

Chapter 3
Research Methodology- Sampling Techniques &
Questionnaire

3.0 Introduction:

During more than 40 years of active involvement and association with the IT industry, the researcher has been advising, guiding, educating, assisting and servicing several businesses and industries, located not only in India but also in a few other countries, for introduction, selection, implementation and enhancement of IT infrastructure.

Being based at Pune, the researcher has had the privilege to be closely associated with several businesses and industries located at Pune, for gainful utilization of Information Technology. This association with several companies at Pune spanned over 40 years required not only introduction of IT but also continuous upgrade of the infrastructure and applications to keep pace with the technology life cycle. The above association included assisting the enterprises in: from getting their data processed at an external IT service bureau, to installation of IT infrastructure for in-house batch data processing, to deployment of information technology for on-line IT applications, and finally to the web-based IT applications. This has provided the researcher with keen insight into the IT organization structure deployed; management practices adopted; IT tools, techniques and applications selected; processes and enablers deployed to effectively utilize the Information Technology to assist in achieving sustained growth in all round performance of an organization.

Based on the knowledge gained through the above extensive experience, a need was felt to carry out this research to formalize the experiential findings.

3.1 Research Objectives:

Aims and Objectives of this research are as follows:

- To determine the applications of IT tools and techniques that are deployed by the medium enterprises located in and around Pune.
- To identify the applications of IT tools and techniques that are perceived to contribute significantly to the growth of the medium enterprises.
- To discover the drivers that enable successful implementation of the applications of the IT tools and techniques.

While working towards meeting with the above objectives, researcher also intends to find out the gaps/ weaknesses that act as barriers/ inhibitors in deriving the maximum benefit from the IT tools, techniques and applications (IT infrastructure) deployed. For the identified inhibitors, countermeasures would be found out, which on implementation would go a long way in enabling the enterprise in optimization of the return on investment in the IT infrastructure.

3.2 Research Methodology:

A 'Research Initiative' is driven by a compelling need or inquisitiveness and at times to formally confirm an observation/belief. In short research is really a systematic journey to find/prove/confirm a set of assumptions/hypotheses. The methodology to be followed for a specific research would be driven by the nature of the problem as well as area and type of research.

The driver for this specific research has been the compelling urge to formally confirm the observations and belief arising out of the over 40 years of researcher's experience in providing consulting and services in IT related areas to several enterprises in and around Pune.

Further relevant details of the Research methodology followed are explained in the following sections.

3.3 Hypotheses:

The hypotheses to be tested in this research are as follows:

- **H1:** Innovative applications of tools and techniques are used for implementing:
 - ❖ Participative and empowered Organization Structure.
 - ❖ Management practices focused on stakeholders, quality of processes, products and services, as well as continual improvement of processes.
 - ❖ Execution of the key Operational Processes efficiently and cost effectively.

- **H2:** IT strategic plans are synchronized with the business strategic, tactical and operational plans to provide effective applications' selection and execution support.

- **H3:** There are specific drivers that ensure effective implementation of the selected IT tools and techniques that enable growth of a medium enterprise.

3.4 Types and Sources of Data:

For any research it is imperative to define both the types and sources of data to be collected.

3.4.1 Primary Data:

'Primary data' is the data that needs to be collected to meet the purpose of the research.

It was decided to collect the primary data for this research through a survey of the selected medium enterprises. To enable collection of data uniformly and consistently, a questionnaire approach was selected. The questions included in the questionnaire were designed for generation of a realistic and thorough primary data. In a few cases questions were repeated in a different manner to verify the understanding and essence of the practices and processes followed by the organization being interviewed.

3.4.2 Secondary Data:

The first key step would be to look for the secondary data for supporting the research. The source of the secondary data is for a purpose other than the primary objective of a specific research study. For example source of such secondary data for this study may be the industrial directory of Pune, Automobile Components Manufacturers' Association, World-Wide-Web, etc.

An example of the Secondary data required for this research is the list of the medium manufacturing enterprises located in and around Pune to select the population for conducting a survey.

Books, magazines, journals, ideas posted on the social net working sites (like linked in) relevant to the research were identified for study.

The sources of the secondary data selected also included the web site of the Ministry of Company Affaires, web site of the Ministry of Medium and Small Enterprises, various discussions by the CIOs

group hosted on the "Linked in" a social net working site on the web, Industrial Directory of Pune published by the Marhatta Chamber of Commerce, "Profile and Analysis of Pune Mfg. Inc." published by Mahratta Chamber of Commerce, Industries and Agriculture in Feb. 2008³⁰, several books, journals, business magazines, research articles published on line by the e-periodicals and independent research groups, etc.

