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Improving Software Maintenance Offshore Outsourcing Quality Assurance Using Mixed-Methods Analysis

Muhammad Haseeb Iqbal[1*], Syed Irtaqa Naqi Naqvi[1], Khurram Shahzad[1], and Syed Asad Ali Naqvi[1]

[1]Faculty of Computer Science and Information Technology, The Superior University, Lahore, 54600, Pakistan.
[*]Corresponding Author: Muhammad Haseeb Iqbal. Email: haseeb.ce@gmail.com

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Abstract: The growing dependence on offshore software maintenance outsourcing (OSMO) highlights the necessity of efficient quality assurance systems to guarantee better delivery results. The present quality control frameworks have no connection with contemporary technology such as machine learning, even if outsourcing techniques have advanced. This paper tries to fill in the gaps in the existing literature by utilizing machine learning approaches to assess customer proposals and reduce risks. It also creates a new quality assurance framework for OSMO. Our mixed-methods approach comprised qualitative case studies, industry expert interviews, and numerical analysis. The project employed controlled learning models to assess customer bids and direct decision-making procedures. Information collected from several sources was progressively coded and verified using Rooted Theory. The suggested platform greatly increases the accuracy and dependability of OSMO's job selection and deployment procedures. Among the most important conclusions are the significance of strong risk management, social flexibility, and efficient communication. By highlighting the challenges brought on by linguistic and geographical limitations, the research shows how machine learning may improve decision-making and project outcomes. The case studies also show how resolving cultural and time zone disparities may enhance collaboration and productivity. By executing the suggested quality assurance platform into practice, OSMO procedures will rise dramatically, improving task completion expenses and elevating client happiness. The paper offers insightful analysis and useful recommendations for enhancing quality control in offshore software maintenance.

Keywords: Challenges; Development; Maintenance; Outsourcing; Organization; Software.

1. Introduction

A growing trend in software businesses' efforts to maximize efficiency and cost-effectiveness is outsourcing maintenance work. Offshore software maintenance outsourcing (OSMO) is a growing trend where vendors from less economically developed nations provide maintenance services to clients in more developed countries. This allows vendors to access global markets and generate revenue by offering expertise in maintaining clients' existing software products [1]. Despite the apparent profitability and business potential of client proposals, vendors engaging in OSMO should exercise caution, as appearances can be deceiving. The vendors of OSMO may use prediction and assessment-related approaches to properly review and contrast various bids to make wise judgments. Before accepting the client's proposal, it is crucial to evaluate, forecast, or estimate it. To improve decision-making and choose the best and most advantageous suggestions from the available possibilities, various research studies have investigated the application of estimate and machine learning approaches in this field [2], [3].

1.1. Contribution of Research

This analysis presents a robust system designed to improve OSMO's quality control processes. The framework fills in the gaps in current methods by integrating state-of-the-art machine learning approaches to evaluate customer offers and reduce related risks, an area that was previously understudied in the literature. For the first time, customer bids for offshore maintenance jobs are assessed and improved using

machine learning techniques, specifically controlled learning models. By offering a more precise and reliable technique for job selection and execution, this tale application enhances OSMO's decision-making processes. By Mixed Methods Research integrating qualitative case studies, business expert interviews, and quantitative research, the study employs a full grasp of OSMO practices and obstacles. This process guarantees a thorough assessment of the quality assurance framework's efficacy.

Keeping in view the Key Challenges and solutions the research tackles a number of significant problems that OSMO providers encounter, such as regional variances, linguistic obstacles, and societal divides. It also shows how machine learning may handle these problems, producing better outcomes and more effective cooperation. The paper offers advice for how cultural and time-zone variations affect project performance, along with empirical evidence, case reports, thorough case studies, and theoretical assessments. The results offer practical recommendations for improving vendor-client relations and elevating the overall quality of the project. Functional Implications for the Industry the professionals in OSMO sector who wish to raise task completion rates and customer satisfaction can benefit from the study's findings and the proposed quality assurance system.

Supervised learning, a powerful method in machine learning for classification tasks, involves training models using labeled data to identify patterns and relationships. The goal is for the model to accurately predict or classify new data instances it has not seen before. Through supervised learning, models learn from labeled training data, enabling them to make informed decisions on future data instances, ensuring efficient and accurate classifications [4]. It is advised that the vendors apply machine learning methods, in particular Neural-Networks, to scrutinize customer offers at the stage of project selection, according to the idea published in [3]. Insights from [2] emphasize how machine learning can aid project managers in choosing the most suitable projects from a range of alternatives. By leveraging these advanced technologies, vendors can make well-informed decisions, selecting projects that align best with their objectives and capabilities. Machine Learning (ML), a subset of Artificial Intelligence (AI), utilizes computational and mathematical techniques to create "intelligent algorithms" that enable computers to make predictions or judgments based on datasets or historical data. ML addresses two primary issues in AI: improving program performance and understanding the fundamental concepts underpinning artificial intelligence. By focusing on these aspects, ML has paved the way for the development of intelligent systems capable of learning from data and enhancing their decision-making abilities over time [5]. Since the advent of the big data era, ML has significantly impacted various scientific fields and applications. . It spans a wide range of academic disciplines, allowing researchers and practitioners to harness data for improved insights, forecasts, and decisions. The revolutionary potential of Machine Learning (ML) is growing as it develops, making it a crucial component of contemporary scientific investigation and problem-solving [6].

Machine learning can be categorized into four main types: supervised, unsupervised, semi-supervised, and reinforcement learning. Each grouping exemplifies a unique method for developing algorithms and addressing various learning challenges. Finding structures and patterns in data without labeled examples is the focus of unsupervised learning. Reduced labeled data and increased unlabeled data pools are used in semi-supervised learning to incorporate aspects of both supervised and unsupervised learning. To train models and generate predictions, supervised learning uses labeled data. Finally, reinforcement learning uses a system of incentives and penalties to train algorithms to improve their ability to make decisions in changing settings [7].

