage coordination and collaboration between the project and relevant stakeholders (CMMI DEV, CMMI SVC, CMMI ACQ, ML3). • Team members track actual results and performance against plans on a weekly basis. Team members track progress against individual plans on a daily basis (TSP-CMM). • A documented plan is used to communicate intergroup commitments and to coordinate and track the work performed (TSP-CMM). • Team's managers are responsible for coordination across all project teams (TSP-CMM). • Communication and Coordination practices are institutionalized to ensure they are performed as managed processes (P-CMM, ML2).
	Mitigating the communication and coordination problems between the client and the supplier	• Representatives of the client project's software engineering group work with representatives of the supplier engineering groups to monitor and coordinate technical activities and resolve technical issues (TSP-CMM) • Select team roles, including the role of Supplier Interface Manager, who is the liaison between the team and the supplier company representative and is responsible for requirements change management (TSP-CMM). • Communicate quality issues and ensure the resolution of noncompliance issues with the staff and managers (CMMI ACQ, CMMI DEV, CMMI SVC, ML2). • The organization establishes and maintains a documented policy for conducting its Communication and Coordination activities (P-CMM, ML2).

4. US IT offshoring client companies that are experiencing unique issues of offshoring	Mitigating the: 1) Language barriers 2) Cultural differences	• Ensure that the workforce has the skills to share information and efficiently coordinate their activities (P-CMM, ML2). • Establish a culture for openly sharing information and concerns across organizational levels and among team members (P-CMM, ML3) • Establish project teams and their responsibilities, authorities, and interrelationships (TSP-CMM). • Establish and maintain open and effective project teams' communication and coordination plan (P-CMM, ML2). • Team's managers are responsible to track and resolve intergroup issues (TSP-CMM). • To maintain effective workgroups, interpersonal problems are addressed quickly and meetings are managed to ensure that workgroup time is used most effectively (P-CMM, ML2).
5. US IT offshoring client company experiencing time-zone differences with their supplier	Mitigate Time-zone differences between the client and the supplier	Further investigation is needed for different sets of practices and methods to manage and mitigate offshoring issues of Time-zone difference between the client company and the supplier company.
6. US IT offshoring client companies experiencing contract problems	Mitigate the contracts that are unclear or incomplete	• Establish and maintain a mutual understanding of the contract with selected suppliers and end users based on acquisition needs and the suppliers' proposed approaches (CMMI ACQ, ML2). • Stakeholder needs, expectations, constraints, and interfaces are collected and translated into customer requirements (CMMI ACQ, ML2). • Customer requirements are refined and elaborated into contractual requirements (CMMI ACQ, ML2). • Establish and maintain a formal contract management plan (CMMI ACQ, ML2) • Establish and maintain contractual requirements that are based on client company requirements (CMMI ACQ, ML2)
	Mitigating the contract renegotiation and termination	• Establish and maintain negotiation plans to use in completing a supplier agreement (CMMI ACQ, ML2). • Agreements with suppliers are satisfied by both the project and the supplier (CMMI DEV, CMMI SVC, ML2)
7. US IT offshoring client companies that are experiencing problems with the supplier	Alleviating the differences in project management style and/or practices between the client and the supplier	• Select suppliers based on an evaluation of their ability to meet specified requirements and established criteria (CMMI ACQ, ML2). • Select, monitor, and analyze supplier processes (CMMI ACQ, ML2). • Identify and qualify potential suppliers (CMMI ACQ, ML2). • Suppliers are selected using a formal evaluation (CMMI ACQ, ML2). • Establish and maintain a usable set of organizational process assets, work environment standards, and rules and guidelines for teams (CMMI DEV, CMMI SVC, CMMI ACQ, ML3).

	Managing the no previous experience of the supplier	• Select suppliers based on an evaluation of their ability to meet specified requirements and established criteria (CMMI ACQ, ML2). • Identify and qualify potential suppliers (CMMI ACQ, ML2). • Suppliers are selected using a formal evaluation (CMMI ACQ, ML2).
	Mitigating the lack of supplier standardized working methods	• Select, monitor, and analyze supplier processes, (CMMI ACQ, ML2). • Suppliers are selected using a formal evaluation (CMMI ACQ, ML2). • Select suppliers based on an evaluation of their ability to meet specified requirements and established criteria (CMMI ACQ, ML2). • Supplier technical solutions are evaluated to confirm that contractual requirements continue to be met (CMMI ACQ, ML3).
8. US IT offshoring client companies that experience security issues and technical problems	Mitigating the supplier security/ political issues	There are no practices targeting the security and political issues. Further investigation is needed for different sets of practices and methods needed to manage and mitigate the offshoring issues of: Supplier security and political issues.

7.2 Contributions

This research contributes to the existing body of knowledge on the offshoring of IT services from the client management perspective. This research is an exploratory investigation designed to gather and analyze data indicating whether disciplined development methods of CMM/CMMI can mitigate issues and challenges associated with IT service offshoring projects.

This research has important implications for practice and research. From the practitioner's standpoint, the results provide a benchmark to investigating CMM/CMMI best practices and their effect on managing and mitigating critical issues associated with offshore development.

From a research standpoint, this research fills the gap in investigating CMM/CMMI industrial standards and best practices to manage and mitigate the issues and challenges of IT offshoring projects from the client firm perspective.

This research investigated industrial standards and best practices to manage and mitigate issues and challenges throughout the whole lifecycle of executed offshore outsourcing projects in the IT services industry from a client firms' managerial perspective.

To the client company's decision makers, the results of this research could be a useful guide to improving their current state of offshoring their IT services and software development processes in order to improve project success and performance outcomes.

This dissertation also identified the most appropriate standards and practices used in offshoring of IT services projects. These practices can help develop a CMMI module specifically for IT offshoring. The dissertation also provides a classification of companies with respect to their IT offshoring issues. This classification may serve as a tool for decision makers who are seeking to identify the right practice to mitigate certain IT offshoring issues achieve better project's outcomes.

7.3 Limitations

There are a number of research limitations that need to be considered. These limitations fall within the categories of target population, methodology and research design.

7.3.1 Limitation of targeted population

There are five limitations in this study that are related to the target population. The first limitation in this category is that this study was restricted to the US IT offshoring services companies. Conducting this study in another country would help to make the results more generalizable. Studies such as (Aron et al., 2008, Beaumont and Sohal, 2004, Bernroider, 2002, Bhalla et al., 2008, Burmistrov, 2006, Christiansen, 2007, Yalaho and Wu, 2002) demonstrated that offshoring for IT services do not change significantly from one country to another.

The second limitation in this category is that it focused on client companies located in the US and did not get any data from offshoring supplier companies. CMM/CMMI models are now used worldwide (Rothenberger et al., 2010, Zubrow, Zubrow, 2003). The literature indicates that offshoring IT suppliers achieved higher maturity levels in CMM/CMMI models compared with US IT companies. In order to fully understand the IT offshoring, it is necessary to investigate IT offshoring and CMM/CMMI models from both the supplier company and client company managerial perspective.

The third limitation from the targeted population category is the case of selecting potential survey respondents. The survey was sent to managers in US IT companies that offshored their IT and software development projects. The survey was directed at US IT offshoring company managers and surveyed them about adopting CMM/CMMI models, CMM/CMMI maturity levels achieved, and their offshoring issues and if they were routinely performing CMM/CMMI practices. However, upper level managers may not have been part of implementing the CMM/CMMI models, their practices or managing the related projects in the first place. Therefore, they may not have an accurate assessment or perspective on the routine practices.

