CHAPTER – 3

RESEARCH METHODOLOGY

3.1 Introduction

This chapter discusses the research methodology aspects of the study. Research methodology is a way to systematically solve the research problem. It provides an approach to conduct research in terms of research problem, objectives of the research, target population, sampling technique, data collection methods, questionnaire designing, validity and reliability of the research instrument with statistical methods of data analysis. The details of these aspects are presented in the sections to follow.

3.2 Research Problem

Increasing IT infrastructure, demand for huge power consumption, fast growing e-waste problem are putting tremendous pressure on IT Industry to act in an environmentally sustainable manner. Despite Green IT emerging as an important concern for business organizations, it still lacks systematic approach towards adoption of sustainable Green IT culture in terms of governance policy and practices. Overall, Green IT though an emerging area of research, is still by far at nascent stage. There is a strong need for IT organizations to evaluate their carbon footprints and take effective measures to curb these threatening problems.

The study is endeavored to ascertain the answers to following research questions:

1. What are the motivational factors for IT organizations to implement Green IT?
2. What are the various concern areas that need to be addressed by IT organizations?
3. To what extent the IT organizations are aware and implement Green IT practices?
4. Do they have any formal system in terms of governance and policy to address Green IT? What are the various parameters considered for governance and policy framing?
5. What are the various benefits experienced by implementing Green IT?

6. What stops them to implement Green IT?

3.3 Significance of the Research

Green IT is now no more a choice for IT industry. It has become imperative for their environmental performance. Issues like power consumption of IT equipment, e-waste, environmental friendly purchasing need to be addressed and planned strategically by the IT organizations. Ignoring the importance of Green IT by companies would naturally lead to higher power costs and will ultimately lead to global warming and exhaustion of natural resources. Although the importance of Green IT implementation has been realized but its implementation is observed to be more of ad-hoc basis rather than well designed matured implementation. It still lacks a systematic approach which can help an organization to assess its Green IT initiatives and provide a logical way to certify the maturity level attained by an organization (Molla, 2008: 660; Sayeed & Gill, 2008: 6; Elliot & Binney, 2008: 7; Molla, et al. 2008: 672; Desai &Bhatia, 2011: 50).

Thus, the rationale behind the research was to propose a Green IT management model that that will give a holistic approach to Green IT adoption and will help an organization to evaluate its Green IT maturity.

3.4 Research Topic

Design and Development of Green IT Management model in selected IT Organizations in Pune city.

3.5 Objectives of the Research

The current research on Green IT focused on the following objectives:

3.5.1 Primary Objectives

1. To explore and identify issues and driving factors of Green IT implementation.
2. To explore and identify the parameters of Green IT governance and Green IT policy.

3. To examine and investigate the awareness and implementation of Green IT practices amongst management in selected IT organizations.
4. To propose a framework for Green IT management and to design and develop a Green IT maturity model that can be used to assess the Green IT maturity of an IT organization.

3.5.2 Secondary Objectives

1. To examine and investigate the implementation of Green IT practices amongst employees in selected IT organizations.
2. To know the opinion of employees regarding Green IT implementation in selected IT organizations.

3.6 Research Hypothesis

The hypotheses of the study are as follows:

1. $H_{1:}$ Green IT drivers differ in magnitude as claimed by IT organizations.
2. $H_{2:}$ There is a significant relationship between size of the organization and existence of Green IT policy.
3. $H_{3:}$ Small, medium sized and large IT organizations differ in implementation of Green IT practices.
4. $H_{4:}$ Small, medium sized and large IT organizations differ across Green IT governance.

3.7 Scope of the Research

The geographical, thematic and periodic scope is explained below:

1. Geographic Scope

The study was restricted to IT organizations of Pune city registered with NASSCOM (A not-for-profit Indian consortium created to promote the development of the country's IT and business process outsourcing (BPO) industries). (Refer Appendix – II for list of IT organizations)

2. Thematic Scope

The study included exploring and identifying the Green IT drivers, concern areas, parameters of Green IT governance and policy. It investigated the extent of awareness and adoption of Green IT practices amongst management of selected IT organizations. It helped to know the extent of implementation of Green IT practices amongst employees and their opinion regarding Green IT implementation in selected IT organizations. It also included the Green IT benefits and barriers experienced by the selected IT organizations. The current study does not consider Green IT practices applicable at IT hardware manufacturing stage.

3. Periodic Scope

The primary data for the study was collected during 2013- 2015.

3.8 Definition of Small, Medium and Large IT Organization

Green IT implementation varies with the size of the organization. The IT organizations registered with NASSCOM have different employee count hence the population was heterogeneous. In order to improve the effectiveness of the findings of the study, the IT organizations have been categorized according to the size of the organization. These three categories are termed as Small, Medium sized and Large IT organizations.

Due to the fact that that there is no well accepted definition of small medium sized and large organizations which can be applied to IT sector, the researcher has considered the definition of small, medium and large IT organizations based on the employee count of the organization. Small IT organizations have employee count up to 100, medium sized IT organizations have employee count between 101 and 1000 and large IT organizations have employee count above 1000. This definition has been considered after taking in to account the definition considered by Gartner (World's well known IT research firm) and the discussions with governing authorities like NASSCOM, Software Exporters association of Pune (SEAP) etc. and experts from IT industry. (Refer Appendix: III for more details)

3.9 Type of Research

The type of research is exploratory and descriptive. Exploratory studies are a valuable means of finding out what is happening, to seek new insight, to ask questions and to assess phenomena in a new light. It is used to develop a better understanding of the problem (Kasande, 2009: 1.8). Extensive literature review and in-depth interviews conducted with IT experts helped the researcher to explore the various parameters of Green IT governance and policy. Green IT practices were explored more in depth. A model based on the three important Green IT dimensions- governance, policy and practices has been proposed by the current research to evaluate the maturity in terms of the extent of Green IT implementation in an IT organization.

The major purpose of descriptive research is description of the state of the affairs as it exists at present (Kasande, 2009: 1.8). The current study also depicts the status of overall Green IT implementation in selected IT organizations.

3.10 Universe

The population of the study was the IT organizations in Pune city registered with NASSCOM. There were 92 IT organizations registered with NASSCOM (as on Jan 2013).

3.11 Sampling Design

The sample technique used for the study was stratified sampling. The entire population was categorized in to three groups: small, medium sized and large IT organizations and simple random sampling was performed on each group. This categorization was done for the following reasons:

1. IT organizations registered with NASSCOM have different employee count hence the population was heterogeneous, the use of simple random sample may not have produced representative sample.

2. Green IT implementation varies with the size of the organization hence some of the bigger strata might have got over representation while some of the small ones might have got entirely eliminated.
3. Categorization improved statistical efficiency.
4. The researcher wanted to study the characteristics of a certain population subgroups: small, medium sized and large IT organizations and wished to draw some conclusion from these categories.

