An empirical analysis of perceived significance of information security service quality to predict the organisational performance in software service industry

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Abstract Businesses have derived various benefits from offshore outsourcing of information and communication technology services while accepting and managing perceived risks with respect to the service quality of information security delivered in the supply chain. In this empirical research, taking India as a case which tops the global information technology outsourcing supply chain world ranking, we examine the perceptions of Indian software services provider (service provider) employees with respect to information security service quality delivered to customers and its impact on the service provider organisational performance. Using the existing dimensions and instruments for service quality and organisational performance, our study provides a framework suitably modified to reflect the context of information security. We have used SmartPLS, a structural equation modeling technique, to analyse field survey data collected from across different Indian cities and companies. Significant finding of our research is that information security service quality in an IT offshore outsourcing company providing software services has an impact on the service provider organisation performance, which can be predicted. In addition we also establish that there is positive relationship collectively between elements of information security service quality and organisation performance. We conclude that there is an urgent and serious need for software outsourcing business enterprises to focus on, amplify and commit to information security service quality at strategic, tactical, and operational levels if they wish to achieve revenue expansion, completely satisfied customers and create long term trusted relationships.

Keywords Information security service quality · Information technology offshore outsourcing · Indian software service providers · Supply chain · Organisation performance · Trust relationship

1 Introduction

The remarkable increase and dependency on information and communication technologies (ICTs) by businesses to achieve efficiency, collaboration, improved effectiveness and competitiveness has also led to an increasing demand for software services, which can be broken down into their constituent parts and traded [1]. This increased demand has led to and is fuelling the unstoppable growth of IT outsourcing business [2] and outsourcing is making the world a better place by the redistribution of wealth [3]. As offshore outsourcing service providers and customers continue to innovate and devise new services for outsourcing there is also an increasing challenge for service providers to ensure that they provide assurance and compliance against information security breaches including service failures. Information security assurance along with risk management, quality, financial issues and other factors are essential parameters in selecting an IT outsourcing partner [4]. Few studies have investigated outsourcing issues from the vendor's perspective and there is need of research from an information security perspective in offshore outsourcing context at the vendors end. In this study we empirically investigate whether information security service quality has an impact on software services organisation performance from the offshore outsourcing service provider perspective. We conclude that there is an urgent and serious need for the development of adequate security measures such as information security service quality by the

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service providers if they wish to achieve revenue expansion, completely satisfied customers and create long term trusted relationships.

2 Theoretical background

2.1 Offshore outsourcing

Rapid advances in the information and communication technology have transformed the way services are traded and have provided tremendous boost to cross border trade in services. This globalisation of services sector has given rise to offshoring—the cross border sourcing of ICT enabled business support services. In the trade of services based on the General Agreement on Trade in Services, four modes to trade services internationally have been identified based on the location of the service provider and customer of the traded service [5]. Offshore outsourcing of software (part of information technology services) is defined as “when the supplier of software development is from another country than the firm that decides to outsource information systems” [6]. A vast body of knowledge exists with respect to outsourcing covering various aspects such as benefits and implications of outsourcing, economic theories, management of key risks during outsourcing, client perspective, relationship perspective, provider perspective, process view to security frameworks for outsourcing [4, 6–20]. Offshore outsourcing of software services is one of the leading strategies followed by majority of business enterprises from developed countries to achieve a competitive lead and achieve efficiency gains while reducing their costs and skills shortage. It is documented in past research that information systems outsourcing is a strategic management practice which is currently going through an unstoppable growth period [13, 21] and India is the largest exporter of ICT services in the world [4, 22]. But at the same time there have been questions raised with respect to service quality and information security violations offshore [23].

2.2 Quality, service quality and information security

An effective strategic technique which is used to achieve competitive lead by business enterprises is quality [24] and for expanding the offshore outsourcing industry trade bodies indicate quality as a differentiator to the customers [25]. In any relationship between a service provider and customer, quality persists to be an essential aspect as established by [26] in their research. Reliable and consistent quality is the most important dimension in terms of perceived value for customers trust and satisfaction [27]. Causal relationship between trust, long term relationship and role of quality has been established through structural equation analysis by [28].

