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Systems approach in dynamic capabilities

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Abstract

The ontology of dynamic capabilities (DCs) is grounded in a systemic perspective of organisational strategy. In a controversial move, DCs theory adopts systems thinking as a metaphorical reference, not a possible research method. Systemic methodologies can provide a holistic management perception and guide managers to develop DCs differently, considering the deliberate learning and design process as a non-linear dynamism of causal loops. Calling attention to the conceptual origins, this work proposes a framework based on systemic methodologies to manage and develop organisational DCs. Based on two different systemic methodologies, the viable system model (VSM) and soft systems methodology (SSM), we integrate the systems approach of learning and design into DCs management guidelines.

KEYWORDS

dynamic capabilities, soft systems methodology, systems approach, systems methodologies, viable systems model

1 | THE CALL FOR A SYSTEMS APPROACH IN THE THEORY OF DYNAMIC CAPABILITIES

The nature of dynamic capabilities (DCs) is grounded in a holistic concept of organisational strategy (Cyert & March, 1963; Nelson & Winter, 1982; Penrose, 1959; Schumpeter, 1934). The seminal DCs authors approach their fundamental characteristics as systemic (Eisenhardt & Martin, 2000; Teece et al., 1997; Zollo & Winter, 2002).

During its early days, the DC concept was criticised for lacking a coherent theoretical foundation, weak empirical support and unclear practical implications (Arend & Bromiley, 2009, p. 75). Since then, the research effort has addressed these earlier criticisms and moved the dynamic capabilities forward (Schilke et al., 2018).

Even though the research on DCs has flourished, a systems approach is underexplored, not valuing its essence. Some authors have already pointed out the need for a more holistic approach to DCs (Wilden et al., 2016). By 'more holistic', we understand the introduction of a systems perspective in theoretical and methodological approaches and a shift from a unique competitive advantage emphasis to a concept of superior performance (Wilden et al., 2016). Babío (2011) highlights that systems thinking contributes to organisational competitiveness and performance due to its ability to create a long-term perspective of the interactions and consequences of changes.

However, references to systems theory in DC theory seem to be metaphorical and allusive in most cases (Kozlowski & Klein, 2000). The empirical research on DCs has been employing a traditional approach, primarily based on linear causal models and conventional qualitative and quantitative methods of scientific research (Kozlowski et al., 2013, p. 606; Schilke et al., 2018: 407). Research has moved from the concept of seminal authors such as Teece et al. (1997), Eisenhardt and Martin (2000) and Zollo and Winter (2002) to more structured empirical

modelling and testing (Wilden et al., 2016). As DCs theory shifted from its genesis concept, it deviated from its systemic essence (Wilden et al., 2016). The resulting models are not necessarily wrong or invalid, but they capture only part of the management challenge of designing DCs. They are, thus, able to reveal only part of the concept.

When we use a linear research method to investigate a complex phenomenon such as DCs, we can see just part of the reality, metaphorically as a blind man touching different parts of an elephant and failing to get the whole picture (Peteraf et al., 2013). For instance, investigating DCs as a linear causal relationship can lead to a limited time horizon (Sterman, 2000) in exploring the dynamism of the phenomena.

Mingers and White (2010) call systems approach or systems thinking, a field intimately connected to developing soft operations research and management science. A system approach is congruent to a particular theory or concept when it: (1) provides theoretical insights based on systems thinking; and (2) provides practical management methods to deal with complexity.

The research on DCs addresses systems thinking as a metaphorical reference, not as a possible research and management method (Kozlowski & Klein, 2000). As organisational complexity increases and societal challenges become more threatening, management science studies should follow this movement by trying new approaches and methods to better address complexity. There are increasing efforts to introduce a systems perspective to managerial science; however, the approach is metaphorical as a new way of seeing and understanding the organisational environment. These recent efforts are not advancing yet to use systems methods to address organisational complexity effectively. In this sense, there is a need to emphasise the systemic nature of DCs, contributing to organisational strategy science. Besides allowing new methods, this changed perspective can improve a more dynamic development of DCs and open new avenues for the critical epistemological analysis of the literature. The rationale of system methodologies allows the capability to emerge from non-linear interactions among foundational elements, involving both negative and positive feedback loops (Chen & Fong, 2015; Harwood, 2011). Systems methodologies can be a way to manage complexity by tackling dynamic organisational behaviour (Shayne Gary, 2005).

We focus on the systems methodologies, often called systems approaches, and the underlying theories that support them. Our primary interest is in the VSM and SSM and their application as theoretical lenses to understand DCs and as methodological approaches to managing DCs.

By searching the literature, we only found three papers (Anggraeni et al., 2017; Cezarino et al., 2019; Liboni et al., 2018) articulating both themes, DCs, and systems methodologies. Two used systems methodologies as a secondary lens, whereas only one presented it as its primary focus. These papers did not offer the fulfillment of both criteria for the congruence of the systems approach to DCs. Even though this literature (Anggraeni et al., 2017; Cezarino et al., 2019; Liboni et al., 2018) touches on the themes, it does not provide combined insights and practical guides consistently congruent to suppress the metaphorical perspective of system thinking.

Since the under-exploration of a systems approach is evident, we propose to call attention back to the systemic essence of DC and to present the value of systems methodologies to contribute to both theoretical insights and practical guidance. By proposing a return to the origins, our objective is to demostrate the systems perspective's contribution to the research of DCs, particularly regarding the application of systems methodologies.

We believe our insights are of interest to both systems researchers and DCs scholars and managers. DC scholars could benefit as they integrate insights provided by the systems methodologies into their theoretical frameworks and empirical research designs. Managers will benefit from recommendations on applying systems methodologies to build or guide the evolution of organisational DCs.

