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Abstract

Purpose – The purpose of this paper is to examine eco-innovation practices within project networks. Eco-innovation practices involve systematic series of actions that integrate resources to create value.
Design/methodology/approach – Using case research, the authors conducted an intensive study of innovation practices within project networks, using multiple sources of evidence to provide information to scholars and practitioners (Halinen and Tornroos, 2005). Analyzing practices facilitated an empirical investigation of how contextual elements shaped the social construction of eco-innovation.
Findings – An empirical analysis of eight project networks identifies three eco-innovation practices: cleaning up the landscape, connecting life and work, and boosting the efficiency of inbound and outbound processes. A methodological framework based on this practice approach is used to discuss the main elements of the practices in question, including actors, actions, resources, and value.
Practical implications – The practice-based approach (PBA) may help companies to make information and communication technology (ICT) more sustainable. By developing forms of eco-innovation that support project networks, companies can focus on holistic corporate performance, efficiency, and business value. Eco-innovation thus becomes a collective achievement that allows practitioners to appraise and critique the performance of their environmental practices, and that thereby allows them to constantly refine those practices.
Social implications – The development and use of Green ICT solutions enable actors' sense-making and sense-giving within ongoing social practices wherein macro-level phenomena, such as sustainability and environmental issues, are created and recreated through the micro-level actions of project network actors.
Originality/value – This research extends beyond the more traditional issues of ecologically sound company operations and sustainable ICT use to address sustainable ways of doing business.

Keywords Practices, Systemic approach, Eco-innovation, Green ICT

Paper type Research paper

Introduction

Google has revealed that its global electricity consumption and greenhouse gas emissions are approximately 2.26 bn kWh of electricity, which is approximately equivalent to 200,000 homes in the USA (M&C, 2011). Recently, increasing numbers of corporations have begun to address the problem of their carbon footprints. In all, 73 percent of the Global 500 now voluntarily provide figures pertaining to their greenhouse emissions (Carbon Disclosure Project, 2010).

Ecology, the environment and sustainability are becoming key themes in business and in the academic literature. Many perspectives have taken shape in the study of business and environmental sustainability. These perspectives include strategic management (Carroll, 1999; Porter and Kramer, 2002), business ethics (De George, 1999), policy and economics (Drucker, 1994), multinational business (Collier and Wanderley, 2005), supply chain management (Carter and Jennings, 2004), and marketing and services (Edvardsson and Enquist, 2009; Sheth *et al.*, 2011). Furthermore, it is increasingly accepted that sustainability falls within the domain of mainstream innovation research, which has substantially affected the progress of academic and business debates (Shrivastava, 1995; Elkington, 1997; D'Amato and Roome, 2009). Sustainable innovation is characterized as the foundation for the next industrial revolution (Braungart and McDonough, 1998), and

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the topic is suggested as a compelling one within business studies, as such innovation is believed to foster competitiveness (Rodriguez *et al.*, 2002; Little, 2006). However, sustainability in innovation studies remains a fuzzy concept (Arundeland Kemp, 2009). Its emergence has generated more general terms such as eco-innovation (Fussler and James, 1996), sustainable innovation (Nidumolu *et al.*, 2009), and corporate social responsibility innovation (Russo-Spena and De Chiara, 2012), as well as more detailed concepts such as eco-design, eco-preneurship, and clean-technology venturing (Hockerts and Morsing, 2000).

The initial theories of sustainability in innovation have focussed on environmental benefits such as pollution control, abatement activities, and waste minimization (Fussler and James, 1996; Hellström, 2007). As Rennings (2000) indicates, these first approaches worked from a general, neutral definition of sustainable innovation that defined the concept as "new idea behaviour, products, [and] processes that contributed to a reduction in environmental burdens or to ecologically specified sustainability targets" (p. 322). Seeking to refine this definition, some authors argue that eco-innovation research should involve "unintended" eco-effects of innovations (Arundel and Kemp, 2009; Nill and Kemp, 2009). Other scholars advocate the use of a comprehensive concept that includes innovations in resource use, energy efficiency, waste minimization, reuse and recycling, new material use, and eco-design (Smith *et al.*, 2010).

An additional perspective moves beyond products, resources, and businesses to consider the social component of eco-innovation. Freeman (1996) argues that the evolution of social arrangements and institutional structures supports eco-innovation. Including a social and cultural component leads to greater acceptance of eco-innovation, thereby increasing its effectiveness (Hellström, 2007). The OECD definition of eco-innovation includes institutional innovations that reduce negative effects on the environment, such as changes in values, beliefs, knowledge, norms, and administrative acts, as well as changes in management, organization, laws, and systems of governance (OECD, 2008a, b). Similarly, the *Oslo Manual*'s definition of eco-innovation expands the domain of eco-innovation by including the use of novel technology that was originally developed by a different firm or institution. Thus, eco-innovation is:

> The production, assimilation or exploitation of a product, production process, service or management or business methods that is novel to the firm and which results, throughout its life cycle, in a reduction of environmental risk, pollution and other negative impacts of resources use (including energy use) compared to relevant alternatives (Arundel and Kemp, 2009, p. 5).

