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Aligning Green IT with Environmental Strategies: Development of a Conceptual Framework that Leverages Sustainability and Firm Competitiveness

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Aligning Green IT with Environmental Strategies: Development of a Conceptual Framework that Leverages Sustainability and Firm Competitiveness

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ABSTRACT

Environmental technologies are becoming increasingly important for business firms to reduce environmental impacts and differentiate from competitors. In this paper, fundamental approaches of strategic management are presented and the strategic significance of sustainability initiatives and Green Information Technology (Green IT) is analyzed. Environmental strategies are introduced and the importance of strategically aligning the business, sustainability, and IT domain is highlighted. We argue that there is no consistent approach for aligning Green IT with sustainability goals and business objectives so far. To close this research gap, we integrate Green IT into the concept of IT strategy and develop the Strategic Green IT Alignment Framework (SGITAF), which could prove meaningful for both practitioners and academics. The SGITAF differentiates between an internal and an external perspective and comprises the domains Green IT and environmental sustainability. Four distinct Green IT alignment perspectives, which vary according to their competitive focus and their competitive advantage, are suggested.

Keywords

Information Technology, Green IT, sustainability, environmental strategies, strategic alignment, competitive advantage

INTRODUCTION

Sustainability has emerged as relevant topic of strategic management during the last years – and it is supposed to become a game-changing megatrend (Lubin and Esty, 2010). However, business executives are struggling to identify sustainability-based sources of competitive advantage and to integrate environmental aspects into their corporate strategy. In addition, the strategic role of information technology (IT) still challenges executives. The IT strategy must be aligned with the business strategy to enhance firm competitiveness (Henderson and Venkatraman, 1993). Anyhow, IT/business alignment remains a major concern of Chief Information Officers (CIOs) and the necessity to consider environmental aspects of IT further increases the complexity of this strategic challenge (Avison, Jones, Powell and Wilson, 2004; Luftman, 2004). IT is responsible for substantial amounts of carbon dioxide emissions and the demand for data processing and storage capacities rises continuously. Even so, Green IT practices can enhance energy efficiency and the consequent application of green technologies can decrease IT-related carbon dioxide emissions. Green IT is acknowledged as strategic technology that will play a fundamental role in reengineering business and production processes to reduce the environmental footprint of organizations (Watson, Boudreau and Chen, 2010). Furthermore, Green IT practices induce considerable cost savings and often have a positive return on investment (Harmon, Demirkan, Auseklis and Reinoso, 2010).

This paper illustrates how Green IT practices can increase IT value creation and firm competitiveness. To leverage the full potential of environmentally-friendly IT systems, it is imperative to align the Green IT measures with the competitive environmental strategy. However, little research about Green IT alignment has been conducted so far.

To develop a Strategic Green IT Alignment Framework (SGITAF), which promotes the consideration of strategic aspects of environmental IT practices, the paper is structured as follows. First, we introduce the relevant research topics in the scope of a literature review. We define the term "Green IT" before we explain important approaches of strategic management and analyze the strategic relevance of sustainability for the creation of competitive advantage. Next, we illustrate the necessity of IT/business alignment and present the widely applied Strategic Alignment Model (SAM). On the basis of the literature

review, we emphasize the need for the alignment of Green IT. Subsequently, we integrate Green IT into the concept of IT strategy. Then we conceptualize the SGITAF, which comprises four distinct Green IT alignment perspectives. The SGITAF is supposed to provide practitioners with an applicable framework for the strategic alignment of Green IT and to give researchers new insights concerning the strategic relevance of sustainability and IT.

THEORETICAL BACKGROUND AND LITERATURE REVIEW

Green IT has become the latest buzzword in IT management although a common understanding of the coverage and scope is still missing in research and practice (Velte, Velte and Elsenpeter, 2008). Amongst researchers the terms *green*, *eco-efficiency* and *sustainability* are widely used (Molla, 2009). We apply the term *green* to specify the analysis and minimization of environmental impacts. This specification differs from the term *sustainability*, which is discussed later. The process of corporate *greening* can be understood as a first step towards the superior goal of sustainability. HARMON AND AUSEKLIS (2009) refer to Green IT as "the practice of maximizing the efficient use of computing resources to minimize environmental impact." In the scope of this research we define *Green IT* as follows:

Green IT is the systematic application of practices that enable the minimization of the environmental impact of IT, support the superior goal of corporate sustainability, maximize efficiency and allow for company-wide emission reductions based on technological innovations.

