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Decision tree for adaptation after radical changes: linking dynamic capabilities, ambidexterity, and strategic alliances

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Abstract

We developed a decision tree that integrates relevant organizational adaptation theories to respond to radical changes. The understanding of organizational adaptation often requires a combination of multiple theoretical lenses, especially considering today's radical changes in technologies, markets, and regulations. However, the research streams on adaptation and change are often disconnected and we lack a unifying adaptation framework that might reveal the synergistic contribution of each theoretical perspective to the problem. To fill this important lacuna, we integrate four relevant scholarly perspectives on the topic: dynamic capabilities, ambidexterity, vertical alliances, and horizontal strategic alliances. Our main contribution is an integrative decision tree that unveils when and why each perspective is most appropriate to respond to radical changes. Our research also unpacks dynamic capabilities theory by suggesting when ambidexterity, vertical, and horizontal alliances are appropriate to integrate the upper-level theory of dynamic capabilities, and how they can overcome some of its limitations. The paper also clarifies that, in order to adapt ambidextrously after radical changes destroying core and/or complementary assets, companies need specific alliance strategies.

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1 Introduction

The business landscape is changing dramatically due to several radical changes that companies are facing today (Eisenhardt et al., 2016; George et al., 2016). For years, big technology companies and digital platforms have transformed industries but also threatened incumbent organizations with their disproportionate power and value capture capacity (NBC, 2021). The Covid-19 pandemic has accelerated the already ongoing process of digital transformation (Associated Press, 2022). Recent developments in AI, such as ChatGPT, have further exacerbated the radicality of the change by threatening to destroy several organizational competences (Business Insider, 2023). Regulatory constraints have also been imposed on companies to reduce their carbon emissions, hindering the advantage of traditional carmakers (*InsideEVs.com*, 2022; Politico, 2023). These and other ongoing phenomena represent exogenous radical changes that require firms' strategic responses and adaptation. We define:

> *radical changes* as significant technological, regulatory, or market changes taking place outside of the boundaries of an organization and requiring firms' significant adaptation of knowledge, practice, or business models. These radical changes may encompass cases of technological discontinuities, disruptive innovations, regulatory changes, and market and customer preference changes[1].

The vast literature on strategic organizational adaptation and change (Cozzolino & Verona, 2022; Eisenhardt & Martin, 2000; Eggers & Kaplan, 2009; Lavie & Rosenkopf, 2006; Teece et al., 1997; Tripsas, 1997; Tushman & O'Reilly, 1996; Zollo & Winter, 2002) is essential to understand how companies can navigate some of today's radical changes. Four separate streams of research are critical, in our view, to understand the multiple strategies necessary to adapt and survive in the context of current unprecedented changes. A first important stream is that on dynamic capabilities that explain companies' successful adaptation in rapidly changing environments (e.g., Peteraf et al., 2013; Eisenhardt & Martin, 2000; Helfat et al., 2009; Teece et al., 1997). While the dynamic capabilities literature aims to provide an upper-level theory (Winter, 2003) and it has merits, it often lacks direct practical applicability (e.g., Schreyögg & Kliesch-Eberl, 2007) and it has received some criticisms (Ambrosini & Bowman, 2009; Barreto, 2010). A second stream on organizational ambidexterity (e.g., Andriopoulos & Lewis, 2009; Gibson & Birkinshaw, 2004; Lavie & Rosenkopf, 2006; Tushman & O'Reilly, 1996) is particularly useful for researchers to understand how companies can practically explore new opportunities while mastering their existing businesses. The third and fourth streams of research that we consider useful

[1] Most research has defined and used the concept of radical vs. incremental "innovations" (e.g., Henderson & Clack, 1990) whereas the concept of radical "changes" is often not defined and is used mainly to refer to types of changes (e.g., Benner, 2010 used it in reference to technological discontinuities). In our integrative definition, radical changes can include technological discontinuities (Tushman & Anderson, 1986; Cozzolino & Rothaermel, 2018), disruptive innovations (Christensen & Bower, 1996; Kumaraswamy et al., 2018), regulatory changes (Aversa & Guillotin, 2018; Cozzolino & Geiger, 2024), market and customer preference changes (Tripsas, 2008; Zanella et al., 2022), provided that these changes satisfy the conditions above.

for strategic adaptation after radical changes are that on strategic vertical alliances (Pisano, 1990; Rothaermel, 2001; Tripsas, 1997; Tushman & Anderson, 1986) and strategic horizontal alliances (Browning et al., 1995; Cozzolino & Rothaermel, 2018; Cozzolino & Verona, 2022). These two additional research streams offer adaptation strategies contingent on the impact of the radical change on incumbents' core and complementary assets.

Figure 1 provides our concentric view of the four research streams relevant to understand adaptation after radical changes. While dynamic capabilities are represented as the overarching theory of adaptation and strategic change, three concentric layers of theories are useful to specify and further improve our understanding of adaptation, starting with the ambidexterity stream that has been interpreted as a dynamic capability (O'Reilly & Tushman, 2008) but has evolved separately (Farzaneh et al., 2022). The other two research streams at the center of Fig. 1 provide contingent frameworks of alliance-based adaptation strategies in response to radical changes affecting incumbents' core and/or complementary assets. We place them at the very center of our conceptual view because strategic alliances can provide implementations of dynamic capabilities (Kale & Singh, 2007; Schilke & Goerzen, 2010) and also because the contingency regarding the locus of the radical change helps to be specific on the type of alliance to adapt ambidextrously (e.g., Cozzolino & Verona, 2022; Rothaermel & Deeds, 2004).

The historical and conceptual separation of these four research streams makes it sometimes difficult for scholars from specific fields to identify the frameworks that are more appropriate to examine the response to a radical change. This issue is relevant also for managers given that solutions to today's radical changes are often not simple and unidimensional, due to the multi-level challenges companies are facing. To provide our humble contribution to scholarship, this article offers a reasoned overview of the above four research streams and then develops a simplified decision tree to explain contingent uses of relevant adaptation theories. The scope of this paper

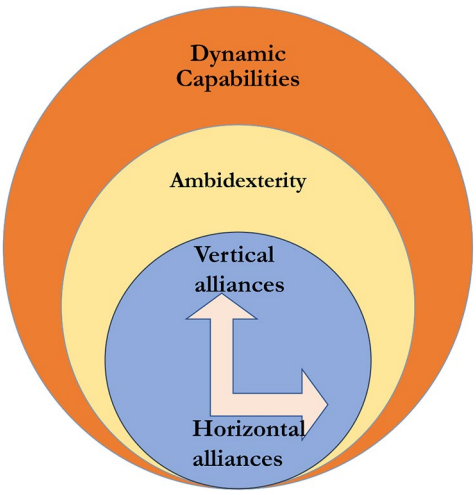

Fig. 1 Concentric view of relevant theories of adaptation and change

is not to provide a literature review but rather to connect research streams about firm adaptation in new ways.

