Green ICT Process Management Maturity of Indian Organisations

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Information communication technology (ICT) has a profound impact on the modern business environment. The role of ICT in organizations has changed significantly over the past forty years. It is certainly in the interest of ICT companies to identify the longer-term environmental and societal benefits of sustainable business practice Therefore sustainable ICT is the need of the hour, ensuring economic, social and environmental sustainability developments. This paper attempts to study the maturity of one aspect of sustainable ICT (SICT) being process management (PM) using the capability-maturity framework (CMF). Content analysis is used to explore the major themes of Green PM, on the basis of the content analysis a questionnaire was used as a survey mechanism to understand the maturity level of Green PM in organisations. The dimensions of PM considered are sourcing maturity, operations maturity, infrastructure technology maturity, data center physical infrastructure maturity and governance maturity. Results from the survey and content analysis indicate that 50% of the companies selected for this study exhibit maturity in all the dimensions of (PM). This study can be expanded to other categories of CMF framework to understand the overall position of Indian organisations in the maturity framework.

Keywords: Sustainable Information and Communication Technology, Capability Maturity Framework, Process management, sourcing, operations, infrastructure technology, data center physical infrastructure and governance

1. Introduction

Global environment changes are increasingly challenging Indian businesses to look beyond financial performance and integrate environmental and social concerns into their strategic outlook. Indian companies are slowly but steadily moving beyond corporate social responsibility as a philanthropic activity, and integrating green and sustainability-related initiatives into their core business operations. Awareness among Indian organizations in sustainability, green technology and climate change issues is growing, although there is still a lot to be achieved. There is a need to reduce operational costs, adhere to regulations and mandatory disclosures, and to cater to a growing demand from investors, customers, partners, and consumers for reports on the risks related to climate change, as well as the opportunities and organizational climate policy efforts. In environment, social and governance (ESG) areas, the adoption of green technologies and sustainable practices will continue to grow in the future (Gartner,2014).

Information communication technology (ICT) has a profound impact on the modern business environment. The role of ICT in organizations has changed significantly over the past forty years. This industry needs to be more aware of the risks and opportunities related to key sustainability issues. It is certainly in the interest of ICT companies to identify the longer-term environmental and societal benefits of sustainable business practice. Its initial data-processing support function has evolved into it functioning as a corporate resource of strategic importance and competitive advantage. It is estimated that ICT is responsible for atleast 2% of the greenhouse gases (GHG) emissions(Webb,2008). Greening of information Technology (IT) aims to reduce the 2% of global emissions from IT by reducing the footprint of ICT by actions such as improving the efficiency of hardware. Greening by IT or Sustainable IT is shifting the focus towards reducing the remaining 98% by focussing on the innovative use of IT and information systems (IS) in the business processes to deliver positive sustainability benefits beyond the direct foot print of IT. The use of IT for greening will play a key role in the delivery benefits that can alleviate an estimated five times the GHG footprint of IT itself (Enkvist et.al,2007). The ICT sector plays a significant role in creating a low carbon society and enabling sustainability. It has delivered innovative products and services that are integral to everyday life and increased productivity and supported economic growth.

Modern information and communication technology (ICT) is helping companies not only to excel, but also frequently to survive. In fact, almost all organizations, private or public, in manufacturing, agriculture or services use various forms of ICT, including electronic commerce, to support their operations (Turban et al. 1999). Technological developments have followed very precisely the prediction Gordon Moore made in 1965 and are now advancing more rapidly than ever before. The nature and role of ICT in organizations has also evolved over the past forty years from providing little more than data-processing support in the 1960s to being an indispensable strategic business asset to twenty-first-century corporations. ICT has become the major facilitator of business activities in the world today and is also a catalyst of fundamental changes in the structure, operations and management of organizations (Dertouzos 1997).

The commercialization of the Internet, for example, has created profound changes in the business environment. New channels of supply and distribution are emerging. New electronic marketplaces and exchanges are being created. The infrastructure of firms and the industries within which they operate has been altered permanently (Applegate et al, 2003). In addition to the Internet, environmental, organizational and technological factors are creating a highly competitive, global

business environment. Furthermore, these factors are subject to quick and unpredictable changes, requiring companies to react frequently and rapidly to both the problems and opportunities resulting from this new business environment (Turban et al 1999).

