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Research Article

Motivators in Green IT-outsourcing from Vendor's Perspective: A Systematic Literature Review

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Abstract: Green IT is becoming an important concept for the organization since over the last decade, however, not every organization is completely ready to implement Green IT initiatives. Therefore, it is necessary to develop an easy-to-use but comprehensive self-assessment to evaluate organizational readiness to implement Green IT. We have reviewed the literature through systematic literature review (SLR) process to identify motivators in Green IT-outsourcing from vendor's perspective. Our final sample of publication selection comprises 82 papers in total. We have identified, through the SLR, a list of 9 motivators. Six of these motivators were identified as significant motivators. These significant motivators are 'energy efficiency', 'development and use of environment-friendly softwares', 'overall business cost reduction', 'promoting reusability and sustainability both in terms of hardwares and softwares', 'improving quality of services' and 'deployment of virtualization strategies with respect to hardwares, softwares and processes'. We have further analyzed the identified motivators on the basis of different variables including, study strategy/methodology and period of years. We have found more similarities than differences in the identified motivators across study strategy/methodology and period of years.

Keywords: Green IT, motivators, systematic literature review, outsourcing vendors

1. INTRODUCTION

Green IT has recently emerged into an active research area in the information systems (IS) discipline. The term 'green IT' is defined as "optimal use of Information and Communication Technology ICT for managing the environment sustainability of enterprise operations throughout their life cycles" [1]. Green IT is becoming an important concept for outsourcing vendor organizations, however, not every organization is completely ready to apply Green IT initiatives. Therefore, it is necessary to develop an easy-to-use but comprehensive self-assessment to evaluate organizational readiness to implement Green IT. The primary goal of the emerging discipline of IT sustainability is to enable firms to use computing resources more efficiently while maintaining or increasing overall performance. The first wave of these efforts is commonly identified as "green computing" where the emphasis has been primarily minimizing power usage for datacenters and technical equipments (such as desktops, projectors) [2]. The benefits of green computing in terms of reducing power consumption and corporate carbon footprints are direct and relatively rapid to achieve [2]. However, to move beyond internally focused green-computing initiatives to the realm of competitive advantage and corporate sustainability, more attention needs to be directed to how a second wave of sustainable IT practices can align with and enable corporate sustainability strategy.

Software behavior can significantly affect computer energy efficiency in everything from small devices up to servers in data centers. However, if Green IT software's can use the software developers, then it can reduce the energy consumption of drivers and applications [3].

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Several companies have recently announced plans to build "green" datacenters, i.e. datacenters partially or completely powered by renewable energy. These datacenters will either generate their own renewable energy or draw it directly from an existing nearby plant [4]. Besides reducing carbon footprints, renewable energy can potentially reduce energy costs; reduce peak power costs, or both. However, certain renewable fuels are intermittent, which requires approaches for tackling the energy supply variability [4]. One approach is to use batteries and/or the electrical grid as a backup for the renewable energy [4]. For highest benefits, green datacenter operators must intelligently manage their workloads and the sources of energy at their disposal [4].

However, Green IT outsourcing has several benefits but it faces different challenges such as: Recently, energy efficiency or Green IT has become a hot issue for many IT infrastructures as they attempt to utilize energy efficient strategies in their enterprise IT systems in order to minimize operational costs. Networking devices are shared resources connecting important IT infrastructures, especially in a data center network they are always operated 24/7 which consumes a huge amount of energy, and it has been obviously shown that this energy consumption is largely independent of the traffic through the devices. As a result, power consumption in networking devices is becoming more and more a critical problem, which is of interest for both research community and general public [5].

The environmental impact of the healthcare sector has become an important factor globally and is continuing to draw the attention of regulators. The energy use of the healthcare sector (whose largest sub-segment is `hospitals') has been growing due to many factors. These factors include the rapid growth and adoption of Information and Communication Technology (ICT) in healthcare [6]. Outsourcing, co-location and cloud computing, energy and cost-efficiency, environmental and legislative issues: running a data center in a constantly changing world is a huge challenge [7]. Looking at high power data center applications on medium voltage level, the biggest challenge was to find a green (SF6 free) switchgear with a small footprint, a maintenance free mechanism with a high number of operations, high reliability and that is easy to scale [7]. As a natural evolution of services computing, cloud computing has provided a promising way, for delivering flexible and cheap computing resources, via cloud platform. However, the computing resources held by a cloud platform are usually limited, compared with the nearly unlimited resource requirements from various end users [8]. As the primary energy source, coal is widely used for power generation, which causes serious concerns related to the environment and sustainability. Thus, renewable energy sources have been developed significantly over the past decade. Unfortunately renewable energy tends to be variable and uncertain because of the prime movers (i.e., wind and solar) and the dependence on natural and neurological conditions [9].

We have formulated the following research questions in order to understand the motivators for Green IT outsourcing from vendor's perspective.

RQ 1: What are the motivators, as identified in the literature, for green IT outsourcing?

RQ 2: Do the identified motivators vary based on study strategies used?

RQ 3: Do the identified motivators vary with the passage of time?

2. BACKGROUND

Green IT or Green Computing has emerged as a fast growing business paradigm in recent years in order to develop sustainable softwares and energy-efficient peripheral devices. With the constant evolution of technology and the world critical environmental status, all private and public information technology (IT) businesses are moving towards sustainability [10]. Green IT simply means using technology efficiently, while taking into account the triple bottom line: "economic viability, social responsibility and environmental impact" [10]. Reduction in energy consumption over the full equipment life cycle as the prime motivator for "green" application design; with energy reduction as the best measure of "green-ness" [11]. Organizations are now actively pursuing Green IT solutions for a multitude of reason and benefits, including reduce power consumption, lower costs, lower carbon emissions and environmental impact, improved systems performance and use, increased collaboration and interaction amid constituents, space savings, and an agile workforce [12]. IT virtualization reduces costs for hardware,

improves software testing and deployment, reduces energy and physical space use, and increases the flexibility of hardware investments [12]. Similarly, automation of business processes through virtualization (e.g., online electronic commerce) enables increased utilization of business resources, time and space flexibility for the participants and operations of the process along with reduction in cost and improved service delivery to customers [12]. Sensory readiness, relationship readiness, synchronism readiness, identification and control readiness, champion support, resource commitment, firm size, regulatory support and competition intensity are important antecedents of undertaking Green IT initiatives via virtualization [12]. Advantages of Green IT to the environment clearly grip reduce the cost, effectiveness of energy, improved the interaction of stakeholders, reduction in reuse, improvement, variety of image and devotion [13].