Another important aspect of eco-innovation is the work of interlinked actors such as customers, communities, and suppliers, in addition to firms. The collaborative and network approaches to eco-innovation within the industrial marketing (IM) tradition (Baraldi *et al.*, 2007, 2011) provide insight into this aspect of the concept. Since the seminal research by Håkansson and Snehota (1995), IM scholars have described a firm as being embedded in a network of ongoing business and non-business relationships that both facilitate and constrain performance (Ritter *et al.*, 2004). Based on the ARA (Actors, Resources, Activities) framework, Baraldi *et al.* (2011) conducted a rich case study that highlights the importance of engaging and mobilizing a network of actors for innovation that improves eco-sustainability.

Recently, additional studies (Hasan and Meloche, 2013; Eladwiah and Rahman, 2013; Røpke and Christensen, 2012) have contributed toward an understanding of the stakeholder view of eco-innovation. These studies focus on Green technology and discuss the role of information and communication technology (ICT) in realizing the

sustainability potential of interconnected networks of actors. However, all of these studies give evidence of isolated efforts that are often tied to a specific context. Eco-innovation is still a scattered topic in business studies; thus, more studies are needed to address eco-innovation from an integrated perspective.

Understanding of the companies' patterns in deploying eco-innovation is lacking, and there is a need to move beyond the analysis of single sustainable solutions to make greener the use of resources, actors' actions and the deployment of processes toward a more systemic approach. To fill this gap, we adopt a practice-based lens on the ICT business. We identify three eco-innovation practices that concern how companies organize a system of elements (actors, resources, actions) within project networks to enact new, sustainable ways of doing business. In the remainder of this paper, we provide a review of the practice-based approach (PBA) to innovation. After presenting a case-study analysis, the paper ends with a discussion of the results and their implications for future practice and research.

The PBA

In the social sciences, recent studies stress a practice-based view, referencing scholars such as Bourdieu (1990), Giddens (1984), and Dreyfus (1991). There is no unified theory of practice; instead, there is only an array of theoretical perspectives. However, the practice-based lens is an epistemological choice to understand phenomena in organizations and society.

The PBA has shaped studies of organizations (knowing-in-practice: Gherardi, 2000), strategy (strategy as a practice or the practice of strategizing: Whittington, 2003), leadership (leadership as practice: Carroll *et al.*, 2008), and design (design as practice: Kimbell, 2009). Within the marketing literature, one recent initiative has been the promotion of practice theory (Skalen and Hackley, 2011). Studies of markets as practices (Kjellberg and Helgesson, 2007) and consumer research (Schau *et al.*, 2009) also emphasize practice theory. However, in IM, there are a few recent advocates for a PBA (Vargo, 2010; Mason and Spring, 2011).

In PBA, the unit of analysis is a practice or a set of practices, rather than an individual or organization. The practice lens joins the individual and collective dimensions and the human and technological elements, thereby emphasizing "doing" and "knowing." The social realm is understood "as [a] materially mediated nexus of activities" (Schatzki *et al.*, 2001, p. 11), and social systems can be characterized "as ongoing self-producing arrays of shared practices" (Barnes, 2001, p. 17). In this view, companies and networks are bundles of practices: that is, sets of activities, routines, and material arrangements.

However, there is still no common definition of the concept of a "practice" (Gherardi, 2009; Corradi *et al.*, 2010). Table I highlights some definitions that have been used in practice-based studies. A practice can be defined in terms of what it is, and what it is not. It is not simply an action, the result of an action, or a process; it is not an experience, nor is it the mental status of an individual. A practice is a way of doing that is embedded in inwardly and outwardly linked elements (Korkman *et al.*, 2010). The practice lens focusses on performance within a constantly evolving social-historical-cultural setting (Sole and Edmondson, 2002). Rather than relying on linear descriptions of work flows composed of actions, researchers must adopt a systemic view and seek to understand how actors interact, integrate resources, and develop relationships within their social context.

In sum, practices are not simply equivalent to "routines" or "commonalities" among the activities of social groups, and are not a generic equivalent of "what people do"

Araujo *et al.* (2008, p. 7)	A focus on practice involves consideration of the links between material devices, embodied skills and mental representation and the configurations in which they come together
Carlile (2002 p. 447)	In a practice-based research approach, it is crucial to be able to observe what people do, what their work is like and what effort it takes to problem solve their respective combinations of objects and ends
Korkman *et al.* (2010, p. 237)	Practices can be defined as more or less routinized actions, which are orchestrated by tools, know-how, images, physical space and a subject who is carrying out the practice
Reckwitz (2002, p. 249)	A routinized type of behaviour which consists of several elements, interconnected to one another: forms of bodily activities, forms of mental activities, "things" and their use, a background knowledge in the form of understanding, know-how, states of emotion and motivational knowledge
Schatzki *et al.* (2001, p. 2)	Practices as embodied materially mediated array of human activity centrally organized around shared understanding
Schau *et al.* (2009 p. 31)	Practices as linked and implicit ways of understanding, saying and doing things – that include practical activities, performances and representations or talk
Sole and Edmondson (2002, p. 18)	Practice connotes doing and involves awareness and application of both explicit (language, tools, concepts, roles, procedures) and tacit (rules of thumb, embodied capabilities, shared worldviews) elements. Central to the practice perspective is acknowledgement of the social, historical and structural contexts in which actions take place. Contextual elements are thus seen to shape how individuals learn and how they acquire knowledge and competence
Vargo (2010, p. 234)	Practices are more than just actions or processes. They have a contextual component and need to be understood systemically
Storbacka and Nenonen (2011, p. 241)	The concept of practice refers to "a way of doing", which is embedded in a context of interlinked subjective and objective elements. It is important to note that practice is not synonymous with action, but it enlarges the unit of analysis to the system that fosters action