In various approaches to combining machine learning (ML) and pattern recognition, supervised learning (SL) is notably the most complex and challenging method. It starts by giving the algorithm a collection of input examples together with the labels or results that correspond to each one of those input instances. The algorithm may use this method to generalize patterns from the examples presented and produce precise predictions or classifications for brand-new instances of unexplored data. As it permits the creation of prediction models that can be trained and improved using labeled data, supervised learning is crucial in many applications because it enhances decision-making and problem-solving skills [8]. Outsourcing refers to the act of procuring products or services through a written agreement with an external source. In the IT sector, outsourcing software development involves a contractual agreement between the customer and the vendor. The customer delegates some or all of their Softech responsibilities of vendors in exchange for compensation and advantages. This strategy permits businesses to efficiently

manage software development projects by utilizing external resources and expertise, all while maintaining a positive and fruitful partnership between the customer and the vendor [9].

Outsourcing has become a popular strategic choice in the software industry to access skilled workers worldwide, reduce costs, increase flexibility, and share risks. However, outsourcing also comes with several potential hazards that can lead to project failure. One of the major challenges is the geographic distance between the customer and the vendor, which can cause language barriers and communication issues, resulting in misunderstandings of critical business requirements and, ultimately, poor software projects [10]. Additionally, cultural differences and varying time zones can create interaction and collaboration issues that significantly impact the success or failure of a software project. These difficulties frequently raise the risk of project failure and lower the quality of deliverables. Successful outsourcing partnerships must have excellent project management, defined requirements, and efficient communication channels to get beyond these challenges [11]. In this research article, we evaluate a client's proposal for Offshore Software Maintenance Outsourcing using machine learning techniques. Specifically, we used supervised learning classifiers in combination with causal agents to provide insightful forecasts. Our goal is to assist the OSMO vendor in evaluating the proposal effectively. The forecast will serve as a guide for the vendor, helping them make an informed decision about whether to accept or reject the customer's business proposal. In this research, data triangulation—which encompassed data collection, analysis, and interpretation—was employed consistently. The strategy's key goal was source diversification, which made it feasible to produce a dataset that was richer and more comprehensive. The trustworthiness, correctness, and corroboration of our findings were improved by utilizing this technique, which also raised cross-validation and substantiation [12].

Despite the similarities between IT outsourcing and software offshore outsourcing, it is exceedingly uncommon for these two practices to be the subject of the same inquiry few studies have focused on identifying the essential elements for offshore outsourcing of both software maintenance and IT. All of the aforementioned studies either concentrated on offshore software maintenance outsourcing, offshore IT outsourcing, or offshore IT outsourcing's advantages.

Key objectives in Offshore Software Maintenance Outsourcing (OSMO) Identification Review and comprehend the particular difficulties that suppliers and clients in OSMO encounter, such as societal divides, communication limitations, and physical distance. To Expand an All-Inclusive Quality Assurance Structure for OSMO: Create and implement a novel quality assurance system that incorporates cutting-edge machine learning methods to enhance task procurement, execution, and overall software quality in OSMO. To Evaluate the Efficacy of the Suggested Framework: To determine the effect of the recommended quality assurance platform on project outcomes in OSMO, conduct empirical research, such as case studies and debates. Investigating Machine Learning's Potential to Improve Decision-Making Examine client proposals and how decision-making processes might be enhanced by using controlled studying models [13].

1.2. Problem Statement

Particular Problems or Issues with the Research: The major goal of the research is to identify and analyze the problems that offshore software maintenance outsourcing, or OSMO, encounters. The following spaces are especially targeted for closure by the research:

Communication Barriers: What are the variations in language, culture, and geography that affect communication between clients and offshore vendors?

Problems with Quality Assurance: Which Q.A. issues do the OSMO now face, and how may they be resolved?

Risk management: What is the perception and management of hazard among different stakeholders in OSMO?

Which strategies may be applied to improve social adaptation in order to improve OSMO cooperation and project results?

By asking probing questions, these studies hope to provide light on the critical components that influence OSMO and offer suggestions for enhancement.

Offshore collaborations have become a cost-effective choice in modern software maintenance outsourcing. However, physical distance, cultural differences, and communication challenges often lead to quality-related problems. While conventional quality assurance techniques work well in local settings,

they frequently fall short in the dynamic environment of offshore software maintenance. This gap underscores the urgent need to develop and implement innovative quality assurance methodologies tailored to the complexities of offshore software maintenance. In order to provide consistent and high-quality software results in offshore environments, which organizations increasingly rely on for the maintenance of software assets, this problem demands a thorough assessment and a creative strategy.

Outsourcing is not a new notion; it has been around for a while. This idea then gained popularity and had rapid expansion in the years that followed. It changed to meet the rising expectations of organizations for the creation and administration of IT projects [14]. Eastman Kodak made a crucial choice in 1989 that might be linked to one of the early examples of software outsourcing. Eastman Kodak made the decision to assign several IT projects to outside service providers at that time [15]. Delegating business process operations to a third party outside of one's organization is known as outsourcing. The following characteristics define the engineering technique [16] known as software development outsourcing:

a) Customer involvement, usually from an outsourced company or client.

b) Contact a vendor organization, which is a common kind of IT supplier.

c) The implementation of an IT project, which might include all or just a portion of the software development endeavor.

d) A deal where the vendor provides services to the client in return for payment [17].