We will structure this paper into four sections. The first section discusses the concepts of DCs, using the most influential authors (Eisenhardt & Martin, 2000; Teece et al., 1997; Zollo & Winter, 2002). We then highlight the concepts of systems thinking, presenting two systems methodologies, soft systems methodologies (SSM) and viable systems methodologies (VSM). Finally, we illustrate how DCs concepts are aligned with these systems methodologies, developing two methodological frameworks using a system approach to DCs.

2 | THE FUNDAMENTALS OF DYNAMIC CAPABILITIES

Strategy studies are dedicated to an organisation's choices for its evolution in a competitive environment. Such decisions are interrelated to allow its adaptation to the environment and even to shape it (Augier & Teece, 2008). Fostered in this process, the theory of dynamic capabilities develops as an approach that explains the competitive advantage of organisations in environments of high complexity and constant change by the ability to create and recombine resources in new ways (Eisenhardt & Martin, 2000; Helfat & Peteraf, 2009; Teece et al., 1997).

The theory of dynamic capabilities can be understood as an approach to dynamic environments based on internal factors, understanding the organisation as an evolving set of resources, skills and abilities that consolidates the competitive advantage in the long term. It can be considered an extension of the resource-based view (RBV) since this approach lacks clarification on how companies can gain a competitive advantage in a changing environment (Vincentin, 2015, p. 26).

According to Teece (2007, p.1320), DCs refer to the organisational ability to shape ecosystems, develop new products and processes and design viable business models. The term 'capability' emphasises the critical role of strategic management in adapting, integrating and shaping internal and external organisational competencies (Teece et al., 1997).

A capability implies satisfactorily performing an activity with intent and a specific purpose (Dosi et al., 2000; Helfat et al., 2007; Winter, 2003). The word capability derives from the seminal article by Teece et al. (1997). They consider the capability to perform a given task (Helfat et al., 2007). There are two types of capabilities: operational capabilities (OC) – also known as ordinary capabilities – and dynamic capabilities (Helfat et al., 2007; Winter, 2003). The OCs allow the organisation to perform activities to maintain current standards: the same techniques, the same scale, the same products and the same customers. In contrast, DCs allow the organisation to change how it competes in the market by modifying its resource base (including OCs) or characteristics of the competitive environment (Eisenhardt & Martin, 2000; Teece, 2014, 2007; Winter, 2003). A resource base includes tangible, intangible and human assets (or resources) and the capabilities the organisation owns, controls or has privileged access to. According to Teece (2014), while the OCs result in technical suitability (efficiency), the DCs result in evolutionary suitability (innovation). Helfat et al. (2007, p. 4) define DCs as an organisation's capacity to purposefully create, extend and modify its resources.

Thus, 'dynamics' refers to the ability to renew skills to achieve congruence with the changing business environment (Teece et al., 1997). Wang and Ahmed (2007) point out that the essence of the DCs lies in the firm's behaviour in reconfiguring and recreating resources and capabilities as a way of responding to external *stimuli*. In addition, they reinforce that this dynamism aims to achieve and maintain competitive advantages. DC is the result of reliable repetition and standardised behaviour (Dosi et al., 2000; Helfat et al., 2007; Winter, 2003) flourishing in the organisation through its experiences.

Teece et al. (1997: 515) state that the DCs approach 'builds upon the theoretical foundations provided by Schumpeter (1934), Penrose (1959), and Nelson and Winter (1982)'. Eisenhardt and Martin (2000: 1106) state that DCs 'resemble the traditional conception of routines by Cyert and March (1963) and Nelson and Winter (1982)'.

Based on the bibliometric analysis, Helfat and Peteraf (200) conclude that the definitions of DCs by Teece et al. (1997), Eisenhardt and Martin (2000) and Zollo and Winter (2002) had the most significant influence on the development of the DCs literature. Another recent bibliometric study involving 493 publications on DCs, confirms that these three papers remain the most cited in the field (Saito et al., 2019: 7, 8).

Teece et al.'s (1997) and Eisenhardt and Martin's (2000) papers present contrasting views of dynamic capabilities, although they are complementary in many aspects (Arndt & Pierce, 2017, p. 414; Peteraf et al., 2013: 1389). According to Teece et al. (1997), DCs are idiosyncratic to each firm; for Eisenhardt and Martin (2000), DCs are generalisable and replicable constructs. However, all of these definitions can be analysed by the system approach, as we demonstrate in the next section of the paper.

3 | SYSTEMS APPROACH METHODOLOGIES

Systems thinking is a growing area of complexity knowledge (Castellani, 2018). What we call systems perspective can be divided into two main topics: (1) managerial and organisational complexity and (2) systems science engineering, both classified as systems science. Mingers and White (2010) call it a systems approach or systems thinking, a field intimately connected to developing smooth operations research and management science (OR/MS). These authors discern three significant phases of theoretical development: (1) the development of the fundamental concepts from the 1920s to 1960s; (2) the rise of systems methodologies between 1970 and 1990; and (3) the emergence of chaos and complexity theory, more recently.

We focus on the systems methodologies, often called systems approaches, and the underlying theories that support them. Churchman (1979) refers to their application as a systems approach. Checkland (1981) refers to their application as systems practice.

Our primary interest is in the viable system model (VSM) and soft system methodology (SSM) and their application as theoretical lenses to understand DCs and as methodological approaches to managing DCs.