From the experience of several industrial trials on smart grid with communication infrastructures, we expect that the traditional carbon fuel based power plants can cooperate with emerging distributed renewable energy such as wind, solar, etc, to reduce the carbon fuel consumption and consequent green house gas such as carbon dioxide emission [14]. As a new generation green lighting source, the light emitting diode (LED) is rapidly replacing traditional incandescent and fluorescent light sources [15]. Apart from providing energy savings, the use of LED lighting technology creates scope for an innovative optical wireless communication technology known as visible light communication (VLC), which takes advantage of the superior modulation capability of LEDs to transmit data through a wireless channel [15]. VLC is capable of concurrently providing communication as well as illumination [15]. Hitec Power Protection, a leading manufacturer of rotary Uninterruptible Power Supply (UPS) systems using flywheel energy storage is active in the data center business for over 20 years [7]. One of their integrated solutions operates on medium voltage level and is the perfect green and efficient solution for high power data centers [7]. Attribute-based encryption (ABE) with outsourced decryption not only enables fine-grained sharing of encrypted data, but also overcomes the efficiency drawback (in terms of cipher text size and decryption cost) of the standard ABE schemes [16].

IT energy consumption sustainability is important from an economic, societal and environmental perspective for organizations [17]. These three dimensions are overlapping factors for sustainability, but very often the economic and societal are ultimately constrained by the environment [17]. Energy efficient software can play an important role in these three overlapping spheres of sustainability [17]. Green IT infrastructures are responsible for 2% of the CO_2 world emissions and for the greenhouse effect, which is the first reason of the global warming [17].

A number of researchers have highlighted the importance of Green IT in the context of outsourcing, e.g.:

- Energy saving can be achieved by adopting renewable energy resources or improving design of certain hardware (e.g., power amplifier) to make it more energy-efficient, the cost of purchasing, replacing, and installing new equipment (including manpower, transportation, disruption to normal operation, as well as associated energy and direct cost) is often prohibitive [18].
- In the recent years, many organizations have started to consider the importance of green manufacturing and take steps towards this new responsibility. Manufacturers try to achieve an end of life, a cost-effective and a green solution, enabling them to answer effectively to the future legislation regarding responsibility of their products. The authors [19] argue that context re-manufacturing, as a solution for green manufacturing, can be defined as the reconstructing or reassembling of a used product by using a combination of process. In order to be feasible, re-manufacturing should answer not only to the legislation, but also it should be profitable for the companies [19]. So, from the phase of conception, it is necessary to design the products such that they can be easily disassembled, cleaned, tested, and re-assembled to have a new life and a new value [19].
- In the current business environment, the competitiveness of companies and their supply chain depends not only on lowest cost, high quality, reduced lead time, and high service level, but also on their ability to avoid and

overcome the numerous disturbances that jeopardize their performance [20].

- Gu et al [21], argue that "having greener software practices can have advantages for hosting service providers and for their customers. For example, green practices for developing green software in data centers could be investigated".
- Recent changes in environmental legislation have focused company thinking on business practices, particularly concerning the importance of integrating environmental concerns like outsourcing and procurement in supply chain networks [22]. Supply chain partners are becoming progressively more accountable not only for their internal practices, but also for their suppliers' behavior because implementing a "greener" supply chain is far from an individual strategy [22].
- Al-Hasib and Sharmin [23] argue that Green IT paradigm also necessitates experts in the industry and the academia to focus on green software development in order to develop high quality and energy efficient softwares. They have proposed energy efficient software development framework to design energy efficient software.
- Li and Zhou [24] have conducted survey on state of the art in green computing and have identified various generic issues. These include the modeling and evaluation of energy efficiency, energy-awareness and green networking.
- Information Technology (IT) is at the heart of every successful modern business. IT is so pervasive, that energy efficiency through the implementation of Green IT has moved to center stage for many companies in their pursuit of helping make a difference for the environment [25].
- For mobile operators in particular, another motivation and objective of "green" approaches is to gain extra commercial benefits, mainly by reducing operating expenses related to energy cost [26].
- Ambtman [13] has worked on Green IT auditing to assess the greenness of an organization through auditing process and proposed Green IT control framework. The research is based on findings from the literature through ordinary literature review and questionnaire survey in Green IT industry. The results conclude that "In order to achieve Green IT objectives, Green IT initiatives within organizations should include Green management, procurement, use and disposal. For providing a certain level of assurance on the effectiveness of these mechanisms, performing a Green IT audit is considered useful. However, in practice the level of auditor involvement and hence level of assurance in Green IT audits is limited" [13].

We have used systematic literature review (SLR) as a research methodology to dig-out the motivators in Green IT outsourcing from vendor's perspective. Till date, no SLR study in this domain has been published for identification of motivators that have positive impact in Green IT-outsourcing, which shows the novelty of our research. The findings of the paper will assist vendor organizations to be aware about all possible motivators that have positive impact in Green IT outsourcing. Timely awareness about the motivators in Green IT outsourced project will also necessitate towards findings of the strategies, practices and tools, for addressing the challenges faced to Green IT outsourcing vendors, which we plan to do in future.

3. RESEARCH METHODOLOGY

A Systematic Literature Review (SLR) [27] process was used for data collection, because it is more thorough, less biased, rigorous and open as compared to ordinary literature review [27]. In finding, evaluating and summarizing all available evidences on a specific research question, a systematic review may provide a greater level of validity in its findings than ordinary literature review. A number of researchers [28-31] have used the SLR approach for reviewing the literature. Protocol development is the first phase of the SLR process and it describes planning of the review. In this connection a systematic review protocol was written first to describe the plan for the review. Details of the various steps in our SLR methodology are discussed in the following sub sections:

3.1 Research/Problem Identification

Identification of motivators in Green IT outsourcing from vendor perspectives is the main goal of this research. We have formulated the research questions given in the Introduction section of the paper.

3.2 Searching of the Literature

A trial search string was initially used in different digital libraries in this phase. Based on the available access, the digital libraries IEEE Explore (http://ieeexplore.ieee.org), ScienceDirect (http://www.sciencedirect.com), Google Scholar (http://scholar.google.com.pk), and CiteSeer (http://citeseerx.ist.psu.edu) were used to carry out the search phase of the SLR. The final list of sources searched, their search terms, and the number of publications found for each resources are listed in Table 1. We have selected these resources based on our previous SLRs [29-32] experiences and discussions with our colleagues at the University.

("Green Software" OR "Energy-efficient software" OR "sustainable software") OR ("Green computing" OR "Green IT-outsourcing")

Table 1 presents the overall final list of resources that we have searched during this phase and found number of publications in each digital libraries. A similar approach has been used by other researchers [29-31, 33-35].

3.3 Literature Selection

3.3.1 Inclusion Criteria

The following inclusion criteria have been used for the selection of relevant papers:

- Research work that describe web Green IT from vendors point of view.
- Research papers that describe challenges in Green IT-outsourcing.
- Research papers that describe motivators or success factors for Green IT-outsourcing.
- Research work that describe the practices/solutions for Green IT-outsourcing.
- Research work that describe strategies/ paradigms for developing Green softwares.
- Research work that describe tools/ technologies for the development of Green softwares.
- Research papers that describe the design and prototype development of distributed data-intensive service-oriented architectures – a key technology for Green IT.

3.3.2 Exclusion Criteria

The following exclusion criteria have been used for the selection of relevant papers:

- Papers/articles/books etc not following the inclusion criteria have been excluded.