Service providers in outsourcing can be categorized into local and foreign. Local suppliers operate inside the nation of the consumer, whereas international providers are located outside. Various kinds of outsourcing exist, and businesses may cede some or all of their authority over their development duties to an outside outsourcing organization. It's important to note that this outsourcing of software development duties, also known as offshore outsourcing, can take place inside the same nation but most typically includes assigning these tasks to a third-party provider based outside [18]. The outsourcing sector has seen impressive growth and a rise in demand in recent years. The global market for software application development grew by 3.5% in 2013, with projections for continued growth at a rate of 4.7% over the following five years [19]. Certain countries exhibit a stronger propensity for outsourcing than others. González and colleagues noted that, compared to other European nations, the demand for software outsourcing has recently grown far more quickly in Spain, Finland, and the United Kingdom. When businesses choose to outsource their software projects, their primary objectives are to access top talent, leverage the expertise of skilled professionals, increase focus on core operations, reduce costs, and strengthen their global economic presence [20].

2. Materials and Methods

With a mixed-methods approach, this project aims to develop and evaluate an extensive quality assurance framework for offshore software maintenance outsourcing (OSMO). By merging qualitative and quantitative techniques with state-of-the-art machine learning techniques for customer proposal evaluation, we hope to close gaps in current quality control protocols.

2.1. Data was collected through two primary methods:

2.1.1. Qualitative Case Study

We conducted semi-structured interviews with stakeholders involved in offshore software maintenance across various organizations. These interviews provided in depth insights into the challenges, practices, and effectiveness of current quality assurance strategies.

2.1.2. Quantitative Analysis

We employed supervised learning models to analyze and evaluate client bids for offshore maintenance projects. The quantitative data were derived from historical project data and client proposals to assess the accuracy and reliability of the proposed quality assurance framework.

2.2. Case Study Methodology

2.2.1. Arbitrary Case Study

Subjective case studies were selected because they may be used to examine complex occurrences in their daily contexts. The following justifications make this strategy appropriate:

Depth of Insight: It makes it possible to look closely into OSMO's issues and strategies.

Contextual Understanding: It offers a thorough examination of the particular environments in which various outsourcing strategies are implemented. Flexibility is key for these kinds of experimental investigations since it enables the investigation of fresh issues or new fields of study. Compared to mixed-method methods or quantitative research, the qualitative case investigation was shown to be the most successful in gathering the detailed and context-specific information required to comprehend the complexity of OSMO.

2.2.2. Research Design

To further understand how quality assurance methods are created in the context of outsourcing offshore software maintenance, the study employed a qualitative case study methodology. Case studies are ideally suited for exploring complex phenomena in their real-world settings, allowing for a comprehensive understanding of the connections and interactions involved. We adopted a research strategy based on multiple case studies for this study, which strengthens our findings by supporting them with data and analysis from various examples. Research using multiple case studies is typically thought to be more reliable and durable than research using a single instance [21].

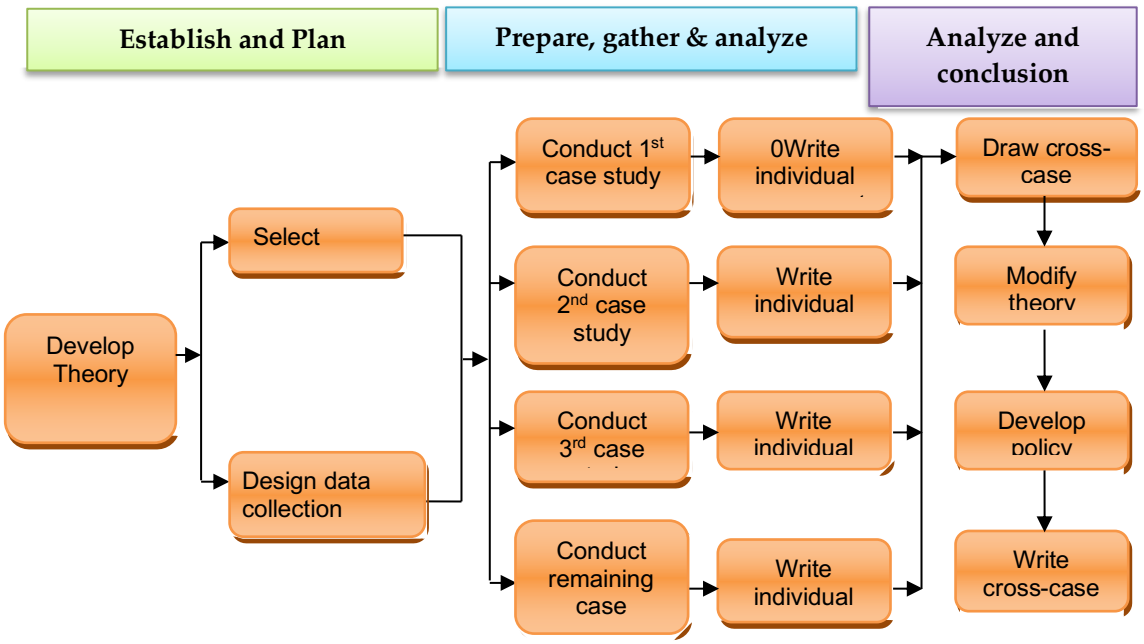

Figure 1. Multiple case study design for outsourcing

However, conducting multiple case studies requires significant financial and time investments, which is a major drawback. Multiple-case studies might be more difficult to implement than single-case studies, which are frequently more practical to carry out due to their reduced resource and time needs. In this study, we examined four diverse situations, which depicted a software application development company that offers outsourced services and concluded them [21]. The flow of research methodology for our multiple-case research is depicted in Figure 1.When conducting multiple case studies, it is advisable to establish a theoretical framework that contextualizes the study for both research participants and analysts interpreting the findings. This framework should be grounded in relevant literature related to the study being conducted, providing a solid foundation for understanding and analyzing the research outcomes [22].