3.5 The Survey:

The Survey research is a systematic gathering of information from respondents for the purpose of understanding and/or predicting some aspects of the behavior of the population of interest. Every survey aims to collect information from the identified sample, to verify the associated hypotheses. A Survey could be of various types: personal, mail, computer-based, telephonic, etc.

This research required views of the top management (CEO or CFO) of the enterprises to be surveyed. Senior persons of this level in a company are busy persons and may delegate activity of filling up a survey form to a junior assistant who may not provide responses that reflect the perspective of the top management and strategic plans of the enterprise. Hence the only effective way to get reliable information was for the researcher to interview each person personally. To sum up, the survey methodology of personal interviews was selected.

3.6 Sampling Techniques:

Determining the "Sample-Size" and the "Sampling" process to identify the sample size assumes a key role in any study involving a survey. Both the above activities contribute substantially to the

³⁰ "Profile and Analysis of Pune Mfg. Inc." published by Mahratta Chamber of Commerce, Industries and Agriculture in Feb. 2008

adequacy of data collection from the right sample size. The issues to be addressed are:

- What kind of sample needs to be considered?
- How large the sample should be?

The salient features of the sampling process are provided in the following paragraphs.

3.6.1 The statistical population:

A **statistical population** is a set of entities concerning which statistical inferences are to be drawn. (Source: Wikipedia)³¹

This could be defined in terms of elements, units, time, etc.

For the purpose of this study, the population was defined as the medium manufacturing enterprises. List of manufacturing enterprises was compiled from the "Profile and Analysis of Pune Mfg. Inc. published by Mahratta Chamber of Commerce, Industries and Agriculture in Feb. 2008" and from other sources of secondary information specified above.

3.6.2 Sampling:

Sampling is that part of statistical practice concerned with the selection of a subset of individual observations within a population of individuals intended to yield some knowledge about the population of concern, especially for the purposes of making predictions based on statistical inference. (Source: Wikipedia)³²

The sampling frame specified for this study was defined as "the manufacturing enterprises located in Pune, which had annual sales between 100 crores and 500 crores during the financial year ending

³¹ www.wikipedia.com

³² www.wikipedia.com

March 31st 2007". From the population established above, criterion of sales turn over, specified above, was applied and the enterprises meeting with the criterion selected. To that list, additional companies, from other secondary sources, meeting with the criterion were added. The no of companies that qualified for the sample frame are as follows:

➤ No of enterprises identified from the "Profile and Analysis of Pune Mfg. Inc. published by Mahratta Chamber of Commerce, Industries and Agriculture In Feb. 2008.	37
➤ No of enterprises identified from other sources	17
➤ Total	54

3.6.3 Specifying the sampling unit:

This could be a company or a household or a city section based on pin code or otherwise, etc.

For this study, the unit was specified to be a company in the sampling frame.

3.6.4 Specifying the sampling method:

This would provide the method to be followed for selection of the sample units. Normally the sampling method is decided using the following choices:

- Probability versus non-probability
- Single unit versus cluster of units
- Stratified versus un-stratified
- Equal unit probability versus unequal unit probability
- Single stage versus multiple stage

For the purpose of this research, non-probability and un-stratified sampling were considered.

3.6.5 Determination of the Sample Size:

Since the sampling frame consisted of a total of 54 enterprises, we decided to approach all of them for collection of the feedback. Out of the 54 companies approached 39 companies (72%) confirmed their willingness to participate in the requested interview. Among the above 39 companies the researcher was able to interview CEOs of 35 companies and CFOs of the remaining 4 companies.

The list of the companies who accepted to participate is enclosed as Annexure 3-01.

3.7 Questionnaire:

A questionnaire comprises a formalized set of questions for eliciting information.

Function of the questionnaire is measurement, and hence 'minimization of the measurement error' needs to be carefully addressed. Measurement error may be minimized by a careful design and development of the questionnaire.

The survey questionnaire for this research study was designed to gather in-depth data related to the research topic. The design of the questionnaire was based on the researcher's 40 years long experience as a consultant with a large no of organizations.

To minimize the measurement error, in the questionnaire designed for this study, questions have been kept unambiguous and provision of checks has been provided. The questions in the questionnaire are both open ended and close ended. A total number of 37 questions are included in the questionnaire.

