EXAMINING THE CONTRIBUTION OF GREEN IT TO THE OBJECTIVES OF IT DEPARTMENTS: EMPIRICAL EVIDENCE FROM GERMAN ENTERPRISES

Nils-Holger Schmidt
Chair of Information Management, University of Goettingen, Germany
Email: nschmid@uni-goettingen.de

Koray Erek
Chair of Information and Communication Management, Berlin Institute of Technology, Germany
Email: koray.erek@tu-berlin.de

Lutz M. Kolbe
Chair of Information Management, University of Goettingen, Germany
Email: lkolbe**@uni-goettingen.de**

Ruediger Zarnekow
Chair of Information and Communication Management, Berlin Institute of Technology, Germany
Email: ruediger.zarnekow@tu-berlin.de

ABSTRACT

The article examines the contribution of Green IT activities to the objectives of IT departments by analysing empirical data from 116 companies using exploratory factor analysis. The outcomes indicate that Green IT contributes to the objectives of efficient internal operations, reputational management, and market competitiveness. In particular, reputational management plays a major role for Green IT engagement. These findings provide CIOs, IT managers, and environmental officers with new insights and enable a more systematic application of Green IT measures.

INTRODUCTION

Enterprises are increasingly challenged by the changing demands of their stakeholders in the scope of eco-awareness and social consciousness (Hewlett et al. 2009). Dealing proactively with social and environmental issues is much more than just cost-driven; it can be a source of opportunity, innovation, and competitive advantage (Porter & Kramer 2006).

This general movement has reached information technology (IT) departments. There, the environmental impact of IT is being discussed under the term of Green IT. Green IT has been driven primarily by business, and is seen as one of the major concerns for chief information officers (CIOs) (Kurp 2008; Molla et al. 2008).

Scientific research and industry literature outline the importance of Green IT by referring to its multifaceted benefits (Mines & Davis 2007; Molla 2008; Erek et al. 2009; Fujitsu Australia 2009; Gadatsch & Juszczak 2009). Kuo and Dick assume that Green IT implementation is a response to pressures from competition, legitimation and social responsibility (Kuo & Dick 2010). In this research, we consider Green IT as an instrument of the IT departments to pursue certain objectives. To explore these objectives, we investigate the underlying factors of Green IT benefits. Describing this interdependency will provide researchers and practitioners alike with a better understanding of the topic. The article aims to answer the following three research questions.

- What do IT departments want to achieve with Green IT?
- How do the objectives relate to the domains and processes of IT departments?
- Which recommendations can be derived for researchers, CIOs, IT managers, and environmental officers?

In the next step, the research questions will be answered with the results from a large cross-sectoral survey of 116 German companies. We apply factor and correlation analysis to discover the underlying objectives. These findings contribute to existing knowledge on Green IT and provide practical recommendations for CIOs, IT managers, and environmental officers, as well as new opportunities for further research in this field.

THEORETICAL BACKGROUND

The principle of corporate sustainability

Sustainability has been extensively discussed within corporate management under the synonyms of corporate social responsibility (CSR), greening the business, eco-efficiency or eco-advantage. Although many studies concerning sustainable management have been introduced, sustainability in information systems (IS) research has not been evaluated until now. Global development and challenges as well as the general need to align IS strategy to corporate strategy, form the need for an integrated concept of sustainability in IS. In its primary sense sustainability can be described as a survival assurance meaning that an economical, environmental or social system should be preserved for future generations so that, necessary resources should only be exploited to a degree where it is possible to restore them within a regeneration cycle. The most common definition, from the Brundtland Commission defines sustainability as a "development that meets the needs of the present without compromising the ability of future generations to meet their own needs" (WCED, 1987). All definitions of sustainability have the preservation of the economical, environmental and social system for the benefit of future generations in common. These dimensions represent the three main pillars of sustainability and are known as the "triple-bottom-line" concept (Elkington, 1997). The "triple-bottom-line" concept provides a framework for companies to measure and report their performance and organisational success in relation to these pillars. Thus, the primary objective of a corporate sustainability program is to account for the triple bottom line. Corporate sustainability is about minimizing a business' negative impacts on people, societies and the environment while maintaining or enhancing value for customers, business partners and shareholders. Especially at the business level, sustainability is mainly equated with the economical or financial sustainability (Dyllick & Hockerts, 2002). However, integrated corporate sustainability is achieved by recognizing the interdependence of the three dimensions over time and keeping an optimal balance between them.

