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**Sustainability-oriented innovation dynamics:
Levels of dynamic capabilities and their path-dependent and self-
reinforcing logics**

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ABSTRACT

In this article, we build on dynamic capabilities theory to explore the organizational dynamics for sustainability-oriented innovation (SOI). We carried out a multiple case study of seven leading companies fostering SOI, searching for common patterns in their adaptation. We found three different levels of dynamic capabilities (adapting, expanding, and transforming) interconnected to strategic sustainability dimensions. We thus propose an evolving framework that explains how the generative variation of innovative change and adaption follow two interconnected logics that explain the SOI dynamics. First, we study the time-evolving transformation that encourages companies to transform dynamic capabilities following a path-dependent logic. Second, we study organizational transformations that enhance self-reinforcement among strategic sustainability dimensions. This conceptualization contributes to the theoretical underpinnings of SOI, providing new insights on how SOI transforms dynamic capabilities for innovation and adapts companies' strategic sustainability.

Keywords: sustainability-oriented innovation, organizational capabilities, strategic SOI

1. Introduction

In recent years, numerous firms have engaged in so-called ‘sustainability-oriented innovation’ (SOI) (Jay and Gerand, 2015), which is:

Making intentional changes to an organization’s philosophy and values, as well as to its products, processes or practices, to serve the specific purpose of creating and realizing social and environmental value in addition to economic returns (Adams et al., 2016, p. 2).

Scholars have studied how SOI leads to better economic performance for the firm (Przychodzen and Przychodzen, 2015) while enhancing its environmental and organizational performance (Arnold and Hockerts, 2011; Iñigo and Albareda, 2016; Huang and Li, 2015). Other scholars have also shown how SOI acts as a key driver for competitiveness (Aragon-Correa and Sharma, 2003; Arnold and Hockerts, 2011). Previous research on SOI (Adams et al., 2016; Carrillo-Hermosilla et al., 2010; Iñigo and Albareda, 2016; Van Kleef and Roome, 2007) has shown that it involves a staged organizational transformation with the aim of shaping sustainable systems.

Scholars have identified specific competencies to innovate sustainably (Castiaux, 2012; Van Kleef and Roome, 2007), varying from traditional understandings of innovation (see Crossan and Apaydin, 2010), targeting strictly economic gains, to the additional goals of economic, social and environmental value-creation. In this sense, the transformational nature of SOI requires changes in company resources, fostering the emergence of different levels of complex dynamic capabilities for innovation that aim to respond to the adaptation and transformation to sustainable business (Castiaux, 2012; Zollo et al., 2013). Dynamic capabilities are defined as follows:

The firm’s processes that use resources—specifically the processes to integrate, reconfigure, gain and release resources—to match and even create market change. Dynamic capabilities thus are the organizational and strategic routines by which firms achieve new resource configurations as markets emerge, collide, split, evolve, and die (Eisenhardt & Martin, 2000, p. 1107).

According to Zollo et al., (2017) these dynamic capabilities connected to SOI are not different from other dynamic capabilities for innovation; the difference lies in how firms pursue the evolution of such capabilities to adopt inclusive, sustainable and multi-stakeholder enterprise models. The literature on SOI and dynamic capabilities is growing; however, although some researchers have already explored how Teece's (2007) levels of dynamic capabilities can be applied to green innovations (Castiaux, 2012), we still do not have a full picture on the connection between dynamic capabilities, SOI and the evolution to sustainable businesses. Therefore, a key gap remains unexplored: an analysis of the how different levels of dynamic capabilities for innovation connect and evolve in the company's transformation to achieve sustainability.

We build on this research gap and propose a multiple case study (Eisenhardt and Graebner, 2007; Yin, 2009), searching for common patterns among SOI performing businesses when launching new products, services and sustainable business models. Therefore, this research adds new and critical proposals to SOI literature. First, we expand the knowledge on SOI by developing an evolving framework of dynamic capabilities that connects with strategic sustainability. We contribute to SOI literature showing how companies adopting SOI practices and processes transform the dynamic capabilities for innovation from a lower level (adapting capabilities) to a higher level with more complex capabilities (transforming capabilities). Second, we extend the knowledge on SOI, providing an understanding of the evolving logics between the strategic sustainability of the firm and levels of dynamic capabilities. We study two different evolving logics: path dependence and self-reinforcement. Our data-driven analysis reveals common patterns but also diversity. The existence of two evolving logics (path dependence and self-reinforcement) also features different pathways depending on time and different organizational features, including differences such as industry, size and company commitment. This results in different evolving processes, both in terms of pace and content.

2. Theoretical background

In this section we review the literature to connect the analysis of different models of SOI engagement that reflect how SOI is an evolving process to the literature on hierarchical levels of dynamic capabilities. Coupling these two research fields, we discuss how SOI research needs to explore how companies require the transformation of different levels of dynamic capabilities to successfully engage in SOI. This justifies the analysis of the evolving processes between different levels of dynamic capabilities for innovation and the transformation of sustainable business (Zollo et al., 2017).

2.1. Models of SOI engagement

In the last few decades, research on SOI has grown as a body of literature, studying the interface between innovation (i.e., new market economic value-creation) and social and sustainable value-creation (i.e., innovation that aims to create new value for the market, society and the environment) (Adams et al., 2016; Bos-Brouwers, 2010; Hansen et al., 2009; Jay and Gerand, 2015; Porter and Kramer, 2011).

To explain this transformation, Adams et al. (2016) propose an SOI model based on three evolutionary stages: operational optimization, organizational transformation and system-building, explaining the deeper systemic transformation that SOI implies for companies. Iñigo and Albareda (2016) propose a complex adaptive system journey, while Carrillo-Hermosilla et al. (2010) also propose a staged, evolutionary view of SOI engagement in eco-innovation, grounding this development across two axes: the economic impact on the system and the environmental and social impact on the system. Thus, companies might engage in four primary organizational changes: viewing new social and environmental regulations as an opportunity; making their value chains sustainable (operations and lifecycle assessment); designing sustainable products and services; and developing sustainable business models (finding novel ways to deliver and capture value).

These studies reveal three main SOI transformation dimensions. First, SOI fosters changes in businesses that go from simple operational practices and processes to systemic changes in economic and social systems, such as the generation of new sustainable business models (Adams et al., 2016; Nidumolu et al., 2009). Second, SOI transformations include the application of scientific sustainability knowledge, changing organizational routines and eco-efficiency processes into advanced organizational processes (e.g., cradle-to-cradle, circular economy, waste to management, etc.) (Carrillo-Hermosilla et al., 2010). Third, SOI changes must be empowered by new capacity-building, aimed specifically at seeing SOI as a complex adaptive system transformation across the organization and beyond its boundaries (Adams et al., 2016; Iñigo and Albareda, 2016). We argue that this research connects to the study of dynamic capabilities for innovation adopted by leading SOI companies.

2.2 Hierarchical approaches to dynamic capabilities

The theory of hierarchical dynamic capabilities is instrumental in operationalizing how this transformation takes place at the organizational level. Dynamic capabilities are built on the resource-base of the firm, that is, the valuable, rare, difficult to imitate and non-substitutable resources that confer upon the firm a competitive advantage in the market (Barney, 1991). Dynamic capabilities focus on adapting to changes in dynamic environments by making adjustments to this resource base; hence, they illustrate a dynamic, rather than static, resource-based view of the firm (Schilke et al., 2017). As opposed to the analysis of the resource-based view that studies the firm's current resources -tangible and intangible assets and the operational capabilities- (Eisenhardt and Martin, 2000), the study of dynamic capabilities focuses on how the company's resource-base is modified, encompassing changes in the organizational capabilities as a response to the perception of external changing environments (Teece, 2007). A main stream in the study of dynamic capabilities highlights how different levels of dynamic

capabilities (Collins, 1994) transform and evolve towards more complex hierarchies of capabilities (Winter, 2003).

Several authors have proposed different ways to classify dynamic capabilities. Zahra et al. (2006) distinguish between substantive (ordinary) capabilities, including abilities and resources that allow a company to solve a problem or to achieve an outcome, and dynamic capabilities (the ability to change and innovatively recombine substantive capabilities, thus reconfiguring a firm's resources and routines in the manner envisioned and deemed appropriate by a firm's principal decision-makers). Teece (2007) differentiates between sensing, seizing and reconfiguring dynamic capabilities based on an analysis of the nature and microfoundations of the capabilities necessary to sustain superior enterprise performance. Felin et al. (2012) identify these capabilities at three levels: individuals, processes and structure, while Ambrosini et al. (2009) examine these differences between levels of complexity and hierarchies, introducing the three levels of incremental, renewing and regenerative dynamic capabilities depending on the type of environment to which they respond.

