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TOWARDS A CONTINGENCY MODEL FOR GREEN IT GOVERNANCE

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Abstract

Although practitioners have begun to implement Green IT into their companies, the governance of Green IT varies significantly. No research has been done to explain these differences in Green IT governance. Building upon contingency theory and IT governance, we develop a contingency model for Green IT governance which demonstrates the fit between contingencies and the company-specific configuration of Green IT. In the first step, three archetypes of Green IT governance reaching from centralized over federal to decentralized are presented. In the second step, we identify from literature competitive strategy, firm size, organization structure, performance strategy, environmental impact of industry, environmental strategy, IT infusion, and IT diffusion as contingency factors determining the ideal type of Green IT governance. The contingency model for Green IT governance is validated based on insights from five case studies. With the enhanced understanding of how Green IT governance is shaped by contingency factors, organizations are able to select the most successful Green IT governance form.

Keywords: Green IT, Green IS, contingency theory, governance, organization

1 Introduction

In information systems (IS) research, the environmental impact of information technology (IT) and related measures for its reduction and management are being discussed under the headline of Green IT (Watson et al. 2010; Yi and Thomas 2007; Kuo and Dick 2010; Schmidt et al. 2009). Green IT incorporates measures and activities of an enterprises' IT department to achieve environmental sustainability (Chen et al. 2008; Molla et al. 2009; Schmidt et al. 2009).

Although practitioners have begun to implement Green IT into their companies, the governance of Green IT varies significantly (Molla et al. 2009). No research has been done so far to explain these differences in Green IT governance or to provide a framework which helps to determine the ideal type of Green IT governance for a given context. Many researchers have investigated and explained how organizations structure their general IT governance (e.g. Brown, 1997, 1999; Tavakolian, 1989; Wetherbe & Whitehead, 1977; Yajiong et al., 2008). Building upon this, we want to extend this research to the specific case of Green IT governance.

Studies on IT governance indicate that the decision rights for IT management differ between companies depending on contingency factors such as competitive strategy, firm size or organization structure (Ein-Dor and Segev 1982; Olson and Chervany 1980; Tavakolian 1989). Based on the findings for IT governance, we assume that the differences of Green IT governance also depend on certain contingency factors. To analyse organizational structures in the context of sustainability research in IS, Melville (2010) suggests the application of contingency theory.

Referring to this, contingency theory and case study research are used in this paper to increase our knowledge about Green IT governance. Specifically, we want to answer the following two questions:

1. What Green IT governance patterns exist?
2. How do contingency factors influence Green IT governance patterns?

This paper proposes a flexible Green IT governance approach, which demonstrates the fit between contingencies and the company-specific configuration of Green IT. In this respect, competitive strategy, firm size, organization structure, performance strategy, environmental impact of industry, environmental strategy, IT infusion, and IT diffusion have been identified as contingency factors.

While this paper focuses on the coordination aspect of Green IT governance, it does not examine guidelines and compliance facets. The paper outlines the first results from case studies on Green IT governance, which the authors conducted with five companies of different size and from different industries.

With an enhanced understanding of how Green IT governance is shaped by contingency factors, organizations may be able to select the most appropriate Green IT governance form to achieve desired outcomes within specified contexts.

This paper is organized as follows: we begin with a literature review on IT governance and contingency theory. Following this, we develop a contingency model for Green IT governance from literature. Then, the applied case study research design is described from which we draw our findings. The conducted case studies provide information to validate the proposed contingency approach for Green IT governance. We conclude with implications and a discussion of future research opportunities.

2 Developing a Contingency Model for Green IT Governance

2.1 IT Governance and Contingency Theory

Many researchers have investigated the link between IT and organizational structure. The organizational structure describes the ways in which an organization divides its labour into distinct tasks and achieves coordination among them (Melville 2010). Organizational aspects in the scope of IT are associated with IT governance. Effective IT governance is supposed to be the single most important predictor of the value an organization generates from IT (Weill and Ross 2004). IT governance is the practice that allocates decision rights and establishes the accountability framework for IT decisions to ensure alignment with strategic objectives (Weill and Ross 2005).

