CHAPTER III

III. RESEARCH METHODOLOGY

3.1 Research Objectives

On the basis of the aspects to be explored under this research topic and experience of the researcher in the Indian IT Industry the following objectives were formulated:

1. To study Knowledge Sources from a software project’s environment.
2. To study the effect of the Knowledge Sources on a software project’s success.
3. To compare the degree of influence of the identified Knowledge Sources on a software project’s success.
4. To identify the most prominent Knowledge Sources.
5. To study interrelationships between the identified Knowledge Sources.

3.2 Hypotheses

Knowledge sources from a software project’s environment can affect its success in a positive as well as in a negative manner. In the present research, the researcher has constructed the survey questionnaire to focus on adverse effects of Knowledge Sources on a project’s success. Hence a Knowledge Source includes only environmental factors, which are affecting a software project’s success in an adverse manner. Based on this, the following directional Hypotheses are constructed.

Hypothesis I

“There is a correlation amongst the different Knowledge Sources from a software project's environment”
Hypothesis I

“Knowledge Sources from a software project's environment affects the project’s success in an adverse manner leading to partial or total failure of the project.”

3.2.1 Explication of operational terms in the Hypotheses statement

The terms used in the Hypotheses statement are explained from the viewpoint of this research study. Such terms are underlined in the statement of Hypotheses and are explained below.

Hypothesis I

“There is a correlation amongst the different Knowledge Sources from a software project’s environment”

In the present study, related environmental factors are categorized into groups and the group is referred as a Knowledge Source. As a part of the present study following Knowledge Sources were studied.

1. Customer Knowledge (Know Your Customer) – KYC
2. Business Acquisition and Relationship Management – BRM
3. Personnel and Capabilities Management – PCM
4. Skills and Capabilities Development – SCD
5. IT Infrastructure Management – ITM
6. Multi vendor, geographically distributed project Delivery Management – MDM.
The section 3.3.1 Exploratory research, describes in detail about how the environmental factors were identified and Knowledge Sources were defined using them.

The Knowledge Sources studied as part of present research are not independent of each other. There is correlation amongst them. A Knowledge Source may influence or affect one or more Knowledge Sources. This means that while studying the effect of a Knowledge Source, one must understand how it is related to other Knowledge Sources.

Software Project Environment – Software project environment is the settings or conditions in which software projects are developed, maintained and supported.

Hypothesis II

“Knowledge Sources from a software project’s environment affects the project’s success in an adverse manner leading to partial or total failure of the project.”

Following project success criteria was used for the present research to determine project success.

Project success criteria- A software project is successful if it fulfills the following criteria

- A project is delivered as per the agreed Schedule, Efforts/Costs, and Quality and fulfills explicit and even implicit customer requirements.
- Achievement of Short term as well as Long term business goals of software vendor organization.

If a project is not able to fulfill the project success criteria, then its success gets adversely impacted leading to a partial or total failure of the project.
The researcher has hypothesized that the Knowledge Sources studied as part of present research: KYC, PCM, SCD, BRM, ITM, MDM and KMP affect a software project’s success. This results into a partial or total failure of project.

3.3 Research Design and Process

The nature of the research is exploratory research followed by descriptive research. The exploratory research is carried out using literature review and the IT practitioners’ interviews. The descriptive research is carried out using the survey method. The following diagram gives important steps followed in the present research.

3.3.1 Exploratory research

The research started with the exploration of the key factors from a software project’s environment attributing to its success in a favorable as well as in an adverse manner. The key inputs for this phase were the researcher’s own experience of the
Indian IT Industry; literature related with software project failure, guidance provided by the research guide and inputs from the subject matter experts.

The researcher started with informal discussions with selected senior IT professionals from the Indian IT Industry. Fifteen senior IT professionals were carefully selected for these discussions. Out of fifteen, ten professionals were from top five IT services companies as per NASSCOM, four professionals were from Indian arm of global IT services companies and one very senior professional with more than 35 years of professional experience. The key focus of these discussions was to explain the research idea to experts, seek their opinions and understand their experiences while delivering software projects. The researcher also discussed about the experts’ experiences about the changing dynamics of the Indian IT Industry. These discussions helped to understand expert views about the research topic and verify the researcher’s understanding about the challenges faced by the Indian IT Industry while delivering software projects. It was noted that there was a difference of opinion in defining software project failures. However, all of them agreed that success rate is low while delivering software projects and the changed dynamics of the Indian IT Industry has resulted in new challenges which are also affecting the software project success in an adverse manner. The participants gave feedback to focus the study on adverse impact of environmental factors on a software project’s success. According to them, this focus would help to clearly identify the factors based on the actual project failure experiences instead of what participants’ individual opinion/understandings. The researcher agreed with the feedback received and decided to focus the study on only environmental factors affecting a software project’s success in an adverse manner.
After these discussions, the researcher started identifying the environmental factors affecting a software project’s success in an adverse manner. Based on the researcher’s experience, literature review and inputs of subject matter experts the researcher prepared a first draft list of factors. The list went through multiple revisions with inputs and reviews by subject matter experts. Only environmental factors were retained in the list. E.g. Factors related with software engineering and related processes were removed. Equipped with the list, the researcher conducted unstructured interviews of carefully selected senior IT experts. The researcher conducted twenty unstructured interviews. The researcher interviewed the same fifteen IT experts who had participated during the initial informal discussions and, additionally, five more IT experts were interviewed.

The key objective of these interviews was to finalize the list of environmental factors and group related factors together. During the interviews the list of factors along with their initial classification were discussed with the IT experts. The interview discussions and analysis of inputs received during the interviews resulted in removing certain factors and introducing additional factors in the scope of the study. The related environmental factors were grouped together. At the end of the analysis seven groups were defined along with their respective factors.

The researcher named these groups as “Knowledge Sources” for the current study purpose.
Figure 7 Knowledge Sources and Software Project
The following table gives a list of environmental factors identified. The list is classified as per Knowledge Sources.

