Green Information System Adoption and Sustainability: A Case Study of Select Indian Banks

G. P. Sahu, Monika Singh

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G. P. Sahu[1] and Monika Singh[2]

[1] Associate Professor, Motilal Nehru National Institute of Technology Allahabad
gsahu@mnnit.ac.in

[2] Research Scholar, Motilal Nehru National Institute of Technology Allahabad
rms1502@mnnit.ac.in

Abstract. This paper investigates the Critical Success Factors (CSFs) for successful adoption and implementation of Green Information System (Green IS) in organizations. Extensive literature review conducted to identify the CSFs and these CSFs are validated through case studies of two Indian banks- State Banks of India (SBI) and Housing Development Finance Corporation Limited (HDFC). Nineteen CSFs are identified, namely: Leaders Obligation, Environment Changes, Industry's Vision and Strategy, Resource Allocation, Expert Selection, Communication, Conflicts Resolution, Standard Adoption, Human Resource Induction and Training, Efficient Organization Structure, Cost-Benefit Analysis, Inspection/Audits, Financial Support, Technological Advancement, Customer Demand, System Integration, Rivalry Pressure, Awareness, and Government Policies. An interrelationship among these nineteen CSFs is established and a model is developed for effective Green IS implementation. Interpretive Structural Modeling (ISM) used to develop the model with the opinion of IT Experts and academicians. Moreover, this paper explores sustainability issues of Green initiatives. This study will enrich existing literature and assists researchers and policy makers in this area.

Keywords: Green Information system, Green IS adoption, Sustainability process, Green IS, CSFs, Green Banking, ISM

1 Introduction

"We don't inherit the environment from our ancestors; we borrow it from our children".

Stated by a renowned ecologist David Brower [11] indicating the necessity of Green initiatives adoption and its sustainability. While information system and information technology are the sources of industry/country growth, but on the other hand it is responsible for Greenhouse Gases (GHGs) emission contributing 1.6% share of total emission and expected to be account for 2% by 2020 [20]. It is required to use the IT/IS resources in a power competent and cost-effective manner [18], [70], thus Green IS/IT emerged as an essential strategic tool to reduce organizations carbon footprints [12], [14], [67] resulting in conservation of natural resources and the environment. The increasing demand of green product/services, public and consumers awareness towards for environmental issues [1], [24], [53] and restricted policies

over manufacturing and providing eco-friendly products/services [50] encourages public and private organizations to manage their activities' impact on the environment and to achieve good reputation with avoiding additional expenditure [66].

Banking sector, being the less pollutant industry, is observing increasing rate of GHGs emission due to the massive use of electronic equipments and appliances [65]. These issues necessitate the adoption of Green initiatives. Green IS adoption affects the reputation, quality of assets and rate of return on long term basis [56]. The social responsibilities of banks encourages them to finance the green projects and adopt the innovative Green initiatives to control their business activities [4,5].

Green IS refers to the developing and using Information Systems to assist and enable ecological sustainability programs tends to have an indirect and positive [35]. Green IS facilitates waste and energy reuse, and routing effectively [10],[15]. Green manufacturing strategy is essential on a long term implementation basis and a five-layer model is proposed by authors for implementation and planning [39]. The identified research gap is, limited literature available on factors influencing effective and efficient adoption of Green IS and barriers of implementation that because majority of available literature is on significance of the Green IS/IT. This paper fills this gap by identifying nineteen factors and few barriers through literature review and two Indian banks.

This research paper is an attempt to identify the factors influencing the implementation of Green IS in the banking sector through extensive review of existing literature and in-depth personal interview of policy makers and IT experts of SBI and HDFC banks at Allahabad branch. The case studies these banks explored barriers in Green IS adoption. Nineteen CSFs identified and validated by these case studies. ISM model is used to determine relationship among these CSFs and to develop a model. Later, sustainability issues of Green initiatives are discussed. The entire research methodology is present in the third section. Paper is ended up with discussion and conclusion.