3.4 Publication Quality Assessment

We have performed the publication quality assessment after the final selection of publications. During the selection process of studies, some questions were check listed to ensure the quality of the selected studies. The reason of applying these quality criteria is to facilitate the studies selection process and to ensure that only relevant papers are being selected. The questions used in our settled quality criteria were:

- Is it clear how the motivators were measured in Green IT-outsourcing relationship? (Yes/No/Partially)
- Is it clear how the motivators in the selection of Green IT-outsourcing vendor were identified? (Yes/No/Partially)

For validation purpose a secondary reviewer scored a small subset of the selected publications. By using publication quality assessment questions, studies that are not scholarly reviewed were excluded. Only those studies are selected that aims the motivators in Green IT-outsourcing relationships. Similarly, studies that do not provide persuasive results in motivators in the aspects of Green-IT outsourcing relationships were excluded.

During the search phase of the SLR, initially we found 1676 papers as shown in Table 1. After reviewing through title and abstract of each of the identified paper we selected 210 papers as our primary selection. After applying the aforementioned criteria, we have selected 82 papers as our final selection. Thus we found 82 papers in total as our final sample for the data extraction phase, as shown in Table1.

3.5 Data Extraction and Synthesis

In the data extraction phase of the SLR, the data was extracted from each paper of our final sample of publication on a pre-defined data extraction

Table 1 Data sources and search strategy for motivators.

Name of Digital Library	Search Strategy	Date of Search	Year Covered by Search	No. of Publication Found	Initial Selection Decision	Final Selection Decision
IEEE Explore	("Green Software" OR "Energy-efficient software" OR "sustainable software") OR ("Green computing" OR "Green IT-outsourcing")	1st July 2013	All	1,167	68	28
Science Direct				397	104	23
Google Scholar		27-Nov-13		87	31	25
CiteseerX				25	07	06
			Total	1676	210	82

Table 2 List of motivators in green IT outsourcing identified through SLR.

S. No.	Motivators	Paper-ids (details are given at the Table 5)	Total Papers = 82	
			Freq	%
1	Energy efficiency	P-1, P-2, P-3, P-4, P-5, P-6, P-7, P-8, P-9, P-10, P-11, P-12, P-13, P-14, P-15, P-16, P-17, P-18, P-19, P-20, P-21, P-22, P-23, P-24, P-27, P-28, P-29, P-30, P-34, P-35, P-36, P-37, P-38, P-39, P-40, P-41, P-42, P-43, P-44, P-45, P-47, P-48, P-49, P-50, P-51, P-52, P-53, P-54, P-55, P-56, P-57, P-58, P-59, P-60, P-61, P-62, P-63, P-64, P-65, P-66, P-67, P-68, P-69, P-70, P-71, P-72, P-73, P-74, P-75, P-76, P-77, P-78, P-79, P-80, P-81, P-82	76	93
2	Development and use of environment-friendly softwares	P-1, P-2, P-3, P-4, P-5, P-6, P-7, P-8, P-9, P-10, P-11, P-12, P-13, P-14, P-15, P-16, P-17, P-18, P-19, P-20, P-21, P-22, P-23, P-24, P-25, P-26, P-27, P-28, P-29, P-30, P-31, P-32, P-36, P-37, P-38, P-39, P-40, P-41, P-43, P-44, P-45, P-46, P-49, P-50, P-51, P-52, P-53, P-54, P-55, P-56, P-57, P-58, P-59, P-60, P-61, P-62, P-63, P-64, P-65, P-66, P-67, P-68, P-69, P-70, P-71, P-72, P-73, P-75, P-76, P-77, P-78, P-79, P-80, P-81, P-82	75	91
3	Overall business cost reduction	P-1, P-2, P-3, P-4, P-5, P-6, P-7, P-8, P-9, P-10, P-11, P-12, P-13, P-14, P-15, P-16, P-17, P-18, P-19, P-20, P-21, P-24, P-25, P-28, P-29, P-30, P-31, P-33, P-36, P-37, P-40, P-41, P-43, P-44, P-45, P-47, P-49, P-50, P-51, P-52, P-53, P-54, P-55, P-56, P-57, P-58, P-59, P-60, P-62, P-63, P-64, P-65, P-66, P-68, P-70, P-71, P-72, P-75, P-76, P-77, P-78, P-79, P-81, P-82	64	78
4	Promoting reusability and sustainability both in terms of hardwares and softwares	P-1, P-3, P-4, P-5, P-6, P-8, P-13, P-24, P-25, P-27, P-31, P-32, P-33, P-36, P-37, P-38, P-39, P-43, P-46, P-49, P-50, P-51, P-52, P-53, P-54, P-55, P-56, P-57, P-58, P-59, P-60, P-65, P-67, P-68, P-69, P-70, P-71, P-72, P-75, P-76, P-77, P-78, P-79, P-80, P-82	45	55
5	Improving quality of services	P-1, P-3, P-4, P-6, P-7, P-8, P-9, P-19, P-20, P-21, P-22, P-24, P-27, P-28, P-31, P-33, P-36, P-37, P-38, P-41, P-46, P-49, P-50, P-52, P-53, P-55, P-56, P-59, P-65, P-66, P-67, P-68, P-69, P-70, P-71, P-73, P-75, P-76, P-77, P-79, P-80, P-81, P-82	43	52
6	Deployment of Virtualization strategies with respect to hardwares, softwares and processes	P-1, P-2, P-4, P-5, P-6, P-7, P-8, P-10, P-12, P-15, P-16, P-18, P-20, P-21, P-24, P-25, P-26, P-29, P-36, P-37, P-38, P-40, P-41, P-43, P-50, P-52, P-53, P-54, P-55, P-56, P-57, P-58, P-59, P-60, P-61, P-62, P-63, P-64, P-65, P-66, P-67, P-68, P-69, P-70, P-71, P-72, P-73, P-74, P-75, P-76, P-77, P-78, P-79, P-80, P-81, P-82	69	84
7	Use of cloud based resources	P-4, P-8, P-10, P-12, P-17, P-18, P-20, P-21, P-25, P-31, P-36, P-39, P-40, P-41, P-49, P-50, P-51, P-52, P-54, P-55, P-56, P-57, P-58, P-60, P-61, P-62, P-63, P-64, P-65, P-66, P-69, P-70, P-71, P-72, P-75, P-78, P-79, P-80	39	48
8	Lowering CO_2 emission	P-1, P-4, P-6, P-10, P-26, P-38, P-55, P-56, P-57, P-58, P-59, P-60, P-65, P-67, P-68, P-70, P-77, P-79, P-82	19	23
9	Use of green IT equipments	P-4, P-24, P-37, P-45, P-55, P-57, P-58, P-59, P-60, P-62, P-65, P-66, P-68, P-70, P-77	15	18

form. The data extraction form contains the following areas: Date of review, Title, Authors, Reference, Database, motivators: factors that have a positive impact on Green IT-outsourcing relationship, Methodology (interview, case study, ordinary literature review, systematic literature review, report, survey etc), Target Population, Sample Population, Publication Quality Description, Organization Type (software house, university, research institute etc), Company size(small, medium, large), Country/location of the Analysis and Year.