In a service encounter where the trade of outsourcing software services between customers and the service providers providing software services takes place, the service providers strive to be competitive and a market leader by delivering superior customer value by focusing on three value disciplines (wherein they meet industry standards in two of them and excel in the third) which are operational excellence, product/service leadership and customer intimacy [29]. The outsourcing success of a service provider is dependent on service quality, which is supplying high quality and value added information systems services in the best interest of the customers, and partnership elements like trust [30]. Over the years, extensive and rich literature has been available in the area of service quality. Services are difficult to evaluate as compared to goods/products since they tend to be intangible, the customer is involved in their creation, they are processes and also dependent on the behaviour of the service provider [30]. The most widely accepted and cited service quality model in literature is the GAP model from Parasuraman et al. [31]. Service quality, with respect to this model, is widely defined in published literature as the gap between the service expectation by customers from a service provider and actual service perceived to be delivered to the customer by the service provider. The service quality conceptual framework from Parasuraman et al. [32–35] identifies five dimensions that customers consider in their assessment of service quality—reliability, responsiveness, assurance, empathy and tangibles. A 22 item instrument, popular in literature as SERVQUAL tool is available, which helps to assess the service quality gap between customers’ perceptions and expectations and found to be appropriate for measuring information systems service quality [32, 34–38]. The service quality model can be used to study the gap between customer driven expectations and perceptions which are formed based on service providers services and behaviour.

Reference [39] has decomposed quality into its relevant component factors (attributes or characteristics) and established clearly that security along with safety and survivability are quality factors. Information security has been identified as a dimension of information quality and further characterized as dependable information for service quality [40]. The Code of Practice BS7799 for Information Security, also accepted by the ISO in the ISO/IEC 27000 family and also aligned with ISO 9000 (quality management), considers security to be a part of quality as it is based on the continuous improvement “plan-do-check-act” cycle which is used for quality (ISO 9000) and known as the Deming cycle or PDCA [41, 42]. As per Woody [43], security is a quality area, a shared responsibility across the organization, does not have complete requirements and a failure to recognise it is an organisational risk leading to liability. One of the vital selection parameter for selecting

an offshore outsourcing service provider is information security assurance levels, their effectiveness, efficiency, adequacy at the service provider side and information security is essential for initial and continued outsourcing trust [4, 11, 18, 20, 44, 45].

2.3 Performance

Security breaches can cause a sustained loss in an organisations share price, thus impacting its performance [46]. Lodahl and Redditt [47] point out that “most companies still manage IT to minimize its cost rather than to maximize its contribution” and in their work they found that the information technology “contribution measure accounts for half the variance ($R^2 = 0.52$) in company profit margins normalized by industry”. In literature, the relationship between quality management practices and organisational performance has been much researched. Understanding and delivering on customers’ expectations, is a dynamic business situation requiring continual quality improvement which in turn relates quality practice to improved financial performance (significant at $p < 0.01$) based on data collected from 977 business firms from across the globe [48]. This is further strengthened by providing empirical evidence that firms after having received quality awards show better operating income-based measures [2]. Integrating quality initiatives with the 5P’s (Purposes, Principles, Processes, People, and Performance) model helps in providing feedback and control for strategic decision making, based on the performance of an organisation for its long term survivability and profitability [49].

The performance of an organization denotes two aspects—(1) the operational efficiency such as quality improvement having measures such as customer satisfaction which is derived from the business process performance and (2) the improvement of the bottom line such as revenue increase or reducing costs or profitability which are measured based on financial parameters derived from overall organisational performance [50]. A firm’s performance, relating to effectiveness, is the action it takes to meet customer demands and quality, including service quality dimensions, has been the main driver for expansion in scope of performance measurement, including operations performance—requiring multiple measures, both financial or monetary and non-financial or value [51–53].

