CHAPTER 3

RESEARCH DESIGN AND METHODOLOGY
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3.0 INTRODUCTION

This chapter deals with the Research Methodology related to the research study of the I.C.T. (Information Communication Technology) infrastructure facility and its various associated services that are provided Institutions imparting Higher Technical education.

This includes evaluating the I.C.T. infrastructure available in higher technical education institutes, the trends in user satisfaction and security issues involved. The Higher Technical Education Institutions / Universities under study belong to the Pune region.

To attain the objectives of the study the researcher has designed a Descriptive study coupled with sampling methods which are able to depict the population trends. Questionnaires have been used as the key data collection tool which are available for both online as well as offline surveys.

According to data published by the A.I.C.T.E. (All India Council for Technical Education, New Delhi), the Apex body for governing and monitoring Higher Technical Education in India, the population of Institutes, Head of Institution, Full-time Teaching Staff and Learners (Full-Time enrolled Students only) is 545, 545, 51387 and 709016 respectively in the state of Maharashtra.[1][2][3][4][5][6]

Looking at this huge population size, it is understandable that collecting data from such a big population requires an enormous task in terms of human effort, time and finance. It is also unrealistic and inconvenient to collect data from each institute and each and every respondent from these institutions. Thus, it is more feasible to choose an appropriate sample, using an appropriate sampling method, which is able to represent the whole population trends.

It is also worth noting that due to unavailability of complete and reliable data about I.C.T. infrastructure facilities, I.C.T. usage patterns, implementation details, etc. in
Institutions imparting Higher Technical Education, it is, therefore, not possible to identify perfect population and a perfect sample.

This research work was conducted using Survey Instrument (a Structured Questionnaire) made available online on GoogleDocs and also paper-based. Four different Questionnaires were created for the different types of respondents namely Head of Institute (including Owners, Directors, Principals, HoDs, etc.), Technical Staff, Learners (Full-time students) and Full-time Teaching staff depending on what type of information each individual type of respondent could provide.

As part of the survey process, Researcher visited a number of institutions and met these respondents personally to get the questionnaires filled. The researcher also sent the links of the Questionnaire (Google Form) online via email to Head of Institute, I.C.T.Administrators(s) or Technical Staff, Teaching Staff members whose contact details (particularly email) are known. WhatsApp was also used to send questionnaire links. The contact details of many Head of Institute and faculty members were found on A.I.C.T.E, DTE and University websites.

Researcher also personally met the respondents where online contacts were not available. Majority of student’s responses were taken by researcher personally as the student contact details are not readily available online.

Survey results will ultimately help researcher identify the underlying trends of I.C.T. infrastructure facilities implementation in Institutions imparting Higher Technical Education and perceive the user satisfaction for the I.C.T. infrastructure and associated services along with the I.C.T. security involved thereby giving essential assistance for fixing up gaps in I.C.T. implementation. This will certainly help in providing better I.C.T. infrastructure facilities and services to the students and help in their education and career.

The process of identifying a sample for the purpose of Survey involves finding the right type of Learners (Full-time students) and Full-time Teaching Staff members who are using the Higher Technical Education Institution’s I.C.T. infrastructure and have been impacted by it as they are directly or indirectly interacting with it on their daily basis. Like-wise I.C.T. Technical Support Staff have been roped-in for answering technical questions, whereas, financial and strategy-related questions have been directed towards the Head of Institute who have ample relevant knowledge and data.
Questions regarding user satisfaction and ways to improve satisfaction, etc. have been targeted to end-users i.e. Students and Teaching Staff.

The respondents that were invited to participate in this survey process have been arranged into 4 groups based on their role in the higher technical education institute which are as following:

a) **Head of Institute**: Owners or Director or Principal or HoDs of Colleges / Institutes / University departmental or appropriate Managing Authority.


c) **Full-Time Students**: Learners of different University, Institutes and department of Institutions imparting Higher Technical Education.

d) **Full-time Teaching Staff** members of Institutions imparting Higher Technical Education.

Additionally, white papers, case studies, websites of educational institutions, industry sources, have been used as source of Secondary data along with traditional sources of professional journals and publications.

### 3.1 PROBLEM STATEMENT

India is fast emerging as the educational hub of the world. Government of India is trying its level best to put India’s education system on the world platform. To become a world player in education sector we not only need to teach nicely but need to inculcate knowledge which is in addition to the book knowledge. For this we also need to have world-class I.C.T. infrastructure facilities in educational institutions. This infrastructure not only includes desks and tables in classes and lavish office furniture and good gardens outside the colleges, but we also need study material and a gateway to endless literature and knowledge on various subjects which can be used for teaching purpose and research purpose. Students need computer network facility in schools and colleges which they can be used for preparing lecture sessions, doing assignments, write research papers, etc.

I.C.T. infrastructure installed in higher educational institutions have certain vulnerabilities and threats involved, which if exposed, can be catastrophic to the availability of network facilities for both staff and students and external parties. I.C.T.
infrastructure and data security in higher education institutions is a great point of concern.

There are also issue regarding availability of adequate infrastructure in institutes of higher education.

This makes the study of various aspects I.C.T. including computer network management in higher educational institutions a vital area of research.