2.2.3. Research Design

In this study the following main research questions relating to the expansion of quality assurance offshore software maintenance outsourcing have formulated. This study is motivated by a number of major research questions, each of which is carefully crafted to investigate and clarify important aspects of outsourcing offshore software maintenance within the IT sector, with an overall focus on developing quality assurance procedures. Our investigation's primary research questions are the following:

RQ1: About its complex business model, how is outsourcing operationalized in the IT sector? What are the crucial elements, as seen from the perspective of vendors, which operate as accelerators for outsourcing activities?

RQ2: How much do regional restrictions have an impact on the landscape of IT outsourcing within the IT industry?

RQ3: To what extent do the factors found in this study actively influence and affect the decisions made regarding the sourcing of IT services and software maintenance tasks?

Our focus is narrowed down to certain aspects of software outsourcing thanks in large part to the research queries. They also offered crucial help in developing the framework for data collection, notably in the process of creating our interview questions. The primary source of information for this paper, and the foundational dataset for our study, was derived from the interviews we conducted. Case Study Selection and Context

This investigation focused on four software application development firms specializing in providing outsourced services. Senior-level executives from these firms, possessing knowledge of the company's policies, strategic decisions, and resource allocation, were the primary subjects of analysis. The decision to focus on these particular situations resulted from a number of considerations, including the management of the firm's willingness to cooperate with our study, the accessibility of team, and authors' own contacts with these organizations.

2.2.4. Data collection

Records, observations, and interviews were used to compile data in order to present a thorough picture. By employing triangulation to cross-check data sources, reliable and consistent findings were produced. Using a range of choices lessened the influence of biases and improved the research credibility. A diverse variety of industries, such as manufacturing, finance, healthcare, and technology, provided a wealth of case studies and challenges. The effects of regional and cultural variations on the instances were examined in relation to vendors and clients from various geographic locations. A variety of OSMO procedures were examined in the study due to the size and variety of the tasks examined. Direct offshore software maintenance was a requirement for each scenario, ensuring that the results are precise and relevant to the subject of the study.

We used an interview-based methodology in this study to collect data. Four distinct cases, designated as C1, C2, C3, and C4, each representing a software development outsourcing company, were selected for our study. We conducted focus group discussions and interviews with individuals from these cases. Our data collection from the first three cases (C1, C2, C3) involved numerous interviews with a range of stakeholders, including managers, directors, and software team leaders. In contrast, for the fourth case (C4), which involved overseeing the quality assurance process in software applications and technical matters, we opted for a focus group interview approach with three senior managers. This interview session spanned a single session. The interview in this focus group took place over the course of one session. The application of data triangulation at different critical phases, including data collection, analysis, and interpretation, was deliberately done throughout the duration of this investigation. We used a triangulation of data sources strategy to improve the comprehensiveness and resilience of our dataset. Our study findings were enhanced by doing this in terms of confirmation, verification, and general support [23].

Our data triangulation strategy was founded on three core principles. First, we adopted numerous sources of evidence by collecting information from both focus groups and interviews. Second, we used a case study database technique, painstakingly storing all the information associated with our case studies and creating a vast collection of facts and evidence. Finally, we put a data validation process into action, which resulted in the production of a data validation report. The data we acquired was thoroughly validated and discussed in this paper, guaranteeing its suitability for answering our study questions [24]. Semi-structured interviewing approach we used, as recommended by [25]. This approach provided flexibility by allowing for a planned series of questions while also enabling the exploration of responses in depth and clarification of any ambiguities. Importantly, it encouraged interviewees to freely express their thoughts and insights, thereby facilitating a more comprehensive understanding of their perspectives.

Comprehensive logs of all conversations were kept throughout our interviews. These interactions were then painstakingly transcribed before starting the data analysis step [26]. With the help of direct tracking and reinforcement of the validity of our evidence chain, this thorough method enabled us to maintain the integrity of the interview and focus group data. We separated the interview transcripts into different papers and gave each one a special identifying code in order to organize this data for analysis.

We then applied particular codes to individual sentences throughout the analysis phase and compared the results to the original texts.

2.2.5. Data analysis

To analyze the qualitative data, which includes interview transcripts and various documents, we employed thematic analysis. The objective of this research is to identify recurring themes, patterns, and relationships within the data. We may use both inductive and deductive coding techniques to achieve this.

Deductive coding involved applying established categories from previous studies, enabling us to uncover new insights embedded in the data [27]. Concurrent data analysis and collection were conducted simultaneously to enhance the data gathering phase. The approaches detailed in many qualitative research, such as those cited in [21] and [28], are consistent with our approach to theme coding. The main steps in our thematic coding procedure were familiarization with the data, application of codes, identification of topics, review of these themes, definition, and labeling of these themes, and thorough document analysis.