A cross-sectional study by Samson and Terzioviski [54] showed that there is a significant relationship between total quality management practice and organisational performance in terms of quality performance, operational and business performance indicators. A key determinant of an organisations success is superior service quality [55, 56]. In the ever increasing competitive conditions for capturing global software outsourcing business and completely

satisfying increasing customer demands, it is inevitable for software service providing organisations to amplify their superior service quality so as to highlight operational efficiencies. To achieve this amplification, the service provider organisations should take responsibility in helping customers perceive the advantage by enhancing their measurement knowledge [57]. Service provider organisations need to understand that, based on research of thirty organisations from five different markets, it should be their top priority to have completely satisfied customers which requires some investment and in return these customers turn out to be very loyal and the investment of the service provider is paid back many times over thus helping drive the long term financial performance of the service provider [58]. In a service industry context financial measures have some limitations and hence performance is enhanced by non-financial measures where decision makers look at causes instead of effects in service operations [59]. The empirical results for financial returns from quality indicate superior outcomes for a customer satisfaction approach which is marketing and leads to revenue expansion as compared to efficiency approach which is operations and leads to cost reduction or as compared to both which is revenue expansion and cost reduction at the same time [60].

Researchers have also provided questions, elements or attributes that they have used for their survey instruments in their research and contribution to organisations operational performance [51, 54, 56].

3 Research model and hypothesis

Since information security is a part of quality, it is also an integral part of service quality. Thus there is a link between information security service quality (based on SERVQUAL) and organisation performance. In our research we have considered the five dimensions of SERVQUAL and two dimensions of performance—monetary and value. With respect to service quality, we have studied the perceptions from employees perspective who are providing the services to customers. The motivation of this research paper is to build upon the existing dimensions and instruments for service quality and performance while modifying them to reflect the context of information security. In addition, this also helps us to ensure the control of measurement error. We have administered these instruments on employees at the Indian software service providers end to study:

The service quality that is followed at the Indian software service providers in terms of their perception of what the customer expects which is ideal and their perception of what they provide which translates to customer perception which is actual, and

Fig. 1 Conceptual framework

Their perception, with respect to information security, of their organisations performance in monetary and value terms.

The research model for our conceptual framework between information security service quality and organisation performance is in Fig. 1.

Our assumptions are that information security service quality drives organisation performance based on perceived value for customer trust, long term customer relationship, determining customer satisfaction and building service providers brand identity. Our hypothesis is that:

- (1) Quality of security services in an outsourcing company providing software services can predict the organisation performance, and
- (2) There is positive relationship collectively between elements of Security service quality and organization performance.

4 Research design and methodology

4.1 Research design and sample

Our study has used survey methodology to gather data. The target audience was security professionals in the Indian software service provider companies. We received responses from 61 respondents from 22 companies covering various cities across India where outsourcing software services vendors are situated—Bangalore, Chennai, Hyderabad, Delhi, Noida, Gurgaon, Lucknow, Bhubaneswar, Mumbai, Pune. The data was collected on a Likert scale, where 1 indicated minimum agreement and 7 indicated maximum agreement. The data demographics are as in Table 1

4.2 Measures of the construct

We have used measures that have been validated in previous research of SERQUAL and performance to ensure the control of measurement errors. However, we have modified and constructed some measures to reflect the context of information security. Construct validity as well as structural coefficients have been analyzed by SmartPLS

Table 1 Data demographics

	%
Region	
North and East India	32.78
West India	19.67
South India	47.55
Age group	
25–30	29.5
31–40	34.43
Above 41	36.07
Service years	
1–5	29.5
6–10	29.5
11–15	24.6
16 and above	16.4

[61], a software application for the design of structural equation models.