In respect to the distribution of decision rights, IT governance has been categorized into different archetypes such as centralized, federal, hybrid, and decentralized (Brown 1997; Magill and Brown 1994). Weil and Ross (2005) identify six archetypal approaches to IT decision-making, ranging from highly centralized to highly decentralized. Organizational centralization specifies the level of concentration in decision-making rights (Yajiong et al. 2008).

From a scientific perspective, IT governance researchers highlight the importance of aligning IT governance with the overall organizational context. Scholars investigated the relationship between organizations' IT governance design and contingency factors using contingency theory (Brown 1997; Grant and Brown 2005; Sambamurthy and Zmud 1999; Weber et al. 2009; Weill and Ross 2005; Yajiong et al. 2008).

Firms govern IT very differently depending on a number of contingency factors (Weill and Woodham 2002). The underlying assumption is that there is no general IT governance design fitting all organizations and that the contingency factors impact the contribution of IT governance in improving the organization's success (Figure 1). The model illustrates the two main idea of contingency theory. First, the characteristics of an organization, e.g. the allocation of decision rights, impact the organization's success. Second, the ideal organizational configuration is determined by specific contingency factors.

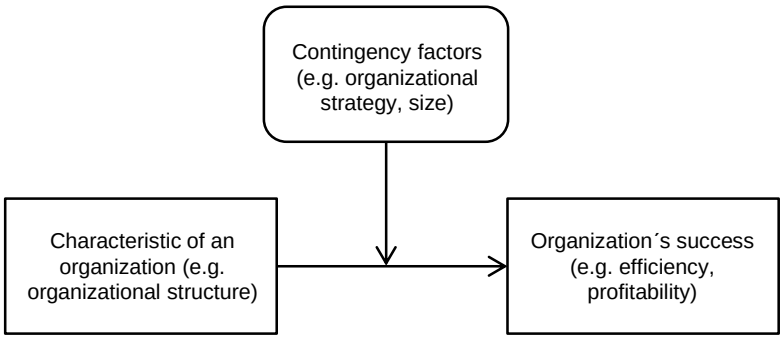

Figure 1. Contingency model adapted from Weber et al. (2009) and Umanath (2003)

Numerous studies on IT governance applying contingency theory have identified various elements which influence the ideal shape of IT governance leading to success. Contingency factors are for example: Competitive strategy (Tavakolian 1989), diversification breadth (Brown 1997; Sambamurthy and Zmud 1999), firm size (Ein-Dor and Segev 1982), organization structure (Olson and Chervany 1980; Ein-Dor and Segev 1982), performance strategy (Weill and Ross 2005), IT infusion and IT diffusion (Sullivan 1985; Ward and Peppard 2002) or line IT knowledge (Sambamurthy and Zmud 1999). It seems reasonable that these contingency factors are also relevant in the scope of Green IT governance.

2.2 Green IT

Green IT is a systematic application of environmental sustainability criteria to the design, production, sourcing, use, and disposal of the IT infrastructure in order to reduce IT, business process, and supply chain related emissions and waste and improve energy efficiency (Molla et al. 2009). Green IT also comprises managerial aspects to control and monitor the effectiveness of implemented measures as well as marketing measures to communicate the success towards important stakeholders (Erek et al. 2009). Examples of concrete Green IT measures are provided by Schmidt et al. (Schmidt et al. 2009) or Kumar and Mieritz (2007) and cover ideas such as efficient cooling concepts, server virtualisation or thin clients. These measures can be structured regarding their strategic, operational and technical impact and along the IT activity chain of IT departments covering a source, make (data center, office environment), deliver and return process (Schmidt et al. 2009; Molla 2008).

2.3 Archetypes of Green IT Governance

Green IT governance can be defined as an operating model that describes the administration of Green IT initiatives (Molla et al. 2009). Adapting the IT governance definition from Weil and Woodham (2002), Green IT governance specifies the decision rights and accountability framework to encourage environmentally desirable behaviour in the sourcing, use and disposal of IT. To achieve this, roles, responsibilities, accountability, and control for Green IT initiatives need to be clearly established (Molla et al. 2009).