The fourth limitation in this category is regarding the IT offshoring issues, adoption of CMM/CMMI models, the maturity level achieved and routinely performed practices. Upper level managers may only have an approximate idea of the offshoring issues experienced and whether CMM/CMMI practices were routinely performed. This might be a question better posed to IT managers, project managers or software engineer managers who may have more accurate assessments. Results from middle management personnel were not possible due to a lack of direct contact information. Thus, the limitation of the survey was that contacts were limited to top or high level IT management in such companies.

The final limitation from the targeted population category is that the conclusions are based on the responses of the decision makers. Their responses are assumed to reflect what their companies are actually doing. Validation of the results by the experts helped to reduce the significance of this limitation.

7.3.2 Limitation of methodology

As described in Chapter 4: Data Collection, invitations to participate in a web-based survey were delivered through four follow-ups (including the original contact). The original contacts were made by sending emails using Qualtrics software with three subsequent follow-ups using direct emails. In this research, based on Dillman's Tailored Design Method, care was taken to create respondent trust, increase rewards and ensure that emails were not flagged as spam through the following techniques (Dillman, 2000, Dillman et al., 2009):

- *Rewards:* monetary incentives, align with professional groups, make questions interesting, offer summary of results.

- *Trust*: university sponsorship, follow-ups to make completion appear important.

- *Emails are not flagged as spam*: carefully select the Sender Name and Address and the Subject Line Text for email communication and appeal to respondents in the Subject Line Text, whereby responding they would be helping complete a PhD dissertation.

Researchers using survey research have indicated experience with low response rates for similar types of surveys (Tucker, 2011). Although this study obtained a slightly better response rate compared to other similar studies (Tucker, 2011), we believe data collection was limited because we did not have a way of knowing exactly how many emails actually got into the email inbox of the managers of the targeted IT companies. From the randomly selected sample, the first wave of invitations from Qualtrics software generated 236 email failures due to emails being no longer active, emails no longer available or invalid emails. An additional 2734 invitees (22%) were asked to be removed for the following reasons: they were federal government contractors and could not participate in any survey (1,265), they were IT and software engineer staffing companies (913), they were wholesalers/retailers for IT and software development (378), or they declined to take the survey and had asked to be removed from the mailing list without mentioning any reason (178). The limitation of the survey was the uncertainty whether survey invitees received the email or whether the invitation was flagged as spam. Knowing these outcome(s) could assist in assessing the response rate issue. It is a limitation of the method in that it is uncertain whether every single invitee did indeed receive the email or the email was flagged as spam. Knowing all of this information could assist in more accurately assessing response rate issue.

7.3.3 Limitation of research design

There are four limitations related to the research design.

The first limitation is that this research was limited by the set of relationships (correlations) that were tested. The tests included: applying CMM/CMMI models → IT offshoring issues, CMM/CMMI maturity level achieved → IT offshoring issues, routinely performing CMM.CMMI practices → IT offshoring issues, applying CMM/CMMI models → Offshored project's performance outcomes, CMM/CMMI maturity level achieved → Offshored project's performance outcomes, routinely performing CMM/CMMI practices → Offshored project's performance outcomes. Beyond these tests, testing other relationships using the same variables is possible and meaningful and these other relationships are described in section 7.4 Future Research. The set of relationships was restricted based on the structure of the research hypotheses and the interests of the investigators.

The second limitation related to research design was that only a limited number of CMM/CMMI models were tested: (1) CMMI for Development/Services, (2) CMM for Acquisition, (3) People-CMM and (4) TSP.

This research focused on companies that applied one of the four CMM/CMMI models and could not conduct additional analysis for companies that adopted multiple CMM/CMMI models because that would (1) reduce the robustness of the claims one could make on the current analyses and (2) deviates from a pure application of the scientific method. As mentioned before, testing other relationships using the same variables is possible and meaningful. These other relationships are described in section.

The third limitation related to research design was that this research was limited to CMM/CMMI quality standard models. Of the total responses received (n=451), 19% applied CMMI-DEV/SVC and 18% applied CMM-ACQ. 18% of the companies did not adopt any quality standard models. 10% of the companies adopted TSP and PMBOK, and

9% adopted ISO-9000-3. Other models applied (2%): Agile, Lean Agile, ITIL, ISO-9001-2008 and their own methods (internal systems, in-home methods, home-grown, home-made, home-grown standards) as illustrated in Figure 46. Besides this limitation, testing other relationships such as applying ISO-9003 model→ IT Offshoring issues, applying PMBOK→ IT Offshoring issues, ISO-9000→ IT Offshoring issues is possible and meaningful. These other relationships are described in section 7.4 Future Work. The set of relationships was restricted based on the structure of the research hypotheses and the interests of the investigators.

A fourth limitation is the resulting non-significance of People-CMM maturity level achieved→IT offshoring issues, People-CMM maturity level achieved→ offshored project's performance outcomes and sample size concerns. In the study, four CMM/CMMI models were selected and respondents were surveyed about these models. The results of analysis were surprising where People-CMM maturity level achieved were not found to be a significant part of the research model. A lack of significance was somewhat expected since the People-CMM is mainly adopted by human resource training departments. However, sample size is a limitation of this study. It may be possible that with a larger sample size, the People-CMM maturity level achieved may have a larger significance in the model.

7.4 Future research

Further research is recommended in multiple areas. First, it would be interesting to expand the testing relationships beyond CMM/CMMI quality standards models. As discussed in the limitations section 7.3 and as shown in Figure 46, respondents reported adopting other quality standards models such as ISO-9000 and ISO-9003 and PMBOK. Testing relationships between adopting these models and IT offshoring issues will be a good future research.

For future research, it will be interesting to test companies that adopted more than one CMM/CMMI model such as CMMI-DEV/SVC + CMMI-ACQ, CMMI-DEV/SVC→ IT Offshoring issues, TSP + CMMI-DEV/SVC + P-CMM→ IT Offshoring issues, CMMI-DEV/SVC + CMMI-ACQ + TSP + People-CMM→ IT Offshoring issues, CMMI-ACQ and TSP→ IT Offshoring issues. Examples of future research testing relationships are provided in Table 79.

Table 79: Future Research Relationship Tests

Testing relationships between adopting multiple CMM/CMMI models and IT offshoring issues
1. CMMI-DEV/SVC + CMMI-ACQ + P-CMM + TSP → IT Offshoring issues 2. CMMI-DEV/SVC + CMMI-ACQ → IT Offshoring issues 3. CMMI-DEV + P-CMMI → IT Offshoring issues 4. CMMI-DEV + TSP → IT Offshoring issues 5. CMMI-ACQ + CMMI-DEV/SVC → IT Offshoring issues 6. CMMI-ACQ + P-CMM → IT Offshoring issues 7. CMMI-ACQ + TSP → IT Offshoring issues 8. P-CMM + CMMI-DEV/SVC → IT Offshoring issues 9. P-CMM + CMMI-ACQ → IT Offshoring issues 10. P-CMM + TSP → IT Offshoring issues

In this research, statistical significance was used in hypotheses testing. For future research, it will be interesting to expand statistical significance methodology to practical significance and effect size (ES). Statistical significance focuses on whether a research result is due to chance or sampling variability while practical significance seeks to assess whether the result is useful in the real world (Kirk, 1996).

