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Resource interdependence and successful exit: A configurational perspective on young technology firms

Emily Cox Pahnke[1] | David G. Sirmon[1] | Jen Rhymer[2] | Joanna T. Campbell[3]

[1]Management and Organization, Foster School of Business, University of Washington, Seattle, Washington, USA

[2]Strategy and Entrepreneurship, UCL School of Management, University College London, London, UK

[3]Management, Carl H. Lindner College of Business, University of Cincinnati, Cincinnati, Ohio, USA

Correspondence
Emily Cox Pahnke, Management and Organization, Foster School of Business, University of Washington, Seattle WA 98195, USA.
Email: eacox@uw.edu

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Abstract

Research Summary: Successful exits are important outcomes for young technology firms. Research has investigated how *individual* resources affect exit, but both foundational RBV scholarship and newer microfoundations work suggest the need to examine resource *configurations* in specific contexts. Using an abductive approach and fsQCA methodology, we explore how resource configurations affect exit in the U.S. minimally invasive medical device industry. We find no single resource is necessary or sufficient for exit. Instead, we find four unique equifinal configurations of resources that are sufficient to support exit in certain contexts. Further, these configurations are largely replicated when we distinguish specific exit modes (IPO vs. acquisition). This study advances growing conversations on the role of resource configurations in entrepreneurship with an emphasis on interdependence, complexity, and equifinality of exit.

Managerial Summary: New firms' early resource portfolios are powerful determinants of their future success. No theory exists, however, to predict if or how the combinations of these resources affect young technology ventures' abilities to achieve a successful exit—an outcome important to founders and early investors. In this study, we utilize fsQCA to explore this issue on a sample of startups in a segment of

the U.S. medical device industry. We focus on configurations of technological, commercial, social, human, and financial capital as well as the external environment. Our results point to four unique paths that support successful exit. Each configuration includes multiple ingredients for success. This suggests that realizing successful exit is more complex than previously thought as several unique resource configurations support successful exit.

KEYWORDS
acquisitions, entrepreneurial exit, FsQCA, IPO, resource bundles

1 | INTRODUCTION

> *Exactly the same resource when used for different purposes or in different ways and* in combination with different types or amounts of other resources *provides a different service or set of services.*
>
> *Penrose (1959, p. 25)*

Successful exits via IPO or acquisition represent important achievements for technology firms. These events provide capital infusions that fuel firm growth and provide returns for investors and founders (Bermiss et al., 2017; Hoehn-Weiss & Karim, 2014; Wang et al., 2022). Given the importance of exits, it is not surprising that significant attention has been paid to understanding their antecedents. Most prominently, research has focused on the effect of individual resources, including investor reputation and status (e.g., Hsu, 2004; Pollock et al., 2010; Sørensen, 2007), founder experience and status (Beckman et al., 2007; Beckman & Burton, 2008), innovation capabilities (Graebner & Eisenhardt, 2004; Roche et al., 2020), and geographic location (Stuart & Sorenson, 2003). These prior studies explicitly or implicitly assume that these individual resources are necessary for successful exit. Reading across this literature may lead one to conclude that to successfully exit, a founder must have deep relevant experience, locate the firm in an environment with supportive infrastructure, obtain funding from high-status venture capitalists, *and* rapidly develop innovative technologies and products.

While helpful, these insights provide an idealized—and perhaps even distorted—picture of the paths to exit. Most entrepreneurs do not control all of these resources; yet, many still manage to lead their firms to a successful exit. Moreover, exits are complex, interdependent outcomes, and focusing on individual resources in isolation oversimplifies the resource-exit relationship because it does not account for the effect of resource bundles and how such configurations, situated in a particular context, may affect exit. This begs the question—are there *specific* resources necessary and/or sufficient for successful exit, or are there alternative *combinations* of resources that together are sufficient for exit in a given environmental context?

This question is relevant as prior literature advances both possibilities. First, the resource-based view (RBV; Barney, 1991) literature has detailed the importance of singular resources on critical outcomes such as performance and internationalization (Hitt et al., 2001, 2006), among many others (see D'Oria et al., 2021). However, a growing voice in this conversation, driven by both an appreciation for Penrose's (1959) foundational work as well as recent developments of microfoundations (Barney & Felin, 2013), is calling attention to the importance of resource configurations—that is, combinations of different kinds of resources—to firm outcomes (e.g., Sirmon et al., 2007, 2008). Indeed, this work is gaining momentum in entrepreneurship research (Amit & Han, 2017). For instance,

research has not only demonstrated the effect of resource configurations on young technology ventures' performance (Danneels, 2012; Gruber et al., 2010) and growth (Clarysse et al., 2011), but has considered resource configurations in a wide range of applications such as resourcefulness (Welter et al., 2018), entrepreneurial orientation (McKenny et al., 2018; Wales et al., 2020), founding teams (Reese et al., 2021), and a venture's socio-historical roots (Decker et al., 2020).

Configurational research builds on the idea of complementarity, which exists when two activities or resources reinforce each other (Ennen & Richter, 2010). But as Barney and Felin (2013) discuss in their treatment of microfoundations, such interactions are inherently messy and characterized by complexity and equifinality. For instance, the microfoundations literature promotes the importance of considering how the interdependence between actors, organizational mechanisms, and the firm's broader local/environmental context jointly affect the emergence of firm-level outcomes (Distel, 2019; Felin et al., 2015). Thus, it is likely that specific outcomes can be supported by different combinations of factors coalescing in unique ways, including interactive relationships and substitution effects (Felin et al., 2012; Raveendran et al., 2020). Collectively, recent research suggests that furthering our understanding of successful exits requires evidence on whether a singular resource is necessary and/or sufficient or if—alternatively—various configurations are sufficient. And, if the latter is valid, then treatment of complex interdependencies and equifinality among resources in a particular environment is needed.

We follow the logic of foundational RBV literature as well as the recent microfoundations conversation to address these issues. More specifically, we extend our understanding of successful entrepreneurial exits by adopting a neo-configurational perspective and leveraging the capacity of fuzzy set qualitative comparative analysis (fsQCA; e.g., Bell et al., 2014; Campbell et al., 2016; Crilly et al., 2012; Fiss, 2011; Meuer, 2014; Misangyi & Acharya, 2014; Smith et al., 2019). This approach offers a promising conceptual lens and empirical methodology for modeling complex interdependencies and equifinality (see Misangyi et al., 2017, for a review). In particular, it allows scholars to capture three key elements reflected in the conversations around the role of resource bundles and their interdependence with their environmental context: (1) conjunction, or the idea that constellations of factors underlie a given outcome of interest; (2) equifinality, or the presence of multiple paths to a successful outcome; and (3) asymmetric causality, meaning that what leads to the presence of an outcome (here, exit) is not simply the opposite of what leads to its absence (i.e., bankruptcy).

Our study is set in the medical device industry—a setting where firms have high resource needs and a strong motivation to successfully exit. Many firms in the minimally invasive surgery sector (MIS) are founded by surgeons who design devices based on their deep expertise, which may account for the relatively high rate of successful exits in the industry. Following the microfoundations approach, we aim to capture a range of factors that are argued to matter to success in this setting—individual (founder) factors, organizational factors, and the environmental context at the time of exit (e.g., Felin et al., 2012, 2015; Sirmon, 2021)—and use fsQCA to uncover various configurations (or paths) to exit. Via an abductive approach, we explore the various types and levels of resources and environmental conditions that holistically form configurations that support exit. We find that no single factor is necessary or sufficient on its own, but instead we find four equifinal configurations that are sufficient for successful firm exit. When we differentiate the model of exit between IPOs and acquisitions, these paths are largely replicated, and we still find no single factor is necessary or sufficient on its own.

