Capability Lifecycle and its motivating force on strategy: the case of Green IT/S Dynamic Capability

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Abstract. While a great amount of literature has focused on dynamic capability and IT dynamic capabilities, there has been little theory and systematic research done on their lifecycle. Based on the dynamic capability and IS literature, this paper aims to contribute to this body of knowledge by studying the lifecycle of the Green Information Technologies/Systems (IT/S). Dynamic Capability is defined as the two-fold organizational process of: (1) recognizing the role played in ecological sustainability by the Information Technologies and Systems (IT/S), and (2) the contribution made to the ecological sustainability by the IT/S. We advance a research model aimed at understanding the role of the Green IT/S' Dynamic Capability in choosing and managing green IT/S strategies.

Keywords: Dynamic capabilities framework, Green IT/IS, Capabilities, Capability Lifecycle, Green IT/S strategies

1   Introduction

In recent years, the increasing diffusion of Information Technologies and Systems (IT/S) has contributed to the rise in power consumption and the overuse of scarce resources. Hence, the necessity for responses to the global challenges of ecological sustainability emerges. IT/S are currently estimated to be responsible for 2% of global carbon emissions, the Internet alone accounts for 10% of the energy consumption in the US [1]. On the other hand, IT/S play a significant role in making both business processes and products more ecologically sustainable [2]. IT/S can be used to monitor and report on Green House Gas emissions; manage and create systems to increase energy efficiency; and help design greener products [2, 3]. Green IT/S have emerged as a new area of scholarship in the last few years to address these issues and to help in the ecological sustainability quest. In this vein, scholars have called for research that studies the transformative power of IT/S to create an ecologically sustainable society [3]. This paper aims to broaden the contribution of IT/S to ecological sustainability.

Using dynamic capability as a theoretical foundation, we accomplish such objectives by conceptually introducing a particular dynamic capability: Green Information Technologies and Systems (Green IT/S) capability. The dynamic capability lens helps to relate Green IT/S to a firm's strategy in the same way that dynamic capabilities enable an organization to rethink their market positioning and their strategies [5]. We assume that it's through a firm's strategy that the transformative power of IT/S can create an ecologically sustainable society that will be more effectively leveraged. Finally, a lifecycle perspective will show how the Green IT/S dynamic capability develops and how this development influences a firm's strategy.

Few studies give evidence of the link between internal (among them the dynamic capabilities) and external factors and firm strategies [4, 6]. Even though the research on this subject recognizes the importance of the evolution of a dynamic capability in sustaining competitive advantage over time [11], unfortunately empirical research on dynamic capability lifecycle and its force on strategy are missing. We hope that our research contributions can help to fill this research gap by formalizing the Green Information Technologies and Systems (IT/S) Dynamic Capability Lifecycle. The choice toward Green IT/S Dynamic Capability Lifecycle comes from the growing attention directed at the challenges related to sustainable development by the managerial and academic literature [3]. Filling this lack of research would inform the theory about the dynamic capability lifecycle, and in practice to enhance the transformative power of IT/S.

This paper is organized as follows: Firstly, we introduce the theoretical framework, which is based on dynamic capability and dynamic capability lifecycle theories and we describe the theorization of a Green IT/S Dynamic capability and its lifecycle; Consequently we presents the research model and presents the research methodology; Finally, we highlight some concluding remarks highlighting the future direction and achievements.

2   Theoretical Framework

In these turbulent environments, organizations need to constantly match or create market changes, and Dynamic Capabilities are "the firm's processes that use resources – specifically the processes to integrate, reconfigure, gain, and release resources – to match and even create market change" [7]. Hence, dynamic capabilities have the potential to create, to evolve, and to recombine internal existing resources to adapt to turbulent environments [8]. This adaptability is especially required in fast-paced technological environments [8]; as it has been theorized that adaptability can lead to improved customer value and achieve a competitive advantage. This causal distance of dynamic capabilities from sustained competitive advantage implies, nevertheless, an evolution of the dynamic capabilities over time in order to stay tuned to the turbulent environment and the internal resources. Helfat & Peteraf [10] defined this evolution as the capability lifecycle, "which articulates general patterns and paths in the evolution of organizational capabilities over time" [10]. The capability lifecycle includes three stages. The founding stage relates to the gathering of individuals, in a