Green IT is supposed to significantly decrease the environmental footprint of the IT industry and to foster ecological innovations in other industry sectors (Dutta and Mia, 2010). Nonetheless, one of the current key challenges of Green IT is to advance from uncoordinated cost-cutting investments to consistent Green IT strategies that leverage the full ecological potential of innovative environmental technologies (Harmon et al., 2010; Olson, 2008).

Dominant approaches of strategic management

The fundamental objective of strategic management research is to identify how competitive advantage can be created and sustained (Teece, Pisano and Shuen, 1997). Strategies determine the firm's market position and identify necessary key resources being required to assure long-term competitiveness. PORTER (1996) emphasizes that strategy is always a question of choice, coming along with trade-off decisions. Different complementary approaches trying to identify the sources of competitive advantage have evolved during the last decades (Orsato, 2009). The most important framework of strategic management is the SWOT analysis, which is commonly used to identify the internal strengths and weaknesses of a firm and to reveal the opportunities and threats originating from the external environment (Andrews, 1971).

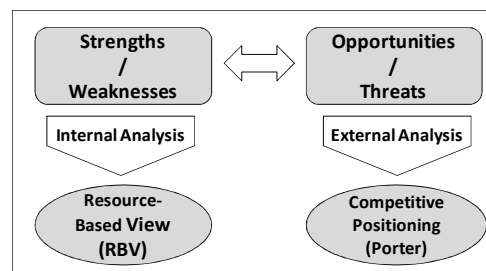


Figure 1. The relationship between SWOT analysis, RBV and Competitive Positioning (Barney, 1991).

Porter's competitive positioning approach focuses on the company's external context and argues that business success depends on the attractiveness of the industry and the firm's relative position in that industry. To achieve competitive advantage, a firm necessitates pursuing a clear and focused strategy (Porter, 1980). Porter proposes three distinct generic positioning strategies: the low-cost strategy, which aims at low prices and high sales volumes, the differentiation strategy, which targets unique products and premium pricing, and the focus strategy, which seeks for small but profitable market segments. The disregard of the structure and internal competencies of the firm in the scope of Porter's strategic positioning approach resulted in the development of the Resource-Based View (RBV), which can be seen as the dominant approach of strategic management today (Eisenhardt and Martin, 2000).

The RBV analyzes the significance of firm-specific resources and capabilities for the creation of competitive advantage. GRANT (1991) distinguishes between tangible, intangible, and personnel-based resources while capabilities are organizational competencies, such as processes and business routines. Resources and capabilities should be the basis for the formulation of corporate strategy because they are the sources of competitive advantage and shape the firm's permanent identity. Accordingly, Porter's strategic positioning approach is directed towards the external competitive environment whereas the RBV elucidates internal firm-specific sources of competitive advantage. WADE AND HULLAND (2004)

emphasize that the consolidation of these complementary strategic approaches is appropriate and applied by numerous IS researchers.

Sustainability as a new dimension of corporate strategy

The most common definition of the term sustainability originates from the WCSD (1987): "Sustainable development is development that meets the needs of the present without compromising the ability of future generations to meet their own needs." Sustainable management considers the effects of business activity under consideration of the triple bottom line. It refers to a long-term process of simultaneously optimizing economic, ecological and social goals to ensure the enduring activity of business practices. Sustainability "is in the process of becoming a competitive and strategic issue" (Elkington, 1997) and it is supposed to cause fundamental shifts in the competitive landscape and create game-changing opportunities (Dutta and Mia, 2010). That is why organizations must advance from unfocused investments to consistent sustainability strategies being aligned with core business activities (Lubin and Esty, 2010). There is empirical evidence for a positive relationship between corporate responsibility and firm performance (Funk, 2003; Hart and Milstein, 2003; Klassen and McLaughlin, 1996) and PORTER AND LINDE (1995) even claim that the efficient use of resources is a new paradigm, uniting environmentalism and competitiveness.