Together, our conceptual and empirical approach and findings make several contributions. First, we contribute to research on entrepreneurship by conceptually and empirically addressing the complexity ventures face in reaching a successful exit. In line with our expectations, we find that successful exit is driven by intricate resource and environmental interdependencies that have not been identified by extant research. We also demonstrate that considering these factors in isolation obscures the complex interactions among resources, confirming that traditional approaches such as regression-based modeling provide limited understanding of some phenomena (Furnari et al., 2021). Second, we show that there is no one best path to success. Instead, we find that exit is equifinal—there are alternative paths to the same outcome, driven by different combinations of resources. This finding has important

practical implications for entrepreneurs who face difficulty in overcoming resource scarcity as it suggests that their focus need not be on acquiring specific resources, but rather on assembling one of many possible resource configurations. Thus, we extend recent research that takes a dynamic view of resource dependence theory by suggesting that there is considerable flexibility in the combination and sequence of resources that help ventures succeed (Katila et al., 2022). Third, we show that specific paths are tied to specific types of exit. This contributes to recent entrepreneurship research that indicates that early decisions made by firms can shape the type of exit they experience (e.g., Wang et al., 2022). These findings also suggest that entrepreneurs have agency in leveraging interdependencies among resources that provide many paths to achieve success (Eisenhardt & Schoonhoven, 1990). Finally, our study offers a contribution by answering Douglas et al. (2020) recent call for applications of fsQCA to research on the microfoundations of entrepreneurship and the emergence of new firms, and highlighting the importance of considering complexity, interdependence, and equifinality when studying entrepreneurial exit.

2 | THEORETICAL BACKGROUND

2.1 | Configurations of resources as drivers of entrepreneurial exit

Our article is premised on the notion that identifying resource configurations embedded in particular environmental contexts, as opposed to standalone resources (e.g., Gimmon & Levie, 2021), is key to advancing our understanding of entrepreneurial exits. Configurational logic is found across multiple organizational literatures (for a review, see Misangyi et al., 2017). For instance, Argyres and Liebeskind (1999) argue that prior commitments and contracts create complicated interdependencies that affect a firm's future. However, Ennen and Richter (2010) suggest that prior work on configurations has largely ignored contextual elements and has been overly reliant on performance as the outcome of interest. In line with this sentiment, microfoundations researchers have examined how lower-level elements interact to affect the formation of higher-level phenomena (Felin et al., 2015). For example, microfoundations research addresses complex interactions among individuals, organizational factors (e.g., processes and available resources), and broader contextual elements (e.g., environmental conditions and time) (Felin et al., 2012). And indeed, this vision of future research is starkly different from much prior work, which has shied away from viewing complex interdependencies as the drivers of organizational outcomes.

As a prime example, the resource-based view of the firm has a long history of examining how individual resources, such as human capital (Hitt et al., 2001), financial capital (e.g., Colombo & Grilli, 2010), social capital (e.g., Florin et al., 2003), and technological capital (e.g., Lee et al., 2001), among others (see Newbert, 2007), affect firm performance and growth (Barney, 1991). Yet, this focus on *individual* resources runs counter to foundational RBV work. Penrose (1959) stressed the importance of resource bundles, while Black and Boal note that most studies "treat the evaluation of resources from a stand-alone viewpoint ignoring how resources are nested in and configured with one another" (Black & Boal, 1994, p. 132). In fact, Miller asserts that resource configurations form the "heart of distinctive competence" (Miller, 1996, p. 509). Moreover, the work of Brush and Artz (1999) and Miller and Shamsie (1996) provide evidence that resource value is contextualized by environmental conditions.

Indeed, researchers are now empirically exploring the relationship between resource configurations and firm outcomes. Broadly, this research suggests that focusing on the complex interdependencies embedded in resource configurations holds rich potential—a view that dovetails with the more recent microfoundation lens. For instance, Borch et al. (1999) demonstrate via cluster analyses that firms' resources form configurations that then support competitive strategies. Carmeli and Tishler (2004, p. 1267) found that "the 15 interactions among the six organizational elements are positive and substantial in size [...] organizational elements enhance each other in their effect on the performance." Similarly, Gruber et al. (2010) explored equifinality by examining how eight organizational elements

clustered into four configurations of sales and distribution functions in young technology firms, while Clarysse et al. (2011) applied inductive case methodology to examine how the young technology firms configured their resources to obtain growth.

Because a firm's early resources create "an integrated whole in which it is difficult to change one element without unraveling the whole" (Eisenhardt & Schoonhoven, 1990, p. 505), we build on the configurational research stream by moving away from regression-based tools, which place limits on examining higher-order (e.g., three-way) interactions, as well as small-N case studies, which limit generalizability and transferability. Instead, we model interdependence and test necessity as well as sufficiency with a method that has prominently emerged in recent years as a useful tool for studying complex phenomena—fuzzy set qualitative comparative analysis (fsQCA). FsQCA allows researchers to examine such interdependencies, thereby allowing us to shift the focus away from the individual effects of accumulated resources to more complex combinations of founder, organizational, and environmental factors.

While greater access to, and depth of, resources would seemingly be beneficial to founders in laying the foundation for a successful exit, the literature provides little guidance beyond these simple predictions for young firms in terms of developing early resource portfolios. Importantly to our research question, there is no theoretical model that predicts the impact of different resource-context *configurations* on specific firm outcomes such as successful exit. As such, we apply fsQCA—a middle ground between qualitative and quantitative methodologies (Ragin, 2008)—in an abductive rather than deductive manner to discover how early resource-context configurations are likely to impact a venture's success. As Misangyi et al. (2017) argued, QCA complements inductive (e.g., grounded theory) and deductive (e.g., regression analysis) tools because it is at its very roots an abductive method (Ragin, 1987, 2000). Indeed, the majority of extant research in the organizational sciences applies fsQCA in an abductive or modified-inductive manner. We follow this tradition to examine resource bundles and entrepreneurial exits, using fsQCA to explore our "research hunches" and ideas with the help of extant literature, and support the small but growing theoretical narrative (Douglas et al., 2020; Misangyi et al., 2017). In the next section, we discuss the context and the resources that are germane to our setting.

2.2 | Successful exit: The significance of liquidity events for ventures

Given the importance of exit to both founders and early investors, extensive research in entrepreneurship and finance has focused on both acquisitions and IPOs as highly desired exits that are sought after by firm founders and their investors (see, for e.g., Beckman et al., 2007; Hoehn-Weiss & Karim, 2014; Pollock et al., 2010; Sørensen, 2007; Wang et al., 2022). Both types of exit provide capital infusions that accelerate growth and provide liquidity to founders and investors. When a venture is acquired, it is sold outright to another firm; typically, to one with related technologies in the same industry. The sale results in immediate liquidity for firm founders and investors and, especially in the medical device industry, are seen as a very positive outcome for the venture. In contrast, going public (or IPO) represents a partial sale of the firm to the public on the open market. It is a complex process that requires extensive due diligence and usually only occurs when a firm has products that generate a relatively steady stream of revenue. Exits via acquisition and via IPO generally generate returns and are viewed as positive events, in contrast to bankruptcy, which is a negative form of exit.

These two types of exits are the main motivation for venture capitalists to fund new ventures as they create liquidity, allowing for a return on investment. VCs typically have a fund length of 10 years, during which they need to invest in startups and earn some kind of return on that investment (Gompers & Joshua, 2004; Lerner & Nanda, 2020). This highlights the time trajectory of a firm's exit as an important facet of VC's investment theses, as companies that take a long time to exit may not provide an investment return within the time horizon needed by investors. Previous research indicates a minimum range of 3–5 years for exit to occur (Hoehn-Weiss & Karim, 2014; Wang et al., 2022). In our industry setting, exit is neither particularly rare (since the majority of firms eventually exit) nor expected (since a sizeable portion of firms still do not reach this milestone), making it well-suited to our study's goals.

2.3 | Building blocks of success: Technological, commercial, social, human, and financial capital

To understand how a single resource (or bundles of resources) might impact new ventures, we construct a guiding theoretical framework based on prior work and deep knowledge of the setting, in line with QCA best practices. The configurational theorizing process involves three stages—scoping, linking, and naming (Furnari et al., 2021). The scoping stage involves choosing an "anchor" for identifying relevant attributes to include, "complexifying" from that anchor, and developing theoretical "hunches" about the theme that organizes the attributes into configurations (Furnari et al., 2021). We situated our study in foundational RBV logic, using the basic notion of a "resource" as our theoretical anchor. We then proceeded to complexify from it to identify the individual resources relevant to our setting. Specifically, with understanding entrepreneurial exit in mind, we reviewed the entrepreneurship and strategy literature to identify the individual resources that are likely to matter in a high-technology setting like medical devices.