2 Literature Review

In the current era, when ICT is responsible for growth and development of countries by providing IT/IS services products, on the other hand it is accountable for contribution of 1.6% GHGs emission in the environment [20]. Worldwide firms and government move towards adopting Green practices due to exponentially increasing rate of GHGs emission and increasing demands of green products and services. [1], [12], [14], [24], [53], [67]. Accord-

ing to Dedrick [18] and Watson [70], it is required to use the IT/IS resources in power efficient and economical manner through implementing Green IS.

Firms adapting ISO 140001 certifications or other eco-friendly practices certificate rewards in many ways such as: reductions in incurred cost, waste production and in GHGs emission increment in savings; enhanced communication; reduction in penalties; well improved corporate reputation; and improved operational processes [13], [17], [28], [38], [43], [47], [59], [72,73]. Henningsson & Hedman [31] found that Green IS is a bottom–up practice that attracts and make expert the individuals worried about environment, to investigate the problems and resolve it. Majority of the literature found on the antecedents of Green IS [37], [46] and its role in environment sustainability [9], [14], [29], [41], [45].

Sarkar & Young [57] suggested effective cost model and awareness programmes as influencing factors for Green IT adoption. Schmidt et al. [60] found corporate administration, ecological commitment and initiatives from IT workforce as predictors of Green IS adoption. Butler [12] found that institutional essentials persuade the acceptance and implementation of Green IS initiatives. González [19] identified external factors (organization position, relations, policies) and internal factors (organizational strategy, technology and financial capacity) influencing adoption of clean technologies.

The benefits of GIS, augmented public awareness of environmental issues and regulatory instructions forced the organizations to Go Green through implementing Green IS [15]. Consequently Green IT/IS policy, design, and practice initiatives in recent times emerged into a vigorous research area in the Information System area. However, the existing literature represents a major gap of nonexistence research [14], conceptual and empirical both, that can aid organizations to build up strategy and framework to adopt and implement Green IS and practices.

3 Research Design

Extensive literature review is conducted for identification of CSFs, while IT experts and academician's opinion (via personal interview) are used to validate these driving and restraining factors of Green IS implementation. ISM methodology is used to find out the relationship among the identified nineteen CSFs and thereafter, to develop a model to aid the researcher in this area and policy makers for smooth implementation of Green initiatives. The entire research design is presented in the Figure 1.
The research is based on the case studies of two banks: SBI, largest public bank in India and HDFC, among the top most private banks of India to exam-

ine and analyze the factors driving and restraining the implementation of Green IS in banking sector.

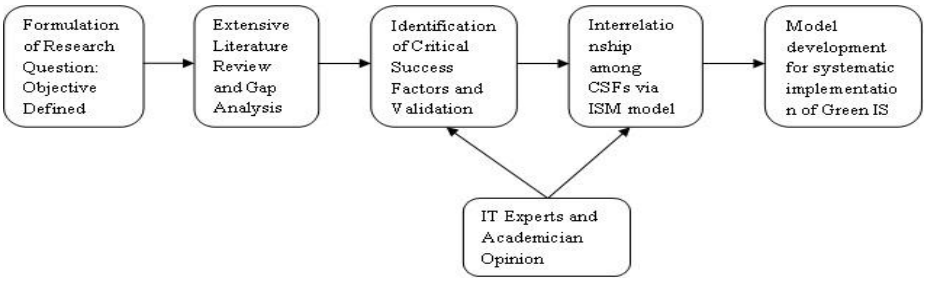

Fig. 1. Research Process of the study

The first phase involves the extensive literature review and interview of 5-6 IT experts and policy makers from these two banks using structure and open ended questions in order to gain deep information about process and significance of Green IS implementation. Second phase includes synthesizing the case study to identify the CSFs and barriers of Green IS adoption and to validate them. ISM model is a tool to structure the various directly-indirectly interrelated elements into a complete systematic structure [3], [56], [64]. According to Gupta and Sahu [27] this is the best technique to examine the interdependency among the CSFs. Therefore, ISM model is used and a model is developed to draw the interrelationship among these nineteen CSFs.