The data was extracted on the pre-defined extraction form from each of the finally selected paper. Our final selection includes the sample size of 82 papers as shown in the Table 5. After the data extraction phase, the data synthesis was performed for the identification of the motivators from the extracted data.

The data synthesis phase was done by the primary reviewer (the primary author) with the help of secondary reviewer (the co-author). After a thorough review with external reviewer, we have identified 9 motivators from the sample of 82 papers in Green IT-outsourcing from vendor's perspectives as shown in Table 2.

After identifying motivators for Green IT-outsourcing from vendor's perspectives through SLR, we classified few motivators in different tables as shown in results section. The criteria for selection of significant motivator as, that motivator will be considered as significant motivator whose frequency was ≥50. The identified significant motivators are 'energy efficiency', 'development and use of environment-friendly softwares', 'overall business cost reduction', 'promoting reusability and sustainability both in terms of hardwares and softwares', 'improving quality of services' and 'deployment of virtualization strategies with respect to hardwares, softwares and processes'.

4. RESULTS

For answering RQ1 Table 2 presents a list of 9 motivators, in total, in Green IT-outsourcing from vendor's perspective. In the following table 'P' represents paper id, such as 'P1' means paper 1, details listed in the Table 5. We have classified six motivators as significant motivators. The classification of significant motivators is based upon the criteria, such as: those motivators are considered as significant motivators whose frequency ≥50. The identified significant motivators are 'energy efficiency – 93%', 'development and use of environment-friendly softwares – 91%', 'overall business cost reduction – 78%', 'promoting reusability and sustainability both in terms of hardwares and softwares – 55%', 'improving quality of services – 52%' and 'deployment of virtualization strategies with respect to hardwares, softwares and processes – 84%'.

On these identified motivators, we have then performed statistical analysis based on different variables. They are, study strategy/methodology and year. The aim is to recognize whether these motivators remain stable /consistent in each study strategy and year respectively or vice versa. These analyses are presented in the sub sequent sections.

4.1 Analysis of the Motivators for Green IT-Outsourcing Vendors Based on Study Strategy

In order to answer RQ2, Table 3 explains the analysis based on various study strategy used. The number of articles with respect to various study strategies used in these articles are shown in Fig. 1. In the SLR process we have found the sample size of 82 papers as shown in the Table 5. From this sample size we have then extracted the information regarding the study strategies for each paper. We have identified five study strategies used in our sample during synthesizing the extracted data. These include ordinary literature review (OLR), case studies, empirical study, formal methods and systematic literature review (SLR). According to our findings, the majority of motivators have been reported through OLR, case studies and formal methods, as given in Table 3.

Among the list of 9 motivators in both OLR and case studies, our results shows 7 significant motivators have been cited in ≥50 of the articles. These motivators are identified through OLR are 'energy efficiency – 96% ', 'development and use of environment-friendly softwares – 96%', 'overall business cost reduction – 68%', 'promoting reusability and sustainability both in terms of hardwares and softwares – 72%' , 'improving quality of services – 60%', –

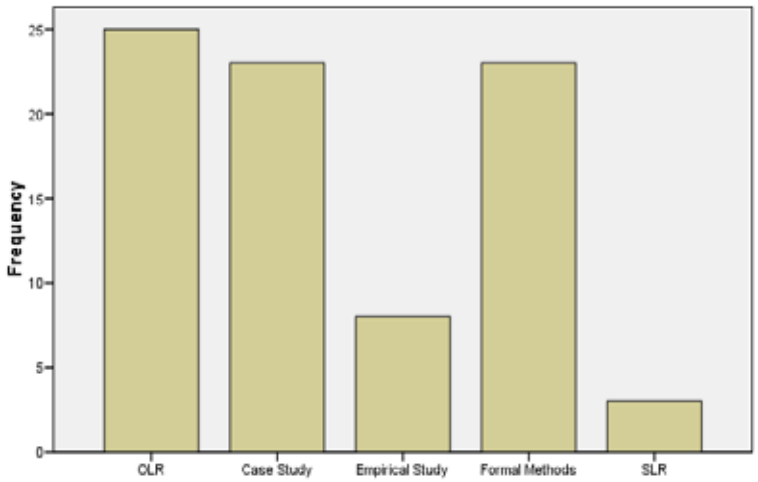

Fig. 1. Distribution of motivators, identified through the SLR, based on study strategy.

Table 3. Distribution of motivators, identified through the SLR, based on study strategies.

S. No	Motivators	Occurrence in SLR (N=82)										Chi-square Test (Linear-by-Linear Association α=0.05), df=1	
		OLR (N=25)		Case Study (N=23)		Empirical Study (N=8)		Formal Methods (N=23)		SLR (N=3)			
		Freq	%	Freq	%	Freq	%	Freq	%	Freq	%	X^2	P
1	Energy efficiency	24	96	19	83	8	100	22	96	0	0	0.344	0.558
2	Development and use of environment-friendly softwares	24	96	21	91	7	88	20	87	0	0	0.715	0.398
3	Overall business cost reduction	17	68	20	87	7	88	17	74	0	0	0.479	0.489
4	Promoting reusability and sustainability both in terms of hardwares and softwares	18	72	15	65	4	50	8	35	0	0	10.551	0.001
5	Improving quality of services	15	60	12	52	3	38	11	48	1	33	1.229	0.268
6	Deployment of Virtualization strategies with respect to hardwares, softwares and processes	20	80	13	56	6	75	15	65	2	67	0.530	0.467
7	Use of cloud based resources	14	56	12	52	2	25	8	35	2	67	1.712	0.191
8	Lowering CO_2 emission	8	32	5	22	2	25	4	17	0	0	1.912	0.167
9	Use of green IT equipments	3	12	4	18	4	50	4	17	1	33	0.806	0.369

'deployment of Virtualization strategies with respect to hardwares, softwares and processes 80%' and 'use of cloud based resources – 56%'. Similarly the significant motivators identified through case studies are 'energy efficiency – 83%', 'development and use of environment-friendly softwares – 91%', 'overall business cost reduction – 87%', 'promoting reusability and sustainability both in terms of hardwares and softwares – 65%' , 'improving quality of services – 52%', 'deployment of Virtualization strategies with respect to hardwares, softwares and processes – 56%' and 'use of cloud based resources – 52%'.

Table 3 shows that 6 significant motivators have been cited in ≥ 50% of the articles among the list of 9 motivators in empirical study. These are 'energy efficiency – 100%', 'development and use of environment-friendly softwares – 88%', 'overall business cost reduction – 88%', 'promoting reusability and sustainability both in terms of hardwares and softwares – 50%' , 'deployment of Virtualization strategies with respect to hardwares, softwares and processes – 75%' and 'use of Green IT equipments – 50%'. Similarly we have identified 4 significant

Table 4 Distribution of motivators, identified through the SLR, based on period of years.