Barney (1991) suggested that resources can be divided into several key types, but there is no clear consensus among researchers regarding resource classification. Hofer and Schendel (1978), for example, categorize resources into five different types: financial, physical, human, organizational, and technological. In a study of small firms, Greene et al. (1997) substituted social capital for technological capital, resulting in financial, physical, human, organizational, and social categories. Das and Teng (1998) categorized resources into just four groups in their examination of resources in the context of alliance formation: financial, physical, technological, and managerial. In spite of the variation among these works and others, we observed significant conceptual overlap across studies and across time in the categories used to classify resources. Building upon this commonality, we organized resources into general categories for the purposes of this study: financial, human, social, and split organizational capital into two parts: technological and commercial capital, due to their relevance to the medical device industry (Katila et al., 2017; Pahnke, Katila, & Eisenhardt, 2015). We then coupled these categories with extensive fieldwork in the industry to identify the specific types of resources that were germane to our study of resource configurations in medical device startups. For instance, prior research in the medical device industry identified founder experience (working at other firms in the industry), inventions (in the forms of patents), innovation (receiving FDA clearance to be sold in the United States), financial capital (access to funding), and geographic location (in medical device hubs) as critical resources (Chatterji, 2009; Katila et al., 2017; Pahnke, Katila, & Eisenhardt, 2015; Wu, 2013).

While physical capital (i.e., manufacturing plants, trucks, equipment, etc.) is important to many settings, it is not included in this study because resource-based logic indicates that it rarely forms the basis of competitive advantage. As Quinn (1992, p. 241) notes, "with rare exceptions, the economic and producing power of the firm lies more in its intellectual and service capabilities than its hard assets—land, plant, and equipment." More importantly, physical capital does not meaningfully differentiate young firms in the MIS segment of the medical device industry—the vast majority relies on original equipment manufacturers (OEMs) to manufacture the devices they develop.

2.3.1 | Technological capital

In technology-intensive industries such as the medical device industry, technological capital—an element of organizational capital—is critical (Graham et al., 2009). Patents represent important milestones for new ventures that ultimately appeal to potential acquirers and the public markets, as they signal a firm's ability to create novel technologies.

2.3.2 | Commercial capital

Similarly, product introductions demonstrate a firm's ability to commercialize an idea, which is indicative of abilities in technology development and production, as well as the firm's understanding of and competence in navigating

government regulations and processes. FDA clearance is a regulatory milestone in the medical device industry, as products in this industry are not allowed to be sold without it. This milestone allows us to determine when a venture releases a product on the market (Chatterji, 2009).

2.3.3 | Social capital

Social capital, or the relationships among individuals and/or organizations that enable actions toward creating value (Alder & Kwon, 2002), is necessary for firm survival. Social capital enables learning, resource procurement, and opportunity recognition, among other vital activities, and is especially valuable to younger entrepreneurial firms. Prior research suggests that social capital accumulated through relationships (including both strong and weak ties) is critical to new venture performance (Batjargal et al., 2013; Florin et al., 2003). An especially important source of social capital in the medical device industry is ties to venture capitalists (VCs), especially those that are high-status. Funding from high-status VCs and other prominent sources can legitimate a new venture and improve its likelihood of success (Pahnke, Katila, & Eisenhardt, 2015; Pahnke, McDonald, et al., 2015).

2.3.4 | Human capital

Becker's (1964) foundational work on human capital focused on attributes acquired or developed via experience. Human capital, then, reflects the firms' employees' education, skills, experience, and knowledge (Hitt et al., 2001). In our study's setting, relevant knowledge and skill are accumulated through past entrepreneurial experience and via managerial experiences at other medical device firms (Colombo & Grilli, 2010; Katila et al., 2017). Meta-analytic evidence points to a strong relationship between human capital and firm performance (Crook et al., 2011), which can eventually affect entrepreneurial exit.

2.3.5 | Financial capital

Financial capital is "the most basic and most flexible of an organization's resources" (Hofer & Schendel, 1978, p. 146), and it can be an important determinant of success when large differences exist between rivals—especially in young firms. For example, developing new technologies and products and scaling a technology all require substantial financial capital. Differences in financial capital can, consequently, separate rivals' abilities to compete in this sector of the medical device industry (Pahnke, Katila, & Eisenhardt, 2015; Pahnke, McDonald, et al., 2015; Park & Lee, 2011). Ultimately, external financial capital allows a firm to pursue various strategic alternatives, which can affect new venture exit.

2.3.6 | Environment

The environment that a firm is embedded in shapes the impact that resources can have around the time of exit. As Felin et al. discuss, "one pillar of microfoundations is the explicit recognition of contextual factors," which "can take many forms," including market and industry factors (Felin et al., 2015). "A microfoundations focus moves the macro context from background to foreground." (Felin et al., 2015, p. 604). Accordingly, we recognize that just like some soils are more or less fertile, so are the environmental conditions that firms exist in, which can be more or less conducive to a successful harvest. In our context, such "environmental fertility" varies by industry and across years, as acquisitions and IPOs tend to be cyclical (Gulati & Higgins, 2003).[1] Accordingly, we account for environmental

fertility at the time of a venture's exit. As described in more detail below, we measure environmental fertility at exit by combining measures of industry momentum, industry munificence, and location in a rich industry cluster.

3 | METHODS

3.1 | Industry context

Fuzzy set QCA relies on purposive (as opposed to random) sampling (for best practices, see Greckhamer et al., 2018). The goal is to build a sample that includes multiple instances of the outcome of interest (here, firm exit) and multiple cases that vary on the attributes theorized to drive that outcome (here, resources). The process starts with identifying a relevant population of interest (in this study, an industry or industry segment), which given our research focus must meet the following criteria: (1) resources can be theoretically categorized; (2) outcomes are not simply the byproduct of a single resource (e.g., financial capital); (3) there is heterogeneity in resource endowments of firms, and multiple "successful" bundles likely exist; and (4) young firms, with identifiable resource bundles (Brinckmann & Hoegl, 2011; Contigiani & Young-Hyman, 2021), play an important role in the overall industry. These theoretical constraints led us to identify a subset of the medical device sector as a germane empirical context—specifically, the minimally invasive surgical (MIS) device segment of the broader medical device industry—as described in more detail below. MIS devices are highly specialized surgical tools utilized across various areas of patient care, including cardiology, gynecology, and urology.

There are several reasons why the MIS device sector is very well suited to studying the relationship between resource bundles and venture exit. First, there is evidence that both exit by acquisition and by IPO are desired outcomes in this industry and that they are common enough to allow for the study of the variation in resource bundles of firms that achieve them. Second, a variety of resources are needed to exit in this industry. For example, human capital in the form of founders who are surgeons has been shown impact on the ability of firms to innovate (Katila et al., 2017; Smith & Shah, 2013). Similarly, while firms rely heavily on patents to protect the technologies they develop (Graham et al., 2009), they do not patent entire devices; thus, both patents and products are distinct and valuable resources that firms develop (Lahiri et al., 2019). Third, firms in this sector can be successful with widely different resource endowments—for example, research suggests that there is a range of funding amounts and development times needed for firms to innovate (Pahnke, Katila, & Eisenhardt, 2015; Pahnke, McDonald, et al., 2015). Fourth, new ventures are an important source of innovation and often create break-through technologies and devices (Smith & Shah, 2013). At the same time, small firms in this industry do not have manufacturing or distribution capabilities and rely on either original equipment manufacturers (OEMs) or partnerships with established companies. This means that exits are not just desired but often necessary to scale these capabilities either through large cash infusions (IPO) or to gain access to complementary manufacturing and distribution (being acquired by larger firms with those capabilities).

3.2 | Sample and data

Our sample includes longitudinal data on startups in the MIS device sector of the larger U.S. medical device industry. We began our data collection by identifying 198 firms that attempted to develop one of these devices and were founded between 1986—which marks the year of the first minimally invasive procedure in the United States—and 2007. After identifying the entire population of firms, we constructed longitudinal histories on each firm, including data on their founding teams, funding histories, patenting, FDA product approvals, and firm outcomes (including survival, bankruptcy, IPO, and acquisition). Firms without complete founder data[2] were not included in the final sample. The results presented below are based on our analyses of 132 cases—firms that were active at 3 years of age and

either went through a subsequent IPO or acquisition at some point before 2020, declared bankruptcy before 2020, or continued to operate until 2020.

Following other studies on this industry (e.g., Lahiri et al., 2019; Pahnke, Katila, & Eisenhardt, 2015; Pahnke, McDonald, et al., 2015), we compiled data on these firms from numerous sources, including industry analysts, the Delphion patent database, the U.S. Patent and Trademark Office (USPTO), the Food and Drug Administration (FDA), VentureXpert, VentureSource, firm websites (using archive.org to access contemporary data when needed), and press accounts. Additionally, we conducted more than 40 interviews with entrepreneurs, investors, regulators, and industry experts to validate our measures and constructs, and to provide insight into the overall industry.