The entire population consisted of 92 IT organizations. Out of which 20 were small, 43 were medium sized and 29 were large IT organizations according to the criterion applied for categorization of IT organizations in to small, medium sized and large IT organizations. All 92 organizations were approached for the study, out of which 60 organizations have responded to the researcher. From these 60 organizations, 52 organizations have responded well and completed the questionnaire. More than 50% of the population is considered for the study.

The number of sampling units drawn from each stratum is in proportion (approx.) to the relative population size of the stratum, thus the sampling technique is proportionate stratified sampling. Table 3.1 includes the details of the IT organizations selected for the sample.

Table 3.1: Distribution of IT organizations selected for the sample

	Distribution of IT Organization as per size of the Organization			**Total**
	Small IT Organizations	**Medium sized IT Organizations**	**Large IT Organizations**	
Total number of IT organizations registered with NASSCOM	20	43	29	92
Percentage of total population	21%	47%	32%	100%

	Distribution of IT Organization as per size of the Organization			Total
	Small IT Organizations	**Medium sized IT Organizations**	**Large IT Organizations**	
Number of IT organizations selected for sample	11	24	17	52
Percentage of total sample	21%	46%	33%	100%
Percentage of population sample	55%	56%	59%	57%

3.12 Source of Data

Primary as well as secondary data sources have been used in this research study.

3.12.1 Primary Data

Interview and questionnaire methods were the two tools used for primary data collection.

1. **Interview Method**

   Interview method is the best source of qualitative information. The study being exploratory in nature, it was essential to conduct in-depth interviews to gain better understanding of the true facts regarding policy and opinions of the industry regarding the overall status of Green IT. This method has greatly helped the researcher to tap the knowledge and experience of senior/middle management on the subject under study. In-depth interviews were conducted with 22 representatives from senior management of the IT organizations (Large: 4, Medium: 12, Small: 6).

   The interviews were majorly focused on the following aspects of Green IT: drivers, issues, governance, policy and practices. Fujitsu Consulting India Pvt Ltd, Persistent Systems, Symantac, E-Zest, Harbinger Knowledge Products Pvt Ltd, SEED Infotech Ltd, SQS India and Zcon Solution Pvt. Ltd. are some of the IT organizations which were considered for the in-depth interviews. Due to non-

disclosure agreement with many of the IT organizations, their identities have not been disclosed in the above list.

2. Questionnaire Method

Inline with the objectives of the study, the researcher compiled two questionnaires for different category of respondents with close and open ended questions to gather factual information. This method has its own importance in terms of convenience of respondents, answers to structured questions, reachability to respondents who are reluctant for interviews. These questionnaires had been filled by physically approaching IT organizations. Some of the responses were also collected through mails and survey monkey according to the convenience of the respondents.

The two questionnaires for different category of respondents are:

- **Management Level Questionnaire**

This questionnaire aimed at analyzing the overall management of Green IT with respect to the following Green IT dimensions:

1. Green IT Driving Factors
2. Green IT Issues / Concern Areas
3. Green IT Governance and its Parameters
4. Green IT Policy and its Parameters
5. Green IT Practices at three stages-IT purchasing, IT use and IT disposal
6. Green IT Benefits
7. Green IT Barriers

The respondents of this questionnaire were senior management, middle management, IT infrastructure manager or someone who was aware and well versed with the overall status of Green IT in the organization, keeping the above dimensions in to consideration. (Refer appendix - IV for questionnaire)

- **Employee Level Questionnaire**

  This questionnaire was designed to essentially assess the level of Green IT implementation within the employees and to know its realization in observing this in their day to day work. This questionnaire also helped to understand the gap or mismatch, if any that exists between the organization's vision about Green IT and that perceived and practiced by the employees.

  The respondents of this question were Software Developers at all the levels, Team/Project Lead, Software Quality Engineer, Software Architect, Software Trainer etc. (Refer appendix - IV for questionnaire)

3.12.2 Secondary Data

Secondary data was collected from various books, journals, magazines, newspapers and websites related to Green IT. 150 research papers/articles from various sources and 14 books were reviewed for thorough literature review.

3.13 Designing the Questionnaire

Two separate questionnaires for different category of respondents were designed: Management level questionnaire and Employee level questionnaire.

3.13.1 Management Level Questionnaire

The management level questionnaire was designed with the aim of collecting information related to Green IT issues, drivers, governance, policy and practices. The research also explored the benefits and barriers experienced by IT organizations. Hence, a questionnaire with a combination of close ended and open ended questions was used. The close ended questions were of rating type, multiple options type and Yes/No type. The Likert Scale was also used to obtain the opinion of the respondent on Green IT. The questions designed in the questionnaire are as follows:

1. **Demographic Variables**

   Demographic variables like type of IT organization (Product based, Service based and IT training), position of the respondent (Senior management, Middle Management and IT infrastructure), number of employees and number of PCs/Laptops in the organization (Up to 100, 101 to1000, above 1000) were included in the questionnaire. These questions were asked to know the profile of the respondents. The data collected has been analyzed based on the number of employees as Green IT implementation varies according to the size of the organization. IT organizations has been categorized in to small (employee count up to 100), medium sized (employee count between 100 to 1000) and large IT organizations (employee count more than 1000). (Included as Question number: 1,2,3,4 and 5 in the questionnaire)

2. **Green IT Concern Areas**

   Any IT organization wishes to implement Green IT must be aware of the various issues or concern areas of Green IT before implementing it. These concern areas will help an organization to identify the issues to focus and plan its strategy in terms of governance, policy and practices. A five point scale (1-Not concerned, 2-Somewhat, 3-Fairly, 4-Very, 5-Extremely concerned) was used to know the level of concern for the various issues or concern areas of Green IT. 11 concern areas had been identified (Included as question number: 6 in the questionnaire). The question is mentioned below:

- ***On a five-point scale, what is the level of concern for the following areas in Green IT for your organization?(1-Not concerned, 2-Somewhat, 3-Fairly, 4-Very, 5-Extremely concerned)***

  The answer to the above question was captured in the format illustrated in table 3.2.

Table 3.2: Level of concern in areas of Green IT

Sr. No	***Areas in Green IT***	***1***	***2***	***3***	***4***	***5***
1	*Effect of IT on greenhouse gas emission*					
2	*Regulations on greenhouse gas emissions*					
3	*Environmental friendly IT purchasing*					
4	*IT energy consumption (Use of IT in an energy efficient manner)*					
5	*Cost of powering IT infrastructure*					
6	*E-waste management (Discarding IT in an environmentally friendly way)*					
7	*Data center optimization*					
8	*Contribution of IT to reduce carbon footprint*					
9	*Suppliers' environmental footprint*					
10	*Clients' environmental footprint*					
11	*Overall environmental footprint*					

3. Green IT Policy

Green IT policy gives a direction to the effective implementation of Green IT in the organization. It was necessary to know whether the organization has the Green IT policy or not and what are the parameters considered in the policy. Five parameters were identified, which are listed below. The respondents were asked to choose the parameters which are included in their Green IT policy.