A change in the management of information systems and information and communication technology (IS/ICT) is implied by the exponential trend of technological development together with an increased interdependence between business strategy, rules, processes and procedures, on the one hand, and information system software, hardware, data and telecommunications on the other (Laudon and Laudon 1996). IS/ICT management strategies need to be amended on a regular basis to ensure that they remain appropriate. This interdependence and accelerated development demands enormous and innovative management effort if organizations are to remain competitive. Therefore, a contemporary research initiative aimed at synthesizing various independent IS/ICT management process improvement programmes are both indispensable and relevant. Management of IS/ICT has diverse functions including, but not limited to: IS/ICT strategic planning, project management, information systems development, architecture development, hardware acquisition, configuration management, maintenance, user support, and training (Lainhart IV 2000). These constituent elements of IS/ICT management have received intensive, individual attention in research literature over the past forty years. It is noticeable, from a review of these writings that the individual IS/ICT management elements have evolved over time, but that very little attention has been paid to the interaction and interdependence between them (Renken, J ,2004). (Renken, J, 2004) developed an IS/ICT management capability maturity framework integrating the various IS/ICT management process improvement initiatives. (Donnellan, B.et.al,2011) introduced the capability maturity framework of sustainable information and communication technologies. This paper objectivises the stand of Indian organisations in terms of Green IT process management in the SICT-CMF framework.

A data survey (Figure1) by the Green IT Portal, a compendium of Green IT related news and views from India indicated that the awareness levels are fairly high with 52% of them stating that Green IT was a necessity. Of all the respondents, with 8% debunked Green IT as hype and 27% still seem to be undecided on it. That means that even though the awareness levels are fairly high, there is still a lot of ambiguity around the issue of Green IT in India. The graph indicates the Green IT awareness across all the sectors in India. The driving factor behind the rising awareness levels for issues like Green IT are basically two schools of thoughts, firstly being the economics that is driving up the awareness and also the adoption, while the other claims social responsibility as the primary driver.
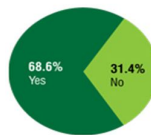

Figure 1.a *Data Survey by Green IT Portal (pie chart)*
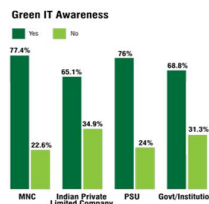

Figure 1.b *Data survey by Green IT Portal*

It is debated that ICT is a cause of the carbon emissions in an organisation but it can also serve as a solution. Cautious usage of ICT can reduce its negative impact on the environment which is estimated to be roughly around 2% of the global greenhouse gases (GHG); however ICT can be used as a solution to reduce the rest of 98% of the GHG. Thereby there is a need for sustainable ICT (SICT) to develop solutions that caters to both the categories. It can be done by aligning all ICT processes and practices with the core principles of sustainability, which are to reduce, reuse, and recycle; and also finding innovative ways to use ICT in business processes to deliver sustainability benefits across the enterprise and beyond.

To address this issue, a consortium of leading organizations from industry, the non-profit sector, and academia has developed and tested a framework for systematically assessing and improving SICT capabilities. The Innovation Value Institute (IVI; http://ivi.nuim.ie) consortium used an open-innovation model of collaboration engaging academia and industry in scholarly work to create the SICT-Capability Maturity Framework (SICT-CMF).

Although it's useful to understand the broad path to increasing maturity, it's more important to assess an organization's specific capabilities related to SICT. The SICT framework consists of nine capability building blocks across the following four categories - strategy and planning, process management, people and culture and governance. In this study we consider analysing the process management category of the SICT framework. Since this stage is directly related to the usage of devices or systems (servers, PC's and other communication components) and the appropriate practice of utilizing these devices/systems can reduce the impact on the environment and hence making these technologies sustainable. The paper starts

with explaining SICT-CMF. It then examines the methodology used and finally the conclusion of the paper regarding the maturity of Indian organisations.

2. Capability Maturity Framework for SICT

The IT-Capability Maturity Framework (IT-CMF) is a high-level process capability maturity framework for managing the IT function within an organization to deliver greater value from IT by assessing and improving a broad range of management practices. The framework identifies 33 critical IT processes and describes an approach to designing maturity frameworks for each process. A core function of the IT-CMF is to act as an assessment tool and a management system with associated improvement roadmaps that guide senior IT and business management in selecting strategies to continuously improve, develop, and manage the IT capability in support of optimized business value delivery.