5 Data analysis and results: model testing and construct validity

We have used partial least square (PLS), a structural equation modeling (SEM) technique for modeling. The PLS procedure is a second-generation multivariate technique [62] which has been gaining interest and use among researchers specifically in computer science, management, accounting, marketing, operations management and psychology. PLS is a component based variance analysis method and determines the prediction relevance of latent variables; meaning how well a specific construct value can be predicted by another construct value [63]. Hence PLS is a prediction-oriented model. PLS is similar to regression, but can assess the measurement model and structural model simultaneously in one operation.

PLS has been used since our primary concern is the prediction of dependent endogenous variables—as PLS generates latent variable scores that can be used to predict a model, does not impose homogeneity or normality requirements on the data, can be used to analyze a model that incorporates reflective variables, it is a powerful data analysis technique even when a sample size is small—

recommendation of a minimum sample size of 40 may be sufficient, can be used for complex and simple models [64–68].

In our research we have used the data collected for (1) security service quality through 22 questions for what the employees at the Indian software service providers perceive what the customer expects which is ideal and 22 questions for their perception of what they provide which translates to customer perception which is actual. The break up for the 22 questions in service quality is as follows: 4 for tangibles, 5 for reliability, 4 for responsiveness, 4 for assurance and 5 for empathy. We have provided the results for service quality by taking actual and also by taking ratio of actual to ideal, and (2) organisation performance through 16 questions as follows: 3 for monetary and 13 for value.

6 Testing of individual item

Alpha should be greater or equal to 0.80 for a good scale, 0.70 for an acceptable scale, and 0.60 for a scale for exploratory purposes [69]. The average variance extracted (AVE) by each construct should exceed 0.50 to have convergent validity [70]. The criteria for alpha and AVE are met as can be observed in Tables 2 and 3.

Most of the standardized loadings of individual item were over the acceptable cutoff level of 0.6 [71] (in survey questions—the 2P notation is used for the service quality and 5P notation for performance). The only loadings lower

than 0.6 were 0.431327 and 0.516107 but more than 0.4 [72] while being significant as per the *T* statistics, out of 38 reflective indicators and hence have been considered as acceptable as can be seen in Table 4.

As an example the question 2P1 is: organization has up to date technology and processes for security; the question 2P8 is: they adhere to meeting security services (physical, network, application, people as required contractually) at the times they promise to do so; the question 2P22 is: the

Table 4 Loading values

	Original sample	<i>T</i> statistics
2P1 ← tangibles	0.852299	24.493884
2P10 ← responsiveness	0.743990	11.405581
2P11 ← responsiveness	0.904114	42.247984
2P12 ← responsiveness	0.910618	37.264586
2P13 ← responsiveness	0.839591	27.629891
2P14 ← assurance	0.908007	50.664170
2P15 ← assurance	0.926416	59.832158
2P16 ← assurance	0.792716	16.832030
2P17 ← assurance	0.820830	24.561316
2P18 ← empathy	0.780287	18.084508
2P19 ← empathy	0.626910	4.935627
2P2 ← tangibles	0.655564	5.108374
2P20 ← empathy	0.802960	22.407331
2P21 ← empathy	0.864385	31.957495
2P22 ← empathy	0.755512	15.722911
2P3 ← tangibles	0.842512	24.053056
2P4 ← tangibles	0.431327	2.205204
2P5 ← reliability	0.696141	11.161609
2P6 ← reliability	0.780036	13.031310
2P7 ← reliability	0.873246	26.246160
2P8 ← reliability	0.748278	16.506445
2P9 ← reliability	0.755462	9.927595
5P1 ← monetary	0.939733	36.625475
5P10 ← value	0.810433	21.785686
5P11 ← value	0.784643	17.178982
5P12 ← value	0.845262	33.507022
5P13 ← value	0.516107	5.807412
5P14 ← value	0.659261	10.467477
5P15 ← value	0.611660	8.352136
5P16 ← value	0.662731	10.318879
5P2 ← monetary	0.948392	20.095252
5P3 ← monetary	0.864379	15.418377
5P4 ← value	0.779031	17.278598
5P5 ← value	0.841202	23.859022
5P6 ← value	0.745334	14.356103
5P7 ← value	0.817656	21.824642
5P8 ← value	0.775755	13.830023
5P9 ← value	0.724701	13.820947