Economic and ecological value can be created in the internal domain by enhancing the efficiency of processes and material utilization, both resulting in cost savings and emission reductions. In the external domain, sustainability can constitute a unique value proposition the customers are willing to pay for. Sustainability-related innovations can create new markets and enable differentiation while an improved firm reputation can increase the demand for products and services. OLSON (2008) states that a "green strategy has the potential to significantly impact both top line revenue growth and bottom line cost savings." He emphasizes the crucial significance of aligning the sustainability strategy with the business, IT, and technology strategy. However, the value creation potential of sustainable business practices depends on the firm-specific context. Competitiveness and returns will only increase if the eco-investments are appreciated by internal or external stakeholders (Bieker, 2005).

ORSATO (2009) proposes four generic, choice-based environmental competitive strategies which distinguish between the internal and the external domain of value creation and competitive advantage, which refers to the consolidation of the two leading strategic management approaches (Porter and the RBV) as explained above. He underlines that "strategy implies choice, priority, and focus" (Orsato, 2009), which implies that trade-off decisions have to be made. The environmental strategies are subdivided into two dimensions: in the "competitive advantage" dimension, firms can either pursue a low-cost strategy by reducing their operational costs through environmental initiatives, or they can strive for competitive differentiation based on a superior, sustainability-related value proposition. The "competitive focus" dimension determines whether the environmental investments are targeted at internal organizational processes or at market-oriented products and services. On the basis of this classification, four different environmental strategies are defined, as illustrated in Figure 2.

Competitive advantage	Competitive focus	
	Organizational processes	Products and services
	Low-cost	Environmental cost leadership
	Differentiation	Eco-branding

Figure 2. Generic competitive environmental strategies (Orsato, 2009).

The *eco-efficiency* strategy aims at the minimization of waste, by-products and emissions. In this way, the production efficiency can be enhanced and costs can be reduced. Although initiatives that allow for a reduction of the environmental footprint and simultaneously come along with cost savings are attractive for virtually every firm, this strategy proves to be particularly appropriate for mass volume producers with intense industrial processing. The *beyond compliance leadership* strategy concentrates on organizational processes as well, but the competitive advantage is rooted in differentiation rather than in cost reductions. Firms pursuing this strategy even approve unprofitable environmental initiatives to reduce their ecological footprint. The positive corporate image helps to attract new customers and to intensify the relationships with established ones. In contrast, the *eco-branding* strategy refers to a competitive focus on products and services. This strategy strives for competitive differentiation based on ecological product characteristics. The customer must be willing to pay for this ecological differentiation. Hence reputation and credibility are important intangible assets associated with this strategy. In highly price-sensitive markets, the *environmental cost leadership* strategy can be a suitable approach. This strategy targets radical product innovations instead of incremental process enhancements. Substitution of decisive input materials or new business practices can significantly change markets and competitive conditions.

Strategic IT/business alignment

For many years already, IT/business alignment is a major concern of business executives and the number one topic of CIOs (Luftman, 2004). Many firms are not able to leverage the full potential of their IT due to a lack of alignment between the IT and their business goals. Firms that have a high degree of alignment achieve to apply IT for strategic purposes, to position themselves strategically in the market, and to leverage their core competencies with the help of the latest technologies (Ravichandran and Lengworsatien, 2005). Strategic alignment can result in superior strategies due to the fact that the "alignment process and its outcomes constitute a unique firm asset capable of producing IT-based competitive advantage" (Kearns and Lederer, 2003). AVISON ET AL. (2004) underline that "firms cannot be competitive if their business and information technology strategies are not aligned."