3.1 | The viable system model (VSM)

The VSM was created by Stafford Beer (1979, 1985) from cybernetics (Ashby, 1956; Wiener, 1948). It includes

insights from open systems theory (Bertalanffy, 1968). To be 'viable' means maintaining a separate existence (Beer, 1985, p. 1). The ability to adapt to changes is required in a constantly changing environment. To promote viability and adaptation to changes, the VSM uses a variety of engineering approaches (Beer, 1985, p. 26) to diagnose and design organisations. Variety, in cybernetics, is the measure of complexity. Variety naturally proliferates without control through interactive systems (Beer, 1979: 39, 97). Variety engineering consists of designing organisational mechanisms dedicated to controlling the unconstrained proliferation of variety.

The VSM consists of five subsystems:

- System One (S1) comprises the autonomous operating units that 'produce' the viable system by performing activities that meet the organisation's purpose (Beer, 1979, p. 132).
- System Two (S2) is an anti-oscillatory apparatus responsible for coordinating the decisions and activities between the autonomous units of S1 (Beer, 1979, p. 176).
- System Three (S3) controls the internal and immediate activities of the system, thus granting the short-term viability of the whole system (Beer, 1979, p. 201). It includes System Three* (S3*), responsible for sporadic operational monitoring.
- System Four (S4) is targeted at the external environment. It can foresee alternative futures and, eventually, invent them, to grant long-term viability of the system (Beer, 1979, p. 227).
- System Five (S5) oversees organisational purposes and values and maintains the balance between S3's short-term and S4's long-term concerns (Beer, 1979, p. 261).

Subsystems S3, S4 and S5 comprise the metasystem of the VSM, which is responsible for maintaining the synergistic cohesion of the autonomous units of S1.

All of the five subsystems are necessary and sufficient for viability. In addition, for the system to be viable, each of its S1 subsystems must be a viable system. Once all five subsystems are necessary and sufficient for viability, each S1 must have the structure of a viable system containing its whole structure (Beer, 1979, p. 313). This logic results in a recursive form, i.e., a multilevel structure of viable systems with likely systems. Beer (1985: 2) highlights that such recursion characterises an exact definition of viability.

The VSM allows diagnosing the mechanisms of an organisation to use them in the design of the organisational system for viability (Espejo & Reyes, 2011, p. 91). This implies both short- and long-term adaptability. The VSM can also support discussions about the implications of strategy and the process of strategy creation (Harwood, 2011). Schwaninger (2015) observes that successful applications worldwide have demonstrated the potential of the VSM to contribute to the 'conscious evolution of society and organisations.

3.2 | Soft systems methodology (SSM)

The Soft Systems Methodology (Checkland, 1981, 2000) challenged the application of the systems concept as if systems were objective facts of reality, an approach he called 'hard' systems thinking. He proposed a new approach based on a phenomenological epistemology and an interpretive sociological paradigm called 'soft' systems thinking. Checkland understood organisations as purposeful human activity systems (Checkland, 1981, p. 115) that emerge from the participants' interaction. Human activity systems can be represented and studied using systems models, but from the soft systems perspective, these models should never be taken as portraits of objective reality. From a soft systems perspective, a system model is just a tool used to capture an interpretation of reality by an observer or group of observers. Thus, systems models can be used as vehicles to convey these interpretations of reality in a debate between the participants in a problem situation.

The SSM (Figure 1) is a cyclic learning system that involves the iteration of four activities:

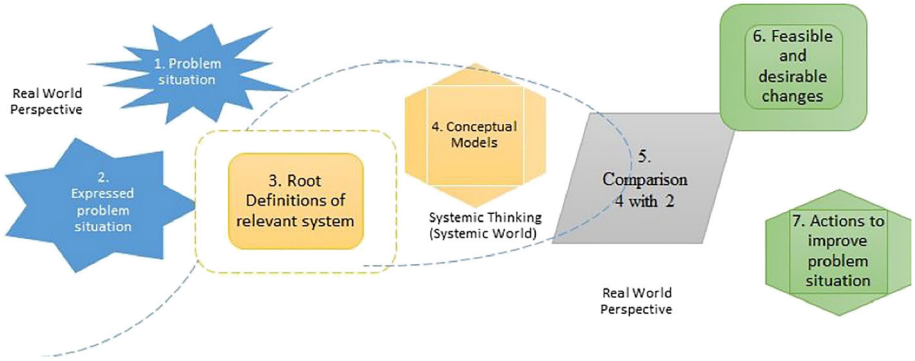

FIGURE 1 Soft systems methodologySource: Cezarino et al. (2015) and Checkland (1981) [Colour figure can be viewed at wileyonlinelibrary.com]

- Finding out about a problem situation, i.e., a situation perceived as problematic by the people involved (Checkland, 2000, p. 22).
- Formulating some purposeful activity models (Checkland, 2000, p. 26). These models are intended to foster and structure debate about the problem situation.
- Debating the situation, using the models. The models are contrasted against the perceptions of the actual situation to identify desirable and (culturally) feasible changes (Checkland, 2000, p. 32), given the prevailing attitudes and power structures. The debate is expected to lead to accommodations between conflicting interests, enabling action-to-improve to be taken.
- Taking action in the situation towards improvement (Checkland, 2000, p. 33).

When dealing with a complex system, there is no guarantee of improvement after an intervention. Notwithstanding, the situation can be addressed using one or more cycles of the methodology in an ongoing learning process that brings progress. Based on our analysis in this section, we understand that the VSM and SSM are congruent with the firm's behavioural features. Therefore, we propose their application in understanding and managing organisational behaviour.

4 | SYSTEMS NATURE OF DYNAMIC CAPABILITIES

This section aims to discuss the congruence between DCs theory and systems thinking. We start our analysis by emphasising that the nature of DCs is essentially systemic and implies a connection between both concepts.