These classifications can also be studied as dynamic capability hierarchies (Winter, 2003) as they change from zero, first and second order. The zero level of dynamic capabilities comprises the ability of firms to foster individual routines, incrementing the resource base (Danneels, 2002), such as continuous improvements and incremental adjustments and improvements to these resources (Ambrosini et al., 2009). The first order of dynamic capabilities involves renewing dynamic capabilities (Ambrosini, et al., 2009) with the goal of extending and modifying the resource-based advantages representing environmental shifts. The second level includes a transformation of the resource base, fostering the organization's strategic change (Helfat et al. 2007).

2.3. Research on SOI, sustainability strategy and dynamic capabilities

Within that last twenty-five years, scholars have carried out in-depth studies on how the natural resource-based approach and the concept of dynamic capabilities help us understand how organizations generate proactive corporate strategies in favor of ecological responsiveness (Aragon-Correa and Sharma, 2003; Bansal, 2005; Bansal and Roth, 2000; Hart, 1995; Russo and Fouts, 1997). Previous literature on corporate environmental strategies and sustainable business discusses how the dynamic capabilities needed to develop proactive environmental strategies emerge from international experience, capital management capabilities and organizational slack (Bansal, 2005) or even from contingent elements such as uncertainty, complexity and munificence (Aragon-Correa and Sharma, 2003). In trying to explain the necessary capabilities for corporate sustainable development (Bansal, 2005) and sustainable business (Van Kleef and Roome, 2007), the literature on business and the natural environment has often pointed to innovation as a key dimension (Hoffman et al., 2012; Rodríguez et al., 2002; Sharma and Vredenburg, 1998). However, we still lack a comprehensive theory that looks at the dynamic capabilities required specifically for SOI.

New research published in the last few years explores how companies require a different set of capabilities to successfully engage in SOI strategies (Adams et al., 2012; Ayuso et al., 2006; Castiaux, 2012; Ketata et al., 2015). Recently, scholars have also looked at the evolutionary change processes adopted by companies, proposing a model of organizational evolution that positions dynamic capabilities for innovation as a core dimension for generative variation and the selection of innovative change (Zollo et al., 2017). These capabilities are dynamic since they need to respond to rapid changes in the business-economic environment and to environmental and societal challenges, forcing companies to react quickly in highly changing and disruptive conditions (Van Kleef and Roome, 2007). Recent research also analyzes the evolutionary change process that multinationals go through as they strive to innovate and adapt to corporate sustainability pressures (Zollo et al., 2017).

Previous studies have also identified separate dynamic capabilities that are related to SOI due to the latter's complexity and the dynamism it requires as compared to mainstream innovation. Dynamic capabilities fostering SOI involve more comprehensive and socially-complex innovation management, production and manufacturing processes (including cross-disciplinary coordination), cross-stakeholder management and engagement and system-thinking (Adams et al., 2012; Ayuso et al., 2006; Castiaux, 2012; Ketata et al., 2015; Van Kleef and Roome, 2007), as shown in Figure 1.

INSERT FIGURE 1 AROUND HERE

However, as illustrated in Figure 1, the literature on dynamic capabilities and SOI is highly fragmented and does not examine the evolving organizational transformation. There are only a few integrative studies (Castiaux, 2012; Van Kleef and Roome, 2007), and the connection between these studies is scant. As observed in Figure 1, out of a list of 22 capabilities identified in the literature, only 5 are interconnected. For this reason, the analysis of dynamic capabilities and SOI requires a comprehensive analysis of patterns across firms to understand how they evolve and transform while they connect to adopt sustainable business models. Research that corroborates this analysis with empirical evidence is also needed.

That notwithstanding, previous studies on dynamic capabilities and SOI have reached some shared conclusions. Five commonality elements have been found in at least two previous studies (as numbered in Figure 1): 1) more openness to agents that are external to the firm (Castiaux, 2012; Ketata et al., 2015); 2) stakeholder involvement in the innovation process (Ayuso et al., 2006; Castiaux, 2012); 3) being able to identify and respond to regulatory and technological changes; 4) a systemic approach to society (Adams et al., 2016) in which the relationship with other actors in the ecosystem is well-managed; and 5) building trustful

relationships (Castiaux, 2012; Van Kleef and Roome, 2007). These capabilities have been identified with some nuances in different studies, but, interestingly, they are classified under different hierarchies (ordinary or dynamic capabilities) or functions (e.g., as the study of a ‘unique capability’ in Ayuso et al. (2006) or as a ‘seizing capability’ in Castiaux (2012).

These five frequently identified capabilities reflect that adequately managing stakeholders and the external environment is of major importance (Ayuso et al., 2006; Castiaux, 2012) to integrate the firm’s demands and knowledge regarding the innovation process (Ben Arfi et al., 2017). This is related to a culture of openness and engagement with the external environment, not merely interacting but creating durable bonds with the different actors in the firm’s environment (Adams et al., 2016; Castiaux, 2012; Ketata et al., 2015; Van Kleef and Roome, 2007). It is also important for the firm to create a climate of trust and commitment that fosters long-term projects and a sense of mission to face the added complexity of SOI (Castiaux, 2012; Van Kleef and Roome, 2007).

Therefore, the originality of our research lies in the development of an empirical study of the different levels of dynamic capabilities for innovation adopted by companies developing SOI and their evolutionary dynamics. For this reason, we carry out a comparative case study (Eisenhardt and Graebner, 2007; Yin, 2009), searching for common patterns among leading companies in SOI for the last decade as explained in the next section. Based on this research, we hypothesize that we will find the following structural patterns:

- a) In line with previous research on hierarchies of dynamic capabilities, we expect to find at least three different levels of dynamic capabilities of increasing complexity.
- b) In accordance with research on dynamic capabilities for SOI, we expect to find dynamic capabilities related to: 1) openness; 2) the integration of stakeholders; 3) a response to regulatory and technological changes; 4) a systemic approach to society; and 5) the development of trustful relationships.

3. Methods

3.1. Methodological approach

In examining the underlying conceptual structure of SOI literature and how companies evolve and transform dynamic capabilities, we divided the empirical research into two step-wise processes. First, we conducted a review of scientific and grey literature to identify and elaborate the set of dimensions which are unique to SOI. Second, in dealing with the complex evolution upon which SOI transforms dynamic capabilities, this study drew on different levels of dynamic capabilities (Collins, 1994, Winter, 2003; Ambrosini et al, 2009). Building on this challenge of different evolutionary paths, this research includes a multiple case study (Eisenhardt and Graebner, 2007; Yin, 2009), searching for common patterns among leading companies in SOI. We elaborated on current knowledge, framing an inductive-deductive research design (Pratt, 2008, 2009). We built on previous research but let the empirical analysis proceed with the tenets of grounded theory (Corbin and Strauss, 1990), including data gathering, codification and analysis.

3.2. Research design

We conducted this research using a circular inductive-deductive process. It began with a review of the literature on dynamic capabilities and SOI, in keeping with the theory-data-theory approach suggested by Pratt (2009). The study comprised a review of the literature on dynamic capabilities and SOI so that we could develop an initial conceptual framework based on previous research. We used this framework during the second stage to structure the cross-case study and develop data collection protocols for company interviews. Based on this protocol, we interviewed different managers in seven companies. We then carried out a content analysis of the data collected through three-level coding methods (Gioia et al., 2013). Finally, we contrasted these results again with those in the literature. After three cyclical rounds of

literature review and data coding (when we achieved theoretical saturation), we built our framework. Figure 2 illustrates the research design.

INSERT FIGURE 2 AROUND HERE

3.3. Sample selection

We based the selection of the cases on theoretical and purposeful sampling principles (Eisenhardt, 1989; Pratt, 2009) to guide our research in a way that best addressed the research problem. To obtain more comprehensive results and find common patterns across the firms that are otherwise very different (Bryman, 2008), we sought maximum variation by sampling for heterogeneity in terms of industry, size and firm age (Patton, 2005). Three of the seven companies are SMEs (under 250 employees) according to the EU classification. This type of purposeful sampling complements the existing corpus of empirical research, which relies mostly on single case studies. The selected companies are seven leading firms fostering SOI in Spain. These companies have either been recognized through awards for their innovation and/or sustainability activities and/or are active members of associations promoting SOI. In selecting the sample, we initially searched for the leading Spanish innovative companies according to their R&D intensity (percentage of turnover invested in R&D) and contrasted these to leading sustainable companies. We then selected a set of 50 leading companies in SOI. Next, we used the analytical framework developed by Adams et al. (2016) to study how these companies had accomplished the three evolving stages: operational optimization, organizational transformation and system-building. To assess whether the firms had incorporated such practices, we screened their official websites and reconfirmed by phone whether the firms had participated in such activities. We finally selected 10 companies, only seven of which accepted being interviewed. Our sample thus includes 7 leading companies in

SOI. We provide details on the sample companies and their SOI activities and stages in Table 1. We purposefully hide these companies' names, using their respective industries to identify them: Chemical, Climate, Electric, Fashion, IT, Technological and Wind.

