

# From capability to strategic action: the case of Green IT/S Dynamic Capability

Paola Floreddu, Claudio Vitari

► **To cite this version:**

Paola Floreddu, Claudio Vitari. From capability to strategic action: the case of Green IT/S Dynamic Capability. 2013. <hal-00969204>

**HAL Id: hal-00969204**

**<http://hal.grenoble-em.com/hal-00969204>**

Submitted on 2 Apr 2014

**HAL** is a multi-disciplinary open access archive for the deposit and dissemination of scientific research documents, whether they are published or not. The documents may come from teaching and research institutions in France or abroad, or from public or private research centers.

L'archive ouverte pluridisciplinaire **HAL**, est destinée au dépôt et à la diffusion de documents scientifiques de niveau recherche, publiés ou non, émanant des établissements d'enseignement et de recherche français ou étrangers, des laboratoires publics ou privés.

## From capability to strategic action: the case of Green IT/S Dynamic Capability

Paola Floredu<sup>1</sup>, Claudio Vitari<sup>2</sup>

<sup>1</sup> Università di Cagliari, Cagliari, Italy

{[flo.paolab@gmail.com](mailto:flo.paolab@gmail.com)}

<sup>2</sup> Grenoble Ecole de Management, Grenoble, France

{[claudio.vitari@grenoble-em.com](mailto:claudio.vitari@grenoble-em.com)}

**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

Research supported by French Rhône Alpes region (<http://www.rhonealpes.fr/>).

### 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. IT-based products have brief product life spans (e.g., laptops 3–4 years; networks 5–7 years). Data centers currently consume 1.5-2% of all global electricity; this is growing at a rate of 12% a year (Greenpeace 2012).

On the other hand, IT/S plays a significant role in making both business processes and products more ecologically sustainable (Chen, Boudreau, & Watson, 2008). 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 (Chen et al., 2008; Watson, Boudreau, & Chen, 2010).

Green IT/S has 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 (Watson et al., 2010).

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 Technology and System (Green IT/S) capability. An analysis of existing IT/S literature demonstrates that a number of concepts are used in the pairing of “Green” and “IS” and “IT”. We thus, prefer the more encompassing Green Information Technology and System - Green IT/S (Jenkin et al. 2011), as it incorporates a greater variety of possible initiatives to support ecologically sustainable business processes.

The dynamic capability lens for Green IT/S 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 (Harreld et al. 2007). Accordingly, management theorists have addressed green issues from a strategic choice perspective (Starkey and Crane 2003; Hrebiniak & Joyce, 1984).

Based from this assumption, 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. Few studies give evidence of the link between internal (among them the dynamic capabilities) and external factors and firm strategies (Agarwal and Helfat 2009; Jenkin et al. 2011).

However, a lifecycle perspective showing how the Green IT/S dynamic capability develops and how this development influences a firm's strategy is lacking. This lack in perspective is relevant to inform the theory about the dynamic capability lifecycle, and in practice to enhance the transformative power of IT/S.

In this study, we want to explore how the evolutionary change of a dynamic capability during its lifecycle allows for change to a firm's strategy. We perform that on a new dynamic capability: the Green IT/S has the capability for practical relevance. We integrate perspectives from the literature on dynamic capabilities, green IT/S and strategic management to propose how the evolutionary change of a dynamic capability during its lifecycle will influence the development of a corporate strategy for managing the natural environment.

This paper is organized as follows: Section 1 introduces the theoretical framework, which is based on dynamic capability and dynamic capability lifecycle theories; Section 2 describes the theorization of a Green IT/S Dynamic capability and its lifecycle; Section 3 presents the research model; Section 4 presents the research methodology; and Section 5 presents some concluding remarks highlighting the future direction and achievements.

## **Theoretical Framework**

### ***Dynamic capabilities***

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" (Eisenhardt and Martin 2000). Hence, Dynamic Capabilities have the potential to create, to evolve, and to recombine internal existing resources to adapt to turbulent environments (Teece et al. 1997). This adaptability is especially required in fast-paced technological environments (Teece et al. 1997; Zahra et al. 2006); as it has been theorized that adaptability can lead to improved customer value (Sambamurthy et al. 2003; Wheeler 2002).