Desirable behaviour is different in every company. Businesses need to determine whether the responsibility for Green IT initiatives should be assigned to CIOs (Chief Information Officers) or to environmental managers (Molla et al. 2009). Current Green IT governance practices vary significantly. Some organizations allocate the responsibility to govern Green IT more centralized to IT managers; others consider Green IT as part of enterprise wide sustainability initiatives and follow a more decentralized approach (Molla et al. 2009).

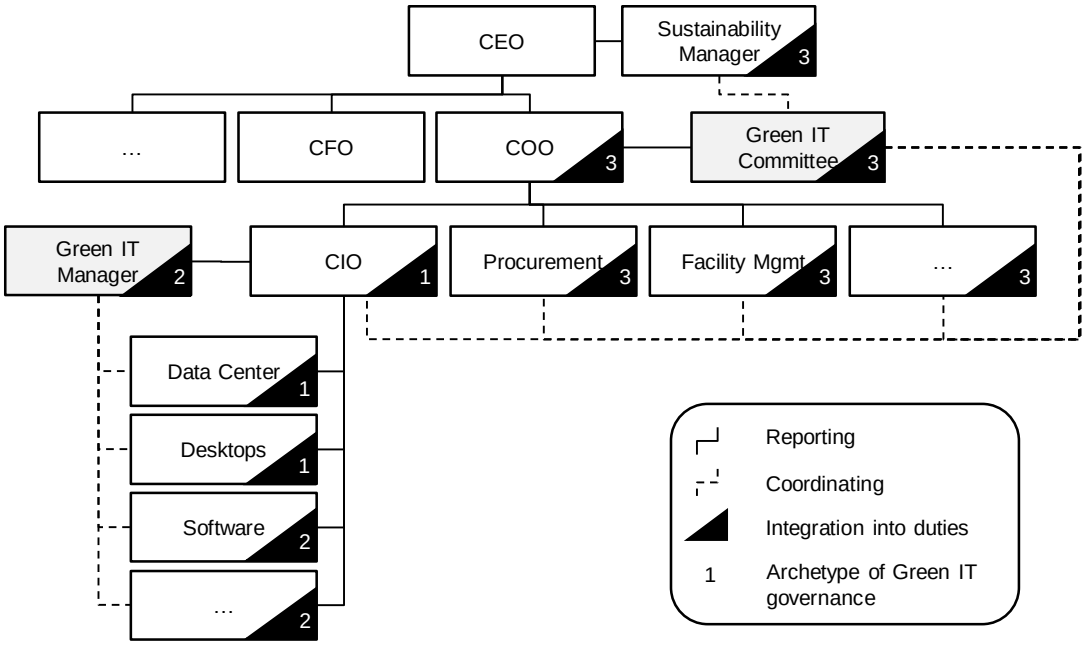

Figure 2. Archetypes of Green IT governance patterns

Regarding theses insights from literature and the presented case studies, we assume that there are three ideal Green IT governance archetypes which differ by the level of centralization of Green IT decision-making (Figure 2). This answers our first research question.

The Green IT governance archetypes represent a continuum of coordination arrangements reaching from centralized (1) over federal (2) to decentralized (3) (Table 1). In practice, Green IT governance is likely to occur in a specific form along the continuum, thus varying slightly from the proposed archetypes. Nevertheless the archetypes provide a first approach to structure Green IT governance.

Archetype of Green IT governance		Description
1	Centralized	Green IT is centralized to few domains of the IT department. The coordination of Green IT is done by extending job responsibilities, e.g. in the data center or the office environment. The CIO has primary authority. Green IT measures are treated like other IT projects. They are mainly focused on cost reduction by lowering the energy consumption in the data center and/or the office environment. Green IT is of low importance for the company.
2	Federal	Green IT is coordinated by a designated Green IT manager. Typically, the Green IT manager is member of the IT department and keeps track of all initiatives, proposes new ideas and reports to the CIO. The Green IT manager might be contact partner for the sustainability or environmental manger. Green IT is addressed in the entire IT department and provides first links to other domains. Green IT is of medium importance for the company.
3	Decentralized	Green IT is coordinated by a designated Green IT committee throughout the various business units of the company following a matrix approach. It consists of a Green IT manager, members from various business units and the sustainability or environmental manager, who reports to the CEO (Chief Executive Officer). The committee holds periodic meetings. The committee reports to a COO (Chief Organization Officer). Green IT activities are integral part of the company's sustainability strategy. All aspects of Green IT are considered and evaluated. The Green IT committee might also impact the company's strategy by developing new Green IT related products or services which potentially lead to a competitive advantage. Green IT is of high importance for the company.