Our first contribution is therefore to integrate separate adaptation theories in a decision tree of organizational adaptation after radical changes (see Fig. 3). By connecting and bringing clarity about when and why the four streams can be used, this study can foster future research about adaptation by encouraging studies at the intersection between these scholarly streams. By doing so, we also address recent calls for more interdisciplinary research (Eisenhardt et al., 2016; George et al., 2016) and less conventional approaches (Colquitt & George, 2011) to develop useful and important research (Markides, 2011). Our second contribution is to relate the upper-level dynamic capability theory to three middle-level theories that offer some practical guidance and specific insights regarding adaptation after radical changes (see Fig. 2). In terms of managerial implications, the developed decision tree can significantly support managers in the understanding of complex changes and use of appropriate response strategies.

2 Adapting after radical changes: relevant theories and building blocks

In order to develop a coherent framework of organizational adaptation after radical changes, four relevant theories constituting the main elements of the framework need to be presented: dynamic capabilities, ambidexterity, vertical alliances, and horizontal alliances.

2.1 Dynamic capabilities: ambition as a general theory of advantage and adaptation

The dynamic capabilities literature has the ambition to develop an upper-level theory of competitive advantage, change, and adaptation, and this explains why we positioned dynamic capabilities in the upper echelon of Fig. 1. The origins of dynamic capabilities research are rooted in the seminal works by Teece et al. (1997) and Eisenhardt & Martin (2000). Teece et al. (1997) introduced the framework of dynamic capabilities to answer the research question of "how firms achieve and sustain competitive advantage" when "operating in environments of rapid technological change" (p. 509). These authors defined dynamic capabilities as:

> the firm's ability to integrate, build, and reconfigure internal and external competences to address rapidly changing environments. Dynamic capabilities thus reflect an organization's ability to achieve new and innovative forms of competitive advantage given path dependencies and market positions" (p. 516).

In the Teeceian's view, the dynamic capabilities perspective extends the resource-based view (RBV) (Barney, 1991) by focusing on rapidly changing Schumpeterian environments, such as those faced by IBM and Philips during high-technology advancements in semiconductors and ICT. In these fast-paced technological envi-

ronments, the resource-based strategy of resource accumulation does not seem to be sufficient, and a rapid and dynamic resource configuration is instead necessary (p. 515). Examples of relevant studies linked to Teece's initial legacy are Helfat et al., (2009), Helfat & Peteraf (2003), Makadok (2001), Zollo & Winter (2002), and Winter (2003). Common to these studies is that dynamic capabilities are distinct from ordinary routines or organizational competences (e.g., Zollo & Winter, 2002), and even dynamic capabilities are hierarchically ordered in ways that the higher-order capabilities contribute the most to adaptation after radical changes (Winter, 2003):

> If exogenous change is 'competence destroying' at the level of first-order dynamic capabilities, those who invest in routinizing the response to familiar types of change may find themselves disadvantaged relative to more flexible players who have invested in higher-order capabilities (Winter, 2003 p. 994).

In 2007, Teece continued to elaborate the dynamic capability framework "to explain the sources of enterprise-level competitive advantage over time" (Teece, 2007; p.1320) in a rapidly changing environment where innovation and manufacturing capabilities are dispersed. Teece (2007) added the characterization of three building blocks of dynamic capabilities: *sensing, seizing, and reconfiguring capabilities*. "Sensing" refers to the ability to identify technological or market opportunities. "Seizing" refers to the ability to address the opportunity through processes, products, and services. The third capability of "reconfiguring" refers to "the ability to recombine and to reconfigure assets and organizational structures as the enterprise grows, and as markets and technologies change" (Teece, 2007; p. 1335).

Differently from Teece, the conceptualization provided by Eisenhardt & Martin (2000) restrained the applicability of dynamic capabilities to only moderately dynamic environments, thus limiting the contribution of Teece's framework whose novelty with respect to the RBV was the consideration of rapidly changing environments. Eisenhardt & Martin (2000) defined dynamic capabilities as:

> 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. (p. 1107).

Eisenhardt & Martin (2000) restricted the ambition of the dynamic capability framework arguing that in "high-velocity markets… dynamic capabilities are themselves unstable" (p. 1118) and dynamic capabilities shall be characterized as "best practices" in moderately dynamic environments. Practical examples of dynamic capabilities according to Eisenhardt & Martin (2000) can be product development, strategic decision-making, and alliances. By considering dynamic capabilities as best practices, these authors render the concept of dynamic capabilities more practical and generalizable, and as "neither vague nor tautologically defined abstractions" (p. 1106). However, the downside of Eisenhardt's view, according to Teece (2007), is that "best practices" are "not likely to constitute a dynamic capability" precisely because best

practices are "well-understood and replicable" (p. 1321). Relevant studies linked to Eisenhardt's initial legacy are Benner and Tushman (2003), Galunic & Eisenhardt (2001), and Rindova & Kotha (2001).

According to Peteraf et al. (2013), the two sub-streams that originated from Teece & Eisenhardt's seminal studies have advanced separate and sometimes contradictory conceptualizations. Differently from Teece's view, Eisenhardt restrained the applicability of dynamic capabilities to only moderate environments by considering them simply as best practices, and suggested that they can only explain relatively small and temporary advantages. Peteraf et al. (2013) also noted that a conversation about the two illustrated contradictory positions is absent. The lack of a formal discussion to reconcile and benefit from these different views has further contributed to the lack of cumulative development of the field, which remained focused on foundational aspects (e.g., Winter, 2003) or presented relatively sparse and divergent empirical findings (Ambrosini & Bowman, 2009; Zahra et al., 2006). Scholars have questioned the clarity and tautology of the constructs (Barreto, 2010; Priem & Butler, 2001; Kurtmollaiev, 2020), what are dynamic capabilities and how useful the theory is (Ambrosini & Bowman, 2009; Eisenhardt & Martin, 2000), how they are measured (Schilke & Goerzen, 2010; Zahra et al., 2006), and whether there is an infinite regress problem given the unspecified initial conditions (Hallberg & Felin, 2020).

To improve our understanding of organizational adaptation after radical changes, in the following we present three additional streams of research that offer more practical guidance compared to the higher level of abstraction of dynamic capabilities research. Figure 2, named "Unpacking dynamic capabilities and adaptation", shows in a three-dimensional space the three streams—ambidexterity, vertical alliances, and horizontal alliances—which are seen as ways to implement dynamic capabilities (Rothaermel & Deeds, 2004; Kale & Singh, 2007). As it will be clear from the fol-

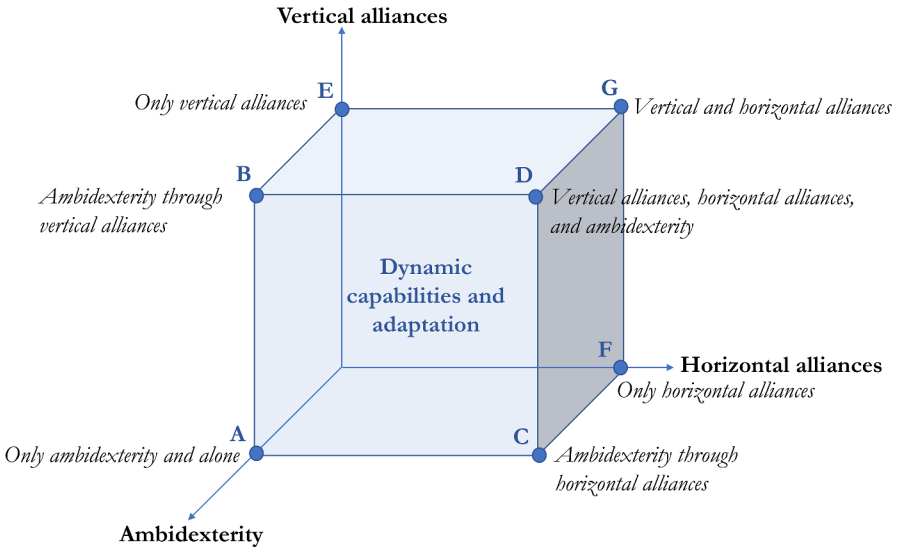

Fig. 2 Unpacking dynamic capabilities and adaptation

lowing, the three theories and their combinations permit us to be more specific and sometimes contingent regarding dynamic capabilities and adaptation.