INSERT TABLE 1 ABOUT HERE

3.3 Data collection and sources

The researchers collected data from May 2013 to July 2014. At least one of the researchers developed trustful relationships with at least one informant in each company, thus facilitating follow-up meetings and contact with other agents in each company. We detail data sources in Table 2. These include:

- (1) Semi-structured interviews (n=31). The interviews targeted innovation and sustainability managers as well as CEOs. In some companies, these responsibilities overlapped and fell on the same person. These, in turn, identified other informants apart from those initially targeted as most relevant to SOI processes, which differed from one company to another, leading the researchers to interview persons in other positions, such as marketing managers and environmental managers. The two researchers participated in each interview, and they contrasted answers obtained in the first round of interviews with other informants in the same companies. Interviews lasted from 50 minutes to over three hours. Interviews and focus groups were transcribed verbatim to codify the data.
- (2) Focus groups (n=3). Both researchers participated in all three focus groups with respondents from three different companies. In these they discussed preliminary results and were also able to identify trade-offs between different company roles and how the participants' perceived their respective companies' SOI journeys. During the focus groups, one of the researchers acted as moderator while the other took notes. After asking

participants to interpret their firms' SOI journeys and strategies, the moderator informed them about the preliminary results and asked them to discuss these based on their own experience.

(3) Observations. The authors conducted joint multiple site visits to the companies and stayed as observers. The respondents showed the researchers the different companies' facilities and had the opportunity to interact with and observe employees. Independently, each of the researchers collected data by taking detailed and individual field notes of their experiences and interactions, which both later discussed and contrasted to understand their individual impressions. During the site visits, the authors also had informal discussions with the respondents about the firms' organizational culture, their SOI projects and how the companies had evolved over time.

(4) Archival data. The researchers gathered secondary data from the companies' internal documents and other data provided by the informants. Archival data played a limited role in the research process, and the authors used it mostly for sample selection and result validation.

INSERT TABLE 2 ABOUT HERE

3.4. Data analysis

Data analysis included a process of codification following content analysis as proposed by Gioia et al (2013). We coded the interviews, focus groups and researchers' field notes, contrasting new data to preliminary analyses (Corbin and Strauss, 1990). We used the open coding function found in the NVivo software program. The first author initially coded the data, while the two authors independently conducted the second and third levels of codification. The two authors then compared the resulting themes and aggregate codification levels and

discussed them in cases of disagreement, although the intercoder agreement was high at both codification levels (78% and 85%, respectively). After three rounds of codification with contrasts with the literature, we achieved theoretical saturation. Figure 3 details the conceptual development from codes to categories (coding scheme). The coding process was conducted as follows:

INSERT FIGURE 3 ABOUT HERE

(1) Concepts (first-order codes): we initially coded the interviews with a focus on organizational routines, repeated performance and learning processes in an open coding manner. We first created descriptive codes (Miles and Huberman, 1984) (e.g., “co-creating with suppliers,” “being responsive to client needs” and “alignment of strategy with sustainability goals”). The first researcher analyzed the capabilities and interactions, examining respondents’ narratives over time and then comparing answers from interviewees in the same firms for similar and different concepts, contrasting data and constantly modifying and honing the basic concepts of the growing theory based on the research questions (Strauss and Corbin, 1990). Both researchers sought for categories that helped to explore the research question. We looked for similarities and differences among the categories and reduced these to a manageable number. We labeled these categories with concept descriptors. We thus obtained 192 different codes during the first-level coding stage.

(2) Themes (second-order codes): both researchers grouped the previous codes, including the continuous analysis of their subcategories (Corbin and Straus, 1990:13), testing their relationship against the data and preliminary emerging themes as concepts that helped to explain the phenomena. Both then verified the emerging hypotheses, validating those that were supported and eliminating those that were not contrasted. This second level of codification let

the authors build conceptual linkages and understand under what conditions new dynamic capabilities take shape across different evolving levels. Upon achieving theoretical saturation (Glaser and Straus, 1967), the researchers reduced the number to 36 themes, consistent with the repeated patterns and validated hypotheses (Strauss and Corbin, 1990).

(3) Aggregate dimensions: finally, the authors employed a third level of abstraction, searching for aggregate dimensions, including conceptual connections across 2nd order codes (Gioia et al., 2013). We also found that aggregate codes of dynamic capabilities pivoted around three sustainability strategic dimensions: sustainability-driven market reconfiguration; sustainable business management; and sustainability networking and leadership. Moreover, when examining the relationship between the strategic dimensions and capability levels and looking back at the data and the storyline of capability development found in each of the companies (see Table 3), we observed interconnected logics. In fact, most of the interviewees provided a historical narrative of their firms' evolution, allowing us to observe the development of SOI organizational transformation within and explore questions related to ordering over time. This allowed us to observe path-dependent and self-reinforcing logics. We thus generated 19 codes that we classified into different categories.

3.5. Result validation

We deployed several strategies to validate our results. The first strategy implied data triangulation. In this regard, we ensured informant triangulation in each of the cases by interviewing different informants in each of the companies studied (Miles and Huberman, 1984; Yin, 2009). We conducted interviews in each case with different company managers, who brought distinct perspectives and who, a priori, had dissimilar interests and responsibilities (Denzin and Lincoln, 1997). Second, we also triangulated primary data sources with secondary data, as a complementary source of validation to contrast the primary data and analyze the validity of the information obtained through the interviews. Third, when codifying the

interviews, we used an iterative process, continuously contrasting data and theory, comparing each step of our codification with theory and recoding the data to find for more aligned codes between data and theory (Pratt, 2008). In this process, we reached data saturation after coding 23 interviews (corresponding to 5 cases), although we coded all 31 interviews without finding new patterns in the data (Fusch and Ness, 2015). Finally, we also contrasted preliminary results with the focus group participants, which helped to guide our aggregate and axial coding and informed the discussion of results.

4. Results

4.1. Evolving framework of dynamic capabilities: hierarchies and dimensions

With the open codification of the data (see Figures 2 and 3) from each of the cases, we observed different types of dynamic capabilities involved in the SOI process, as detailed in Table 3. The latter summarizes our findings regarding capability development in each of the SOI strategic dimensions across the seven case studies.

INSERT TABLE 3 AROUND HERE

4.1.1. Hierarchies: levels of dynamic capabilities

Initially, we identified these capabilities for each individual case. In the second and third stages of codification, previous research on hierarchies of dynamic capabilities helped us to identify different levels of complexity among the capabilities that emerged from the data. As expected, we were able to identify three different levels of capabilities. The cross-case analysis of each of the characteristics of each of the levels showed consistent patterns within dynamic capability levels. We identified the following three levels of capabilities emerging from the data:

(1) The *adapting* level. These dynamic capabilities emerge first in most of the companies and involve continuous improvements and adjustments to the firm's resource base, transforming these resources into new sustainability-oriented routines and learning processes, incrementing the individual skills and the emerging sustainability organizational knowledge and routines towards SOI strategic design. Ambrosini et al. (2009) also refer to these as 'incremental' capabilities.

(2) The *expanding* level. This second level shows when companies have been building and expanding SOI projects into more advanced initiatives. These dynamic capabilities are based on the emergence of new organizational capabilities that were not in the company before, improving and advancing SOI processes for the markets, aligning innovation and sustainability and collaborative networks. Firms expand to address sustainable customers' needs and market demands, including new sustainability management processes and vanguard clean technologies and organizational learning processes in collaboration with external SOI partners and stakeholders (Roome and Wijen, 2005). These are similar to what Ambrosini et al. (2009) define as 'renewing' capabilities.

(3) The *transforming* level. Our data also show that a higher level of dynamic capabilities for innovation emerges in the case of more advanced transformative companies in the process of adopting a sustainable enterprise model. These complex and transforming dynamic capabilities appear when the company regenerates and reconfigures previous SOI processes in the pursuit of system-building (Adams et al., 2016; Iñigo & Albareda, 2016), moving towards new system-based transformational processes in order to create new social, environmental and economic value. These include advanced organizational learning processes with external stakeholders (Roome and Wijen, 2005), building sustainability-oriented organizational resilience in the markets, generating new sustainability leadership strategies and new sustainable business models and adopting the "sustaincentrism" process (Valente, 2012). These

represent a higher-order level of dynamic capabilities (Winter, 2003), “reconfiguration” (Teece, 2007) or “regenerative” capabilities (Ambrosini et al., 2009).