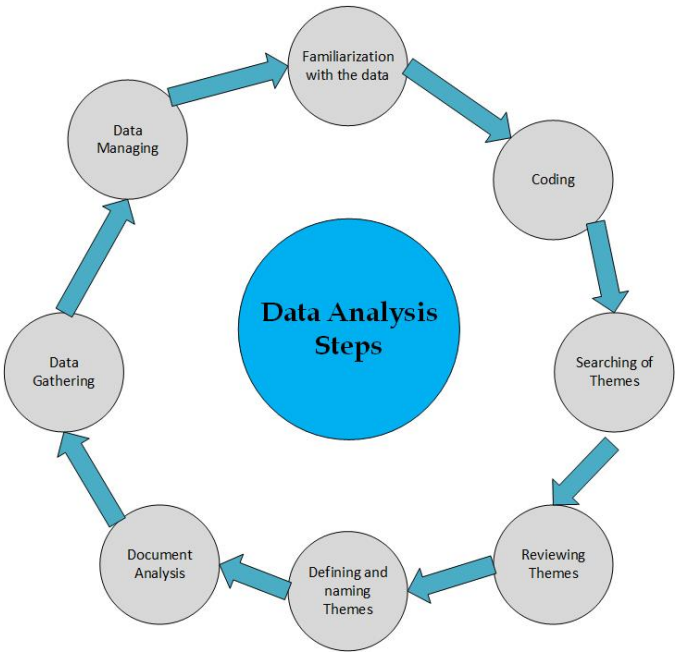

Figure 2. Depicts the orderly stages we followed during this operation.

2.2.6. Examination of a cross-case

A thorough cross-case analysis was conducted to identify commonalities, differences, and recurring trends among the chosen cases as mentioned in [29]. This in-depth analysis is expected to facilitate the development of quality assurance methods in the context of offshore software maintenance outsourcing. In addition to the core data obtained through focus groups and interviews, intelligent use of secondary data was used to further our understanding of the issue. This extra information was presented using pertinent research, reports, project documents, and conversation logs, among other sources. Primary and secondary data sources were merged to provide our data analysis with a well-rounded viewpoint. Our strategy for data analysis included two points of view: a close examination of the data in each unique situation, in keeping with the strategy endorsed by [30]. Each case's specifics were carefully scrutinized as part of this comprehensive review. We performed a thorough cross-case analysis that synthesizes insights from all cases, allowing for broader observations and conclusions.

2.2.7. Contributions of Research

The project creates a new quality assurance platform for OSMO that uses machine learning techniques to enhance risk assessment and client proposal evaluation. Utilizing controlled learning models, the research develops a unique approach to enhance decision-making in offshore software maintenance, therefore addressing deficiencies in existing quality control protocols. Application of experimental verification and methodology comprises quantitative analysis and case studies that offer helpful perspectives and recommendations for enhancing OSMO procedures. Cultural and time zone differences, as well as communication hurdles, are significant challenges that the research discovered and addressed. These aspects are especially relevant for offshore maintenance projects. Every participant provided

informed consent, and their right to privacy and anonymity was respected throughout the analytic process. The study followed moral guidelines to preserve the reliability and integrity of the data gathered.

3. Results

In this section, we offered a comprehensive analysis of the findings derived from investigating four distinct case studies. These businesses are local companies known for their successful track record in outsourcing services. For confidentiality reasons, we refer to these entities as C1, C2, C3, and C4 in our presentation. Workforce Size Categorization: The study further categorizes these companies based on their workforce sizes. The breakdown of this classification is as follows:

- Large Businesses/Companies: These are businesses that typically employ more than 200 people.
- Medium business/Companies: The workforce size of companies in this category ranges from 70 to 200 people, making it a modest size.
- Small Business/Companies: This category includes small enterprises since they generally employ fewer than 70 people.

Understanding the context and size of each organization included in the categorization might be crucial when analyzing the study's conclusions.

The first outsourcing organization, referred to as C1, is a large entity that offers a wide range of services in software and hardware solutions. They serve both domestic and international clients, with a significant portion of their workload coming from foreign clients located in countries such as the US, France, Israel, and Taiwan.

Moving to the second outsourcing company, designated as C2, we encountered a medium-sized business. C2 specializes in providing diverse services across software and hardware industries, catering to a global clientele that includes established startups and multinational corporations like Cisco and HP. Their client base is notably diverse, primarily originating from countries like Israel and the United States, with fewer engagements from Europe. Next, the third outsourcing organization, C3, is also of medium size, focusing primarily on providing software services to a varied customer base. Notably, the majority of their clientele is situated in USA, the United Kingdom & Europe.

Finally, examining the fourth outsourcing corporation, we discovered a medium size business with a focus on several areas of software engineering. Their knowledge included a system administration, quality control, and web development. It's interesting to note that most of their projects were carried out for foreign clients, largely based in the US and Europe, with just a small number of engagements engaging local clients.

Table 1. The four instances' demographics:

Case Study ID	Specialized Services	Business Dimension	Locations of Worldwide Customers
C1	Hardware, Software	Large	France, India, Malaysia, United States
C2	Hardware, Software	Medium	Malaysia, United States, Italy
C3	Software	Medium	United States, Europe
C4	Software	Medium	United States, Italy

The results of our qualitative multiple-case investigations into the areas mentioned in our research queries are covered in the following parts.

3.1. Motives for and challenges of IT outsourcing in the IT industries

According to members from C3 and C4, outsourcing is critical for the software industry. A software development manager at C2 emphasized that software outsourcing is a primary business strategy within the industry. Similarly, an R&D software manager at C1 highlighted the essential nature of outsourcing for achieving success in the IT sector. The collaboration between foreign businesses and the IT sector is often necessitated by global factors such as high demand for software outsourcing services and shortages of engineering resources in local markets. A manager of design verification at C1 stated that these chances gave outsourced businesses the chance to learn, gain useful experience, and build solid reputations, establishing them as fierce rivals in the market.

Businesses often showcase their capabilities to attract clients, but being perceived as the best option doesn't solely hinge on this, especially when their service costs are higher compared to emerging regions

like the Middle East and Eastern Europe. However, a manager responsible for software application development at C2 noted that they are frequently viewed as a good solution for the Malaysian market owing to features including geographic closeness, synchronicity with neighboring time zones, and the adaptability to fit client meeting schedules.