Given below are a few of the salient points considered during design of the questionnaire and while conducting the survey:

- Most of the questions are designed to be objective. Such objective questions had 4 response options, except for a couple of questions where 5 response options were provided. A few questions are of descriptive type to determine the approach followed for a specific subject and the underlying essence and spirit.
- Plan of how data will be analyzed and used, was finalized prior to the design of the questionnaire
- Survey questionnaire was designed keeping in view the planned data analysis and ease of interpretation.
- Survey questions were designed based on personal experience of the researcher and informal input received from other experts.
- "Personal interview" methodology was used to eliminate the occurrence of no-response and ambiguous response. This approach eliminated any possibility of misunderstanding a question and consequent erroneous and misleading response. Such occurrences can result in erroneous analysis and hence the conclusions.
- The survey reliability was further ensured by the following:
 - ❖ Researcher personally interviewed in majority of the cases CEO (35 out of 39) and in a few cases where CEO was not available CFO (4 out of 39) of the organization being surveyed.
 - ❖ The CEO or the CFO interviewed is truly the topmost management person who could authoritatively provide correct organizational perspective.
 - ❖ The persons interviewed were forthcoming freely and honestly in their responses.

- ❖ Responses were taken down while the interview was being conducted, thereby ensuring accuracy of the survey data captured.
- Design of the data analysis is as important as the design of the questionnaire. Appropriate data analysis methods to properly analyze the responses gathered in the survey, were selected before finalizing the survey questionnaire. The data analysis methodology is explained below in the next section.

A sample of the 'Survey Questionnaire is enclosed as 'Annexure 3-02'.

3.8 Interview:

One to one interview between the interviewee and the researcher was carried out at the offices of the interviewee. Each interview took between 2 to 3 hours. Majority of the interviewees are known to the researcher, which substantially contributed towards making the interview an open and frank interaction.

Design of the questionnaire helped in cross checking vital data through multiple questions. Any gaps in the questions intended for cross checking, were clarified immediately. Responses to the questions were noted down immediately during the interview on a copy of the questionnaire to ensure accuracy of data capture.

Encouraging part is that several CEOs interviewed found the questionnaire to be comprehensive and of help to them in defining the future direction of their IT functions. Several of the CEOs are interested in knowing the outcome of the research to the extent it may be useful to their organization.

3.9 Data Analysis:

Following methodology is followed for analysis of the data collected as a result of interviewing the 39 enterprises.

- For each question in the questionnaire, the options provided were categorized under conforming and non-conforming.
- All the responded survey questionnaires were analyzed and responses rolled up against each option of each question.
- Responses to questions compiled above were further categorized under conforming and non-conforming as defined under the first bullet above.

The survey questions where multiple options provided are grouped under seven criteria. List of the criterion, together with the questions considered under each criterion, is enclosed herewith as Annexure 4-01.

- Responses to the questions under a criterion were analyzed for conformance and non-conformance. The next step was to test the responses to the questions grouped under each criterion for homogeneity. This was carried out by applying the Chi square test to the above conformance/ non-conformance data of the questions under a criterion.

Chi square test is a statistical method to test whether two (or more) variables (or group of data) are homogeneous. The chi-square test for homogeneity examines whether two populations have the same proportion of observations with a common characteristic. (Source: Wikipedia)³³

³³ www.wikipedia.com

- The test was carried out for each criterion as well as for a sub-criterion where ever it has multiple questions.
- Where ever it was found that the criterion fails the homogeneity (Chi square) test, Z test using p-chart was carried out to identify the question/s that were driving the criterion to be non homogeneous. P-chart is defined below.

P-chart is a type of statistical control chart used to monitor the proportion of nonconforming units in a sample, where the sample proportion nonconforming is defined as the ratio of the number of nonconforming units to the sample size, n.

The p-chart³⁴ only accommodates "conforming"/"not conforming" type of data. The control limits for this chart type are $\bar{p} \pm 3\sqrt{\frac{\bar{p}(1 - \bar{p})}{n}}$ where \bar{p} is the estimate of the long-term process mean established during control-chart setup. If the lower control limit is less than or equal to zero, process observations only need be plotted against the upper control limit. (Source: Wikipedia)²¹

- Z test using p-chart was repeated after excluding the culprit question/s. The process was repeated till Z test was found to be positive. The questions responsible for non homogeneity represent gaps and present opportunities for improvement at the criterion level. Further each individual sub criterion (question), even if the criterion was found to be homogeneous, was studied and the sub criterion with high non conformity level identified as gaps.