Wilden et al. (2016: 22) found that the seminal authors' influence over time could not reveal the systemic nature of DCs in the development of recent literature. This shift represents a change in orientation and also in methods. This is consistent with Schilke et al.'s (2018) suggestion to use more mixed-methods research, which combines different approaches to gain deeper insight into the dynamic behaviour and the broader role of DCs.

Unveiling the systemic nature of DCs, previous studies observed that: (1) DCs are part of a set of capabilities that are unseparated from the whole; (2) DCs are heterogeneous across different firms; (3) linear modelling approaches are inadequate to study DCs as a complex phenomenon, (4) DCs are multilevel and longitudinal, i.e., they operate over time and across levels; and (5) DCs are dynamic, and their behaviour is affected by stocks and flows (Wilden et al. (2016).

Hence, there is a need for attention to the underlying network of causal dependencies that explain the behaviour of DCs and their outcomes, including feedback loops and interactions among variables (Schilke et al., 2018). Their dynamics involve multiple levels of analysis (Salvato & Vassolo, 2018).

Wilden et al. (2016: 33) present a significant step in advancing DC toward systems thinking by focusing on integrating a complete and parsimonious model. They propose an architectural model entitled 'House of Dynamic Capabilities'. However, even though their analogy of a house is very elucidative, it is still deficient in referring to an inherently dynamic phenomenon, such as DCs.

DCs perspective invites a highly integrative approach that flexibly draws on adjacent theories and is likely to benefit from the creative combination of different views (Schilke et al., 2018). However, they do not mention systems theories and systems approaches among the theoretical streams.

Salvato and Vassolo (2018) developed a new multilevel theory of DCs, which consists of a hierarchy of three levels: (1) the micro/individual level, (2) an intermediate level that consists of interpersonal connections among a firm's employees and (3) the macro/organisational level. The authors propose that DCs emerge at the firm level from the relationship between employees at the interpersonal level (Salvato & Vassolo, 2018: 1736). Their proposal is systemic to the extent that hierarchy and emergency are core systems thinking concepts (Checkland, 1981). However, the individual and the organisational level are too complex to be modelled as a single layer.

Even though these researchers (Salvato & Vassolo, 2018; Schilke et al., 2018; Wilden et al., 2016) indicate the need for a systems rationale to advance the knowledge of DCs, none of them explicitly mentions systems thinking or systems methodologies. We will then present how systemic rationality is inherent in the DCs theory by showing the fundamentals of DCs from a systems perspective.

Helfat and Peteraf (2009) propose two pictures representing the rationale involving dynamic capabilities, using the articles from Teece et al. (1997) – Figure 2a; and Eisenhardt and Martin (2000) – Figure 2b.

Figures 2a and 2b is representative of the type of model that has typically been used in DCs research. They present the concept of DCs in a linear approach, a unidirectional flow of causes and consequences. We observe that in Figure 2. 'Prior paths' and 'Positions (resources/assets)' are the same concept as 'New paths and positions' but at different times. The same applies to

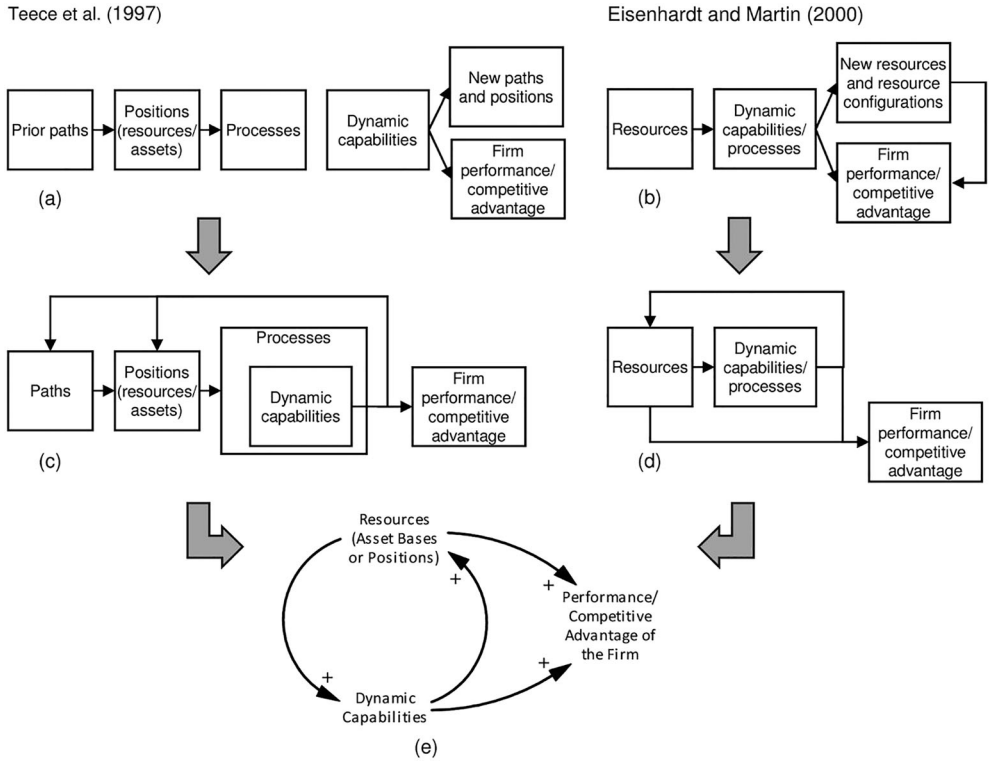

FIGURE 2 Moving from a reductionist to a systemic perspective of DCs

'Resources' and 'New resources and resource configurations' in Figure 2b.