Table 1. Description of Green IT governance archetypes

There is no single best model of Green IT governance. Specific external and internal factors of the company, deriving from the organizational, regulatory-market, socio-cultural, ecological, and technological environment influence the organization's actions (Jenkin et al. 2010). Research indicates that the importance and uncertainty about Green IT and the extent of its implementation differs for every organisation (Schmidt et al. 2010).

Therefore, every organisation will attempt to encourage different behaviours. This also determines the ideal type of Green IT governance coordination and the allocation of decision rights. It is important to understand how Green IT governance archetypes are shaped by contingency factors because they may affect desired outcomes of Green IT. The evaluation of contingency factors and their impact on the best fit for Green IT governance is done in the consecutive part.

2.4 A Contingency Model of Green IT Governance

Contingency theory respects the fact that each enterprise needs a specific Green IT governance configuration that fits a set of external and internal factors. Green IT governance helps companies structure their Green IT responsibilities. Contingencies and their influence determine which configuration of Green IT governance fits a company best. Finding the best configuration would ensure that Green IT contributes to the business objectives of an enterprise.

In the following, we answer the second research question by outlining how contingency factors influence Green IT governance patterns. From literature review we identify competitive strategy, firm size, organization structure, performance strategy, environmental impact of industry, environmental strategy, IT infusion, and IT diffusion as potential contingency factors for allocation of decision rights in Green IT governance (Figure 3).

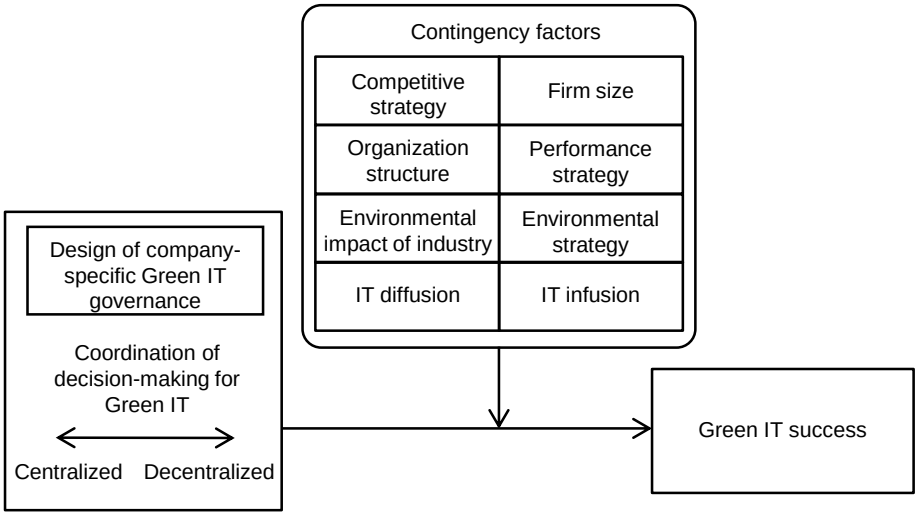

Figure 3. Contingency model of Green IT governance

Most contingency factors are adopted from research on IT governance because they proof to be also relevant in the scope of Green IT governance. Further contingency factors are added from environmental research (Table 2).

The competitive strategy of a company has an influence on the degree of centralization of IT decision-making (Tavakolian 1989). Tavakolian (1989) distinguishes between three main strategies: defender, analyzer, and prospector. A defender is an organization with a conservative competitive strategy which has a tendency to rely on centralized decision-making. Organizations with a moderate competitive strategy relying on a federal decision-making are called analyzer. A prospector is an organization with an aggressive competitive strategy and attempts to pioneer in product or market development. A prospector has a tendency to rely on decentralized decision-making (Tavakolian 1989). It seems reasonable that this also applies to Green IT governance. While conservative companies will do what is necessary, aggressive companies will try to gain a competitive advantage from Green IT. In this case decentralized Green IT governance promises the best way to develop such advantages.