2.2 Ambidexterity as a dynamic capability after most radical changes

Organizational ambidexterity is a first useful theory to implement dynamic capabilities (O'Reilly & Tushman, 2008) and organizational adaptation after most types of radical changes. Indeed, ambidexterity is not specific to configurations of radical changes such as competence-destroying or core-knowledge discontinuities (Tushman & Anderson, 1986), disruptive innovations (Christensen & Bower, 1996), complementary-assets discontinuities (Cozzolino & Rothaermel, 2018), and it is sufficiently practical to address some of the criticisms around dynamic capabilities. To understand these points, we need to highlight the main elements of ambidexterity.

The concept of ambidexterity is rooted in March (1991)'s seminal study about *exploration* and *exploitation*, which characterizes exploration and exploitation as two contradictory but complementary activities:

> Exploration includes things captured by terms such as search, variation, risk taking, experimentation, play, flexibility, discovery, innovation. Exploitation includes such things as refinement, choice, production, efficiency, selection, implementation, execution (March, 1991 p. 71).

An adaptive organization needs to balance both activities to survive: March (1991) explains that an organization that engages only in exploration without exploitation will suffer the cost of experimentation and will lack the economic benefit of exploitation, and the opposite applies when an organization does the contrary. However, balancing exploration and exploitation is challenging because these activities are contradictory, and the ambidexterity literature helps to address exactly this problem (Gibson & Birkinshaw, 2004; He & Wong, 2004; Jansen et al., 2009; Tushman & O'Reilly, 1996).

The first characterization of ambidexterity, proposed by Tushman & O'Reilly (1996), suggests that ambidexterity is the "ability to implement both incremental and revolutionary change" (p. 8). Evolutionary change is the short-term constant improvement of a strategy, structure, and culture which is necessary to sustain the status quo, while revolutionary change is the long-term process of destroying the same alignments to succeed, and it is what exogenous discontinuous changes often ask from an organization. Key in their conceptualization is that:

> [Ambixexterity as] the ability to simultaneously pursue both incremental and discontinuous innovation and change results from hosting multiple contradictory structures, processes, and cultures within the same firm. (p. 24)

This first characterization already suggests how a similar ambidextrous ability is a capability to adapt to radical changes and, more in general, it is a dynamic capability. Tushman & O'Reilly (1996) explain that Hewlett-Packard and Johnson & Johnson manifested ambidexterity when they maintained their respective businesses of musi-

cal instruments and consumer products through incremental innovation (exploitation) while entering revolutionary new businesses such as computers and pharmaceuticals through radical innovation (exploration). These authors proposed an adaptation approach to balance exploration and exploitation which is named *structural ambidexterity*, then further developed by other scholars (Jansen et al., 2009; Tushman & O'Reilly, 1996; Tushman et al., 2010). Based on this approach, an organization needs to structurally separate the exploitative from the explorative units because each of them entails different cultures, processes, and incentives that are conflicting with each other. A senior management team with a tolerance for uncertainty and an overarching ambition are then necessary to enable some integration of the structurally separated units. Tushman et al. (2010) provide several examples of companies that used the structural ambidexterity approach to successfully adapt and thrive: *USA Today*, HP, and IBM. For instance, *USA Today* separated the printed newsroom (exploitative) from the digital newsroom (explorative) to adapt to the Internet discontinuity without having the first traditional business cannibalize the latter, and then reintegrated the two newsrooms in a later stage. Similarly, IBM developed a separate network technology business unit led by an ambidextrous senior manager to explore radical new chip technologies, it used the traditional exploitative business to manufacture, and it set new ambitious goals for the entire organization. These cases provide further evidence of ambidexterity as a dynamic capability to respond and master radical changes. Jansen et al. (2009) added important details regarding the integration mechanisms that mediate structural ambidexterity: formal and informal senior team integration mechanisms (such as contingency rewards and social integration) and formal and informal organizational integration mechanisms (such as cross-functional interfaces and connectedness). They also provided a measurement of key constructs, which is useful for both scholars and practitioners.

A second characterization of ambidexterity is named *contextual ambidexterity* (Gibson & Birkinshaw, 2004) which is particularly necessary when the organization does not possess the resources and size to develop new business units (Lubatkin et al., 2006) or to manage strategic alliances. Key to this second approach is that companies need to work on the organizational context supporting operational managers (rather than on structural separation) to resolve the paradox of combining exploration and exploitation. The focus is on designing organizations that assist the employees through discipline, stretch, support, and trust (Ghoshal & Bartlett, 1994) at the individual level to make all organizational members act ambidextrously (Gibson & Birkinshaw, 2004). The idea of contextual ambidexterity initially advanced by Gibson & Birkinshaw (2004) is rooted in the conceptualization by Ghoshal & Bartlett (1994) that a context is characterized by four behavioural attributes (discipline, stretch, support, and trust) that stimulate individual initiative, cooperation, and learning. Gibson & Birkinshaw (2004) extended their conceptualization by arguing that:

> When a supportive organization context is created, individual engages in both exploitation-oriented actions (geared towards alignment) and exploration-oriented actions (geared towards adaptability) and this results in contextual ambidexterity (p. 213).

The difference between structural ambidexterity and contextual ambidexterity is that the former recommends the development of separate structures to be coordinated by ambidextrous senior teams, while the latter recommends building an organizational context that permits individuals to divide their time between alignment and adaptability. The similarity, instead, is that in both cases organizational ambidexterity is an approach and capability of certain companies to innovate and simultaneously maintain their existing business, thus guaranteeing short-term performance and long-term adaptability to change (Gibson & Birkinshaw, 2004; Raisch et al., 2009; Tushman et al., 2010).

In both cases, organizational ambidexterity can be seen as a dynamic capability (O'Reilly & Tushman, 2008) or be related to it (Farzaneh et al., 2022). Concerning Teece (2007)'s building blocks of dynamic capabilities—sensing, seizing, and reconfiguring— exploration can be in part related to sensing, exploitation to seizing, and their dynamic balance and new resource development to reconfiguring. Teece (2007) indeed explained that "the first two [dynamic] capabilities recognized as fundamental—sensing and seizing—are related to but different from March's (1991) concepts of exploration and exploitation". The fact that these constructs are sufficiently related explains why other scholars (e.g., O'Reilly & Tushman, 2008), including us, see the ambidextrous ability to balance exploration and exploitation as a dynamic capability. According to O'Reilly & Tushman (2008), the ambidextrous capability requires a coherent alignment of structure, competences, and culture to explore, an opposite coherent alignment to exploit, and senior leaders with cognitive and behavioural flexibility to nurture and integrate both.