We examine early resource configurations 3 years after firm founding, and we study IPO and acquisition outcomes when they are achieved. We chose the 3-year mark because it represents a time within which firms typically *begin* raising funding, filing patents, and introducing products to the market. However, 3 years is a relatively short amount of time with which to accomplish these milestones; given the capital requirements and product development times in the industry, even firms that are ultimately successful are unlikely to have a complete resource portfolio within 3 years. This 3-year mark, therefore, allows us to see how *early* resource configurations impact later successes. As these firms were founded at different times and achieved outcomes at different rates, we follow each firm until either an outcome of interest (i.e., IPO or acquisition) was achieved, or the end of 2020. Firms that remained active at that time were categorized as still operational. Firms that went bankrupt by the end of 2020 or did not show any activity for two or more years prior were categorized as bankrupt.

3.3 | Analytical approach

To explore our research question in a configurational manner, we relied on a set-theoretic approach in the form of fuzzy set QCA (fsQCA). QCA is a unique hybrid between quantitative and qualitative methods, allowing for systematic inferences (Ragin, 2008) and the use of large samples, while also allowing for iterations between guiding theory and emergent findings and maintaining the researcher's connection to the cases under study (here, new ventures). Fuzzy set QCA, a modern extension, is grounded in the broader field of set theory, a branch of mathematics. In fuzzy set theory, the degree of membership in a given class or set is expressed by a value ranging between 0 and 1 (Zadeh, 1965). Constructs are operationalized in terms of set membership ranging from 0 (fully outside of the set) to 1 (full membership), with multiple degrees of membership in between (e.g., 0.75 would represent "more in than out" and 0.25 would mean "more out than in" the set). This method relies on Boolean algebra (i.e., AND, OR, NOT operators) and necessity/sufficiency analyses (discussed in more detail later).

To enable analysis, data must first be calibrated, which refers to the process of converting raw data into set membership scores. The process of calibration is grounded in substantive knowledge of the empirical context and theory related to set membership, and involves determining which raw variable values constitute full membership ("fully in") in a given set or category (e.g., highly funded), full non-membership ("fully out"), and the crossover point, or the point of so-called "maximum ambiguity" ("neither in nor out"). In line with prior studies, we used the direct method of calibration for continuous variables, "in which the researcher specifies the values that correspond to the three above-mentioned points (Ragin, 2008) for each causal condition, after which the variable is [algebraically] transformed into fuzzy membership scores using the three benchmarks" (Campbell et al., 2016, p. 169) by software using log odds of full membership (Ragin & Davey, 2016).[3] For multivalue and crisp (binary) sets, as opposed to fully continuous ones, we manually assigned the specific calibration points based on the guiding theory and our substantive knowledge of the empirical context. Upon calibration, the measures (corresponding to the so-called "causal conditions") on which the analyses are performed range between 0 and 1, with multiple possible values in between.

3.4 | Measures and calibration of causal conditions

3.4.1 | Outcome: Exit

The outcome of interest is entrepreneurial exit, which is reflected in liquidity events: getting acquired or going public via an IPO. We focus on these outcomes as they represent significant milestones that are the result of complex interactions between numerous resources over a number of years. Set membership here is calibrated as a categorical set. Specifically, *exit* was coded as 1 (fully in) if a firm had an IPO or was acquired at any point before 2017. Firms that are simply still operating in 2020 were coded as 0.49 (more out of the set than in), and those that went bankrupt were coded as 0 (fully out).[4] By selecting a calibration of 0.49 for firms that are still operating aligns conceptually with the idea that an exit is still feasible but has not been achieved yet. This value is just shy of the point of maximum ambiguity (0.50), since it is considered slightly more out of the set than in. At the same time, the specific value of 0.49 also reflects the high rate of exits specific to the medical device industry.[5]

In an effort to further understand any pattern in our results, we also separated the data by type of exit—IPO or acquisition—and ran additional models. We coded the variables the same way as in the initial analysis, 1 (fully in) if a firm exited, 0.49 (just slightly more out of the set than in) for firms still operating, and 0 (fully out) for firms that went bankrupt. However, a restricted sample based on the type of exit was used. To analyze firms that exited via an IPO exit the sample was restricted to firms that have gone bankrupt, are still operating, or had an IPO exit—this totaled 73 firms. Similarly, for the analysis of firms that exited via acquisition, the sample was restricted to firms that have gone bankrupt, are still operating, or had an acquisition exit—a total of 97 firms.

3.4.2 | Technological capital: Patents

Patents are an indication of a venture's ability to create novel technologies and are heavily relied on to protect intellectual property in the medical device industry (Cohen et al., 2000; Graham et al., 2009). *Patent* is a crisp set—firms that applied for at least one patent that was subsequently granted by the third year after founding were coded as 1 (fully in); firms that had no such patents filed in the first 3 years were coded as 0 (fully out). In the medical device industry, patents are filed for individual technology components, not entire devices or products.

3.4.3 | Commercial capital: Products

Products represent the integration of multiple technologies and are the way firms can earn revenue and begin to decrease their dependence on external resource providers. *Product* is also a crisp set—firms are coded as 1 (fully in) if they have a product cleared by the FDA by the end of their third year of their operations and coded as 0 (fully out) otherwise.

3.4.4 | Social capital: VC ties

Venture capital investment is a significant event for medical device firms and indicates that professional investors have vetted their technology and commercialization prospects. Investment by high-status VCs in particular has been associated with increased likelihood of venture success, as these VCs act as both a conduit to future connections and a signal to others of firm potential (Podolny, 2001; Pollock et al., 2010). Thus, *VC ties* was coded as a three-value set, calibrated at 1 (fully in) when a high-status VC invested in the firm; 0.80 if any VC invested (since investment by any VC firm is a significant event/resource); and 0 if no funding came from a VC firm (fully out). VCs were coded as

being high-status if they were one of the Top 30 VC firms based on their eigenvector centrality in VC syndicates (Katila et al., 2008).

3.4.5 | Human capital: Experience

We considered the amount of experience that the founders of ventures had working in established medical firms or starting other medical device ventures as indicative of their knowledge of how to create successful products and companies in the industry (Chatterji, 2009; Katila et al., 2017). *Experience* is a composite, or so-called superset (i.e., higher-order set), of two lower-order sets: entrepreneurial experience and managerial experience.[6] Following Greckhamer (2016), both types of experience were calibrated individually, and the aggregate experience measure (set) was constructed using the compensation method (Ragin, 2000), whereby the values in lower-order sets are averaged. The values were again driven by our knowledge of this industry; entrepreneurial experience of founders is a four-value set: three or more prior firms founded was coded as 1 (fully in); two firms founded at 0.85; one firm founded at 0.60; and no prior firms founded coded as 0 (fully out). This means that any prior experience of founding a firm has a "more in than out" value, with increasing but diminishing returns for additional founding experiences. Managerial experience of founders mirrors the coding of entrepreneurial experience, with three prior positions as a vice-president (VP) or above on the founding team considered coded as 1 (fully in), two coded at 0.85, one prior position as a VP or above coded at 0.60, and no prior senior management experience coded as 0 (fully out). The composite set (i.e., superset) of the founding team combines these two measures of experience to produce a single experience value.

3.4.6 | Financial capital: Total funding

Total funding was coded as a continuous variable—the thresholds were set to 0.95 (fully in) if the amount of funding at year three of the venture's operation was $40 million; 0.5 (crossover) at $10 million; and 0.05 (fully out) if no funding was obtained by that time. These calibration thresholds are based on substantive knowledge of the industry and interviews with industry experts who suggested that firms typically require at least $40 million in funding to get a device through FDA approval (Pahnke, McDonald, et al., 2015).

3.4.7 | Environmental fertility at exit

We measure how fertile a firm's environment was at time of exit by using a superset (composite) of three variables. We individually calibrated raw metrics of industry momentum ("heat"), industry munificence, and cluster location; these were then aggregated to give a single measure of environmental fertility—a *fertile context* superset. Specifically, we captured the industry's heat at the time of exit by gathering data on the yearly count of VC investments in U.S.-based medical device firms. These data were collected from the Crunchbase database and capture both resource availability within the broad sector and a forward-looking sentiment about the prospects for the sector in the future. The count of VC deals by year was calibrated as a continuous variable: set based on full range of industry data, the thresholds were as 0.95 (fully in) if the total count of the year was in the top 5%; 0.5 (crossover) at 50%; and 0.05 (fully out) if the total count of the year was in the bottom 5%. This was done separately for acquisitions and IPOs. The match was based on year of exit and type of exit (IPO vs. acquisition). If a firm went bankrupt, they were given a value based on the average of IPO and acquisition; if a firm was still operating, they were given a value of 0.49 (this was necessary to assign a value as there was no year to match with).