Table 1 KYC factors

<table>
<thead>
<tr>
<th>1. Customer Knowledge (Know Your Customer) - KYC</th>
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<tbody>
<tr>
<td>Non availability of a single point of contact from the customer side.</td>
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<tr>
<td>Non availability of all the required persons from the customer side as per the project requirements.</td>
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<tr>
<td>Inadequate outsourcing management skills/experience of the customer.</td>
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<tr>
<td>Trust deficit between the project team and the customer.</td>
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<tr>
<td>Lack of a strong relationship between the vendor’s senior management and the customer.</td>
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<tr>
<td>Lack of senior executive support from the customer side.</td>
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<tr>
<td>Lack of understanding of the customer's culture.</td>
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<tr>
<td>History of not very successful projects with the customer.</td>
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<tr>
<td>Politics in the customer’s organization.</td>
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<tr>
<td>Micro management by the customer.</td>
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<tr>
<td>Lack of regular feedback from the customer about a project’s progress and its status.</td>
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<tr>
<td>Multiple stake holders from the customer side responsible for accepting project deliveries.</td>
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<tr>
<td>Dual relationship with the customer – as a customer and also as a partner.</td>
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<tr>
<td>Customer’s geography.</td>
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<tr>
<td>Unreasonable demands of the customer.</td>
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Table 2 BRM factors

<table>
<thead>
<tr>
<th>2. Business Acquisition and Relationship Management – BRM</th>
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<tbody>
<tr>
<td>Stressed project margins (financial).</td>
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<tr>
<td>Inadequate support and commitment of the Sales team during the entire project.</td>
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<tr>
<td>Inadequate support of the senior management and the Sales team in managing the customer’s expectations.</td>
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<tr>
<td>Lack of trust between the Sales team and the project delivery team.</td>
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<tr>
<td>Lack of willingness of the Sales team to renegotiate the project contract, if required.</td>
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<tr>
<td>Lack of clarity of the contracts between the multiple vendors working on the same project.</td>
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<tr>
<td>Lack of clarity of the contracts between the vendor and the customer.</td>
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<tr>
<td>Lack of clarity of the implicit/explicit commitments made by the vendor to the customer.</td>
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<tr>
<td>Non Time and Material based business models.</td>
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<tr>
<td>Sales team’s influence on effort estimates.</td>
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<tr>
<td>Weak global economic conditions.</td>
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<tr>
<td>Overselling of projects.</td>
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Table 3 PCM factors

<table>
<thead>
<tr>
<th>3. Personnel and Capabilities Management – PCM</th>
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<tbody>
<tr>
<td>Human resources of matching skills and desired quality are not allocated to the project right from the required date.</td>
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<tr>
<td>Direct allocation of human resources to projects.</td>
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<tr>
<td>Lack of effectiveness of human resource selection processes.</td>
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<tr>
<td>Non availability of vetted skill and capability profiles of individual team members.</td>
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<tr>
<td>Non availability of previous appraisal details.</td>
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<tr>
<td>High percentage of fresh engineers on the project teams.</td>
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<tr>
<td>Inadequate project management skills/capabilities.</td>
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<tr>
<td>Non availability of domain/technology consultants.</td>
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<tr>
<td>Unable to send key team members at the customer site during the project course.</td>
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<td>High human resource attrition rate.</td>
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Table 4 SCD factors

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<thead>
<tr>
<th>4. Skills and Capabilities Development – SCD</th>
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<tr>
<td>Ability to send the project team members for training during the project.</td>
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<tr>
<td>Satisfaction about the training received by fresh/experienced engineers.</td>
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<tr>
<td>Lack of involvement of the training department in the project team’s skill and capability development.</td>
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Table 5 ITM factors

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<th>5. IT Infrastructure Management – ITM</th>
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<tr>
<td>Non availability of the desired infrastructure when required.</td>
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<tr>
<td>Limited access to the customer's environment.</td>
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<tr>
<td>Non availability of the hardware/software environment similar to the production environment.</td>
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Table 6 MDM factors

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<tr>
<th>6 Multi vendor, geographically distributed project Delivery Management – MDM</th>
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<tbody>
<tr>
<td>Large project/program gets divided across multiple vendors.</td>
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<tr>
<td>Difference in the capability maturity amongst the vendors.</td>
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<tr>
<td>Geographically distributed projects.</td>
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<tr>
<td>Project transition from the customer’s IT team to the vendor</td>
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Table 7 KMP factors

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<tr>
<th>7 Knowledge Management Practices – KMP</th>
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<tr>
<td>Non availability of a company level knowledge repository</td>
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<tr>
<td>Non Availability of a project level knowledge repository</td>
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<tr>
<td>Lack of formal knowledge management processes</td>
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<tr>
<td>Non Availability of channels / tools for knowledge sharing</td>
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Detailed explanation of individual Knowledge Source and environmental factors belonging to them is described in the following sections.
3.3.1.1 Customer Knowledge (Know Your Customer) KYC

Lack of knowledge of a customer creates multiple challenges while delivering software projects successfully. Sometimes, even basic knowledge about the customer is not available with the project team.

Multiple environmental factors related with KYC were studied. The following factors were found to be crucial affecting a software project’s success in an adverse manner.

**Non availability of a single point of contact from the customer side:** It is very essential to have a single point of contact from the customer side. All project related queries can then be routed through this contact. The single point of contact can co-ordinate between various stake holders in a customer organization and resolve all project related queries, issues, dependencies, etc in an effective and timely manner. Non availability of such persons results in delays as the project team from the Vendor Company first doesn’t know whom to talk with and may get information from a wrong source. It may delay the decision making process resulting in the project teams working with wrong assumptions or understandings. This results in schedule extension, extra efforts and also possible functionality and quality issues leading to a project failure.

**Non availability of all the required persons from the customer side as per the project requirements:** It is very important to identify upfront what kinds of inputs are required for successful project deliveries. With the help of established processes the project team usually identifies all inputs required and/or project dependencies before beginning of a project and tracks it continuously as the project progresses. It is observed that even if all dependencies are identified at the beginning of the project, it may not get necessary inputs as per the project requirements. For example, a project
may need inputs related to security from the customer’s security team. If a concerned person from the security team is not available, then the project’s progress gets affected. Lack of security clearance delays the project resulting in project failure. Sometimes, it is also observed that the project needs requirements clarification from business people (people responsible for a business process such as Billing etc). Non availability of business people results in project delays.

**Inadequate outsourcing management skills/experience of the customer:** It is observed that sometimes the customer representatives responsible for outsourcing of software projects are not trained in managing outsourced projects or do not have enough experience in managing outsourcing relationships. E.g. a Customer representative may have a strong experience in managing his/her team. However, for outsourced projects, the representative may not have any visibility of the vendor project team and is expected to manage vendor project deliveries. This is a big change for the customer representative and may result in too much micro management. This creates challenges for the vendor and ultimately starts affecting the project success in an adverse manner.