We redrew the conceptual models in Figure 2c and 2d to merge the concepts. The new version concerns the circular dependency between DCs and resources, assets and positions. Figure 2e unifies both figures 2c and 2d in a single causal model, showing that DCs involves positive feedback, delays and non-linear behaviour. This makes DCs truly dynamic, evidencing the systemic nature of DCs.

Refining these concepts, we present Figure 3 as an enhanced version of Figure 2e. It adds the mutual dependency between DCs and the environment or, more specifically, environmental dynamism (Eisenhardt & Martin, 2000). There may be, for instance, time delays involved in the dependency relationship. This new version of the conceptual model denotes that DCs affect and are affected by endogenous (resources) and exogenous (environment) factors.

The conceptual model depicted in Figure 3 is not intended to describe DCs thoroughly. It is an abstraction that captures the essential behavioural pattern that characterises DCs.

This pattern can be identified in the mutual causal processes constituting the knowledge management of an organisation that, depending on how it is managed, can either turn into virtuous cycles of increasing returns or, instead, degenerate into vicious processes that yield progressively adverse outcomes (Garud &

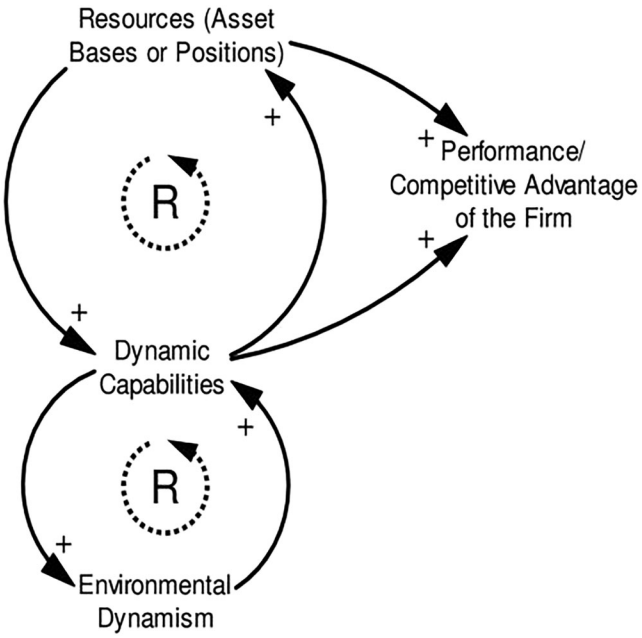

FIGURE 3 Causal loop diagram that captures the essence of DCs under a system dynamics perspective

Kumaraswamy, 2005). The pattern in Figure 3 can also be recognised in work by Chirico et al. (2012) and Romme et al. (2010).

Figures (2e and 3) conceptually show the essence of systems nature in DCs. However, they do not present

practical guidance on how to develop DCs through systems methodologies.

5 | DEVELOPING DCS THROUGH SYSTEMS METHODOLOGIES

In the conceptualisation of Teece et al. (1997: 524), the firm is much more than the sum of its parts; it is a synergistic whole. Under normal circumstances, their structure, process and performance suffer little or no impact as individuals join or leave the organisation; it is an autopoietic system (Beer, 1985, p. 408). Furthermore, they define DCs as the firm's ability to adapt to change and defend that decentralisation and autonomy favour adaptation. In synthesis, the firm is an autonomous, adaptive, autopoietic and synergistic whole (Teece et al., 1997).

Thus, we develop our analysis by focusing on specific aspects of DCs' systemic nature, such as learning by environment adaptation and designing organisational routines.

The environmental context and its relation to the organisation is a common discussion among systems and DCs. It invites us to consider the varying degrees of environmental dynamism (Eisenhardt & Martin, 2000). The work of Eisenhardt and Martin (2000) calls our attention to high-velocity markets, dynamically changing from boom to recession, far from the state of equilibrium (Prigogine & Stengers, 1984). In high-velocity markets, the industry structure is unclear, and change becomes nonlinear and less predictable. They are different from low-velocity markets closer to the homeostatic state of equilibrium, presenting a relatively predictable and linear behaviour and, consequently, a stable industry structure. The authors point out that these different degrees of dynamism demand different approaches to organisational learning and adaptation. Managers cannot wholly control such an evolutionary process but can guide it.

For Eisenhardt and Martin (2000), learning mechanisms guide the evolution of DCs. The expression 'guide the evolution' conveys the idea that DCs are part of a complex evolutionary process, as Schumpeter (1934) and Nelson and Winter (1982) describe. Furthermore, according to Teece et al. (1997: 520), learning is a repetition and experimentation process that enables organisational improvement. They add that learning processes are intrinsically social and collective and allow joint contributions to understanding a complex problem.

Three learning mechanisms are involved in creating and evolving dynamic capabilities: experience accumulation, knowledge articulation and knowledge codification. Zollo and Winter (2002) consider the first a relatively passive process, during the second two a more deliberate cognitive process. Finally, they defend that DCs 'emerge from the coevolution of tacit experience accumulation processes with explicit knowledge articulation and codification activities' (Zollo & Winter, 2002, p. 342). Zollo and Winter (2002: 340) define DC as 'a learned and stable pattern of collective activity through which the organization systematically generates and modifies its operating routines in pursuit of improved effectiveness'

Even though the nature of routine is an object of heated debate in the literature (Becker, 2004), we add our perspective by observing the concept of human behavioural systems. Consequently, a soft systems approach can adequately address routine organisational behaviour (Nelson & Winter, 1982). Zollo and Winter (2002) distinguish between operating routines (OCs) – and DCs. OCs and DCs are routinised activities, and the development of routines in a profound learning process enables the emergence of DCs.

In this sense, SSM is a methodology that can address the soft process of learning by adapting the organisational routines. This validates the application of SSM in the context of routine operations to the extent that organisational improvement results from repeating organisational routines and acquiring experience. It is a cyclic process that involves both searches for performance improvement and adjustment of expectations at each learning cycle (Checkland, 1981).