3.1 Case Study 1: State Bank of India

The first largest and oldest bank of India, SBI, is on the 46th position all over world ranking with brand value of $6.56 for FY 2014-15. According to Annual Report-2015 of SBI, this bank is practicing accountable banking to reduce its carbon footprints and to improve eco-sustainability through introducing Green initiatives and adopting the electronic mode of operations. SBI has been providing Green Channel Counters (GCC), financial support to construction of wind farms in India, Online banking, Solar ATMs, beginning of a pilot project to calculate the carbon footprint levels, funding to renewal energy projects. Currently SBI has more than 16,333 computerized branches and more than 22 millions netbanking users, since 2009-10 and faced various favored and disfavored factors in implementation of Green IS. By interview of IT experts and managers at SBI Allahabad main branch it is observed that various factors like government policies, financial support, customers and employees' awareness towards degradation of environment, technological innovation, customer demand are encouraging the branch to adopt Green initiatives. They are using old heritage building, in order to minimize the use of cooling systems, Kiosks, GCC for environment sustainability. However they are facing various problems like old aged customer's rigidness towards ac-

ceptance of new technologies, lack of trust in online services, threat of online theft etc. Sometimes villagers or old aged person come to the banks (not using online banking) only to visit/walk or for gossiping with other customer.

3.2 Case Study 2: Housing Development Finance Corporation Limited

HDFC, established in 1994 in India, is second largest private lender in asset volume and 45th global rank holder. With the brand value of $12.6 billion for FY (2014-15), HDFC is one of the dynamic branches in the field of environment sustainability, accountable for operations effects on environment, adopted various Green initiatives as an essential elements of its business practices to control GHG emission and reduce carbon footprint. HDFC is signatory to the Carbon Disclosure Project and was amongst 16 firms in India to achieve Carbon Disclosure Leadership Index score 17 in 2012. Interview of IT experts and policy makers at HDFC Allahabad branch it is explored that through multi-channel delivery and E-statement it has reduced the consumption of papers; using Energy-Efficient Lighting concepts HDFC have achieved 10% reduction in electricity consumption. Also, it has adopted the 'Phase-out' policy to change inefficient lighting options, green infrastructure concept for water management and energy savings. The employees promote and conduct green awareness campaigns in order to change the behavior and attitude of stakeholders towards environment sustainability. According to them, Green IS implementation influencing factors are leader's commitment, government policy, customer's awareness and green services demand and cost-benefit analysis.

4 Green IS Critical Success Factors

Through extensive literature review and interview of policy makers, IT experts of SBI and HDFC, and academician nineteen CSFs for implementation of Green IS are identified and listed in Table 1. Maximum of the influencing factors identified in the study are general in character and could be used in any type of organizations despite of the nature, sector and size of the industry.

Table 1. Critical Success Factors for implementation of Green IS

SN	CSFs	Description	Study
1.	Leaders Obligation	Top management support importance in adopting environmental sustainability strategy	[13],[16],[22], [27],[30],[37], [46,47],[73]
2.	Environment Changes	Dynamic process of changing of organization environment in adapting new technologies.	[19], [47], [53], [69], [73]