³⁴ www.wikipedia.com

- To identify the drivers (strengths) and inhibitors (weaknesses) of the IT organization within a medium enterprise, responses to the relevant questions were collated by the strengths and weaknesses. Arranged by the no. of occurrences reported in the responses, the drivers and inhibitors were further grouped and the top perceived strengths and weaknesses identified.
- To find the best (most contributing) IT applications, responses to the relevant questions were analyzed and collated by the application areas both deployed currently and planned in the near future. The IT applications arrived at above was grouped by the primary application area. Using Pareto analysis²² top contributing IT application areas were identified.
- The seven criteria were mapped to the hypotheses. Each criterion mapped to a hypothesis was checked for its individual homogeneity. Wherever all criterion for a hypothesis were tested to be homogeneous, the hypothesis was be considered to be tested true.

The Analysis of Data using the above analysis process is presented in Chapter Four.

Validation:

Findings arrived at above were validated with the help of secondary data collected from the various articles and interviews of the leading executives, practitioners and consultants.

3.10 Scope and Limitations of the study:

The medium manufacturing enterprises (as per the criterion defined for this study) are spread all over India. Pune has emerged to be a leading manufacturing centre in general and specifically for

the automobile as well as automotive sector including the ancillaries that service this sector. With large number of medium manufacturing enterprises located in and around Pune, the research study would reflect the medium manufacturing enterprises across India.

For collection of the primary data, it was planned that the researcher will personally interview the top management persons of the enterprises that agree to participate. The medium manufacturing enterprises meeting with the criterion would be identified and contacted with a request for participation in the survey.

Diligent care was taken in formulating the questionnaire that enabled cross checking the responses. Responses were planned to be noted on a copy of the questionnaire during the course of the interview thereby avoiding errors in data capture.

The survey responses being the primary data, any errors in the responses arising out of misplaced sense of secrecy would be a limitation.

3.11 Findings:

The primary data collected were further analyzed in the following manner.

Responses to the 'multi-choice-questions' were categorized under 'conforming' (C) and 'non-conforming' (NC). Further the questions were be grouped under seven criterion and the responses rolled up for each criterion. The rolled up responses for each criterion were tested for homogeneity using chi-square test. Data for the criterion that failed the chi-square test were put through the p-chart test iteratively till the drivers for non-homogeneity were identified confirming thereby that the remaining data comes from a

homogeneous domain. These drivers (questions) would be considered to be the gaps (weakness) that offer opportunities for improvement.

Individual sub-criterion (questions) within a criterion was analyzed to identify high non-conformity areas that provide challenge for improvement.

Inter relationship among the challenges (gaps) identified above was analyzed to identify cause and effect relationships if any.

The gaps were further analyzed with respect to the impact.

The above analysis led us to the findings of the research study.

The findings were validated using the secondary data.

3.12 Recommendations:

The validated findings of the gaps were further analyzed to evolve a set of counter measures to mitigate the same. The counter measures after due deliberation are suggested. The recommendations based on the findings of this research are included in Chapter Six.

3.13 Summary:

For this research a well accepted methodology is followed. Using the sources of secondary data, population of the medium manufacturing enterprises located in Pune is identified. The above population is narrowed down to the sampling frame by applying criterion of selection (i.e. sales turnover to be between approximately Rs 100 to Rs. 500 crores during the financial year ending March 31st 2007) and the medium enterprises that cleared the criterion identified.

A questionnaire was designed in such a manner so as to by and large assure the accuracy of responses.

Chief Executive Officers/ Managing Directors (CEOs) of all the fifty four enterprises included in the sampling frame were contacted

with a request for participation in an interview on the subject. Thirty nine enterprises out of a total of fifty four (a very healthy percentage of 72%) agreed to the request for the interview.

To ensure that the responses to the questionnaire represent views of the top management of the enterprises interviewed, it was decided that the researcher would personally interview the concerned CEOs. The researcher personally visited all the thirty nine companies that agreed to the request and interviewed thirty five CEOs and four CFOs (Chief Financial officers). The responses were recorded on a copy of the questionnaire during the interview itself to ensure accuracy of data capture.

The data captured above was analyzed using the statistical analysis techniques and methodology stated above in section 3.9 above. Hypotheses were tested statistically that confirmed the research. Aims and objectives of the research were also tested and proven in the affirmative.