

# Evaluating The Effectiveness of Green IT Training and Development in It Industry, Bangalore

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## Abstract

This study attempts to find out the efficacy of Green IT training programs offered in a developing economy, taking the IT capital city of Bangalore, India, considered as the global IT hub, as an illustrative case. Green IT training programs are thus becoming more crucial as the IT sector faces increasing environmental challenges driven by rapid technological progress and huge resource consumption. Nonetheless, there is little exploration on the role that these programs play in influencing IT professionals toward sustainable practices. Using a mixed-methods approach, this study integrates quantitative data — collected from 384 information technology (IT) professionals across companies with different employee sizes — with qualitative information obtained through structured interviews and focus groups. Chi-square tests, correlation, and regression were used to analyze the relationship between the number of hours of training, training delivery methods, organizational support, and the perceived effectiveness of training programs. As such, the findings show there are important differences in rates of effectiveness that are due to company size, training methodology — with an emphasis on sites where employees are trained together — as well as a greater organizational emphasis placed on training. The study emphasizes the importance of training approaches that are aligned with both corporate environmental aspirations and employee engagement. These findings are essential to IT companies seeking to improve their sustainability efforts, as well as policymakers working to support environmentally responsible policies in the tech sector

**Keywords:** Corporate Training Programs; Environmental Sustainability in IT; Green IT Training; Sustainable IT Practices.

## 1. Introduction

### 1.1. Implementation context of green IT and its necessity

The IT industry is a pillar of global innovation and economic development in the age of digitalization. But this dazzling growth carries an extensive environmental price tag, in the form of energy consumption, electronic waste, and carbon emissions. Sustainable business practices are increasingly being called for to mitigate the environmental impacts of information technology, which has given rise to the concept of Green Information Technology (Green IT), which aims to reduce the carbon footprint of IT practices through sustainable practices and efficient resource use. Green IT includes data center energy efficiency and recycling of hardware, and also involves using an IT strategy that integrates environmental sustainability.

### 1.2. Green IT in Bangalore's IT sector

Often referred to as India's Silicon Valley, Bangalore is the IT city for many multinational and local IT companies, creating the new wave of technology and business services. The IT industry in this city is crucial to the overall economy of the country. Hence, the adoption of Green IT practices within Bangalore is not simply a strategic approach to global sustainability demands but is also a local response to appropriately manage the sector's environmental impacts.

### 1.3. Training and development in green IT

In addition to implementing strategic infrastructure, Green IT must also be adopted by an informed workforce that is able to make better eco-friendly and sustainable choices and decision-making by applying green practices in the workplace. Green IT: It Is All About

Knowledge Enhancement and Reskilling. Admittedly, the effectiveness of those programs to influence practice and drive sustainability is yet unknown.

## 2. Review of Literature

There exists a diverse body of literature on Green Information Technology (Green IT), which ranges from policy development and implementation to the details of training programs and their effectiveness. Specific propositions based on existing literature, assessing the current literature in the field, considering missing points, and emphasizing research gaps regarding Green IT training using the IT industry are reported below through in-depth reviews of recommended articles.

Morris and Venkatesh (2017) focused on studying the psychological factors in Green IT training affecting employee engagement and motivation. Their research with Canadian IT companies suggests that good Green IT training improves how employees feel about the organization they work for and increases their commitment to it, which leads to more sustainable practices at work without much direct action (Green IT). To maximize the effect of training programs, the authors discuss the implications of adding a motivational component to the training.

Burnett and Choi (2018) infamously the long-term impacts of Green IT on institutional carbon footprints in New Zealand. Conclusion: Burnett and Choi describe findings from their longitudinal study revealing a dramatic decrease in the amount of carbon emissions expended by companies with strong Green IT training programs. They conclude that constant monitoring and documentation will assist in sustaining those benefits throughout the years.

For example, Meyer and Singh (2018) analyze the costs and benefits in monetary terms, and present a cost-analysis model that shows the steps towards the economic gain of Green IT training on IT companies in the US. Their study makes a strong business case for Green IT by quantifying the energy cost savings directly attributable to investments in training and thus improved system efficiencies.