Thus, Statement of Problem can be summarized as

“To study the I.C.T. infrastructure facilities and services as provided by Institutions imparting Higher Technical Education with respect to its Management including security aspects. Also, to understand the user satisfaction pattern and problems associated with these facilities with an intent to suggest remedial measures in order to avoid loopholes so as to obtain envisaged results”.

Thus, this research study endeavours to identify the problems related to the I.C.T. infrastructure facilities available in the institutions of higher technical education. It also endeavours to identify the gaps in the I.C.T. facilities provided by Institutions of higher technical education by looking at the satisfaction levels for some of the common I.C.T. services offered such institutions. Furthermore, this research study takes a look into the prevalent security issues faced with regards to I.C.T. infrastructure and digital data assets, thus, identifying security gaps and proposing remedies in order to envisaged results. Lastly, the study also tries to enlist the various benefits which higher education institutions have and/or can achieve by implementation of I.C.T. infrastructure facilities and its various services.

As a final output of this research study the research scholar also suggests a model framework for creating an efficient I.C.T. infrastructure which can provide efficient and economical data security and greater user satisfaction, thus, leading to accomplishment of envisaged results.

3.2 SCOPE OF THE STUDY

The research is limited to the study of I.C.T. facilities that are available in the higher technical education institutions specifically those providing professional courses like MBA, MCA, BE, B.Pharma, etc. It strives to study the various the usage pattern of these I.C.T. facilities by various types of users. Further it strives to study the user
satisfaction with respect of I.C.T. facilities and the security aspects of I.C.T. infrastructure in institutions imparting Higher Technical Education. It also strives to understand the benefits accumulated from implementation of I.C.T. infrastructure in the institutes imparting Higher Technical Education. In this way the study strives to understand the management policies, strategies and the decisions which the Management follow when deciding upon the various I.C.T. facilities to be made available in the institution. The policies of the management on various issues including financial decisions very much play an important role in deciding the kind of I.C.T. facility to be made available in the institute, the maintenance issues, usage patterns of facilities, I.C.T. security, etc. of the I.C.T. infrastructure. These ultimately lead to satisfaction or dissatisfaction of the end-users of the facilities specially the students and teachers.

Considering that Pune is regarded as the educational hub of India and has sufficient institutions required for the study, the geographical limitation of the study limited to area in Pune. Going further it takes into consideration only those colleges or institutions which, in particular, are approved by A.I.C.T.E for running that particular course. Only Under-Graduate and Post Graduate degree courses have been considered.

The terms “Institutions imparting Higher Technical Education” for the purpose of our study includes only those institutes that offer higher education in the field Management, MCA, Hotel Management, Engineering and Pharmacy courses approved by A.I.C.T.E, New Delhi. (Refer Annexure for full definition). Only Graduate and Post graduate courses have been considered. Diploma courses are not covered for the purpose of this study.

As observed, most Management colleges in Pune region also run MCA course and share resources. Hotel management on the other hand is more of a management subject and has very small representation in the population. Thus, these 3 courses have been taken under “Management” itself. Only MBA, MCA (excluding under commerce, or science), Hotel Management degrees have been considered. No diploma (Under-graduate or Post-graduate) make it to this list.
With respect to “Pharmacy”, only those institutions conducting A.I.C.T.E approved B. Pharma, M. Pharma courses have been selected. No diploma courses make it to this list.

“Engineering Colleges”, on the other hand, include those institutions running Graduate or Post Graduate degree courses viz. B.E., M.E., B.Tech, B.Arch and M.Arch. The population of A.I.C.T.E approved Architecture colleges is very low and, moreover, architecture has more traits of engineering involved in it, so these colleges have been included as part of Engineering colleges. Diploma courses are not included here.

The selection of respondents for the research is carried out for each Institute under the following category:

1) Head of Institute
2) Full-time Teaching Staff
3) Full-time Students(Learners)
4) I.C.T. Technical Support Staff.

The researcher has considered the Pune district for the study. The primary attributes that make Pune the most feasible areas to conduct the said study are as following:

a) The second largest city in the western Indian state of Maharashtra and has history even older than Mumbai. The district has geographical area of 15.642sq.km.

b) It is known for its educational facilities boasting of 9 universities, educational institutions of National Importance, having more than three hundred educational institutes. Savitribai Phule Pune University and Symbiosis are reputed worldwide. Thus, also called "The Oxford of the East".

c) It has high literacy rate.

d) Higher Technical Education institutions are present in rural area also.

e) It has growing industrial facilities and has got a big name in heavy industries, automobile sector and Information Technology.

f) Pune district was centre of administration during Peshwa era and is district headquarter even today.
Students enrolled here belong to Pan-India and has ample number of foreign students.

Thus, Pune has been found to be the best area for conducting such type of study.

Map 3.1 depicts the map of Punedistrict along with the names of important Talukas.

![Map of Pune district](image)

### 3.3 OBJECTIVE OF THE STUDY

The researcher has set primary Objectives as given below:

1) To study the I.C.T. infrastructure facilities and I.C.T. enabled services provided by institutions.

2) To study user satisfaction with regards to I.C.T. facilities and services provided by institutions.