team or in an organization, around an objective that requires, or centrally involves the creation of a capability. In the founding stage valuable capabilities are created, thanks to the ability of a firm to integrate internal and external resources [11]. The development stage covers the searches of these individuals for viable alternatives to capability development, combined with the accumulation of experience over time. In this stage, learning, resources, routines, managers' beliefs, and the knowledge and experience held by an organization's members are recognized as critical factors that affect capability evolution [12]. The maturity stage entails the maintenance of the capability, through its exercise, embedding it in the memory of the team or the organization, and making it tacit in nature. In this stage, firms maintain their dynamic capability by integrating resources into core activities [11].

2.1 Dynamic capability lifecycle and its force on Strategy

The issues related to understanding why organizations differ, how they behave, how they choose strategies, and how they are managed have been central in strategy research for years. The organization's strategy depends critically on the characteristics of the industry in which the firm competes [13], on the firm's position in the marketplace, on the external forces such as evolution in technology available, or the changes in customer needs [6, 13]. At the same time, internal forces such as critical resources (tangible and intangible assets), capabilities, routines, processes, and people affect the corporate strategy of an organization and its ability to succeed in the future [6, 7]. In this vein, dynamic capability is one of the internal forces which explain firms' strategies [5, 7, 14, 15]. Moreover, the evolutionary and gradual change of a dynamic capability during its lifecycle has an impact on the firm's strategy, indeed [5, 10]. This influence is recognized already for IT/S dynamic capabilities [16,17,18] "*Such digitally attributable capabilities also determine how much of this value, once created, can be captured by the firm-and how much will be dissipated through competition or through the power of value chain partners, the governance of which itself depends on IT.*" [19]

3 Green Information Technologies and Systems (IT/S) Dynamic Capability Lifecycle

At the same time, IT/S can play a central role in reducing ecological impacts, and can be a possible solution to many ecological problems. On one hand, the Green IT/S concept is associated with technologies and techniques aimed at improving the IT stewardship and reducing energy consumed by IT hardware and software [2, 3, 20]. Examples of this include server virtualization, data centre energy optimization, and rightsizing IT equipment. On the other hand, Green IT/S refer to the use, the creation, and the development of systems that enable ecological responsibility initiatives [3]. Examples of this include the design of innovative information systems for monitoring and reducing energy consumption [3]. Given the existence of these technology and system orientations, we decided to include both in our development, and we refer to

Green IT/S as the information technology and information system initiatives and programs that address ecological sustainability [4].

The sustainable actions offered by Intel are good examples for understanding the role of Green IT/S in addressing ecological sustainability. Intel includes environmental performance goals throughout its operations, extending into its global value chain. In order to reduce its carbon footprint, Intel's IT department delivers services to all employees, such as videoconferencing, power management practices, and green printing services (www.intel.com).

Green IT/S Dynamic Capability

Our focus for Green IT/S is put into perspective through the dynamic capability theories, and their applications to the IT/S domain.

These fast changing environments concern ecological issues too. For example, new laws and policies put in place to protect nature are constantly changing market conditions and, at the same time, customers are increasingly sensitive to ecological issues. Consequently, organizations are required to combine their resources in new ways, and to gain additional resources to adapt to changes in their business contexts in order to reduce their impact on the environment. We call this dynamic capability to respond to these transformations the "Green IT/S Dynamic Capability". We define it as the two-fold organizational process of:

(1) recognizing the role in the ecological sustainability played by the Information Technologies and Systems (IT/S), and

(2) contributing to the ecological sustainability by the IT/S.