**Trust deficit between the project team and the customer:** The Project team and the customer must have a strong relationship based on mutual trust. Lack of or inadequate trust results in the customer micro managing the project team and the project team starts becoming risk averse and may not go out of its way to deliver the project successfully. It is also observed that a past failure of a project (customer history) may result in lack of trust.

**Lack of a strong relationship between the vendor’s senior management and the customer:** It is very important to have a strong relationship between the vendor’s
senior management and the customer. The customer should feel that the senior management is available to him when needed and upon escalation his problems can be addressed. Also if the project manager wants to escalate some issue, s/he should be able to escalate it through the senior management. Unless there is a strong relationship between the vendor’s senior management and the customer, such challenges cannot be addressed in an effective manner. E.g. In case of a large IT services vendor company, sometimes its relatively small customers may develop a feeling that they are not getting enough importance they deserve and the senior management is not approachable. During an IT practitioner’s interview, he shared an interesting case. The IT practitioner was working with one of the leading Indian IT companies. The IT Company’s CEO got changed. During regular customer feedback session, the customer candidly said that the earlier CEO used to come and meet him regularly but the new CEO had not visited even once.

**Lack of senior executive support from the customer side:** The support of a senior executive team from the customer’s side is very crucial for project success. Lack of support may result in project budget cuts or due to a lack of visibility the project may not get attention needed by the other executives from the customer’s organization. This may affect the project in an adverse manner.

**Lack of understanding of the customer's culture:** The IT Industry is a global Industry. Usually, the customer and the vendor(s) are from different countries/cultures. For a vendor, it is very important to understand the customer’s culture. Lack of it may result in unnecessary friction between the customer and the vendor teams. E.g. Knowledge of local customs, manners, etc. is very important for the vendor representative. It helps to build strong relationships.
History of not very successful projects with a customer: All projects delivered to a customer by a vendor may not be successful. There are multiple reasons behind project failures. If a vendor has failed in delivering a project in past then it may have a negative impact on the other projects.

Politics in the customer’s organization: It is very essential for a vendor to understand politics in their customer’s organization. For a vendor, it is very important to know who are the key people in the customer organization and with whom he should develop relationships. Politics may affect a project’s success in an adverse manner.

Micro management by the customer: It is observed some customers are more comfortable in micro managing vendor teams. E.g. The Customer gets involved in selecting project team members or may even start participating in day to day project activities. They almost start managing projects. This has a negative effect on the vendor’s project manager and also on the project team. The team feels that the customer doesn’t trust them. Micro management can potentially affect an outsourced project in an adverse manner.

Lack of regular feedback from a customer about a project’s progress and its status: The customer must share a feedback on the project and should be updated about the project progress. Lack of or inadequate feedback may result in wrong assumptions by the project team or certain expectations may get highlighted very late in the project. All this potentially affects the project in an adverse manner.

Multiple stake holders from the customer side are responsible for accepting the project deliveries: Due to the large size of projects, more than one customer representatives interact with the vendor teams E.g. IT manager, Business Manager or Security expert, etc. All such customer representatives may have different objectives
and requirements. It is very important for the vendor to manage their expectations in an effective manner.

**Dual relationship with the customer – as a customer and also as a partner:**
This is a very interesting aspect of a customer and vendor relationship. For example: A large telecom company may outsource its key software projects to a vendor. At the same time, some other unit of vendor may tie up with the same telecom company for global system integration opportunities. Thus at the same time the Telecom company and the vendor have customer – vendor as well business partner relationship. It is observed that challenges in one relationship may affect the other relationship. E.g. Failure to win a system integration contract may have an adverse impact on projects outsourced to vendor.

**Customer’s geography:** Customer’s geography may have an impact on project’s success. E.g. Projects outsourced from matured markets such as North America or UK may have a better chance of success as compared to those outsourced from developing markets such as Africa.

**Unreasonable demands of the customer:** Customers are always demanding. They try to extract maximum value from their investments. However, sometimes demands may become unreasonable and vendors have to accept it under pressure. This increases chances of project failure.

**Weak economic conditions in a customer’s geography can affect projects in adverse manner:** Due to economic pressures, customers try to extract maximum from their investments and may push for discounts with vendors. In response to that, the vendor needs to cut costs. It may result in allocation of less experienced human resources on projects which affects the project’s quality.
3.3.1.2 Business Acquisition and Relationship Management – BRM

To maintain high growth and succeed in an increasingly competitive IT services business, acquiring a new business and growing the current business is becoming more and more challenging for the Indian IT companies. The Indian IT companies are also facing a tough competition from global IT companies. This is putting pressure on the Sales organization of the Indian IT companies.

Due to global slowdown and competition, billing rates of the Indian IT companies have become stagnant and at the same time, customers are aggressively demanding discounts and pressurizing project teams to deliver more work without increasing the payments. This has started affecting project profitability.

In this challenging environment, the role of Sales team and senior management is very crucial for delivering projects successfully. It was observed that adverse interests and lack of co-ordination between the teams managing business and the teams managing project delivery is affecting the project’s success in an adverse manner.

In the Indian IT Industry, Time and Material model was the most common business model used. In this model, the customer is charged based on the amount of time spent by the project team on the project. The payment is only related with time spent and not on project outcome. As the IT business is getting matured, customers have now started expecting projects to be delivered with non time based models such as fixed price model. In a fixed price model, a fixed price is agreed at the time of awarding the project contract. Based on deliverables, the customer releases the payment. This model is more risky than the time and material model. Apart from the fixed price model, other business models based on the business outcome or based on business transactions are also getting implemented. In these models the risk is very
high and it requires in depth understanding of the customer and, customer’s business. The customers have also started putting stringent penalty clauses related with software project delivery.

All these factors are related to the IT business and hence were included in a broader area of Business Acquisition and Relationship Management – BRM Knowledge Source.

Multiple environmental factors related with BRM were studied. The following factors were found to be crucial affecting a software project’s success in an adverse manner.

**Stressed project margins (financial):** Stressed or thin financial margins usually results in cutting of project budgets. It may result in allocation of low cost human resources who may not be skilled or experienced enough, or it may result in non availability of essential hardware or software. This affects the overall project in an adverse manner.