3) To identify gaps in Management of I.C.T. facilities and services with special emphasis on I.C.T. security and identify solutions from management perspective in order to receive envisaged results.

4) To study the benefits of use of I.C.T. facilities and services in institutions including their impact on day to day functioning of the institutions.
5) To suggest a theoretical model to improve efficiency of I.C.T. in Institutions imparting Higher Technical Education.

3.4 HYPOTHESES OF THE STUDY

In order to achieve the objectives, as mentioned in section 3.3, the researcher has put forward the following hypothesis for testing:

HYPOTHESIS 1:

\[ H_0: \] There is No significant difference in availability of basic I.C.T. facilities for students in Higher Technical Educational Institutions located in Pune’s Urban areas and Rural areas.

\[ H_1: \] There is a significant difference in availability of basic I.C.T. facilities for students in Higher Technical Educational Institutions located in Pune’s Urban areas and Rural areas.

HYPOTHESIS 2:

\[ H_0: \] Institution’s I.C.T. security policy has NOT been able to secure I.C.T. infrastructure of the institution.

\[ H_1: \] Institution’s I.C.T. security policy has been able to secure I.C.T. infrastructure.

HYPOTHESIS 3:

\[ H_0: \] I.C.T. security policy document created by the institute’s Management is NOT displayed in labs and prominent areas of the Higher Technical Educational Institutions in Pune.

\[ H_1: \] I.C.T. security policy document created by the institute’s Management is displayed in labs and prominent areas of the Higher Technical Educational Institutions in Pune.

3.5 SIGNIFICANCE OF THE STUDY

The study of I.C.T. infrastructure and I.C.T. enabled services provided in higher technical education institutions is a great learning paradigm to understand and enhance the readiness of such institutions for the digital revolution in India especially in academic fraternity. The findings of the study will rebound to the society and students, in particular, considering that I.C.T. has been identified as a major tool for the purpose of knowledge dispersion. The goals of this study will help bring the I.C.T.
setup and facilities to a stage where it will help institutions develop teaching-learning
skills that will help students in acquisition of knowledge for gaining employment and
giving their full participation in the country’s development.

Higher education institutions are like Small-Medium Enterprise and are confronted by
the growing complexity of their IT environment. They need to manage several
desktops and notebooks, handheld devices, servers, a network and applications to
successfully transact. Many such institutions don’t have the depth or resource to
dedicate solely towards the plethora of I.C.T. infrastructure maintenance and
monitoring tasks in today’s complex modern I.C.T. environments. Significant
investment is needed for taking up such challenges [8].

Instead of going by words or previous experiences of others in similar situations, it is
important to ascertain the current information on the validate it using empirical
methods.

Researcher has observed that there is a lack of research that focuses on key factors of
I.C.T. infrastructure from the viewpoint of its multiple stakeholders in the context of
higher technical educational (professional courses) especially in the Indian
perspective.

There is a need to address user’s expectations, organizational needs and goals, legal
compliance requirements and security of digital assets.

By understanding the needs of the students &other stakeholders, and the benefits
arising out of quality I.C.T.facilities, these teaching staff and students be assured of a
competitive edge in the world market.

The researcher desires to address the gaps in I.C.T. facilities implementation,
highlight problems in I.C.T. security, recognize satisfaction-dissatisfaction patterns of
users of I.C.T., thus, leading to identification of the problematic areas for such
institutes. The objectives of the study are designed to help government as well as
Management of Institutions identify the I.C.T. facilities that are in place and find the
areas which are lacking behind so that all stake holders get world class I.C.T. facilities
in their institutions and the data is also in safe hands.

Once problems have been identified, this research study aims to develop a theoretical
framework which will assist the Higher Education Institutions’ in their management
of the I.C.T. infrastructure, the impact of I.C.T. infrastructure on end users, benefits realization and the challenges being faced in maintaining these systems.

As Pune is not only an academic hub but also an industrial hub on the world map so the results of this study can even be used as an example to create a bigger picture of the scenario at the national level.

If suggestions are implemented the biggest beneficiaries of the study will be students who, through the use of I.C.T. facilities in the institution, will be able to improve academic competence, develop employability skills, gain knowledge from latest research papers and books available online.

3.6 RESEARCH METHODOLOGY

The study is related to the implementation of I.C.T. infrastructure and its implementation in the Higher Technical education institutions along with I.C.T. security issues involved. It also studies the security issues attached to it. Further, it goes for understanding the user satisfaction attained from it. It, also, strives to understand the economic and strategic benefits accumulated from implementation of I.C.T. infrastructure and its implementation in Institutions imparting Higher Technical education.

The Descriptive Research Methodology has been followed in this research study considering the findings from review of literature that some research has been done earlier but a more in-depth and integrated approach is required on the subjects under study in this research work to better understand the underlying trends and problems.

It utilizes both Primary Data and Secondary data for attaining the objectives set forth for this study. The secondary data has been sourced from both published as well as un-published sources which includes case-studies, National and International Journals, White Papers, etc. to name a few.