3.	Industry's Vision and Strategy	Firm's vision and plans to encourage employees and to give them a sense of purpose.	[2], [9], [14], [19], [30], [46], [70], [73]
4.	Resource Allocation	Allocation of resources (like money, technologies, personnel etc.) and their continuous availability.	[27], [31], [61,62], [73]
5.	Expert Selection	Appointment of individual/s to identify and resolve Green IS issues	[30], [49], [73]
6.	Communication	2-way communication between the organization & stakeholders.	[13], [19], [47], [71], [73]
7.	Conflicts Resolution	Evade personality clashes and keep the egos behind	[26], [45], [73]
8.	Standards Adoption	Standard guidelines requirements e.g. ISO14001 standards	[7], [53], [60], [73]
9.	Human Resource Induction and Training	Training of all stakeholders in order to trim down or eliminate their resistance and to develop awareness.	[6], [17], [19], [30], [34], [42], [48], [54], [61], [73]
10.	Efficient Organization Structure	Required IT equipments along with network infrastructure	[19], [32], [73]
11.	Cost-Benefit Analysis	Incurred cost-benefit calculation results from Green IS adoption.	[18,19], [27], [46], [48], [73]
12.	Inspection/Audits	Periodical audit/inspection for process review and expenses	[19], [32], [40], [68], [73]
13.	Financial Support	Funds availability from organization and other financial agency	[19], [58], [73]
14.	Technological Advancement	Innovative technologies to meet environment-customers demand	[17], [19], [46], [73]
15.	Customer Demand	Customer demands for eco-friendly products and services	[19], [25], [52], [73]
16.	System Integration	Ability of integration of different organization functionalities.	[18], [27], [51], [46]
17.	Rivalry Pressure	Global rise of competition to provide green products/services	[21], [27], [33], [63]
18.	Awareness	Understanding of Green IS as a means of reducing carbon footprints	[18], [21], [23], [27], [58]
19.	Government Policies	Government laws, regulations and enforcement of penalties	[27], [46], [37], [63]

It is observed from Table1 that these nineteen factors are critical factors for

organizations if they want effective and smooth implementation of Green IS/initiatives. Many authors as shown in the table found in their studies these factors critical for implementation and also, IT experts, policy makers and academicians have supported and validated these factors as critical factors for Green IS implementation in their organizations.

5 ISM Methodology and Model Development

According to A.P. Sage [55], ISM modeling technique is an interactive learning process, aid to determine interdependency and direction among the variables of a system. This is a superior interactive planning method that enables people of a team to build up a structure to define/establish relationships among factors in a set [8]. To build up the structure, a set of questions are answered by Experts of the relevant field.

This model is used by various authors to interpret the relations and direction among the known variables relevant to the problem and to develop a structured model for better understanding of interdependency [27], [33], [64]. Therefore, ISM model is used and all steps followed to develop the model. The process consisted several steps: 1) Identified Critical Success Factors/elements via literature review and experts/academician's opinion (Table 1); 2) Developed Structural Self-Interaction Matrix (SSIM) pointing to pair-wise connection between elements; 3) Developed a Reachability matrix from SSIM, and checked whether the matrix is transitive or not i.e. if factor 1 is related to factor 2 and factor 2 is related to factor 3 then, definitely factors 1 and 3 are directly-indirectly related to each other according to ISM assumption (Table 2); 4) Developed Antecend Set and Intersection Set from SSIM, followed by partitioning of Reachability matrix into different level (Table 2). Based on the results from step 4, a directed graph is drawn resulting into a model by removing transitive relationship (Figure 2).

Table 2. Reachability Set and Levels of Factors

Factors		**Reachability Set**	**Antecend Set**	**Intersection Set**	**Level**
1	Leaders Obligation	1,3,4,5,6,8,9,10,11,14, 16,20	1,2,6,8,11,13,14,15,17,18,19	1,6,8,11,14	V
2	Environment Changes	1,2,4,6,7,9,15,17	2,3,6,8,10,11,14,15,17,18,19,20	2,6,15,17	IV
3	Industry's Vision and Strategy	2,3,4,5,6,8,9,10, 12, 13,14,16,20	1,3,8,11,12,13,14,15,17,18,19	3,8,12,13,14	IV
4	Resource	4,5,9,10,14,20	1,2,3,4,6,7,8,10,	4,10,14	II