Table I.
Definitions of practices

(Gherardi, 2009). As Rouse (2002) and Østerlund and Carlile (2005) argue, a practice involves the production of social relations, and results from the production process:

> Practices are not only recurrent patterns of action (level of production) but also recurrent patterns of socially sustained action (production and reproduction). What people produce in their situated practices is not only work, but also the (re)production of society (Rouse, 2002, p. 16).

PBAs to innovation

This research uses a practice-based view to understand how actors within networks deploy innovation. The innovation literature has described innovation processes in discussing firm-level best practices (Griffin, 1997). However, these authors advance a traditional vision of practices as well-codified, internal routines. This paper adopts a wider definition of the term "practice," in line with previous practice-based studies (Corradi *et al.*, 2010).

The PBA is a budding field within innovation studies that focusses on practice-based knowledge (Orlikowski, 2002; Dougherty, 2004) or the relationships between objects, knowledge, work practices, social groups, and social contexts (Swan *et al.*, 2007). Recently, Russo-Spena and Mele (2012a, b) have shown how the practice lens allows the analysis of innovating as co-creation practices that involve an array of factors, including actors, actions, and resources, in addition to the mere innovation

output itself. Innovators are seen as carriers of practices who perform actions through the use and integration of resources (symbolic, linguistic, and material). These studies on innovation can be complemented with an understanding of value creation within practices. Schau *et al.* (2009) note that "practices create value" (p. 39) in the sense that engaging in practices involves a process of collective value creation (p. 35). Furthermore, Korkman *et al.* (2010) draw from practice theory and service-dominant logic (Vargo and Lusch, 2008) to outline practices as resource integrators, and thus as fundamental units of value creation.

The PBA advocates a contextual and process-oriented view of co-creation and innovation. Innovation occurs within practical constellations (Schatzki *et al.*, 2001) of actions and resources such as tools, images, spaces, and competences, all of which are used and integrated. Focussing on practices enables us to analyze the social connections among individuals, collectives, organizations, institutions, and the social contexts in which these connections are formed. As Barnes (2001, p. 17) affirms, "practice is all there is to study and describe," and a researcher can study the process of innovating by examining developed and shared systems of practices.

Case research

The IM literature identifies case research as a suitable investigation method (Järvensivu and Törnroos, 2010; Piekkari *et al.*, 2010). However, a nuanced debate has recently emerged concerning the strengths and weaknesses of this method. This work follows the advice of scholars who address the need to adopt innovative patterns in case research (Piekkari *et al.*, 2010) employing a practice-based methodology. Using case research, the authors conducted an intensive study of innovation practices within project networks, using multiple sources of evidence to provide information to scholars and practitioners (Halinen and Törnroos, 2005). An analysis of practices facilitated an empirical investigation of how contextual elements shaped the social construction of eco-innovation. This research method is similar to that of Järvensivu and Törnroos (2010), who define moderate constructionism as a way to "better [take] into account the multiple constructed community-bounded realities" (p. 100) of a case. The authors recorded conversations and analyzed documentary materials. They aimed to develop a "multi-voiced rather than convergent understanding of the case under study" (Piekkari *et al.*, 2010, p. 111). The conversations were social encounters in which the active parties (i.e. the researchers and practitioners) collaboratively constructed knowledge. The authors also viewed documents as a communal representation of the actors' experience, which is a written form of storytelling.

This research adopted an emergent, flexible, abductive process, oscillating between theoretical insights and empirical work (Dubois and Gadde, 2002).

Research design

This study examined a leading global IT firm that sells integrated, customized solutions to ICT problems. This case offered access to the firm's practices, providing an opportunity for in-depth analysis of eco-innovation development (Siggelkow, 2007). Managers at the company headquarters in Germany, and at its Italian office, participated in the study. Table II displays the four stages of the research design.

In Stage 1, the authors contacted the head project manager in Italy to discuss how the company develops projects and leads project networks. They also talked with the marketing manager in Italy and the Green ICT managers in both Italy and Germany in

	Method	Content	Time	Output
Stage 1: pre-understanding	Conversations 5 with head project manager 2 with head marketing manager 2 with Green ICT manager Observations within some projects	With reference to the focal company Corporate and Business strategy Methods of developing projects Methods of leading projects Innovation and sustainability	4 months	Pre-understanding of project networks and innovation in the focal company
Stage 2: eco-innovation projects	Analysis of documents, reports, magazines, and other similar materials	Company's projects related to eco-innovation (Green ICT)	4 months	Selection of 8 projects related to Green ICT
Stage 3: eco-innovation practices	Focus on the selected project Conversations with team members Analysis of each project network Analysis of some partners Intra-case and inter-case analysis Comparison of the cases	Focal company's practices Project network's practices: actors, actions, resources, and value	5 months	Identification of eco-innovation practices
Stage 4: final report	Member check	Reading the paper for internal consistency (of the findings and discussion)	1 month	Comments on the paper Discussion of implications

Table II.
Research design

order to understand the firm's Green ICT strategy and the actors' involvement. These managers supplied the researchers with company documents, reports and other materials that were useful for this analysis.