The firm size is associated with the degree of IT governance centralization (Ein-Dor and Segev 1982). A larger firm is likely to possess a greater potential for Green IT and be more aware current IT trends which makes decentralized Green IT governance more favourable.

The organization structure and the degree of IT governance centralization have shown to be related (Olson and Chervany 1980; Ein-Dor and Segev 1982; Sambamurthy and Zmud 1999). It seems reasonable that this overall characteristic also impacts Green IT governance.

Weill and Ross (2005) differentiate between three performance strategies - profit, asset utilization, and growth - and assign them to a continuum of governance modes reaching from more centralized to more decentralized. A profit oriented strategy aligns well with centralized Green IT governance, which focuses on the biggest energy consumers such as the data center or the office environment. Growth is associated with innovation that is more likely to be achieved through decentralized Green IT governance gathering multiple business units in a Green IT committee.

The environmental impact is different for each industry and implies specific regulations, stakeholder pressures, technological developments, and environmental risks for the companies (Schaltegger and Synnestvedt 2002). Companies from disparate industries are likely to have a different perspective on environmental management, e.g. a transportation company vs. a software company. We assume that companies from industries with a higher environmental impact tend to be more control oriented in their environmental management and their Green IT governance than companies from industries with a lower environmental impact.

Contingency factor	Definition	References	Green IT governance archetypes		
			1. Centralized	2. Federal	3. Decentralized
Competitive strategy	Type of engagement in product/market development and commitment to stability	(Tavakolian 1989)	Defender	Analyzer	Prospector
Firm size	For example number of employees or revenue	(Ein-Dor and Segev 1982; Sambamurthy and Zmud 1999)	Small	Medium	Large
Organization structure	Degree of centralization of the organization	(Olson and Chervany 1980; Ein-Dor and Segev 1982; Sambamurthy and Zmud 1999)	Centralized	Federal	Decentralized
Performance strategy	Enterprise performance objective companies emphasize	(Weill and Ross 2005)	Profit	Asset utilization	Growth
Environmental impact of industry	Level of environmental impact by industry	(Schaltegger and Synnestvedt 2002)	High	Medium	Low
Environmental strategy	Enterprise approach towards regulations and stakeholder pressures	(Aragón-Correa and Sharma 2003)	Reactive	Balanced	Proactive
IT infusion	Degree to which an organization is dependent on IT to carry out core operations	(Sullivan 1985; Ward and Peppard 2002)	Low	Medium	High
IT diffusion	Degree to which IT is dispersed throughout the organization	(Sullivan 1985; Ward and Peppard 2002)	Low	Medium	High

Table 2. Contingency factors and their assumed influence on Green IT governance

Environmental strategies for managing environmental activities can be classified along a continuum that ranges from reactive to proactive (Aragón-Correa and Sharma 2003). At one end of the continuum, a reactive posture is a response to changes in environmental regulations and stakeholder pressures (Aragón-Correa and Sharma 2003). Proactive organizations are more likely to decentralize decision-making about environmental issues (Aragón-Correa and Sharma 2003). According to Jenkin et al. (2010), a more proactive environmental orientation induces an elaborated Green IT strategy to which the organization will strive. Therefore, it can be concluded that proactive organizations implement more decentralized Green IT governance while reactive organizations tend towards a more centralized configuration.

The level of IT infusion and IT diffusion define the importance and the dispersion of IT (Sullivan 1985; Ward and Peppard 2002). They are both related to the centralization level of IT governance (Sullivan 1985; Ward and Peppard 2002). It seems reasonable that this also applies to Green IT

governance. If IT is of high importance (e.g. a software company) than Green IT will probably be too. A high level of diffusion implies a high level of energy consumption by IT and makes more Green IT measures useful. Greater importance and more benefits are likely to be accommodated by decentralized Green IT governance. The developed contingency model for Green IT governance is validated in the following section by case study research.

3 Case Study Research Design

Given the objective of addressing "how" and "why" questions about a present phenomenon within a complex natural setting a case research design was selected for this study (Benbasat et al. 1987). Case study research is a widely acknowledged and used methodology in IS research (Dubé and Paré 2003). It is suitable for exploration of new topic areas which lack empirical validation (Crane 1999; Eisenhardt 1989; Robertson 1993). It can serve multiple purposes: describing phenomena, testing theories or developing new theories and hypothesis (Benbasat et al. 1987; Eisenhardt 1989). This applies to the given situation and corresponds with the papers intention to explain Green IT governance patterns by contingency theory.