The below question related to existence of Green IT policy enabled the researcher to develop the relationship between size of the organization and existence of the Green IT policy. Its association with the variable- size of the organization helped to

validate the hypothesis – 2 (Included as question numbers: 7 and 8 in the questionnaire). The questions are mentioned below:

- ***Does your organization have Green IT component as a part of its overall IT policy?***

  Yes ☐ *No* ☐

- ***If yes, which of the following areas are included in your organization's Green IT policy****?*
  - *Environmental friendly IT purchasing/ sourcing*
  - *IT equipment usage reduction and energy efficiency*
  - *IT use to reduce environmental impact*
  - *Data center optimization*
  - *E-waste management*
  - *Not applicable*
  - *Any other (please specify)*

Information about existence of Green IT policy and its parameters would have not given a complete clarity about the detailed contents of Green IT policy. It was necessary to know what are the next level parameters considered for each Green IT policy parameter. These next level parameters gave the clarity of the detailed content of the Green IT policy and also helped to identify the maturity of the Green IT policy in an IT organization. The respondents were asked to choose these sub parameters at various stages of IT- purchase, use and disposal (Included as question numbers: 9, 10, 11 and 12 in the questionnaire). The questions are mentioned below:

- ***Which of the following parameters do you consider while purchasing/sourcing IT equipment in your organization?***

- *Energy efficiency*
- *E-waste reduction*
- *Compliance to applicable Green IT laws*
- *Vendor evaluation (for their green track record)*
- *Recyclable IT hardware*
- *Any other (please specify)*

- ***Which of the following areas are focused for IT equipment usage reduction and energy efficiency in your organization?***

  - *Use of IT in an energy efficient manner*
  - *Rightsizing IT equipment*
  - *Printer optimization*
  - *Any other (please specify)*

- ***In order to reduce impact of IT on the environment, which of the following technologies / software do you adopt in your organization?***
  - *Energy efficiency technologies (e.g. Virtualization)*
  - *Travel reduction technologies (e.g. Videoconferencing)*
  - *IT software to monitor business's carbon footprint*
  - *Any other (please specify)*

- ***For E-waste management, which of the following areas are focused in your organization?***

  - *Environmental friendly IT disposal*
  - *IT reuse (Donation/Refurbishment)*
  - *Any other (please specify)*

4. Green IT Practices

Green IT policy should be reflected in terms of adoption of Green IT practices in an IT organization. Green IT practices have been categorized in to five main categories:

- Environmental friendly IT purchasing/ sourcing (includes 9 practices)
- IT equipment usage reduction and energy efficiency (includes 13 practices)
- Use of IT (IT as an enabler) to reduce impact on environment (includes 8 practices)
- E-waste management (includes 3 practices)
- Data center specific (includes 8 practices)

Adoption of Green IT practices is one the important dimension that contributes to evaluate the overall Green IT maturity hence it was important to know the level of awareness and implementation of Green IT practices. A five point scale (1-Not aware at all, 2-Somewhat aware, 3-Fairly aware, 4-Much aware, 5- Extremely aware) was used to measure the level of awareness of Green IT practices for the five categories. A five point scale (1-Not practiced at all, 2-Practiced rarely, 3-Practiced sometimes, 4-Practiced fairly regularly, 5-Ensured to be practiced at all the times) was used to measure the level of implementation of Green IT practices for these five categories.

Questions related to implementation of Green IT practices enabled the researcher to show the difference in implementation of Green IT practices amongst small, medium sized and large IT organizations. This difference has been considered based on the extent or level of adoption of Green IT practices which was measured on five point scale. Association of implementation of Green IT practices with the variable-size of the organization helped to validate the hypothesis – 3 (Awareness level - Included as question numbers: 13 to 17, Implementation level - Included as question numbers: 18 to 22 in the questionnaire). The questions are mentioned below:

- ***On a five-point scale, what is the awareness level of the following Green IT practices regarding environmental friendly IT purchasing/ sourcing in your organization? (1-Not aware at all, 2-Somewhat aware, 3-Fairly aware, 4-Much aware, 5- Extremely aware)***

The answer to the above question was captured in the format illustrated in table 3.3.

Table 3.3: Awareness level - Green IT purchasing practices

Sr. No	***Green IT Practices***	***1***	***2***	***3***	***4***	***5***
1	*Preferring IT suppliers that offer take-back options*					
2	*Preferring IT suppliers that have green track record*					
3	*Giving weightage to environmental considerations in IT procurement (considering ENERGY STAR, ROHS, EPEAT, WEEE etc. or looking for Eco-labeling)*					
4	*Preferring laptop over PC*					
5	*Preferring LCD monitor over CRT monitor*					
6	*Preferring recycled printer cartridge*					
7	*Preferring ink jet printer over laser printer*					
8	*Preferring multifunction devices (scanning, copying, printing) over printers*					
9	*Preferring LED (Light emitting diode) over CCFL(cold cathode fluorescent lamp) LCD monitors*					

- ***On a five-point scale, what is the awareness level of the following Green IT practices regarding IT equipment usage reduction and energy efficiency in your organization? (1-Not aware at all, 2-Somewhat aware, 3-Fairly aware, 4-Much aware, 5- Extremely aware)***

The answer to the above question was captured in the format illustrated in table 3.4.

Table 3.4: Awareness level - Green IT practices regarding IT equipment usage reduction and energy efficiency

Sr. No	***Green IT Practices***	***1***	***2***	***3***	***4***	***5***
1	*Enforcing PC power management (e.g. switching off the monitor and PC when not in use, using Sleep mode/Hibernate mode etc.)*					
2	*Enforcing double side printing*					
3	*Enforcing draft printing*					
4	*Sharing printer (network enabled printer)*					
5	*Printing only what you need*					
6	*Reducing font size for printing*					
7	*Using print preview before printing*					
8	*Secure printing (printer prints only when the user is physically located at the printer and inputs a user code)*					
9	*Preferring document sharing services(e.g. Google Doc) over printing multiple copies*					
10	*Enforcing data de-duplication (storing one copy of single data)*					
11	*Enforcing telecommunication strategies*					
12	*Enforcing removal of screen savers*					
13	*Enforcing removal of software bloats*					

- ***On a five-point scale, what is the awareness level of the following Green IT practices regarding use of IT for reducing environmental impact in your organization? (1-Not aware at all, 2-Somewhat aware, 3-Fairly aware, 4-Much aware, 5- Extremely aware)***

The answer to the above question was captured in the format illustrated in table 3.5.