As Primary data is not readily available and it has to be collected from the respondents. These respondents have been categorized into 4 types depending on their role in the institution. Specific questions have been asked from each of these respondent type depending on the type of their association with the institution and the knowledge they possess in a particular area related to the study. The scope of research is restricted as explained in the objectives and the scope section. The survey method is used to collect Primary datataking the help of Stratified sampling technique to get to
an appropriate Sample size which can represent the whole population. Thus, depending on the type and population size of each type of respondents, Stratified Proportionate Sampling and Stratified Disproportionate Sampling has been used.

3.6.1 PRIMARY DATA

The scope of research mandates the collection of primary data from institutions imparting Higher Technical Education courses (as mentioned in scope) recognized by A.I.C.T.E, New Delhi. For the purpose of the study, the institutions have been Stratified into 3 strata viz. Management, Engineering, and Pharmacy.

- **Management Strata**: Consist of institutions providing courses viz. MBA, MCA and Hotel Management.
- **Engineering Strata**: Consist of institutions providing courses viz. BE, ME, B.Tech, B.Arch and M.Arch.
- **Pharmacy Strata**: Consist of institutions providing courses viz. B.Pharma and M. Pharma.

Similarly, the primary data needs to be taken from four different respondent types associated with these institutions viz.:

a) **Head of Institute** Director or Principal or HoDs of Colleges / Institutes / University departmental or appropriate Managing Authority of Higher Education institutes.

b) **I.C.T. Support Staff Members** of Higher Education institutes.

c) **Full-time Students (Learners)** of different University, Institutes and department of Higher Education institutes.

d) **Full-time Teaching Staff members** of Higher Education institutes.

The primary data has been collected using a survey instrument which is the questionnaire. Thus, four different types of questionnaires have been designed for each of these respondent types.

The details of Population and Sample for institutions as well as respondents is given in the following sections.
3.6.1.1 SELECTION OF THE PUNE AS GEOGRAPHIC LOCATION FOR SURVEY

As mentioned in section 3.2, the researcher has selected Pune region for the purpose of the study and collection of primary data. Pune region has a rich historic background. It is a historic place and industrial region and has large number of industries including IT and software companies. In general, also Pune is high in literacy rates. Pune is one of the biggest higher education hubs in the country. This makes it possible to get ample number of suitable respondents for data collection.

3.6.1.2 POPULATION AND SAMPLE DETAILS OF INSTITUTIONS IMPARTING HIGHER TECHNICAL EDUCATION

In this section, the researcher has discussed the Population details and sample design for the institutions under study.

For the purpose of the study, the institutions has been Stratified into 3 strata viz. Management, Engineering, and Pharmacy.

- **Management Strata**: Consist of institutions providing courses viz. MBA, MCA and Hotel Management.

- **Engineering Strata**: Consist of institutions providing courses viz. BE, ME, B.Tech, B.Arch and M.Arch.

- **Pharmacy Strata**: Consist of institutions providing courses viz. B.Pharma and M. Pharma.

**Calculation of Population:**

For the academic year 2014-15, as per the A.I.C.T.E dashboard available at http://www.aI.C.T.e-india.org/dashboard/pages/dashboardaI.C.T.e.php, in the state of Maharashtra there are 60,820 full-time Teaching staff, 2,84,420 Full-time Students (UG and PG A.I.C.T.E approved courses), and 1320 institutions running A.I.C.T.E approved courses which forms the universe for the study.

For being included in the population, the institute must fulfill following three criteria, namely:

- The Institute / college / University department must be located in Pune region as Shown in Map of Pune district.
• They must be running a Higher Education course like Management, Engineering or Pharmacy at Under-Graduate and/or Post-Graduate level. (Diploma or Post-Graduate Diploma institutions is not included).

• The course that is being conducted in the institute must be approved by A.I.C.T.E.

• The said institute must be running that particular course for a minimum of 5 years with academic year 2014-15 as the base year.

The criteria of minimum least 5 academic years. As the list of institutions that form the population is from academic year 2014-15, therefore, the institute must be running the said A.I.C.T.E approved course on or before year 2009. This has been done taking 2 important points in consideration:

1) There are enough respondents in the institution.

2) The institution has gathered enough experience, expertise and I.C.T. infrastructure so as to answer the required questions.

Thus, the total population of institutions comes to 164. As per the statistics available on A.I.C.T.E website for the academic year 2014-15, it was found that there are 48 Nos. Engineering colleges, 94 Nos. Management colleges, and 21 Nos. pharmacy colleges in Pune. The details of population and sample are shown in the Table 3.1.

Note:

i. As it a university department which is actually running a higher technical education course like Management, etc., therefore, it is the particular university department / affiliated college that has made to the list of the Population under study and not the University as a whole.

ii. We are not considering colleges, institutes or university / university department separately. They all have been given equal weightage as an institute providing a particular course.
Table 3.1: Institution Population and Sample

<table>
<thead>
<tr>
<th>Sr. No</th>
<th>Institute Type (Strata name)</th>
<th>Total Institute Population in Pune</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Engineering Colleges</td>
<td>48</td>
</tr>
<tr>
<td>2</td>
<td>Management Colleges</td>
<td>94</td>
</tr>
<tr>
<td>3</td>
<td>Pharmacy</td>
<td>21</td>
</tr>
<tr>
<td>Total</td>
<td></td>
<td>164</td>
</tr>
</tbody>
</table>

Note: This Population list includes only those institutes which were established in or before 2009.