However, a firm's ability to deliver superior process performance in a competitive environment does not automatically imply that it can achieve sustained competitive advantage, because other variables could intervene that prevent this (Helfat and Winter 2011; Ray et al. 2005). Acknowledging the interpositions between dynamic capabilities, single superior process performance, and sustained competitive advantage highlight the value of studying Dynamic Capabilities independently from competitive advantage variables.

### ***Dynamic capability lifecycle***

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 (2003) defined this evolution as the capability lifecycle, "which articulates general patterns and paths in the evolution of organizational capabilities over time" (Helfat and Peteraf, 2003 page 997). The capability lifecycle includes three stages.

1. 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, leadership, organizational culture, and information technology are critical resources which underlie the creation of a capability (Montealegre 2002). Valuable capabilities are created, thanks to the ability of a firm to integrate internal and external resources (Montealegre 2002).
2. 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 (Hoopes and Madsen 2008).
3. 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; by experimenting; and by investing in, leveraging, and co-opting resources from its external and internal contexts (Montealegre 2002).

### ***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 (Porter 1980), on the firm's position in the marketplace, on the external forces such as evolution in technology available, or the changes in customer needs (Agarwal and Helfat 2009; Porter 1980).

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 (Agarwal and Helfat 2009; Barney 1991; Eisenhardt and Martin 2000; Teece 2010).

In this vein, dynamic capability is one of the internal forces which explains firms' strategies (Ambrosini and Bowman 2009; Eisenhardt and Martin 2000; Harreld et al. 2007). Moreover, the evolutionary and gradual change of a dynamic capability during its lifecycle has an impact on the firm's strategy, indeed (Harreld et al. 2007; Helfat and Peteraf 2003).

### **Green Information Technology and System (IT/S) Dynamic Capability Lifecycle**

Even though the research on this subject recognizes the importance of the evolution of a dynamic capability in sustaining competitive advantage over time (Helfat et al. 2007), unfortunately empirical research on dynamic capability lifecycle and its force on strategy is missing. The three stages of the dynamic capability lifecycle have not been extensively studied for any given dynamic capability. We hope that our research contributions can help to fill this research gap by formalizing the Green Information Technology and System (IT/S) Dynamic Capability Lifecycle.

#### ***Green IT/S***

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. Sustainable Development is defined as: "the development that meets the needs of the present, without compromising the ability of future generations to meet their needs" (World Commission on Environment and Development, 1987, p. 8). Sustainability is a broad concept that generally includes three components: the nature, the society, and the economy.

Given the broadness of the concept with its three components, we decide to focus on the ecological sustainability, such as: preventing climate change, stopping environmental deterioration, minimizing CO<sub>2</sub> emissions, and preventing natural resource depletion; by using clean technologies (Hart 1995). This focus is based on the scientific evidence that without ecological sustainability, any societal sustainability and economic sustainability are, simply but dramatically, impossible.

We further reduce our scope to the IT/S domain as; first of all, IT/S has the fastest growing global footprint, as fast as the global footprint of the aviation domain (GeSI 2010). 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 (Chen et al. 2008; Melville 2010; Watson et al. 2010). Examples of this include server virtualization, data center energy optimization, and rightsizing IT equipment (Molla & Abereshi,

2011). On the other hand, Green IT/S refers to the use, the creation, and the development of systems that enable ecological responsibility initiatives (Watson et al., 2010). Examples of this include the design of innovative information systems for monitoring and reducing energy consumption, or the use of management systems that allow the traceability of environmental information around the creation of products, components, and services (Watson et al. 2010).

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 (Jenkin et al. 2011).

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. Additionally, in 2007, the company initiated a program called "Proactive Server Refresh" to refresh its servers on a four-year average cadence, which allows Intel to improve its energy efficiency ([www.intel.com](http://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 business, functional, and personal expertise (Eisenhardt & Martin, 2000). 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 (Watson, Boudreau, Li, & Levis, 2010).