4.1.2. Dimensions of dynamic capabilities for SOI

Our data reveal three different levels of dynamic capabilities (adapting, expanding and transforming) connected to the three different SOI strategic dimensions which we have found to be common patterns. By studying the dynamic capabilities identified in each of the cases and informed by patterns of dynamic capabilities for SOI in previous research (see Section 2.3.), we found that dynamic capabilities for SOI at different levels revolved around three different functions or dimensions: (1) sustainability-driven market-reconfiguration; (2) sustainable business management; and (3) sustainability networking and leadership. They appear in all the companies as the main aggregated dimensions of SOI strategic transformation. In the following sub-sections (4.2.-4.4.), we explain our findings regarding the evolving framework across the different SOI strategic dimensions. They emerge through an evolutionary cycle, with three different levels of dynamic capabilities that evolve and transform in each company, but, again, with common patterns.

To explain our findings, we include company-based examples, with case descriptions and quotations. Figure 4 describes the conceptualization of this evolving framework. Below we study the three levels of dynamic capability transformation in favor of innovation across the three strategic SOI dimensions, showing the common patterns that emerge in our empirical data.

4.2. Sustainability-driven market-reconfiguration

A key sustainability strategic dimension found in all the case studies is the fact that SOI connects to new market opportunities also referred to as reconfiguration. According to our analysis, SOI projects emerged mainly because companies envision new market-based opportunities to develop new sustainability products or services. Demand pulls the

development of SOIs (Ghisetti, 2017); however, how these companies develop capabilities to satisfy such demands differs. Large companies might respond to market demands for sustainability-products, while SMEs tend to search for new market opportunities. This was a major concern for all of the companies, as some had encountered marketability struggles with their SOI projects, leading them to trial-and-error learning processes for new market-related capabilities. This was especially important among the SMEs in our sample. Larger, more established market-driven companies leveraged their existing market capabilities to successfully commercialize their SOI products or services, though they also encountered problems with market maturity or when exploring new markets. Therefore, economic viability was also a main goal of their SOI projects and practices (Crittenden et al., 2010; de Medeiros et al., 2014; Teece, 2007).

Our data analysis reveals that market-driven strategies followed evolving processes that forced companies to engage in developing increasingly complex dynamic capabilities that changed over time:

4.2.1 Adapting level

First, we saw that companies need to develop sustainability-scanning skills to understand the new trends among customers. They also need to understand how sustainability-related regulatory and environmental changes and market megatrends will affect the company. Most of the companies induce SOI in their industries, exploring new markets. Some firms, such as Technological, have formalized technological vigilance systems in place, while others, such as Chemical, include sustainability trends in this formalized form of environmental scanning.

The CSR Manager at Wind explained it this way:

Sensing trends for SOI consists mainly of an inward flow; we observe what's happening at the international level in certain areas that are not directly concerned with our company; for instance, issues of reputational impact, advances of other companies that are important to the market but had not been evaluated before, some things that are not

perhaps directly related to innovation, but that are good practices that are useful for us to innovate and incorporate as a best practice.

4.2.2 Expanding level

At the second level of dynamic capabilities, going beyond adapting capabilities for SOI, companies focus on client responsiveness, expanding strategic activities with their main customers based on their key needs, co-designing innovation strategies and co-creating new products and services. Therefore, this second level of dynamic capabilities involves complex learning and organizational activities, learning from customers, maintaining ongoing conversations with them and co-creating with them. Being responsive to clients is a main dynamic capability developed by most of the studied companies, such as Technological and IT. These have developed capabilities that enable them to rapidly respond to client demands for sustainability. In case of the SMEs, Climate's CEO explained how the firm's new ideas for SOI projects had come from conversations with clients. In other words, new innovation ideas came from the demands for sustainability that other (larger) firms had not identified or been able to meet. However, other companies have developed marketing capabilities to create new markets for SOIs, something which often requires educating the customer base on the sustainability-related advanced features of their products, as is the case with Chemical, Fashion and Climate. This explains how these companies seized new SOI projects following their engagement with clients, discussing and meeting with them, and aiming to both learn and educate. For instance, the Innovation Manager at Chemical explained:

Before, when we launched the first eco-designed products in the market, it was like preaching in the desert. None of our clients knew what eco-design was or what a lifecycle was, and our salesmen were desperate because they had to give too many explanations. We had to change our sales strategy completely by highlighting the efficiency of our eco-design products, promoting them as new solutions for clients' demands. Our sales team needed to develop new marketing skills related to an in-depth explanation about how the products work and how they could be more efficient and safe for our clients. Most of them were in the food production business, where health safety is a major principle.

4.2.3. Transforming level

Finally, some advanced SOI companies have developed a third-level of dynamic capabilities for their sustainability market reconfiguration strategies. According to our analysis, this level requires more complex and evolved dynamic capabilities. We only found them in the most advanced companies, mostly SMEs with a clear commitment to sustainability. These firms have been able to develop new capabilities by learning from vanguard value propositions and transforming their SOI market-based models into new sustainable business models (e.g., eco-designed and green chemistry cleaning products for hospitals). At this level of dynamic capabilities, these companies develop new functions that frame new sustainable business models including disruptive changes. These require not only minor changes in terms of how the firms operate but a major reframing of market dynamics and operational components. For instance, the *slow fashion* business model adopted by Fashion required a major reboot of its operations, logistics and design cycles and requirements, different from its major competitors. The slow fashion business model competes against the current dominant business model in the industry (fast fashion) by designing garments with greater durability, working with ethical and fair textile suppliers and less CO2 emitting logistics (lengthier ship transport rather than airfreight, for example), among other measures. For the firm, this transformation required a complex and interconnected learning process with external stakeholders (Roome and Wijen, 2005), as imitating previously successful business models was not possible. We see the importance of framing dynamic capabilities for sustainable business models by the comment provided by the CSR Manager at Technological:

In the end, we knew how to transform our business model into a sustainability approach. We understood the main building blocks of the previous business model [...] and we employed a differential business model; if we had done what everyone else was doing, we would not have been sustainable; we would have collapsed.

4.3. Sustainable business management

After market reconfiguration, we find a second strategic dimension in most of the companies that is important to enhance SOI. It is based on the integration of sustainable business management tools (Sharma and Vredenburg, 1998). Sustainable business management acts not only as an important internal driver for SOI projects but also as a way to integrate sustainability-related knowledge, environmental management systems and clean technologies, the basis for new SOI initiatives. Our analysis reveals that it ultimately serves as a key driver to transform and adapt the dynamic capabilities to achieve SOI goals and reinforces the development of a corporate identity constructed around sustainability (Valente, 2012). As previously identified, our analysis of dynamic capabilities for innovation shows how these adapt and transform to complex levels while improving the firms' sustainable business management. Our research shows three levels of evolving dynamic capabilities:

4.3.1. Adapting level

At the less complex level, companies gradually implement and nurture SOI projects with the knowledge acquired through environmental management systems (ISO, EMAS and others) and sustainability certifications, which have shown to be levers for building resources for SOI (Amores-Salvadó et al., 2015). As our respondents explained, these serve as key enablers when searching for SOI solutions and ideas. As the Innovation Manager at Chemical described, instead of hindering innovation, implementing management systems throughout the firm helped to standardize sustainability practices and organizational routines across the whole firm and introduce the quest for sustainability into all its activities; in particular, it helped SOI:

Environmental management systems and eco-design certifications are very important for us, because in achieving their goals, we learn and gradually incorporate those requirements in our products.

All the studied companies have used these management systems to improve SOI projects, bring new opportunities and create value, adopting them as a resource to learn new methodologies, monitor progress, align strategies and integrate different aspects of the innovation process. They also acquire knowledge on sustainability from other sources, such as industry associations, sustainability-oriented organizations (e.g., a local eco-design center, environmental agency or inter-industry associations for sustainability) or methodology courses (on eco-design, lifecycle, bio-mimicry and others). Evidence on how sustainability management systems were used as sources of knowledge for SOI projects was provided by the CSR Manager at Electrical:

We defined a management system with a CSR commission, which is integrated by the advisors and a person from each department, that is, one person from Health and Environment, another from Quality, another from Procurement, another from Human Resources... Little by little, more and more actions have been implemented through this management system, and this now influences design and improves new innovation for sustainability projects.