The value chain of IT departments

In order to define the field of research, it is necessary to identify the relevant scope of IS management and to outline the key activities of IT departments. The IT business consists of internal (in-house) and

external organisations that provide products and services, such as hardware, software and services that can be assigned to IT departments. These types of departments generally follow the processes source, make, deliver, and return through which the value creation takes place. The management of these processes defines the scope of IT management. The foundation for this process-oriented concept originated from the Supply Chain Operations Reference (SCOR) model (Supply Chain Council, 2006), a well-known value chain concept in industrial management, which makes it applicable for IT hardware providers. The transfer of the SCOR model to IT software and IT service providers has been done by Zarnekow et al. by developing the integrated information management (IIM) model (Zarnekow, Brenner & Pilgram, 2006). The IIM model focuses on the whole IT value chain including customer and supplier relationship, while traditional IT management concepts are focusing on the management of applications (Hochstein, Brenner & Uebernickel, 2006) Figure 1 illustrates the value chain of IT business, including a return process and the stakeholders' interests.

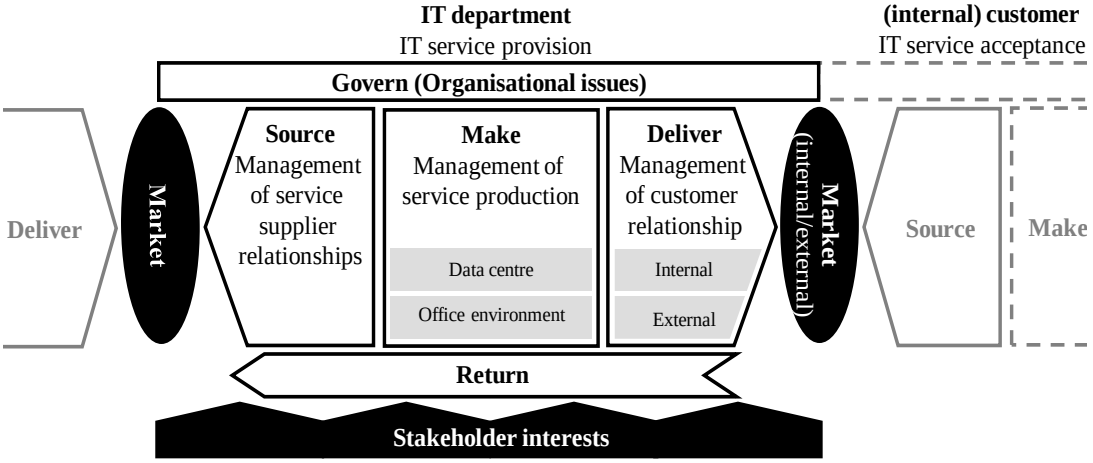

Figure 1. Value chain of the IT department (Source: Erek et al. 2009)

The **govern** function encompasses strategic procedures and measures which ensure that allocated IT products and services contribute to the business objectives. In particular, IT governance determines the supervisory functions, organisational structures, and processes.

The **source** process covers all tasks within the supplier relationship management. Usually, IT departments purchase hardware components, software solutions, personnel or other technological resources. These resources are used in the production phase and are transformed to marketable IT services.

The **make** process comprises all tasks for the management of IT service production. This paper focuses on the two main locations of IT service production: the data centre and the office environment. Attention is therefore drawn to the efficient planning, development and production of IT services in these two areas.

The **delivery** process is responsible for the management of internal and external relationships. The main objective is to meet all types of internal and external demands in an adequate manner. This not only comprises IT services, but also demands for compliance or transparency. The delivery process can be seen as a mediator function between the internal make and the customers' source process.

Based on the original SCOR model we included a **return** process into the IT value chain. The return phase depicts the processes of recycling, preserving and reusing tangible and/or intangible resources. It ensures a lifecycle oriented view on IT services, including waste management and reutilisation of products in the value chain.