Table 2 Actual

	AVE	Cronbach's alpha
Assurance	0.746683	0.886807
Empathy	0.592809	0.825288
Monetary	0.843638	0.908677
Reliability	0.596569	0.829956
Responsiveness	0.73194	0.87659
Tangibles	0.525433	0.698719
Value	0.551379	0.930441

Table 3 Ratio—(actual to ideal)

	AVE	Cronbach's alpha
Assurance	0.769987	0.900482
Empathy	0.643411	0.861207
Monetary	0.839901	0.908677
Reliability	0.576366	0.813923
Responsiveness	0.855353	0.942979
Tangibles	0.530499	0.715973
Value	0.543703	0.930441

employees/associates of the organization understand the specific security needs/regulatory requirements of their customers; the question 5P1 is: financial performance of the company (for example, net income, profits, and profit margins); the question 5P7 is: customer satisfaction with respect to security; and the question 5P13 is: how much in your opinion is the security related cost reduction for customers.

Therefore, considering the alpha values, AVE and loading values (as per Table 4), reliabilities of each item are acceptable.

7 Testing of overall model

The validity and reliabilities of each individual item have been established and as a next step we have proceeded to test the overall model in a two stage process. In the first stage the measurement model is evaluated and in the second stage the structural model is evaluated.

7.1 First stage

Reliability: composite reliability assesses the internal consistency of the constructs. The acceptable values for composite reliability are the same as those for Cronbach's alpha [70, 73, 74] (alpha should be greater than 0.70 for an acceptable scale). The values are acceptable as can be seen in Tables 5 and 6.

Validity—convergent and discriminate validity: average variance extracted (AVE) is used for establishing convergent validity. It reflects the average communality for each latent factor and in an adequate model, AVE should be greater than 0.50 [70] which can be seen in Tables 5 and 6 as acceptable values.

The cross loading test is used for evaluating the discriminate validity at an indicator level, where the loading of each indicator is expected to be greater than all of its cross-loadings. The latent variable predicts each variable in its construct better than the other constructs when the

correlations load is higher on the respective latent variables than other latent variables [73]. Within-construct item loadings should exceed the inter-construct cross loadings by at least 0.10 [70, 75] and hence the highlighted values as seen in Tables 7 and 8 are acceptable.

The discriminate validity at a construct level is investigated by comparing the square root of the average variance extracted (AVE) with the correlations between the variables and the correlation between different variables should be lower than the square root of the AVE [75] as can be seen acceptable in Tables 9 and 10.

Thus, as part of the first stage, sufficient reliability and validity of the measurement model is established.

Table 7 Actual

	Performance	Service quality	<i>T</i> statistics
A-Assurance	0.510344	0.884767	34.358746
A-Empathy	0.558414	0.883954	38.036846
A-Reliability	0.416175	0.860936	22.476872
A-Responsiveness	0.502313	0.889169	37.741185
A-Tangibles	0.415053	0.806520	19.355049
Monetary	0.603775	0.184767	4.225425
Value	0.968322	0.589348	46.985015

Table 8 Ratio—(actual to ideal)

	Performance	Service quality	<i>T</i> statistics
Assurance	0.281081	0.948382	32.837001
Empathy	0.343445	0.936427	32.295591
Monetary	0.642873	0.127590	3.029331
Reliability	0.305819	0.929564	20.725785
Responsiveness	0.253373	0.936630	23.954954
Tangibles	0.262461	0.909768	24.825542
Value	0.954627	0.325170	23.215215

Table 9 Actual

	Performance	Quality
Performance	0.806905	
Quality	0.559613	0.865621

Table 10 Ratio—(actual to ideal)

	Performance	Quality
Performance	0.813818	
Quality	0.313618	0.932241

Table 5 Actual

	AVE	Composite reliability
Performance	0.651096	0.779822
Service quality	0.749299	0.937206

Table 6 Ratio—(actual to ideal)

	AVE	Composite reliability
Performance	0.662299	0.790729
Service quality	0.869073	0.970746

7.2 Second stage

The coefficient of determination, R^2 is used for assessing the proportion of variance in the dependent latent variable that can be accounted for by the independent latent variables. The effect size of R^2 can be classified into three categories [76] based on its values—small (0.0196), medium (0.13), and large (0.26).