S. No	Motivators	Occurrence in SLR (N=82)				Chi-square test (Linear-by-Linear association α=0.05) df=1	
		Period-1 (N=8)		Period-2 (N=74)			
		Freq	%	Freq	%	X^2	P
1	Energy efficiency	6	75	70	95	4.038	0.044
2	Development and use of environment-friendly softwares	8	100	67	91	0.817	0.366
3	**Overall business cost reduction**	**6**	**75**	**58**	**78**	**0.048**	**0.827**
4	Promoting reusability and sustainability both in terms of hardwares and softwares	7	88	38	51	3.763	0.052
5	**Improving quality of services**	**4**	**50**	**38**	**51**	**0.005**	**0.942**
6	Deployment of Virtualization strategies with respect to hardwares, softwares and processes	7	88	49	65	1.492	0.222
7	Use of cloud based resources	5	63	33	45	0.919	0.338
8	Lowering CO_2 emission	3	38	16	22	1.010	0.315
9	Use of green IT equipments	2	25	13	18	0.264	0.608

motivators through formal methods, these are 'energy efficiency – 96% ', 'development and use of environment-friendly softwares – 87%', 'overall business cost reduction – 74%', and 'deployment of Virtualization strategies with respect to hardwares, softwares and processes – 65%.

We have identified 2 significant motivators from Table 3 that have been cited in ≥ 50% of the articles among the list of 9 motivators in SLR. These are 'deployment of Virtualization strategies with respect to hardwares, softwares and processes – 67%' and 'use of cloud based resources – 67%'. Our analysis reveals that these motivators are important to be noted by the Green IT-outsourcing vendors for successful outsourcing relationship with their clients.

We have used Linear-by-linear Chi-Square test for the identification of statistically significant differences among the various study strategies used. According to literature study this test is more powerful and preferred best as compare to Pearson chi-square test [36], when testing the differences between ordinal variables. The following hypotheses have been examined:

Null Hypothesis (H_0): To expose the motivators, there is no significant difference among the various study strategies used for a particular motivator.

Alternative Hypothesis (H_1): To expose the motivators, there is a significant difference among the various study strategies used for a particular motivator.

We will consider H_0, if the value of 'p' is greater than 0.05 for motivators otherwise H_1 will be considered. In our analysis maximum motivators have no significant differences; it means that there are no big differences for the motivators across the various study strategies used.

4.2 Analysis of the Motivators, Identified through the SLR, Based on the Period of Years

In order to answer RQ 3, Table 4 shows the analysis of our results based on the two periods of years used. Period-1 contains papers from 1999 to 2009 and Period-2 contains papers onwards to 2009. Fig. 2 shows the number of articles with respect to the two periods of year used in these articles. We have extracted the information regarding these periods in the sample size of 82 papers.

According to our findings, as given in Table 4, the majority of motivators have been reported through period-2. In our results 7 significant motivators have been cited in ≥ 50% of the articles among the list of 9 motivators in period-1. These six motivators are 'energy efficiency – 75%', 'development and use of environment-friendly softwares – 100%', 'overall business cost reduction – 75%', 'promoting reusability and sustainability both in terms of hardwares and

Table 5. List of finally selected publications in the SLR.

Paper-id	Papers
P1	S. Naumann, M. Dick, E. Kern, and T. Johann, "The greensoft model: A reference model for green and sustainable software and its engineering," *Sustainable Computing: Informatics and Systems*, vol. 1, pp. 294-304, 2011.
P2	G. Agosta, M. Bessi, E. Capra, and C. Francalanci, "Automatic memoization for energy efficiency in financial applications," *Sustainable Computing: Informatics and Systems*, vol. 2, pp. 105-115, 2012.
P3	A. Kipp, T. Jiang, M. Fugini, and I. Salomie, "Layered green performance indicators," *Future Generation Computer Systems*, vol. 28, pp. 478-489, 2012.
P4	L. Ardito and M. Morisio, "Green IT - Available data and guidelines for reducing energy consumption in IT systems," *Sustainable Computing: Informatics and Systems*, 2013.
P5	Q. Gua, P. Lago, H. Muccini, and S. Potenza, "A categorization of green practices used by Dutch data centers," *Procedia Computer Science*, vol. 19, pp. 770-776, 2013.
P6	C. Colicchia, G. Marchet, M. Melacini, and S. Perotti, "Building environmental sustainability: empirical evidence from Logistics Service Providers," *Journal of Cleaner Production*, vol. 59, pp. 197-209, 2013.
P7	E. Capra, C. Francalanci, and S. A. Slaughter, "Is software "green"? Application development environments and energy efficiency in open source applications," *Information and Software Technology*, vol. 54, pp. 60-71, 2012.
P8	D. Aikema, R. Simmonds, and H. Zareipour, "Delivering ancillary services with data centres," *Sustainable Computing: Informatics and Systems*, vol. 3, pp. 172-182, 2013.
P9	L. Ardito, M. Torchiano, M. Marengo, and P. Falcarin, "gLCB: an energy aware context broker," *Sustainable Computing: Informatics and Systems*, vol. 3, pp. 18-26, 2013.
P10	L. M. Zhang, K. Li, D. C.-T. Lo, and Y. Zhang, "Energy-efficient task scheduling algorithms on heterogeneous computers with continuous and discrete speeds," *Sustainable Computing: Informatics and Systems*, vol. 3, pp. 109-118, 2013.
P11	T. Sheltami, A. J. Siddiqui, H. I. Abbasi, U. Baroudi, and L. Ghouti, "Implementation of Rank Based Sleep Scheduling (RBSS) Protocol for WSNs in a Fixed Grid Topology," *Procedia Computer Science*, vol. 19, pp. 348-355, 2013.
P12	A. E. Trefethen and J. Thiyagalingam, "Energy-aware software: Challenges, opportunities and strategies," *Journal of Computational Science*, vol. 4, pp. 444-449, 2013.
P13	A. El Kouche, L. Al-Awami, and H. Hassanein, "Dynamically Reconfigurable Energy Aware Modular Software (DREAMS) Architecture for WSNs in Industrial Environments," *Procedia Computer Science*, vol. 5, pp. 264-271, 2011.
P14	Y.-W. Kwon and E. Tilevich, "The impact of distributed programming abstractions on application energy consumption," *Information and Software Technology*, vol. 55, pp. 1602-1613, 2013.
P15	M. Kazandjieva, B. Heller, O. Gnawali, P. Levis, and C. Kozyrakis, "Measuring and analyzing the energy use of enterprise computing systems," *Sustainable Computing: Informatics and Systems*, vol. 3, pp. 218-229, 2013.
P16	L. Wang, S. U. Khan, D. Chen, J. KoÅ‚odziej, R. Ranjan, C.-z. Xu, and A. Zomaya, "Energy-aware parallel task scheduling in a cluster," *Future Generation Computer Systems*, vol. 29, pp. 1661-1670, 2013.
P17	C. De Alfonso, M. Caballer, F. Alvarruiz, and V. HernÃ¡ndez, "An energy management system for cluster infrastructures," *Computers & Electrical Engineering*, vol. 39, pp. 2579-2590, 2013.
P18	B. Dougherty, J. White, and D. C. Schmidt, "Model-driven auto-scaling of green cloud computing infrastructure," *Future Generation Computer Systems*, vol. 28, pp. 371-378, 2012.
P19	X. Zheng and Y. Cai, "CMDP based adaptive power management in server clusters," *Sustainable Computing: Informatics and Systems*, vol. 3, pp. 70-79, 2013.
P20	T. GuÃ©rout, T. Monteil, G. Da Costa, R. Neves Calheiros, R. Buyya, and M. Alexandru, "Energy-aware simulation with DVFS," *Simulation Modelling Practice and Theory*, vol. 39, pp. 76-91, 2013.
P21	M. Marzolla and R. Mirandola, "Dynamic power management for QoS-aware applications," *Sustainable Computing: Informatics and Systems*, vol. 3, pp. 231-248, 2013.
P22	Y. Woo, S. Y. Park, and E. Seo, "Virtual Battery: A testing tool for power-aware software," *Journal of Systems Architecture*, vol. 59, pp. 794-800, 2013.
P23	M. Witkowski, A. Oleksiak, T. Piontek, and J. WÄ™glarz, "Practical power consumption estimation for real life HPC applications," *Future Generation Computer Systems*, vol. 29, pp. 208-217, 2013.
P24	S. S. Shenoy and R. Eeratta, "Green software development model: An approach towards sustainable software development," presented at 2011 Annual IEEE India Conference (INDICON), 2011.
P25	Y. Sun and Y. Song, "Beyond Green: Evolution to Adaptability and Recyclability," presented at 2011 International Conference on Green Computing and Communications (GreenCom) IEEE/ACM, 2011.
P26	P. Gupta and G. Singh, "User centric framework of power schemes for minimizing energy consumption by computer systems," presented at 2012 International Conference on Radar, Communication and Computing (ICRCC),, 2012.
P27	M. Dick, J. Drangmeister, E. Kern, and S. Naumann, "Green software engineering with agile methods," presented at 2013 2nd International Workshop on Green and Sustainable Software (GREENS), 2013.