We theorize Green IT/S dynamic capability as a dynamic capability for two reasons. First, it depends on a specific and identifiable process in which firms combine their various businesses, functional, and personal expertise [7]. Second, Green IT/S dynamic capability allows firms to reconfigure internal IT/S-related procedures and to internally generate new IT/S cultures and processes, making them more ecologically sustainable; and externally generate new IT/S-based products and services with reduced ecological impact. An example of this Green IT/S dynamic capability is offered by UPS, one of the most important messenger companies in the United States, as it shows how the internal reconfiguration of IT/S generates new processes making them more ecologically sustainable. UPS has developed sophisticated information systems to improve the ecological impact of its delivery trucks, collecting the state of its vehicles, and now UPS has access to more than 200 vehicle-related elements (oil pressure, seatbelt use, accelerations, etc.). Thanks to the data collected via the above sensors, UPS can analyze and interpret this data and proceed with recommendations. There are multiple ecological benefits, such as significant reduction in mileage, in fuel consumption, and even in replacement parts [22].

Green IT/S dynamic capability lifecycle

Even though many examples, like the previous two, exist, the Green IT/S dynamic capability is still not common place. In order to generate these new cultures, processes, products, and services, Green IT/S dynamic capability has to move through the different dynamic capability lifecycle's stages, starting at stage zero.

Prior to the founding stage, the organization is characterized by the absence of the Green IT/S dynamic capability. In the founding stage, the organization's personnel gather, in a team, with the objective of collectively recognizing the role played by the organizations' IT/S in the ecological sustainability, hence, contributing to its IT/S. Maybe, stimulated by a few internal members that were already attentive to the issue, the organization accepts to open the issue about the possible impact of the organization's IT/S on nature and the organization states the wish to tackle down the emerging ecological problems [21].This stage of the Green IT/S dynamic capability occurs, for example, when an officer signs a Green Digital Charter initiative. The Green Digital Charter is a declaration that commits cities to work together to tackle climate change through the innovative use of digital technologies city-wide (www.greendigitalcharter.eu). In the development stage, the constituted team searches for viable methods to recognize the role played by the organization's IT/S in ecological sustainability, and to contribute to the IT/S to the ecological sustainability. The team looks outside and inside the organization for expertise and examples to inspire action. The explored methods can be very different, but their common objective is to test their viability: from green washing, i.e. promoting the perception that the organization's IT/S is environmentally friendly, to ecological design, i.e. minimizing environmentally destructive impacts of an organization's IT/S by integrating IT/S within its living processes. One example of the development stage is offered by Microsoft's explorative project aiming at searching for a viable method to make data centres green. In recent years, Microsoft has made a big effort to reduce the impact of its data centres. In 2010, the company started introducing the idea of a Data Plant as a grid independent data centre that integrates power plants and data centres. Recently, the company has launched the first green data centre, enabling it to operate entirely off the grid. In the maturity stage, the viable methods are identified and applied throughout all the organization's IT/S-based initiatives and activities. These viable methods are, little by little, embedded in the memory of the team and in the organization at large, becoming part of the organization's culture. Regular assessments to measure the role played by the IT/S in ecological sustainability are performed as a normal process of the organization. Organizational and IT/S codes are set, implicitly or explicitly, in order to assure the integration of the ecological issues in any and all of the organization's activities. Any potential IT/S initiative is studied, taking explicitly into consideration its impact on nature. The organization rethinks how it operates in order to infuse ecological sustainability considerations throughout all of the firm's activities and interactions with the goal of stopping ecological degradation altogether. It could mean a drastic reduction in energy and material consumption, and adapting the use for the remaining consumption, of renewable energy and material sources. SAP, the world leader in enterprise applications in terms

of software and software-related service revenue, established 400 sustainability metrics embedded in its processes, and saved $250 million between 2008 and 2010 in energy costs. SAP believes that sustainability is not a separate function or activity, but a core value embedded in the company. In addition, the company develops sustainable solutions that better serve customers' needs; SAP offers an iPhone application called CarbonTrack that allows users to track carbon footprints from daily commuting or business trips.

Green IT/S dynamic capability lifecycle and its force on Strategy

Dynamic capabilities are a force impacting on a firm's strategy [5, 7], and the capability lifecycle has an impact on a firm's strategy too [5, 10]. In particular for our study objectives, research shows that the presence of a Green IT/S Dynamic Capability determines many aspects of the competitive strategy of a firm. The analysis of Green IT/S literature reveals that different Green IT/S related strategies exist [4, 23]. In our study, we adopt the definition of Green IS strategy provided by Loser et al [23]. We enlarge their definition to include the IT/S dimension and not only the IS one. Hence, the Green IT/S strategy is the organizational perspective on the investment in, deployment, use, and management of IT/S in order to minimize the negative ecological impacts of IT/S, IT/S-enabled products and services, and business operations [23].