4.3.2. Expanding level

We also found that most of the companies went beyond and moved towards a second level of dynamic capabilities for SOI. We see how these companies developed new dynamic capabilities that let them align their innovation and sustainability strategies, which were previously separated. As analyzed above, by embedding sustainability in the firm's core values and mission and its strategy-design process and ensuring a high absorptive capacity for sustainability knowledge, companies developed SOI organizational learning processes that helped them to align sustainability to their innovation strategies. For instance, Technological includes SOI goals in its Action Plan. This Action Plan is part of the company's longer-term strategy. We also see from our analysis how, Electrical, for example, integrated and aligned its innovation and sustainability concerns. As this company's CSR Manager explained:

We currently don't understand sustainability as a business model based on the binary alternative of responsibility versus reality. Instead, we recognize the importance of aligning strategic development with the needs and expectations of our stakeholders, hence bringing together the achievement of economic benefits with social commitment and respect for the environment. Therefore, sustainability is not a separate strategy; in contrast, we have integrated sustainability in management and innovation policies, conceiving innovation projects that respond to sustainability standards and the needs and worries of our stakeholders.

For Climate, sustainability was part of its innovation strategy from the outset. In any case, it required absorptive capacity in order to improve the company's capabilities to integrate sustainable business culture throughout the organization. Hence, companies adopt sustainability management and knowledge as core routines including clean technologies and sustainability-tools (e.g., eco-design certification, LEED certification, lifecycle assessment tools and circular economy).

4.3.3. Transforming level

Finally, the most advanced companies in the SOI journey are able to develop complex dynamic capabilities linked to sustainable business management. Even leading companies such as those in the sample have not all been able to develop capabilities at this level. These are mainly related to the firms' organizational resilience, based on system change and their adaptability to frame innovation projects that lead to system transformations (Valente, 2012). These companies build organizational resilience through sustainability transitions that increase organizational slack, create trust among stakeholders and embed the firms in their communities. In this case, these companies are evolving and incorporating sustainable development as a core principle. Such firms can absorb shocks at several levels in highly discontinuous environments; they can grow from these experiences and use them to learn, transforming their capabilities. For instance, Chemical adopted a comprehensive, sustainable business approach, including a sustainable business model, green chemical technologies, eco-design processes and operations, client alliances and training courses, making it a clear leader

in the transformation of the chemical industry. A similar case was Fashion, which adopted sustainability management to foster advanced SOI projects to transform the whole industry and have it adopt a slow fashion model. These companies are better equipped to survive changes in their complex environments, face new challenges and assume risks derived from SOI. This is also the case with Climate, which continuously changes its SOI to adapt and transform to be able to tackle new sustainability challenges, becoming a flexible and resilient organization in the process. As its CEO explained:

We are not very much in favor of permanent structures. I mean, I picture that everything will have an expiration date: for instance, if we are finally able to set up [name of the project], it will have a couple of years of peak, because people will be motivated, they'll contribute... But most surely a moment will come when the effectiveness and capacity to integrate ideas will be reduced, new internal or external challenges and difficulties will be faced, and then we will need to find another way to do it. We will have to change it. And I think that this is very important to keep in mind. We have learned how to adapt and successfully face continuous challenges to sustainability markets, client demands and external regulations or crisis.

Advanced organizations explain how they become resilient through system transformations. Thanks to the organizational resilience generated by higher adaptive organizational routines and learning processes, firms can anticipate and react to disruptive changes and thrive in the turbulent environments and sustainability changes experienced in the last few years.

4.4. Sustainability networking and leadership

Finally, we also found a third sustainability strategic dimension that helps to enhance SOI. This strategic dimension pivots around the development of sustainability-oriented networks with societal stakeholders and advanced leadership capabilities in the market and society, with firms participating in the wider system transition for sustainability (Russel and Smorodinskaya, 2018). Our data reveal that companies are able to build new ecosystems for SOI, beyond the boundaries of the firms, attracting new talent with knowledge of SOI, building leading SOI teams and connecting and networking with a broad range of societal and

environmental stakeholders (Goodman et al., 2017). SOI requires new dynamic capabilities to create a network of sustainability leaders and implementers across the firm, building sustainability-driven ecosystems with societal stakeholders. These networks include an extended ecosystem of scientific and sustainability-oriented stakeholders that bring new knowledge and tools (e.g., eco-efficiency, eco-design, circular economy, lifecycle analysis, etc.) to the company. We also find the three levels of evolving dynamic capabilities (adapting, expanding and transforming).

4.4.1. Adapting level

At this level, companies develop new skills to attract talent and gain access to professionals who are highly educated, trained and committed to sustainability. This capability becomes crucial, and new, sustainability-oriented talented teams are found in all the companies. They develop new SOI organizational routines and adopt learning processes, as observed in many of the studied companies. Sustainability-based human capital constitutes a source of adaptation and variation of dynamic capabilities for innovation. They explore new ideas and develop new SOI projects: it is vital for human capital to be aligned with each company's core values, principles and strategic goals. Hence, all the companies hire or promote new professionals who have completed formal sustainability-related technological and certification training programs but who also demonstrate a commitment to the firms' objectives. Companies also describe the emergence of new multidisciplinary innovation teams to search for new SOI opportunities, learn about clean technologies and generate new ideas geared towards developing SOI. The importance of diversity and sustainability knowledge within teams was mentioned by the Head of Innovation at IT:

All of the people on the team bring in a different expertise; professionals with different backgrounds and sustainability careers work together. And we need complementary profiles to attend to both the social and technological challenges we face when we innovate. Building different teams with sustainability knowledge was very important for us. It still is as this knowledge needs to be continuously refreshed.

Furthermore, some of our sample companies hired new professionals to acquire specific new knowledge and to collaborate in generating diverse and efficient teams (e.g., Fashion and Climate) or train internal human resources. Company informants explicitly described how they sought out specialized professionals with different technological and sustainable backgrounds.

4.4.2. Expanding level.

At the second level of dynamic capabilities, our data analysis reveals that collaboration with external stakeholders oriented toward sustainability often leads to product or end-user co-creation, which serves as a source of added-value. The capacity to find, attract and collaborate with new partners linked to new SOI ecosystems (e.g., universities, end-users, certification organizations, etc.) becomes a key capability to develop multi-stakeholder projects and R&D partnerships, gradually blurring the boundaries between the firm and sustainability ecosystems. This implies that a company maintains an open attitude towards local and global stakeholders and builds new sustainability-based ecosystems (Goodman et al., 2017; Walrave et al., 2017). When Fashion started its SOI journey on its own, it introduced some natural fibers in its production process, believing that these would be more sustainable than the synthetic alternative. However, the company started collaborating with industry associations to acquire new sustainability-related knowledge and learned that the washing and dyeing process associated to this natural fiber polluted even more than the synthetic fiber. Thanks to its work with these associations, Fashion learned that there was a newer, more sustainable synthetic fiber that it could use as an alternative to both fibers. The Innovation Manager at Chemical also stated a similar approach:

As a small company, one cannot get far alone. Hence, it is good to collaborate and cooperate with other companies, and we have always been very active in the [regional sustainability] programs [...]. Collaborating with external sustainability stakeholders, such as the Environmental Cluster or the Basque Eco-design Center has also been very

important - we have forged alliances with other companies that have followed our same approach to sustainability.

4.4.3. Transforming level

Finally, the third level of dynamic capabilities involves building sustainability-based leadership across the organizations. Advanced companies on this journey instill collective responsibility towards SOI with an inclusive and trust-based leadership. The sustainability manager at Fashion explained this collective leadership as follows:

[The CEO] generates a lot of ideas, most of them very good, though some cannot be put into practice. I think [the CEO] is a generator of ideas, and needs the person to execute these ideas on his side. I think he is one of the motors of what we do [regarding sustainability practices]; it's his will, but also [the Design Manager] and I have firm convictions about what we do. We are all sensitized and take sustainability into consideration in whatever we do.

A main result is that these leaders become active system-builders to achieve sustainable development. Hence, different managers and teams become co-leaders, promoting new SOI organizational ecosystems and reconfiguring social capital as well as adopting a systems-thinking approach by considering social, ecologic and economic systems as interconnected (Valente, 2012). Thus, transforming SOI capabilities reveal the importance of leadership capabilities to reconfigure social capital across the firms and promote sustainability-based intrapreneurial abilities and visibility across societal and environmental stakeholders.