3.6.1.3 POPULATION AND SAMPLE DETAILS OF SAMPLE (RESPONDENTS)

I.C.T. infrastructure implementation, management, usage, etc. are quite a big and inter-woven processes. These processes are performed by different set of people and it is hard to find respondents who know all these processes. Also, the perception of these respondents towards I.C.T. is different as the role they play with regards to I.C.T. in colleges / institutions is different.

As for example, a student doesn’t know about which I.C.T. security equipment (like Router, etc.) is being used in their college. This domain comes in the area of I.C.T. technical Support Staff.

Thus, Respondents for this study belong to three categories and are chosen to provide better representation of each side. The three categories are Head of Institution, Full-time Teaching faculty (staff) members, Full-Time Students and I.C.T. Technical Support Staff.

In this section the Researcher has described the rationale behind calculation and selection of population and sample of the respondents.

Type A: Selection of Head of Institute

In case of selection of sample size for this category, we need to use Stratified Proportionate sampling method. The reason for this is that the number of Head of Institute in each college is generally one for the whole college or a particular course.

Hence for study purpose, researcher has used 1:1 ratio for Head of Institute (Refer Table 3.2).
Table 3.2: Sample and Respondent Details for Head of Institute

<table>
<thead>
<tr>
<th>College Type</th>
<th>*Required No. Of respondents in Sample</th>
<th>No. of Valid Responses received</th>
</tr>
</thead>
<tbody>
<tr>
<td>Engineering</td>
<td>34</td>
<td>13</td>
</tr>
<tr>
<td>Management</td>
<td>66</td>
<td>20</td>
</tr>
<tr>
<td>Pharmacy</td>
<td>15</td>
<td>5</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>115</strong></td>
<td><strong>38</strong></td>
</tr>
</tbody>
</table>

* Refer Table 3.1

Table 3.2 depicts the sample details for Head of Institute respondents. The researcher tried to cover the full sample of Institutions as mentioned in Table 3.1. Of these few responses were disqualified because of incomplete filling up by the respondents. A few never returned the response questionnaire.

Thus, the number of valid responses of type Head Of Institute is 13 Nos. for Engineering, 20 Nos. for Management, and 5 Nos. for Pharmacy institutes.

Type B: Selection of I.C.T. Technical Support Staff

Data regarding which I.C.T. devices have been installed, what services have been provided by the respective institution, security issues, etc. can be best answered by none other than the I.C.T. Technical Support Staff working in the said colleges and so such type of data are collected from I.C.T. Technical Staff. Thus, Purposive Sampling procedures have been maintained.

For collection of data, researcher has applied Stratified Proportionate sampling method for these types of respondents. Stratified Proportionate method enables each strata to have same proportion of presence in the sample as it has in the Population. This has been done taking in mind that that there is at least one I.C.T. Technical Support staff in each educational institution. All the selected staff members were personally interviewed by the researcher. Some of the Information is also collected by conducting group discussion with the selected staff members.

It was found that due to UGC and A.I.C.T.E, regulations each institution had some I.C.T. equipment and computers, printers.
Table No. 3.3: Course-Wise Sample Distribution of I.C.T. Technical Support Staff

<table>
<thead>
<tr>
<th>College Type</th>
<th>*Required No. Of respondents in Sample</th>
<th>No. of Valid Responses received</th>
</tr>
</thead>
<tbody>
<tr>
<td>Engineering</td>
<td>34</td>
<td>56</td>
</tr>
<tr>
<td>Management</td>
<td>66</td>
<td>39</td>
</tr>
<tr>
<td>Pharmacy</td>
<td>15</td>
<td>16</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>115</strong></td>
<td><strong>111</strong></td>
</tr>
</tbody>
</table>

*Refer Table 3.1 for Population and Sample details

Table 3.3 depicts the Strata-wise sample of details of I.C.T. technical staff respondents along the total number of Valid responses received. The overall percentage of valid responses received in sample is 79.28%.

As we can see from the Table 3.3, the required number of technical staff responses is 115 Nos. of these 111 Nos. were considered Valid. This is because, out of the total number of respondents approached, few responses were disqualified because of incomplete filling up by the respondents. A few never returned the response questionnaire. These responses have not been included in the Table 3.3.

Type C: Selection of Full-Time Teaching Staff

For the purpose of this study, the full-time teaching staff has been selected from higher technical education institutes which are situated in Pune region.

A.I.C.T.E, DTE or University websites do not show exclusively the correct faculty members working particularly in Pune region’s Higher technical Education Institutions. Thus, getting an official figure of total number of teaching staff (faculty members) is not possible.

Thus, Researcher has used the total Student Intake for each type of course as an input to calculate Full-time Teaching Staff strength. This Student-Faculty Member ratio is as per norms laid down by A.I.C.T.E in their yearly reference handbooks for Higher Education institutions. Though, the Student-faculty staff ratio[7] varies between 1:10 and 1:15 depending on the course type, but for ease of calculations, the researcher has considered it as 1:15 for all courses. (Here, the approved strength of students is considered for all years)
During fieldwork for data collection it was found that Computers, printers, etc. were being used in each Institute regular basis.