Table 3.5: Awareness level - Green IT practices regarding use of IT (IT as an enabler) to reduce environmental impact

Sr. No	***Green IT Practices***	***1***	***2***	***3***	***4***	***5***
1	*Remote conferencing*					
2	*Remote support/ Online services*					
3	*Server consolidation & virtualization*					
4	*Storage consolidation & virtualization*					
5	*Desktop virtualization*					
6	*Power down systems*					
7	*Thin clients*					
8	*Cloud computing*					

- ***On a five-point scale, what is the awareness level of the following Green IT practices regarding e-waste management in your organization? (1-Not aware at all, 2-Somewhat aware, 3-Fairly aware, 4-Much aware, 5- Extremely aware)***

The answer to the above question was captured in the format illustrated in table 3.6.

Table 3.6: Awareness level - Green IT practices regarding e-waste management

Sr. No	***Green IT Practices***	***1***	***2***	***3***	***4***	***5***
1	*Disposing IT in an environmentally friendly way*					
2	*Donating IT equipment*					
3	*Refurbishment of IT equipment (upgrade and use IT)*					

- ***On a five-point scale, what is the awareness level of the following data center specific Green IT practices in your organization? (1-Not aware at all, 2-Somewhat aware, 3-Fairly aware, 4-Much aware, 5- Extremely aware)***

The answer to the above question was captured in the format illustrated in table 3.7.

Table 3.7: Awareness level - Green IT practices specific to data center

Sr. No	***Green IT Practices***	***1***	***2***	***3***	***4***	***5***
1	*Blade server*					
2	*Airflow management*					
3	*Hot aisle/ Cool aisle data center layout*					
4	*Airside/ Waterside economizer*					
5	*Install more energy efficient lights*					
6	*Localized cooling*					
7	*Free cooling*					
8	*Upgrade to more energy efficient transformers and UPS*					

- ***On a five-point scale, how will you rate maturity (in terms of adoption) of the following Green IT practices regarding environmental friendly IT purchasing/ sourcing in your organization? (1-Not practiced at all, 2-Practiced rarely, 3-Practiced sometimes, 4-Practiced fairly regularly, 5-Ensured to be practiced at all the times)***

The answer to the above question was captured in the format illustrated in table 3.8.

Table 3.8: Implementation level - Green IT purchasing practices

Sr. No	***Green IT Practices***	***1***	***2***	***3***	***4***	***5***
1	*Preferring IT suppliers that offer take-back options*					
2	*Preferring IT suppliers that have green track record*					
3	*Giving weightage to environmental considerations in IT procurement (considering ENERGY STAR, ROHS, EPEAT, WEEE etc. or looking for Eco-labeling)*					

Sr. No	***Green IT Practices***	***1***	***2***	***3***	***4***	***5***
4	*Preferring laptop over PC*					
5	*Preferring LCD monitor over CRT monitor*					
6	*Preferring recycled printer cartridge*					
7	*Preferring ink jet printer over laser printer*					
8	*Preferring multifunction devices (scanning, copying, printing) over printers*					
9	*Preferring LED (Light emitting diode) over CCFL(cold cathode fluorescent lamp) LCD monitors*					

- ***On a five-point scale how will you rate maturity (in terms of adoption) of the following Green IT practices regarding IT equipment usage reduction and energy efficiency in your organization? (1-Not practiced at all, 2-Practiced rarely, 3-Practiced sometimes, 4-Practiced fairly regularly, 5-Ensured to be practiced at all the times)***

The answer to the above question was captured in the format illustrated in table 3.9.

Table 3.9: Implementation level - Green IT regarding IT equipment usage reduction and energy efficiency

Sr. No	***Green IT Practices***	***1***	***2***	***3***	***4***	***5***
1	*Enforcing PC power management (e.g. switching off the monitor and PC when not in use, using Sleep mode/Hibernate mode etc.)*					
2	*Enforcing double side printing*					
3	*Enforcing draft printing*					
4	*Sharing printer (network enabled printer)*					
5	*Printing only what you need*					

Sr. No	***Green IT Practices***	***1***	***2***	***3***	***4***	***5***
6	*Reducing font size for printing*					
7	*Using print preview before printing*					
8	*Secure printing (printer prints only when the user is physically located at the printer and inputs a user code)*					
9	*Preferring document sharing services(e.g. Google Doc) over printing multiple copies*					
10	*Enforcing data de-duplication (storing one copy of single data)*					
11	*Enforcing telecommunication strategies*					
12	*Enforcing removal of screen savers*					
13	*Enforcing removal of software bloats (computer programs that have meaningless and unnecessary features that are surplus to requirements for most users or software that offer little or no benefits to its user)*					

- ***On a five-point scale how will you rate maturity (in terms of adoption) of the following Green IT practices regarding use of IT for reducing environmental impact in your organization? (1-Not practiced at all, 2-Practiced rarely, 3-Practiced sometimes, 4-Practiced fairly regularly, 5-Ensured to be practiced at all the times)***

  The answer to the above question was captured in the format illustrated in table 3.10.

Table 3.10: Implementation level - Green IT practices regarding use of IT (IT as an enabler) to reduce environmental impact

Sr. No	***Green IT Practices***	***1***	***2***	***3***	***4***	***5***
1	*Remote conferencing*					
2	*Remote support/ Online services*					
3	*Server consolidation & virtualization*					
4	*Storage consolidation & virtualization*					
5	*Desktop virtualization*					
6	*Power down systems*					
7	*Thin clients*					
8	*Cloud computing*					

- ***On a five-point scale how will you rate maturity (in terms of adoption) of the following Green IT practices regarding e-waste management in your organization? (1-Not practiced at all, 2-Practiced rarely, 3-Practiced sometimes, 4-Practiced fairly regularly, 5-Ensured to be practiced at all the times)***

  The answer to the above question was captured in the format illustrated in table 3.11.

Table 3.11: Implementation level - Green IT regarding e-waste management

Sr. No	***Green IT Practices***	***1***	***2***	***3***	***4***	***5***
1	*Disposing IT in an environmentally friendly way*					
2	*Donating IT equipment*					
3	*Refurbishment of IT equipment (upgrade and use IT)*					

- ***On a five-point scale how will you rate maturity (in terms of adoption) of the following data center specific Green IT practices in your organization? (1-Not***

practiced at all, 2-Practiced rarely, 3-Practiced sometimes, 4-Practiced fairly regularly, 5-Ensured to be practiced at all the times)

The answer to the above question was captured in the format illustrated in table 3.12.

Table 3.12: Implementation level - Green IT practices specific to data center

Sr. No	***Green IT Practices***	***1***	***2***	***3***	***4***	***5***
1	*Blade server*					
2	*Airflow management*					
3	*Hot aisle/ Cool aisle data center layout*					
4	*Airside/ Waterside economizer*					
5	*Install more energy efficient lights*					
6	*Localized cooling*					
7	*Free cooling*					
8	*Upgrade to more energy efficient transformers and UPS*					

5. Green IT Drivers

Green IT drivers vary from country to country. It was essential to find out what motivated the IT organizations to adopt Green IT. Before adopting Green IT culture in the organizations, the organizations should know the reasons behind it. A five point scale (1-Not relevant, 2-Relevant to a little extent, 3-Somehwat relevant, 4-Fairly relevant, 5-Extremely relevant) was used to find out the main drivers for pursuing Green IT in their organizations. 13 drivers were provided and respondents were asked to rate these drivers.