Effect Size (ES) is an index that quantifies the degree to which the study results should be considered negligible or important regardless of the sample size. The ES has two major differences over statistical significance testing: (a) it is independent of size of the sample and (b) it is a scale-free index. Therefore, ES can be viewed in different studies regardless of the sample size, the original scales of variables (Kirk, 1996, Trusty et al., 2004).

Because of the two important differences of the effect size (independent of sample size and scale-free characteristic), some professional research journals recently began to recommend, and some require, that the authors report the effect size outcomes in their submitted empirical articles (Hojat and Xu, 2004).

Additionally, the researcher noticed that multiple companies applied home-made methodologies or home-grown standards. These companies reported fewer issues regarding Time-Zone differences and Supplier Political and Security issues. It would be interesting to conduct qualitative research with these companies to learn about their practices that could mitigate these issues.

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Appendix A: Survey Instrument

Portland State
UNIVERSITY

To Start the Survey, Please click **NEXT >>** at the bottom of this page.

Informed Consent Form

You are being contacted for your knowledge and expertise in the IT and software development industry. We would like to invite you to respond to a survey about "*Managing issues through the lifecycle of IT service off-shoring projects* ".

We are asking experts who are working in the IT service and software development companies that off-shores part or all of its projects to a country outside the United States. Your feedback to this survey is very important and will help further the understanding of the most appropriate standards and best practices used to manage and mitigate issues throughout the life cycle of implemented off-shoring projects in the IT services and software development industry from a client firms' managerial perspective.

You will be asked to complete a short questionnaire about issues and practices in your offshored IT and software projects. The questionnaire consists of 10 questions and will take approximately 10 minutes.

Prize drawing: To thank respondents for their participation, we are offering $100 Amazon gift cards to three randomly selected participants who answered all the questions in the survey. The winner may choose to donate this amount to the charity of their choice. If you choose, you can enter the drawing by keying in your e-mail address at the end of the survey.

Risks are minimal for involvement in this study. The survey instrument has been approved by a rigorous and federally compliant Internal Review Board at Portland State University. No identification data is collected (unless you voluntarily provide it in order to get additional feedback), and will not be reported. All data will remain confidential with the research team.

All data obtained from participants will be kept confidential and will only be reported in an aggregate format (by reporting only combined results and never reporting individual ones). All questionnaires will be concealed. No one other than the primary investigator and assistant researchers will have access to them. The data collected will be stored until it has been deleted by the primary investigator.

Participation in this research study is completely voluntary. You have the right to withdraw at anytime or refuse to participate entirely. If you desire to withdraw, please close your internet browser. This work is being done in partial fulfillment for a doctoral degree at Portland State University. If you have questions regarding this study, you many contract Rosine Hanna at rosine@pdx.edu. If you have concerns or problems about your participation in this study or your rights as a research subject, please contact the Human Subjects Research Review Committee, Office of Research and Sponsored Projects, Research and Strategic Partnerships, Market Center Building Suite 620, 1600 SW 4th Ave., Portland Oregon 97207 USA, (503) 725-4288/ 1-877-480-4400.

Survey Completion

0% 100%

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Section 1: General Questions

Organization/company names will be solely used for statistical purposes and to track responses and never for reporting.

1. Organization/Company (*optional)	
2. State (*required)	
3. Approximate number of employees (*required)	

4. Does your company offshore* IT projects outside the US? (*required)

*Offshore by either contracting out to countries outside the US or owning subsidiaries outside the US

- Yes
- No

5. Your Functional Area: (*required)

Offshore is contracting projects out to countries outside the US or owning subsidiaries outside the US

Chief Executive Officer	Project Manager	Information Systems Manager	Software Engineering Manager	Engineering Manager	Customer Interface Manager	Other (Please indicate)

6. Approximate number of IT projects your company off-shored in the past 2 years

1-5	6-15	16-25	26-50	More than 50	Don't know

Section 2: Research Questions

Question 1 of 10

The table below lists issues that may challenge a company's ability to implement IT off-shoring for service and software development. For each indicate the frequency with which your company faced that issue while implementing your IT off-shoring in the past 2 years.

- **Supplier company (Subcontractor)** is the company or party that supplies IT process or software development services based on a contract or agreement. **Supplier company (Subcontractor)** could also be a subsidiary that is located outside the US.

	Always	Almost Always	Occasionally	Rarely	Never
Over expenditure due to hidden costs					
Poor execution plan specifically timing and type of work transferred to the supplier					
Difference in interpretation of project requirements between your company and your supplier					
Poorly developed and documented requirements by your company					
Poor tracking and managing requirement changes by the your company					
Lack of a full communication plan between your company and the supplier					
Communication and coordination problems between your company and the supplier					
Language barriers between your company and the supplier					
Time-zone differences between your company and the supplier					
Cultural differences between your company and the supplier					
Incomplete and unclear contract					
Contract renegotiation and termination					
Difference in project management practices between your company and the supplier					
Unable to measure the performance of the supplier					
Supplier technical/security and political issues					
Insufficient previous experience of the supplier					
Lack of supplier standardized working methods					

Question 2 of 10

Please indicate the extent to which the overall off-shored IT projects' deliverables were received **on time** in the past 2 years. (Please chose the one that best fits your **overall experience** with the off-shored IT projects).

	Earlier than planned time	On time	About 20% more than planned time	50% more than planned time	Double or more of the planned time
Projects Time/ Schedule					

0% 100%

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Question 3 of 10

Please indicate the extent to which the overall off-shored IT projects' deliverables were received on **cost/budget** in the past 2 years. (Please chose the option that best fits your **overall experience** with the off-shored IT projects).

	Less than estimated budget	On budget as estimated	More than 10% of estimated budget	More than 20% of estimated budget	More than 50% of estimated budget
Projects Cost/Budget					

0% 100%

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Question 4 of 10
Please indicate your average level of satisfaction to the extent to which the overall off-shored IT projects' deliverables were received on **expected quality** in the past 2 years. (Please chose the option that best fits your **overall experience** with the off-shored IT projects).

Expected Quality: The overall service was provided as specified in the contracts and overall off-shored IT projects' requirements were fully satisfied.

	Very Good	Good	Adequate	Poor	Bad
Project's Quality	◯	◯	◯	◯	◯

0% 100%

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Question 5 of 10
Does your company apply **Capability Maturity Model Integration CMMI for Development (DEV)/Services (SVC)** when implementing **off-shoring** IT service and software development?

Capability Maturity Model Integration (CMMI) is a process improvement approach that helps organizations improve their performance. CMMI can be used to guide process improvement across a project, a division, or an entire organization.

- ◯ Yes
- ◯ No

Question 5.1 of 10
Please indicate the **maturity level** your company achieved in **CMMI for Development (DEV) / CMMI for Services (SVC)**

- ◯ Maturity Level 1
- ◯ Maturity Level 2
- ◯ Maturity Level 3
- ◯ Maturity Level 4
- ◯ Maturity Level 5
- ◯ CMMI for Development(DEV)/Services(SVC) applied but no maturity level number was determined
- ◯ Not Answered

Question 6 of 10
Does your company apply **Capability Maturity Model Integration CMMI for Acquisition** when implementing **off-shoring** IT service and software development?

- Yes
- No

Question 6.1 of 10
Please indicate the **maturity level** your company achieved in **CMMI Acquisition**

- Maturity Level 1
- Maturity Level 2
- Maturity Level 3
- Maturity Level 4
- Maturity Level 5
- CMMI for Acquisition applied but no maturity level number was determined
- Not Answered

0% 100%

Question 7 of 10
Does your company apply **People Capability Maturity Model** when implementing **off-shoring** IT service and software development?