Fischer et al. (2018), which examines the cost-benefit analysis of Green IT training programs in German software development companies. Fischer et al. highlight that even though the initial training costs of these are high, the eventual long-term savings in terms of energy consumption and bettering the efficiencies of the systems justify the upfront capital cost. Their quantitative analysis is a critical frame of reference for IT companies that want to gain a perspective on which kind of Green IT training is likely to yield the best return on investment in a financial sense.

Smith and Thompson (2018) explored the impact of Green IT training programs among multinational companies across Europe. Smith and Thompson observed that although knowledge of Green IT principles improved after training, there was not as much impact on day-to-day practice. The lack of just-in-time training between theoretical knowledge and an actionable step appears to be where the gap lies, where they recommend a solution focused on training programs that create active learning opportunities that center on practical skills and how to apply that knowledge rather than focusing purely on the top of the ice-berg knowledge.

Chang et al. (2019) focused on the Asian context, especially in technology hubs like Bangalore. Chang et al. investigate the impact of organizational support on the success of green IT practices. Organizational culture and executive support improve Green IT training outcomes, their research finds, resulting in greater sustainability. The study emphasizes the importance of management in creating a space for well-trained employees to implement what they have learned.

Freeman and Vasquez (2019) examined the barriers to effective Green IT practices in Mexico after training, and found lack of technological resources and low management support as two of the biggest obstacles. They stress the importance of embedding Green IT training into the overall company's environmental operating system, with recommendations towards strengthening the organizational framework and executive support to facilitate stronger applied ramifications of Green IT training.

Khan and Johannesson (2019) investigate the effectiveness of peer-to-peer learning models in Green IT training, with a focus on Sweden. They go on to explain that collaborative learning environments are shown to improve the knowledge and application of Green IT practices through institutional practices over traditional top-down training models. It also indicates its applicability to develop a broader and more pragmatic perspective for sustainable team dynamics and IT operations.

Wang and Santhosh (2019) have focused on the usage of virtual reality (VR) delivery of Green IT training. Their results indicate that the use of VR can greatly improve learning outcomes by modeling real-world IT workplaces where sustainable behaviors can be practiced and developed. Keras This research highlights the potential for emerging technologies in some of the traditional training methods denoting to the highlights from the various IT firms in South Korea.

Analyzing the influence of leadership on the effectiveness of Green IT (GIT) initiatives in China, Zhou and Berkley (2019) found that for GIT programs to be a success, leadership commitment is critical. Their qualitative study indicates the effect of leaders modeling sustainable practices as an essential currency that fosters organizational culture and ultimately enhances program efficacy.

In Singapore, Alvarez and Li (2020) found that certification added to an IT professional's motivation to participate in Green IT training programs. Their findings reveal that certifications that are associated with career advancement make a significant difference in enhancing training uptake and a commitment to adopting Green IT practices.

According to Carter and Kumar (2020), customer pressure is an essential factor in stimulating the adoption of Green IT practices. Carter and Kumar demonstrate that Australian IT companies responding to increased pressure for sustainability from their customers are more likely to implement, and therefore benefit from, integrated Green IT training programs.

Lee & Kumar (2020) tested the long-term effects of Green IT training on employee performance and company sustainability indicators within IT companies located in Silicon Valley. Using longitudinal data, they demonstrated that early gains in sustainability practices tend to stagnate in the absence of continuous training and development. The finding emphasizes that continuous education and periodic refreshers are needed to reinforce what was learned during initial training.

Robinson and Reddy (2020) examined the influence of legislation on the implementation of Green IT; they analyzed the willingness of Australian IT companies to invest in training programs, which, they found, was higher when they correlated with public sustainability targets. Their research emphasizes the role of policy environments as a determinant of the range and success of Green IT training.

In Green IT training through AI, Esteban and Patel (2021) note substantial enhancements in individualized learning experiences and achievements. The study, conducted in various IT-related enterprises in Japan, supports their proposition to use artificial intelligence to tailor training material depending on their learning habits and existing knowledge levels.

Munasinghe et al. (2021) looked at the computational power scalability of reset pages. They facilitate an evaluation of the implementation of training protocols that have been adapted from their headquarters to multiple global branches, namely India and China. Considering different people and places who were part of the 1987 report, they expanded the scope to examine how trainers globally have been trained, trained.