Munificence is based on four-digit industry sales compared with the previous rolling 5-year sales average. Growth in this figure represents increased munificence (Dess & Beard, 1984). Moreover, it is appropriate for our single industry context where traditional approaches require sales to be regressed with the resulting coefficient being divided by average sales (with all values being in the same four-digit category, the results would be a constant). Next, we calibrated this factor as a continuous fuzzy set, with the software performing the ultimate calibration: the thresholds were set as 0.95 (fully in) if the sales growth was in the top 5% of the range of growth; 0.5 (crossover) at 50%; and 0.05 (fully out) if sales growth was in the bottom 5% of the range. Each firm was then matched by year to the calibrated munificence value.

Medical device clusters are also indications of resource availability. Prior research on the medical device industry, as well as our own field work, indicates that there are four geographic regions that are unique in the supports they offer to new medical device firms, including substantial investment capital, experienced medical device entrepreneurs, established medical device companies, and medical device manufacturers (Katila et al., 2017; Pahnke, Katila, & Eisenhardt, 2015; Pahnke, McDonald, et al., 2015; Thirumalai & Sinha, 2011). Medical device cluster location was therefore coded as a three-value set, with firms located in the Boston or San Francisco Bay area coded as 1 (fully in, based on both the prevalence of medical device firms there as well as other entrepreneurial supports, such as VC firms); firms in Minneapolis and Orange County coded as 0.80 (firms located there are clearly more in the set than out, as these areas have prominent established medical device firms and manufacturers); and all others coded as 0 (fully out).

Tables 1 and 2 summarize each measure and its calibrations and provide descriptive statistics.

3.5 | Analysis

The goal of fsQCA is to identify necessary and/or sufficient subset relations (Ragin, 2000, 2008) by analyzing so-called causal conditions, which in the present study are the six individual resources (including environmental context). An individual resource would be considered *necessary* if it is a subset of a given outcome (here, a successful exit or fast successful exit). In other words, if all successful cases include the presence of a particular resource, that resource is causally necessary. That is, "an outcome can be attained only if the attribute … is present" (Fiss, 2011, p. 1184). On the other hand, an individual resource would be *sufficient* if it can produce the outcome by itself. But fsQCA also allows the examination of combinations of conditions that together are sufficient for the outcome to occur. If a combination is found to be sufficient, it indicates that it nearly always produces the outcome. As such, these types of combinations are often referred to as "causal recipes" or configurations.

Two additional terms related to fsQCA warrant introduction: consistency and coverage. *Consistency* refers to the degree to which a condition or a combination of conditions (as discussed above) consistently produces the outcome of interest. Low consistency implies that a given condition or configuration is not reliably linked to the outcome, while high consistency implies that it almost always leads to the outcome. A benchmark value of 0.80 is used to establish a consistent subset relation (Misangyi & Acharya, 2014), with 1.00 indicating perfect consistency. *Coverage* "indicates the empirical relevance" (Ragin, 2008, p. 45) and, based on the level of analysis, assesses the degree to which instances of the outcome of interest are accounted for by a given condition, by a given configuration (i.e., individual path), and by the solution as a whole (i.e., all paths). Again, 1.00 would indicate perfect coverage, where all the instances of the outcome are accounted for. Conceptually, this would be analogous to an R^2 equal to 1.

The primary analyses for this study were performed with fsQCA 3.0 (Ragin & Davey, 2016), using the truth table algorithm for fuzzy sets. We first conducted necessity analyses, applying the recommended consistency benchmark of 0.90 (Schneider & Wagemann, 2012), and evaluating the conditions' coverage to ensure that any potentially necessary conditions were also empirically non-trivial. We did not find a single necessary condition that exceeded the benchmark; the highest consistency across the analyses was for VC ties (in the all-exit analysis, the consistency

TABLE 1 Fuzzy set calibrations and descriptive statistics of resources.

Resource type	Attributes	Measure description	Calibration type	Calibration value (0–1)	Calibration description	Calibration Descriptives			
						Mean	SD	Max	Min
Technology capital	Patents	Patent application filed, by the third year, which was subsequently granted	Crisp	1	1 or more patents	0.477	0.501	1	0
				0	No patents				
Commercial capital	Products	Product on the market by the end of the third year of operation	Crisp	1	1 or more products	0.288	0.454	1	0
				0	No products				
Social capital	VC ties	Access to VC resources and knowledge via investment tie	Categorical	1	Investment from top 30 VC firm	0.709	0.337	1	0
				0.8	Investment from VC firm				
				0	No VC investment				
Human capital	Experience	Superset of experience types	Super set		Average of entrepreneurial and managerial experience	0.474	0.317	1	0
	Entrepreneurial experience	Number of firms previously founded	Categorical	1	3 prior foundings	0.347	0.406	1	0
				0.85	2 prior foundings				
				0.60	1 prior founding				
				0	No prior foundings				
	Managerial experience	Number of VP level or higher positions previously held	Categorical	1	3 prior positions	0.600	0.436	1	0
				0.85	2 prior positions				
				0.60	1 prior position				
				0	No prior positions				
Financial capital	Total funding	Total amount of money raised by a venture in the first 3 years	Continuous	Fully in (0.95)	$40 million raised	0.302	0.360	1	0.047
				crossover (0.5)	$10 million raised				
				Fully out (0.05)	No money raised				
Environment	Fertile context	Superset of types of context	Super set			0.574	0.200	0.959	0.047

(Continues)

TABLE 1 (Continued)

Resource type	Attributes	Measure description	Calibration type	Calibration value (0–1)	Calibration description	Calibration Descriptives			
						Mean	SD	Max	Min
					Average of munificence, sales hotness, and location				
	Heat	Yearly (1992–2019) count of VC deals in broader medical device industry	Continuous	Fully in (0.95)	95th percentile of data range	0.531	0.257	0.927	0.047
				crossover (0.5)	50th percentile of data range				
				Fully out (0.05)	5th percentile of data range				
	Industry munificence	Yearly (1992–2019) sales total in the broader medical device industry	Continuous	Fully in (0.95)	95th percentile of data range	0.574	0.200	0.969	0.060
				crossover (0.5)	50th percentile of data range				
				Fully out (0.05)	5th percentile of data range				
	Location	Located within a medical device cluster city	Categorical	1	Top cluster locations	0.618	0.459	1	0
				0.8	Moderate cluster locations				
				0	Any other location				

TABLE 2 Fuzzy set calibrations and descriptive statistics of outcomes.

Outcome	Measure description	Calibration type	Calibration value (0–1)	Calibration description	Calibration descriptives			
					Mean	SD	Max	Min
All exit	Successful liquidity event (acquisition or IPO) anytime	Categorical	1	Exit	0.805	0.332	1	0
			0.49	Still operating				
			0	Bankrupt				
Acquisition exit[a]	Successful acquisition anytime	Categorical	1	Acquisition exit	0.735	0.363	1	0
			0.49	Still operating				
			0	Bankrupt				
IPO exit[a]	Successful IPO anytime	Categorical	1	IPO exit	0.647	0.380	1	0
			0.49	Still operating				
			0	Bankrupt				

[a]Restricted sample.

value was 0.73; in the acquisition exit analysis the consistency was 0.74; and in the IPO exit analysis the consistency was 0.70). We then conducted sufficiency analyses.

First, we constructed a truth table, which is a Boolean property space comprised of 2^k logically possible combinations, where k is the number of causal attributes under consideration (Greckhamer et al., 2008). Our truth table had 64 rows.[7] Following best practices (e.g., Fiss, 2011), we consolidated the truth table based on (1) the minimum number of cases required[8] per row (configuration) for a given solution to be considered, and (2) the minimum level of consistency. We applied a frequency threshold of two cases per configuration to ensure that single cases (i.e., firms) were not driving our solution and/or conclusions. In large-N situations, such as ours, it is "prudent [...] to treat low-frequency causal combinations the same as those lacking strong empirical instances altogether (i.e., the same as those with frequency = 0)" (Ragin, 2008, p. 133). For these reasons, in large N studies, applying a frequency threshold is essential per QCA standards; at the same time, it is "important to inspect the distribution of the cases when deciding upon a frequency threshold" (Ragin, 2008, p. 143). Upon inspecting our data, a threshold of two cases was deemed appropriate and still allowed us to retain ~70% of our cases across the various subsamples (all of which met the large sample criterion).