Point A in Fig. 2 shows how ambidexterity can be used by a single organization as a primary mechanism to adapt. Point B and C show that combinations of ambidexterity and alliances (vertical and horizontal ones) are also possible to cope with specific types of change (Lavie & Rosenkopf, 2006; Rothaermel & Deeds, 2004), as discussed in the following.

2.3 Vertical alliances to adapt after core-knowledge discontinuities

We now describe an adaptation strategy and capability that is appropriate after a specific type of radical change: after core-knowledge discontinuities. When a radical change destroys a company's core knowledge (an event frequently named as "competence-destroying discontinuity"—Tushman & Anderson, 1986), vertical alliances or vertical acquisitions are particularly useful to adapt. To understand how vertical alliances are an important adaptation strategy and capability and how they work, we first explain the building blocks and constructs used in this and the subsequent section.

According to Teece (1986), the resources or assets of an organization can be divided into two categories: "*core knowledge*" and "*complementary assets*". A firm's core knowledge or know-how is the asset through which the organization can innovate and thus create value. Examples of core knowledge are the scientific know-how or R&D capability of technological companies. Subsequent studies have extended the use of the term core knowledge beyond the innovation activities originally considered by Teece. In particular, it has been noted that the knowledge of teachers in the

education system (Cozzolino & Rothaermel, 2018) and that of journalists in the media sector (Cozzolino & Verona, 2022) are examples of core knowledge in non-scientific contexts because that knowledge allows to create value. The core knowledge concept is partially related to Hamel & Prahalad (1990)'s concept of core competence as both terms refer to a firm's resources to sustain a competitive advantage, but they are slightly different because the core knowledge concept is used mainly to indicate value creation in relation to complementary assets that indicate value capture. Complementary assets, in fact, are resources that allow companies to capture the value created by the core knowledge. According to Teece (1986), when complementary assets are *specialized* they represent a greater source of advantage for their owners, as opposed to when they are *generic* and freely available:

> In order for such know-how to generate profits, it must be sold or utilized in some fashion in the market …. Services such as marketing, competitive manufacturing, and after-sales support are almost always needed. These services are often obtained from complementary assets which are specialized. (p. 288)

Another key construct is that of "*destruction*" which refers to the resource obsolescence experienced by a company's resources after a radical change (Tushman & Anderson, 1986). As mentioned above, radical changes can be *discontinuous* technological changes, but also market and customer preference changes (Tripsas, 2008; Zanella et al., 2022) or regulatory changes (e.g., Aversa & Guillotin, 2018; Cozzolino & Geiger, 2024). The technological change literature (Tushman & Anderson, 1986; Henderson & Clark, 1990) has documented how radical technological changes often introduce new knowledge that "destroys" (renders obsolete) an incumbent's core knowledge. Similar changes have been originally namely as competence-destroying discontinuities (Tushman & Anderson, 1986), but more recently they have also been referred to as *core-knowledge discontinuities*, to distinguish them from complementary-asset discontinuities (Cozzolino & Rothaermel, 2018). Given that core-knowledge discontinuities can cause company failure[2], it is important to examine possible adaptation strategies and capabilities.

Vertical alliances have emerged as an effective adaptation strategy after core-knowledge discontinuities (Afuah, 2001; Arora & Gambardella, 1990; Pisano, 1990; Rothaermel, 2001). Scholars found that incumbents can avoid failure related to core knowledge destruction if they vertically ally (cooperate) with upstream entrants that introduce the new knowledge by offering them incumbents' complementary assets. To understand why these alliances are called "vertical" we need to remember that the core knowledge of an incumbent tends to occupy the upstream part of its vertical value chain whereas the complementary assets for commercialization occupy the downstream part. Incumbent organizations are often vertically integrated to control both core and complementary assets, and the entrants destroying incumbents' core knowledge are therefore upstream entrants. Because these upstream entrants typi-

[2] Relevant causes of company failure are, among the others: competence obsolescence and rigidity (e.g., Leonard-Barton, 1992), fixed cognitive mindsets towards the core business (e.g., Tripsas & Gavetti, 2000), and overinvestments on core customers (Christensen & Bower, 1996).

cally lack the complementary assets necessary for commercialization (Gans & Stern, 2003) they are willing to cooperate with incumbents possessing the necessary downstream assets for commercialization. An example is provided by a radical change that took place in the pharmaceutical industry (Afuah, 2001; Arora & Gambardella, 1990; Pisano, 1990; Rothaermel, 2001). In the 1980s, incumbent pharmaceutical companies used to develop drugs through their internal R&D core knowledge of organic chemistry. A radical new knowledge to develop drugs was then advanced externally by an entrant, Genentech, founded by two university professors patenting their scientific discovery of recombinant DNA for genetic chemistry. The new knowledge of genetic chemistry was considered superior to the incumbents' core knowledge in organic chemistry. Incumbent pharmaceutical companies such as Eli Lilly partnered with the startups pioneering the new knowledge to avoid failure due to core knowledge obsolescence. This adaptation strategy is effective not only to survive but also to thrive. Rothaermel (2001) found that incumbents forming vertical alliances with entrants performed better than those trying to develop the new knowledge in-house by themselves. The rationale of this cooperation is that incumbents would experience significant time delays and capability challenges (Dierickx & Cool, 1989) and uncertainty regarding technological development (Abernathy & Utterback, 1978) if they would try to develop the upstream core knowledge by themselves. Instead, through a vertical alliance, incumbents can access rapidly and more securely the new upstream knowledge from an upstream entrant.

This adaptation strategy can be represented by either point B or point E in Fig. 2. In point B the company forms a vertical alliance to explore while it keeps its exploitative business, as the above example of the pharmaceutical incumbents has revealed. In point E the organization would only use vertical alliances but either without exploring or without exploiting. In sum, vertical alliances between incumbents and entrants can be ideal adaptation strategies and dynamic capabilities (Kale & Singh, 2007; Rothaermel & Deeds, 2004) after core-knowledge discontinuities. Based on the protection mechanisms available for the entrant introducing the new core knowledge, we can also predict when vertical alliances are more appropriate than vertical acquisitions. Vertical alliances are usually more appropriate when patents and other intellectual property mechanisms are strong (e.g., Arora & Gambardella, 1990; Pisano, 1990), whereas vertical acquisitions are the only option when patents and the appropriability regime are weak because the entrant would not be willing to accept an alliance in the absence of adequate protection mechanisms (Cozzolino & Rothaermel, 2018; Tripsas, 1997).