A complementary example of this Green IT/S dynamic capability is offered by Google as it shows the development of new IT/S-based services aimed at reducing ecological impacts. Google, once it perceived the emergence of new customers' trends about ecological sustainability, developed new smart-phone applications that help individuals identify ecologically sustainable opportunities that they can take to lead to an overall more sustainable lifestyle ([www.google.com](http://www.google.com)).

## ***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.

- *Stage 0:* Prior to the founding stage, the organization is characterized by the absence of the Green IT/S dynamic capability. The organization does not recognize the role played by the IT/S in ecological sustainability, and hence, does not contribute with its IT/S. IT/S is employed taking into account only economic and/or social issues of the sustainable development's triple bottom-line. If some members of the organization individually recognize the role played by the IT/S in the ecological sustainability, they have not or have little room for action to contribute to ecological sustainability. Anyway, the organization does not recognize it as valuable. An example of this stage comes from people in an organization signing e-mails to promote awareness of reducing printing and paper usage, but at the same time, their organization does not recognize this initiative and hence, does not openly promote it.
- *Stage 1:* 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 (Melville, 2010). 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](http://www.greendigitalcharter.eu)).
- *Stage 2:* 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 centers green. In recent years, Microsoft has made a big effort to reduce the impact of its data centers. In 2010, the company started introducing the idea of a Data Plant as a grid independent data center that integrates power plants and data centers. Recently, the company has launched the first green data center, enabling it to operate entirely off the grid ([www.microsoft.com/microsoftservices/en/us/article\\_Greening\\_the\\_Data\\_Center.aspx](http://www.microsoft.com/microsoftservices/en/us/article_Greening_the_Data_Center.aspx)).
- *Stage 3:* 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. Depending on the business, it may require a radical change in how business is done. 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 (<http://www.sap.com/about-sap/sustainability-corp-social-responsibility.epx>).

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

Dynamic capabilities are a force impacting on a firm's strategy (Ambrosini and Bowman 2009; Eisenhardt and Martin 2000; Harreld et al. 2007), and the capability lifecycle has an impact on a firm's strategy too (Harreld et al. 2007; Helfat and Peteraf 2003).

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 (Bowman and Ambrosini 2003). The analysis of Green IT/S literature reveals that different Green IT/S related strategies exist (Hedman and Henningsson 2011; Jenkin et al. 2011; Loeser et al. 2012; Murugesan 2008).

In our study, we adopt the definition of Green IS strategy provided by Loser et al (2012). We enlarge their definition to include the IT/S dimension. 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 (Loeser et al. 2012).

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.

#### ***From Founding stage to Green IT/S for efficiency***

As said before, the founding stage of the Green IT/S dynamic capability is characterized by the recognition of the crucial role of the IT/S played in the ecological sustainability, by, at least, few key members of the organization, gathered in a team.

The real commitment of few internal members of the organization is enough to launch a green strategy (Newton 2002), as to demonstrate a green vision, organizations do not need the commitment to the ecological cause by each organization's member, just few members' commitment is enough (Crane 2000).

This recognition of the crucial role of the IT/S played in the ecological sustainability changes the managerial interpretations, attitudes, and perceptions, which have been shown to significantly influence the development of a firm's strategy for managing the impact of firm's operations on the natural environment (Aragón-Correa and Sharma 2003). The wish to tackle down the emerging ecological problems suggests an organization's shift in values to embrace ecological sustainability principles (Newton 2002). The tendency is, hence, to try to reduce, first of all, the present impact of the firm's operations on the natural environment by improving the operations' efficiency. Therefore, in the founding stage of a Green IT/S dynamic capability, the organization perspective is related, in general, to look for means to support the traditional core business, but more efficiently. In this case, strategy involves investments in IT/S with reduced negative ecological impacts to support the same business operations, when there is a direct economic interest in it, what Loeser et al, (2012) call "Green IT/S for Efficiency".