According to a C4 quality assurance manager, these businesses routinely deliver top-notch quality, which significantly boosts customer happiness. A C3 software development manager also noted that regional businesses had a strong dedication to fulfilling customer demands. This commitment results from the great services provided by these businesses, which enable them to compete on an equal basis with foreign rivals.

The solid relationships that C3's business has built with its clients and have a big impact on their ability to succeed. Long history of unshakable dedication, great communication skills, and consistently high job quality have allowed them to build a solid and reliable reputation with their clientele. As a result of this reputation, the business has grown, including the formation of a larger software team and the creation of additional divisions for both technical and non-engineering tasks like marketing and customer service. Similar results were seen by C2, who emphasized that these exceptional profiles not only enabled the development of their services for current clients but also positioned them as potent international rivals. Due to their competitive advantage, more customers are now engaging with their business.

Each of the cases under investigation uses the same method to gauge the performance of their outsourcing efforts for software development. To determine this success, they depend on two models. There are two main methods for outsourcing software that have been seen:

- One-time software outsourcing scheme: In this case, the vendor provides a software product that complies with the specifications the customer sets. This is completed on schedule, with good quality guaranteed, and at a certain, pre-set fee.
- Clients typically incorporate people into their own teams in this manner of operation for continuous software outsourcing. This frequently happens when providers routinely meet or exceed client expectations, which prompts an expansion in hiring on the vendor's end to match client demands.

Table 2. List of the strategies used by the instances under investigation to reduce the possible hazards associated with software outsourcing:

Strategy	Case study ID			
	C1	C2	C3	C4
assembling a knowledgeable team to look for and tackle new tasks	✓			
establishing trusting relationships with the clients they serve	✓	✓	✓	✓
the availability of professionals that can assist with reaching and competing in projects for major worldwide corporations	✓			
Keeping the flow of work organized to prevent job shortages among our personnel	✓	✓	✓	✓
fostering strong links with our regional institutions to close the knowledge gap between academia and business, allowing us to securely recruit and rely on our recent graduates more quickly and smoothly	✓	✓	✓	✓
To find the finest candidates that can match our organization, we train recent grads there.	✓	✓	✓	✓

3.2. Geographical Limitations

While the case study method provides deep insights, its applicability to broader contexts can be limited by the selection of relevant and appropriate cases. The quality of the outcomes is influenced by the selection of relevant and appropriate situations. The ability to cooperate with clients nearby is greatly influenced by proximity to software outsourcing enterprises. A manager responsible for software application development at C2 stated that "when clients and vendors are geographically close, establishing a strong working relationship becomes more manageable." Furthermore, a development manager & researcher at C1 emphasized that for IT firms, closeness to customers has been beneficial. It allowed these

businesses to build strong relationships with local customers, which promoted cooperation and the creation of good reputations. This stellar reputation acted as a springboard for growing their clients internationally.

Although its effect has changed over time, the geographic distance between clients and vendors continues to be a significant element impacting communication and coordination processes. The difficulties caused by distance have reportedly been greatly lessened because of improvements in contemporary digital communication technology, claims C4. These technologies successfully close the distance between customers and suppliers. As a result, clients may no longer get the same level of benefit from mere proximity as they formerly did. Clients are less concerned with developers' actual presence than in the past.

Conversely, the design-verification manager at C1 contends that certain clients still like working with providers nearby.

The difference amongst time zone vendors & clients, resulting from geographical separation presents a significant difficulty, nevertheless, as was noted in all of the examples under consideration. Particularly if there are no common working hours between the two parties, it may make communication difficult. C1 provided a different viewpoint though, relating a time-zone-spanning experience from working on a team that was geographically separated. The client profited in this instance from the daylong project progress and uninterrupted service supply. The customer was able to get the intended project of software as a result in minimum timeline.

3.3. Cost Reduction

Cost reduction was repeatedly emphasized as the main motivation for outsourcing software in all of the findings made from the situations that were looked at. Companies typically choose in-house development to reduce the risks associated with third-party outsourcing when the costs involved with producing software products within the client's organization are comparable to those incurred by outsourcing. A technical manager at C4 made a significant discovery when he observed that if the vendor company provides the client with efficient assistance while also lowering service costs without compromising quality, it fosters a stronger commitment from the client to maintain high product quality. The customer typically benefits and expands as a result of the greater emphasis on quality preservation. A manager of design verification at C1 concurred with this discovery in a similar manner.

4. Discussion

To support our conclusions, we examined the main discoveries from case studies in this part and comparison was made with previous research. Previous studies mostly focused on examining software outsourcing, discovering its motivating elements, and clarifying the difficulties involved [31], [32].

4.1. Motives for and difficulties with IT outsourcing in the IT industries

It is clear from the answers to RQ1 that Information Technology industry is a rapidly growing field characterized by constant growth and progress. Software outsourcing is the main force driving this industry ahead since it is essential to the expansion and success of regional businesses. We discovered that a key motivator for local businesses to prosper is the widespread high mandate for services regarding software outsourcing [31]. Due to the high demand, businesses have successfully competed with established outsourcing hubs globally, such as Malaysia and China, demonstrating their capability to thrive.

The trust factor was a significant aspect supported by our researched cases. Companies engaging in software outsourcing invest in building strong client-vendor relationships. The mutual trust between the two sides results in a more enduring and advantageous partnership. The effectiveness of communication between the client and the provider is a crucial component. The importance of communication quality was acknowledged in each of the situations we looked at, and this was supported by [33]. All necessary management and technical levels of communication abilities, according to our participants' assurances, are present in their organizations.

We have observed several factors that discourage organizations from outsourcing software. One such barrier to these businesses being globally competitive is the relatively modest size of the local community, especially in high-demand fields like machine learning, artificial intelligence, and Development, Security and Operations. The fundamental cause of this restriction is the dearth of qualified experts in these fields.