- Yes
- No

Question 7.1 of 10
Please indicate the **maturity level** your company achieved in **People Capability Maturity Model**

- Maturity Level 1
- Maturity Level 2
- Maturity Level 3
- Maturity Level 4
- Maturity Level 5
- People Capability Maturity Model applied but no maturity level number was determined
- Not Answered

0% 100%

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Question 8 of 10
Does your company apply **Team Software Process (TSP)** when implementing **off-shoring** IT service and software development?

- Yes
- No

0% 100%

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Question 9 of 10
Please indicate if your company use any of the following **quality standards** when implementing **off-shoring** IT service and software development. **(Please select all that apply)**.

- ☐ **ISO-9000**
- ☐ **ISO-9000-3**
- ☐ **eSCM-CL**
- ☐ **eSCM-SP**
- ☐ **Project Management Body of Knowledge (PMBOK)**
- ☐ Others (please specify)
- ☐ Not Answered

0% 100%

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Question 10 of 10
Please indicate the **frequency** your company performs routinely each of the following "**industry standards" practices** when off-shoring IT projects.

	Always	Very Frequently	Occasionally	Rarely	Never
Establishes and maintains a project plan as the basis for managing the project	○	○	○	○	○
Establishes and maintains the overall project plan	○	○	○	○	○
Estimates the project's effort and cost for work products (parts of the product, services, processes, specifications) and tasks based on estimation rationale	○	○	○	○	○
Establishes and maintains the project's budget, schedule, milestones, constraints and dependencies	○	○	○	○	○
Monitors off-shoring supplier project progress and performance (effort and cost) as defined in the contract	○	○	○	○	○
Manages invoices submitted by the supplier	○	○	○	○	○
Develops an understanding with off-shoring supplier on the meaning of requirements	○	○	○	○	○
Validates requirements to ensure that the resulting product performs as intended in the end user's environment	○	○	○	○	○
Obtains commitment to requirements from project participants	○	○	○	○	○
Manages changes to requirements as they evolve during the project.	○	○	○	○	○
Ensures that project plans and work products (parts of the product, services, processes, specifications) remain aligned with requirements	○	○	○	○	○
Customer Interface Manager leads the team in estimating and documenting the impact of every change in requirement and works with the Configuration Control Board (CCB) to get approval for changes to those requirements	○	○	○	○	○
Representatives of your company project's software engineering group work with representatives of the supplier engineering groups to monitor and coordinate technical activities and resolve technical issues	○	○	○	○	○
Selects team roles, including the role of Supplier Interface Manager, who is the liaison between the team and the supplier company representative, and is responsible for requirements change management	○	○	○	○	○

Communicates quality issues and ensures the resolution of noncompliance issues with the staff and managers					
Establishes and maintains a documented policy for conducting its Communication and Coordination activities					
Establishes and maintains quantitative objectives to address quality and process performance, based on customer needs and business objectives.					
Manages the project using statistical and other quantitative techniques to determine whether or not the project's objectives for quality and process performance will be satisfied.					
Performs root cause analysis of selected issues to address deficiencies in achieving the project's quality and process performance objectives.					
Manages corrective actions to closure when the project's performance or results deviate significantly from the plan					
Periodically reviews the project's progress, performance and issues experienced					
Reviews the project's accomplishments and results at selected project milestones					
Establishes and maintains records of quality assurance activities					
Monitors the actual project performance and progress against the project plan					
Ensures that the supplier agreement is satisfied before accepting the acquired product					
Establishes and maintains the off-shoring strategy					
Establishes and maintains the plan for performing the off-shoring					
Determines the type of acquisition for each product or product component to be off-shored					
Plan transition to operations specifically timing and type of work transferred to the supplier					
Collects and translates stakeholder needs, expectations, constraints and interfaces into customer requirements					
Maintains bidirectional traceability among requirements and work products					
Establishes and manages the coordination and collaboration between the project and relevant stakeholders					
Project's team members track actual results and performance against plans on a weekly basis. And project's team members track progress against individual plans on a daily basis.					
Develop a documented plan to be used to communicate inter-group commitments and to coordinate and track the work performed					
Managers are responsible for the coordination on their project teams					
Communication and coordination practices are institutionalized to ensure they are performed as managed (formally defined) process					
Ensures that the workforce has the skills to share information and coordinate their activities efficiently					
Establishes a culture for openly sharing information and concerns across organizational levels as well as among team members					
Establishes project teams as well as their responsibilities, authorities and interrelationships					
Establishes and maintains open and effective project teams' communication and coordination plan					
Managers are responsible to track and resolve inter-group issues					
Maintains effective work-groups, interpersonal problems are addressed quickly and meetings are managed to ensure that work-group time is used most effectively					
Establishes and maintains a mutual understanding of the contract with selected suppliers and end users based on acquisition needs and the suppliers' proposed approaches					
Requirements are refined and elaborated into contractual requirements					
Establishes and maintains a formal contract management plan					
Establishes and maintains contractual requirements					
Selects supplier technical solutions to be analyzed and analysis methods to be used					
Conducts technical reviews with the supplier as defined in the supplier agreement					

Evaluates and categorizes each identified issue using defined risk categories and parameters and determines its relative priority					
Establishes and maintains negotiation plans to use in completing a supplier agreement					
Insures that agreements with suppliers are satisfied by both the project and the supplier					
Selects suppliers based on an evaluation of their ability to meet specified requirements and established criteria					
Identifies and qualifies potential suppliers					
Selects, monitors, and analyzes supplier processes					
Selects suppliers using a formal evaluation					
Establishes and maintains a usable set of organizational process assets, work environment standards, rules and guidelines for teams					
Evaluates supplier technical solutions (designs) to confirm that contractual requirements continue to be met					

0% 100%

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Appendix B: Service Characteristics

Based on the literature Table appendix B provides many considerations associated with service characteristics of intangibility, heterogeneity, inseparability, and perishability (IHIP).

Table A-B-1: List of the considerations associated with the service characteristics