		Corporate social responsibility	**Green IT**
		Benefits on the corporate level	**Benefits on the IT department level**
Categories of main objectives (Wagner 2007)	**Internal operations**	• Asset utilisation (Figge 2005) • Optimized production processes (Schaltegger & Synnestvedt 2002) • Cost savings (Schaltegger & Synnestvedt 2002)	• Cost efficiency (Erek et al. 2009; Gadatsch & Juszczak 2009; Mines & Davis 2007) • Increased flexibility (Erek et al. 2009) • Energy efficiency (Gadatsch & Juszczak 2009; Fujitsu Australia 2009) • Improved business efficiency (Molla 2008) • Reduced carbon emissions (Molla 2008)
	Market competitiveness	• Customer satisfaction (Luo & C.B Bhattacharya 2006) • Buying intention (Sen & C. B. Bhattacharya 2001; Klein & Dawar 2004) • Attitude towards products and services (Berens et al. 2005)	• Influence the mindset of customers (Molla 2008) • Better quality of products and services (Erek et al. 2009) • Strategic differentiator and competitive advantage (Molla 2008; Fujitsu Australia 2009) • Facilitating innovations (Gadatsch & Juszczak 2009) • Enabler of other green initiatives (Molla et al. 2008) • Increased customers (Fujitsu Australia 2009)
	Reputation management	• Corporate image (Yoon et al. 2006) • Attractiveness for investors and business partners (Tsoutsoura 2004) • Workplace attractiveness (Turban & Greening 1997) • Reputational improvement (Fombrun 2005; Tsoutsoura 2004; Schwaiger 2004; Verschoor & Murphy 2002) • Stronger brand (Sen & C. B. Bhattacharya 2001; Brown & Dacin 1997)	• Risk reduction (Erek et al. 2009) • Influence mindset of investors (Molla 2008) • Reputational improvement (Erek et al. 2009) • Increased staff morale (Fujitsu Australia 2009) • Positive brand image (Fujitsu Australia 2009; Molla 2008; Gadatsch & Juszczak 2009) • Regulatory compliance (Mines & Davis 2007; Molla 2008; Fujitsu Australia 2009)

Table 1: Comparison of CSR and Green IT value drivers and their possible categorization

To frame the value chain of IT departments, **stakeholders'** interests are taken into account. The reason for doing so is that the diversity of stakeholders like shareholders, policy makers, suppliers, labour unions, customers or others, can have a major impact on corporate - in this case IT management - performance. Summing up, the model cuts the value chain into four core processes, which have to be considered simultaneously for implementing sustainability in IT management.

Green IT measures can be structured regarding the strategic, operational and technical levels of an IT department (Schmidt et al. 2009). They also can be assigned to the value chain of IT management; more specific to the source, make, deliver and return processes (Molla 2008; Schmidt et al. 2009).

Comparison of benefits from CSR and Green IT

For our Green IT survey we draw on research from the scope of CSR. A literature review shows a broad variety of potential benefits from CSR for the corporate level (Table 1). Wagner (2007) categorized these benefits in an empirical investigation into the three categories of objectives: internal operations, market competitiveness and reputation management. Literature review on Green IT reveals benefits, which are comparable to those of CSR. Due to the similarity of the benefits, we assumethat the discovered categories of Wagner (2007) are also applicable to Green IT.

METHODOLOGY

Research model

The proposed research model as shown in Figure 2 is based on the findings from the literature review. Green IT measures are implemented in one of the processes (govern, source, make, deliver, return) of the value chain of IT departments. These measures generate certain benefits for the IT department or the entire enterprise.

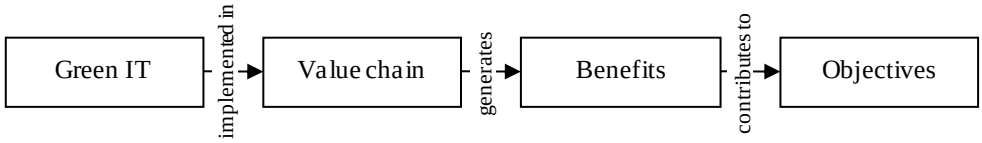

Figure 2. The connection between Green IT, value chain, benefits and objectives

All benefits are related to some type of overall objective. Through these mediators, Green IT contributes to the strategic objectives of the IT department. Understanding the relationships helps to select adequate Green IT measures under the given objectives of the IT department.