Once SSM involves a cyclic process, as it aligns the debate between the participants in a problem situation, it can be understood as part of an evolutionary process to improve routines and enable DC emergence continuously. This definition evokes SSM's learning system in at least four aspects: (1) learning is a collective activity; (2) learning is captured in stable patterns or routines; and (3) the purpose of learning is organisational improvement.

The learning experience allows the participants to reinforce courses of action as they perceive success trajectories. Thus, SSM is a collective (relational) learning system that operates through cycles of exploration of a complex problem situation, debate and intervention in the organisational reality (Checkland, 1981). As this process is cyclically repeated, as shown in Figure 4, organisational members accumulate knowledge and improve routines. Thus, the learning cycle process performs all forms of acquired knowledge, including experiential, articulated and codified.

In addition, Teece et al.'s description of the learning process matches SSM's learning system (Checkland, 1981, 2000) in at least the following aspects: (1) it is a repetition process, (2) it is an experimentation process, (3) it is an organisational improvement process,

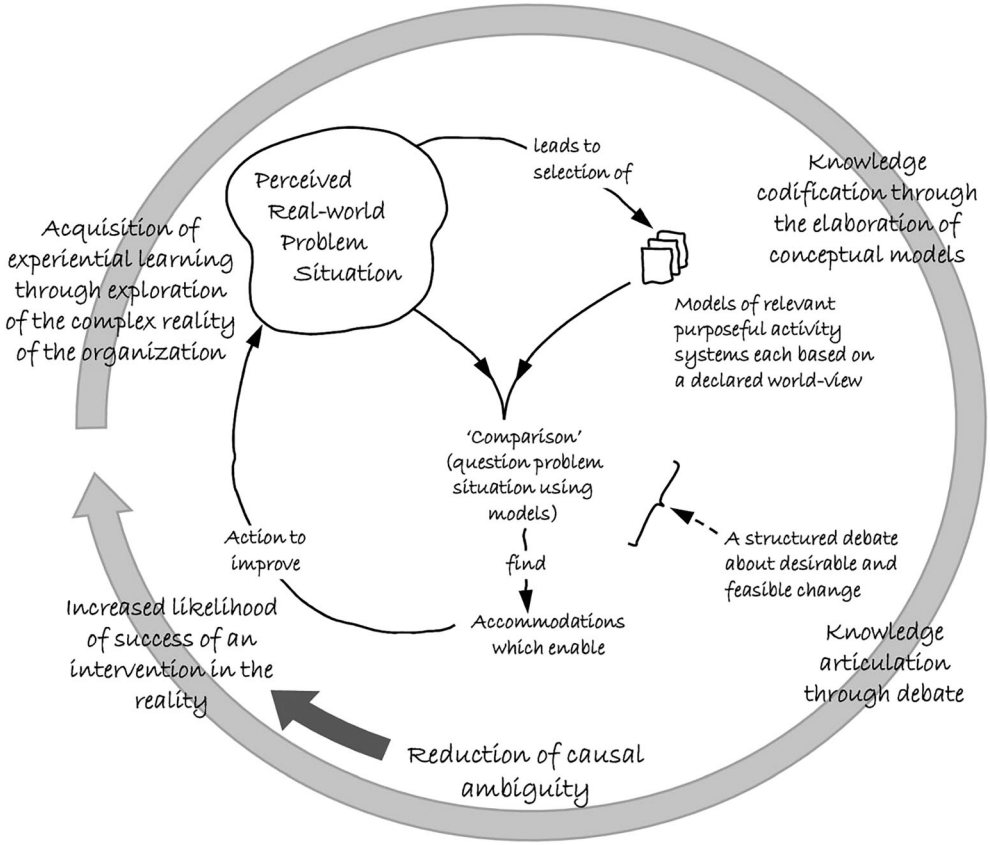

FIGURE 4 Evolution by learning with soft system methodology

(4) it is a collective process, (5) it allows joint contribution, (6) it seeks for accommodations and (7) it deals with complex problems.

Also, Figure 4 shows the match between SSM's learning cycle and Zollo and Winter's knowledge evolution cycle (2002). Experiential learning is typically the outcome of learning-by-doing or a trial-and-error approach (Zollo & Winter, 2002). In SSM, experiential learning occurs as participants in complex problem-situation explore reality (Checkland, 1981, p. 165), take action to implement changes (Checkland, 1981, p. 180), and get feedback. SSM allows the codification of knowledge in root definitions of relevant systems (Checkland, 1981, p. 166) and conceptual models of human activity systems (Checkland, 1981, p. 169). In both cases, participants in the problem situation can codify their different perceptions (*Weltanschauungen*) of a problem they face. The different perceptions will vary for each participant regarding the dynamism of the environment in which they are inserted. The more dynamic environment will require a different pace in the SSM application.

SSM demonstrates the dynamism of the DC learning perspective, what we refer to as 'evolution by learning', enabling the development of capabilities within this evolutionary process.

In addition to using SSM as a systems methodology for the evolution by learning, we use the VSM methodology for the development by design.

VSM provides a tool to support discussions about the organisational implications of both the process of strategising and considered strategies (Beer, 1979). The VSM diagnoses dysfunctionality supports the organisational design and explores the possibilities for action. Two aspects of the VSM make it particularly interesting as a complement to established approaches in the field of strategy: (1) the notion of adaptation as a mechanism for change and (2) the modelling of the structural and relationship implications of particular strategies (Harwood, 2011).