Service Characteristics	Considerations
Intangibility	• Several studies suggest that intangibility cannot be used to differentiate evidently between all products and services because the intangible-tangible concept is hard for people to grasp. Especially in cases where an item contains mix of tangible and intangible qualities, it is difficult to classify it in terms of product or service such as "Restaurant Meal" (Bowen, 1990, Onkvisit, 1991, Wyckham, 1975, Wolak et al., 1998). • Based on the assumption that intangibles can rarely be tried out, inspected, or tested before purchasing. Actually, almost all tangible goods can't be reliably tested or experienced beforehand like computers, dishwashers, frozen pizza, shampoo, detergents or even canned sardines. Therefore, most testable, feel-able, smell-able goods (tangibles) are, just promises, before they are purchased (Levitt, 1981). • Most services processes involve some goods which imply that services have a tangible characteristic (Vargo and Lusch, 2004). Several studies have noted that by intangibility criteria there are no pure services or goods. Their argument is based on the observation that basically all goods have a service element, whereas fundamentally all services have some form of tangible representation (Shostack, 1977, Swartz et al., 1992). All products have elements of tangibility and intangibility (Levitt, 1981, Levitt, 1985). • Several researchers argued that goods have little value in and of themselves – for example what is marketed in automobile is not "steel and chrome" (tangible) but the intangible benefits such as transportation, status, comfort and power (Shostack, 1977, Gronroos, 1994, Kotler, 1997, Normann and Ramirez, 1993, Schlesinger and Heskett, 1991).
Inseparability of Production and Customer Consumer and producer must interact simultaneously for the service to be received (Vargo and Lusch, 2004).	• The ability to alter and customize goods to the customers' demands and preferences means that many goods also have that inseparability characteristic (Levitt, 1981). • The customer is also involved in the evolution of many tangible goods (e.g., automobile, houses, and personal computers). The customer's participation in customizing the good to meet his/her needs suggests that goods also have the inseparability characteristic (Darby and Karni, 1973, Hartman and Lindgren, 1993). • Lovelock called inseparability "a dangerous oversimplification" and argued that many offerings that are typically classified as services, such as financial, entertainment, and information technology services, are partially, if not fully, "produced" separate from the consumer (Lovelock and Wirtz, 2004). • Dell and others (computer manufacturers) use direct connections with their customers through the enhanced technologies to bring customers virtually inside their business so they can meet their customers' needs faster and more efficiently than anybody else (Vargo and Lusch, 2004). • Levis's individualized deign of denim jeans, Cannondale's customized bicycles, and Acumin's individualized vitamin formulation (Wind and Rangaswamy, 2000). • Most IT-based services don't require face-to-face interaction with seller such as half of the all retail banking transactions are currently accomplished without the help of a bank employee (Lawrence and Karr, 1996). • Another examples are automated airline ticketing, hotel reservations and rooms checkout, self-scanning at retail stores, home shopping using the internet, student can register for university courses and collect their grades online and some schools provide online classes where students and teacher interact virtually on the internet

	(Dabholkar, 1997, Dabholkar, 1994). Federal Express package and tracking and online brokerage services (Meuter et al., 2000). • There are many services that do not require the customer directly such as car repair, dry cleaning, information and financial services, and goods transportation (Edvardsson et al., 2005).
Heterogeneity (Non-standardization)	• Although services are typically perceived differently from customers that do not automatically mean that there cannot be homogeneous delivery of some services. For example, the homogeneous delivery of a university lectures to all students (Vargo and Lusch, 2004). • Services such as medical procedures, airline transportation, or the provision of information through commercial databases, are as homogeneous as the manufacture of the airplanes, medical instruments, and computers (Vargo and Lusch, 2004). • Service providers such as retail banks offer highly standardized services (Gummesson et al., 2000). Lovelock argued that controlled processing services, such as education (mental-stimulus-processing), are often offered homogeneously (Lovelock and Wirtz, 2004). • Several services are characterized by standardization through IT such as internet-based and telecom services or through machine-intensive service operations such as ATMs (Edvardsson et al., 2005). Credit cards and cash machines provide standardized and firmly controlled services (Gummesson, 2007). • For more than a century, transportation and electricity services has been industrialized (Gummesson, 2007). • Macdonald's and Starbucks represent successful replication of business process as franchise, wherever you go you will have the same taste and same experience (Chesbrough and Spohrer, 2006).
Perishability (Cannot be inventoried)	• "The claim that services cannot be stored is nonsense. Services are stored in systems, buildings, machine, knowledge, and people" (Gummesson et al., 2000). ETM is a store of homogeneous cash withdrawals (Vargo and Lusch, 2004). • Customers that participate in some service process acquire knowledge which represents part of the stored service's value (Lovelock and Wirtz, 2004). • Tangible goods are perishable, several products have limited lives, bananas rot, bread gets old and rotten, and automobiles corrosion and become inoperative (Vargo and Lusch, 2004, Grönroos, 2001, Gummesson, 2007). • From a demand point of view, all goods are subject to perishability, try selling 5 years old car, or last generation computer ship, the previous season's cloth it will lose it is perceived value and thus the price will be perished considerably, because consumer needs, tastes, styles, and expectations change over time (Vargo and Lusch, 2004, Gummesson, 2007). • Service companies store service capabilities: a hotel is a "store of rooms", a "hospital is a store of medical knowledge, equipment and procedure"(Grönroos, 2001) (Gummesson, 2007).

Appendix C: Content Validation

Expert Panel comments on Q1, Q2, Q3, Q4, Q6 and Q10 and the changes applied to Survey questions

Table A-C-1: Expert Panel Comments and changes applied to the Survey Questions

Question 1				
	Inte.	Easy	Comments	Changes done and answers
Exp 3	5	1	Why not look for each of these answers based on 'supplier' and 'client'? What is the role of the company answering this survey, client or the supplier? Maybe it can be either	The focus of this research is on the Client companies
Exp 7	4	2	Consider explaining very briefly what you mean by "supplier" in this survey.	A brief explanation of supplier and client was provided in the question
Expt 9	5	3	Issue 1 - who is the "Client" - the text of this issue confused me. Issue 11 - do you mean "...early contract termination"? Issue16 – do you mean “insufficient previous experience .”?	• Definition of supplier is added. The word client company was removed from the question and replaced by "your company" . • Issue 11 changed “Contract termination” to Early Contract Termination” • Changed “No Previous experience of the supplier" to "Insufficient previous experience ".
Exp 14	4	3	First question is too vague. "No previous experience of the supplier" better worded as "Insufficient previous experience of the supplier". Last question is unclear.	Changed "No previous experience of the supplier" to "Insufficient previous experience of the supplier".
Exp15	4	4	Good list of issues.	
Exp 16	5	4	I like the balance and wording in the five response categories. I'm a little worried about the 'always' and 'never' categories though. Anchoring the intended meaning of the end points can be crucial for getting well-distributed replies. Engineers sometimes can be very literal, in which case the end categories are worded fine. 'Almost always' often can be a better break point from 'very frequently' though. However the 'never' category might be just fine here to distinguish rarity across the items. Nice job overall.	Changed “Very Frequently” to “Almost Always”.
Question 2				
	Intnt	Easy	Comments	Changes
Expt 3	4	1	Should they answer this question based on all the projects during the last 5 years? Or should they answer it based on the last 2 years projects?	Based on their overall experience with the offshored projects of the past 2 years

Expt 4	4	2	Since you are asking about projects over a 5 year period, this question may be difficult to answer. Some projects will be early, some late, some on time. Maybe ask about the overall experience of the projects in the last 2 years etc.	The question asks about the overall experience of the offshored projects "Please indicate the extent to which the overall projects' deliverables were received on time in the past 2 years. (Please choose the one that best fits your overall experience with the off-shored IT projects)."
Expt 7	2	2	Should they answer this question based on all the projects during the last 5 years? Or should they answer it based on the latest project? Please indicate clearly. During the past 5 years they might have had projects that are on time and projects that are very late and even projects that are never finished.	Changed to overall projects in the past 2 years
Expt 15	4	4	Change last selection to something like "Double or more of the planned Time".	Changed to Double or more of the planned time
Expt 16	4	3	• I presume that the response categories are closer to your intent, i.e., the extent to which the projects' deliverables were received on time. I'd drop the reference to satisfaction. • The response categories that you're currently using for the single question are discrete, not continuous. So you should ask the respondents to please choose the one that best fits their experience. (Speaking of which it's often useful to include such instructions, in parentheses after the question mark.)	Please indicate the extent to which the overall projects' deliverables were received on time in the past 2 years. (Please choose the one that best fits your overall experience with the off-shored IT projects)." Dropped the reference to satisfaction.
			Question 3	
	Intnt	Easy	Comments	Changes
Expt 3	4	1	same comment as question #2 - maybe ask for an experience of 2 years since it is easier to remember	Changed the question to 2 years of experience instead of 5 years.
Expt 4	4	2	I have the same comment as questions #2 - i.e., perhaps asks for an overall experience on 2 years of experience.	The question asks about the overall offshored projects (Please indicate the extent to which the overall off-shored projects' deliverables were received on cost/budget in the past 2 years. (Please chose the option that best fits your overall experience with the off-shored IT projects)).
Expt 7	2	2	Should they answer this question based on all the projects during the last 5 years? Or should they answer it based on the latest project? Please indicate clearly. During the past 5 years they might have had projects that are on time and projects that are very late and even projects that are never finished.	the answer should be based on the overall offshored projects and overall experience with offshored projects
Expt 16	4	3	My remarks to the previous question also fit here the extent to which the projects' deliverables were received on cost/budget. I'd drop the reference to satisfaction. • The response categories that you're currently using for the single question are discrete, not continuous. So you should ask the respondents to please choose the one that best fits their experience. (Speaking of which it's often useful to include such instructions, in parentheses after the question mark.)	Changed the question to “Please indicate the extent to which the overall off-shored IT projects ‘deliverables were received on cost/budget in the past 2 years. (Please choose the option that best fits your overall experience with the off-shored IT projects).