The specific research design is based on multiple case studies. Between December 2009 and September 2010, interviews with SMEs (Subject Matter Experts) from five different companies were carried out, using a structured interview guideline. The case sites – referred to here as company A to E – were selected based on company size and industry, ensuring a cross-sectoral analysis (Table 3). They became accessible to the author as part of a book project on sustainability in IT. All companies consider themselves as experts in the scope of Green IT. Profit, size, and its lack of financial problems suggested that major structural differences in Green IT governance would not be due to a turnaround situation (Brown 1997).

Characteristics	Company				
	A	B	C	D	E
Industry	Transportation	Computer software	Financial services	Newspaper, media	Pharmaceuticals, chemicals
Revenue (2009)	0.17 Bn €	10.67 Bn €	27.95 Bn €	2.61 Bn €	31.17 Bn €
Number of Employees (2009)	1,886	47,578	81,929	10,740	108,400
Market served	national	global	global	international	global
SME roles	CIO, Environmental Manager, Director Data Center Operations	Vice President Sustainability, Director Global IT Client, Vice President Green IT, Director Data Center Operations	Global Lead Eco-Efficient IT, Vice President Corporate Social Responsibility	Project Manager Green IT, Director Newspaper Publishing Applications, Director Sustainability	Director Global Data Center Operations, Green IT Coordinator, Director Procurement & Transport
Time	Dec 2009	Jun 2010	Sep 2010	Mar 2010	Sep 2010

Table 3. Description of case studies

The structure and questions were developed based on a literature review and the developed contingency model of Green IT governance from Section 2. The questions of the interview guideline were structured as following: 1. Introduction: position, responsibilities and experiences of the SME, 2. Characteristics of the company and the IT department, 3. Environmental management, 4. Structure of Green IT governance, 5. Closing, feedback, additional documents. The interviews were recorded and transcribed. All information was used to asses each contingency factor and to determine the existent form of Green IT governance.

4 Findings from Case Studies

To illustrate the validity of the proposed approach the results from one company are described in detail (Table 4). The findings from all five cases are summarized in Table 5.

Contingency factor	Assessment for company A
Competitive strategy	The public transport company defends its regional monopoly to provide services. Other markets are not supposed to be served.
Firm size	With little more than 10,000 employees the company is a regional player. Compared to other companies it is rather small.
Organization structure	The company is located in one city in one prime headquarter and various outposts managing the vehicles. The organizational structure is assessed as centralized.
Performance strategy	The company is owned by the state. The main objective is neither profit nor growth. Main goal is the efficient utilization of all assets.
Environmental impact of industry	The company belongs to the transportation industry which can be considered to have a high environmental impact.
Environmental strategy	The company is issuing annual environmental reports and following a necessary environmental management process. This is a reaction to stakeholder pressures.
IT infusion	Core operation is passenger transportation by trams or busses. IT is only needed to support these activities and to provide basic office applications.
IT diffusion	Most employees work in trams or busses. IT is used in the offices and the control center. Compared to other companies the IT diffusion is low.
Observed Green IT Governance	Green IT is centralized responsibility of the CIO and the Director of Data Center Operations. The importance of Green IT for the company is low.

Table 4. Influence of contingency factors on the Green IT governance design of company A

Following the contingency model from Section 2, the observed contingency factors from companies A to E determine the theoretical Green IT governance archetype, which is compared with the observed type of Green IT governance of each company (Table 5). From this comparison a confirmation level of the contingency model is derived.