**Inadequate support and commitment of the Sales team during the entire project:** Usually a Sales person gets engaged before a project is won and during initial period of the project. It is observed that the project needs support and commitment of the Sales person for the entire project duration. E.g. The Sales person may know the customer better as compared to the recently allocated project manager. Hence, his involvement becomes important during customer expectations management.

**Inadequate Support of the senior management and the Sales team in managing the customer's expectations:** Managing the customer expectations effectively is very essential for project success. It is observed that sometimes the project manager needs senior management or Sales team’s support/involvement in
managing customer expectations. Inadequate support may affect the project in an adverse manner.

**Lack of trust between the Sales team and the project delivery team:** It is observed that sometimes there is lack of trust between the project delivery team and the Sales team. The project delivery team feels that Sales team doesn’t support them during difficult situations. The Sales team feels that the project delivery team over estimates project efforts resulting in a loss of business opportunity. Both teams should work as one team and must trust each other fully for successful project delivery.

**Lack of willingness of the Sales team to renegotiate the project contract, if required:** Sometimes during the project course, the requirements change, this results in increase in the project scope. During such situations, the project manager gets engaged with the customer to manage the change and negotiate the contract. S/he needs support of the Sales team for the same. It is observed that sometimes the Sales team is not willing to engage and expects the project manager to manage the changed requirements and contractual changes. This may result in acceptance of the changed scope without adequate change in schedule and cost affecting the project success adversely.

**Lack of clarity of contracts between multiple vendors working on the same project:** Due to the large size of projects, a larger project may get split across multiple vendors. This leads to dependencies between the vendor teams. It may also result in conflict of interest between multiple vendors. For example Vendor A may be responsible for software development and Vendor B responsible for software testing. Competition between vendors may result in passing the buck and delays in meeting dependencies. E.g. Vendor B may act tough to show that Vendor A’s work quality is
below expectation or vice versa. This may ultimately affect the overall project success in an adverse manner.

**Lack of clarity of contracts between the vendor and the customer:** Sometimes, it is observed that there is a gap in understanding the contractual terms and conditions. E.g. who is going to invest into software license cost? Lack of clarity in the contract results in unavailability of acquiring essential software. This affects the project’s success in an adverse manner.

**Lack of clarity on implicit/explicit commitments made by the vendor to the customer:** Sometimes it is observed that there is a gap in understanding of the implicit/explicit commitments given to the customer between the Sales team and the project delivery team. This results in friction during project deliveries. E.g. The Sales team may commit availability of certain expertise during the project’s proposal stage; however, at the time of the project’s delivery, expertise may not be available as per customer’s expectations resulting in challenges while managing customer’s expectations.

**Non Time and Material based business models:** In Time and Material business model, the customer is charged based on the number of human resources working on the project. This model has a very low risk for the vendor. Customers have started moving away from the Time and Material business model. Projects are increasingly getting delivered using fixed price or outcome based or transaction based business models. In the fixed price business model, the vendor charges a fixed price for a project and is independent of the number of human resources working on the project. The fixed price project carries a high risk as the price is already agreed with the customer and the vendor is responsible to deliver the project as per the customer’s
requirements. In case of outcome based business model, the vendor is paid based on the benefits received by the customer. E.g. The Customer pays the vendor depending upon the benefits earned after the project implementation. In case of transaction based business model, the charges are based on each transaction processed. E.g. A retail store customer may outsource development and maintenance of e-commerce website to a software services company. The payment to vendor is related to the number of shopping transactions coming through the e-commerce portal.

Thus, the non Time and Material business models carry a high risk of failure. The vendor team including senior management, Sales and engineering must have necessary skills and expertise to deliver projects using non time and Material business models. Lack of skills and expertise may result in project failure.

**The Effort estimates are influenced by the Sales team:** Technical or business experts estimate the project efforts. The efforts are used to determine the project price to be charged to the customer. It is observed that sometimes the Sales team is aware of at what price the customer is likely to accept the project proposal. Instead of adjusting the final price, Sales team tries to influence the effort estimates to ensure that efforts are adjusted to match the expected price. Technical or business experts may come under pressure and accept adjusted effort estimates. This results in an under estimated project which results in failure.

**Weak global economic conditions have affected budgets of the IT Industry’s customers:** Today Customers are under pressure to implement projects at reduced budgets. Due to this, they increasingly put pressure on vendor companies to reduce costs and increase productivity. The Indian IT companies are facing intense competition amongst themselves and also from global IT services companies. This has
resulted in aggressive bidding by IT companies for large contracts and accepting projects with high risk. An IT expert during an interview shared an interesting example of aggressive bidding and how it resulted in project failure. An IT company got a large project transitioned from another IT company. The key reason for project transfer was promise of 20% of savings to the customer and increase in productivity for subsequent years by the new company. Right from the beginning everybody knew the challenges of managing the project. To cut costs, the team size of the project was reduced. This resulted in higher loads of work on the remaining team members. Within first 6 months, more than 30% of the project team members either resigned due to work pressure or asked for project release. This resulted in further challenges on the project and ultimately the project was declared as failed one.

**Overselling of the projects:** Overselling is also one of the most common factors affecting a project’ success adversely. Overselling of project is in terms of overselling of expertise, experience or even in terms of price. Overselling, results in over committing to the customer, which cannot be delivered. Overselling makes customer expectation management very difficult and ultimately, affects project success in an adverse manner.

### 3.3.1.3 Personnel and Capabilities Management – PCM

The IT Industry is a people’s Industry. The key success factor of the Indian IT Industry is availability of skilled human resources in a cost effective manner. The service quality of an IT company depends very heavily on quality of human resources and their capabilities. One of the key reasons of project failure is unsuitable or insufficient skills/capabilities of the project team. However, it was observed that, apart from an individual team member’s skills and capabilities, other human resource
management related factors also affect the project success in an adverse manner. It was observed that sometimes the management is not able to allocate right skilled and experienced human resources as per project requirement in time. For example, a project starts with only partial allocation of human resources and full allocation happens later. As the human resource allocation gets delayed, many times human resource quality is compromised to complete the staffing. Thus, at the beginning of the project itself seeds of its possible failure are sown. The effectiveness of human resource allocation policies and practices plays a very important role while allocating human resources to projects. It is observed that there are elaborate processes for Human resources allocation. However, they face various implementation challenges.