Question 4				
	Intnt	Easy	Comments	Changes applied
Expt 1	3	3	Would it be better to treat functionality and quality as distinct? Intro text only mentions functionality.	will consider quality only for this question
Expt 2	4	2	Mixing functionality and quality makes it difficult to answer.	will focus on quality
Expt 3	4	1	Functionality and quality are two different things which make it difficult to answer. May want to put them in two questions	will focus on quality only
Expt 4	4	3	This might be better represented as two questions - one on functionality and another on quality. The term functionality might need some description. I assume that you are asking whether the project's requirements were fully satisfied (e.g., service provided as specified) or not. The quality question may be answered somewhat different. For example, perhaps the service was provided as specified, by the quality was poor. If you are only interested in satisfaction, when having the two concepts (functionality & quality) in the same question is probably ok.	Will focus on quality and will describe it as the service was provided as specified in the contract. Project requirements were fully satisfied.
Expt 5	5	3	As there could be multiple offshore projects, with varying functionality/quality performance, perhaps consider rewording "the level of your" to instead say "your average level of"	Overall project's
Expt 6	5	2	During the past 5 years they might have had projects that are on quality and projects that are very low quality and even projects that are never finished or no quality. Maybe 2 years is easier to remember.	That is why they will provide their judgment based on their overall experience with the offshored projects in the past 2 years
Expt 7	2	2	Should they answer this question based on all the projects during the last 5 years? Or should they answer it based on the latest project? Please indicate clearly. It is better to ask the respondents about their overall experience in the past 2 years.	Respondents will provide their judgment based on their overall experience with the offshored projects in the past 2 years
Expt 11	5	2	Functionality and quality can be different in different areas/phases. Areas of poor functionality and poor quality are likely to be remembered even if they are only a small part of the whole.	Managers will provide their judgment based on their overall experience with the offshored projects in the past 2 years
Expt 16	4	3	• The average level of satisfaction to the extent to which the projects' deliverables were received on expected quality. • The response categories that you're currently using for the single question are discrete, not continuous. So you should ask the respondents to please choose the one that best fits their experience. (Speaking of which it's often useful to include such instructions, in parentheses after the question mark.) • I'd replace neither 'Neither Good nor Bad 'with' Adequate, which gets better at the notion of mixed results.	Please indicate your average level of satisfaction to the extent to which the overall off-shored IT projects' deliverables were received on **expected quality** in the past 2 years. (Please choose the option that best fits your **overall experience** with the off-shored IT projects). Option "Neither good nor bad" was changed to "Adequate".

Question 6				
	Intnt	Easy	Comments	Changes
Expt 1	1	1	These managers may not be aware of the organization's maturity level, which can vary across organizational units and models.	The focus of the research is to gather information about IT managers that offshore IT projects and if they are part of the CMM/CMMI models and not on the organizational level.
Expt 2	4	2	Q 6.1 - same comment as Q 5.1. (Q 6.1 ignores possibility of using Capability Levels.)	Added Capability level in the options
Expt 4	4	3	Same comment as question #5 regarding the term "applies". (The question text that says "applies CMMI" is a little vague. A company may have completed a CMMI appraisal, in which case they can indicate the CMMI maturity level achieved. Or the company may be pursuing a maturity level (i.e., have not completed an appraisal yet) but are targeting a particular maturity level.)	Option added that indicate "CMMI Model(s) applied but no maturity level number was determined"
Expt 9	4	5	Again, as for the last question, I would suggest changing the wording for the first part to: "Does your company....", since you are looking for a yes/no answer.	Text of the question changed to "Does your company apply CMMI."
Expt 16	4	2	This one is better than the previous question since acquisition is a separate model. Note again though that a single screening question is all that you need if you really do want to distinguish among all of the sundry CMMI models.	Question changed 'Applies' was removed and changed to "Does your company apply CMMI." Within the option the companies will have the chance to give their level, if they are in the processes of appraisal.
Question 10				
	Intnt	Easy	Comments	Changes Applied
Expt 1	5	2	It's a long list - some people may lose patience,	Discuss with committee distributing the 58 practices into 4 questionnaires.
Expt 3	4	1	list is too long for managers to answer - they don't have time	Discuss with committee distributing the 58 practices into 4 questionnaires.
Expt 4	5	4	Question #7 uses the term "managed process" - probably only companies who are actively using CMMI will know what that means - maybe you could say something like "managed (formally defined) process".	In question 7: Changed managed process to managed (formally defined) process.

Expt 5	5	2	• General: Each of the 29 items starts with the words "Client company." If you are sending it to the companies in the USA that offshore to outside the USA, would that make them client companies, anyway I would remove these two words and add them to the instruction for the overall question. • This then also brings focus to the verb that often follows, which should make evaluating each item easier (and would improve my rating in #32). You might also consider splitting such a long list into two questions. Most of the items have a verb following "Client company" and these items could go into the first question with the remaining items (that have a more irregular structure) into the second question. • Fourth item is compound. I'd either split into two items or delete the second item ("...team members... individual plans... daily..."), which might make sense as I don't know too many managers who know what their team members do on a daily basis (unless they've adopted the TSP) but perhaps it is important enough to keep and make its own item. • Sixth item, consider replacing "across all project teams" with "on their project teams" • Seventh item: unless the respondent is CMMI savvy, "managed process" is a heavy term--perhaps delete the item as it looks like you have other items covering pieces of "managed process?" • 11th item: delete "and coordination plan" at the end of the item because I'm not sure what this is asking. • 18th item: I think the item becomes ambiguous at the end as to who does the analysis. Perhaps replace "to be analyzed and analysis methods to be used" with "the client company will analyze and the analysis methods to be used." • 25th item: I'd reword to say "Client company selects supplier process to monitor and analyze and then monitors and analyzes these" (or similar wording). The problem with the current wording is that it almost sounds as if the client company selects which processes the supplier will use which is not the intent here.	Removed the word Client company – two questions at the general questions insure that the respondents are working in a company that offshore outside the USA. This insures that they are the client company and thus the word client company could and should be removed. Removed the client company words and brought the focus to the verb(s) that follows. Fourth item: Since the practices mapped on a one-to-one basis with specific CMM/CMMI practices. Will keep this as one item. Sixth item: Changed "across all project teams" to "on their project teams". Seventh item: Changed "managed process" to managed (formally defined) process. 11th item: Establishes and maintains open and effective project teams' communication plan and coordination plan. 18th item: changed to "Selects and analyze supplier technical solutions and analysis methods to be used". 25th item "client company"
Expt 6	4	1	This is too much information. Having in mind project managers just has a few minutes, well I'd quit...	
Expt 9	5	4	In previous questions you have asked for details of levels of CMMI adherence. I just wonder does that mean that the respondent, when they get to this question, will feel compelled to tick the "Always" box, if they have a level of CMMI? / / I have checked the "Easy" box because I think the respondent may have a bit of chasing to do to determine if these points happen on all projects.	
Expt 10	5	3	It's a long list - some people may lose patience and focus.	
Expt 11	4	4	Item 28: the term "technical solutions" may not be recognized by non-CMMI users as "designs".	28th item (last one) the word "designs" was added "Evaluates supplier technical solutions (designs) to confirm that contractual requirements continue to be met"