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Table 5 (Contd.)

Paper-id	Papers
P28	R. Zhang, Z. Zilic, and K. Radecka, "Energy efficient software-based self-test for wireless sensor network nodes," presented at Proceedings of the 24th IEEE VLSI Test Symposium (VTS'06), 2006.
P29	S. Bhattacharya, K. Gopinath, K. Rajamani, and M. Gupta, "Software Bloat and Wasted Joules: Is Modularity a Hurdle to Green Software?," *IEEE Computer Society*, vol. 44, pp. 97-101, 2006.
P30	A. Sivasubramaniam, M. J. Irwin, M. Kandemir, and N. Vijaykrishnan, "Designing energy-efficient software," presented at Proceedings of the International Parallel and Distributed Processing Symposium (IPDPS'02), 2002.
P31	N. Khamis, A. M. Misfian, and R. Md Noor, "Towards sustainable software criteria: Rescue operation and disaster management system model," presented at 10th IEEE International Conference on Networking, Sensing and Control (ICNSC), 2013, 2013.
P32	A. Larab, E. Conchon, R. m. Bastide, and N. Singer, "A sustainable software architecture for home care monitoring applications," presented at 6th IEEE International Conference on Digital Ecosystems Technologies (DEST), 2012, 2012.
P33	H. Koziolek, D. Domis, T. Goldschmidt, P. Vorst, and R. J. Weiss, "MORPHOSIS: A Lightweight Method Facilitating Sustainable Software Architectures," presented at 2012 Joint Working Conference on Software Architecture & 6th European Conference on Software Architecture, 2012.
P34	G. Konduri, J. Goodman, and A. Chandrakasan, "Energy efficient software through dynamic voltage scheduling," presented at Proceedings of the 1999 IEEE International Symposium on Circuits and Systems, 1999. ISCAS'99., 1999.
P35	M. R. Sabharwal, "Software power optimization: Analysis and optimization for energy-efficient software," presented at 2011 International Symposium on Low Power Electronics and Design (ISLPED), 2011.
P36	N. S. Chauhan and A. Saxena, "A Green Software Development Life Cycle for Cloud Computing," *IT Professional*, vol. 15, pp. 28-34, 2013.
P37	K. Erdelyi, "Special factors of development of green software supporting eco sustainability," presented at IEEE 11th International Symposium on Intelligent Systems and Informatics (SISY), 2013, 2013.
P38	T. Johann, M. Dick, E. Kern, and S. Naumann, "Sustainable development, sustainable software, and sustainable software engineering: An integrated approach," presented at 2011 International Symposium on Humanities, Science & Engineering Research (SHUSER), 2011.
P39	S. Dustdar, F. Li, H.-L. Truong, S. Sehic, S. Nastic, S. Qanbari, M. Vogler, and M. Claesens, "Green software services: From requirements to business models," presented at 2nd International Workshop on Green and Sustainable Software (GREENS), 2013, 2013.
P40	M. Liangli, Y. Chen, Y. Sun, and Q. Wu, "Virtualization Maturity Reference Model for Green Software," presented at Proceedings of the 2012 International Conference on Control Engineering and Communication Technology, 2012.
P41	C. Sahin, F. Cayci, J. Clause, F. Kiamilev, L. Pollock, and K. Winbladh, "Towards power reduction through improved software design," presented at Energytech, 2012 IEEE, 2012.
P42	D. Q. Ren, E. Bracken, S. Polstyanko, N. Lambert, R. Suda, and D. D. Giannacopulos, "Power Aware Parallel 3-D Finite Element Mesh Refinement Performance Modeling and Analysis With CUDA/MPI on GPU and Multi-Core Architecture," *IEEE Transactions on Magnetics*, vol. 48, pp. 335-338, 2012.
P43	G. Scanniello, U. Erra, G. Caggianese, and C. Gravino, "Using the GPU to Green an Intensive and Massive Computation System," presented at 2013 17th European Conference on Software Maintenance and Reengineering (CSMR),, 2013.
P44	A. Noureddine, A. Bourdon, R. Rouvoy, and L. Seinturier, "Runtime monitoring of software energy hotspots," presented at Proceedings of the 27th IEEE/ACM International Conference on Automated Software Engineering(ASE), 2012, 2012.
P45	M. A. Khan, C. Hankendi, A. K. Coskun, and M. C. Herbordt, "Software optimization for performance, energy, and thermal distribution: Initial case studies," presented at 2011 International Green Computing Conference and Workshops (IGCC), 2011.
P46	B. Penzenstadler, H. Femmer, and D. Richardson, "Who is the advocate? Stakeholders for sustainability," presented at 2nd International Workshop on Green and Sustainable Software (GREENS),2013, 2013.
P47	Y. S. Shao and D. Brooks, "Energy characterization and instruction-level energy model of Intel's Xeon Phi processor," presented at 2013 IEEE International Symposium on Low Power Electronics and Design (ISLPED), 2013.
P48	S. Alawnah and A. Sagahyroon, "Modeling smartphones power," presented at 2013 IEEE EUROCON, 2013.
P49	Z. Durdik, B. Klatt, H. Koziolek, K. Krogmann, J. Stammel, and R. Weiss, "Sustainability guidelines for long-living software systems," presented at 28th IEEE International Conference on Software Maintenance (ICSM), 2012, 2012.
P50	V. G. Moshnyaga, "An assessment of software lifecycle energy," presented at 23rd International Workshop on Power and Timing Modeling, Optimization and Simulation (PATMOS), 2013, 2013.
P51	J. Arnoldus, J. Gresnigt, K. Grosskop, and J. Visser, "Energy-efficiency indicators for e-services," presented at 2nd International Workshop on Green and Sustainable Software (GREENS), 2013.
P52	S. K. Garg, S. C. Yeo, and R. Buyya, "Green Cloud Framework for Improving Carbon Efficiency of Clouds," *Springer-Verlag Berlin Heidelberg 2011*, pp. 491–502, 2011.
P53	N. Amsel, Z. Ibrahim, A. Malik, and B. Tomlinson, "Toward Sustainable Software Engineering (NIER Track)," in ICSE'11, Waikiki, Honolulu, HI, USA, 2011.
P54	Q. Gu, P. Lago, and S. Potenza, "Aligning Economic Impact with Environmental Benefits: A Green Strategy Model," in IEEE