Multiple environmental factors related to PCM were studied.

Following factors were found to be crucial affecting a software project’s success in an adverse manner.

**Human resources of matching skills and desired quality are not allocated to the project right from the required date:** It is expected that before the project starts, it must be fully staffed as per the project’s requirements. However, often it is observed that even if the project starts it is not fully staffed. Allocated human resources also may not have expected skills, capabilities and experience. E.g. A project may require ten JAVA (JAVA- programming language) (51) developers with minimum 4 years of JAVA development experience. However, the project may get only four or six resources with desired experience and remaining developers may be fresh engineers just out of college. This affects the project’s success in an adverse manner.

**Direct allocation of human resources to the projects:** Usually the project manager gets an opportunity to select appropriate human resources for his/her project.
However, sometimes no choice is available to the project manager and human resources are directly allocated by the human resource department. The Project manager has to deliver project with such directly allocated human resources. This often affects the project’s quality adversely.

**Lack of effectiveness of the human resource selection processes:** Organizations follow various human resource selection processes which may involve conducting interviews, conducting technical tests, etc. A Majority of the organizations have strong human resource selection processes. However, it is observed that the project managers may not get the right human resources even after following these processes.

**Non availability of vetted skill and capability profiles of individual team members:** Resume or profile of a candidate is used to describe/showcase his/her experience, skills, capabilities, etc. However, many times, it is found that there is a difference between actual skills/capabilities and skills/capabilities mentioned in the resume. Hence, the project manger needs to spend additional time to evaluate human resources suggested by the staffing department. This challenge can be addressed if a 3rd party can evaluate human resources in advance and record their skills/capabilities rating in a repository. Availability of such repository can help the staffing department and the project managers immensely while selecting the right human resources on projects.

**Non availability of previous appraisal details:** Previous appraisal details of the project team members are very important source of information for a project manager to evaluate the prospective team members. Appraisal contents can be very helpful in assessing suitability of a team member. Non availability of appraisal details
results in more time investment by the project manager in evaluating prospective candidates or wrong allocation.

**Percentage of fresh engineers on the project team:** It is observed that the percentage of fresh engineers in a project team is usually high. This is due to the low cost associated with fresh engineers. However, a high percentage of fresh engineers results in increased pressure on experienced project team members. Experienced project team members need to spend time in guiding fresh engineers instead of actual project activities. This affects the overall quality of the project and may also result in project delays.

**Inadequate Project management skills/capabilities:** In the Indian IT Industry, it is very commonly observed that human resources are pushed to project management roles at an early stage of their career. Such project managers may not have adequate project management skills and capabilities. They end up learning project management on the job. This results in serious challenges for the projects affecting their success in an adverse manner.

**Non Availability of domain/technology consultants:** It is very difficult to get experts in certain technologies and/or business domains. For example, a senior architect with deep knowledge of cloud computing platform (52) or an expert with strong experience in investment Banking. Even if such experts are available, they get allocated to projects and their capabilities are not available for other projects. Customers or even project managers also hold such experts and don’t release them. This results in non availability of expertise on some projects. Organizations are trying to build internal expertise or hire consultants from outside to address this challenge.
Unable to send key team members at the customer site during project course: In a typical offshore project, few key team members may get deputed to the customer’s location. These team members are called as onsite team members. The presence of these members at customer location is very important from the overall project success point of view. The key advantage of these team members is that they are available to the customers during their work hours and they can also attend many customer meetings. The offshore team due to time zone difference may be available only for one or two hours for the customer meetings. The onsite team members can follow up with the customer about queries and take care of all the customer interactions. Due to travel restrictions such as visa issues it becomes difficult to send the team members at customer’s location. As the onsite team members increase the cost of the projects, customers are also not very keen in having vendor team members at their locations (onsite). However, absence of onsite team members affects a project.

High human resource attrition rate: High human attrition rate is one of the most important factors behind project failure. The IT Industry is human resource intensive Industry and the IT organizations’ greatest assets are human resources. If human resources leave organization then it results in loss of knowledge and skills/capabilities. Due to high attrition, it becomes difficult to build a stable and reliable team which is essential to work together seamlessly.

3.3.1.4 Skills and Capabilities Development – SCD

To remain competitive in the market, an IT company needs to invest continuously in developing skills and capabilities of technical and management staff. The key challenge faced by the IT Industry today is that, the project cycles are shortening but skill and capabilities development cycles are getting longer. E.g. Due to
business pressures, customers are expecting more frequent software project deliveries. With continuous changing business requirements and introduction of new technologies such as cloud, mobile, social networking, etc. an IT company needs to continuously invest in the skills and capabilities development of its staff. However, learning new technology and developing reasonably strong expertise takes time and investment.

One of the key challenges an IT company faces is lack of clear visibility of skill demand. During the IT professionals’ interviews, it was noted that sometimes, an IT company invests into a certain skill development and at the end of skill development it realizes that the skill requirement has changed. This results in reinvestment into skills development.

With demanding customers and continuous project deliveries, project managers are not able to send the project team members for training. This results in skill gaps and de-motivation of the project team members, which may in turn results in attrition of the key team members.

Multiple environmental factors related with SCD were studied. The following factors were found to be crucial affecting a software project’s success in an adverse manner.

**Ability to send the project team members for training during a project:**

Even if the project manager wants to send the project team members for training s/he cannot send them for training as the project team members are busy in the project related tasks. If a team member is sent for training then it may result in a loss of revenue for the project for the training duration. Thus, due to billing and customer pressures sometimes the project manager is not able to send team members for training. This not only stops the team member’s skill building but also de-motivates him/her.
Satisfaction about training received by fresh engineers: The Indian IT companies recruit fresh engineers in very large numbers. The engineers are recruited from various engineering or professional colleges and then trained by the IT companies as per their needs. The acceptance of fresh engineers on projects depends upon effectiveness of training received by fresh engineers. If fresh engineers are not trained in an effective manner and then allocated to projects, it results in quality issues.

Lack of involvement of the training department in project team development: Involvement of the training department in project team development is very essential in developing project ready resources. Lack of involvement may result in ineffective training. The training department needs to partner with the project delivery department to develop skill and capabilities plan as per the project and the customer needs. Lack of development of such plan results in shortage of skills and capabilities affecting project success.