2.4 Horizontal alliances to adapt after complementary-asset discontinuities

When a radical change destroys an incumbent's complementary assets (namely, *complementary-asset discontinuities*—Cozzolino & Rothaermel, 2018; Cozzolino & Verona, 2022), a specific adaptation strategy and capability is necessary: horizontal alliances or horizontal acquisitions. The constructs behind this type of radical change are the same as those presented in the case of core-knowledge discontinuities (*core knowledge, complementary assets*, and *destruction*). However, the locus of innovation/destruction (Gatignon et al., 2002) is now downstream at the complementary-

asset level (rather than upstream at the core-knowledge level) and the adaptation mode and rationale are completely different. In this scenario, downstream entrants introduce radical innovations in manufacturing, distribution, and sales which can destroy the downstream complementary assets of incumbent organizations. The phenomenon of complementary-asset discontinuities is common in the history of industries despite it has not received sufficient attention until the recent destructions brought by Internet-based digital distribution. More historical cases of similar destructions were the impact faced by incumbent radio and traditional TV broadcasters after the introduction of radical technologies of cable and satellite-based television in the 1970s and 1980s in the U.S. (Ghemawat, 1993), or the impact faced by incumbent publishers by the introduction of computer typesetting (Tripsas, 1997), among some other cases (see for instance, Roy & Cohen, 2017).

However, a clear turning point in the study of complementary-asset discontinuities was achieved when Cozzolino & Rothaermel (2018) clarified conceptually, and Cozzolino & Verona (2022) extended and showed empirically, that an intriguing case is when the incumbent's complementary assets are destroyed by a discontinuity while the core knowledge is preserved. In particular, Cozzolino & Rothaermel (2018) defined complementary-asset discontinuities[3] as:

> an advance in which new technologies in manufacturing, distribution, and sales offer superior alternatives in terms of price/performance ratios and efficiency to incumbents' specialized complementary assets that no improvements in the older assets can match the performance of the new ones. (p. 6)

This configuration of change is important because when incumbents face complementary-asset discontinuities they tend to lose their value-capture ability and therefore they need to re-establish their value capture assets while defending their preserved core knowledge. Cozzolino & Rothaermel (2018) theorized that, in this case, a horizontal alliance with other incumbents can be a better adaptation strategy than a vertical alliance. While in the case of core-knowledge discontinuities a vertical alliance with upstream entrants can be beneficial for incumbents to access the new knowledge (whose value can be captured by incumbents' complementary assets), in the case of complementary-asset discontinuities the situation is the opposite. The downstream entrant would capture the value created upstream from the preserved core knowledge of incumbents. Therefore, a vertical alliance with the downstream entrants, despite being an option, is problematic because the entrant as the owner of the new asset would extract value from incumbents. An example of how a vertical alliance can be problematic in this case is offered by the entrant Netflix and incumbent movie producers. As a radically new platform distributor, Netflix extracted significant revenues from incumbent movie producers that vertically allied with Netflix, causing them to change their adaptation strategy, as we will discuss later. Another

[3] The construct "complementary-asset discontinuity" is used in an abbreviated form to refer to the destructive case of a discontinuity (and not to the enhancing case), because the most challenging situation for incumbents is when discontinuities cause destructions (Tushman & Anderson, 1986). Hence, in this literature "complementary-asset discontinuity" is an abbreviation of "complementary-asset destroying discontinuity" (see Cozzolino & Verona, 2022).

not ideal option is the attempt by incumbents to develop the new complementary assets alone in-house because incumbents are usually late movers lacking the competencies, culture, and incentives to develop radical technologies (Leonard-Barton, 1992; Tripsas & Gavetti, 2000). A better adaptation strategy after complementary-asset discontinuities is the cooperation with other incumbents (and potentially also with a controlled third-party entrant) to quickly develop joint downstream assets, pull together upstream resources, and confront the downstream entrants. For instance, to compete with Netflix, incumbent movie producers cooperated among themselves and jointly acquired the third-party entrant Hulu.

Cozzolino & Rothaermel (2018) explain in detail the rationale of the vertical alliance strategy, as briefly summarized above, but also the contingencies when it is more suitable. For instance, when the incumbents' specialized complementary assets are destroyed initially by new generic assets (Teece, 1986), many more actors gain access to the factors of production and distribution (the new generic assets) to imitate the incumbents' core knowledge and to produce more, increasing supply. An example is the initial destruction of newspapers' specialized printing presses by new generic assets such as online content management systems and RSS feeds, which enabled anyone to republish, imitate, and distribute, thus leading to an abundance of news online. In similar conditions of excess supply and fragmentation, Cozzolino & Rothaermel (2018) predict that entrants develop newly specialized platforms (assets) to gain an advantage by aggregating and transacting many products (Greve & Song, 2017; Gawer & Cusumano, 2008), by exploiting external economies of scale and externalities (Marshall, 1920) rather than internal economies of scale (see also Cozzolino, Verona, & Rothaermel, 2018). The adaptation strategy for incumbents is to cooperate among themselves to jointly create new proprietary complementary assets and defend their preserved core knowledge from value misappropriation; this allows them to counteract the attack of those downstream entrants that introduce the new complementary assets. For instance, universities cooperated among themselves to create joint proprietary platforms (e.g., Coursera and edEx) to pull their massive online open courses together (MOOCs) in response to the initial disruption of online lecture distribution by downstream entrants like Udemy or Udacity.

While the ability to identify and manage horizontal alliances is an important dynamic capability, their use is contingent on specific factors such as the appropriability regime in an industry (the ease of protecting innovation from imitation) and time (whether a dominant platform has emerged over time). Cozzolino & Rothaermel (2018) explain that incumbents facing a weak appropriability regime are unlikely to ally with downstream entrants, absent the mechanism to protect their core knowledge, and thus the incumbents only ally horizontally among themselves (e.g., news, academia). When the appropriability regime is strong, incumbents can afford some degree of cooperation with the downstream entrants provided that the incumbents simultaneously ally horizontally among themselves to increase their bargaining power relative to entrants (e.g., music, movies). As an example, the three major incumbent music labels de facto cooperated horizontally among themselves when they acquired ownership of Spotify with which they vertically allied by licensing their content to the platform in exchange for royalties, given the better appropriability regime for music products (compared to news or lectures that can be easily imitated).

Time is another key contingency because incumbents can change their strategy if the downstream entrants have imposed a dominant platform over time, thus forcing the incumbents to accept the second-best option of a vertical alliance with the new dominant platform.

Another important consideration is that the response to complementary-asset discontinuities usually involves three interrelated levels of adaptation: resource, demand, and ecosystem-adaptation (Cozzolino & Verona, 2022). Through an in-depth study of six incumbent newspapers from 1995 to 2019, Cozzolino & Verona (2022) provided an empirically grounded adaptation framework of the levels, mechanisms, and outcomes to respond to complementary-asset discontinuities. They found that a resource adaptation level is necessary to combine existing resources and new complementary assets and that the speed and depth of the recombination depend on the company's beliefs about the synergies to be generated. The second level is that of demand adaptation: incumbents experimenting with customers are more likely to update their beliefs about value creation and implement new value creation strategies. The third level is that of ecosystem adaptation: incumbents experimenting via cooperation with other actors and incumbents (horizontal alliances) are more capable of updating their beliefs about value capture and implementing new value capture strategies. Of the six newspapers, those organizations who believed in the presence of synergies between their core knowledge and the new complementary assets, that experimented with customers, and that experimented with other ecosystem actors, were those adopting first and more profoundly the new technologies and changing their value creation and capture strategies more radically.