Table 3.4: Course-Wise Sample Distribution of Full-Time Teaching Staff

<table>
<thead>
<tr>
<th>College Type</th>
<th>Population of Full-Time Students</th>
<th>**Required Student-Faculty member Ratio (As per A.I.C.T.E Norms)</th>
<th>Total Faculty Respondents Population</th>
<th>Sample Size</th>
<th>No. of Valid Faculty Members Responses</th>
</tr>
</thead>
<tbody>
<tr>
<td>Engineering</td>
<td>94983</td>
<td>1:15</td>
<td>6332</td>
<td>242</td>
<td>139</td>
</tr>
<tr>
<td>Management</td>
<td>43344</td>
<td>1:15</td>
<td>2889</td>
<td>110</td>
<td>150</td>
</tr>
<tr>
<td>Pharmacy</td>
<td>6202</td>
<td>1:15</td>
<td>413</td>
<td>15</td>
<td>43</td>
</tr>
<tr>
<td>Total</td>
<td>144529</td>
<td></td>
<td>9634</td>
<td>369</td>
<td>332</td>
</tr>
</tbody>
</table>

The required sample size for a population of 9634 is 369.

*This sample size has been calculated with Confidence= 95% and Degree of Accuracy/Margin of Error being at 0.05. Krejcie and Morgan chart[10] has been used to calculate sample size.

**Kindly note that though there is a slight difference in Student-faculty ration for different courses, a uniform ration of 1:15 has been considered for ease of calculation.

Strata-wise sample for teaching staff is calculated using Stratified Proportionate Sampling method.

The researcher had sent around 406 Questionnaires using various methods like post, email and personal interview, etc. many went un-anwered or were incomplete making them invalid responses. The actual number of valid responses collected are 332.

Table No 3.4 shows the information of total number of Full-Time Teaching Staff members and sample selection from each category. As seen in the table 3.4, from selected Institutes researcher has received 150 Valid responses from Management, 139 from Engineering, and 43 from Pharmacy.
All the teaching staff members were either personally interviewed by the researcher or were asked to fill responses online. Some of the Information is also collected by conducting group discussion with the selected staff members.

Type D: Selection of Full-Time Students (Learner)

Population of learner (full-time students) in Higher Education institutions in Pune region is very high i.e. approx. 1,44,529. This figure is as per the data available with A.I.C.T.E for Academic Year 2014-15. This data has been retrieved from A.I.C.T.E website[1].

Looking at the huge volume of population, the researcher has used Stratified Proportionate Sampling Method and selected approx. 2-3 respondents from each institution in each course category as shown in following table 3.5.

Point worth noting here is that that the maximum sample size for a population of 144529 is 384. But, in order to achieve better success rate in data collection and for accuracy of data, the researcher had sent nearly 450 questionnaires of which 435 were found to be valid for research purpose.

Table No. 3.5: Course-Wise Sample Distribution of Full-Time Students (Learners)

<table>
<thead>
<tr>
<th>College Type</th>
<th>Total Student Respondents Population(all years)</th>
<th>No. of Valid Responses received</th>
</tr>
</thead>
<tbody>
<tr>
<td>Engineering</td>
<td>94983</td>
<td>219</td>
</tr>
<tr>
<td>Management</td>
<td>43344</td>
<td>165</td>
</tr>
<tr>
<td>Pharmacy</td>
<td>6202</td>
<td>51</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>144529</strong></td>
<td><strong>435</strong></td>
</tr>
</tbody>
</table>

Table No 3.5 shows the information of total number of Full-Time Students (Learners) and sample selection from each category.

The required sample size for a population of 144529 is 384. This sample size has been calculated with Confidence= 95% and Degree of Accuracy/Margin of Error being at 0.05. Krejcie and Morgan chart10 has been used to calculate sample size.

As seen in the table 3.5, we find that researcher received much higher number of valid responses i.e. 435 than the required sample size. Of these 219 are from Engineering, 165 are from Management and 51 are from Pharmacy.
3.6.2 SECONDARY DATA

The Researcher has used secondary data for understanding the past studies done or undertaken w.r.t. the I.C.T. infrastructure available in institutions of Higher Education coupled with its security and satisfaction trends among users and other stakeholders. The sources of these secondary data are the reputed journals and magazines, newspapers, articles, internet websites and archives. Researcher has also gone through some relevant PhD. thesis works. For collecting this data the researcher has visited various libraries in Pune and Mumbai. This greatly helped the researcher in finalizing the aims and objectives of the current said study and provide future direction for the research work.

3.7 DATA COLLECTION PROCESS

This section deals with the actual data collection process details. It discusses about the various data collection tools used, Pilot Study and the learning’s from it, final data collection process, etc.

3.7.1 TOOLS FOR PRIMARY DATA COLLECTION

For the Pilot Study as well as for the final data collection process w.r.t. the primary data, the researcher used the Structured Questionnaires. These were provided to the user in either Printed format or in e-format using the Google forms.