In Stage 2, the authors focussed on company documents, reports, materials, and magazines and discovered valuable written information about lessons learned (as a sort of written storytelling) within the company and about its practices. The authors also identified and analyzed several Green ICT projects.

In Stage 3, the authors focussed on eight eco-innovation projects and related project networks. They talked with team members working on each innovation project and provided analyses.

This study followed Järvensivu, and Törnroos (2010) in collecting and coding the data. The researchers identified the eco-innovation practices constructed by project networks and the various elements of these practices. The information on the categories of analysis; that is, the set of actors, actions, resources, and value outcomes, was the research output. The authors reviewed the findings to ensure that they had conducted a useful data-collection procedure that provided a full description of the practices in question. This iterative process continued until the description of the practices was accurate.

In Stage 4, a senior manager from the focal company read the case descriptions and discussed the principal implications of the descriptions. This procedure is a good example of a "member check" procedure (Lincoln and Guba, 1985). Taking such steps increases the quality (i.e. the construct validity) of a study.

The techniques used for the data collection and analysis (Denzin and Lincoln, 1998) helped to enhance the credibility and reliability of this research. Following the suggestions of Richardson (2000) and Maxwell (2005) enhanced the validity of this study.

Finally, the authors addressed the generalizability of the results. According to Halinen and Törnroos (2005) and Järvensivu and Törnroos (2010), case research is not used to generate theories, but instead to give researchers the capacity to understand various phenomena. Similarly, in this instance, the aim was not to reveal universal truths but to obtain new insights and to generate a local and context-specific understanding of eco-innovation practices.

The practices of eco-innovation

The ICT company examined in this case study (the focal firm) engages in eco-innovation by developing and implementing Green ICT solutions that help to preserve natural resources and reduce carbon emissions. "Green ICT" is the term used by analysts, manufacturers, and providers to identify ICT solutions that improve sustainability, including solutions related to hardware, software, and services (source: firm's documents). Although ICT is responsible for approximately 2 percent of global CO_2 emissions, the intelligent use of ICT solutions can help to "green" business processes (Lee *et al.*, 2013).

The environmental strategy of the focal firm in this case study focusses not only on the use of greener ICT technology, but also on the creation of new knowledge and actions that facilitate environmental sustainability. The focal firm aims to improve awareness of Green ICT and to make individuals' and organizations' behaviors more consistent with the principles of eco-innovation.

Oriented toward solutions, the Green ICT initiative is multifaceted: paper usage is reduced through innovative approaches, energy consumption is decreased, travel and traffic are reduced, and less hardware is used. Each type of solution is deployed through several actions and actors in projects performed by ad hoc networks.

Moving beyond a solution view, the authors adopt a different perspective on the process of eco-innovation and examine a collection of solutions, projects, and networks through the practice lens. Three categories of eco-innovation practices arise:

(1) cleaning up the landscape;

(2) connecting life and work; and

(3) boosting the efficiency of processes.

A methodological framework based on the practice approach is used to discuss the main elements of practices, including actors, actions, resources, and value.

Practices: actors, actions, resources, and value

Within a project network, practices emerge as composite systems of elements. Actors are practitioners that perform a series of actions. Through interaction, they jointly complete each project. The use and integration of an array of resources (tools, know-how, and artifacts) allow value to arise as a process of multiple benefits experienced by multiple actors. Table III summarizes the practices in question, and their various elements.

Practices	Projects	Main actors	Actions	Resources	Multifaceted value dimensions
Cleaning the landscape	Pharma	Focal company Pharma firm (i.e. the customer)	Changing habits Promoting outsourcing Reducing operating resources	New devices New solutions	Cost saving Device harmonization Idle resource reduction
	Automotive	Focal company Focal company Automotive specialist (i.e. the customer) Customer's employees	Harmonizing resource infrastructure	New know-how New routines	Customer service improvements Environmental impact reduction Processing data reduction
	Paper, pen and phone	Telecom company (i.e. the customer) Telecom customers		New information	
Connecting life and work	My access key	Focal company Users	Connecting dispersed actors Virtualizing the working environment	New devices	Time saving Cost saving
	Unified communication and collaboration	Focal company Mobile company Technology company (i.e. the customer) Consulting services		New solutions New know-how New routines New information	Customer contact improvements Connection extensions Environmental impact reduction

(*continued*)

Table III.
Focal firm's practices and elements

Table III.