Teece et al. (1997) identify a range of DCs that match the subsystems of the VSM, including coordination (S2) and integration (S3) capabilities, the ability to scan the environment, sense the need to accomplish transformation (S4), the ability to balance the requirements for change (S5) and to make the necessary adjustments.

The VSM is also congruent with Nelson and Winter's model of a firm's behaviour. Nelson and Winter (1982) describe how routine operation meets the conditions of viability by providing the functions of the five subsystems of the VSM. Nelson and Winter (1982) argue that the

coordination function (S2) is central to the performance and that routinisation represents an efficient form of coordination. Nelson and Winter (1982) also identify the operational control function (S3) and adaptive control function (S4) in routine operation, as they observe that, while some routines are related to operational characteristics and govern short-term behaviour, other routines enable flexible behaviour, promoting adaptation in response to changes in the environment. Finally, they observe that there are routines responsible for revising or even radically changing operating characteristics of the firm to scrutinise purpose (S5).

We, thus, associate four of the five subsystems of the VSM with DCs. S1 subsystem is the only one missing; however, we can promptly associate it with operational capabilities (OCs) defined in the literature (Dixon et al., 2014; Flynn et al., 2010; Jinhui Wu et al., 2012; O'Reilly & Tushman, 2008).

DCs are metasystemic about OCs (Gebauer, 2011) and the VSM represents such a relation, as Figure 5 illustrates. Figure 5 maps OCs and specific DCs to the subsystems of VSM. We can trace each subsystem of the VSM to DCs identified in the literature.

System One (S1) (Beer, 1979, p. 132), the viable subsystems of the VSM, which produce the system, corresponds to OCs. They are strategic in the sense that they are necessary for the viability of the system as a whole in a changing environment. Viability means to survive and fulfill its purpose in a changing environment. In the case of a business organisation, the goal may include achieving and sustaining competitive advantage.

To meet the purpose of the whole viable system, especially in a way that makes the system achieve superior performance, the OCs of the viable subsystems (S1) have to be coordinated. Coordination was identified early as a component of DCs (Teece et al., 1997, p. 518). In the VSM, coordination is the function of System Two (S2) (Beer, 1979, p. 176). Regarding DCs, therefore, the role of S2 is to build coordination capability.

To achieve the synergy that results in superior performance, the OCs of the viable subsystems (S1) have to be integrated. The role of integration is to exploit existing OCs in an efficient way to ensure an organisation's current viability (O'Reilly & Tushman, 2008). In the viable system model, integration is the responsibility of System Three (S3) (Beer, 1979, p. 210). Integration has also been

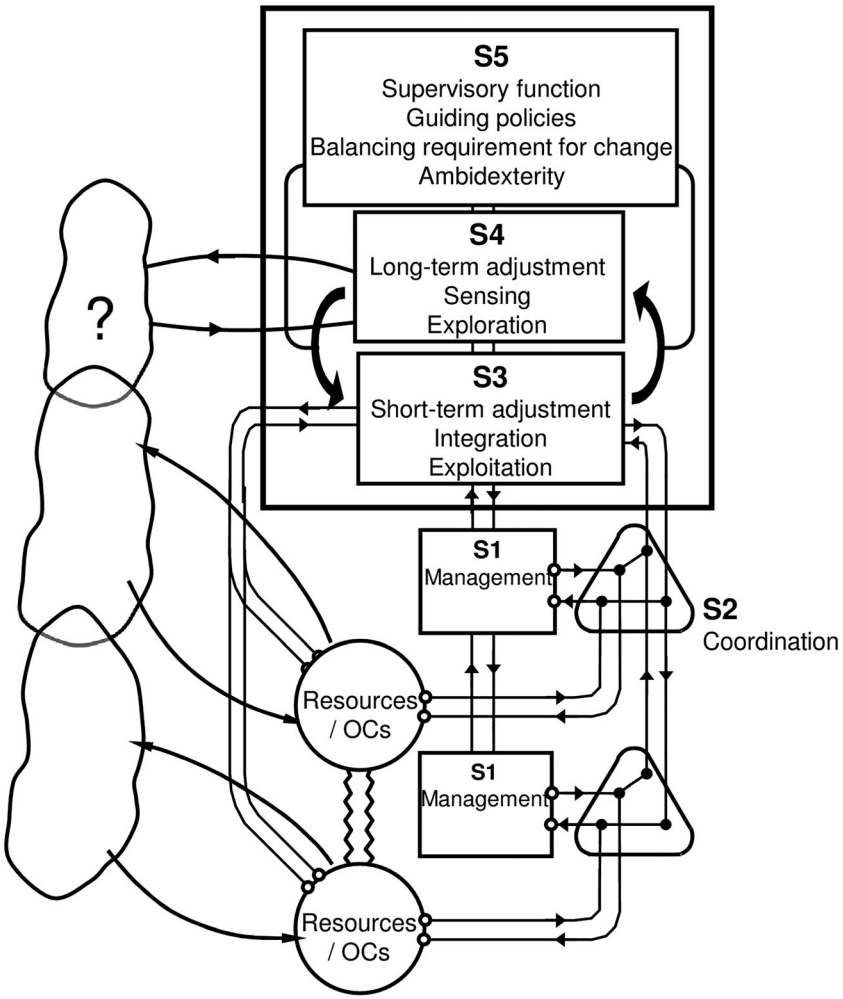

FIGURE 5 Evolution by design with viable system model

named a component of dynamic capabilities (Teece et al., 1997, p. 518). It is a necessary condition of ambidexterity and adaptive capability. Regarding DCs, the role of S3 is to build integration capability, ambidexterity and adaptive capability.