This question enabled the researcher to find out the difference in magnitude of 13 divers. The difference in magnitude is found out by calculating mean ranks for all the drivers and helped to validate the hypothesis – 1. It also helped to find out the

top three drivers that motivated the IT organizations to adopt Green IT (Included as question number: 23 in the questionnaire). The question is mentioned below:

- ***Please rate the factors that were the main drivers for pursuing Green IT in your organization.(1-Not relevant, 2-Relevant to a little extent, 3-Somehwat relevant, 4-Fairly relevant, 5-Extremely relevant)***

The answer to the above question was captured in the format illustrated in table 3.13.

Table 3.13: Green IT drivers

Sr. No	***Green IT Drivers***	***1***	***2***	***3***	***4***	***5***
1	*Reducing cost of IT*					
2	*Corporate strategy*					
3	*Environmental consideration*					
4	*Social acceptance*					
5	*Maturity of Green IT industry*					
6	*Governmental regulations*					
7	*Governmental incentives*					
8	*Clients' pressure*					
9	*Employees' pressure*					
10	*Green IT uptake by more organizations*					
11	*Industry association*					
12	*Competitors' action*					
13	*IT vendors' pressure*					
14	*Any other (Please specify)*					

6. Green IT Governance

Adoption of Green IT practices without effective administration or governance would have led to ad-hoc implementation of Green IT. Green IT governance is

another important dimension that contributes to evaluate the overall Green IT maturity hence it was important to know the status of Green IT governance parameters like budget allocation dedicated to Green IT implementation, association with Green IT groups like Green Grid, tangible benefits from government agencies etc., encouraging employees for attending seminars on Green IT, forming Green IT club to promote Green IT, sharing environmental information through the organization's website, clearly defining roles and responsibilities for Green IT implementation, setting target for carbon reduction, auditing the power efficiency of existing IT systems and analyzing IT energy bill separately from the overall corporate bill.

It was also important to find out whether IT organizations have a green advocate coordinating all Green IT activities, having Green IT advisory team which can include CEO, CTO, CIO, owner, partner, IT department, external Green IT expert etc. for framing policy and having Green IT champion. From customers and suppliers perspective, it was required to gain insights about compliance required from customers' side and any compliance enforced on suppliers.

Other important parameters like using Green IT metrics to evaluate Green IT credentials, Green IT auditing practice and Green IT feedback mechanism to provide corrective and preventive actions to improve the effectiveness of Green IT adoption in the form of reviewing governance, policy and practices were also included in the questionnaire.

Green IT governance parameters were measured on two types of scale. A five point scale (1-Not at all, 2-To a little extent, 3-To some extent, 4-To much extent, 5-To a great extent) was used to measure the extent of few of the Green IT governance parameters like encouraging employees for attending seminars on Green IT, forming Green IT club and sharing environmental information through the organization's website etc. Rest of the parameters were measured on nominal scale like Yes/ No type and categorical options depending on the question. Questions

related to Green IT governance enabled the researcher to show the difference in Green IT governance amongst small, medium sized and large IT organizations. This difference has been considered based on the extent of implementing Green IT governance parameters which were measured on five point scale and nominal scale. Association of Green IT governance with the variable- size of the organization helped to validate the hypothesis – 4 (Included as question numbers: 24 to 35 in the questionnaire). The questions are mentioned below:

- ***What percentage of your organization's budget is allocated explicitly for Green IT initiatives?***
  - *None*
  - *1-5%*
  - *6-15%*
  - *16-25%*
  - *More than 25%*
  - *Don't Know*

- ***Is your organization associated with any group dedicated to Green IT?* (e.g. Green Grid)***

  Yes ☐ *No* ☐

- ***If yes, please mention the name of the group.***

- ***On a five-point scale, please rate the following statements regarding Green IT implementation in your organization. (1-Not at all, 2-To a little extent, 3-To some extent, 4-To much extent, 5-To a great extent)***

The answer to the above question was captured in the format illustrated in table 3.14.

Table 3.14: Statements regarding Green IT governance

Sr. No	***Statements***	***1***	***2***	***3***	***4***	***5***
1	*Encourage employees to attend seminars/workshops on Green IT*					
2	*Encourage employees to suggest, identify and spread Green IT practices by forming a Green IT Forum or Club*					
3	*Share environmental information regarding your product and services through the organization's website*					
4	*Roles and responsibilities for Green IT initiatives are clearly defined*					
5	*Set a target for reducing IT carbon foot print in coming 3 to 5 years*					
6	*Engage the service of Green IT expert for gaining Green IT knowledge*					
7	*Analyzing IT energy bill separately from the overall corporate bill*					
8	*Auditing the power efficiency of existing IT systems and technologies*					

- ***Do you have a green advocate coordinating all green activities?***
  - *Yes, focused on all green initiatives as a whole (including IT)*
  - *Yes, focused exclusively on IT initiatives*
  - *Yes, but they do not focus on all IT initiatives*
  - *No, but we are considering one*
  - *No, not at all*

- ***The "champion" of Green IT within your organization is***
  - *C- Suits – CEO, CTO, CIO*
  - *IT department*
  - *Marketing department*
  - *Owner, chairman, Partners*
  - *Finance department*
  - *Any other (please specify)*

- ***Do you need to consider Green IT compliance required from your IT customers?***

  Yes ☐ *No* ☐

- ***If yes, what kind of compliance you need to observe?***

- ***Does your organization enforce Green IT compliance on your suppliers?***

  Yes ☐ *No* ☐

- ***If yes, what are these compliance?***

- ***Does your organization have a Green IT advisory team?***

  Yes ☐ *No* ☐

- ***If yes, then who are the members of Green IT advisory team in your organization? (E.g. CEO, CTO)***

- ***In order to assess IT's environmental impact, does your organization use any metrics?***

  Yes ☐ *No* ☐

- ***If yes, then please specify the metrics.***

- ***Do you have Green auditing practice in your organization?***

  Yes ☐ *No* ☐

- ***If yes, then how frequently is the Green IT auditing done?***

- ***Does your organization get any tangible benefits from government agencies?***

  Yes ☐ *No* ☐

- ***Do you have a Green IT feedback mechanism to review the Green IT Policy?***

  Ye s ☐ *No* ☐

7. Green IT Benefits

Effectiveness of Green IT implementation can be realized by knowing the various benefits experienced by IT organizations. It was essential to gather the benefits which the IT organizations experienced after implementing Green IT. Hence a five point scale (1-Not at all, 2-To a little extent, 3-To some extent, 4-To much extent, 5-To a great extent) was used to obtain the rating of 13 benefits that were experienced by IT organizations (Included as question number: 36 in the questionnaire). The question is mentioned below:

- ***On a five-point scale, rate the following Green IT benefits that you have experienced in your organization. (1-Not at all, 2-To a little extent, 3-To some extent, 4-To much extent, 5-To a great extent)***

The answer to the above question was captured in the format illustrated in table 3.15.