The framework defines a five-level maturity curve for identifying and developing SICT capabilities:

- **Initial:** SICT is ad hoc; there's little understanding of the subject and few or no related policies. Accountabilities for SICT aren't defined, and SICT isn't considered in the systems life cycle.
- **Basic***: There's a limited SICT strategy with associated execution plans. It's largely reactive and lacks consistency. There's an increasing awareness of the subject, but accountability isn't clearly established. Some policies might exist but are adopted inconsistently.
- **Intermediate***: A SICT strategy exists with associated plans and priorities. The organization has developed capabilities and skills and encourages individuals to contribute to sustainability programs. The organization includes SICT across the full systems life cycle, and it tracks targets and metrics on an individual project basis.
- **Advanced***: Sustainability is a core component of the IT and business planning life cycles. IT and business jointly drive programs and progress. The organization recognizes SICT as a significant contributor to its sustainability strategy. It aligns business and SICT metrics to achieve success across the enterprise. It also designs policies to enable the achievement of best practices.
- **Optimizing***: The organization employs SICT practices across the extended enterprise to include customers, suppliers, and partners. The industry recognizes the organization as a sustainability leader and uses its SICT practices to drive industry standards. The organization recognizes SICT as a key factor in driving sustainability as a competitive differentiator (Donnellan, B. et.al, 2011).

3. Methodology

The objective of the research is to understand the SICT maturity in the Indian organisations. In order to understand the SICT maturity of organisations, research was conducted from working professionals in two consecutive years, 2013 and 2014. The research questions address the extent to which ICT organisations are concerned about climate change and their perceptions of the contribution of ICT and its role to tackle a business environmental footprint. The study is conducted in two phases, a qualitative study was used to understand the major themes considered by Indian organisations for greening the business processes. Secondly, a quantitative study was performed to understand the maturity level of the organisations under consideration by a questionnaire that was formed on the themes emerged from the qualitative study.

The qualitative reports submitted by the participants of the program gave a clear picture as to the practices, attitude, policies, technologies and governance that were being applied in the firm. A content analysis of these reports reemphasised the maturity level of the organisations in the sample considered. The frame work for the content study is as shown in Figure 2.
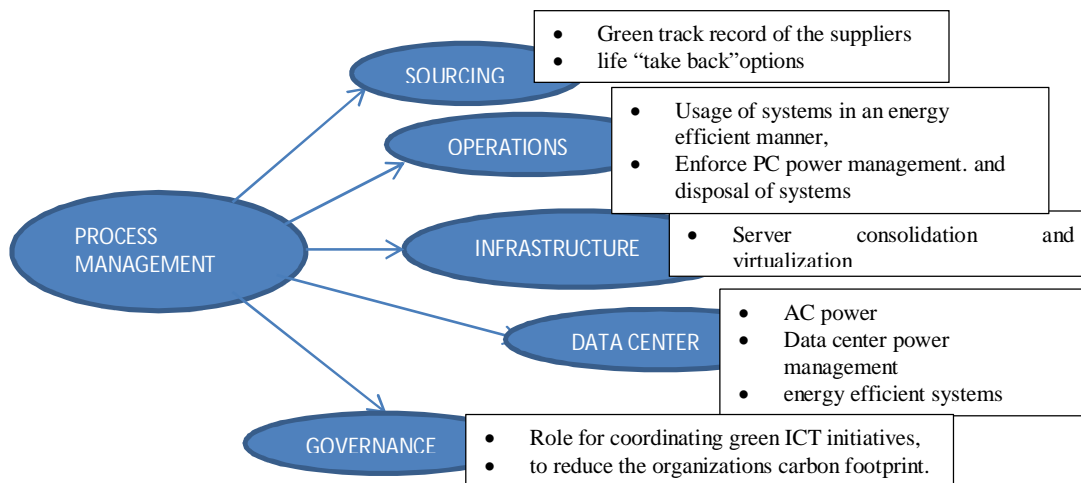

Figure 2 *Framework of the Content Study.*

Figure2 indicates the themes we have considered in the process management capacity building block. The Themes are sourcing, operations, infrastructure, data center and governance and each of the sub themes are indicated. The descriptive statistics for the qualitative study performed with the help of QDA Miner software for content analysis.