Questionnaire and statistical analysis

A cross-sectional survey was conducted to evaluate the proposed research model. A paper-based questionnaire was sent out via postal mailing in September 2009. Additionally, each letter included a covering letter, a self-addressed envelope and the basic definition of Green IT. The addressees were CIOs, IT managers, environmental managers and staff responsibles for Green IT from 619 major companies listed in German stock indexes. To increase the response rate respondents were offered a report of the results. Over the time of three weeks, we received 116 anonymous replies, amounting to a response rate of 18.7%. This response rate is consistent with rates in similar surveys in IS research (Mani et al. 2010; Poppo & Zenger 2002).

The questionnaire was compiled based on a previous survey from the scope of CSR (Wagner 2007). Additional questions were developed based on findings from fifteen case studies conducted on Green IT (Erek et al. 2009). Further questions were added from the survey results of Fujitsu Australia (2009). General questions, regarding the enterprise and the perception of Green IT, were integrated. A panel of five academic experts reviewed the questions to confirm that the constructs were adequately described by the item wording. The statistical analysis was done using the software SPSS Statistics

17.0. All questions for the factor analysis had a 5-point Likert scale ranging from "Agree strongly" to "Disagree strongly" (Hague 2002). For the survey, a practical oriented definition of Green IT was provided to the participants, which tried to comprise the above-mentioned aspects under the given limitations of space and perceivability. We defined Green IT as follows:

"Green IT comprises the management of all activities and measures of the IT department, which are aimed to reduce the resource consumption by IT, e.g. in terms of energy, material or paper. Furthermore, it includes instruments to control, steer, and communicate the success".

This is a broad view of Green IT, which also includes management aspects. The environmental impact, e.g. in form of carbon dioxide emissions, was not pointed out explicitly since we see this as the consequence of reduced resource consumption. We apply exploratory factor analysis, which can be used to reveal underlying variables (Field 2009). Exploratory factor analysis is a widely utilised and broadly applied statistical method in the social sciences to discover structures in large variable sets (Costello & Osborne 2005). Factor analysis aims to reduce complexity by looking at which variables seem to cluster together in a meaningful way (Field 2009). All correlation coefficients are calculated using Spearman's rho (r_s) for non-parametric data.

Sample profile

All findings are based on the sample profile shown in Table 2. The participating enterprises belong to a variety of industries, such as manufacturing (35%), trade and commerce (19%), information and communication technologies (16%), and others (30%), which are representative for Germany.

Annual turnover 2008 in millions of Euros			**Employees of the enterprise**			**Employees of the IT department**		
	Percent	Frequency		Percent	Frequency		Percent	Frequency
1-4	6%	7	1-99	9%	10	1-4	10%	12
5-9	3%	4	100-499	16%	19	5-9	8%	9
10-49	5%	6	500-999	9%	11	10-49	29%	34
50-499	25%	29	1,000-4,999	30%	35	50-499	18%	21
500+	53%	62	5,000+	35%	41	500+	35%	40
Missing values	7%	8			N=116			N=116
		N=116						

Table 2: Turnover and employees of the responding companies

The annual turnover and the number of employees indicate that large enterprises dominate the sample. The total number of employees significantly corresponds to the number of employees in the IT department, $r_s = .74$, $p < .001$.

Following Zarnekow et al. (2006), the participants were asked regarding the target market of their IT department. The results in Table 3 show that the internal market is most relevant to IT departments of the respondents.

Employees in the IT department	**Target market of the IT department**

	Percent	Frequency		Percent	Frequency
1 - 4	10%	12	Internal market	76%	88
5 - 9	8%	9	Internal and external market	16%	19
10 - 49	29%	34	External market	3%	3
50 - 499	18%	21	Missing values	5%	6
500 +	34%	40			N = 116
		N = 116			

Table 3: Size and target markets of the IT departments

RESULTS FROM THE EMPIRICAL ANALYSIS

Importance and implementation

For 56% of all participants, Green IT is an important or very important topic. The importance of Green IT is significantly related to the overall environmental engagement of the company, $r_s = 0.542$, p (one-tailed) < 0.001. This illustrates that Green IT is seen, in the environmental context, of the enterprise. Green IT also correlates significantly with the number of employees in the enterprise, $r_s = 0.245$, p (one-tailed) < 0.001, and the number of employees in the IT department, $r_s = 0.374$, p (one-tailed) < 0.001. This indicates that larger companies tend to be more active in the scope of Green IT. Green IT is primarily implemented in the make process of the IT value chain. There, the data centre is the most considered domain for Green IT (Table 4).