	Allocation		11,13,14,15,16, 17,18,19		
5	Expert Selection	5,6,8,10,11,12,14, 16,18,20	1,3,4,5,6,8,9,10, 12,13,14,15,17, 18,19	5,6,8,10,12,14 ,18	VI
6	Communication	1,2,4,5,6,7,9,10,11 ,14,16,20	1,2,3,5,6,8,9,10, 12,15,16,17,18	1,2,5,6, 9,10,16	IV
7	Conflicts Resolution	4,7,9,10,12,17,20	2,6,7,14,16,17	7,17	II
8	Standards Adoption	1,2,3,4,5,6,8,9,10, 12,14,16,20	1,3,5,8,11,13,14 ,15,17,18,19	1,3,5,8, 14	V
9	Human Resource Induction And Training	5,6,9,10,13,20	1,2,3,4,6,7,8,9,10,11,12,13,14,15,16,17,18,19	6,9,10, 13	II
10	Efficient Organization Structure	2,4,5,6,9,10,11,12, 14,15,17,20	1,3,4,5,6,7,8,9,10,11,13,16,18,19	4,5,6,9, 10,11	IV
11	Cost-Benefit Analysis	1,2,3,4,8,9,10,11,13,14,16,20	1,5,6,10,11,12,13,15,17,18,19	1,10,11 ,13	VI
12	Inspection/Audits	3,5,6,9,11,12,13,20	5,7,8,10,12,13,17,18,19,20	5,12,13 ,20	IV
13	Financial Support	1,3,4,5,8,9,10,11,12,13,14,16,20	3,9,11,12,13,18, 19	3,9,11, 12,13	VI
14	Technological Advancement	1,2,3,4,5,7,8,9,14, 16,20	1,3,4,5,6,8,10,11,13,14,15,16,17,18,19	3,4,5,8, 10,14,16	V
15	Customer Demand	1,2,3,4,5,6,8,9,11, 14,15,16,17,20	2,10,15,18	2,15	VII
16	System Integration	4,6,7,9,10,14,16,20	1,3,5,6,8,11,13, 14,15,16,17,18, 19,20	6,14,16 ,20	III
17	Rivalry Pressure	1,2,3,4,5,6,7,8,9,11,12,14,16,17,20	2,7,10,15,17,18	2,7,17	VI
18	Awareness	1,2,3,4,5,6,8,9,10, 11,12,13,14,15,16, 17,18,19,20	5,18,19	5,18,19	VIII
19	Government Policies	1,2,3,4,5,8,9,10,11 ,12,13,14,16,18,19 ,20	18,19	18,19	VII

20	Green IS implementation	2,12,16,20	1,3,4,5,6,7,8,9,10,11,12,13,14,15,16,17,18,19,20	12,16,20	I

It is depicted from the Table 2 that all nineteen factors influencing implementation of Green IS into an organization are categorized under eight levels from I to VIII. Green IS implementation is on level I and Awareness is on Level VIII. The table 2 shows the antecend of the factors and their Reachability to the other factors. A model is developed (refer Figure 2) from Table 2 i.e. ISM model of CSFs for better understanding of interdependency on each other.