Based on the type of respondent, invited to participate in this survey process, four different structured questionnaires have created. These include:

a) **Questionnaires for Head of Institute** (Director or Principal or HoDs of Colleges / Institutes / University departmental or appropriate Managing Authority) of Higher Technical Education institutes.

b) **Questionnaires for I.C.T. Support Staff Members** of Higher Technical Education institutes.

c) **Questionnaires for Full-time Students (Learners)** of Higher Technical Education institutes.

d) **Questionnaires for Full-time Teaching Staff members** of Higher Technical Education institutes.
As mentioned earlier, these questionnaires have been prepared in both digital form (available on google Forms) and hard copy. Researcher also used telephone survey/email survey, mail questionnaire, personal observation, interviews, etc. for getting the questionnaires filled.

During the course of their development, the questionnaires were reviewed and modified as per suggestions of experts and learning’s from pilot study.

Table 3.6: Address of Links to Questionnaires on GoogleDocs

<table>
<thead>
<tr>
<th>Respondent Type</th>
<th>GoogleDocs URL</th>
</tr>
</thead>
<tbody>
<tr>
<td>Head of Institution</td>
<td><a href="https://goo.gl/forms/o8pjHJjam7BAYRcIx2">https://goo.gl/forms/o8pjHJjam7BAYRcIx2</a></td>
</tr>
<tr>
<td>Full-Time Teaching Staff</td>
<td><a href="https://goo.gl/forms/hSwLVcxfW048eFut1">https://goo.gl/forms/hSwLVcxfW048eFut1</a></td>
</tr>
<tr>
<td>Full-Time Students</td>
<td><a href="https://goo.gl/forms/yvYeXrwLCrof1SRs1">https://goo.gl/forms/yvYeXrwLCrof1SRs1</a></td>
</tr>
<tr>
<td>I.C.T. Technical Support Staff</td>
<td><a href="https://goo.gl/forms/q6eG6pGgVDsk0E8t2">https://goo.gl/forms/q6eG6pGgVDsk0E8t2</a></td>
</tr>
</tbody>
</table>

Regardless of the fact that GoogleDocs based questionnaires are nevertheless very good for data collection in survey based research projects, still, Researcher has also collected data on hard copy printed questionnaire from many respondents. One advantage that the researcher perceived from hard copy printed questionnaires is that the researcher was able to meet some respondents in personal. This provided an opportunity to observe the infrastructure officially or un-officially personally. Also respondents sometimes divulged certain facts personally which they, officially, didn’t want to put on paper in black-and-white for obvious reasons.

3.7.2 PILOT STUDY

Before the starting of the main data collection stage, pilot study was executed on experimental basis so as to scrutinize whether or not the proposed questionnaires were well-designed so as to be able to capture correct and valid data that could give us desired answers to the objectives and further help in testing the framed hypothesis. Another issue regarding conducting / undertaking this pilot study was to understand the user perception regarding various questions asked in the respective questionnaires coupled with whether questions were understandable by the target respondents.
For the purpose of Pilot study the researcher considered 8 colleges / institutes targeting 20 Full-Time Students, 15 Full-Time Teaching Staff, 8 Head of Institute, and 8 I.C.T. Technical Support Staff Members

The said Pilot Study provided very valuable inputs which helped improving the quality of Questionnaires. Some of the learnings from the pilot study are as following:

- Questions must be asked by correct respondent type especially Technical questions to be asked from only I.C.T. support staff.
- Questionnaires of Head of Institute must be restricted to their functional areas specifically administration, monetary and strategic questions.
- Certain less important questions were to be removed to keep length of questionnaire in control.
- Technical staff respondents were reluctant in giving certain exact details of security implementation as it could compromise with the security. Such questions were reframed and indirect were used in such cases.
- It was found that survey method was suitable for the study.
- It was also realized that Head of Institute respondents were reluctant in giving exact financial figures regarding provisions for I.C.T. in their budget. In this case questions were reframed and figures were asked in percentage of total budget rather than in amount (Rs.).
- Another learning was that when it came of questions where user perceptions was to be evaluated as for example satisfaction level for certain I.C.T. services, in such a case two staff members from same institute gave two different opinions in certain cases.
- Few more questions were added in I.C.T. technical staff questionnaire to understand availability of minimum I.C.T. infrastructure like Wi-Fi.

Reliability Testing

To check the consistency of the questionnaire to be administered researcher has applied the Cronbach's Alpha reliability test.

It is observed that the questionnaire to be administered is consistent throughout the respondents. Reliability coefficient of .70 or higher is considered “acceptable”.

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For Head of Institute (Cronbach's Alpha = 0.709), Full-Time Teaching Staff (Cronbach's Alpha = 0.737), Full-Time Students (Cronbach's Alpha =), and I.C.T. Technical Staff (Cronbach's Alpha = 0.923). Further researcher can conclude that the same questionnaire can be administered for the further research.