HENDERSON AND VENKATRAMAN (1993) developed the Strategic Alignment Model (SAM), which is the most widely applied alignment concept in academic research and practice (Tarafdar and Qrunfleh, 2009). The SAM differentiates between four domains of alignment: business strategy, IT strategy, organizational infrastructure and processes, and IT infrastructure and processes. The alignment of these four domains is achieved by the utilization of two established concepts of strategic management: strategic fit, which describes the interrelation between the external environment and the internal structure of the organization, and functional integration, which addresses the harmonization of the business and the functional domains respectively. The externally-oriented strategies are determined by their scope, specific competencies and governance principles while the internally-oriented domains specify the provisioning of infrastructure and processes and the development of required functional architectures and skills. The four domains of the SAM must be balanced to achieve strategic IT/business alignment. To do so, Henderson and Venkatraman (1993) developed a system of cross-domain relationships, which are denominated alignment perspectives. Within the SAM, four dominant alignment perspectives are explained: strategy execution, technology transformation, competitive potential, and service level.

Findings and motivation

As revealed by theoretical and empirical research, Green IT practices can indeed have the capability to leverage firm competitiveness. By implementing consistent Green IT initiatives, competitive advantage can be created and thus Green IT should be understood as an integral part of IT strategy. IT-based environmental initiatives can support low-cost strategies or facilitate competitive differentiation. However, the interrelation of business strategy, sustainability goals and IT constitutes a complex challenge. Even so, linking and aligning these strategic domains promises great opportunities for environmental protection and economic progress. Regardless, Green IT initiatives are considered recently as a means to reduce costs and risks whereas technology-based overall strategies aimed at the creation of competitive advantage and sustainable, profitable growth can hardly be found.

Aligned Green IT strategies are essential because they can contribute to the achievement of sustainability targets of corporations. Firm competitiveness can be improved through environmental commitment that differentiates from competitors and enhanced efficiency that comes along with higher productivity. To leverage Green IT's full potential, a company requires a clear strategic orientation and alignment between its sustainability and IT strategy. Executives need a sound rationale that conducts their sustainability initiatives for setting priorities in line with the company's core business. Non-aligned environmental activities do neither lead to increased competitiveness nor to the optimal reduction of the firm's environmental footprint. The development of aligned Green IT strategies requires the appreciation of the impact that IT and corporate sustainability can have on firm competitiveness. That is why a framework for the alignment of business, sustainability and IT strategies is strongly needed.

CONCEPTUALIZATION OF GREEN IT ALIGNMENT

The concept of Green IT should be integrated into the theoretical framework of IT strategy to facilitate the linkage of environmental IT practices and the strategic context of the firm. The IT strategy expresses how the application of IT is supposed to fulfill the requirements of the organization by providing efficient IT processes and services to the business, by supporting the corporate goals, and by delivering value. Thus the IT strategy must refer to the specific competitive environment of the enterprise and its business objectives. The IT strategy takes costs, risks and opportunities of currently available and future information technologies into account and must assess their possible business impact (IT Governance Institute, 2005).

In line with EARL (1989) we propose a definition of IT strategy that consists of three basic items: technology strategy, systems strategy, and Green IT strategy. This concept of IT strategy is illustrated in Figure 3 and it is supposed to allow for a holistic IT management under consideration of strategic goals and environmental aspects. On the one hand, the systems strategy assures that the IT systems and applications fulfil the requirements of the business. The respective systems requirements specify the technology strategy, which is aimed at the optimization of the IT architecture under consideration of

efficiency and functionality. Business value and competitive advantage are created through efficient service provisioning, superior IT services that provide differentiation, and technological innovations that create IT-based business opportunities. On the other hand, the IT strategy is aligned with the sustainability strategy on the basis of the Green IT strategy. The Green IT strategy aims at enhancing the eco-efficiency of the IT infrastructure. The reduction goals concerning IT-related emissions are determined by the objectives of the corporate sustainability strategy. In this way, Green IT supports the sustainability strategy by facilitating eco-efficiency and competitive differentiation. Furthermore, Green IT can create opportunities for environmental technology innovations, which can change prevalent business practices.

As discussed above, competitive advantage should be regarded from two dimensions: the internal dimension, where IT can enable cost-efficient business processes, and the external dimension, where IT can be utilized to provide unique customer value (Henderson and Venkatraman, 1993). The IT organization should be effective and efficient in the provisioning of internal, standardized technology solutions while developing externally-focused distinctive solutions considering the strategic business context (Gartner, 2008).