Next, we eliminated any solutions with a consistency benchmark below 0.75 as indicating substantial inconsistency (Ragin, 2008; Schneider & Wagemann, 2012) and ensured that all of our solutions exceed the 0.80 recommended threshold used in prior research (e.g., Crilly, 2011). We then applied the more conservative proportional-reduction-in-inconsistency (PRI) consistency threshold, which eliminates the empirical paradoxes that sometimes arise in subset relations (i.e., when a configuration leads to both the outcome and its absence). We verified that each configuration is above the 0.65 PRI minimum recommended (Douglas et al., 2020) and used in recent research (e.g., Greckhamer, 2016). Finally, the truth table rows were logically reduced using the software's Boolean algorithm, which is based on counterfactual analysis. The analysis produces three solutions: complex, intermediate, and parsimonious. Considered "needlessly complex" and providing little insight, the complex solution is rarely used (Fiss, 2011, p. 403). The intermediate solution, which lies in the middle of the complexity-parsimony continuum, differs from the complex solution in that causal conditions that are inconsistent with existing knowledge are removed (Ragin, 2008). The parsimonious solution, which represents the most reduced form, employs all simplifying assumptions—that is, those that may be consistent with empirical evidence but inconsistent with theoretical knowledge (Schneider & Wagemann, 2012).[9] Based on prior research on entrepreneurial resources (e.g., Beckman et al., 2007; Beckman & Burton, 2008; Graebner & Eisenhardt, 2004; Hsu, 2004; Pollock et al., 2010; Roche et al., 2020; Sørensen, 2007; Stuart & Sorenson, 2003), we assumed each of the resources should, in theory, contribute to a successful exit, but note that this assumption does not affect actual cases observed in our data and only applies to the counterfactuals (i.e., configurations that are theoretically possible but not

observed in the sample). In line with the majority of recent research, our table incorporates both the intermediate and parsimonious solution, allowing us to differentiate conditions that are "core" to a given configuration (based on stronger evidence) from those that play a "contributing" or peripheral role. Core conditions are part of both solutions, while the latter are absent in the most simplified, parsimonious solution.

4 | RESULTS

By the end of 2020, 59 firms had been acquired, 35 had gone public, 25 were still operating, and 13 had declared bankruptcy. In total, 94 firms (72 percent) experienced some kind of a successful exit across our sample time period. Below, we first present aggregate results on successful exits and then separate results for IPOs and acquisitions.

4.1 | Paths to a successful exit

Our analyses did not identify any necessary conditions based on QCA necessity analyses. Instead, our results identified four different paths or combinations of resources that are sufficient for an exit and we present these results graphically in Table 3. A solid circular symbol (●) indicates the presence of a condition, the crossed-out open circle symbol (⊗) indicates a condition's absence, and a blank space represents a "do not care" condition, where the presence or absence is immaterial to the outcome (Ragin & Fiss, 2008). Larger symbols denote a core condition and smaller symbols signify a peripheral condition. However, unless there is strong prior theory to suggest they should be of lower importance, they should be interpreted as equal parts of the path (Dwivedi et al., 2018).[10]

In total, these four solutions exceed the benchmarks recommended for consistency and coverage. Moreover, these solutions require unique resource bundles; two solutions include two conditions, while the other two are comprised of three conditions. This substantiates our notion of interdependence and equifinality, but limits complexity

TABLE 3 Resource paths sufficient for successful exit.

	Technology driven	Connected idea	Flush with cash	Product driven
Patents	●	●	⊗	
Products				●
VC ties		•	•	•
Experience				
Total funding	⊗		●	
Fertile context		●		
Consistency	0.863	0.885	0.941	0.917
Raw coverage	0.278	0.273	0.090	0.264
Unique coverage	0.091	0.061	0.060	0.086
Overall solution consistency	0.896			
Overall solution coverage	0.572			

Note: Full black circles ("●") indicate the presence of a condition, and open circles ("⊗") indicate its absence. Blank spaces indicate "do not care"—that is, the condition is not relevant to that particular configuration with regard to the outcome. Large circles suggest "core" or central conditions, while small circles indicate contributing/complementary condition.

to configural yet parsimonious paths. Next, we engaged in the next two steps of configurational theorizing—linking and naming (Furnari et al., 2021).

The first path in Table 3 includes both the presence of a patent and a marked absence of funding. In line with the principles of articulating with simplicity, capturing the whole, and evoking the essence of the configuration (Furnari et al., 2021), we name this path *Technology Driven*. These two conditions are together sufficient for successful exit, and environmental fertility at exit does not play a role. In contrast, the second path, *Connected Idea*, includes the presence of a patent along with VC ties and a fertile environment at exit. Here, an idea, in the form of patent, needs two more elements—VC ties and a fertile environment—to support successful exit. It is worth noting that this is the only path were context matters. The third path includes the absence of a patent at year 3, VC ties, and high levels of early funding. Accordingly, we name this path *Flush with Cash*—it suggests that, interestingly, financial capital combined with valuable social capital can override the absence of technological resources early in the new venture's life. Finally, the fourth path includes the presence of a product and VC ties; as such, we name it *Product Driven*.

Collectively, these results suggest that no one type of resource is necessary for success—there is no single resource that is shared across all of the solutions. In fact, only one resource, VC ties, is present in even three out of the four the solutions. This equifinality and variability in the resource bundles that lead to success is intriguing as it suggests that—in line with our early expectations and theoretical hunches—many different configurations of resources can help young firms achieve their goals. In addition, all the solutions include a number of "do not care" conditions—this means that a young firm can have these resources at their disposal but they are not integral components of the paths to success.

We next analyzed the two types of successful exits, IPO and acquisitions, separately to ascertain if they largely show the same configurations of resource bundles or if they point to distinct paths. As explained in further detail below, we find support for our overall pattern of findings. These more fine-grained analyses, however, offer further detail for modality-specific alignment.

4.2 | Paths to an acquisition

Because fsQCA calls for maintaining a close connection to the underlying conceptual logic and the cases under consideration, we also evaluated the modality-specific results in light of the cases' membership in each solution. Accordingly, for each path in Table 4, we provide an exemplar firm from our data that serves as an illustrative example of that given configuration, starting with the acquisition paths. As can be seen, the paths largely replicate what we find in Table 3, with the paths to an acquisition overlapping with the first three paths shown there.

Below, we provide details on the resource bundles associated with each successful path to exit. A summary of each of these paths is provided in Table 5.

4.2.1 | Acquisition path: Technology Driven

Firms in the *Technology Driven* path have not yet raised significant financial capital (i.e., marked absence of funding). This path has no specifications with respect to social or human capital. However, these firms patent early and are likely able to subsequently attract additional resources based on the value of those patents. Advanced Bionics serves as an example of a firm in this path. Advanced Bionics was founded in 1993 by Alfred Mann to commercialize cochlear implant technology that was developed from research at University of California, San Francisco (UCSF). Organizational capital, in the form of patents, was essential in Advanced Bionics' early resources. They filed for their first patent in October of 1994, but their first product was not released until 1998. Notably, Advanced Bionics did not raise any venture capital funding before their acquisition for a reported $740 million in 2004 by Boston Scientific.

TABLE 4 Resource paths sufficient for an acquisition exit and an IPO exit.

	Acquisition exit			IPO exit		
	Technology driven	Connected idea	Flush with cash	Product+ driven	Connected idea lite	Flush with cash
Patents	●	●	⊗	●	●	⊗
Products				●		
VC ties		●	●	●	●	●
Experience						
Total funding	⊗		●		⊗	●
Fertile context		●			●	
Consistency	0.810	0.837	0.924	0.819	0.774	0.872
Raw coverage	0.282	0.272	0.102	0.243	0.166	0.086
Unique coverage	0.125	0.116	0.102	0.162	0.084	0.086
Overall solution consistency	0.840			0.823		
Overall solution coverage	0.499			0.413		

Note: Full black circles ("●") indicate the presence of a condition, and open circles ("⊗") indicate its absence. Blank spaces indicate "do not care"—that is, the condition is not relevant to that particular configuration with regard to the outcome. Large circles suggest "core" or central conditions, while small circles indicate contributing/complementary conditions.