It is very important for the training department to work closely with the business teams to understand the customer expectations and future needs of desired skills and capabilities.

3.3.1.5 IT Infrastructure Management – ITM

IT companies need to continuously invest into the IT infrastructure to ensure smooth project operations. Apart from its obvious necessity, the infrastructure also has started affecting business acquisition strategies and project success. E.g. Customers have started expecting additional infrastructural investments by IT companies such as totally isolated network infrastructure from an IT company’s corporate network or investments in sophisticated network monitoring tools, etc. These investments ultimately get loaded as project costs and affects project margins.
Any delay in acquiring desired infrastructure or lack of adequate infrastructure affects a project’s schedule and ultimately affects the project’s success. During IT experts’ interviews it was noted that a project was delayed by over 3 months due to lack of access to a customer’s network.

Lack of or inadequate tools/technologies may affect a project adversely. E.g. a Software Application support project is likely to be more successful if it has access to tools/technologies which can pre-empt possible support issues. It was also observed that the difference between hardware and software environments between the customer and the IT Company is also one of the major causes of project failure.

Multiple environmental factors related with ITM were studied. The following factors were found to be crucial affecting a software project’s success in an adverse manner.

**Non Availability of desired infrastructure when required:** The success of software development depends on the availability of the desired infrastructure such as hardware (servers, laptops, tablets, etc.), software (software development tools and technologies such as Software products/databases, etc.) and network (connectivity to customer network, internet access, etc). This desired infrastructure must be available when required. Often due to various reasons such as delays in procurement, security, budgetary constraints, etc. the project doesn’t get the desired infrastructure. It affects the project team’s productivity adversely and ultimately affects the project’s success in an adverse manner.

**Limited access to the customer’s environment:** Often an offshore project needs access to the customer’s environment such as servers. Sometimes, there are delays in getting an access to the customer’s environment. For example, the customer’s
security team needs to do security audit of the vendor’s network before giving access to the environment. The audit process and later compliance to address the security audit requirements delays access to the customer’s environment. Sometimes, access is given but is not sufficient. For example, a server can be accessed only for a limited time period. It affects the project team’s productivity adversely and ultimately affects the project’s success in an adverse manner.

**Non availability of hardware/software environment similar to the production environment:** The production environment is the environment in which a software project gets implemented. It is often complex and needs significant investments. Development environment is the environment used by software developers to develop software. The development environment doesn’t need higher end hardware and can use development version of software. However, due to difference in these two environments there is always a risk of not knowing upfront challenges faced after deploying software in the production environment. For example in case of a website development, the project requirement could be to support ten thousand website users. To support ten thousand users, one must have higher end servers and enterprise class software. During development, the developers cannot test if the website will support ten thousand users as the environment to support them and tools to generate such load are not available to the developers. This introduces a risk of website failing to support ten thousand users.

3.3.1.6 Multi vendor, geographically distributed project Delivery Management – MDM

The nature of software project delivery has changed over the period of time. It is found that project deliveries are increasingly becoming multi vendor and are also
distributed across geographies. The distributed nature of the project deliveries has created new challenges which may affect a project’s success in an adverse manner.

Multiple environmental factors related to MDM were studied. The following factors were found to be crucial affecting a software project’s success in an adverse manner.

**Large project/program gets divided across the multiple vendors:** E.g. Company A is responsible for software development and Company B is responsible for software testing. This may result in multiple challenges such as conflict of interest across these companies, which may affect project success adversely.

**Difference in capability maturity amongst the vendors:** When a project gets distributed across multiple vendors, sometimes there is difference in capability maturity amongst vendors. E.g. Processes followed by a vendor might be more mature than the other vendor. This may result in challenges affecting the project success adversely.

Due to western world businesses’ drive to move large chunk of IT activities to India, a lot of large programs (Program – may contain group of projects for specific business purposes) are getting transitioned to the Indian IT companies. This is a big opportunity for the Indian IT companies to move up the value chain. However, it also comes with its own complex challenges. E.g. when a project gets transitioned from Company A to Company B, it usually faces a lot of resistance from the project teams working in Company A. This is due to issues such as possible job losses and even transfer of employment from Company A to Company B. All such challenges have the changed project delivery function considerably in the Indian IT companies.

**Project is geographically distributed:** Project teams are increasingly getting distributed across geographies. For example, the customer could be from North
America and the project team could be distributed across North America, Europe and India. This could be due to various reasons such as availability of expertise, costs, etc. However this often results in multiple challenges such as communication, cultural differences, integration, etc.

**Sometimes a project is transitioned from a customer’s IT team to a vendor.**

During the transition process sometimes, the customer’s IT team gets managed by the vendor. This may create challenges between the customer’s IT team and the vendor affecting the project success adversely.

### 3.3.1.7 Knowledge Management Practices - KMP

The Indian IT Industry is a knowledge Industry. Customers are increasingly evaluating an IT company’s capabilities in terms of availability and application of knowledge. This is a very large and important area. In the present scope of research, only a few factors related to the availability of company level or project level knowledge repository, usage of knowledge management processes, etc are included in KMP for study.

The following factors were found to be crucial affecting a software project’s success in adverse manner.

**Non availability of a company level knowledge repository:** This may result in challenges in knowledge sharing at the company level. For example, lessons learned in one project may not be easily available for reference to other projects.

**Non Availability of a project level knowledge repository:** Sometimes, it is observed that projects don’t have a project level knowledge repository. For large distributed projects, lack of such repository creates challenges while sharing knowledge across the project team members.
Lack of formal knowledge management processes: This results in non-standardization of knowledge management practices which may result in ineffective knowledge management.

Availability of channels / tools for knowledge sharing: This is very important for effective knowledge management. It needs investment and commitment from the senior management.

The exploratory study phase of the research was concluded after identification of important environmental factors. The identified factors were grouped into Knowledge Sources.

3.3.2 Descriptive research

The Survey method was used for the descriptive research. During this phase, the researcher prepared a survey tool, conducted a pilot study using the survey tool and then conducted the main study.

3.3.2.1 Survey tool preparation

Based on the Knowledge Sources and important factors belonging to individual Knowledge Sources affecting the project success in an adverse manner, a survey tool (questionnaire) was prepared by the researcher.

There are three important sections in the survey tool.