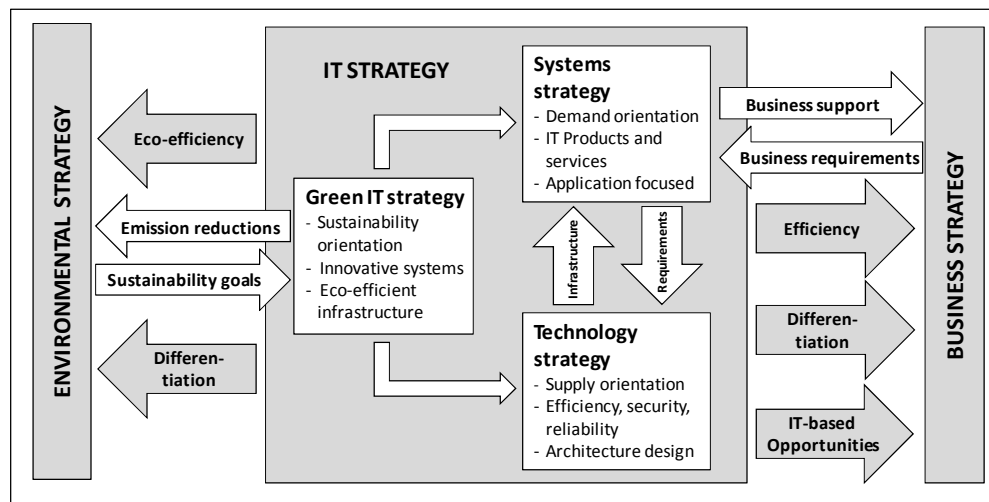


Figure 3. Conceptualization of IT strategy.

The Strategic Green IT Alignment Framework (SGITAF)

It was highlighted above that Green IT merely consists of cost-saving measures currently while the strategic relevance is largely disregarded. The exploitation of the full competitive potential requires the strategic alignment of Green IT strategy and competitive environmental strategy. At this point we decided to refer to the generic environmental competitive strategies of ORSATO (2009) that were already introduced in this paper. This generic, choice-based conceptual typology of environmental strategies corresponds closely to our understanding of business strategy, value creation, and competitive advantage based on environmental initiatives. Furthermore, the SGITAF is based on the fundamental logic and procedures of the SAM (Henderson and Venkatraman, 1993), which proved to be useful for executives and investigators and which is in line with our distinction between internal and external sources of competitive advantage. The SAM has the purpose of aligning the IT and business domain whereas the proposed SGITAF is aimed at aligning the IT and sustainability domain.

The conceptualized SGITAF aims at the identification of sources of competitive advantage and thus aligns the externally-oriented Green IT and competitive environmental strategies. In analogy to the SAM, the SGITAF refers to the achievement of strategic fit and functional integration as displayed in Figure 4. Strategic fit describes the interrelation between externally-oriented strategies at business level and the internal structure of the organization. The SGITAF links uncoordinated Green IT measures at functional level to the strategies at competitive level. The achievement of *strategic fit* removes the prevalent constraints of the strictly internal perspective of Green IT practices and connects Green IT with the strategic external perspective, thus integrating customer and stakeholder aspects and revealing sources of competitive advantage for product differentiation or low-cost strategies. Sustainability goals can only be achieved if the strategies are implemented on the basis of an appropriate IT and organizational infrastructure, which constitutes the basis for low-impact business processes. The process of *functional integration* between the Green IT and the environmental sustainability dimension considers the impact of Green IT concerning the sustainability strategy and vice versa, thus indicating how Green IT can leverage the competitive sustainability strategy and how a sustainability-oriented infrastructure in conjunction with environmentally-friendly processes can increase the sustainability of business operations.