Table 3.15: Green IT benefits

Sr. No	***Green IT Benefits***	***1***	***2***	***3***	***4***	***5***
1	*Saved money*					
2	*Energy efficiency*					
3	*Increased staff morale*					
4	*Met regulatory requirements*					
5	*More competitive*					

Sr. No	***Green IT Benefits***	***1***	***2***	***3***	***4***	***5***
6	*Stronger brand image*					
7	*Increased customers*					
8	*Greater customer satisfaction*					
9	*Healthy relations with vendors*					
10	*Attractiveness for investors and business partners*					
11	*Easier maintenance of IT systems*					
12	*Positive impact on the environment*					
13	*Reduced office space*					

8. Green IT Barriers

There are always some hurdles in implementing new initiatives like Green IT in any organization. It was essential to find out the reasons for not implementing Green IT. Hence a five point scale (1-Not at all, 2-To a little extent, 3-To some extent, 4-To much extent, 5-To a great extent) was used to obtain the rating of 8 barriers that stop IT organizations to adopt Green IT. These barriers can help to identify the areas where IT organizations can focus and overcome them (Included as question number: 37 in the questionnaire). The questions are mentioned below:

- ***On a five-point scale, rate the barriers that stop your organization from implementing Green*** *IT.* ***(1-Not at all, 2-To a little extent, 3-To some extent, 4-To much extent, 5-To a great extent)***

The answer to the above question was captured in the format illustrated in table 3.16.

Table 3.16: Green IT barriers

Sr. No	***Green IT Barriers***	***1***	***2***	***3***	***4***	***5***
1	*The cost of Green IT solutions*					
2	*Inadequate funding*					
3	*Lack of government incentives*					
4	*Lack of support / resistance from management*					
5	*Inadequate skills and training on Green IT*					
6	*Absence of enforceable government regulations*					
7	*Lack of support from employees*					
8	*Uncertainty about business benefit of environmentally sound IT*					
9	*Any other, please specify*					

- ***How have you overcome those barriers in your organization?***

9. Miscellaneous

In order to understand overall opinion regarding Green IT, five statements regarding Green IT were included in the questionnaire. Likert scale *(1-Strongly Disagree, 2-Disagree, 3-Neutral, 4-Agree, 5- Strongly Agree) w*as used to know the opinion about it.

IT organizations were asked to rate their current Green IT maturity on a scale of 1 to 10. They were also asked about their road map to achieve the highest possible maturity in 3 to 5 years of time. This question was necessary to know what IT organizations rate themselves and what their plans are to promote Green IT in their organizations (Included as question number: 39 and 40 in the questionnaire). The questions are mentioned below:

- ***What is your opinion about the following statements regarding Green IT? (1- Strongly Disagree, 2-Disagree, 3-Neutral, 4-Agree, 5- Strongly Agree)***

The answer to the above question was captured in the format illustrated in table 3.17.

Table 3.17: Statements regarding Green IT

Sr. No	***Statement***	***1***	***2***	***3***	***4***	***5***
1	*Implementing Green IT is a costly affair*					
2	*Green IT can be adopted using simple easy to use solutions*					
3	*Important but not practiced much due to lack of law enforcement*					
4	*Important but not practiced much due to lack of awareness*					
5	*Would definitely implement some form of Green IT practice culture*					

- ***What is your current Green IT maturity level in your opinion on a scale of 1 to 10? What is your road map to achieve the highest possible maturity in 3 to 5 years of time?***

3.13.2 Employee Level Questionnaire

1. Demographic Variables

Demographic variables like type of IT organization (Product based, Service based and IT training), designation of the respondent (Software Developer, Senior Software Developer, Software Quality Engineer, Team Lead, Project Lead, Software Architect and Software Trainer), number of employees in the organization

(Up to 100, 101 to1000, above 1000) were included in the questionnaire. These questions were asked to know the profile of the respondents. The data collected has been analyzed based on the size of the organization. (Included as Question numbers: 1,2,3,4 and 5 in the questionnaire)

2. Green IT practices

Green IT practices adopted by the management of IT organizations must be percolated to employee level for its operational effectiveness. Hence it was essential to assess the level of Green IT implementation within the employees and to know its realization in observing Green IT in their day to day work. This question also helped to understand the gap or mismatch, if any that exist between the organization's adoption about Green IT practices and that perceived and practiced by the employees. Green IT practices were categorized in to four main categories:

- Environmental friendly IT purchasing/ sourcing (includes 9 practices)
- IT equipment usage reduction and energy efficiency (includes 13 practices)
- Use of IT (IT as an enabler) to reduce impact on environment (includes 8 practices)
- E-waste management (includes 3 practices)

A five point scale (1-Not practiced at all, 2-Practiced rarely, 3-Practiced sometimes, 4-Practiced fairly regularly, 5-Ensured to be practiced at all the times) was used to measure the level of implementation of Green IT practices for these four categories. NA-Not applicable option was also provided if the practice is not applicable at their level or they are not involved in it. This helped to know the practices that are not applicable at employee level (Included as question number: 6 in the questionnaire). The question is mentioned below:

- ***On a five point scale, please rate, how often do you practice the below mentioned Green IT practices? Please tick NA-Not applicable if the practice is not applicable at your level or you are not involved in it. (1-Not practiced at all, 2-Practiced***

rarely, 3-Practiced sometimes, 4- Practiced fairly regularly, 5-Ensured to be practiced at all the times)

The answer to the above question was captured in the format illustrated in table 3.18.

Table 3.18: Green IT practices

Sr. No	***Green IT Practices***	***1***	***2***	***3***	***4***	***5***	***NA***
Environmental friendly IT purchasing/ sourcing							
1	*Preferring IT suppliers that offer take-back options*						
2	*Preferring IT suppliers that have green track record*						
3	*Giving weightage to environmental considerations in IT procurement (considering ENERGY STAR, ROHS, EPEAT, WEEE etc. or looking for Eco-labeling)*						
4	*Preferring laptop over PC*						
5	*Preferring LCD monitor over CRT monitor*						
6	*Preferring recycled printer cartridge*						
7	*Preferring ink jet printer over laser printer*						
8	*Preferring multifunction devices (scanning, copying, printing) over printers*						
9	*Preferring LED (Light emitting diode) over CCFL(cold cathode fluorescent lamp) LCD monitors*						