Practices	Projects	Main actors	Actions	Resources	Multifaceted value dimensions
Boosting the efficiency of inbound and outbound processes	Inventory management system	Focal company Beer company (i.e. the customer) Customer's logistics partners	Improving resource use Implementing Green processes (e.g. logistics) Monitoring resource consumption	New devices New solutions New know-how New routines New information	Cost saving Improved resource use Logistics and transportation cost reduction Environmental impact reduction Quality service improvement
	Parcel collection and drop-off points	Focal company Logistics company (i.e. the customer) Logistics company's customers			
	New city	Focal company Energy company (i.e. the customer) Energy company's partner			

Cleaning up the landscape. The practice of "cleaning the landscape" involves harmonizing resources. Smart ICT solutions are the central tools that are developed to enable the project network's actors to reduce and eliminate idle resources.

In this practice, the ICT company provides customers with access to its ICT resources to outsource its applications (e.g. processing power, storage software, and bandwidth) on demand, using pooled resources at data centers. These resources can be scaled up or down according to changing needs. Customers pay only for what is available to them. There is no upfront investment in hardware infrastructure, and no need for idle assets.

This is how the "Pharma project" operates. The project network's actors work to reduce operating resources. The key business of the customer firm is the production and global distribution of pharmaceutical drugs, cosmetics, food supplements, and medical devices. For years, the customer company has managed its business data and controlled its production and logistics processes using the corporate software SAP. The ICT company offers better and more flexible use of the required IT infrastructure with "Dynamic Services for SAP Solutions." The economies of scale assist the customer because they reduce operating costs by as much as 15 percent, and help to ensure the use of environmentally friendly business processes.

In the "Automotive project," the customer company, a leading specialist in front-end automotive modules, obtains competitive advantage by harmonizing and updating its global infrastructure without interrupting the company's tightly synchronized production and supply chain. Standardized service processes and clearly defined service levels guarantee the stable operation of all applications. As a result, the service quality reaches a high level. This development benefits all employees at the customer company. The employees profit from a central helpdesk that offers competent and rapid help in all matters related to telecommunications, networks, and office logistics.

Reducing the use of devices involves replacing conventional means of communication with ICT solutions (e.g. e-mail, texting). Such solutions are an increasingly positive component of the office environment. The project network actors in this study are developing and implementing an innovative solution for Telecom. The "Paper, Pen and Phone Project" offers an example of how innovative technology can help new operations save postage and paper while reducing environmental impacts. This project builds on potential savings from the diffusion of digitalization operations that allow the management of the entire document process from digitization to archiving, distribution by e-mail or post, and the generation of web site content, thereby creating an entirely paperless workflow. The innovative pen has a built-in camera that makes it possible to process handwriting and signatures on business documents such as contracts. The customers retain the original signed document, and the digital copy is transmitted wirelessly to a central server, where it is archived. Reducing the cost of processes, improving customer service, and preventing information loss are the main advantages derived for Telecom and its customers. There are also additional benefits, including the reduction of carbon emissions through decreases in, or the termination of, paper manufacturing, printing, and mailing.

In summary, the practice of cleaning up the landscape entails a more systemic view of resource management, including its operative and cultural efforts. In the words of a manager at the focal firm:

> Resource management should be a key consideration for firms that must be managed within a widely integrated, effective approach that includes hard and soft technologies, infrastructures

and new procedures. Often the companies are still deploying too many and not-harmonised resources and devices to operate, and this complex landscape often leads to a lack of transparency. The ratio of users to devices can be significantly improved by analysing the current infrastructure and actual actor uses and requirements; then, changes can be made to the type, number and position of devices, ensuring better utilisation of available assets, and reducing stand-by and idle times. The ability to intelligently assign and administer resources is a key function within any ICT solution, ensuring maximum flexibility in resource allocation.

In sum, the practice of cleaning the landscape involves the integration of new products, services, routines, information, and other resources to reduce and harmonize resource use. This practice allows the actors in the project network to reduce resource waste and make significant contributions to the environmentally friendly use of resources.

Connecting life and work. The practice of "Connecting life and work" involves envisioning new (virtual) environments for actors' life and work. The most crucial tool that is used in this practice is solutions (seen as resources) that enable actors in project networks to work simply, intuitively, securely, and reliably while on the move.

In the project "My Access Key," users are given secure access to their desktop environment at work from anywhere in the world through USB sticks. This also gives them the opportunity to work from home. This resource allows companies to significantly reduce emissions. The ICT firm estimates that by working from home just one day per week, an employee with a daily commute of 40 km in each direction will reduce his or her carbon emissions by as much as 295 kg per year. Audio and data conferences, which facilitate virtual connections within human and non-human networks, significantly help to reduce environmental resource waste by firms.

By combining all key communication channels via a single interface, the "Unified Communication and Collaboration" project allows companies to coordinate projects worldwide in real time, connecting the companies' networks from any site. At Mobile company, leveraging the ICT company's solution has enabled approximately 40,000 videoconferences to be conducted over two years. More than 3,000 employees have benefited from this option. A reduction in carbon emissions of approximately 7,000 metric tons has occurred due to the reduction in air travel. Similarly, with a network infrastructure and a freely programmable operating interface, the ICT firm provides an end-to-end operating solution that has helped the customer company to communicate effectively internationally, and to develop its business in Germany in an economically and ecologically focussed manner. Collaboration between different locations is an everyday event at the customer company. Modern videoconferencing technology supports the work of project teams, accelerating important decision processes, strengthening collaboration on international project teams, and increasing productivity because expert knowledge is rapidly transferred where it is needed. This high-level utilization of virtual work environments is beneficial because it allows the firm to avoid the increasing travel expenses that result from further expansion. Moreover, this development has improved the corporate environmental balance.