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Table 5 (Contd.)

Paper-id	Papers
	2012, GREENS 2012, Zurich, Switzerland, 2012, pp. 62-68.
P55	G. Sissa, "Utility Computing: Green Oppertunities and Risks," *CEPIS UPGRADE The European Journal for the Informatics Professionals,* vol. 12, no. 4, October,, 2011.
P56	A. Ozturk, K. Umit, I. T. Medeni, B. Ucuncu, M. Caylan, F. Akba, and T. D. Medeni, "Green ict (information and communication technologies): A review of academic and practitioner perspectives " *International journal of ebusiness and egovernment studies,* vol. 3, no. 1, pp. 1-16, 2011.
P57	G. Sissa, "Green Software," *CEPIS UPGRADE The European Journal for the Informatics Professionals,* vol. 11, no. 3, pp. 53-63, June,, 2010.
P58	S. Murugesan, G. R. Gangadharan, R. R. Harmon, and N. Godbole, "Fostering Green IT," in IEEE Computer Society, 2013.
P59	S. S. Mahmoud, and I. Ahmad, "Green Performance Indicators for Energy Aware IT Systems: Survey and Assessment," *Journal of Green Engineering,* vol. 3, pp. 33–69, 2012.
P60	A. Harbla, D. P. Dimri, D. Negi, and D. Y. S. Chauhan, "Green Computing Research Challenges: A Review," *International Journal of Advanced Research in Computer Science and Software Engineering* vol. 3, no. 10, pp. 1075-1077, October,, 2013.
P61	M. Sen, A. Dutt, J. Shah, S. Agarwal, and A. Nath, "Smart Software and Smart Cities: A study on Green Software and Green Technology to develop a smart urbanized world," *International Journal of Advanced Computer Research* vol. 2, no. 6, pp. 373-380, December, 2012.
P62	J. S. Jacob, and K. G. Preetha, "Edpac : Event-driven power aware pervasive computing for effective power utilization in green computing," *International Journal of Advanced Information Technology (IJAIT),* vol. 2, no. 1, pp. 55-64, Febraury, 2012.
P63	M. Liangli, and C. Yanshen, "Virtualization Maturity Reference Model for Green Software," *2012 International Conference on Control Engineering and Communication Technology*, pp. 573-576, 2012.
P64	Y.-s. Liu, and G.-z. Cao, "Development of Green Energy-saving Web Atoms Component " *2011 International Conference of Information Technology, Computer Engineering and Management Sciene*, pp. 246-249, 2011.
P65	P. Bozzelli, Q. Gu, and P. Lago, "A systematic literature review on green software metrics."
P66	Y. SUN, Y. ZHAO, Y. SONG, Y. YANG, H. FANG, H. ZANG, Y. LI, and Y. GAO, "Green challenges to system software in data centers," *Front. Comput. Sci. China 2011,* vol. 5, no. 3, pp. 353 – 368, 2011.
P67	C. Siebra, P. Costa, R. Miranda, F. Q B Silva, and A. Santos, "The Software Perspective for Energy-Efficient Mobile Applications Development," in MoMM 2012, Bali, Indonesia., 2012, pp. 143-150.
P68	G. Bekaroo, and C. Bokhoree, "Towards Emerging Green Information and Communication Technologies: A Review ".
P69	D. Schien, P. Shabajee, S. G. Wood, and C. Preist, "A Model for Green Design of Online News Media Services," in International World Wide Web Conference Committee (IW3C2), Brazil, 2013, pp. 1111-1121.
P70	L. Ardito, and M. Morisio, "Green IT – Available data and guidelines for reducing energy consumption in IT systems," *Sustainable Computing: Informatics and Systems*, pp. 9, 2013.
P71	S. S. Mahmoud, and I. Ahmad, "A Green Model for Sustainable Software Engineering " *International Journal of Software Engineering and Its Applications,* vol. 7, no. 4, pp. 55-74, July, 2013.
P72	Y. SUN, and Y. SONG, "Beyond Green: Evolution to adaptability and recyclability," in 2011 IEEE/ACM International Conference on Green Computing and Communications, 2011, pp. 234-237.
P73	L. Ponciano, A. Brito, L. ı. Sampaio, and F. Brasileiro, "Energy Efficient Computing through Productivity-Aware Frequency Scaling," in 2012 Second International Conference on Cloud and Green Computing, 2012, pp. 191-198.
P74	G. Agosta, M. Bessi, E. Capra, and C. Francalanci, "Dynamic Memoization for Energy Efficiency in Financial Applications," in 2011 IEEE, 2011, pp. 8.
P75	N. S. Chauhan, and A. Saxena, "A Green Software Development Life Cycle for Cloud Computing," *IEEE Computer Society*, January/February, 2013.
P76	M. N. Razali, H. R. Loindin, L. Y. Beng, and R. Hanapi, *Ecological Monitoring and Feedback Approach for Green and Sustainable IT*, pp. 131-137.
P77	G.Bekaroo & C.Bokhoree, "Towards Emerging Green Information and Communication Technologies: A Review",
P78	Schahram Dustdar, Fei Li, Hong-Linh Truong, Sanjin Sehic, Stefan Nastic, Soheil Qanbari, Michael V¨ogler and Markus Claeßens, "Green Software Services: From Requirements to Business Models",
P79	Chiranjeeb Roy Chowdhury, Arindam Chatterjee, Alap Sardar, Shalabh Agarwal And Asoke Nath, "International Journal of Advanced Computer Research", Volume-3 Number-1 Issue-8 March-2013, pp. 78-85
P80	Steve Easterbrook, "Climate Change: A Grand Software Challenge",
P81	Julius T. Nganji and Mike Brayshaw, "IS GREEN IT AN ANTIDOTE TO E-WASTE PROBLEMS?", ITALICS Volume 9 Issue 2 November 2010, pp. 1-9
P82	Capra, Eugenio, Politecnico di Milano, "THE IMPACT OF MIS SOFTWARE ON IT ENERGY CONSUMPTION", 18th European Conference on Information Systems, pp. 1-13