Another deterrent comes from concerns about high-risk investments, mostly as a result of the region's political unrest. Investors frequently choose stable, developing nations over areas with a higher risk of instability for their investments. We find it particularly important because our analysis revealed a fresh component that hasn't been extensively discussed in the outsourcing literature. According to this study, software development organizations use a variety of risk-reduction techniques while outsourcing their work. These tactics include creating strong profiles, upholding well-organized workflow procedures to maximize resource utilization, encouraging partnerships with nearby universities to produce graduates with solid theoretical and technical backgrounds, and holding training sessions for recent graduates that are specially tailored to the demands of the business.

The study's key finding was that local outsourcing businesses have an astonishingly low turnover rate. The bulk of the examples we looked at validated this occurrence. This tendency is influenced by a number of variables, including the dearth of promising job opportunities, especially for senior and highly qualified engineers.

The lack of firms in the market with a consistent need for new engineers is another crucial factor influencing the low turnover rate. It's important to note, though, that one of the examples we looked at presented a different viewpoint, claiming that their business has a significant turnover rate, particularly among mid-level engineers. The company's operations are being negatively impacted by this turnover problem.

4.2. Geographical Limitations

Based on the RQ2 findings, we examined a number of situations and highlighted the relevance of geographic proximity as a key element that may either support or undermine the practice of outsourcing. In comparison to companies that are placed at a distance, those that are closer to their clients tend to generate greater trust and incentive in these clients to engage in outsourcing relationships. However, we saw in our examples that this factor's influence and significance have been declining recently. The development of communication technology is mostly to blame for this loss of relevance. The communication gap between customers and sellers has been impressively closed by modern tools including simple contact ways, video conferencing, and simple audio programs. As mentioned in [33], this observation is consistent with the findings of other studies. Furthermore, the instances we examined demonstrated that when prioritizing issues, things like cost and quality come before things like regional restrictions. In essence, the dominating significance of these other two crucial components might overshadow the impact of physical location.

4.3. Cost Reduction

The results constructed on the results of RQ3, it is clear that cost savings are one of the main factors influencing the practice of outsourcing software. This finding supports the findings reached by [34]. However, our case studies have shown that quality takes priority over cost reduction, which, while important, occupies a secondary place. Clients will occasionally work with software outsourcing firms even if their charges are somewhat higher than those in other outsourced locations. This tendency is explained by the high caliber and constant dedication displayed by these businesses. Furthermore, our instances demonstrated that during the project's outset, cost reduction carries the most weight. The emphasis on cost reduction progressively fades, relegating it to a secondary and less important concern as confidence is steadily established and the outsourced business demonstrates its quality and devotion.

4.4. Suggested Model

Numerous outsourcing models have been studied in the literature to date, including Model of Relationship and Contract Dimensions [35] and the Capability and Performance Outsourcing Model [36]. The connection and competence aspects are the focus of the competence and Performance Outsourcing Model, which also makes use of surveys. However, a flaw in this approach is the absence of particular measuring criteria and the rather generic metrics it uses to evaluate relationship management and competency. In contrast, the Relationship and Contract aspects Model emphasizes relationship, contract, trust, and commitment aspects while using interviews and case studies. This approach, however, ignores the capacity dimension. We have developed a conceptual model for creating an outsourced vendor model by drawing conclusions from our investigation of the four outsourcing organizations included in our study. This concept is intended to help outsourcing companies grow their worldwide clientele and make outsourcing techniques easier to adopt.

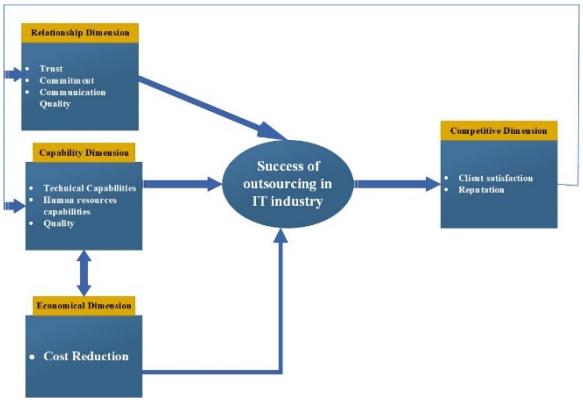

Figure 3. The proposed model

The four fundamental aspects that make up the model we've proposed the connection aspect, the capacity component, the economic dimension, and the competitive facet that receive the most attention. The relationship dimension denotes the link amongst two parties, the service providers and the clients. This connection understood to be a crucial factor determining whether IT outsourcing will succeed or fail. Our results demonstrate that the client-vendor relationship has a major influence on the success of IT outsourcing projects. The degree of trust between these parties may be the deciding factor in whether outsourcing projects succeed or fail. Positive connections frequently result in outcomes that are win-win for all parties involved.

Our findings indicate that the relationship dimension includes essential components including commitment, communication quality, and trust. These factors play a vital part in the achievement and prosperity of outsourcing endeavors. The importance of trust was consistently emphasized in every situation we looked at. In addition to being essential to the success of existing projects, trust releases new possibilities, not just amongst the vendor and the customer nonetheless likewise through recommendations and collaborative efforts from the client. Our experiences also demonstrated the value of dedication, which strengthens and prolongs the bond between clients and suppliers. One of the situations we looked at indicated that a customer had terminated many contracts with Malaysian suppliers after having previously worked with them. The main justification given for this choice was the suppliers' lack of dedication and trustworthiness. Instead, the customer chose to bring these software projects in-house, largely as a result of our company's remarkable dedication and the mutually beneficial working relationship that was developed.