4. Results and Discussion

The results of content analysis are shown in Figure 2. The results indicate that many of the companies are aware of greening the business process. The operations, policies and practices followed by the company are in the terms with Green process management.

The quantitative study was examined using a survey based questionnaire with the themes and keywords that emerged from the qualitative study. The questionnaire formed is shown in the Appendix. The professionals were participants of an executive program in IT Management in a premier Business school. They belong to different industry segments with 1-5 years of experience. A total number of respondents are 55 for the quantitative study and 32 for the qualitative study.

The reliability statistic was computed to be 0.941 indicating that the questionnaire is very robust and consistent. The demographics of the respondents, indicate larger number of respondents has a work-experience of 1-5 years in the current company, 34 of them work in large companies, size is considered as the number of employees in the organisation. 39 the respondents are from the IT domain and 44 respondents are from multinational companies.
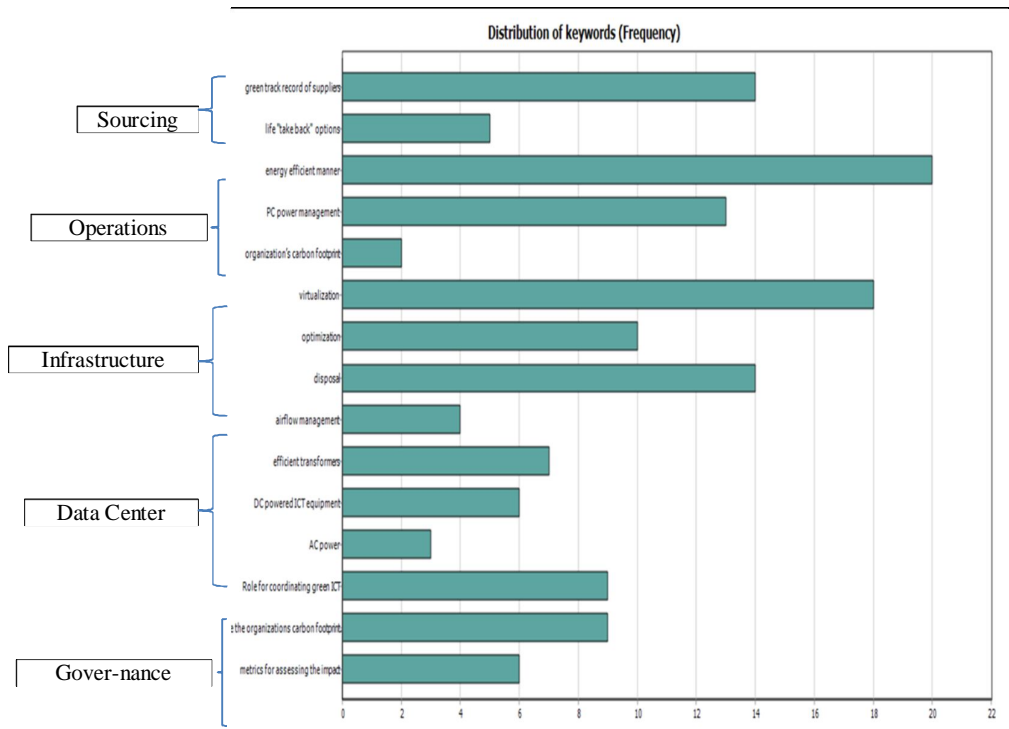

Figure 2 *Results of the Qualitative Study*

The study follows the critical path of qualitative and quantitative research, where the research employs data from the questionnaire filled by the participants of the course and content analysis of the descriptive report submitted by them on the Green IT initiatives followed by the company they are currently employed .

Process management of the SICT framework is classified into sourcing maturity, operating maturity, infrastructure maturity, data center maturity and governance maturity. A questionnaire (shown in appendix) was used for surveying the maturity of each of these categories in the sample space.

The descriptive statistics obtained from IBM SPSS software for the quantitative study is shown in Table1.