The value of R^2 , in our model, is 0.315032 in the actual case and 0.098596 in the ratio case as can be seen in Tables 11 and 12. In the actual case the effect size falls in the large category for performance, and in the ratio case the effect size falls in the small category for performance.

With respect to sign, magnitude and significance the path relationships were evaluated using a bootstrapping procedure where 5,000 sub samples were performed to evaluate the statistical significance of each path coefficient [73, 77]. Critical t values for a two-tailed test are 1.65 (significance level = 10 %), 1.96 (significance level = 5 %), and 2.58 (significance level = 1 %) [75].

For the actual case, it clearly shows that a 100 points change in Information Security Service Quality will bring 55.9613 points change in organisation performance. The values are positive and are at significance level of 1 % which is highly significant as seen in Table 13.

For ratio case it indicates that a 100 points change in information security service quality will bring 31.3618 points change in organisation performance. The values are

positive and are at significance level of 1 % which is highly significant as seen in Table 14.

Thus the hypothesis that there is positive relationship collectively between elements of information security service quality and organisation performance is validated with this.

Further it is validated that information security service quality in an outsourcing company providing software services has a highly significant impact on the organisation performance.

The predictive relevance of the model is measured using the Q^2 statistic [78, 79]. A Q^2 greater than 0 means the model has predictive relevance. Values of 0.02, 0.15, and 0.35 signify small, medium, and large effects. Omission and estimation of data point depends on the chosen omission distance and it should be between 5 and 10 [80] (7 was selected). The cross-validated redundancy, should be used for the PLS path modelling approach [80, 81] for Q^2 .

As can be seen in Tables 15 and 16, the Q^2 values are greater than 0, thus the model has predictive relevance.

It can be seen that the values of Q^2 fall in the medium effect category for organisation performance in the actual case (Table 15) and in the small effect category for organisation performance in the ratio case (Table 16).

Thus the hypothesis that information security service quality in an outsourcing company providing software services has an impact on the organisation performance and can be predicted is validated.

Table 11 Actual

	R^2
Service quality	
Performance	0.315032

Table 12 Ratio—(actual to ideal)

	R^2
Service quality	
Performance	0.098596

Table 13 Actual

	Original sample	Sample mean	Standard deviation	Standard error	T statistics
Service quality → performance	0.559613	0.579510	0.102023	0.102023	5.485156

Table 14 Ratio—(actual to ideal)

	Original sample	Sample mean	Standard deviation	Standard error	T statistics
Service quality → performance	0.313618	0.339691	0.110791	0.110791	2.830720

8 Discussion and limitation

Our research shows that information security service quality drives organisation performance. It also shows that existing dimensions and instruments for service quality and organisation performance, available in literature, can be used by appropriate modification to reflect the context of information security. Software outsourcing business enterprises should focus on, amplify and commit to information security service quality at strategic, tactical, and operational levels if they want to achieve revenue expansion, completely satisfied customers and create trust.

Table 15 Actual

	1-SSE/SSO
Performance	0.152806
Service quality	0.243573

Table 16 Ratio—(actual to ideal)

	1-SSE/SSO
Performance	0.059427
Service quality	0.114569

The limitation of this study is that it has only looked at the software outsourcing business enterprises in India. Future research should cover a larger sample from other service industries and also cover samples from multiple countries.

Given the growing significance of information and dependence on ICT in today's networked globe which is expected to explode in the future, information security is a crucial constituent which needs to be well thought-out and built as part of every aspect including service quality and we hope these findings would provide a step in that direction to other researchers and urge them to build upon our work in this field.

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