Another crucial issue that surfaced was the caliber of communication among the seller and client. Misunderstandings about client's needs, specifications, deliverables, milestones, and schedules may arise from inadequate communication. These kinds of misconceptions might result in project failures. These results are consistent with a prior study by [35], which similarly highlighted client-vendor affiliation dimension as a key element in the accomplishment of IT outsourcing projects.

The capacity dimension, the second dimension, covers one of the main reasons why clients outsource their software projects. Many clients lack the money, IT infrastructure, or software technology skills [33]. In our case studies, this requirement for knowledge was clear. Customers are looking for highly qualified employees who can make use of cutting-edge technology to meet their needs. Clients are freed from the burden of software development when outsourcing suppliers have the required technical know-how and top-notch human resources, allowing them to focus on their core operations and pursue new prospects.

In our case studies, there was universal agreement that the capability factor was of utmost importance. All of our instances emphasized this aspect as the main factor encouraging software outsourcing practices. This is in line with the conclusions of [37] who also highlighted the critical part the capability dimension plays in the success of IT outsourcing. The economic dimension, which mostly revolves around cost reduction, is the third factor we take into account. To increase their sales, clients are eager to save expenditures. The capacity and economic elements are intricately intertwined. Customers always want to get top-notch quality at the lowest price. Vendors must work to balance this type of two aspects, particularly at the commencement of a software project. Long-term relations built on trust and consistently

good quality have a tendency to lessen the importance of the economic factor, allowing customers to lessen their emphasis on cost-cutting.

These factors come together to make IT outsourcing a success overall, putting the customer well in the worldwide market. The third, and last, dimension in our framework—the competitive one—emerges as a result of the accomplishments made in the first three. It denotes client fulfillment and the development of a great reputation, both of which are advantageous to the client-vendor relationship as well as to the client's network of partners and references. A feedback loop that affects the original dimensions is triggered by the realization of the competitive dimension. Improved connections with new clients are a result of client contentment, a stellar reputation, and consistently effective communication. Additionally, it fosters the development of stronger competencies, such as the creation of strong technical and administrative teams, the acquisition of elite human resources, and the achievement of consistently superior outcomes. This feedback loop is an important objective and a worthwhile target for outsourced companies to work towards.

5. Conclusions

We used an exploratory multiple-case study technique in this work to dive into the world of IT outsourcing in actual industrial settings. As part of our serious effort to obtain knowledge about the IT outsourcing practices of the IT sector, identify its driving factors, and overcome its obstacles, our inquiry concentrated on four well-known software development outsourcing organizations. It's important to note that each of the examples we looked at ranks among the top innovators in the field of IT outsourcing. Based on the number of employees, these businesses range in size from modest to giant. Our analysis emphasizes how important software outsourcing is as a key driver of expansion for businesses engaged in the development of the IT sector. The strong global demand for software services is a major driver of this trend, encouraging businesses to work with clients abroad and provide high-quality services adapted to their requirements. Furthermore, our research showed that local businesses prioritize building sustainable, long-term client relationships over short-term, one-off contracts, placing a strong premium on quality and customer satisfaction. The cases we looked at benefited from these successes in client satisfaction and reputation building, giving them a competitive edge. These success tales were used by them to win over new clients as well as keep their current ones as customers. As a result, the IT industry has faced obstacles including a lack of domain specialists in particular disciplines, which has prevented the examples we analyzed from achieving a higher level of global presence and competitiveness. Cost savings continue to be the fundamental driver of investment in IT businesses. The situations we looked at highlighted the importance of cost reduction, particularly when new software projects start and develop. Furthermore, our research has revealed that, when it comes to software outsourcing in the IT industry, quality comes first, followed by economic concerns, with geographic distances playing a less significant role. Furthermore, our study has shown that worries about high-risk investments in software outsourcing, prompted by regional political unrest, have a negative influence on the competitiveness and international ambitions of local outsourcing companies. In addition, we've developed a fresh outsourcing model for the software industry. This methodology not only makes it easier for operations, but make their outsourcing efforts more successful. We want to perform exploratory research connection amongst software outsourcing and staff business in IT organizations in our next work.

6. Patents

It is possible to boost authenticity by using a part watch, which allows participants the ability to examine and certify the veracity of their meeting actions. Through triangulation, the outcomes will be more stable. Data from various sources (interviews, papers) must be cross-referenced in order to confirm the veracity of interpretations. Results are trustworthy and credible when the quality and validity of the study are emphasized [22]. There are common tests that may be applied to determine the validity of this research, including concept validity, internal validity, external validity, and reliability. By [24] [38], these four tests were named and conversed.

We painstakingly addressed a number of issues relating to the reliability of our research in this study. We used a diverse strategy, gathering data from several sources, particularly focus groups and interviews conducted throughout the data-collecting phase, to guarantee construct validity. By giving interview

transcripts individual identifying codes, we scrupulously preserved a chain of evidence and made it possible to clearly track information. Each sentence was also sequentially numbered and cross-referenced to its original source text during the theme classification step. We found that internal validity, which deals with causal claims, was not relevant to our exploratory multiple-case research design and was thus left out of our validity evaluations. In order to address external validity, we built our study on a solid theory that was developed after a thorough evaluation of the body of prior research. Furthermore, we used two crucial strategies to increase the validity of our study. First, we developed a thorough case study technique that served as the blueprint for all of our investigation. In order to guarantee the accuracy and consistency of our conclusions, we also built a case study database, methodically organizing and archiving all relevant data from our case studies.

The quantity of participants in our focus group was one of the study limitations we noted. Creswell [39] states that a focus group should include six to eight individuals; nevertheless, our focus group only had three people.

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