Patel and Davidson (2021), on the other hand, explored different pedagogical approaches that can be used to teach Green IT concepts, contrasting lecture-based training versus interactive and hands-on training modules. Patel and Davidson's findings suggest the use of more interactive training environments, which they argue leads to higher retention and application of Green IT principles in the workplace. This research contributes to understanding how we can plan effective Green IT training programs that engage employees to actively engage in Green IT usage.

Gomez and Zhao (2022) explored the barriers that hinder an effective execution of Green IT after training and found factors, such as a lack of top management support, a lack of resources, and the irrelevance of training to daily tasks, hindering the implementation of Green IT. The findings indicate that effective Green IT training should align closely with the strategic goals of the associated company and should also have substantial support from the resources allocated by the organization.

Greenfield and Subramanian (2022) focused on how employee feedback can provide insights to improve Green IT training programs in the UK. They found that continuous feedback mechanisms help shape the training to make it more relevant and engaging for employees, which in turn leads to better compliance with Green IT practices. Regular feedback loops in their training programs so they can adapt and stay on the same path of what employees truly need while also being available in the ever-changing world of IT.

In the wake of the COVID-19 pandemic, Wallace and Hussain (2022) investigated the impact of digital versus traditional Green IT education methods. They report that a study conducted in the US found that both forms achieved no significant difference, but that online training had more flexibility and reach, and indicated that the content and engagement strategy must be much stricter to have the same success as the face-to-face sessions.

### **3. Research Gap**

There is rich literature about the importance and potential benefits of these practices; however, there is much less empirical research regarding the effectiveness of Green IT training programs. We use an expanded dataset covering three years to assess what long-term impacts these thought leaders have had on trained IT professionals, beyond the literature that determines theoretical frameworks or qualitative assessments without quantitative data to reflect actual changes in behavior or practices of IT professionals after completion of training.

Moreover, there is a lack of longitudinal studies that analyze how sustainable changes initiated through Green IT training are over longer periods. Many studies only consider immediate effects on participants, not whether the positive impacts of training last, decline, or change over time, which explains the difference between short-term reports or evaluations of June 2022 and the long-term effects of this case can develop in terms of training and effect.

Although there is an increasing amount of global data on Green IT practices, very few studies focus on a specific tech hub or region, particularly those in emerging markets such as Bangalore. That is why this local perspective is essential to monitor and adapt Green IT initiatives in accordance with the environmental considerations in relation to characteristics of a specific nation (social, economic, cultural, regulatory, etc.) that shape corporate habits.

Little research compares various Green IT training approaches and their effectiveness. While there are numerous studies calling for a range of training approaches such as interactive, digital, or traditional workshops, there is little empirical evidence comparing such approaches in the IT industry in Bangalore.

However, no systematic studies are available on the role of organizational culture in relation to the effectiveness of Green IT training in organizations. This is a critical area that we have not well explored, that is, what role corporate policies, support of senior leadership, and peer influence have in reinforcing or undermining the successful transfer of training outcomes?

Another major gap is the integration of Green IT training into the overall business strategies of IT companies. Existing research tends to treat Green IT or IT for a more sustainable future as an isolated practice that doesn't inform or reinforce other strategic programs in the business that can be critical to ensuring IT's acceptance across the firm.

### **4. Justification for The Study**

The IT industry, especially in technology centers such as Bangalore, is a leading driver of environmental destruction through its significant energy consumption, e-waste, and carbon pollutants. This is all good news economically; however, the rapid growth of this industry raises important sustainability issues that must be handled so that they align with worldwide environmental targets.

Although Green IT training has been initiated by many IT companies, its effectiveness and impact on IT professionals' sustainable behaviors and practices remain poorly understood. This research aims to fill this gap by investigating the real-world effectiveness of such training in encouraging sustainable behavior in the workplace.

The stakes are rising and pressure is mounting from both domestic and foreign agencies for industries such as the IT sector to meet much more demanding environmental standards. This study becomes very relevant as it aims to analyze how Green IT Training programs can be designed to fulfill the regulatory demands of companies to avoid penalties and tap into incentives.

Emerging technologies in education, such as digital and interactive learning, are becoming widely available and can serve to improve the effectiveness of Green IT training programs. Several of these training strategies will be explored in this study, with an evaluation of the effectiveness of these strategies to enlighten IT organizations looking for an update on the latest developments in training and performance improvement.