Expt 12	4	3	May want to shorten this list. Looks like too much "cut and paste" from CMMI (not everyone speaks "CMMI" terminology). I would also number this list. The term "Client Company" is also strange. I recommend using two standard terms like "Supplier" and "Organization" (or even "Your Organization"). FYI - "Organization" is a better term than "Company" if you plan to survey government, academia, and non-profits.	Discussed with committee members distributing the 58 practices into 4 questionnaires. They are ok with it. Each questionnaire will have 14 practices and removed the word “client company” and provided the word “your company” in the question stem.
Expt 16	4	1	First of all I'd merge and shorten the two sentences in the 'question', e.g., 'Please indicate the frequency ... has performed each of the following "industry standard" practices when off-shoring projects.' Notice my use of full quotes around industry standards. 'Institutionalize' is standards-speak too. I'd drop that. Since the task you're asking folks to complete isn't stated as an interrogative question, you could add a second sentence that defines institutionalize without using the term. The list of practices is way too long. You're asking for test fatigue to set in there. You should break up the list into two or three sets of sub question if you're really interested in that level of detail. I'd suggest that you prune the list down though. In fact it was so long that I just skimmed though it without proof-reading the text	Question changed to “Please indicate the frequency your company has performs routinely each of the following "industry standards" practices when off-shoring IT projects.” Institutionalize is dropped and replaced with routinely.

Appendix D: Validation of Research Results

Email and Document emailed to expert panel, results were validated in phone calls meetings that took 30-45 minutes.

Hello (Name),
Thank you for your feedback on my survey validation. Your feedback was extremely important to my research as well as to the field of IT service off-shoring and your feedback enhanced the survey instrument.

This research investigated CMM/CMMI best practices and their effect on managing and mitigating critical issues associated with off-shore development. The research focused on:

1) Four CMMI/CMM models (MMI-Development/Services, CMMI-Acquisition, People-CMM and Team Software Process (TSP)).
2) Seventeen IT Offshoring issues
3) Fifty Seven CMMI/CMM best practices
4) Three Project performance outcomes (Time/Schedule, Cost/Budget and Expected Quality).

Using a web-based survey, data was collected from Information Technology and software development firms across the United States. The survey population consisted of those who work on offshore IT and software development projects. Quantitative methods were used to test the proposed hypotheses.
As promised, I am pleased to share the results of the research with you and it would be most appreciated if you would validate the results.

The research achieved eight results that are listed in the attached document.
Please scan the results and, if you agree or disagree, please provide your feedback by replying to this email rosine@pdx.edu or call (503) 679-4998.

Thank you for taking the time to validate the results of this research. Your participation in this research expert panel is very important and greatly appreciated as it adds not only to the completion of my doctoral dissertation but also to the body of knowledge in this growing area of off-shoring IT services.

Best regards,
Rosine

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1. Summary

Managing issues through the lifecycle of IT service off-shoring projects

Western countries' information technology and software intensive firms are increasingly producing software and IT services in developing countries. With this swift advancement in off-shoring, there are many issues that can be investigated to enable companies to maximize their benefit from off-shoring. However, significant challenges can happen throughout the lifecycle of off-shoring IT service projects which may turn the potential benefits into losses. This research investigates CMM/CMMI best practices and their effects on managing and mitigating critical issues associated with off-shore development.
Using a web-based survey, data was collected from approximately 430 Information Technology and software development firms in the US. Respondents were invited to participate via email. The survey population consisted of Information Technology and software engineering managers who work on offshore IT and software development projects. Quantitative methods were used to test the proposed hypotheses.

2. The research focused on:

2.1 Four CMM/CMMI models:

i. CMMI-Development/Services
ii. CMMI-Acquisition
iii. People-CMM
iv. Team Software Process (TSP)

2.2 17 IT Offshoring issues

1. Over expenditure or hidden costs incurred by the client
2. Difference in interpretation of project requirements between the client and the supplier
3. Poorly developed and documented requirements by the client company
4. Poor tracking and managing requirement changes by the client company
5. Lack of a full communication plan between the client and the supplier
6. Communication and coordination problems between the client and the supplier
7. Language barriers
8. Time-zone differences between the client and the supplier
9. Cultural differences between the client and the supplier
10. Incomplete and unclear contract
11. Early contract renegotiation and termination
12. Difference in project management practices between the client and the supplier
13. Unable to measure the performance of the supplier
14. Supplier technical/security and political issues
15. No previous experience of the supplier
16. Absence or lack of supplier's standardized working methods
17. Poor execution of the plan and timing of the transition to the supplier

2.3 Three Project performance outcomes (1- Time/Schedule, 2- Cost/Budget and 3- Expected Quality)

2.4 57 CMM/CMMI best practices

3. Research Questions:

Q1. What is the impact of client firms adopting CMM/CMMI industry standards on the frequency of issues experienced by client firms when offshoring IT service projects?
Q2: What is the relationship between the CMM/CMMI maturity level achieved and the frequency of issues experienced by client firms when offshoring IT service projects?
Q3: What is the relationship between performing CMM/CMMI industry standards practices and the frequency of issues experienced by client firms when offshoring IT service projects?
Q4: What is the impact of adopting and practicing CMM/CMMI industry standards on the offshored projects' performance outcomes?

4. Hypothesis of the research

H1: There is a relationship between adopting CMM/CMMI Models and the IT offshoring issues.
H2: There is a relationship between the CMM/CMMI maturity level achieved and the IT offshoring issues.
H3: There is a relationship between performing CMM/CMMI practices and the IT offshoring issues.
H4: There is a relationship between adopting and performing CMM/CMMI industrial standards and the offshored project performance outcomes.

5. Findings:

Finding 1: Applying CMM/CMMI models have fewer issues associated with IT offshoring.
Finding 2: Achieving higher maturity levels of CMM/CMMI have fewer issues associated with IT offshoring.
Finding 3: Applying CMM/CMMI models and routinely performing industry practices have fewer issues associated with IT offshoring.
Finding 4: Applying CMM/CMMI models and routinely performing industry practices have better project performance outcomes.
Finding 5: Utilizing and incorporating different practices from TSP and People into CMMI-DEV/SVC and CMMI-ACQ have fewer offshoring issues of language barriers and cultural differences.
Finding 6: Adopting and practicing CMM/CMMI models did not mitigate the offshoring issues of: 1) Time-zone difference between the client company and the supplier company and 2) Supplier security and political issues.