*P1: The presence of a Green IT/S dynamic capability on the founding stage positively influences the Green IT/S for efficiency strategy*

#### ***From Development Stage to Image-oriented***

The development stage regards searching for viable methods, inside and outside the organization, to recognize and improve the role played by the organization's IT/S in ecological sustainability. This search for viable methods comes from the uncertainty about internal resources, managerial actions and strategies to pursue and the requirement for managers to experiment and to take risks, also in pursuing a green strategy (Aragón-Correa and Sharma 2003). Among the different experiments, transparency and credibility are regular attempts to publicly demonstrate the company alignment to ecological sustainability principles (Loeser et al. 2012). A strategic choice can, hence, be investing in IT/S for public relations and shareholder communication to minimize the negative impact of the business operations and IT/S-enabled products and services perceived by the stakeholders and the general public. Without changing the business activities, organization's members review existing activities to see if they can be presented and promoted as green (Hedman and Henningsson 2011).

*P2: The presence of a Green IT/S dynamic capability on the development stage positively influences the image oriented strategy.*

#### ***From Development Stage to Eco-efficiency***

Still in search for viable methods to contribute to the IT/S to the ecological sustainability, the organization can conclude that investing in IT/S for public relations and communication is not a viable method. The strategic choice is, hence, to conduct an audit of its IT/S and its use from an ecological perspective, and developing a comprehensive plan in order to greening IT/S, and implements distinctive new initiatives (Murugesan 2008): the so called Eco-efficiency strategy.

*P3: The presence of a Green IT/S dynamic capability on the development stage positively influences the eco-efficiency strategy, when the Image-oriented strategy has been considered not viable.*

#### ***From Maturity stage to Product Stewardship***

The maturity stage (stage 3) implies that ecological issues are integrated into the organization's activities, the capability becomes embedded in the memory structure of the organization and more tacit in nature (Helfat and Peteraf 2003). The maturity stage entails that organizational members regularly exercise the capability (Helfat and Peteraf 2003) by redesigning IT/S in order to reduce environmental impact. Any potential initiative is studied taking explicitly into consideration its impact on nature.

As soon as the ecological issues are integrated by different key functional groups and the organization is able to coordinate these functional groups on ecological issues (Hart 1995), the IT/S negative impact is scrutinized throughout the whole IT/S lifecycle,

These abilities to audit the IT/S initiatives and to coordinate different functional groups allows the organization to deciding to steward new IT/S-based products to enrich the product offer with ecological ones. This strategy is called Product stewardship (Jenkin et al. 2011) and involves the use of IT/S to reduce the ecological impacts of this product throughout its lifecycle to achieve eco-equity goals.

By applying this strategy, the firm differentiates its products by establishing the firm as an early mover in new (green) product domains (Hart 1995).

*P4: The presence of a Green IT/S dynamic capability on the maturity stage positively influences the product stewardship strategy.*

#### ***From Maturity stage to Sustainable Development***

Finally, the ecological sustainability principles are accepted as conditions for the execution of all



the business processes, when the Green IT/S capability is embedded in the memory of the whole organization, and the same vision of the future, implying new technologies and competencies, is shared through the firm (Hart 1995), When these conditions are satisfied, the organization evolves all their processes to make them in line with the ecological principles, which involves to invest, to deploy to, use and to manage IT/S to minimize the negative ecological impact of IT/S of whole business processes. In this case, the company pursues a sustainable development strategy (Loeser et al, 2012), and this organization will be able to accumulate the resources necessary for sustainable development more quickly than firms without such capability (Hart 1995).