Sr. No	***Green IT Practices***	***1***	***2***	***3***	***4***	***5***	***NA***
IT equipment usage reduction and energy efficiency							
1	*PC power management (e.g. switching off the monitor and PC when not in use, using Sleep mode/Hibernate mode, remote power management software etc.)*						
2	*Double side printing*						
3	*Draft printing*						
4	*Sharing printer (network enabled printer)*						
5	*Printing only what you need*						
6	*Reducing font size for printing*						
7	*Using print preview before printing*						
8	*Secure printing (printer prints only when the user is physically located at the printer and inputs a user code)*						
9	*Preferring document sharing services(e.g. Google Doc) over printing multiple copies*						
10	*Data de-duplication(storing one copy of single data)*						
11	*Telecommunication strategies*						
12	*Removal of screen savers*						
13	*Removal of software bloats (computer programs that have meaningless and unnecessary features that are surplus to requirements for most users or software that offer little or no benefits to its user)*						
IT use to reduce environmental impact							
1	*Remote conferencing*						
2	*Remote support/ online services*						
3	*Server consolidation & virtualization*						

Sr. No	***Green IT Practices***	***1***	***2***	***3***	***4***	***5***	***NA***
4	*Storage consolidation& virtualization*						
5	*Desktop virtualization*						
6	*Power down systems*						
7	*Thin clients*						
8	*Cloud computing*						
E-waste management							
1	*Disposing IT in an environmentally friendly way*						
2	*Donating IT equipment*						
3	*Refurbishment of IT equipment (upgrade and use IT)*						

3. Green IT implementation

Green IT initiative would be successful if it is positively accepted by the employees of the organization. It is important that Green IT governance and policy adopted by the management of IT organizations must be percolated to employee level for its operational effectiveness. Hence it was essential to know whether employees of the organization were well versed with their organizations' Green IT policy and governance and what is there opinion about Green IT. These questions also helped to understand the gap or mismatch, if any that exists between the organization's vision about Green IT and that perceived by the employees. A five point scale (1-Not at all, 2-To a little extent, 3-To some extent, 4-To much extent, 5-To a great extent) was used to obtain rating for some statements regarding Green IT implementation. Three options (*Yes/ No/ Don't Know)* were provided to know the presence of some of Green IT governance parameters (Included as question numbers 7 and 8 in the questionnaire). The questions are mentioned below:

- ***On a five-point scale, please rate the following statements regarding Green IT implementation. Please tick DK-Don't Know if you do not know the answer. (1-***

Not at all, 2-To a little extent, 3-To some extent, 4-To much extent, 5-To a great extent)

The answer to the above question was captured in the format illustrated in table 3.19.

Table 3.19: Employee perspective - Statements regarding Green IT implementation

Sr. No	***Statements***	***1***	***2***	***3***	***4***	***5***	***DK***
1	*IT equipment contribute to greenhouse gas emission*						
2	*IT can be used to reduce a business's total carbon footprint*						
3	*IT professionals play an important role in reducing business's carbon foot print*						
4	*My organization provides guidelines for observing Green IT practices*						
5	*My organization encourages employees to attend seminars/workshops on Green IT*						
6	*My organization has a formal feedback mechanism available through which I can communicate my thoughts / suggestions/feedback about Green IT initiative*						
7	*My organization encourages employees to suggest, identify and spread Green IT practices by forming a Green IT Forum or Club*						
8	*My organization shares environmental information of its products and services through its website*						

Sr. No	***Statements***	***1***	***2***	***3***	***4***	***5***	***DK***
9	*My organization has implemented Green IT through Green IT Policy*						
10	*In my organization, roles and responsibilities for Green IT initiatives are clearly defined*						
11	*I get involved in Green IT initiatives taken by my organization*						

- ***For each of the following statements, please choose one of the three options. (Yes/ No/ Don't Know)***

The answer to the above question was captured in the format illustrated in table 3.20.

Table 3.20: Employee perspective - Statements regarding Green IT

Sr. No	***Statements***	***Yes***	***No***	***DK***
1	*Budget is allocated for Green IT initiatives in my organization*			
2	*My organization has a green advocate coordinating all Green activities*			
3	*My organization has set a target for reducing IT carbon foot print in coming 3 to 5 years*			
4	*My organization has an Green IT advisory team for its implementation*			

Few open ended questions were asked to know the opinion and additional inputs of the employees about Green IT initiative. They were also asked to rate their organization on a scale of 1 to 10 for Green IT initiatives. This was necessary to

know how they perceived their organization about it (Included as question number 9, 10 and 11 in the questionnaire). The questions are mentioned below:

- ***Do you think Green IT initiatives are important and essential initiative for an IT organization?***

- ***On a scale of 1 to 10, please rate you organization for its Green IT initiatives.***

- ***Any additional input which you would like to give for Green IT implementation.***

3.14 Validity of the Research Instrument

Validity is the accuracy of a measure or the extent to which a test measures what we actually wish to measure (Cooper & Schindler, 2007: 318). Validity of the instrument was assessed in terms of content validity by initial discussions with the IT practitioners. Prior to pilot study, the management level questionnaire was administered by corporate executives to check the relevance and adequacy of the questions with respect to the objectives of the study and to determine if the items considered in the questionnaire is yielding the information that is needed. The questionnaire was reviewed by IT experts from the industry mention in the table. 3.2 below:

Table 3.21: Details of IT experts who administered the management level questionnaire

Sr. No	Name	Designation	Organization
1.	Mr. Akshat Singh	CEO	Enhance Education
2.	Mr. Bijal Patel	CTO	Crossover India
3.	Mr. Jeetendra Sonar	Associate Manager Engineering	Qlogic
4.	Dr. Mukund Kale	Software Engineering Manager	Siemens PLM
5.	Mr. Parag Parulekar	Founder	Dimensions Software

Sr. No	Name	Designation	Organization
6.	Ms. Shrawanti Chakraborty	HR-Sr. Manager	Google, US
7.	Mr. Umar Lone	CEO	Poash Technologies

The suggestions made by the IT experts were incorporated. The questionnaire was divided in to different sections for more clarity. Different sections like Green IT business areas, drivers, policy, practices, and governance etc. were created. It was observed that question related to Green IT practices seemed to be lengthy. In order to increase the response rate, Green IT practices were broken according to different categories.

3.15 Pilot Study

The pilot study is the first step towards practical application of any research. It's a mini-version of a full-scale study or a trial run done in preparation of the complete study. It was conducted with 10 IT organizations with different employee size (small IT organizations: 4, medium sized organizations: 3, large IT organizations: 3). It helped in detecting possible flaws in measurement procedures in terms of:

1. Content coverage of the research instrument with respect to objectives of the research.
2. Comprehensibility of the instructions given in the research instrument.
3. Identification of unclear or ambiguous items in a research instrument.
4. Wording of the survey instrument.
5. Avoiding misleading, inappropriate or redundant questions.

Pilot study assisted in identifying practical problems of the research procedure. Scale reliability was also checked by applying Cronbach' Alpha (details are illustrated in the next section).