4.2.2 | Acquisition path: Connected idea

An illustrative firm for this path is Evalve, Inc., which focused on developing devices for the non-surgical repair of heart valves that reduce the risk and cost associated with open heart surgery. The firm's initial technology was patented early on; however, it took 10 years for Evalve to transition from ideas to a marketed product—the MitraClip. To reach a successful exit, this company needed to bundle their patent with a fertile environment as well as the presence of VC ties. By working in Menlo Park, California, this firm was able to attract high-status venture capitalists, such as New Enterprise Associates, as well as finding itself in a very fertile ecosystem. Consequently, this bundle led Evalve to be acquired by Abbott Laboratories for a reported $410 million in 2009.

4.2.3 | Acquisition path: Flush with cash

Firms in this path were able to raise a significant amount of funding and gain access to VC networks early in their development. However, at year three, they had not yet filed for a patent. The firms in this path, then, raised funds to create new ideas and developed valuable VC ties, but they needed more than 3 years for their initial technology ideas to develop into patents. An illustrative company for this path is Applied Spine Technologies, which was founded in 2004 in New Haven, CT to commercialize technologies out of Yale University. It had early success raising funding, including funds from prominent VCs. By 2007, it had raised three rounds of venture capital totaling more than $35 M, despite having not yet filed for any patents. Applied Spine Technologies received FDA approval for its Stabilimax NZ system that treated lower back pain in 2007, and the company was acquired by Rachiotek in 2011.

TABLE 5 Summary of paths for successful acquisition and IPO exits.

Path label	Definition	Underlying driver
Combined Exit		
Technology Driven (Path 1)	Possesses a patent. Not yet raised significant financial capital (i.e., absence of funding). No specification with respect to products, VC ties, experience, or environmental fertility.	Early patent, able to subsequently attract additional resources based on the value of patents.
Connected Idea (Path 2)	Bundles an idea (patent) with VC ties in a fertile environment. Neutral toward experience or financial capital.	Social capital in a fertile environment, allows firms to leverage its patents.
Flush with Cash (Path 3)	Significant amount of funding early on and access to VC networks, but not yet filed a patent. Neutral with respect to products, experience, or environmental fertility.	Significant funding to create new ideas, but needed time for their initial technology ideas to develop.
Product Driven (Path 4)	Possesses a product early on as well as VC ties. No specification with respect to patents, VC ties, experience, or environmental fertility.	Early product, able to subsequently attract additional resources.
Acquisition Exit		
Technology Driven (Path 1)	Possesses a patent. Not yet raised significant financial capital (i.e., absence of funding). No specification with respect to products, VC ties, experience or environmental fertility.	Early patent, able to subsequently attract additional resources based on the value of patents.
Connected Idea (Path 2)	Bundles an idea (patent) with VC ties in a fertile environment leads to successful exit. Neutral toward products, experience, and financial capital.	Social capital in a fertile environment, allows firms to leverage its patent.
Flush with Cash (Path 3)	Significant amount of funding early on and access to VC networks, but not yet filed a patent. Neutral with respect to products, experience, or environmental fertility.	Significant funding to create new ideas, but needed time for their initial technology ideas to develop.
IPO Exit		
Product + Driven (Path 1)	Possesses both a patent and product early along with VC ties. No specification with respect to VC ties, experience, or environmental fertility.	Early patent and product.
Connected Idea Lite (Path 2)	In addition to having a patent, VC ties and environmental fertility present, the "lite" path variation included the absence of financial capital but maintains neutrality toward experience.	Social capital in a fertile environment, allows firms to leverage relationships despite lacking financial resources.
Flush with Cash (Path 3)	Significant amount of funding early on and access to VC networks, but not yet filed a patent. Neutral with respect to products, experience, or environmental fertility.	Significant funding to create new ideas, but needed time for their initial technology ideas to develop.

4.3 | Paths to an IPO

The paths to an IPO resemble those to an acquisition—with one path being identical, as discussed below. However, we also noted some important differences. We discuss the paths to an IPO below, along with the associated case examples based on their membership scores.

4.3.1 | IPO path: Product + Driven

This path resembles the *Product Driven* path from Table 3 but also includes the presence of a patent; hence we label this path *Product+*. Firms in this path have VC backing, have filed patents, and are able to introduce a product early in the firm's development. Interestingly, these firms do not exist in fertile environments. The success of these firms, however, indicates that a firm's ability to develop valuable novel technologies and products supersede other resources early in its development. AtriCure, an atrial fibrillation solutions company founded in 2000 and headquartered in the suburbs of Cincinnati, Ohio, serves as a good example of this path. In 2001, the AtriCure bipolar ablation system was cleared for sale by the FDA. The next year, a peer-reviewed article on AtriCure devices was published in *The Journal of Thoracic and Cardiovascular Surgery*, drawing considerable attention to the company and its products. The company went public in August of 2005 on the NASDAQ Stock Exchange. AtriCure is still in business and currently holds more than 138 patents, employs more than 700 people worldwide and sells products in more than 50 countries.

4.3.2 | IPO path: Connected idea lite

This path resembles the *Connected Idea path* from Table 3 but includes the absence of funding; accordingly, we label it *Connected Idea Lite*. Firms in this path patented technologies early in their history. And while they formed some ties to VCs, they did not raise significant funding early on. However, being situated in a fertile exit context aids in their eventual ability to go public. A firm that exemplifies this path is Accuray, which was founded in 1990 to develop devices for the precision treatment of cancers using high-dose radiation. Accuray was able to file for successful patents early on—with one in its first year, and two by year three. Despite their early patenting success, they did not raise VC funding until year 10. Accuray's location in Sunnyvale, CA meant that from the start Accuray was in a fertile environment from the start and exited at a particularly opportune moment. Due to the success of its CyberKnife devices, Accuray had a successful IPO in 2007 and is still in operation today.

4.3.3 | IPO path: Flush with cash

As we already established earlier, interestingly, some firms that do not develop technologies early on are still able to eventually exit successfully. In this final IPO path, firms did not patent early on but did have some VC investors and—perhaps most crucially—large amounts of funding. These financial resources helped them eventually develop successful products and to go public. An example of this path is Conformis—founded in 2004 in Burlington, Massachusetts—which develops custom knee implants. Although it did not have any patents until nearly 8 years after founding, Conformis was able to raise $20 in funding from VCs during its first 2 years. Eventually, Confirmis raised over $240 million from VCs, private equity funds, and sovereign wealth funds before going public in 2015.

4.4 | Supplemental analysis: Experience

We were somewhat surprised that experience was not more central in our results as we expected that it may play a role for a subset of our successful outcomes. In the abductive spirit of our article, in supplemental analyses, we thus explored speed to exit as the outcome of interest on the subset of firms that had a successful exit or where still operating. "Fast exit" was calibrated as a continuous variable—the thresholds were set to 1 (fully in) if the time to exit was 7 years or less; 0.5 (crossover) at 15 years to exit; and 0 (fully out of the fast exit set) if the time to exit was 20 year or more. These thresholds were based on our substantive knowledge of the research setting.

Following the same analytical procedures as described earlier, we found three sufficient paths. One of the paths, Product Driven, was the exact replica of the recipe we found earlier. In addition, we found two versions of the Connected Idea path, both of which included one additional condition. Specifically, *Funded Connected Idea* included patents, VC ties, fertile context, and funding; *Experienced Connected Idea* included patents, VC ties, fertile context, and founder experience. As such, while experience may not be empirically relevant to our configurations reported earlier when time to exit is not considered, human capital in the form of experience does matter for fast exit and suggests that it can speed up success.[11]

5 | DISCUSSION

In this study, we address a fundamental question regarding our understanding of entrepreneurial exit: are *specific* resources necessary for successful exit, or are there alternative combinations of resources that together are sufficient for exit in a given environmental context? To answer these questions, we employed an abductive research process that was informed by the growing work related to the importance of resource configurations, including microfoundations.

Our results show that no single resource was sufficient on its own in any path nor necessary across all paths. These findings highlight that specific resource configurations are needed for both exit types; no individual resource on its own drives these outcomes. Thus, these results substantiate the vital role that resource configurations play in entrepreneurial exit and show how interdependence and equifinality is fundamental to furthering our understanding of this complex phenomenon. Our results reveal four equifinal configurations for successful exits, and when we consider IPO and acquisitions separately, we identify three related but distinct paths for each type of exit.