*P5: The presence of a Green IT/S dynamic capability on the maturity stage positively influences the sustainable development strategy, when same vision is shared by the whole organization.*

<b>Table 1- Green IT/S strategies and Stage Lyfecycle</b>					
Stage Lifecycle	Condition	Green IT/S Strategy	Definition	Source	Proposition
Founding Stage		Green IT/S for Efficiency	Involves investments on IT/S with reduced negative ecological impacts only when there's a direct financial return on investment.	Loeser et al, 2012	<i>The presence of a Green IT/S dynamic capability on the founding stage positively influences the Green IT/S for efficiency strategy.</i>
Development Stage	It is necessary that organizational members organized itself around the objective of developing a Green IT/S dynamic capability. They start promoting their ecological organization's IT/IS.	Image-oriented	Involves investing in IS for public relations and shareholder communication to minimize the perceived negative impact of the business operations and IT/S-enabled products and services.	Jenkin et al (2011); Hedman and Henningsson (2011)	<i>The presence of a Green IT/S dynamic capability on the development stage positively influences the image oriented strategy.</i>
	Capability development entails improvement over time. The capability develops through	Eco-efficiency	Involves managing efficiently IT/S in order to reduce negative IT/S environmental impacts.	Jenkin et al, 2011; Murugesan (2008)	<i>The presence of a Green IT/S dynamic capability on the development stage positively</i>

	search new alternatives to reduce environmental impact.				<i>influences the eco-efficiency strategy, when the Image-oriented strategy has been considered not viable</i>
Maturity Stage	During the maturity stage, organizational member exercising the capability by redesigning IT/S in order to reduce environmental impact.	Product stewardship	Involves the use of IT/S to reduce the ecological impacts of an organization's products throughout its lifecycle.	Jenkin et al, 2011	<i>The presence of a Green IT/S dynamic capability on the maturity stage positively influences the product stewardship strategy.</i>
	It is the final step of capability lifecycle. Sustainability principles are in core of all business process. The capability is embedded in the memory of the organization.	Sustainable development	Involves invest, deploy, use and manage IT/S to minimize the negative ecological impact of IT/S, IT/S enabled products and services and business operations.	Jenkin et al, 2011; Loeser et al, 2012; Murugesan (2008); Hedman and Henningsson (2011)	<i>The presence of a Green IT/S dynamic capability on the maturity stage positively influences the sustainable development strategy, when same vision is shared by the whole organization</i>

## 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 IS 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 IS 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. Our final aim is to contribute to eliminating the causes of actual ecological non sustainability, for the purpose of human advantage.

## Reference

- Agarwal, R., and Helfat, C. E. 2009. "Strategic Renewal of Organizations," *Organization Science* (20:2), pp. 281–293.
- Ambrosini, V., and Bowman, C. 2009. "What are dynamic capabilities and are they a useful construct in strategic management?," *International Journal of Management Reviews* (11:1), pp. 29–49.
- Aragón-Correa, J. A., and Sharma, S. 2003. "A Contingent Resource-Based View of Proactive Corporate Environmental Strategy," *The Academy of Management Review* (28:1), pp. 71–88.
- Barney, J. 1991. "Firm resources and sustained competitive advantage," *Journal of management* (17:1)Sage Publications, pp. 99–120.
- Bowman, C., and Ambrosini, V. 2003. "How the Resource-based and the Dynamic Capability Views of the Firm Inform Corporate-level Strategy," *British Journal of Management* (14:4), pp. 289–303.
- Chen, A. J. W., Boudreau, M.-C., and Watson, R. T. 2008. "Information systems and ecological sustainability," *Journal of Systems and Information Technology* (10:3), pp. 186–201.
- Crane, A. 2000. "Corporate Greening as Amoralization," *Organization Studies* (21:4), pp. 673–696.
- Eisenhardt, K. M., and Martin, J. a. 2000. "Dynamic capabilities: what are they?," *Strategic Management Journal* (21:10-11), pp. 1105–1121.
- Greenpeace. 2012. "How dirty is your data?," .
- Harrell, J. B., O Reilly, C., and Tushman, M. L. 2007. "Dynamic Capabilities at IBM: Driving Strategy into Action," *California Management Review* (49:4)California Management Review, pp. 21–43.
- Hart, S. L. 1995. "A Natural-Resource-Based View of the Firm," *Academy of Management Review* (20:4)JSTOR, pp. 986–1014.
- Hedman, J., and Henningsson, S. 2011. "Three Strategies for Green IT," *IT Professional* (13:1), pp. 54–57.
- Helfat, C. E., Finkelstein, S., Mitchell, W., Peteraf, M. A., Singh, H., Teece, D. J., and Winter, S. G. 2007. "Dynamic capabilities: Understanding strategic change in organizations," Oxford: Wiley-Blackwell.
- Helfat, C. E., and Peteraf, M. a. 2003. "The dynamic resource-based view: capability lifecycles," *Strategic Management Journal* (24:10), pp. 997–1010.
- Helfat, C. E., and Winter, S. G. 2011. "Untangling Dynamic and Operational Capabilities: strategy for the (n) ever-changing world," *Strategic Management Journal* (32:11), pp. 1243–1250.
- Hoopes, D. G., and Madsen, T. L. 2008. "A capability-based view of competitive heterogeneity," *Industrial and Corporate Change* (17:3), pp. 393–426.
- Jenkin, T. a., Webster, J., and McShane, L. 2011. "An agenda for 'Green' information technology and systems research," *Information and Organization* (21:1)Elsevier Ltd, pp. 17–40.
- Loeser, F., Juni, S., and Ereik, K. 2012. "Towards a typology of Green IS Strategies: Insights from Case Study research," in *Thirty Third International Conference on Information Systems, Orlando, ,* pp. 1–19.