Table 1 *Descriptive Statistics of Quantitative Study*

	N	Mean	Std. Deviation
SOURCE	55	3.5318	1.00468
OPER	55	3.6364	.95745
INFRA	55	3.7182	.96891
DCEN	55	3.7109	1.05667
GOV	55	3.5455	1.12008

The results of the study indicate that each of these categories is significantly correlated as the value of the correlation is greater than 0.5. Governance and Data center infrastructure maturity are correlated with a score of 0.412; the reason might be that the policies which are considered by the officials have not come into practice yet. Correlation table is shown in Table2.

Table 2 *Correlation Values of the Categories*

Correlations					
	SOURCE	OPER	INFRA	DCEN	GOV
SOURCE	1				
OPER	.782**	1			
INFRA	.736**	.885**	1		
DCEN	.586**	.607**	.597**	1	
GOV	.610**	.775**	.722**	.412**	1
**. Correlation is significant at the 0.01 level (2-tailed).					

The quantitative study indicates that most of the companies are in advanced stages as the respondents have scored a "high" opinion about the companies they are employed to in the sourcing category. The questions under this category were "Preference of ICT suppliers that have a green track record", "Giving weight to environmental considerations in ICT procurement", "Shortening IT equipment refresh periods to gain access to more energy efficient equipment" and "Prefer vendors that offer end of ICT life "take back" options". A graphical representation of sourcing maturity in terms of capability maturity levels are shown in Figure 3.
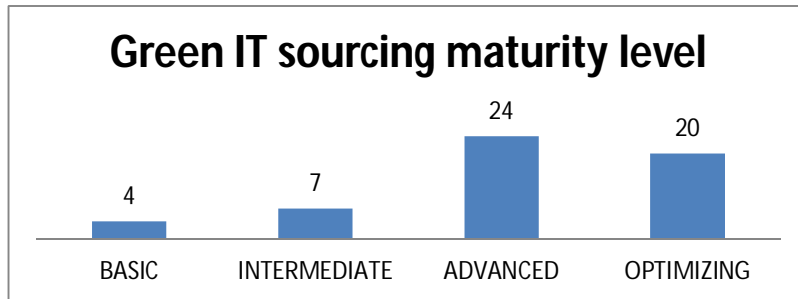

Figure 3 *Sourcing Maturity in Terms of Capability Maturity Levels of the Companies*

21companies are in optimising stages as the respondents have scored a "very high" opinion about the companies they are employed to in the operations category. The questions under this category were "Operate existing ICT systems in an energy efficient manner", "Audit the power efficiency of existing ICT systems and technologies", "Enforce PC power management.", "Analyses ICT's energy bill separately from overall corporate bill.", "Implemented ICT projects to monitor organization's carbon footprint" , "Engages with a professional service provider regarding green ICT", "Retires energy inefficient systems." The operations maturity is represented in figure 4.
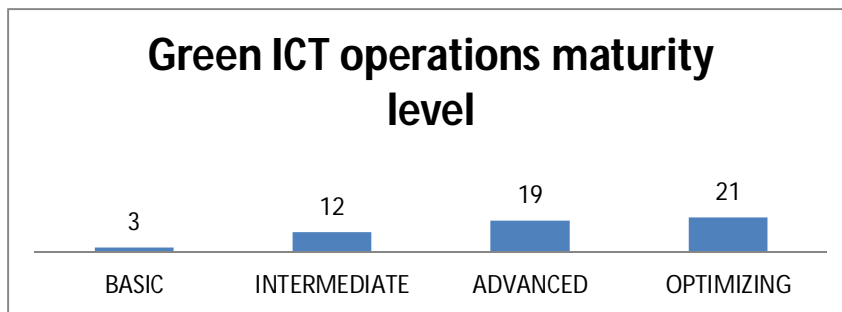

Figure 4 *Operations Maturity in Terms of Capability Maturity Levels of the Companies*