Section I – This section contains questions about the following basic demographic information of a participant

1. Age
2. Current Designation
3. Total Professional experience
Name of the participants and their employment details were not recorded to maintain the confidentiality and comply with non disclosure agreements signed by the participants with their respective employers.

Section II – This section contains questions about the following Software Project Failure Indicators

1. **Schedule:** Project not delivered as per the agreed or planned schedule. A question is designed to understand what percentages of projects are not delivered as per the agreed schedule as experienced by the respondent. The options include 0 to 10%, 10 to 20%, 20 to 30%, 30% to 40%, 40% to 50%, 50% and above.

2. **Effort/Costs:** Project is delivered by taking extra efforts/Costs. A question is designed to understand what percentages of projects are delivered by taking extra efforts/costs as experienced by the respondent. The options include 0 to 10%, 10 to 20%, 20 to 30%, 30% to 40%, 40% to 50%, 50% and above.

3. **Quality:** Project is not delivered as per the agreed quality criteria. A question is designed to understand what percentages of projects are not delivered as per the agreed quality criteria as experienced by the respondent. The options include 0 to 10%, 10 to 20%, 20 to 30%, 30% to 40%, 40% to 50%, 50% and above.

4. **Non fulfillment of customer’s requirements/expectations:** A question is designed to understand what percentages of projects are not delivered as per customer requirements and expectations as experienced by the respondent.
The options include 0 to 10%, 10 to 20%, 20 to 30%, 30% to 40%, 40% to 50%, 50% and above.

5. **Unable to accomplish short term goals:** A question is designed to understand what percentages of projects are not delivered as per the company’s short term goals as experienced by the respondent. The options include 0 to 10%, 10 to 20%, 20 to 30%, 30% to 40%, 40% to 50%, 50% and above.

6. **Unable to accomplish long term goals:** A question is designed to understand what percentages of projects are not delivered as per the company’s long term goals as experienced by the respondent. The options include 0 to 10%, 10 to 20%, 20 to 30%, 30% to 40%, 40% to 50%, 50% and above.

**Section III** - This section contains seven subsections belonging to each identified Knowledge Source. **In each subsection a set of questions is designed to understand the adverse impact of environmental factors on a project’s success.** Likert scale (53) is used to design questions in this section. Likert scale is a psychometric response scale primarily used in questionnaires to obtain the participant’s preferences or degree of agreement with a statement or set of statements. 5 point rating scale with the options of Always(4), Often(3), Sometimes(2), Never(1), Undecided(0) or options of Strongly Agree(4), Agree(3), Disagree(2), Strongly Disagree(1), Undecided(0) is used.
The following table gives the no. of questions belonging to each Knowledge Source.

Table 8 Number of questions belonging to individual Knowledge Source

<table>
<thead>
<tr>
<th>Knowledge Source</th>
<th>Number of Questions</th>
</tr>
</thead>
<tbody>
<tr>
<td>Customer Knowledge (Know Your Customer) – KYC</td>
<td>20</td>
</tr>
<tr>
<td>Business Acquisition and Relationship Management – BRM</td>
<td>21</td>
</tr>
<tr>
<td>Personnel and Capabilities Management – PCM</td>
<td>24</td>
</tr>
<tr>
<td>Skills and Capabilities Development – SCD</td>
<td>9</td>
</tr>
<tr>
<td>IT Infrastructure Management – ITM</td>
<td>9</td>
</tr>
<tr>
<td>Multi vendor, geographically distributed project Delivery Management – MDM</td>
<td>12</td>
</tr>
<tr>
<td>Knowledge Management Practices – KMP</td>
<td>4</td>
</tr>
</tbody>
</table>

The survey tool was critically reviewed by subject matter experts, academic experts and an expert statistician. The survey tool went through multiple iterations and review cycles until the researcher and the subject matter experts were satisfied with the content of the tool.

The internet based survey tool, SurveyMonkey (54) was used to design and administrate the survey. The SurveyMonkey is the world’s most popular online survey tool. It is very easy to create questions in SurveyMonkey by using 15 question types including rating scales, multiple choices and more. The survey designed in SurveyMonkey can be sent to the participants using email or can be published as a link on a website. It gives powerful features to track participant responses, sending reminders, etc. SurveyMonkey provides powerful reporting features on collected
survey responses and also provides facility to export survey response data in SPSS or Excel format. The target respondents for the survey were IT professionals with easy access to internet and already comfortable using web based applications. Hence, it was decided to conduct the survey using an online survey tool such as SurveyMonkey. Please refer to Annexure A for the survey tool details used in the present research.

3.3.2.2 Pilot study

A pilot study was carried out using the survey tool prepared by the researcher. For the pilot study, twenty participants were carefully selected. The selected participants had minimum fifteen years of professional experience and had worked in at least two major Indian IT companies as per NASSCOM’s top 20 IT companies list or in a multinational IT company with significant presence in India. The researcher also ensured that the selected participants were not only interested in filling the survey but also willing to give a detailed feedback. The pilot respondents were instructed that the researcher was not only interested in response data but also wanted a detailed feedback about overall survey process, survey questions, time required to fill the survey, coverage of the research subject, etc.

The survey form was sent to the participants using SurveyMonkey tool with the detailed email describing the survey instructions. Categorically, it was stated that their identity and their employment details would remain confidential and individual survey response data would not be shared with anybody.

After collecting the survey response data, the individual respondents were telephonically interviewed to understand their feedback about the survey. Specific questions were asked about the number of questions, their clarity and overall coverage
of the research subject. The participants were also asked to give a feedback about the questions which needed to be reworded to remove ambiguity or to reduce complexity.

The collected data was exported in MS-EXCEL (55) and studied to check for possible data issues such as blank values, unexpected answers, possible skewed responses, etc. The data was then analyzed to check if it captured information which the researcher was interested.

The collected data was then imported in SPSS (56) version 17 for analysis. For reliability analysis, the survey tool was tested for internal consistency. The internal consistency of survey instrument is a measure of reliability of different survey items intended to measure the same characteristic. Cronbach’s coefficient alpha (57) was used to establish the reliability. Cronbach's alpha is an estimate of reliability, specifically, the internal consistency, of a test or scale. Cronbach’s coefficient alpha is appropriate for use when the questionnaire has been designed to measure a particular attribute that is expected to manifest a high degree of internal consistency. Higher the coefficient more is the inter-item consistency. The Cronbach’s coefficient alpha above .70 indicates that the questionnaire/tool is reliable (58). In the present research, Cronbach’s coefficient alpha has been used to see the internal consistency for each Knowledge Source: KYC, PCM, ITM, KMP, MDM, BRM and SCD.