The connecting life and work practice improves customer contact, particularly in a context that requires extensive consulting services. Virtual consulting allows real-time services for customers, whether in customers' homes, the main office or branch offices.

This "way of doing" saves time and reduces travel costs and carbon emissions. As a manager at the ICT firm says:

> Nowadays, teamwork and collaboration spanning the globe are commonplace, which often makes long-distance travel necessary for many more employees than before. Instead of collecting air miles, most of them could be scoring points at their desks as a whole new generation of communication and collaboration tools allows individuals to work together across multiple locations without any loss of quality.

In sum, the practice of connecting actors' lives and work involves envisioning new virtual environments to foster actors' interaction and resource integration within the project networks. This practice allows the actors in the project network to develop environmentally friendly ways of living and working.

Boosting the efficiency of inbound and outbound processes. The practice of boosting the efficiency of inbound and outbound processes takes into account how to integrate resources and use solutions to foster sustainable actions across the internal and external boundaries of firms.

By applying ICT solutions, firms can improve CO_2 emissions and facilitate the in-depth monitoring of energy consumption and CO_2 emissions throughout the value chain. Accordingly, processes and organizational structures can be enhanced. The potential savings are particularly high in industries with extensive, complex logistics, and supply chains. This is the case for the "Beer project." The project network integrates inventory-management systems and forklift-control systems using an interface for the brewer's ERP system. This system helps the customer company to keep its warehouses well stocked with a variety of goods based on demand. Through the use of sensors and WLAN (Wireless LAN), the company workers can locate the necessary resources anywhere within the facility. With the aid of screens built into their vehicles, the forklift drivers can ensure that they reach their destinations quickly and directly. The customer company thus makes better use of resources and achieves Green logistics by increasing inventory turnover and reducing gas consumption by the 14 forklifts. Shortening these vehicles' travel routes decreases CO_2 emissions by nearly 15 percent.

In industries with complex supply chains, the greatest efforts focus on reducing transportation. This type of campaign is being orchestrated in the "Parcel collection and drop-off points project," which includes 2,500 planned automated parcel collection and drop-off points located in Germany. For the logistics company's customers, reducing transportation means less driving and lower costs. The project also helps to reduce the amount of road traffic. The actors in the project network are responsible for the smooth, reliable operation of self-service units that are fully automated, equipped with cutting-edge technology and connected to a sophisticated, failsafe network infrastructure. The collection points transmit information about customers' orders to a central service center whose employees monitor these processes. E-mails or text messages are sent to customers to notify them of shipments that are ready for collection. By using this system, the logistics company can reduce the total distance driven by its trucks and vans by approximately 6,00,000 km per year. The firm's customers drive 3.3 km less, and the 2,500 collection points reduce carbon emissions by nearly 1,000 metric tons.

In the "New city project," actors use tools to provide complete transparency regarding current consumption at different levels of aggregation based on highly

specific statistical reference data. This project explores new ways to deliver power and addresses all facets of smart energy, including smart metering, smart grids, and home automation. In two suburbs in southern Germany, all households have been equipped with smart meters for electricity, gas, and water. The focal firm and its partner have developed a modular method of separating electricity, gas, and water meters from central data-communication units. The data from each meter are reliably transferred to the energy company in real time. As a result, the energy company can allow households to decide how often these meters are read. This approach also minimizes the amount of data that require processing. The data are transferred only as necessary. The steady stream of information about consumption allows the energy company to remain abreast of peaks in demand. In addition, consumers can proactively reduce their usage because they have the necessary information about their energy consumption, and because of the availability of flexible tariffs. Through this project, two local government areas have begun to use smart meters. Moreover, consumers are reducing their energy usage because they can monitor their own energy consumption and are aware of the availability of flexible tariffs.

In sum, the practice of boosting the efficiency of inbound and outbound processes revolves around the use of electronic systems that employ detailed, up-to-the-minute traffic information that is captured by an extensive network of IT devices. This information is transmitted via telecommunications equipment and has a variety of possible applications. As the ICT firm's project network documents report:

> When effectively and comprehensively applied Green ICT can improve business processes that are not directly involved in ICT, and dramatically lower CO_2 emissions and energy consumption throughout the entire process chain.

In sum, the practice of boosting the efficiency of inbound and outbound processes involves the use of integrated resources to reduce environmental waste and operating costs, and improve companies' performance. This practice allows the actors in the project network to develop environmentally friendly processes crossing the boundaries between firms.

Discussion

This paper focusses on eco-innovation practices that allow project networks to pursue innovation and fulfill their environmental responsibilities. Our research extends beyond the more traditional issues of ecologically sound company's operations. We broaden the analysis by addressing sustainable ways of doing business that are embedded in a context of interlinked elements.

Our findings contribute to eco-innovation studies within business literature by offering a conceptualization of three eco-innovation practices:

(1) cleaning up the landscape;

(2) connecting actors' life and work; and

(3) boosting the efficiency of processes.