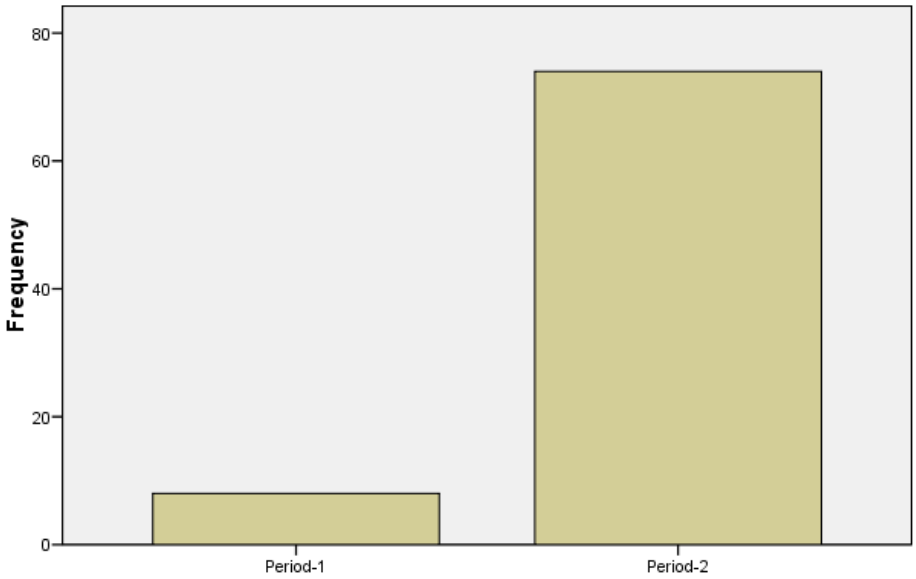

Fig. 2. Distribution of motivators, identified through the SLR, based on period of years.

softwares – 88%' , 'improving quality of services – 50%', 'deployment of Virtualization strategies with respect to hardwares, softwares and processes – 88%' and 'use of cloud based resources – 63%'. Similarly we have identified 6 significant motivators in period-2, these are 'energy efficiency – 95%', 'development and use of environment-friendly softwares – 91%', 'overall business cost reduction – 78%', 'promoting reusability and sustainability both in terms of hardwares and softwares – 51%' , 'improving quality of services – 51%', 'deployment of virtualization strategies with respect to hardwares, softwares and processes – 65%'.

Our analysis reveals that these motivators are important to be noted by the Green IT-outsourcing vendors for successful outsourcing relationship with their clients. We have used a similar Linear-by-linear Chi-Square test also for the analysis of the identification of statistically significant differences among the various study strategies used. In our analysis maximum motivators have no significant differences; it means that there are no big differences for the motivators across the two periods used. Table 4 reveals that only two motivators('overall business cost reduction' and 'improving quality of services') posses' value of 'p' less than 0.05 and exposes statistical significance difference for these motivators only across the two periods.

5. SUMMARY AND DISCUSSION

This study has identified a total of nine motivators for Green IT-outsourcing vendors. For Green IT software outsourcing our findings represents some basic consideration. To develop better Green IT outsourcing idea and plan, the motivators presents some basic key areas which need management's attention and awareness. The IT outsourcing vendor organization can also get help from these findings in order to know that what their clients actually want.

In order to answer RQ1, we identified 9 motivators, in total, for Green IT-outsourcing vendors. Out of these 9 motivators, some have occurrences of greater than or equal to 50% as shown in "Table 2". The identified significant motivators are 'energy efficiency', 'development and use of environment-friendly softwares', 'overall business cost reduction', 'promoting reusability and sustainability both in terms of hardwares and softwares ', 'improving quality of services' and 'deployment of virtualization strategies with respect to hardwares, softwares and processes'.

A similar criterion was also used for addressing the RQ2 and we found, 'energy efficiency', 'development and use of environment-friendly softwares', 'overall business cost reduction', and 'deployment of Virtualization

strategies with respect to hardwares, softwares and processes', most cited. Motivators for each of the research methodologies used respectively as shown in "Table 3".

A similar criterion was also used for addressing the RQ4 and we found, 'energy efficiency', 'development and use of environment-friendly softwares', 'overall business cost reduction', 'promoting reusability and sustainability both in terms of hardwares and softwares', 'improving quality of services', and 'deployment of virtualization strategies with respect to hardwares, softwares and processes', most cited motivators on the bases of period of years respectively as shown in "Table 4".

6. STUDY LIMITATIONS

By using our systematic literature review, we extracted data about the motivators in Green IT-outsourcing from vendor's perspective, but how valid are our findings? To internal validity one possible threat is that for any specific reporting article in the SLR, which may have not in fact described underlying reasons to report motivators in Green IT-outsourcing. In these studies the authors would not be supposed to give the original reasons for a particular motivator. Regarding threats to external validity, in many studies such as case studies, empirical studies and self-reported experience reports may have a propensity to report particular kinds of motivators in Green IT-outsourcing. There may be a chance of publication bias in these studies. By using our SLR process, we may have missed out some relevant papers, due to the increasing number of papers in Green IT- outsourcing domain. Though, like other researchers of SLR, thi**s** is not a systematic omission [37].

7. CONCLUSION AND FUTURE WORK

We have identified 9 motivators, in total, through SLR in Green IT-outsourcing from vendor's perspective. Our results reveal that focusing on these motivators can help vendor organizations in the adoption of Green IT initiatives in the context of IT outsourcing relationships with their clients. The objective of our research is to provide Green IT-outsourcing vendors with a body of knowledge that can assist them to implement and design successful Green IT-outsourcing initiatives. Our results suggest that Green IT-outsourcing vendors should adopt all of the identified motivators in order to be 'Green' in IT-outsourcing relationship.

On the basis of finding of this study, we have identified the following goals to plan our future studies:

- To identify various strategies and software tools that could be used by outsourcing to vendors, to engineer and maintain Green and sustainable software.
- To identify challenges in the adoption of Green IT-outsourcing from vendor's perspective.
- To identify the real-world practices for implementation of the identified motivators.

Our future work will focused on the development of Green IT-Outsourcing Assurance Model (GITAM) that will assist outsourcing vendor organizations to assure greenness of the organizations and to engineer energy-efficient softwares at low cost. The structure of the proposed model has already been published [38].

8. ACKNOWLEDGMENTS

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