The Cronbach’s coefficient alphas for individual Knowledge Source were: KYC = .847, PCM = .651, ITM = .745, KMP = .688, MDM = .875, BRM = .794, SCD = .699.

Based on the Cronbach’s coefficient alpha values, it was concluded that the survey tool was reliable.
For content validation, the survey tool was reviewed with IT practitioners, academic experts and expert statistician. The objective of reviewing the tool with the IT practitioners was to ensure that it was capturing the expected information and there were no gaps. The objective of reviewing the tool with academic experts was to ensure that the tool was fit from overall research methodology point of view. The objective of reviewing the tool with the statistician was to ensure that the collected data was in a format expected by SPSS and planned statistical tests could be performed on the collected data.

Based on the satisfactory review comments and positive feedback of the experts, the researcher concluded the validity of the tool.

The researcher planned certain statistical data analysis for Hypothesis testing and to build a model showing relationships amongst the Knowledge Sources. To ensure that data analysis could be done on the collected data, it was decided to perform certain important data analysis on the pilot data. Factor Analysis and Principal Component Analysis (59) was performed on the pilot study’s collected data to identify factors and its loading. The pilot results confirmed that Knowledge Sources are interrelated and only one component is getting extracted. Based on the results of the pilot study, the researcher concluded that the survey tool was reliable, valid and the main survey can be conducted using the tool.

3.3.2.3 Main study

After establishing psychometric properties (reliability, validity) of the survey tool on the pilot sample, the main study sample was collected. The SurveyMonkey tool (54) was used to conduct survey and track overall survey process.
Purposive sampling (60) was used for the research. Purposive sampling is a form of non-probability sampling in which decisions concerning the individuals to be included in the sample are taken by the researcher, based upon a variety of criteria which may include specialist knowledge of the research issue, or capacity and willingness to participate in the research. The research subject and the purpose necessitated that the participants must have knowledge and experience of the Software Project Management domain and the Indian IT Industry. Hence the researcher decided to use the purposive sampling.

To select the right participants the researcher used the following criteria.

- Overall experience in working with two or more leading Indian IT services companies satisfying the following criteria:
  - The company should be part of the Indian IT Industry. This includes Indian origin IT services companies and Indian arm of global IT services companies.
  - The Company should be from NASSCOM’s list of top 20 players in IT services (2010 – 2011) or has significant India-centric delivery capabilities.
- Minimum 10 years of professional experience.
- Grades or Designations – Architect / Project Manager / Delivery Manager / Director / Vice president or above.
- Strong management experience of managing offshore software projects from India.
- Global exposure.
- Customer interaction/management experience.
• Strong experience in handling various operational aspects of IT services business.

• Experience of working with key functions of a typical IT services company such as Staffing or Human Resource Allocation and Management, Sales and Marketing, Customer Account Management, Infrastructure, Support, Training, etc.

Comprehensive criteria used by the researcher ensured that the selected participants would be most likely to contribute appropriate data, both in terms of relevance and depth and the collected data would be reliable and the sample was representative.

For the present study, a list of possible participants as per the sampling criteria was identified. The list was prepared using the researcher’s professional networking contacts in the IT Industry and using professional networking sites such LinkedIn (the world's largest professional network with 225 million members in over 200 countries and territories around the globe) (61). Apart from this, the participants were selected based on their current company and their overall experience in working with the target IT services companies. The researcher personally called or wrote emails to these participants and asked them if they were interested in participating in the survey. The survey form was sent to the interested participants using email. The email contained brief information about the research, purpose of research, commitment of the researcher about non disclosure of individual participant’s identity and a link to access the survey form. The progress of the survey was continuously tracked using the tracking feature of the SurveyMonkey tool. Reminders were sent to the participants who didn’t respond to the survey request. After receiving the first set of responses, few respondents were
contacted by the researcher with request of sharing contact details of IT professionals from their professional network. The selection criterion was shared with them as guidance for identifying possible participants. Based on the list of possible participants received, the researcher selected suitable participants working in targeted IT services companies and sent them an email about the survey. Using this technique, the survey form was sent to more than five hundred possible participants. Within a period of eight weeks, two hundred and forty respondents responded to the survey. Out of them, two hundred and twenty six complete responses were finalized for the study. Fourteen responses were rejected as they were incomplete.

**Details about sample collected –**

Total participants – 226

Designation wise distribution

**Architects** – 36, **Project Managers** – 36, **Delivery Managers** – 69, **Directors** – 54,

**VP and above** – 31

The designation wise distribution of the sample shows the seniority and experience of the respondents.

Cronbach’s alpha reliability coefficient of the tool for the main study was computed. On the sample of main study (N=226), the reliability coefficients are: KYC = .833, PCM = .836, ITM = .905, KMP = .883, MDM = .853, BRM = .894, SCD = .842.

**3.3.2.4 Data Analysis**

The collected data was analyzed quantitatively for the Hypothesis testing and for statistical analysis related with software project failure experience/Software Project
Failure Indicators. The quantitative analysis was used to propose a model showing relationships between the Knowledge Sources.

Apart from the quantitative analysis of the survey data collected, the researcher did qualitative analysis of the selected survey data to understand details of important aspects related with the software project success/failure. These aspects were not highlighted from quantitative analysis. Hence they were analyzed qualitatively.

3.4 Validation of research outcome

To validate the research outcome, the researcher presented the research output to select fifteen IT professionals. The discussions with the IT professionals were held in person and also telephonically. During the discussions, the researcher described in detail the outcome of the research and the data analysis performed. The researcher then presented the proposed model and the cause effect diagrams and requested the IT professionals to give their feedback and opinions on the model and research results. Specific questions were asked by the researcher to the IT professionals to share instances where they have observed the phenomenon described by the model. They were also asked to comment on possible causes of identified behaviors and their suggestions about possible improvements. The participants agreed with the research outcome and gave detailed information about their observations/experiences about project failures where they experienced the research findings. The observations/feedbacks from the IT professionals are documented in Data Analysis chapter.