- Melville, N. P. 2010. "Information Systems Innovation for Environmental Sustainability," *MIS Quarterly* (34:1), pp. 1–21.
- Montealegre, R. 2002. "A process model of capability development: Lessons from the electronic commerce strategy at Bolsa de Valores de Guayaquil," *Organization Science* (13:5)JSTOR, pp. 514–531.
- Murugesan, S. 2008. "Harnessing Green IT: Principles and," *IT Professional* (10:1), pp. 24–33.
- Newton, T. I. M. I. 2002. "CREATING THE NEW ECOLOGICAL ORDER ? ELIAS AND ACTOR-NETWORK THEORY," (27:4), pp. 523–540.
- Porter, M. E. 1980. *Competitive strategy: techniques for analyzing industries and competitors*, Free Press New York, The Free Press, p. 396.
- Ray, G., Muhanna, W. A., and Barney, J. B. 2005. "Information Technology of the Performance of the Customer Service Process: A Resource Based Analysis," *MIS Quarterly* (29:4), pp. 625–652.
- Sambamurthy, V., Bharadwaj, S. A., and Grover, V. 2003. "Shaping Agility through Digital Options: Reconceptualizing the Role of Information Technology in Contemporary Firms," *MIS Quarterly* (27:2), pp. 237–263.
- Starkey, K., and Crane, A. 2003. "Toward Green Narrative: Management and the Evolutionary Epic," *The Academy of Management Review* (28:2), p. 220.
- Teece, D. J. 2010. "Business Models, Business Strategy and Innovation," *Long Range Planning* (43:2-3)Elsevier Ltd, pp. 172–194.
- Teece, D. J., Pisano, G., and Shuen, A. 1997. "Dynamic capabilities and Strategic management," *Strategic Management Journal* (18:March), pp. 509–533.
- Watson, R., Boudreau, M.-C., Li, S., and Levis, J. 2010. "Telematics at UPS: en Route to Energy Informatics," *MIS Quarterly Executive* (9:1), pp. 1–12.
- Watson, R. T., Boudreau, M. C., and Chen, A. J. 2010. "Information Systems and Environmentally Sustainable Development: Energy Informatics and New Direction for the IS Community," *MIS Quarterly* (34:1), pp. 23–38.
- Wheeler, B. C. 2002. "NEBIC: A Dynamic Capabilities Theory for Assessing Net-Enablement," *Information Systems Research* (13:2), pp. 125–146.
- Zahra, S. A., Sapienza, H. J., and Davidsson, P. 2006. "Entrepreneurship and Dynamic Capabilities: A Review, Model and Research Agenda," *Journal of Management Studies* (43:4), pp. 918–955.