The above findings reveal how horizontal alliances can be practically used to adapt after complementary-asset discontinuities (Cozzolino & Rothaermel, 2018) and how these alliances are linked with other organizational capabilities and interwoven with beliefs (Tripsas & Gavetti, 2000) to reconfigure competences and cognition (Cozzolino & Verona, 2022), exactly as dynamic capabilities should do (Eggers & Kaplan, 2009; Teece, 2007). Points C and F in Fig. 2 are relevant points for this adaptation strategy as they represent, respectively, the case when the organization uses horizontal alliances to implement ambidextrous capabilities and the case when it only uses alliances.

3 Decision tree of organizational adaptation after radical changes

We present here the main framework of this paper (see Fig. 3): a decision tree of the theories of organizational adaptation after radical changes. This framework summarizes some of the considerations presented above to help understand when and why each of the examined adaptation theories is more appropriate. Put differently, our decision tree characterizes the contingencies scholars need to consider when examining adaptation in the form of key questions and answers regarding whether a company possesses the required dynamic capabilities (e.g., Teece, 2007), whether it can respond ambidextrously and alone or through alliances (e.g., Raisch et al., 2009; Rothaermel & Deeds, 2004), and what is the impact of the radical change on the company's knowledge and assets (e.g., Tushman & Anderson, 1986; Cozzolino &

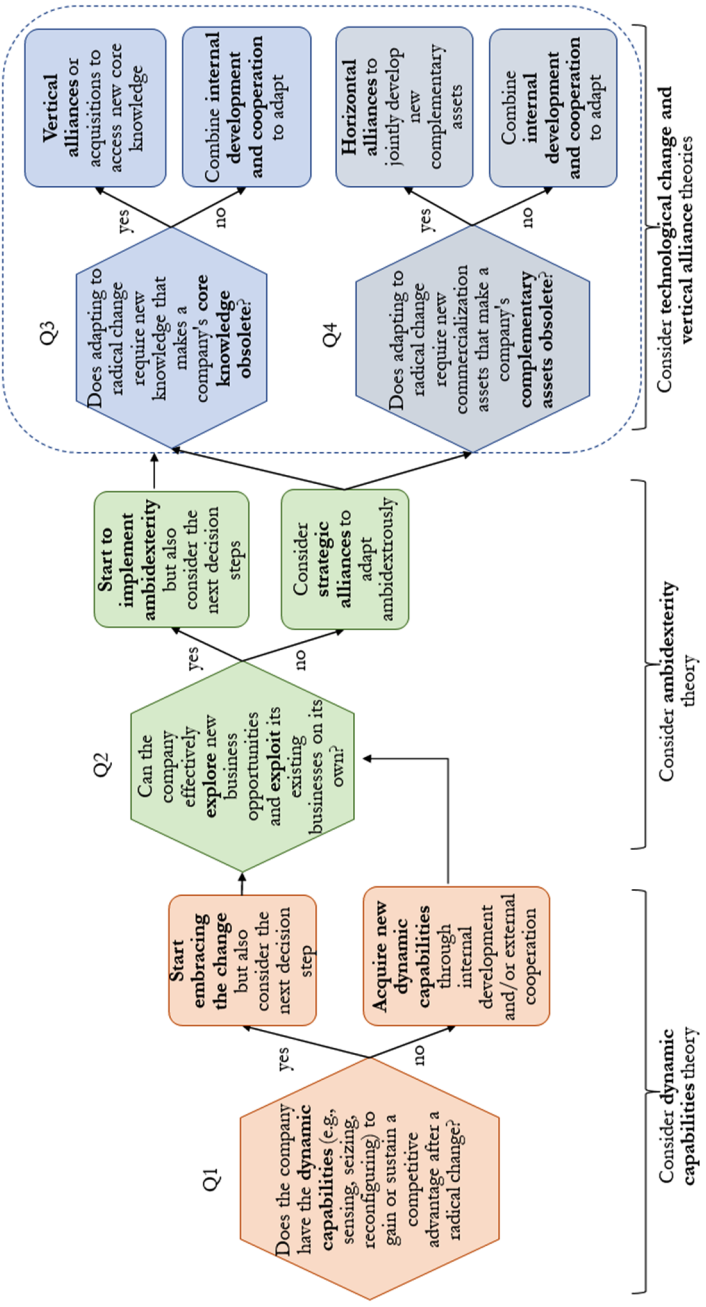

Fig. 3 Decision tree of relevant theories of organizational adaptation after radical changes

Verona, 2022) to assess the appropriate adaptation strategies to build new capabilities and adapt.

Figure 3 shows that the first adaptation challenge emerges when the organization does not internally possess the dynamic capabilities to adapt (e.g., Teece, 2007) and at the same time in the external environment entrants or competitors are introducing important competences or assets to gain advantage after the radical change (e.g., Sosa, 2011). Therefore, the first question to ask is whether the company has the capabilities to adapt after an exogenous radical change:

> Question 1 (Q1): *Does the company have the dynamic capabilities (e.g., sensing, seizing, and reconfiguring) to gain or sustain a competitive advantage after a radical change?*

To start the examination of adaptation through the developed decision tree we propose that one can start from the dynamic capability literature whose ambition is to provide a higher-level theory of success and adaptation in today's technology-driven and changing environments (e.g., Eisenhardt & Martin, 2000; Helfat et al., 2009; Teece et al., 1997; Winter, 2003). In the above section about dynamic capabilities we first examined the different conceptual origins of this literature by contrasting Teece et al. (1997) and Eisenhardt & Martin (2000) and some related studies, consistently with Peteraf et al. (2013)'s examination of these contrasting views. We then considered Teece (2007), an important evolution in this literature, as it provides an influential integrative framework of dynamic capabilities revolving around the constructs of sensing and seizing external opportunities and reconfiguring assets; this is why we refer to sensing, seizing, and reconfiguring in the first question of our framework. If the answer to Q1 is yes, a company can start to adapt by embracing the change; however, if the answer is no, meaning that the company is not yet ready, it will need to acquire new dynamic capabilities through internal development and/or external cooperation. In both cases we suggest that, in order to be specific and understand how companies can adapt, scholars can benefit from considering the next branches of the decision tree, starting with ambidexterity theory considered in question 2. By doing so, scholars not only can gain additional insights, but also overcome some of the limitations of the dynamic capabilities theory regarding conceptual and measurement clarity, not immediate applicability, and tautology (e.g., Ambrosini & Bowman, 2009; Priem & Butler, 2001).