Contingency Factors	Company				
	A	B	C	D	E
Competitive strategy	Defender (c)	Prospector (d)	Prospector (d)	Analyzer (f)	Analyzer (f)
Firm size	Small (c)	Large (d)	Large (d)	Medium (f)	Large (d)
Organization structure	Centralized (c)	Decentralized (d)	Decentralized (d)	Centralized (c)	Decentralized (d)
Performance strategy	Asset utilization (f)	Growth (d)	Profit (c)	Profit (c)	Asset utilization (f)
Environmental impact of industry	High (c)	Low (d)	Low (d)	Medium (f)	High (c)
Environmental strategy	Reactive (c)	Proactive (d)	Balanced (f)	Reactive (c)	Balanced (f)
IT infusion	Low (c)	High (d)	High (d)	Medium (f)	Low (c)
IT diffusion	Low (c)	High (d)	High (d)	High (d)	Medium (f)
Theoretical Green IT governance	Centralized	Decentralized	Decentralized	Centralized / Federal	Federal
Observed Green IT governance	Centralized	Decentralized	Federal	Federal	Federal
Confirmation level	High	High	Low	Medium	High

Table 5. Summary of findings (Trends towards: (c) centralized, (f) federal, (d) decentralized)

5 Theoretical and Practical Implications

The above findings show support for our proposed contingency model for Green IT governance. From this we draw theoretical and practical implications for researchers and companies in the scope of Green IT.

The flexible Green IT governance model presented allows a company-specific design of Green IT governance. Based on insights from five case studies, this article adds to the scientific knowledge about Green IT and its governance within organisations. Green IT belongs to the context of environmental sustainability (Molla et al. 2009). Therefore, this study contributes to the important field of research on environmental sustainability and IS (Melville 2010; Watson et al. 2010). Furthermore, the paper proves the applicability of contingency theory in the scope of Green IT as suggested by Melville (2010).

While the nature of this study is descriptive and explanatory, we offer some prescriptive insights regarding Green IT governance archetypes based on theory and our observations. With the enhanced understanding of how Green IT governance is shaped by contingency factors, organizations are able to select the most promising Green IT governance form.

This leads to implications for companies which have not yet adopted Green IT. For them the framework provides a reference how to coordinate decision-making when implementing Green IT. By assessing each contingency factor for the own situation, the model suggests a Green IT governance archetype which supposedly leads to greatest Green IT success. This helps managers to avoid initial mistakes and to get a realistic perspective on the significance of Green IT for their company. Companies which have already adopted Green IT can benchmark their existent Green IT governance against the proposed archetype from the model. This should either confirm the applied strategy or provide a strategic direction for future development of Green IT governance.

Furthermore, the model provides a framework for implementing Green IT in IT departments and whole organizations. This helps COOs, CIOs, or sustainability managers to define roles and responsibilities and to create the relevant relationships within the organization. The outlined archetypes provide examples on how Green IT governance could look like.

6 Conclusion and Further Research

Although we provided a first qualitative evaluation of the contingency factors and the suggested contingency model for Green IT governance, a number of limitations need to be considered.

This article transfers knowledge from IT governance research to Green IT governance. Green IT governance is not fully comparable to IT governance. Nevertheless, IT governance research pursues similar objectives. Research on contingencies influencing IT governance models is used as a starting point for the Green IT governance contingency model. Other contingency factors, which were not regarded, could also play an important role. Furthermore, the power of each contingency factor on Green IT governance was not assessed. It can be assumed that different factors have a different level of impact on Green IT governance. Some factors might also be interdependent. Although, the scaling and measurement of each contingency factor was done to the best of knowledge, inconsistencies cannot be fully excluded. Each company provided different SMEs, documents, and information. This limits the comparability of the cases and might have an influence on the findings. Because of the small sample, conclusions are limited to the interviewed enterprises. Nevertheless the results describe possible relationships and results that could be relevant for other enterprises.

Further research should be done to validate the proposed model. Although we provided a first qualitative evaluation of the contingency factors, the suggested contingency model should be validated and refined through a quantitative empirical survey in order to demonstrate generalizability of the

factors and their influence on Green IT governance design. Therefore, future research should develop a survey based on the proposed model. Also, an analysis of the guidelines and policy aspects of Green IT governance is recommended. Though the contingency model has not been tested empirically, its suitability could be demonstrated with five case studies. These results provide insights and guidelines for COOs, CIOs, IT managers, and sustainability managers to implement adequate Green IT governance. Companies that understand the relations in the contingency model can design a Green IT governance configuration that fits their specific requirements, hence maximizing the positive contribution of Green IT to their business objectives.

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