We hypothesize that the gradual change of the Green IT/S dynamic capability during its lifecycle allows firms to propose different Green IT/S related strategies. We theoretically advance Table 1, which lists the principal green IT/S strategies that could be potentially adopted at each stage of the Green IT/S dynamic capability lifecycle.

Table 0. Green IT/S strategies and Stage Lifecycle

Stage Lifecycle	Green IT/S Strategy	Definition	Proposition
Founding Stage	Green IT/S for Efficiency [12]	Involves investments in IT/S with reduced negative ecological impacts, only when there is a direct financial return on investment.	The presence of a Green IT/S dynamic capability on the founding Stage positively influences the Green IT/S for efficiency strategy.
Development Stage	Image oriented [4]	Involves investing in IT/S for public relations and shareholder communication to minimize the perceived negative impact of the business operations and IT/S enabled products and services.	The presence of a Green IT/S dynamic capability on the development stage positively influences the image oriented strategy.

Development Stage	Eco-efficiency [4]	Involves managing efficiently IT/S in order to reduce negative IT/S environmental impacts.	The presence of a Green IT/S dynamic capability on the development Stage positively influences the eco-efficiency strategy.
Maturity Stage	Product stewardship [4]	Involves the use of IT/S to reduce the ecological impacts of an organization's products throughout its lifecycle.	*The presence of a Green IT/S dynamic capability on the maturity stage Positively influences the Product stewardship strategy.*
Maturity Stage	Sustainable development [4, 23]	Involves investing, deploying, using and managing IT/S to minimize the negative ecological impact of IT/S, IT/S enabled products and services and business operations.	*The presence of a Green IT/S dynamic capability on the maturity stage positively influences the sustainable development strategy.*

Research Methodology

The propositions in Table 1 will be empirically explored. Critical social theory assumptions [24] will underlie our research efforts. We consider that social reality is historically constituted, and that it is produced and reproduced by people. Although people can consciously act to change reality, people's ability to do so is constrained by various forms of social, cultural, and political domination. Our objective is to bring to light the restrictive and alienating conditions of the status quo, the oppositions, the conflicts, and the contradictions in contemporary society. Our final aim is to contribute to the elimination of the causes of the actual ecological non sustainability, for the purpose of human advantage.

Given the novelty of the research question and the emerging nature of the theoretical framework, we will engage in a longitudinal qualitative research design [25]. Qualitative studies are especially useful for developing theoretical insights when research focuses on areas that extant theory does not address well [26]. Based on our research model, we will include in the study organizations that have not yet started, have just started the development, or have already developed the Green IT/S capability to enable understanding of how firms develop it and how this capability evolves throughout its lifecycle.

Data collection will be based on the qualitative key informant interview. For the purposes of this study, the key informants will be the Chief Information Officer (CIO) and the general manager. CIOs are likely to be the most informed about IT/IS assets

and IT/IS capabilities. The general managers will be targeted because of their general knowledge of the organization as a whole.

Conclusions

Dynamic Capabilities are often considered the factors that justify the different degrees of success of organizations in turbulent environments. However, the evolution of a capability during its lifecycle remains partially unexplained. This paper has aimed to broaden the theory and research, both on dynamic capability and IT/S by examining the Green IT/S Capability Lifecycle. The research model can enrich studies on Green IT/S, offering a means for understanding the strategic role of Information Technology and Systems to enhance possible green IT/S strategies to support sustainable business processes. This research-in-progress presents the basis for continuing research, which aims to enhance our understanding of Green IT/S dynamic capability lifecycles. Future research needed includes the empirical study that enables the understanding of how firms develop it and how this capability evolves to follow its lifecycle. We also believe that our work provides fertile ground for continuing research into this topic, and that such research will provide insights and guidance for managers.

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