In which domains did you implement Green IT? (multiple answers allowed)				
# Item	**Value chain**	**Domain**	**Percent**	**Frequency**
Q10.2	**Govern**	In-house training	14%	16
Q10.4		Remuneration of employees	2%	2
Q10.9	**Source**	Procurement	46%	53
Q10.6	**Make**	Data centre	82%	95
Q10.3		Office environment	48%	56
Q10.5	**Deliver**	Internal and external communication	32%	37
Q10.1		Distribution	13%	15
Q10.7		Marketing	12%	14
Q10.8	**Return**	Disposal	53%	61
				N = 116

Table 4: Implementation and domains of Green IT

Benefits and objectives

To determine Green IT's contribution to the objectives of IT departments an exploratory factor analysis was conducted. For the factor analysis, questions evaluating the benefits related to Green IT were included. The distributions of measured variables should be examined prior to conducting factor analysis (Fabrigar et al. 1999). Therefore, the distributions of these items were tested whether they deviate from a normal distribution. For the test of normality, the Kolomogorov-Smirnov test and Shapiro-Wilk test were applied (Field 2009). With $p < 0.001$ for both tests, the distributions of measured variables were significantly non-normal. If the assumption of normality is violated the principal factor analysis method or principal axis factoring (PAF) (in SPSS) is recommended (Costello & Osborne 2005).

All variables were examined regarding their usability for factor analysis. The reliability of factor analysis and individual variables can be determined using the Kaiser-Meyer-Olkin measure of sampling adequacy (KMO) (Kaiser 1970). KMO values greater than 0.5 are barely acceptable (Kaiser 1974). KMO values between 0.5 and 0.7 are mediocre, values between 0.7 and 0.8 are good, values between 0.8 and 0.9 are great and values above 0.9 are superb (Field 2009). The anti-image correlation matrix provided Kaiser-Meyer-Olkin values for each individual variable. Scores below 0.5 are unacceptable and should be removed from the factor analysis (Hutcheson & Sofroniou 1999). Therefore, one item with KMO = 0.484 was excluded.

There is a debate over the criterion used to decide whether a factor should be retained for analysis (Field 2009). Kaiser recommended retaining all factors with eigenvalues greater than 1 (Kaiser 1960). The scree plot graphs each eigenvalue (Y-axis) against the factor with which it is associated (X-axis). The cut-off point for selecting factors should be at the point of inflexion of this curve. Only factors left of the point of inflexion should be retained (Cattell 1966).

An initial analysis was run to determine eigenvalues for each factor in the sample. Four factors had eigenvalues over Kaiser's criterion of 1, with the fourth factor being just above it with an eigenvalue of 1.033. The scree plot was ambiguous and showed inflexions that would justify retaining three factors. The best choice for researchers to determine the number of factors is the scree test (Costello & Osborne 2005). Furthermore, three factors were proposed in the research model from section 4. Therefore, the three factors, efficient internal operations, market competitiveness and reputation management were retained in the final analysis. The rerun of the examination with three factors showed an equally low crossloading of one item on two factors. Hence, it was dropped from the analysis as suggested (Costello & Osborne 2005).

A principal factors analysis (PAF) was conducted on the remaining 18 items with orthogonal rotation of varimax (Table 5). The Kaiser-Meyer-Olkin measure verified the sampling adequacy for the analysis with KMO = 0.828 as 'great'. All KMO values for individual items were > 0.71, which is above the acceptable limit of 0.5 (Field 2009). Bartlett's test of sphericity should be significant ($p < .001$) (Field 2009). Bartlett's test of sphericity χ^2 (153) = 989.295, $p < 0.001$, indicated that correlations between items were sufficiently large for PAF. In the preliminary analysis the sample was checked for the problem of multicollinearity (Field 2009). The Pearson correlation coefficient matrix reported a determinant of 0.0000306 which is slightly greater than the necessary value of 0.00001, indicating that multicollinearity was not a problem.