6. Hypothetical Scenarios

To explain the statistical results, eight possible hypothetical scenarios are developed based on the company background and targeted goal. Adopting CMM/CMMI models and performing multiple CMM/CMMI practices may help in mitigating the IT offshoring issues as shown in table 78.

Appendix E: SEI CMMI/CMMI Data Information

Move to Inbox More

Software Engineering Institute <info@sei.cmu.edu> 10/26/11

to me

Hi Rosine,

The SEI receives numerous requests from users to reveal the identity and/or maturity level of organizations. As a federally funded research and development center, the SEI is not able to release any information about an appraised organization's identity or its maturity level. The SEI treats all appraisal information as private property and it is kept confidential within the SEI. An appraisal's results are owned by the appraisal sponsor; accordingly, the sponsor may publicize this information at their discretion.

A current list of companies who have completed appraisals against the CMMI Model, and provided us with written authorization for this release of information, is available on our Web site. (Note: clicking on any company listing will provide more detailed information regarding the appraisal.)

Since written authorization must be received from the sponsor of each appraisal posted, there are companies that are using CMMI that are not on this list. Consequently, this list cannot be perceived as an indicator of all, or an exact count of organizations in the world that are using SEI models or appraisal methods.

In terms of more general information regarding appraisal results, please consult the community maturity profiles. These give overall numbers while preserving the anonymity of the appraised organizations.

Specifically see page 19 of the following document: www.sei.cmu.edu/cmmi/casestudies/profiles/pdfs/upload/2011MarCMMI.pdf.

Thank you,

Kara Quinto

Figure: A-E-1: Email received from SEI

CMMI Institute | powered by Carnegie Mellon

Published Appraisal Results

Filter Results

Model/Constellation: CMMI-DEV v1.3

Maturity Level: Maturity Level 5

Year: 2014

Country: Select Country

Apply Filter | Clear Filter

Organization Organizational Unit	Team Leader Sponsor	Appraisal End Date	Model (Representation): Maturity Level
Advanced Information Services Inc. Software Development	Edward Weller Girish Seshagiri	03/07/2014	CMMI-DEV v1.3(Staged):Maturity Level 5
AKS Software Limited Software Development and Delivery function	Rajarshi Kumar Das Anil Kumar Saxena	03/12/2014	CMMI-DEV v1.3(Staged):Maturity Level 5
CenturyLink Technologies India Private Ltd Software Development, Maintenance and Testing projects - Bangalore and Noida	Sankararaman Dhandapani Harsch Bhatnagar	01/24/2014	CMMI-DEV v1.3(Staged):Maturity Level 5
China National Software & Service Company, Ltd. General Products R&D Center	Frank Koch Xin Xie xuerong zhao	01/23/2014	CMMI-DEV v1.3(Staged):Maturity Level 5
China Sciences MapUniverse Technology Co., Ltd. R&D, Quality, and HR Divisions	Patrick O'Toole Xin Yao	03/20/2014	CMMI-DEV v1.3(Staged):Maturity Level 5
CSC Vietnam Ltd. Development, Maintenance and Testing Projects managed from HCM City Vietnam	Gururaj Managuli Phuong Ngo	01/24/2014	CMMI-DEV v1.3(Staged):Maturity Level 5
CVIC SE Business Middleware Co., Ltd Software Research and Development Center	Shane Atkinson jianping cheng	05/06/2014	CMMI-DEV v1.3(Staged):Maturity Level 5
CVIC Software Engineering Co,.Ltd Software Research and Development Center	Shane Atkinson jianping cheng	04/24/2014	CMMI-DEV v1.3(Staged):Maturity Level 5
EPAM Systems KFT Development Projects for the Banking, Business Information and Travelling business lines	Jose Luis Iparraguirre Balazs Fejes	03/28/2014	CMMI-DEV v1.3(Staged):Maturity Level 5
Fujian Newland Software Engineering CO.,LTD. BOSS Product Dept., CRM Product Dept., BI Product Dept.,NMS Product Dept.,Quality Management Dept., Project Management Dept. and HR Dept.	Mary Sakry Jinfa Lin	03/26/2014	CMMI-DEV v1.3(Staged):Maturity Level 5
Hangzhou Golden Software System Inc. R&D Department	Kieran Doyle Bin Hu Qisheng Li	01/22/2014	CMMI-DEV v1.3(Staged):Maturity Level 5
Heinsohn Business Technology S.A. Software Factory Projects & Products	Louis Poulin Luis Fernando Jaramillo	01/31/2014	CMMI-DEV v1.3(Continuous):Maturity Level 5 CMMI-SVC v1.3(Continuous):Maturity Level 1
Hewlett-Packard Enterprise Services Applications Services, Global Delivery - India (Managed Development Work)	Kaliappan Marappa Sumanth Tarigopula	03/28/2014	CMMI-DEV v1.3(Staged):Maturity Level 5
HEXAWARE TECHNOLOGIES LTD Development Centers in India and Mexico	Rajiv Nag Venkatramanan Ramachandran	02/26/2014	CMMI-DEV v1.3(Staged):Maturity Level 5 CMMI-SVC v1.3(Staged):Maturity Level 5
HITSS SOLUTIONS S.A. de C.V.	Giuseppe Magnani	02/14/2014	CMMI-DEV v1.3(Staged):Maturity Level 5

Figure: A-E-2: SEI website – Published Appraisal Results

Appendix F: Statistical Results

Chi-square test was applied to test all the hypotheses using p= 0.05 as the critical significance level:

- H1: The relationship between adopting CMM/CMMI industrial standards and the IT offshoring issues.
- H2: The relationship between CMM/CMMI industrial standards Maturity level achieved and the frequency of issues experienced.
- H3: The relationship between MM/CMMI industrial standards practices and the frequency of issues experienced.
- H4.1: The relationship between adopting CMMM/CMMI industrial standards and the project success factors.
- H4.2: The relationship between CMM/CMMI industrial standards maturity levels achieved and the project success factors.
- H4.3: The relationship between CMM/CMMI industrial standards practices and the project success factors.

Hypothesis 1

Hypothesis 1 tests the relationship between four CMM/CMMI models and the frequency of issues experienced by the client companies. Hypothesis 1.1 tests the relationship between companies that applied only CMMI for Development (DEV)/Services(SVC) and companies that did not apply any quality standard model and the 17 issues of offshoring IT projects; Hypothesis 1.2 tests the relationship between companies that applied only CMMI for Acquisition and companies that did not apply any quality standard model and the 17 issues of offshoring IT projects; Hypothesis 1.3 tests the relationship between companies that used only People CMM and companies that did not apply any quality standard models and the 17 issues of offshoring IT projects; and Hypothesis 1.4 tests the relationship between companies that applied only TSP and companies that did not apply any quality standard model and the 17 issues of offshoring IT projects.

Bonferroni's correction was used when multiple comparisons were drawn from a single sample. Hypothesis tests the 17 issues 4 times with 4 industrial standards. Bonferroni correction (adjusted) p-value= 0.05/(17*4) = 0.05/68 = 0.0007352

H1.1 *There is a relationship between adopting CMMI development/services and the IT offshoring issue.*
H1.2 *There is a relationship between adopting CMMI acquisition and the IT offshoring issues.*
H1.3 *There is a relationship between adopting CMM people and the IT offshoring issues.*
H1.4 *There is a relationship between adopting CMM TSP and the IT offshoring issues.*

Statistical results are available as a PDF supplemental File (8,850KB).