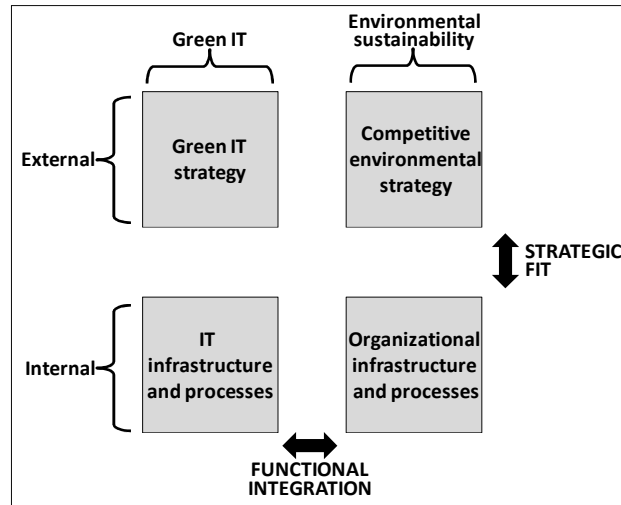


Figure 4. Components of the Strategic Green IT Alignment Framework (SGITAF).

Referring to the SAM, we argue that the four domains displayed in Figure 4 must be balanced to achieve strategic Green IT alignment. In analogy to the SAM (Henderson and Venkatraman, 1993), we identify four dominant alignment perspectives, which determine the cross-domain relationships and the specific characteristics of each domain. Each of these alignment perspectives corresponds to one of the previously introduced environmental strategies. The alignment logic of the four alignment perspectives is illustrated in Figure 5 and their main characteristics are summarized in Figure 6.

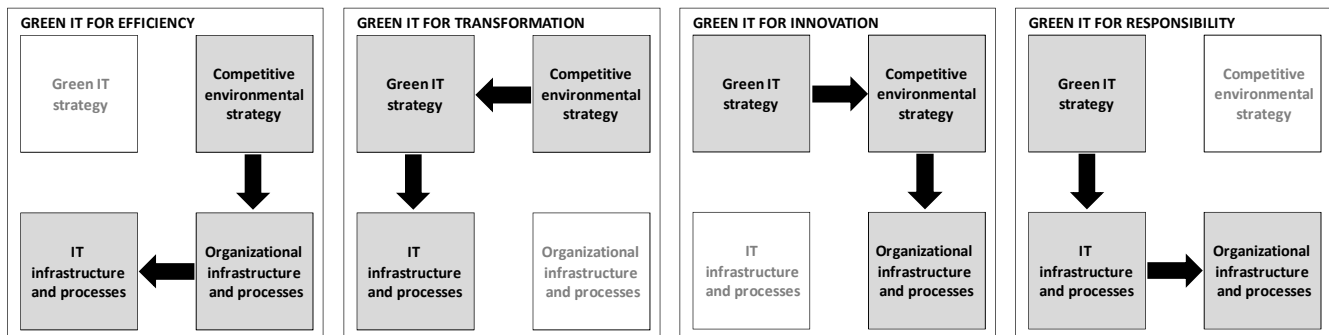


Figure 5. The four Green IT alignment perspectives.

The *Green IT for efficiency* alignment perspective corresponds to the *Eco-efficiency* environmental strategy. The business strategy is the driving force and promotes superior resource productivity. This strategy aims at achieving competitive advantage on the basis of a low-cost approach and focuses on the internal infrastructure and processes. As a consequence, the environmental strategy has a firm-wide scope and the efficiency of business operations is a major goal. Sustainability is regarded from a cost perspective and Green IT measures are implemented if they allow for superior efficiency, coming along with operational cost decreases. The environmental strategy corresponds to the business requirements and the IT is guided by this strategy. The alignment logic reveals that environmental practices targeting the organizational infrastructure are determined by the competitive environmental strategy, which demands for efficient business processes. This efficiency focus sets the terms for the implementation of Green IT practices.

The second alignment perspective, denominated *Green IT for transformation*, is driven by the *Eco-branding* competitive environmental strategy, which aims at product and service differentiation based on environmental attributes. These ecological products usually target niche markets and customers that are willing to pay for the costs of ecological differentiation. Green IT serves as crucial strategy enabler. Green IT-related opportunities are thoroughly considered by the top management. The sustainability management strives for environmental technology leadership and exploits the full environmental potential of the latest technologies. The IT management is responsible for the development of environmental technologies that facilitate a state-of-the-art Green IT infrastructure. Innovative IT solutions are an integral part of the product or service and the environmental characteristics are appreciated by the customers (e.g. provisioning of a CO₂-neutral e-mail service). The

alignment logic reveals that the Green IT strategy enables the competitive strategy on the basis of a specific Green IT infrastructure, which is not constrained by the organizational infrastructure.