The findings of the pilot study indicated that organizations are willing to implement Green IT and there is no reluctance from management and employees of the organizations. They consider Green IT as an important area to focus on but due to lack of awareness about the overall Green IT implementation, inadequate funding and inadequate skills, training on Green IT and law enforcement, organizations are unable to implement it. Initiatives in the form of Green IT practices have been taken in an ad-hoc manner but IT organizations are not focusing on Green IT policy framing and its governance to promote Green IT in systematic way. The study also manifested that Green IT maturity level of large organizations is high in all the three dimensions of Green IT viz., governance, policy and practices but mid-sized and small IT organizations have a long way to go to achieve this maturity.

The findings of the pilot study thus assured the need for the current research.

3.16 Reliability of the Research Instrument

Reliability is an indicator of a measure's internal consistency. Internal consistency represents a measure's homogeneity. Cronbach' Alpha (α) was used to check internal consistency for the multiple items scale included in the questionnaire. The acceptable value for α is 0.7 (Zikmund et. al, 2013: 329). Scale reliability has been checked for both pilot and the main study. SPSS 21 showed that the research instrument is reliable since the value of α is more than 0.7 in all the Green IT dimensions. The details are mentioned in the table 3.22 below:

Table 3.22: Scale reliability for multiple items scale

Dimension	Number of Items	Cronbach' Alpha (Pilot Study)	Cronbach' Alpha (Main Study)	Reliability Supported
Green IT Concern Areas	11	0.853	0.901	Supported
Green IT Drivers	13	0.762	0.916	Supported
Green IT Governance	8	0.938	0.961	Supported

Dimension	Number of Items	Cronbach' Alpha (Pilot Study)	Cronbach' Alpha (Main Study)	Reliability Supported
Green IT Practices -Awareness				Supported
Environmental friendly IT purchasing/ sourcing	9	0.836	0.865	
IT equipment usage reduction and energy efficiency	13	0.965	0.900	
Use of IT (IT as an enabler) to reduce impact on environment	8	0.868	0.906	
E-waste management	3	0.800	0.774	
Data center specific	8	0.922	0.944	
Green IT Practices – Implementation				Supported
Environmental friendly IT purchasing/ sourcing	9	0.819	0.886	
IT equipment usage reduction and energy efficiency	13	0.954	0.917	
Use of IT (IT as an enabler) to reduce impact on environment	8	0.895	0.896	
E-waste management	3	0.887	0.829	
Data center specific	8	0.942	0.939	
Green IT Benefits	13	0.958	0.954	Supported
Green IT Barriers	8	0.913	0.892	Supported

3.17 Data Analysis

Statistical analysis of the primary data enabled to arrive at the results and conclusions. The methodology followed for data analysis and the tools used are described below:

- Data preparation – editing and coding of data
- Data entry for data analysis using SPSS 21
- Descriptive Statistics
- Inferential Statistics

3.17.1 Data Preparation – Editing and Coding of Data

The questionnaires filled in by the respondents, were checked before coding. The collected data was checked for completeness, legibility and consistency to make it ready for analysis. Errors were found to be few. Coding was done by assigning numerical scores or classification symbols to the edited data (Zikmund et. al, 2013: 498-503).

3.17.2 Data Entry for Data Analysis using SPSS 21

Once data was checked, they were organized to form a data table in SPSS by defining appropriate variable names, data types, width, decimal places, descriptive labels, permissible values, missing values and type of measure – nominal /ordinal/ Interval scale. 196 variables were created for management level questionnaire and 60 variables were created for employee level questionnaire. The table was further checked for any processing error such as data entry errors, copying errors, coding & labeling errors, etc. Frequencies were run on the data to determine if there are problems, such as missing values, out of range and confusing responses that need to be corrected before further analysis (Zikmund et. al, 2013: 505).

3.17.3 Descriptive Statistics

Descriptive statistics summarize and describe features of data (Zikmund et. al, 2013: 521). Basic statistical tools such frequency table, bar charts and radar charts have been used to present the data. Cross-tabs have also been used to provide a systematic tabulation and display of results for categorical data. They help to show the strength of

the relationship between the variables. The cross – tabs in the research were used to analyze the data according to the size of the organization and for validating the hypothesis.

3.17.4 Inferential Statistics

Inferential statistics allows us to reason from evidence found in the sample to conclusions we wish to make about population (Cooper & Schindler, 2007: 492). Following tests were applied for hypothesis testing.

1. **Chi-square Test**

   Chi-square test is used to explore the relationship between two categorical variables. Each of these variables can have two or more categories. It is based on a cross tabulation table, with cases classified according to the categories in each variable.

   In the current research, it was applied to check whether there is any relationship between size of the organization and existence of Green IT policy.

2. **Friedman Test**

   Friedman test is the non-parametric and is used when the dependent variable being measured is ordinal.

   In the current research, it was applied to find out the difference in magnitude of Green IT drivers by comparing the mean rank.

3. **Kruskal Wallis Test**

   Kruskal-Wallis test is the non-parametric test and compares the scores on some continuous variable for three or more groups. Scores are converted to ranks and the mean rank for each group is compared. The test was used to determine if there is a statistically significant difference between three groups of the independent variable on the dependent variable.

In the current research, this test was used to find out whether small, medium and large IT organizations differ across implementation of Green IT practices and governance.

3.18 Limitations of the Current Research

Green IT is an initiative which in a way evaluates the positive attitude and concerns towards the environment. Collecting information about it was a bit difficult in small and medium sized IT organizations as not much initiative have been taken by them. On the other hand, large IT organizations were keen in sharing their Green IT initiatives as they are promoting Green IT. The current research has used interview and questionnaire method for collecting the data and found some restrictions while carrying out the research work. Major limitations were related to the survey which was conducted by researcher. These limitations are outlined below.

1. **Access to IT Organizations**

   Getting access and interaction with the concern person from the IT organizations was the major hurdle for data collection. It was difficult for the top executives to take time out of their busy schedule and devote time for filling up the questionnaire. Many a times the questionnaire was forwarded to the middle level management by the top executives. The whole process of taking appointments for these executives required lot of follow up and hence it was time consuming. Even then about 22 appointments were sought for in-depth interview and discussions were carried out with these persons.

2. **Restrictions for providing complete information**

   Some of the IT organizations preferred providing information only in yes or no format for few of the questions and did not provide specific details.

3. **Reluctance for disclosing company name**

   IT organizations generally seemed to be reluctant to disclose the names of their organizations as they were not sure whether the survey would impact their brand name with negative or positive manner.

Summary

This chapter has outlined the research objectives based on the literature review presented in chapter - 2. It further provided an approach to conduct the research with major parameters like target population, sampling technique, data collection methods and formation of questionnaires as basis. The research analysis was conducted for 52 IT organizations who actually meaningfully responded out of 92 that were approached. Questionnaire designed for management for the research was validated by IT experts from the industry. Scale reliability of the questionnaire was also checked by applying Cronbach' Alpha. This chapter also described various statistical tools used to find the answers to the research questions and objectives. These tools have been discussed in next chapter i.e. Data Analysis and Hypothesis Testing.