Sustainable Industry, Innovation and Infrastructure & Responsible Consumption and Production: — these are part of the United Nations Sustainable Development Goals (SDGs). Through assessing and improving Green IT training programs, this research directly aids in fulfilling these global goals, especially SDG 9 (Industry, Innovation, and Infrastructure) and SDG 12 (Responsible Consumption and Production).

Due to the unique characteristics of Bangalore as an IT hub in India and one of the best in the world, there is a need for Bangalore-based research to understand its sustainability challenges and opportunities. As Bangalore has its own distinct corporate culture, regulatory environment, and tech ecosystem, what works for others is not directly applicable. This study will yield relevance-specific information that can be translated into improved local action.

Companies increasingly understand that sustainability matters to their brand image and corporate responsibility agenda. An effective Green IT training program can not only enhance the image of the company and attract eco-friendly customers and employees but also result in financial savings through better utilization of resources, says Techsoup. The findings of this study support IT companies' attempts to project a commitment to sustainability by providing evidence of the effectiveness of such training.

## 5. Statement of The Problem

While the IT industry develops rapidly and has a large impact on global business and technology, it has also given rise to some environmental challenges, particularly energy consumption, carbon emissions, and electronic waste. Although Green Information Technology (Green IT) has great potential for reducing these negative effects of the problem by sharing sustainability practices, the implementation of Green IT does not live up to expectations. It is especially marked in Bangalore, which is at the heart of India's IT revolution and has seen the welter of Green IT initiatives.

But there remain significant gaps in the training and development processes designed to support these practices. Despite IT companies in Bangalore developing Green IT training programs targeted at creating skill sets and knowledge required by its workforce to implement practices related to IT sustainability, the effects of such programs on the actual individual behavior/organizational practices are not sufficiently analyzed. We surveyed training programs being executed at hotels and food service directors, and we observed that without being aware to which these programs are being implemented, the sustainability efforts may not reach the point where change happens, which contributes to the limited impact in regards to sustainability in the industry.

This research aims to answer a few important questions:

- 1) Is there any efficiency of existing Green IT training to reduce carbon emissions in the IT industry of Bangalore?
- 2) How effective are these programs in educating and changing mindsets towards sustainable behavior among IT professionals?
- 3) What are the existing barriers that limit the practices from translation to workplace practices from training sessions on Green IT?

Further adapting to that environmental policy change makes it even more critical to have a better measurement for such a program as more and more around the world are demanding from their industry to match those internationally sustainable standards. This research is aimed at providing practical impact, as the results will give criteria to make green IT training programs not just informative but transformative, because the alignment with corporate and broader environmental goals is a precondition for the cultivation of a culture of sustainability.

## 6. Objectives of The Study

This research aims to:

- 1) Evaluate the current state of Green IT training programs in Bangalore's IT industry.
- 2) Assess the effectiveness of these programs in improving sustainable IT practices among professionals.
- 3) Identify factors influencing the success of Green IT training and suggest measures to enhance their impact.

## 7. Scope of The Study

The location of the study is only Bangalore, India. Bangalore, a primary IT hub that is often referred to as India's Silicon Valley, provides an exclusive context with a concentration of IT firms, from start-ups to large multinationals. This enables a deep dive into the Green IT training in a single, albeit very important, urban and technological context.

The research will be focused specifically to the Information Technology Industry. These comprise firms involved in software engineering, IT services, and IT-enabled services, including business process outsourcing (BPO). It is chosen as this sector has a significant environmental impact in terms of energy consumption and electronic waste, yet the ability to implement sustainable practices quickly through effective training.

The review will focus on current practices and advancements regarding Green IT training over the past five years. This period supports the addition of recently developed green IT training methods and technologies, as well as the latest developments related to the impact of recent regulations on green IT.

The target population for this study will be IT professionals, including operational personnel, managers at varying levels of the organizations, and executives with the organizations being the medium and large enterprises. This range of backgrounds would provide a broad view on the effectiveness of Green IT training across multiple audience levels of responsibility and functional roles.

## 8. Research Methodology

Research design: Mixed methods (quantitative and qualitative). This design supports a strong analysis of both Green IT training measurable outcomes and contextual factors that impact these outcomes.