The alignment perspective *Green IT for innovation* fits the *environmental cost leadership* strategy, which refers to a product focus while following a low-cost strategy. This strategy is associated with radical product innovations instead of incremental process improvements and it is appropriate if the firm strives simultaneously for the lowest environmental impact and the lowest production costs within its competitive environment. This can only be accomplished through radical technological innovations, which are anticipated by a visionary top management that is committed to environmentalism and targets business leadership at the same time. As a result, the Green IT strategy should leverage innovations and drive the competitive environmental strategy. The top management seeks for business and sustainability opportunities which are based on innovative technologies. The IT management regards environmental technology trends and analyzes their impact for the business in close cooperation with the top management. IT influences the business and sustainability strategy as well as product characteristics while the environmental practices change the organizational processes fundamentally.

The fourth alignment perspective is called *Green IT for responsibility*. It is associated with the *beyond compliance leadership* environmental strategy, which has an extended scope covering the entire range of internal processes with the goal of sustainability-based competitive differentiation. The key performance criteria are oriented towards stakeholder satisfaction while the IT management plays an important role for executive leadership. The top management and the sustainability management facilitate direction, analyze stakeholder claims and prioritize investments. The Green IT strategy strives for a high quality, low-impact IT infrastructure that enhances the process efficiency of the whole organization. Green IT promotes the extraordinary environmental dedication and even unprofitable investments that allow for further emission reductions are realized. This gives the firm a first mover advantage in the field of sustainability, shaping the shopping behavior of customers and resulting in an outstanding firm reputation.

Competitive environmental strategy	Competitive advantage	Competitive focus	Objective of sustainability management	Objective of IT management	Performance criteria
Perspective 1: Green IT for efficiency					
Eco-efficiency	Low-cost	Internal processes	Support business strategy	Implement business strategy	Cost/service center
Perspective 2: Green IT for transformation					
Eco-branding	Differentiation	Products and services	Differentiate from competition	Develop green technologies	Environmental technology leadership
Perspective 3: Green IT for innovation					
Environmental cost leadership	Low-cost	Products and services	Become industry leader	Drive ecological innovations	Business leadership
Perspective 4: Green IT for responsibility					
Beyond compliance leadership	Differentiation	Internal processes	Fulfill stakeholder claims	Minimize environmental impact	Stakeholder satisfaction

Figure 6. Characteristics of Green IT alignment perspectives.

CONCLUSIONS AND FURTHER RESEARCH

In this paper we analyzed the strategic impact as well as the underlying dimensions of Green IT. We pointed out that competitive advantage can be achieved by either lowering costs or providing differentiation. Practitioners must acknowledge that strategy is always a question of choice, coming along with trade-off decisions. A consistent Green IT strategy that creates sustainable competitive advantage necessitates the conjointly consideration of technological and environmental aspects. Such being the case, the topic of strategic Green IT alignment is highly relevant, especially because Green IT still consists of the implementation of uncoordinated measures while the strategic potential of environmental technologies is neglected. The presented framework for strategic Green IT alignment can help executives in developing a consistent Green IT strategy.

The proposed SGITAF distinguishes between the internal and external perspective, which are aligned by the concept of strategic fit, while the Green IT and environmental sustainability domain are aligned through functional integration. The four suggested Green IT alignment perspectives *Green IT for efficiency*, *Green IT for transformation*, *Green IT for innovation*, and *Green IT for responsibility* are selected according to the firm's competitive environmental strategy. The Green IT strategies differ with respect to competitive focus and competitive advantage and specify the characteristics, roles and objectives of the firm's Green IT management.

The conducted research can be seen as a first step towards a stringent approach of Green IT alignment. The major limitation of the SGITAF is that it is conceptualized on a theoretical basis exclusively. The framework is based on research findings and propositions of strategic management, IT management and corporate sustainability literature. To advance the applicability and validity of the suggested alignment procedure, the conceptual framework should be tested, refined and verified in the scope of an empirical investigation, for example on the basis of an extensive case study research.

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