27 companies are in optimising stages as the respondents have scored a "very high" opinion about the companies they are employed to in the infrastructure technologies category. The questions under this category were "Server consolidation and virtualization.", "Rightsizing ICT equipment", "Storage teiring.", "Storage virtualization.", "Print optimization.", "Data de-duplication.", "Desktop virtualization.", "Power down systems" and the respondents had to answer to what extent the organization has developed technologies to support these technologies. Results for this category are shown in figure 5.
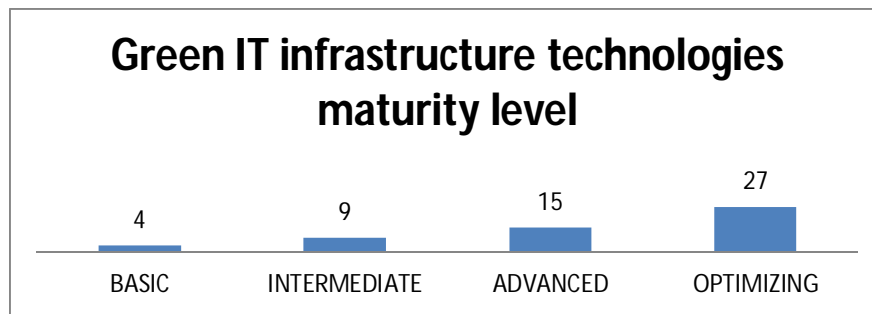
Green IT infrastructure technologies maturity level

	4	9	15	27
	BASIC	INTERMEDIATE	ADVANCED	OPTIMIZING

Figure 5 *Infrastructure Maturity in Terms of Capability Maturity Levels of the Companies*

22 organizations has developed technologies to support Data center airflow management, Free cooling in data centers, water cooled chillers, Hot aisle / cool aisle center layout, Upgrade to more efficient transformers, Airside / waterside economizers, Liquid cooling for ICT equipment, Install more energy efficient lights, High voltage AC power, DC powered ICT equipment in data centers. The employees scored a high value to the data center technologies adapted by the organisations. The results for this category are shown in Figure 6.
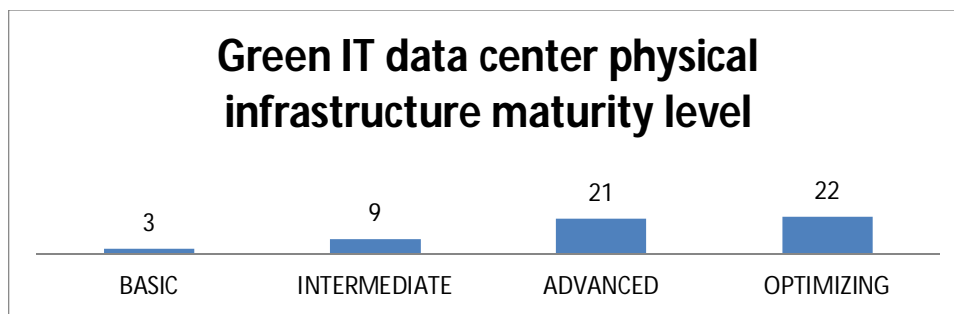
Green IT data center physical infrastructure maturity level

	3	9	21	22
	BASIC	INTERMEDIATE	ADVANCED	OPTIMIZING

Figure 6 *Data Centre Maturity in Terms of Capability Maturity Levels of the Companies*

23 companies have governance policies in the organisation they work. These companies have "Role for coordinating green ICT initiatives are defined", "CEO plays a leading role in green ICT initiatives", "targets are set to reduce the organizations carbon footprint" , "Responsibilities are clearly defined within each green ICT initiative", "ICT department is responsible for its own electricity bill", "metrics are established for assessing the impact of green ICT initiatives". The results are shown in Figure 7.
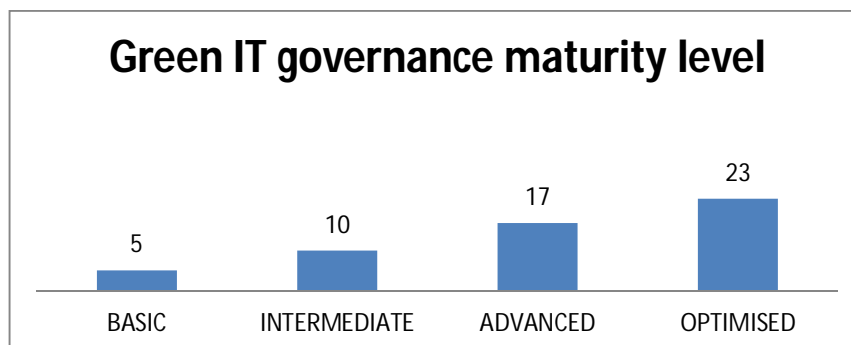
Green IT governance maturity level