Our suggestion to consider additional adaptation theories leads to our Question 2 in Fig. 3. We also note here that Q2 and subsequent questions are relatable to Fig. 1 in which we portrayed the three main adaptation theories useful to unpack dynamic capabilities and adaptation in a three-dimensional space. Therefore, after starting the decision tree with the upper-level theory of dynamic capabilities, the second related question is:

> Question 2 (Q2): *Can the company effectively explore new business opportunities and exploit its existing businesses on its own?*

Q2 pertains to the important issue of ambidexterity to adapt after radical changes. While the dynamic capabilities literature is also concerned with the issue of a company's simultaneous balance of existing and new businesses, the ambidexterity literature is more specific and advanced on this aspect and offers theoretical and empirical evidence, as indicated in our theory section (e.g., Gibson & Birkinshaw, 2004; Lavie & Rosenkopf, 2006; Raisch et al., 2009; Tushman & O'Reilly, 1996). We summarized above how this literature has advanced from the initial conceptualization of exploration and exploitation developed by March (1991) to the subsequent characterization of structural ambidexterity as a solution to the balancing problem (Jansen et al., 2009; Tushman & O'Reilly, 1996; Tushman et al., 2010) and later to studies of contextual ambidexterity (Gibson & Birkinshaw, 2004 based on Ghoshal & Bartlett, 1994). These studies provide specific and applicable solutions to managing the paradoxes and challenges of balancing exploitation and exploration by a single organization. Therefore, if the answer to Q2 is yes, a company may start to implement ambidexterity by itself; however, if the answer to Q2 is no, meaning that it is not competitively effective to explore and exploit alone, the company shall first consider strategic alliances to adapt ambidextrously. In both cases we suggest that the consideration of strategic alliances is beneficial to implement a successful ambidextrous strategy and a dynamic capability. Scholars have noted that alliances can be effective to access missing capabilities and to develop a dynamic capability by increasing the ability to sense or seize opportunities (e.g., Eisenhardt & Martin, 2000; Lavie & Rosenkopf, 2006; Rothaermel & Deeds, 2004).

A paramount consideration is then to examine the effects of the radical change on the company's resources, if alliances are used to adapt. As summarized in our theory section, depending on whether the radical change destroys a company's core knowledge or complementary assets, vertical or horizontal alliances shall be used to adapt. Hence, our decision tree suggests considering specific theories of alliances and technological changes to be more specific regarding how companies can adapt and when. At this point of the decision tree, we propose that scholars consider two questions, not mutually exclusive, to examine the effect of the radical change and the related adaptation strategies.

> Question 3 (Q3): *Does adapting to the radical change require new knowledge that makes a company's core knowledge obsolete?*

To help understand the rationale and conditions behind Q3, we reviewed the technological change literature on vertical alliances (Afuah, 2001; Pisano, 1990; Rothaermel, 2001; Tripsas, 1997; Tushman & Anderson, 1986). We presented the concepts of core knowledge and complementary assets (Teece, 1986) and discontinuous technological changes (Tushman & Anderson, 1986). We discussed when a radical change introduced by upstream entrants destroys the core knowledge of incumbents and how vertical alliances can provide successful adaptation solutions. Therefore, if the answer to Q3 is yes, vertical alliances (or vertical acquisitions[4]) are useful to access

[4] A vertical acquisition might be necessary when a vertical alliance would not be stable due to value capture concerns related to weak appropriability regimes in the industry (Cozzolino & Rothaermel, 2018;

the new knowledge introduced by the entrant and to adapt. Instead, if the answer to Q3 is no, meaning that the company's core knowledge is not destroyed, there is a higher chance that the company can adapt without specific alliances and it can rely on internal development and more generic cooperation.

A fourth question completes the scenario introduced by question three. A fourth question to ask is whether the company needs horizontal alliances in response to the effect of the radical change on its complementary assets:

> Question 4 (Q4): *Does adapting to the radical change require new commercialization assets that makes a company's complementary assets obsolete?*

To explain this scenario and related adaptation strategies, we reviewed the technological change literature on horizontal alliances (e.g., Browning et al., 1995) with specific emphasis on discontinuous changes destroying incumbents' complementary assets (Cozzolino & Rothaermel, 2018; Cozzolino & Verona, 2022). We explained when and why an alliance among incumbents can be a solution to the destruction of incumbents' complementary assets by downstream entrants. Often this cooperation among existing companies helps them to build new proprietary complementary assets to protect their core knowledge in response to the value capture threat by entrants introducing the new assets. Therefore, if the answer to Q4 is yes, companies shall engage in horizontal alliances. If the answer to Q4 is no, meaning that the incumbent's complementary assets are preserved, there is a higher chance that the company can adapt without recurring to specific alliances and it can use internal development and/or generic cooperation to adapt.

4 Conclusions

4.1 Theoretical contributions

The aim of this paper has been to provide an integration of relevant research streams about organizational adaptation after radical changes. We first provided a definition of *radical changes* that adds conceptual clarity and unity into a vast literature that developed through related but separate research streams about discontinuous technological changes (e.g., Tushman & Anderson, 1986), architectural changes (e.g., Henderson & Clark, 1990), disruptive innovations (e.g., Christensen & Bower, 1996), and regulatory/policy changes (e.g., Cozzolino & Geiger, 2024). The commonality among these streams has often been that the changes that mostly challenge incumbents are radical in their nature and/or effect. However, while the literature defines radical vs incremental "innovations" (e.g., Henderson & Clark, 1990; Tushman & Anderson, 1986), it is quite difficult to find a definition of radical "changes" (and one that is used by other scholars) despite this term being frequently used to signify the above changes (e.g., Benner, 2010; Tushman & Romanelli, 1985). Our novel definition of radical changes encompasses major technological, market, and regula-

Moeen & Mitchell, 2020).

tory changes that require significant adaptation of a company's knowledge, practices, and business models. This definition represents by itself a first contribution of our study. We then reviewed separate theories of adaptation—dynamic capabilities, ambidexterity, vertical alliances, and horizontal alliances—to unveil how they are potentially intertwined (see Figs. 1 and 2). We highlighted the main pros and cons of these theories and showed that they can synergistically support each other. Finally, we presented our developed decision tree of adaptation after radical changes (Fig. 3), our major contribution.

We submit that one of our important contributions is a systematic integration of separate organizational adaptation theories after a radical change. This responds to a call for more integrative and interdisciplinary research (Eisenhardt et al., 2016; George et al., 2016). By clarifying the connection between separate literatures addressing a same important phenomenon (organizational adaptation after a radical change), we also aimed to contribute to the development of useful theories (Markides, 2011; Colquitt & George, 2011).

More specifically, this study contributes to dynamic capabilities literature (Eisenhardt & Martin, 2000; Helfat et al., 2009; Teece, 2007) by showing how this research stream can be supported by three more specific literatures on organizational adaptation and their combinations (see the three-dimensional graph in Fig. 2 named "Unpacking dynamic capabilities and adaptation"). While some scholars have recognized that ambidexterity can be seen as a dynamic capability (O'Reilly & Tushman, 2008) and that strategic alliances also represent ways to implement dynamic capabilities (Rothaermel & Deeds, 2004; Kale & Singh, 2007), we lacked a systematic study explaining when and how these theories can be linked and how their integration can solve some of their individual limitations. We started by acknowledging some of the limitations of dynamic capabilities regarding its scarce practicality, conceptual and measurement issues, and potential tautology (e.g., Ambrosini & Bowman, 2009; Priem & Butler, 2001). We then noted how other research streams can mitigate these problems. In particular, ambidexterity research can provide contingent recommendations and practical guidance thanks to its precise characterization of structural (Tushman & O'Reilly, 1996) and contextual ambidexterity (Gibson & Birkinshaw, 2004) and the possibility of measuring them (Jansen et al., 2009). Strategic alliance research adds significant precision and insights about specific adaptation strategies which are based on a radical change's impact on a company's core knowledge and complementary assets. Indeed, this research distinguishes and characterizes vertical alliances (Arora & Gambardella, 1990; Pisano, 1990) and horizontal alliances (Cozzolino & Rothaermel, 2018; Cozzolino & Verona, 2022) as adaptation responses to specific types of radical changes, namely, core-knowledge and complementary-asset discontinuities. We summarized in the nested Venn diagram in Fig. 1 the idea that dynamic capabilities can be seen as an upper-echelon theory of firms' competitive advantage and innovation that is related to more specific theories, potentially nested in turn. Specifically, ambidexterity can be seen as a dynamic capability, and strategic alliances can be seen as ways to implement ambidexterity and dynamic capabilities in general. As noted, these theories can integrate and complement dynamic capabilities in assessing organizational adaptation after a radical change. Figure 2 further expands this idea by showing how ambidexterity, vertical, and horizontal alliances represent