We contend that there is a need to move beyond single solutions and initiatives aimed at making greener the use of resources, actors' actions and the deployment of processes toward a more systemic approach in which the single elements are part of wider practices.

Concerning resources, scholars have addressed the effect of ICT development on specific topics, mainly energy consumption and carbon emission (Coomonte *et al.*, 2013; Moyer and Hughes, 2012). However, Fouchal *et al.* (2013) outline that the improvement of energy efficiency not only needs new technology options, but an understanding of what choices will lead to the greatest impact. Our work contributes to this topic by highlighting the opportunity to adopt a wider view on energy efficiency or carbon emission toward the harmonization of a set of resources. Indeed, the practice of cleaning the landscape involves the integration of new products, services, routines, information, and other resources to reduce and harmonize resource use. This way of doing business allows the actors in the project network to get synergy and make significant contributions to environmentally friendly use of resources.

Regarding actors, environmental studies address the role of ICT in involving people to improve sustainability (Bengtsson and Ågerfalk, 2011). Specific studies report the advantages of ad hoc initiatives such as teleworking and teleconferencing in pursuing Green outcomes (Lee *et al.*, 2013; Trimi and Park, 2013). In recognizing these advantages, Hasan and Meloche (2013) advise the fostering of activities that influence "human understanding and behaviour" (p. 335). Mysen (2012) recognizes the role of the company's value system in promoting socially responsible management. In line with these studies, our research suggests moving beyond single ICT solutions to envision new ways of doing business for actors. The practice of connecting actors' life and work involves envisioning new virtual environments in which to foster actors' interaction and resource integration within the project networks. This practice allows the actors in the project network to develop and adopt environmentally friendly ways of living and working.

In terms of processes, most literature on sustainability focusses on how to make company's processes greener (Perotti *et al.*, 2012; Isaksson and Huge-Brodin, 2013). Hu and Hsu (2010) explore critical factors for implementing Green supply chain management; we go further by addressing the need to improve processes across companies, not only focussing on the infrastructure, but also taking into consideration the provided services. The practice of boosting the efficiency of inbound and outbound processes involves the use of integrated resources and processes to reduce environmental waste and improve companies' performance. This practice allows the actors in the project network to develop environmentally friendly processes that cross the boundaries between firms.

The different topics investigated in the literature draw attention to the benefits arising from Green solutions, including reduced environmental impacts and cost savings. This study contributes to this research strand by highlighting that through the deployment of eco-innovation practices, value accrues in the form of multiple benefits to multiple actors. A systemic vision of value creation arises:

> The ecological impact of a business or product is frequently measured and expressed in terms of its "carbon footprint" – and companies are increasingly expected, and willing, to take steps to reduce it within the scope of their commitment to corporate social responsibility. The main motivation for implementing Green ICT seems to lie in the reduction of costs. But a comprehensive Green ICT strategy offers many other benefits, appealing to all actor groups: employee satisfaction increases, the company's standing with capital markets and with society as a whole improves, and the business can attract new customer groups (ICT firm's report).

By moving away from traditional analysis, the practice approach allows us to focus on the interlinked elements of practices; namely actions, actors, resources, and value. Thus, we suggest that eco-innovation practices are systematic actions carried out by

actors using resources in their value search. These practices develop through resource integration (seen as a composite set of new solutions, information, infrastructure, tools, and languages) by actors within project networks and support the process of creating environmental value. This characterization is consistent with suggestions by Vargo (2010), who advocates a systemic understanding of practices.

The PBA advocates the social, contextual, and process-oriented views of innovation. Eco-innovation is understood as a participative social process (Corradi *et al.*, 2010). Thus, it is not the result of a single company's processes; rather, it is generated in practical constellations (Schatzki *et al.*, 2001) in which actions are performed and resources are used and integrated. In these constellations, actors who innovate are the carriers of practices.

The three practices do not stand alone, but should be seen as complementary. Their conceptualization allows us to move away from innovation as an outcome, to the process of "eco-innovating" (Russo-Spena and Mele, 2012a) as the shared use of ongoing practices. Actors integrate resources and improve sustainability by socializing and sharing knowledge, actions, tools, languages, and artifacts (Russo-Spena and Mele, 2012b).

Implications for scholars

Although scholars and practitioners have begun to focus on Green ICT practices (Trimi and Park, 2013) there is little research on eco-innovation. Jenkin *et al.* (2011) and Mysen (2012) outline the need to guide future research and promote socially responsible management. In this work, we suggest that eco-innovation be analyzed through the PBA.

The practice lens contributes to the literature on eco-innovation within IM (Baraldi *et al.*, 2007, 2011). Although these two research fields work from different theoretical premises with dissimilar ontological and epistemological stances, it is possible for studies to integrate these approaches.

The PBA uses practices as the unit of analysis. Although PBS considers actions, actors, and resources, these scholars adopt a systemic view that allows them to examine practices as a whole. PBS invokes a performative and relational epistemology in which "objects, artefacts, and technologies acquire meaning and agency only in a context of action, and therefore in relation to the human actors that interact with them" (Corradi *et al.*, p. 25). The ontological and epistemological premises of the approach relate to being and knowing as grounded in social practices. Cook and Brown (1999) and Raelin (2007) address the epistemology of practice by arguing that "this approach recognizes that practitioners, in order to be proficient, need to bridge the gap between theory and practice […] Practitioners use theories to frame their understanding of the context but simultaneously incorporate an awareness of the social processes in which organizational activity is embedded" (Raelin, 1997, p. 572).