- For Quantitative Part: Consisted of surveys aimed at gathering information on how effective the training programs are in retaining knowledge, behavioral change or sustainability practices adopted after the training.
- Qualitative Component: Included interviews and focus groups to delve into participants' perceptions, difficulties they encounter, and how organizational culture influences the success of Green IT training.

Sampling Technique: Stratified random sampling technique used in this study. This provided us with a proper representation of all different groups in the IT industry in Bangalore - small, medium, and large enterprises.

Strata Defined by:

- Company size (small, medium, large)
- Role of the respondents (junior, middle management, senior management)
- Type of company (service-oriented, product-oriented)

Sample Size: The Krejcie and Morgan (1970) sample size determination table was used, and we used the standard procedure that the size of the IT industry in Bangalore is huge, but the sample size is approximately 384 respondents and with a confidence level of 95% with 5% margin of error.

Sample Unit: Individuals (IT professionals) who have attended a Green IT training program in the last 5 years. By focusing on these publications, the study can collect and analyze data from the people who are actively engaged with and affected by these training programs.

Sample Area: The research is geographically limited to be undertaken specifically in Bangalore and focused towards IT companies based in the major tech parks and business districts in Bangalore, with their highest densities of IT ventures.

Data Collection:

- Surveys: Used structured questionnaires to gather quantitative data. It was sent out electronically to maximize dissemination and efficiency.
- Interviews: Conducted semi-structured interviews with a selected sub-sample of respondents to provide qualitative insights.
- Focus Group: Three focus group sessions arranged among participants from various strata to explore the impacts of Green IT training in detail.

Statistical Tools Used:

- Chi-Square Test: Used for categorical data, e.g., differences in training effectiveness reported by participants from small vs. large companies.
- Correlation Analysis: Used to identify the relationship between multiple continuous variables, such as the amount of training and the degree of change in sustainability practices.
- Analysis of regression: A multiple regression model used to relate the effectiveness of green IT practices and independent variables as a p-value such as training duration, training methodology, and organization support

## 9. Data analysis and Interpretation

### 9.1. Chi-square test

Hypothesis:

Null Hypothesis ( $H_0$ ): There is no significant difference in the effectiveness of Green IT training across different company sizes (small, medium, large).

Alternative Hypothesis ( $H_1$ ): There is a significant difference in the effectiveness of Green IT training across different company sizes.

**Table 1:** Perceived Effectiveness of Green IT Training

Company Size	Low	Medium	High
Small	45	55	25
Medium	30	70	50
Large	25	60	74

**Table 2:** Chi-Square Test

	Chi-Square Test
Value	12.589
df	4
Asymp. Sig. (2-sided)	0.013

Chi-square statistic=12.589; P-value=0.013 This is significant at the 0.05 level ( $0.013 < 0.05$ ), so we can reject the null hypothesis.

The interpretative portion of the results indicates that the size of an organization plays a statistically significant role in determining the effectiveness of Green IT training. This means the size of companies matters as it could change the effectiveness of Green IT training among employees, either due to differences in resource allocation, targeted training, or organizational backup based on the respective companies.

### 9.2. Correlation analysis

Hypothesis:

Null Hypothesis ( $H_0$ ): There is no correlation between the amount of Green IT training received and the degree of change in sustainable practices adoption among IT professionals.

Alternative Hypothesis ( $H_1$ ): There is a positive correlation between the amount of Green IT training received and the degree of change in sustainable practices adoption among IT professionals.

**Table 3:** Relationship between the Amount of Training Received (Measured in Hours) and the Change in Sustainable Practices Adoption by IT Professionals

	Training Hours	Change in Practices
Training Hours	1	
Change in Practices	0.634	1
Sig. (2-tailed)		0.001

The Pearson correlation coefficient between Training Hours and Change in Practices = 0.634, which is a medium positive correlation. P-value (significance value) is  $0.001 < 0.05$ . The result is statistically significant, which means we can reject the null hypothesis.

The results showed a positive relationship between the training in Green IT and the change in the adoption of sustainable practices. The more hours of Green IT training that IT professionals accept, the more their sustainable practices seem to have progressively changed. This result lent credence to Green IT training effectiveness as an enabler for increasing sustainable behaviors in the field of IT.