theories of adaptation that can be used separately or in conjunction to address complex adaptation problems. For instance, points B and C of Fig. 2 describe the scenarios when ambidexterity is implemented, respectively, through vertical and horizontal alliances. In particular, point B represents the case when vertical alliances are used as a means to explore new opportunities by cooperating with upstream entrants after core-knowledge discontinuities (Rothaermel & Deeds, 2004). Point C describes the situation when horizontal alliances are used to protect and exploit incumbents' core knowledge while exploring new value-capture opportunities after complementary-asset discontinuities (Cozzolino & Verona, 2022). Overall, our study helps to overcome some of the criticisms around dynamic capabilities (e.g., Priem & Butler, 2001) and can support the progress of this theory, as well as the progress of ambidexterity research (e.g., Gibson & Birkinshaw, 2004; He & Wong, 2004; Tushman & O'Reilly, 1996) and alliance research after technological changes (e.g., Afuah, 2001; Cozzolino & Rothaermel, 2018; Pisano, 1990).

Our major contribution is the developed decision tree of organizational adaptation after radical changes (see Fig. 3 and its detailed explanation above). Not only this framework integrates relevant theories of adaptation after radical changes but also provides guidance about when to use them. We suggest that four main questions and related answers can guide a more systematic and comprehensive investigation (although not exhaustive) of adaptation. The first question (Q1) is about whether the company possesses sensing, seizing, and reconfiguring capabilities (Teece, 2007) to respond to the change. The second question (Q2) requires to consider whether the adaptation can be implemented using an ambidextrous approach (Raisch et al., 2009). The third (Q3) and forth (Q4) questions are about a major distinction in the type of radical change: they ask whether the change represents a core-knowledge discontinuity (e.g., Tushman & Anderson, 1986) or a complementary-asset discontinuity (e.g., Cozzolino & Verona, 2022) for incumbents. Each node of the decision tree provides step-by-step guidance on how to adapt based on the company's positioning with respect to the change, its intention to maintain the existing business while exploring the new one, and the specific type of radical change and response strategy. At the same time, the theories incorporated in the decision tree are not always mutually exclusive, and thus, more than one prediction can be followed. Overall, Fig. 2 can greatly support the progress of future interdisciplinary studies (Eisenhardt et al., 2016) at the intersection between dynamic capabilities, ambidexterity, and alliances after technological changes. In our view, the three theories can help to overcome the intrinsic limitation of dynamic capabilities while helping this theory to further progress (Helfat et al., 2009). The value added of considering ambidexterity is that it is more applicable, easily measurable, based on empirical research, and general (non specific) regarding industry transformations. The con, however, is that it is less informative about what to do during specific industry transformations. This is why we discussed ambidexterity first and then two innovation-specific adaptation strategies: vertical alliances after core-knowledge discontinuities and horizontal alliances after complementary-asset discontinuities. These two latter theories have the advantage of allowing a company to effectively implement the dynamic capabilities concept (e.g., sensing, seizing, reconfiguring—see Teece, 2007) and to implement the ambidexterity model (see Fig. 2) using alliances for exploration and/or exploitation (e.g.,

Rothaermel & Deeds, 2004). The other advantage is that they are prescriptive of what companies can do when facing specific and increasingly common types of changes (core-knowledge and complementary-asset discontinuities) and they also add contingency factors. The obvious con is the more limited applicability, but this is not a concern once a decision-maker identifies the most appropriate adaptation strategy, and if necessary, more than one strategy, out of an array of possibilities.

4.2 Managerial implications

Our decision tree can be particularly useful for managers (Markides, 2011) because companies today need to consider multiple adaptation strategies given the increased complexity and uncertainty of the radical changes they are facing. A combination of major technological advancements (e.g., the digitalization of every aspect of people's lives and the pervasiveness of AI), new regulatory changes (e.g., carbon emissions and healthcare restrictions), market changes (e.g., due to changing preferences/conditions and to uncertain geopolitical conditions) call for companies' urgent examination of their capabilities and positioning to adapt. In most cases, companies do not have the capabilities and resources to adapt to similar radical changes in isolation. Therefore, dynamic capabilities is likely to be the first necessary framework to adapt (Q1), while ambidexterity offers more specific predictions about how to transition from old to new businesses (Q2), and strategic alliances can be a means to develop and access new competences / assets or protect the existing ones (Q3 and Q4). While managers and decision-makers can use our decision tree linearly from left to right, they can also start from its end part (Q3 and Q4) and move backward with their examination to Q2 and Q1. This can be very beneficial because it is important to ask the questions Q3/Q4 and Q2 (which are not mutually exclusive) in isolation first, so as to conduct a thorough analysis of the impact of the radical change on the company's assets. Suppose that after doing such a systematic assessment, one concludes that the radical change is destroying the core knowledge and/or complementary assets of the organization. In this case, the practical prescription from the decision tree is to engage, respectively, in vertical and/or horizontal cooperation. For instance, book publishers facing AI in content production shall ask whether this radical change can potentially destroy their access to authors' core knowledge and thus consider vertical alliances with AI providers to access the new artificial intelligence capabilities in writing. Carmakers shall ask what is the impact of new CO2 emission regulations on their traditional manufacturing plants as well as on complementary gas stations, and consider horizontal cooperations among themselves such as the recent one to jointly construct a high-powered charging network by BMW Group, General Motors, Honda, Hyundai, Kia, Mercedes-Benz Group, and Stellantis NV (Forbes, 2023). A similar rationale applies to Q1 and Q2. If the company possesses the dynamic capabilities to adapt, it will likely need to implement an ambidextrous strategy to do so given the high uncertainty of current transformations about their direction and time/duration. The managerial implication part of our study can open opportunities for future research aiming to bridge the gap between theory and practice (Ferraro et al., 2015), thus also overcoming the natural limitation of our study that is conceptual, despite being based on vast empirical research. Scholars can investigate for

example, how managers can practically recognize sensing, seizing, or reconfiguring capabilities in the context of Fig. 3 (see Q1), and this could contribute to improve the applicability of dynamic capabilities research. Future studies can also examine how managers may better and more promptly identify the exact effect of a radical change on a company's core knowledge and complementary assets (see Q3 and Q4), and this could contribute to improve the applicability of technological change and strategic alliance research. Overall, the current study can help companies and scholars to navigate complex adapation strategis after radical changes using the developed decision tree as a framework.

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Declarations

Conflict of Interest We declare no conflicts of interest.

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