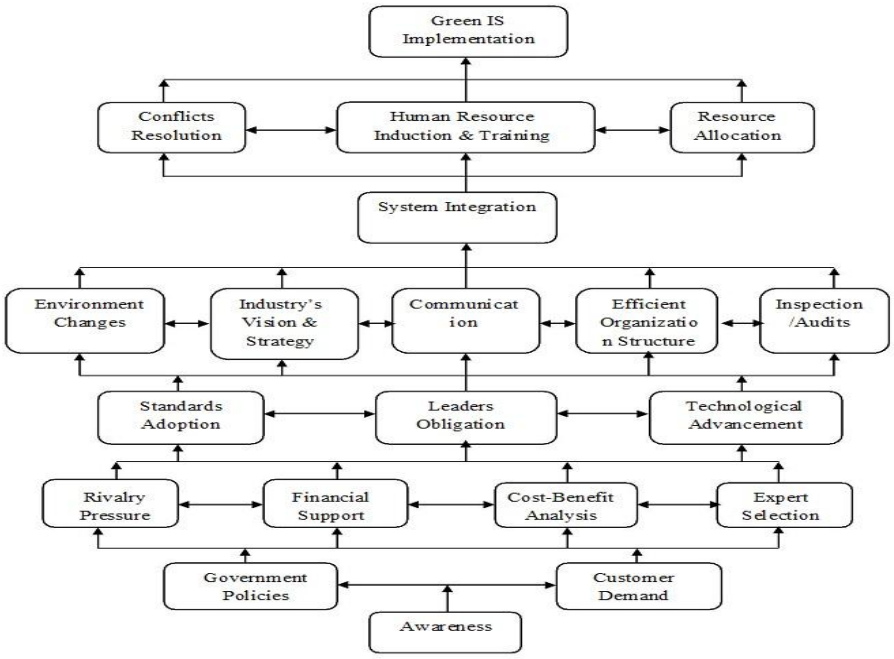

Fig. 2. Model for Critical Success Factors for Green IS implementation

All factors were categorized under eight levels through Reachability matrix and a model developed from the Table 2 representing systematic directly-indirectly relationship among these CSFs. Figure 2 shows (Bottom –up approach) that factor 18, at level VIII, is the predictor of factor 19 and 15 (at level VII), where these two factors are interrelated and predictors of factors 5, 11, 13 and 17 (at level VI). Again these four factors are interrelated and predictors of 1, 8 and 14 (at level V). Similarly all these interdependent fac-

tors at level V are predictors of factors 2, 3, 6, 10 and 12 (at level IV). These interdependent factors at level IV are predictors of factor 16 (at level III). Further, factor 16 is the predictor of three interrelated factors 4, 7 and 9 (at level II).
At level I the factor 20 i.e. Green IS implementation is the objective factor of this study is predicted by factors 4, 7 and 9 and indirectly with all rest sixteen factors. Therefore, this model provides a clear directed vision of inter-dependent CSFs of Green IS implementation in the banking industry as well as other similar organizations.

6 Discussion

In the current fast growing industries where government policies, stake-holders awareness towards environment sustainability, and market competitions are the major factors encouraging firms to adopt Green IS, few factors are pushing back the firms to accept the new Green IT/IS. On other side, if some firms have adopted the Green IT/IS and indulge in providing green services they are unable to sustain due to poor performance or lack of reward.
From the case studies it is observed that many factors like lack of trust (mainly of senior citizens), proper training and awareness programmes for public etc. are responsible for no or slow growth of Green IS adoption in the firms. Also, major factor responsible for slow growth is huge population, which takes time to train/learn, additionally other factors are lack of buy-in of management/employees, insufficient financial sources, lack of experts, undefined goal, lack of communication, inefficient IT infrastructure [9], [38]. Authors find in their research that the companies offering green services and implemented green policies are not earning more profit in comparison to other firms not indulged in green practices.

7 Conclusion

This research paper has identified nineteen Critical Success Factors for effective implementation of Green IS in organizations, with special reference to banking sector, to reduce their carbon footprints. The environmental accountability of industries, laws created by government, customer's awareness etc. are forcing firms to implement Green initiatives as an integral part of their business activities. This study will be helpful to IT Experts/Mangers to gain insight about Green IS/IT and its antecedents and to take appropriate actions to link Green IS with firm's strategy. The research is conducted with

special reference to banking sector, but the results can be implemented to any company indulge in adopting green initiatives or Corporate Social Responsibility (CSR). Study is also helpful in creating increased revenue as the running cost of Green information technology and information system is very low. The proposed model in this study aid banks in adopting Green IS smoothly and efficiently.

Case studies of SBI and HDFC banks used to validate these factors and explored the sustainability issues of Green IS in these banks. Relationship among identified nineteen factors had been established using ISM model. Research model is developed representing the interdependency of all the factors showing that Awareness, Government Policies and Customer Demand are the major drivers of Green Is implementation in the firms.

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