5. Theoretical development: the evolving logics between dynamic capability levels and dimensions for SOI

In this section, we discuss a second set of findings that explain the logics at play in the evolving framework presented in the previous sections. These findings relate the dynamic capabilities view of SOI with the staged, evolutionary journey of transformation that has been described for SOI (Adams et al., 2016; Carrillo-Hermosilla et al., 2010). This research has found that sustainability strategic dimensions were a main source for SOI advancements,

nurturing and fostering the development of advanced dynamic capability levels. This enhances an evolutionary cycle (Zollo et al, 2017) that is guided by time and organizational changes. This research shows the emergence of two evolving interconnected logics that explain this evolutionary cycle and finally help to understand the diverse generative variation and selection of innovation change and dynamic capability levels. These evolving logics reveal how the evolutionary change of SOI is diverse and depends on each company. The case studies demonstrate this diversity, and the different companies follow different time and organizational evolving pathways. This is parallel to what strategic and innovation scholars (Brown and Eisenhardt, 1997; Teece, 2010; Van de Ven et al., 2008) have studied in terms of the innovation journey. These logics are path-dependence and self-reinforcement. We explain the two evolving interconnected logics below building on key arguments or propositions. This is visually illustrated in Figure 4.

INSERT FIGURE 4 AROUND HERE

4.5.1. Path-dependent logic

The path dependencies in each company explain how dynamic capabilities adapt and transform over time. We find that the development of SOI in all the companies was framed by an accelerating pace of capability-building. Companies explained that, at first, they made slow adjustments to adapt their resource bases, representing some changes in human resources, attracting new talent and developing team-building capabilities, taking into account environmental management systems and acquiring new sustainability-related knowledge. Companies generally saw themselves in stable environments so they slowly promoted new sustainability changes. In the market-related strategic dimension, the adapting capabilities led firms to carry out a broad analysis of socio and environmental trends and environmental

scanning. Therefore, adapting capabilities are associated initially to slow stages along the SOI journey, when the companies first face new market and societal pressures and start making small adjustments that prepare and set their resource bases for further changes. As explained by Zollo et al. (2017), varying and selecting dynamic capabilities for innovation in the sustainable enterprise transformation journey first requires sensing stakeholder pressures and sustainability issues. However, our analysis shows how adapting capabilities gradually evolve into expanding dynamic capabilities, accelerating SOI-related changes over time and responding to changing sustainability-driven customer demands and regulatory environments. These dynamic capabilities sustain and refresh the nature of previous firm-based resources but, at the same time, enhance new adapting dynamic capabilities, providing companies with the ability to implement faster and more complex SOI organizational changes beyond small adjustments or efficiency gains. The pace of development accelerates when companies interact with clients to develop new sustainable products and services and work with them on SOI-related R&D projects. They aim to find and create sustainability-driven markets. Our data illustrate how most of the companies co-create innovative solutions with societal and environmental stakeholders, collaboration being a cornerstone of SOI (e.g. Climate, Electric and Wind). Our study also finds a third top-order of SOI dynamic capabilities: transforming SOI capabilities, that is, those that promote complex and advanced organizational transformation (e.g., Climate, Chemical and Fashion). As explained, we did not find all the transforming dynamic capabilities in all the companies studied. We argue that these acceleration logics towards system sustainability are difficult to integrate and absorb and happen at different stages depending on each firm's path-dependencies. Even in advanced companies like the ones in our sample, the final step towards system-building has not occurred across all the SOI strategic dimensions: this underscores that evolution across levels is path-dependent and does not occur uniformly throughout the three strategic SOI dimensions.

Transforming dynamic capabilities help companies respond to highly disruptive environments, with non-linear and discontinuous changes linked to sustainable development market demands and regulatory pressures. They involve restructuring the organization as well as framing new and disruptive sustainable business models and building organizational resilience based on sustainability transitions to meet the needs of a low-carbon economy, climate change transformation, circular economy and other sustainability-oriented proposals. Finally, we also see how some advanced companies are able to constantly build complex capabilities related to sustainability-based leadership, reconfiguring their organizational pool of talent and building sustainability-driven ecosystems between the firm and societal and environmental stakeholders. Thus, transforming SOI capabilities implies the rapid organizational transformation of the business culture, experimentation with external partners and environmental and societal stakeholders and committed leadership, thus facilitating further, more advanced SOI projects.

Each firm engages in different journeys at different speeds of variation (Eisenhardt & Martin, 2000) and degrees of development, resulting in diverse configurations and engagement processes, as illustrated by the diverse paths found in our sample. Furthermore, the development of different complex dynamic capabilities for innovation depends on each company's rate of adaptation, firm performance, previous experience and successful results. Therefore, it varies depending on the firm's corporate identity (Staub et al., 2016). Hence, path-dependency and previous learning processes are key variables to explain individual firm's evolving processes and SOI organizational transformations (Nelson and Winter, 1982; Sydow et al., 2009). Previous research (Barreto, 2010; Teece et al., 1997) has implicitly or explicitly explained how dynamic capabilities are uniquely firm-based. Therefore, SOI changes derive from the ability of individual businesses to enact dynamic organizational change, something which requires a temporal adaptation of dynamic capabilities for innovation and the expansion

of the resource and capabilities base towards the sustainable enterprise (Zollo et al., 2017).

Consequently, we propose:

Proposition 1. *The path-dependent logic explains different speeds of variation and rates of adaptation regarding the three levels dynamic capabilities for innovation (adapting, expanding and transforming) among companies.*

4.5.2. Self-reinforcing logic

This research also shows how the evolving framework includes a self-reinforcing logic between different levels of dynamic capabilities and sustainability strategic dimensions. We see the importance of self-reinforcing dynamic capabilities for innovation across sustainability strategic dimensions. The sustainability strategic dimensions are interconnected with co-evolving dynamics between them, and this is also self-reinforced by the variation or evolution of different levels of dynamic capabilities. Sydow and Schreyögg (2013) have studied self-reinforcing processes in organizations, referring to those mechanisms within an organization that generate desirable and rewarding results and can generate virtuous cycles or even create vicious cycles due to the unintended dynamics beyond intentional actions. In keeping with feedback spiral logic (Sydow and Schreyögg, 2013), we found that new SOI practices and goals are expanded across the organizations, informing decision-makers, providing new values and goals and changing evolving, complex dynamic capabilities for innovation. This self-reinforcing logic acts as a generative side-effect that transforms the organization, improving dynamic capabilities and fostering complex interactions between the strategic dimensions and the routines that ground the transformative dynamic capabilities. An example of these dynamics is the firm, Climate, in which a sustainability-oriented leader was able to attract and create a cohesive, responsible team (adding value to the firm through social capital). This permeated to the entire team's sustainability orientation, reinforcing organizational resilience through the profound commitment of management and employees. This has thus provided the

firm with the necessary trust to experiment with new sustainable business models; in fact, the company has launched a spin-off with different business models approximately every two years since it came into existence.

These self-reinforcing logics become a virtuous cycle that includes greater organizational complexity in corporate SOI strategies, practices and processes. Consequently, we propose:

Proposition 2: *Self-reinforcing logics between the variations of three levels dynamic capabilities for innovation (adapting, expanding and transforming) explain the co-evolving dynamics across SOI strategic dimensions.*

6. Discussion

6.1. Implications for research

Over the last couple of decades, companies have embarked on a journey connecting innovation and sustainability, implying profound organizational transformation (Adams et al., 2016) while solving major societal challenges (Iñigo and Albareda, 2016). Despite the growing literature on the study of specific dynamic capabilities for innovation related to SOI (e.g., Ayuso et al., 2006; Huang and Li, 2015; Ketata et al., 2015) and even the research on different levels of dynamic capabilities (Castiaux, 2012; Van Kleef and Roome, 2007), the evolving cycle between dynamic capabilities for SOI towards sustainable business enterprises has not been thoroughly analyzed from an empirical integrative perspective. Therefore, we have adopted this perspective to expand and interconnect prior literature.

First, as suggested by previous literature, we did find that dynamic capabilities for SOI include: 1) openness; 2) stakeholder integration; 3) responses to regulatory and technological changes; 4) a systemic approach to society; and 5) the development of trustful relationships. However, we found new integrative relationships, providing a more nuanced view of this phenomenon and classifying these relationships into three dimensions: (1) sustainability-driven market-reconfiguration; (2) sustainable business management; and (3) sustainability

networking and leadership. We observed a path-dependent development within the SOI journey which implied these different capabilities evolving by building on each other. This improves our understanding of these capabilities in relation to the staged, evolutionary transformation towards sustainable business.

Second, as expected from previous research, we identified three levels of complexity in the hierarchy of dynamic capabilities for SOI. We expand the knowledge on dynamic capabilities for SOI through an understanding of how different levels of dynamic capabilities transform from a lower level, adapting dynamic capabilities, to a medium level, expanding dynamic capabilities, and then to a more complex level, transforming dynamic capabilities. These three levels of dynamic capabilities are common patterns in a co-evolving dynamic with the different strategic dimensions fostered by SOI practices and processes. Our findings also contribute to research on hierarchical dynamic capabilities literature, as we study these capabilities in the SOI context. Identifying three levels of dynamic capabilities for innovation corroborates previous theoretical notions of hierarchical approaches to dynamic capabilities (Ambrosini et al., 2009; Teece, 2007). We extend this research and explain what Zollo et al. (2017) propose as the evolution of the multi-stakeholder enterprise model, connected to dynamic capabilities.