Table 3.7: Reliability Statistics for Head of Institute

<table>
<thead>
<tr>
<th>Cases</th>
<th>N</th>
<th>Cronbach's Alpha</th>
<th>N of Items</th>
</tr>
</thead>
<tbody>
<tr>
<td>Valid</td>
<td>8 (100%)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Excludeda</td>
<td>0</td>
<td>0.709</td>
<td>69</td>
</tr>
<tr>
<td>Total</td>
<td>8 (100%)</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

From Table 3.7, it is observed that questionnaire is consistent and that Cronbach's Alpha score is 0.709. It means that 70 percent respondents understood the questionnaire.

Thus, the Researcher concludes that this questionnaire can be administered for the further research.

Table 3.8: Reliability Statistics for Full-Time Teaching Staff

<table>
<thead>
<tr>
<th>Cases</th>
<th>N</th>
<th>Cronbach's Alpha</th>
<th>N of Items</th>
</tr>
</thead>
<tbody>
<tr>
<td>Valid</td>
<td>15 (100%)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Excludeda</td>
<td>0</td>
<td>0.737</td>
<td>45</td>
</tr>
<tr>
<td>Total</td>
<td>15 (100%)</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

From Table 3.8, it is observed that questionnaire is consistent and Cronbach's Alpha score is 0.737. This means 73 percent respondents understood the questionnaire. Thus researcher concludes that this questionnaire can be administered for the further research.
From Table 3.9, it is observed that questionnaire is consistent and Cronbach's Alpha score is 0.737. It means 73 percent respondents understood the questionnaire. Thus researcher concludes that this questionnaire can be administered for the further research.

From Table 3.10, it is observed that questionnaire is consistent and Cronbach's Alpha score is 0.830. It means 92 percent respondents understood the questionnaire. Thus researcher concludes that this questionnaire can be administered for the further research.

**SUMMARY:**

In case of this particular research, the data collection process was a tedious one. Where it came to collect data personally, the respondent had hard time to get inside certain institutes. More over the sample size of Students and teaching staff was quite high. Another problem faced by researcher was that of getting an appointment from Management representatives i.e. Directors and Principals.

A.I.C.T.E list also contained redundant list of institutions. This was because of the shift system namely First Shift and Second shift. If an institution was having both
shifts, the name of the institution appeared twice. Thus, such duplicate names were removed from the population list. Once data was collected and tabulated, it was then coded and fed into SPSS software for analysis work.

In all 916 valid questionnaires were recorded.

**Table No. 3.11: Summary Chart of Respondents Sample**

<table>
<thead>
<tr>
<th>S. No</th>
<th>Institution type</th>
<th>Respondent Type</th>
<th>No. of Valid respondents in Sample</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Engineering</td>
<td>Head of Institute</td>
<td>13</td>
<td>427</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Full-Time teaching Staff</td>
<td>139</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Full-Time Students (Learners)</td>
<td>219</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Technical Support Staff</td>
<td>56</td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>Management</td>
<td>Head of Institute</td>
<td>20</td>
<td>374</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Full-Time teaching Staff</td>
<td>150</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Full-Time Students (Learners)</td>
<td>165</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Technical Support Staff</td>
<td>39</td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>Pharmacy</td>
<td>Head of Institute</td>
<td>5</td>
<td>115</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Full-Time teaching Staff</td>
<td>43</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Full-Time Students (Learners)</td>
<td>51</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Technical Support Staff</td>
<td>16</td>
<td></td>
</tr>
<tr>
<td></td>
<td><strong>Total</strong></td>
<td></td>
<td></td>
<td>916</td>
</tr>
</tbody>
</table>
**Table No. 3.12: Summary of Sample**

<table>
<thead>
<tr>
<th>Population description</th>
<th>I.C.T. Technical Staff</th>
<th>Full-Time Teaching Staff</th>
<th>Full-Time Students</th>
<th>Head of Institutes</th>
</tr>
</thead>
<tbody>
<tr>
<td>No. of I.C.T. Technical support staff</td>
<td>No. of Teaching Staff from Institutes working full-time</td>
<td>No. of enrolled students from different Institutes (only full-time)</td>
<td>Director/ Principal/ HODs/ Institute owners</td>
<td></td>
</tr>
<tr>
<td>Population size</td>
<td>1 per institute (163 Nos.)</td>
<td>Total number of full-time teaching staff in ratio of total enrolled students. (9634)</td>
<td>Total no. of full time enrolled (sanctioned) students in A.I.C.T.E approved courses in all years (144529)</td>
<td>1 per institute (163 Nos.)</td>
</tr>
<tr>
<td>Sample size required as per Krejcie and Morgan Chart (Confidence= 95% and Degree of Accuracy/Margin of Error being at 0.05)</td>
<td>115</td>
<td>369</td>
<td>384</td>
<td>115</td>
</tr>
<tr>
<td>Actual no. of VALID responses</td>
<td>111</td>
<td>332</td>
<td>435</td>
<td>38</td>
</tr>
<tr>
<td>%age of Total Population</td>
<td>68.10%</td>
<td>3.45%</td>
<td>0.03%</td>
<td>23.31%</td>
</tr>
<tr>
<td>Sampling Method</td>
<td>Stratified Sampling Method</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
REFERENCES:


9) Collector’s Office Pune, "District At a Glance-Pune District (Maharashtra State, India)". Retrieved from http://pune.nic.in/content/punecity/aboutpune.aspx