The IM tradition has an empirical focus on the interactions between the actors, activities, and resources that are embedded in business relationships. IM scholars have a different perspective on actors; they focus on action and agency, and for them, actors are not necessarily human. The studies in this area adopt critical realism as the philosophical framework that they use to investigate business relationships (Mouzas, 2001; Easton, 2002; Morais, 2008; Ryan and O'Malley, 2006; Sousa and Castro, 2008). "From a critical realist perspective, in studying business relationships one is attempting to identify structures and the mechanisms by which the nature of the relationship are brought into being (Ryan *et al.*, 2012, p. 300).

Notwithstanding these differences between practice-based studies and IM tradition, there is space for dialogue. The practice lens generates a systemic view of activities,

actors, and resources because it focusses on the contextual interdependencies of linked subjective and objective elements (Storbacka and Nenonen, 2011). Social practices are interconnected. This connectivity makes it possible to resolve the individual/collective, action/structure, micro/macro, and theory/practice dichotomies.

Conceiving of eco-innovation practices as involving a combination of actions, actors, resources, and value may enhance the understanding of value among IM scholars (Corsaro and Snehota, 2010). Ford and McDowell (1999) show the need to express value in more complex relational terms by analyzing the value created by different actions. It is also important to analyze the role of dense and interactive network relations. Möller and Halinen (1999) and Ford (2011) argue that value is the outcome of the interaction that takes place in both focal dyads and wider network structures.

Consistently with recent studies by Schau *et al.* (2009) and Korkman *et al.* (2010) – which see practices as the real unit of value creation – the findings of this study reveal that value is intertwined with actions and interactions. The current understanding of practices incorporates the element of value with actors, resources, and actions, and considers the mutual benefits that accrue when actors innovate collaboratively.

This paper refocusses the literature on "value in context" rather than "value in exchange," as the practice lens positions actors in a context in which they act, interact and integrate their resources to shape innovating practices (Mele *et al.*, 2010; Russo-Spena and Mele, 2012b).

In summary, adopting a practice lens can help researchers to better examine eco-innovation practices when resources are integrated through action and interaction to co-create value within a highly interrelated network of relationships (Håkansson and Snehota, 1995; Ford and Håkansson, 2006; Gummesson and Mele, 2010).

Implications for practitioners

Specific implications for practitioners arise from this research. The PBA may help companies to make ICT more sustainable. By developing forms of eco-innovation that support project networks, companies can focus on holistic corporate performance, efficiency, and business value. Eco-innovation thus becomes a collective achievement that allows practitioners to appraise and critique the performance of their environmental practices, and that thereby allows them to constantly refine those practices.

Managers must understand that ICT is becoming a strategic weapon in the greening of their businesses. Although ICT contributes to environmental problems to some degree, it can also represent a fundamental solution to such problems. Of course, the development of eco-innovation is not a predictor of success. Whether firms achieve future competitiveness through sustainability and environmental conditions also depends on institutions, infrastructure, education, regulations, and the macro-economy. Specific implications regarding the PBA can be also drawn from this research. Innovation should be viewed as an emergent phenomenon that can be detected through patterns. Innovation emerges from the flow of actions and interactions, and from shared practices carried out by actors.

Managers should consider eco-innovation practices as the locus of learning, work, and innovation. As practitioners, managers should use practice theory to frame their understanding of projects as contexts in which social processes generate innovation. They should also be aware that practices produce collective knowledge about eco-innovation in such contexts. This knowledge should be activated and distributed through project networks as platforms for continuous eco-innovation. The goal is to facilitate innovation in practice. The eco-innovation practices embrace the idea of

adopting a broad definition of eco-innovation (Arundel and Kemp, 2009) that supports managers in generating a sustainable innovation model (Mysen, 2012). This model has to focus on a holistic environmental performance and a multi-faceted concept of value that includes reduced costs, improved company image, and the enhanced satisfaction of customers and all actors involved.

Implications for society

Our study also has important implications for society. The development and use of Green ICT solutions enable actors' sense-making and sense-giving within ongoing social practices wherein macro-level phenomena, such as sustainability and environmental issues, are created and recreated through the micro-level actions of project network actors (Geels, 2010).

Orlikowski (2002) and Schultze and Orlikowski (2004) have already addressed the need to understand the link between technology and firm-level practices. We suggest that this link should be seen in terms of its potentiality to improve sustainable ways of doing business that not only influence the business sphere, but can have a strong impact on society. Although eco-innovation practices can be motivated primarily by factors other than environmental considerations (e.g. reducing costs, improving use of resources, etc.), they should promote a different human understanding and behavior in relation to how business perform, with a high impact on society. In line with Røpke and Christensen (2012), we promote a focus on the sustainable directionality of ICT-based innovation.

In this sense, eco-innovation practices enable a sustainable way of taking into account people, profit and planet (Hasan and Meloche, 2013).

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Further reading

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