Third, we extend the knowledge on SOI, providing an understanding of the evolving logics between the strategic sustainability of the firm and levels of dynamic capabilities for innovation. Our framework studies two different evolving logics: path dependent and self-reinforcing logics among dynamic capabilities co-evolving with strategic SOI dimensions. We first explore how dynamic capabilities for innovation in leading companies adopting SOI practices and processes follow an accelerating path-dependent logic. Dynamic capabilities evolve differently depending on the firms' previous capabilities and through slow adaptations to their preexisting resource bases. Beyond that, the self-reinforcing logics across these three

levels of dynamic capabilities interconnect through feedback between levels of dynamic capabilities that drive the development of complex evolutionary cycles of transformation.

This research also has implications for the broader study of organizations and the natural environment. Our data suggest that SOI is a core dimension for companies adopting an evolving mindset towards sustainable business (Zollo et al 2013). SOI is then a core issue for sustainable business transformation that helps to learn how companies transform through the three strategic sustainability dimensions described (sustainability market reconfiguration; sustainable business management; and networks and leadership).

6.2. Practical implications

In terms of practical and managerial implications, the dynamic capabilities approach presented in our study can help guide managers on which firm features and capabilities they need to address and develop to implement successful SOI-based strategies. Once managers have identified the existing strengths and shortcomings of their companies, the model's account of capabilities and their dynamics can help them determine how their companies should proceed. Consequently, engagement in SOI is enabled by a set of dynamic capabilities that operate at different levels and dimensions. The path-dependency observed to develop superior capabilities suggests that companies cannot fully engage in SOI overnight; moving towards sustainability-oriented practices and mindsets needs to occur transversally at different levels within the organization. Nevertheless, adapting capabilities and the acquisition of resources for SOI is a fairly deliberate process in which managers are able to implement certain SOI practices. Hence, firms that were not sustainability-oriented at the outset can progressively transform their organizations through SOI. Our analysis also helps them understand how to generate different outcomes. SOI outcomes emerged at the first and second level of SOI organizational capabilities, including new SOI products, services, organizational solutions and business models. And, while advancing towards transforming SOI capabilities, companies

achieve system-innovation outcomes, transforming not only their internal innovation processes but also their productive and economic processes across global supply chains and sustainable consumption and production systems.

6.3. Limitations and future research

This research also needs to acknowledge certain limitations that provide avenues for future research. First, due to the inductive and qualitative nature of our study, we cannot generalize our results universally. Accordingly, we have been hesitant to draw strong distinctions between companies, bearing in mind that the differences we uncover might respond to the limitation of our data. However, our results may offer avenues for analytic generalization (Firestone, 1993; Polit and Beck, 2010), as we performed an in-depth cross-case analysis of findings presented in the literature (Yin, 2009) and compared this analysis with our data. Consequently, the resulting theoretical model may be applicable to other settings (Eisenhardt and Graebner, 2007). Thus, we have been able to generalize our theoretical propositions from ongoing comparisons with previous literature and framed an SOI capability view that should be reviewed and further tested in future research.

A second limitation is not having collected data at different points in time. We based our ordering of findings on the temporal narratives that each informant gave us about the processes their firms adopted. In this sense, analyzing temporal experiences was very important in our codification and contrasting process and allowed us to understand the cyclical, temporal process associated to the development of SOI capabilities. Our temporal analysis based on the interviewees' historical accounts helped us examine the ordering of SOI capabilities over time to carry out ex-post rationalization. However, this implies a recall bias: that is, a re-writing of the respondents' memories under the light of more recent events. We tackled this through respondent triangulation; however, this limitation has to be acknowledged.

A third limitation of our research is its geographic scope. It is difficult to generalize direct claims about SOI capabilities when the study is methodologically limited in that all of the companies studied are headquartered in the same country. However, we intended to further develop existing theory (Pratt, 2008, 2009), and, for this reason, our study represents an in-depth cross-case analysis of seven companies leading SOI transformation in different markets, demonstrating the varied transformations occurring with respect to the firms' resources, competences and capabilities. In sum, more empirical research is needed in order to replicate and validate the results in other countries and contexts. The generation of the capability-based approach will bring new insights and outcomes to the study of the linkages between SOI, innovation management and strategy. Hence, future research should carry out comparative analyses across different countries and industries.

Based on our findings, further analyses that might explain the relationship between SOI hierarchical capabilities and firm performance are worth considering. In this regard, future research could also explore the relationship between SOI capabilities and firm performance, taking into account environmental, market and industry circumstances as moderators.

7. Conclusion

Scholarly research on SOI has focused on examining specific dynamic capabilities for innovation (Ayuso et al., 2006, Castiaux, 2012; Ketata et al., 2015; Van Kleef and Roome, 2007). By contrast, our study contributes to further understand SOI dynamics by examining the existence of common patterns that explain how companies evolve and develop three different levels of dynamic capabilities for innovation (adapting, expanding and transforming) interconnected to sustainable strategic dimensions. In so doing, we highlight the role that path-dependent and self-reinforcing logics across dynamic capabilities play in SOI organizational transformation, including key similarities and differences across firms. We believe that our

findings contribute to expand the theory of SOI as a core dimension of sustainable business transformation literature, an emerging research field requiring new theoretical underpinnings.

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Figure 1. Existing conceptual framework on SOI capabilities