The three factors explain 52.93% of the variance. Table 5 shows the factor loadings after rotation. The items that cluster on the same factors suggest that factor 1 represents the objective of efficient internal operations, factor 2 the objective of market competitiveness and factor 3 the objective of relationship management. All factors have more than three strongly loading items with 0.50 or better. Therefore all factors are considered to be solid (Costello & Osborne 2005).

		Objectives of Green IT		
		Factor 1	Factor 2	Factor 3
#Item	**Benefit**	**Internal operations**	**Market competitiveness**	**Reputation management**
Q32	Postpone investments	**.742**	.031	.050
Q34	Predict future investments	**.720**	.195	.109
Q33	Extend life-span of equipment	**.715**	-.003	.067
Q23	Shorter processes	**.669**	.313	.183
Q30	Better forecast of costs	**.630**	.246	.314
Q21	Lower capital investments	**.625**	.108	.098
Q22	Better utilisation of equipment	**.593**	.015	.201
Q29	Improved process quality	**.582**	.246	.292
Q24	Reduced share of fixed costs	**.540**	.209	.172
Q28	Lower process costs	**.520**	.258	.267
Q16	Above average prices for current IT products / services	.083	**.865**	.155
Q18	More sales of current IT products / services	.118	**.747**	.318
Q17	Above average prices for future IT products / services	.192	**.722**	.253
Q20	Gaining competitive advantage	.368	**.522**	.153
Q27	Decision criterion for the buyer of IT products / services	.178	.337	**.718**
Q26	Quality indicator for selecting contract partners	.214	.210	**.687**
Q25	Competence signal of the IT department	.212	.148	**.665**
Q36	Improved reputation of the IT department	.115	.136	**.651**
	Eigenvalues	4.400	2.677	2.453
	% of variance	24.426	14.874	13.635
	Cronbach's α	.889	.847	.816
	Most important factor for respondents in % (N = 103)	27.2	35.0	37.9

Note: Factor loadings over .40 appear in bold

Table 5: Benefits of Green IT and related objectives

When using factor analysis the consistency of the questionnaire should be checked using Cronbach's α, which should be around 0.8 (Field 2009). The factors representing efficient internal operation, market competitiveness, and relationship management have high reliabilities with Cronbach's α = 0.889 / 0.847 / 0.816.

The objective of efficient internal operations is achieved by the following Green IT benefits: to postpone investments, better planning of future investments and costs, extended life-spans of IT equipment, shortened processes, better utilisation, improved quality and lower process costs (Table 5).

Market competitiveness is achieved by to the opportunity to ask for higher prices and sell more products or services (Table 5). Green IT serves also as a quality indicator and a competence signal which increases the reputation of the IT department (Table 5).
Even though the factor of efficient internal operation explains the greatest variance (24.4%) the majority of respondents (37.9%) perceive the contribution of Green IT to the objective of reputation management as most important, followed by market competitiveness (35.0%) and efficient internal operation (27.2%).

Domains and objectives

Table 6 highlights the correlations of the revealed objectives with the domains in which Green IT is applied. Each objective is significantly positively correlated with a compatible domain. Efficient internal operation is related to Green IT in the data centre, $r_s = 0.276$, p (one-tailed) < 0.001, but not to the office environment. On the other hand, reputation management is linked to the office environment, $r_s = 0.250$, p (one-tailed) < 0.01. Reputation management is also correlated to communication, $r_s = 0.321$, p (one-tailed) < 0.001, and the overall number of domains where Green IT is applied, $r_s = 0.310$, p (one-tailed) < 0.01. Market competitiveness shows a significant link to the domain of distribution, $r_s = 0.241$, p (one-tailed) < 0.01.

			Factor 1	Factor 2	Factor 3
# Item	**Value chain**	**Domain**	**Internal operations**	**Market compete-tiveness**	**Reputation management**
Q10.2	**Govern**	In-house training	.084	-.002	.15
Q10.4		Remuneration of employees	-.021	.213*	-.066
Q10.9	**Source**	Procurement	.030	.098	.165*
Q10.6	**Make**	Data centre	.276**	-.031	.212*
Q10.3		Office environment	.000	.226*	.250**
Q10.5	**Deliver**	Internal and external communication	.191*	.188*	.321***
Q10.1		Distribution	.000	.241**	.119
Q10.7		Marketing	.172*	.132	.082
Q10.8	**Return**	Disposal	-.067	-006	.029
		Number of Green IT domains	.136	.175*	.310**

Note: Spearman's correlation coefficients. Significance of correlation coefficients, * $p < .05$ (1-tailed), ** $p < .01$ (1-tailed), *** $p < .001$ (1-tailed)

Table 6: Correlations between Green IT domains and objectives of the IT department

IMPLICATIONS

From these results in Section 4.2 it can be concluded, with certain limitations, that Green IT measures and activities contribute to the objectives of an IT department, which are efficient internal operations, market competitiveness, and reputation management.