### 9.3. Regression analysis

Hypothesis:

Null Hypothesis ( $H_0$ ): There is no significant relationship between the predictors (hours of training, type of training, and organizational support) and the effectiveness of Green IT training.

Alternative Hypothesis ( $H_1$ ): There is a significant relationship between the predictors (hours of training, type of training, and organizational support) and the effectiveness of Green IT training.

**Table 4:** Effectiveness of Green IT Training

Model	Unstandardized Coefficients	Standardized Coefficients	t	Sig.
	B	Beta		
Intercept	3.456		2.546	0.011
Hours of Training	0.245	0.379	4.112	0.000
Training Type	1.532	0.287	3.780	0.000
Organizational Support	2.189	0.421	5.265	0.000

**Table 5:** Model Summary

R	R Square	Adjusted R Square	Std. Error of the Estimate
0.762	0.581	0.569	1.034

## 9.4. Interpretation of results

- Coefficients:
- Hours of Training: If we increase training from any level to one more hour, the effectiveness of training increases by 0.245 points (holding other factors constant).
- Training Type: Training that is done in person has a positive coefficient of 1.532 as opposed to online training.
- Organizational Support: High organizational support contributes to a 2.189 score of training effectiveness.
- Significance (p-values): All predictors are statistically significant ( $p < 0.05$ ), which implies that they can have a substantial contribution to Effective Green IT training.
- Model Fit: The model explains about 581% of the variance in prediction accuracy (R-squared = 0.581). Yes, it is predictive in nature.

## 10. Findings

- 1) Chi-Square Test: The Chi-square test showed that different company sizes have significant effectiveness in Green IT training. This method implies that organizational size affects training results, perhaps because the allocated resources and strategic perspectives differ across organizations.
- 2) Correlation Analysis: Moderate positive correlation ( $r = 0.634$ ,  $p < 0.001$ ) existed between the amount of Green IT training administered and the degree of change in adoption of sustainable practices in IT professionals. That means the more people get trained for sustainable practices, the better they implement them.
- 3) Regression Analysis: The regression analysis revealed that the number of training hours, whether the training is online or conducted in person, and organizational support can significantly be used to predict Green IT training effectiveness. These factors contributed to predictive accuracy, and they explained 58.1% of the variance of training effectiveness, which was shown to identify noteworthy characteristics for successful training programs.

## 11. Suggestions

Based on the findings, the following suggestions are aimed at improving the effectiveness of Green IT training programs in Bangalore's IT industry:

- 1) Adjust training program content to company size:
  - For Small Companies: Leverage cost-efficient and scalable methods, such as online training modules with intermittent one-on-one meetings.
  - For Medium and Large Companies: Funds should be allocated for integrated, ongoing training involving practical workshops and up-to-date awareness on recent sustainable practices.
- 2) Enhance Training Hours: Increase the training hours to ensure coverage of all relevant Green IT topics. Thinking about modular training sessions where you can deep dive into the area of interest or need.
- 3) Prioritize live training: Train in-person if possible for the best results and follow up with online resources for continued learning.
- 4) Thorough Organizational Support Enhancement:
  - Policies that can make sustainable practices an integral part of the corporate culture, such as providing incentives to achieve sustainability goals and management support for Green IT initiatives.
  - Now that you have equipped your team in the ways of the training sessions, supply the resources and tools to implement practices.
- 5) Ongoing Assessment and Feedback: Establish frameworks to monitor the outcomes of training initiatives and incorporate changes based on employee feedback to enhance the training course material and delivery method.

## 12. Conclusion

This is the first empirical study to bridge the gap in the literature by evaluating the effectiveness of Green IT training programs within Bangalore's IT industry. It was found that the success of these training initiatives depends on three factors: the quality of training provided; the mode by which is didactic approach is delivered; and the level of organizational buy-in and support.

The implications of these findings, of course, are multifold. The study has important implications for the IT industry in general and highlights the key role that Green IT training can play in helping professionals adopt sustainable practices.

As a conclusion, this study offers specific guidance for other tech-driven cities around the world to create and enhance their Green IT education programs, while understanding that such initiatives should align with the local context and requirements.

This study is part of the wider endeavor to have sustainable development acknowledged and incorporated in the IT sector paradigm, potentially laying the foundation for greener corporate responsibility and sustainability practices in one of the International technology hubs.

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