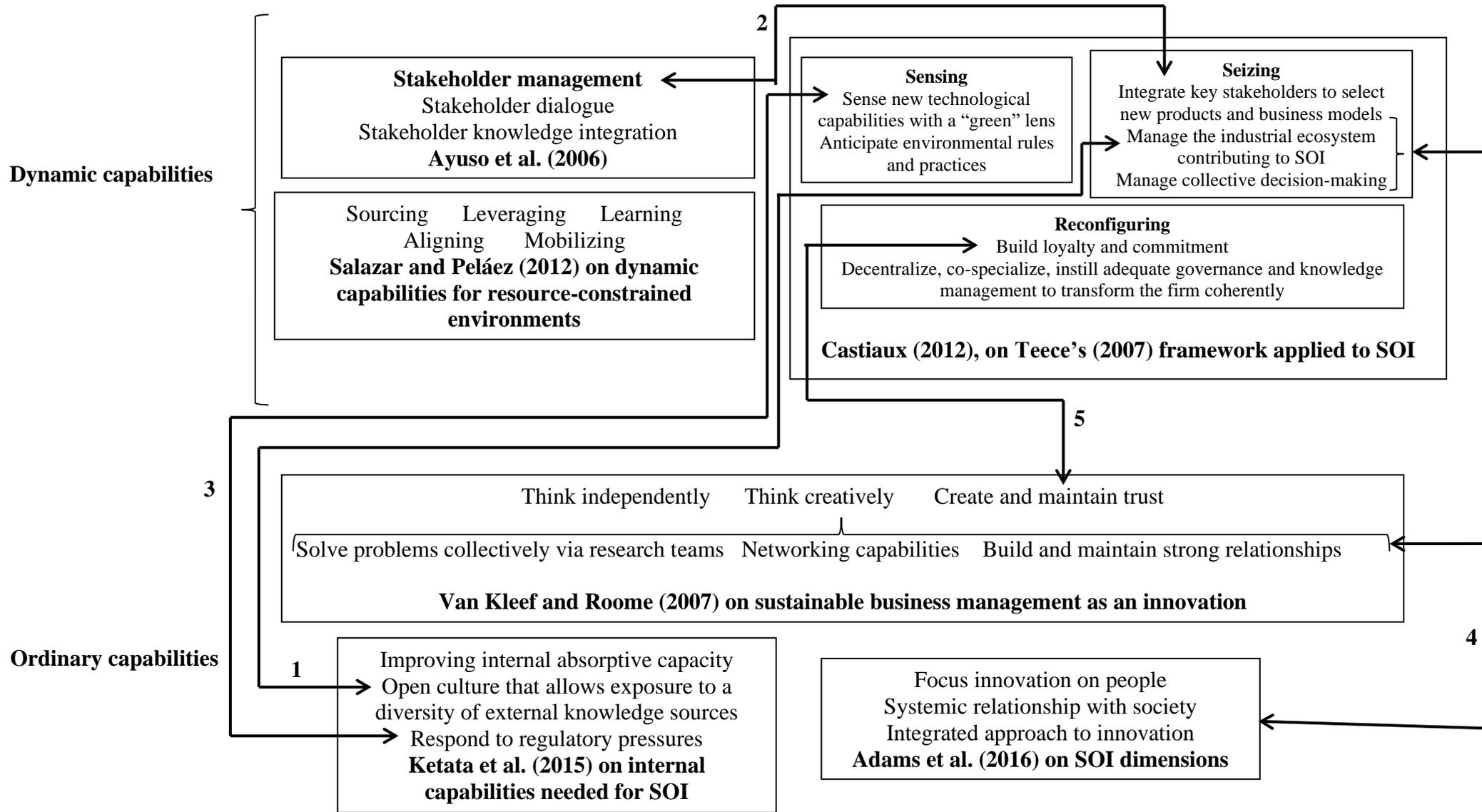


Figure 2. Research design

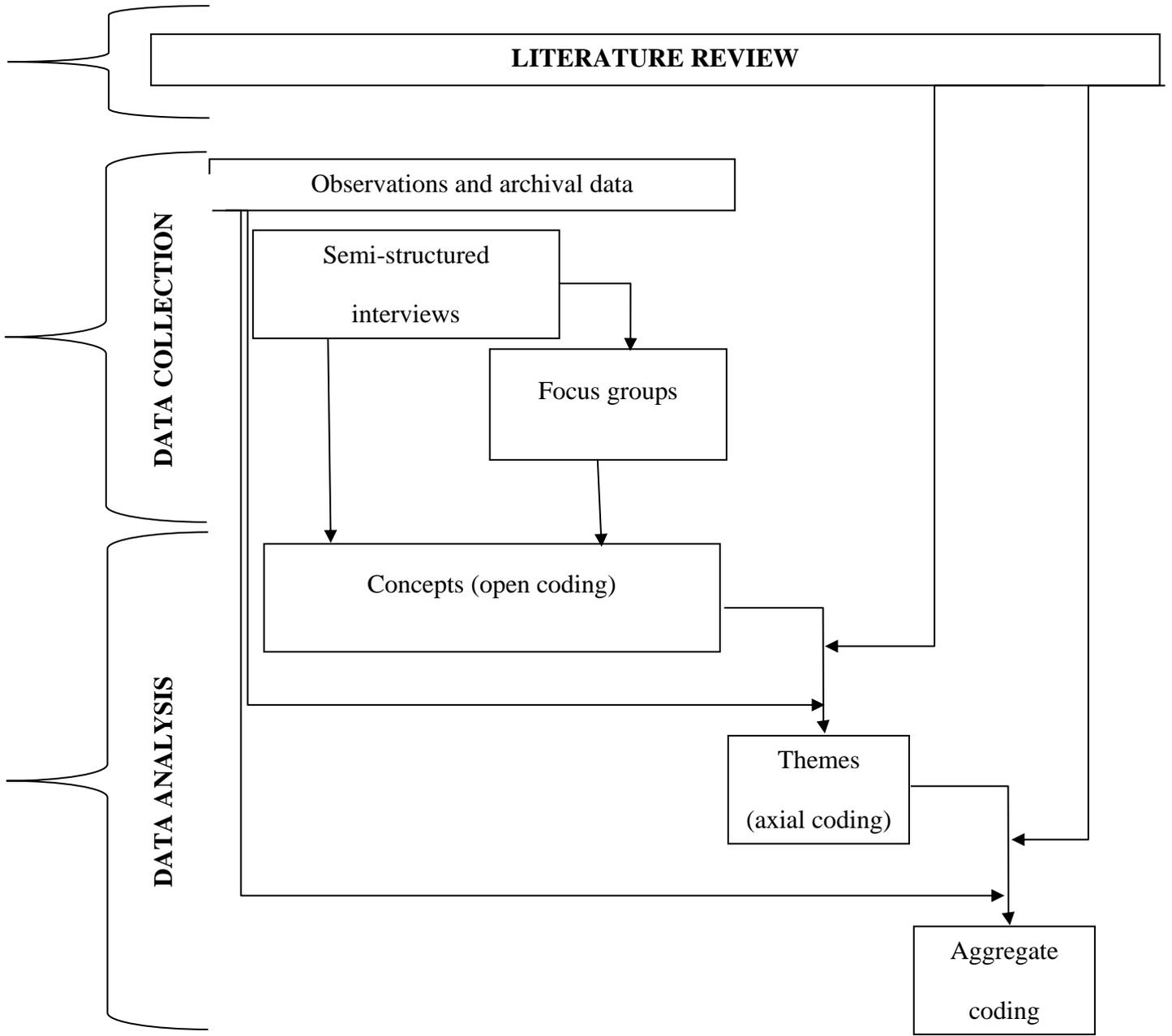


Figure 3. Codification tree and conceptual development

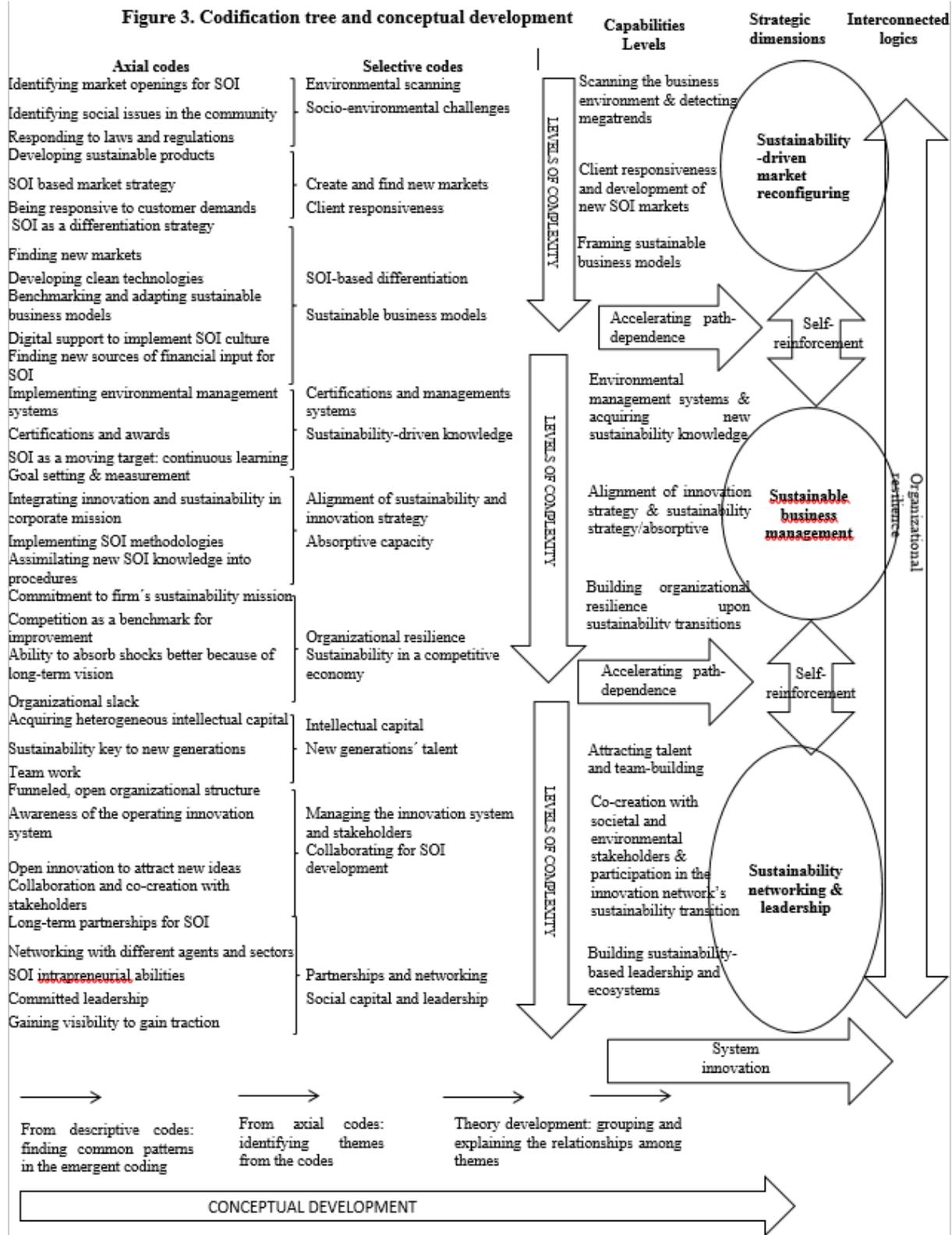


Figure 4. A capability-based view of SOI: Levels, strategic dimensions and interconnected evolving logics