From the revealed objectives in Section 4.2, reputational management (37.9%) is the most important, followed by market competitiveness (35.0%), and efficient internal operation (27.2%). As these outcomes indicate, doing Green IT is not just necessarily aimed at achieving efficient internal operations, for reducing costs or emissions. Doing Green IT is rather used as a tool to signal own competence, quality or reputation to important relationship collaborates, such as suppliers and employees. Considering the factor of market competitiveness, it is also aimed at increasing the sales and prices of products or services.

The objectives are all correlated to the application of Green IT in specific domains (Section 4.3). Efficient internal operation is related to Green IT in the data centre but not to the office environment. This could be done because benefits might be easier to realize with greater impact in the data centre. On the other hand, reputational management is linked to the office environment, communication and the overall number of domains where Green IT is applied. An explanation for this might be that Green IT measures in the office environment are aimed to create involvement, positively influence the employees' opinion about the idea of environmental protection and to demonstrate own competence. Market competitiveness is correlating with Green IT in the domain of distribution, which seems useful when products or services are advertised.

The results provide CIOs, IT managers, and environmental officers with recommendations on how to efficiently implement Green IT into an IT strategy and an overall business strategy. Considering the business and IT strategy, CIOs and IT managers should decide which of the objectives - efficient internal operations, reputation management, and/or market competitiveness - are most relevant for doing the business. Based on this analysis they should implement Green IT in the adequate domains of the IT department value chain.

LIMITATIONS AND CONCLUSION

There are a number of clear limitations in these preliminary findings. Foremost is the exploratory nature of the research and small sample size that limits generalisability of these findings. The sample selection and the applied statistical methods impose specific limitations to the results. Due to the sample selection the results of this study are only representative for German IT departments. The perception of Green IT might vary from region to region (Molla et al. 2008). Limitations also derive from the application of principal factor analysis. Conclusions are restricted to the sample collected and generalizations of the results can be achieved only if analysis using different sample reveals the same factor structure (Field 2009). Furthermore, it has to be noted that showed correlations do not imply causality between two variables because there may be other measured or unmeasured variables affecting the results (Field 2009). To test for non-response bias, the responses were split into two groups based on their chronological return. There is a difference between early and late respondents when cross-tabulated with, "extent of Green IT planning and implementation": 61% of the early respondents had "planned" or "implemented and planned" Green IT, but this proportion decreases to

29% of the late respondent group. The chi-square statistic was significant at $p < .05$. An explanation for this could be that respondents who are currently planning Green IT activities are more likely to answer the questionnaire. It can be assumed that non-response bias has not caused any significant problems with the study.

Despite the given limitations, these results provide insights and guidelines for CIOs, IT managers, and environmental officers for applying Green IT into their daily business.

In this paper we have shown the contribution of Green IT to the objectives of IT departments. We provided theoretical foundation to the topic and suggested practical recommendations for implementing Green IT along the value chain of IT departments. This enables CIOs, IT managers, and environmental officers to get further insights about Green IT and to take the appropriate actions to link Green IT with the IT and business strategy.

The results need further investigation and validation. Therefore, future research should replicate the survey in other countries to determine if the results are transferable. The outcomes should be discussed by conducting case studies and expert interviews.

Green IT is able to contribute to the IT as well as to the business strategy. The development of a procedural model defining tasks, roles and responsibilities in the scope of Green IT for the entire enterprise seems useful.

IT departments have to be aware that environmental topics need to be addressed in order to remain competitive in the future. Given the rising prices for energy and other resources and the increasing awareness of all stakeholders to environmental issues, the relevance of Green IT is destined to gain even more importance in the future. Hence, the concept of environmentally oriented IT has an increased relevance for policy makers, practitioners, and researchers.

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