In a changing environment, an organisation must dedicate time to the external environment, foresee alternative futures and even invent them. In the viable system, this is the responsibility of System Four (S4) (Beer, 1979, p. 225). S4 represents sensing and shaping capability (Teece, 2007, p. 1322). The role of S4 is to explore new technologies and markets, granting the organisation devotes enough energy to research to ensure its future viability (O'Reilly & Tushman, 2008, p. 189). It is also a necessary condition of ambidexterity and adaptive capability. Regarding DCs, the role of S4 is thus to build sensing capability, shaping capability, ambidexterity and adaptive capability.

Ambidexterity is central to the adaptive process. It refers to a fundamental tension that poses a challenge to an organisation's survival: engaging in sufficient exploitation to ensure its current viability while, at the same time, devoting enough energy to exploration to ensure its future viability (March, 1991: 105). The VSM captures the same tradeoff (Beer, 1979: 254–255, 259) between S3, the exploitative subsystem of the VSM concerned with short-term survival, and S4, the explorative subsystem of the VSM concerned with long-term survival. We thus map the function of ambidexterity to S5, which is responsible for balancing these two concerns. This balance is the essence of ambidexterity and a necessary condition of adaptive capability. S5 also represents an organisation's seizing capability (Teece, 2007, p. 1326) once it is responsible for facilitating decisions about which opportunities to seize and which ones to discard. Regarding DCs, the role of S5 is thus to build seizing capability, ambidexterity and adaptive capability.

Finally, as the VSM can be applied to organisational change, it also supports transformative capability (Teece, 2007, p. 1334).

Based on the above analysis, we understand that the VSM is congruent with Teece et al.'s (1997) conceptualisation of DCs. We propose the application of the VSM to support the process of diagnosing and designing organisational capabilities, both OCs and DCs.

Based on the congruence of the VSM and SSM with the routine operation of the firm, as described above, we propose that (1) the VSM is a suitable approach to analyse and design routines and, thus, build DCs; and (2) SSM is a suitable approach to continuously improve routines based on learning and, thus, guide the evolution of DCs.

The evolutionary perspective of DCs (Teece et al., 1997; Zollo & Winter, 2002; Eisenhardt & Martin, 2000) recalls aspects of both VSM and SSM, reinforcing our argument in favour of the application of an **evolution-by-design** approach based on the VSM and an **evolution-by-learning** approach based on SSM. We conclude that the VSM and SSM can be used as approaches to building capabilities with learning and design lenses.

6 | FINAL REMARKS

Our work departed from the aspiration to review and synthesise the DCs literature from the perspective of the VSM and SSM, based on our perception of congruence between these methodologies and the conceptualisation of DCs by the most influential authors. However, as we started to search for scientific evidence upon which to state our thesis, we discovered that there is not enough scientific production relating to DCs with either the VSM or SSM. We found that, even though DCs are essentially systemic, systems approaches have been underexplored in the research of DCs.

According to Teece (2018: 366), the logic of the systems approach undergirds the entire framework of DCs. Teece himself recognises the influence of systems theory in his conception of DC (2018: 360) and who has influenced the field of DCs as the most cited author (Di Stefano et al., 2010; Helfat & Peteraf, 2009: 94; Saito et al., 2019: 7, 8; Wilden et al., 2016: 17), seems to either ignore the evolution of the systems methodologies or underestimate their potential, as he states that 'There is no systems theory toolkit for managers' (2018: 362). Such a toolkit is what systems researchers have been providing through systems methodologies.

While traditional research has successfully provided accurate within a limited scope, systems thinking can help draw the whole picture and put pieces together. We confirm that the systems approach can be used to advance the research field of DCs. We are not defending that systems thinking and systems methodologies should replace traditional methods, but we consider that they are complementary. Systems thinking can be insightful in advancing the DCs theory and empirical research. As a consequence, we point out: (1) systems thinking is widely present in the foundational theories on which DC is based; (2) systems thinking is also pervasive in the early conceptualisations of DCs; (3) systems approaches are congruent with the concept of DCs; and (4) systems approaches have been underexplored in DCs research.

We conceive that the ideas of the foundational DCs authors are highly consistent with SSM and VSM systems

methodologies. We discussed such consistency by mapping theoretical concepts and constructs, demonstrating that the VSM and SSM are congruent with the concept of DCs. We present the VSM as a suitable approach to building DCs and SSM to guide the evolution of DCs. We understand these two approaches as complementary ways of addressing DCs, and we name them 'evolution by design' and 'evolution by learning'. By relating concepts in one realm – systems approach – with concepts in the other sphere – DCs – we found much evidence of systems thinking both in DCs conceptualisation and foundational theories. This reinforced our idea that the VSM and SSM are congruent with DCs and that the concept of DCs is based on a systems ontology.

Regarding the VSM and SSM, we conclude that both approaches are congruent with the DCV. We argue that they are suitable both as theoretical lenses to understand and methodological approaches to develop organisations and their capabilities. The VSM is ideal for designing organisations to manage their resources and capabilities and, ultimately, building DCs. Finally, our analysis of the conceptualisation of DCs by the most influential authors in light of the VSM and SSM suggests that these two methodologies are suitable both as theoretical lenses to understand DCs and as methodological approaches to deploying DCs.

As a limitation of this study, conceptual works are usually limited in validating their propositions. In this sense, we suggest future research to legitimate these frameworks to refine their contributions and propose new enhancements and insights to the DC theory.

There is also an opportunity for further research on applying systems approaches as theoretical lenses to understand organisations and their capabilities. Furthermore, future work can explore the application of systems approaches to deriving practical recommendations for managers on how to develop organisations and their capabilities from a systemic perspective.

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DATA AVAILABILITY STATEMENT

Data sharing not applicable to this article as no datasets were generated or analysed during the current study.

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