	5	10	17	23
	BASIC	INTERMEDIATE	ADVANCED	OPTIMISED

Figure 7 *Governance Maturity in Terms of Capability Maturity Levels of the Companies*

5. Conclusion

The SICT Capability Maturity Framework gives organizations a vital tool to manage their sustainability capability. The framework provides a comprehensive value-based model for organizing, evaluating, planning, and managing SICT capabilities. Using the framework, organizations can assess the maturity of their SICT capability and systematically improve capabilities in a measurable way to meet the sustainability objectives (Donnellan, B. et.al, 2011).

This study quantitatively and qualitatively proves that Indian ICT organisations have high maturity on aspects of process management and thereby the technologies followed by these organisations can be called sustained technologies. The study is confined to a small sample size and one category of CMF model, future studies can leverage it to all the categories of SICT-CMF model to understand the maturity level of Indian organisations embracing sustainable initiatives.

6. APPENDIX: Questionnaire

Sl. No.	A. Demographic information
1	Name of the employee
2	Experience with the current organization
3	Domain of activity of the Organization	IT/ITES/Non-IT/Others (specify)
4	Size of the organization (S, M, L)
5	Turnover
6	No. of employees in the organization
7	National/Multinational
8	Age of the organization
9	Accreditations (if any)
10	Launching year of Green IT practices
11	Awareness level (Low, Medium, High)
12	Recognitions/Awrads for Green IT/Technology (if any)
13	HQ (state/city)

	B. Green ICT sourcing maturity level (Tick the appropriate colum)					
Sl. No.	Indicate to what level your organization gives emphasis on the following:	Very Low	Low	Moderate	High	Very High
1	Preference of ICT suppliers that have a green track record					
2	Giving weight to environmental considerations in ICT procurement					
3	Shortening IT equipment refresh periods to gain access to more energy efficient equipment.					
4	Prefer vendors that offer end of ICT life "take back" options					

	C. Green ICT operations maturity level (Tick the appropriate colum)					
Sl. No.	Indicate to what extent you organization follows the following operational procedures:	Very Low	Low	Moderate	High	Very High
1	Operate existing ICT systems in an energy efficient manner.					
2	Audit the power efficiency of existing ICT systems and technologies.					
3	Enforce PC power management.					
4	Analyses ICT's energy bill separately from overall corporate bill.					
5	Implemented ICT projects to monitor organization's carbon footprint.					
6	Engages with a professional service provider regarding green ICT.					
7	Retires energy inefficient systems.					

	D. Green ICT infrastructure technologies maturity level (Tick the appropriate colum)					
Sl. No.	Indicate to what extent you organization has developed technologies to support the following:	Very Low	Low	Moderate	High	Very High
1	Server consolidation and virtualization.					
2	Rightsizing ICT equipment.					
3	Storage teiring.					
4	Storage virtualization.					
5	Print optimization.					
6	Data de-duplication.					
7	Desktop virtualization.					
8	Power down systems					

	E. Green ICT data center physical infrastructure maturity level (Tick the appropriate colum)					
Sl. No.	Indicate to what extent you organization has developed technologies to support the following in the data centers:	Very Low	Low	Moderate	High	Very High
1	Data center airflow management					
2	Free cooling in data centers					
3	water cooled chillers					
4	Hot aisle / cool aisle center layout					
5	Upgrade to more efficient transformers					
6	Airside / waterside economizers					
7	Liquid cooling for ICT equipment					
8	Install more energy efficient lights					
9	High voltage AC power					
10	DC powered ICT equipment					

	F. Green ICT governance maturity level (Tick the appropriate colum)					
Sl. No.	Indicate to what extent are the following policies implemented in your organization:	Very Low	Low	Moderate	High	Very High
1	Role for coordinating green ICT initiatives are defined.					
2	CEO plays a leading role in green ICT initiatives.					
3	Are set targets to reduce the organizations carbon footprint.					
4	Responsibilities are clearly defined within each green ICT initiative.					
5	ICT department is responsible for its own electricity bill.					
6	Are established metrics for assessing the impact of green ICT initiatives					

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