Beyond showing that complex resource configurations drive entrepreneurial exit, this research also supports the growing conversation within the microfoundations literature (i.e., addressing emergence and interdependence via complex interactions), as well as challenges much prior RBV research (i.e., no single resource is necessary nor sufficient for exit alone) and resource dependence theory (i.e., substitute resources can alter power in relationships). To elaborate on the contributions of our study and the implications, we structure our discussion around salient questions regarding our inquiry.

5.1 | Are some resources more important than others?

Prior research indicates that some types of resources are especially important to ventures. For example, some types of funding sources are more beneficial than others for innovation (Pahnke, Katila, & Eisenhardt, 2015), and high-status partners increase the likelihood and valuation of an IPO (Hsu, 2004). We find considerable support for the effects of resource configurations on exit and little to indicate that individual resources are, on their own, sufficient for venture success. Moreover, we find equifinality among the resource configurations that affect exit regardless of exit type; indeed, there is *no single resource or configuration* that uniquely drives positive outcomes. In other words, no single type of resource or distinct bundle appears to be a silver bullet for venture success.

Some of our results are unanticipated and counterintuitive. For example, there were no configurations that included a high level of every resource. Most surprisingly, patents, products, and funding—three of the most heavily studied contributors to venture success—are not present jointly in *any* of the exit paths. As we noted, it is surprising that experience was not present in any of the paths we identified; however, when we analyzed configurations that lead to fast exits (presented in supplemental analyses), it does play a role. This finding supports the intuitive prediction that experience can be valuable when speed is important and can allow firms to exit quicker; however, when given time (to emerge), firms with less experienced founders can also successfully exit. The fertile context condition was present in only one of the four paths for successful exit as well as in the same path in exit modality-specific

models (Connected Idea). This suggests that the environment at the time of exit can indeed be important and integral part of the successful recipes in some cases.

By further substantiating the importance of resource configurations and their equifinality, these results raise several new questions related to how ventures can configure their resource portfolios during their early years to eventually achieve a successful exit, such as: In what sequence should the resources be acquired? How do different resource configurations impact the relationship dynamics with resource providers? How does a changing technological environment affect configuration development?

5.2 | How does this challenge and elaborate prior theory and recent conversations?

Both RBV and resource dependence are relevant resource-focused theories that our study speaks to. Moreover, this research advances the newer conversation revolving around microfoundations of firm outcomes. First, if we had based our study and predictions on RBV logic, we would have isolated one or two resources, measured their value and rareness, and regressed an outcome on those measures to determine if valuable and rare resources drive venture exit. Alternatively, we could have examined all four resource categories individually, arguing that a firm must have at least one that is more valuable and rarer than rival's to result in positive outcomes. Each of these traditional approaches would not have allowed us to consider complex configurations, even though foundational scholarship suggests that entire configurations or bundles of resources matter. Indeed, lost in much extant work is Penrose's argument that we began this article with, "the services yielded by resources are a function of the way in which they are used—*exactly the same resource* when used for different purposes or in different ways and *in combination with different types or amounts of other resources* provides a different service or set of services" (Penrose, 1959, p. 25).

Our use of fsQCA may hold value as a model for future resource-centric research exploring high-level interactions. While multivariate regression analysis and its derivatives hold enormous utility for a wide range of research questions, they are severely limited in their ability to examine higher-order (e.g., three-) interactions due to both conceptual and empirical limitations (Fiss, 2007). Past empirical attempts to test theoretically rich ideas related to the importance of resource configurations (Black & Boal, 1994) have thus been constrained to testing simple two-way resource interactions (e.g., Hitt et al., 2001), while efforts to move beyond such interactions to examine resource bundles have been limited (c.f. Carmeli & Tishler, 2004). Pushing resource configurations as well as microfoundations research forward, while avoiding the limitations that regression-based methodologies entail, can be achieved via fsQCA, which not only aligns with configurational logics but can model the causal condition of "absence." Indeed, while prior work has considered the effects of resource weakness (Sirmon et al., 2010), the contingent value of resource absence has been neglected.

Overall, our study challenges RBV-centric research to continue the nascent push toward a nuanced consideration of configurations. For instance, Newbert (2007, p. 139) encourages scholars to "resist the temptation to focus solely on the rareness of the resource under examination and instead focus on the rareness of the resource bundle." Additionally, while the RBV's core outcome of interest is competitive advantage, theory could expand to consider outcomes that vary in their difficulty to achieve. Survival, for example, is necessary but not sufficient for growth or profitability. Thus, any configurations that support survival may look significantly different—and are likely characterized by greater variety—than those that also support growth or increasing profitability. Beyond complexity, some important outcomes such as social impact and wealth creation may require resource configurations that are mutually exclusive, thereby requiring research to understand the tradeoffs founders face in the structuring their resource portfolio. Such tradeoffs are likely not limited to the level of resources or even consideration of weakness, but also to their absence. Considering the benefits of *not needing* a resource extends RBV logic in a unique fashion.

Our results also inform entrepreneurship research by suggesting a surprising degree of flexibility in how ventures can manage dependencies on their resource providers. Previous studies have suggested that some resources (such as a high-status investor) are of paramount importance, making entrepreneurs especially dependent on those

who provide them (Alvarez-Garrido & Dushnitsky, 2015; Pahnke, Katila, & Eisenhardt, 2015). Similarly, considerable research has focused on how young firms can protect themselves from misappropriation by resource providers (see, for e.g., Diestre & Rajagopalan, 2012; Hallen et al., 2014; Katila et al., 2008). Our findings related to multiple resource configurations and no necessary resources suggest that it may be possible for ventures to rebalance power in relationships that entail resource dependence via configuring resource bundles in ways that lesson dependence on specific resources. An understanding that there are multiple paths to success and that not all resources are necessary for success may give entrepreneurs more power in their resource exchange relationships. A configurational approach to entrepreneurial resource acquisition, then, may inform "hold up" and power imbalances between resource providers and acquirers.

Our findings about the surprising degree of flexibility that entrepreneurs may have in assembling resource bundles contributes to recent research that takes a dynamic view of resource dependence (e.g., Katila et al., 2022). One implication of our results is that a resource provider's power may vary depending on the composition of the firm's existing resource portfolio or the sequence in which resources were acquired. Entrepreneurs, therefore, may have more flexibility and less dependence on specific resource providers than previously understood. At the same time, however, causal ambiguity may prevent entrepreneurs from clearly understanding which resources should be bundled together. Future research can build on these insights by considering the sequence in which resources are acquired, as well as how that sequence impacts ventures' abilities to complete their needed resource bundles, and how it determines who appropriates the value created.

Lastly, our research also advances the conversation regarding microfoundations, which focuses on understanding how interdependence between actors, organizational mechanisms, and the firm's broader context jointly affect the emergence of firm-level outcomes (Felin et al., 2015). Indeed, our results suggest that fertile context—which represents a broader external context—matters to configurational logic. Thus, our results provide strong support for microfoundations research and encourage exploration in finer-grained detail, to specify complex interdependences around actors, organization and context.

As exciting as finding support for the basic notion of the microfoundation conversation is, it is important to note what our results do not explicitly show. While we indeed model the complex interdependence and equifinality of exit, our results can be thought of as a snapshot of the firm and its resources at a single moment in time. This methodology is not designed to unpack the stream of unfolding choices across time; that is, it is not well-suited to studying processes. Complementary methodologies—such as ethnographies, case studies, and grounded theory—can thus build on our study's evidence to offer process-focused insights on emergence. We also encourage future research to dig deeper into the role of time in the form of the general macroeconomic environment, such as the role of acquisition waves and bandwagon effects in the economy at large (McNamara et al., 2008).

This leads to a more general acknowledgement of this article's limitations that provide opportunities for future study. First, configurational analysis can also provide insight related to failure; however, we did not find consistent paths to failure in our data. This may be a limitation of our context. While this is consistent with prior work examining firm performance (Fiss, 2011) and the notion that there are many ways to fail and only a few paths to success, we strongly encourage future work to explore this topic. Second, an important boundary condition of our analyses is the focus on a single sector; venture success in other industries may rely on different resources and configurations. In order to provide insights to entrepreneurs in other industries, future studies should carefully consider which resources are germane to their empirical setting and identify requisite resource bundles accordingly. For example, young firms in the medical device industry typically rely on other companies to manufacture their devices, and thus do not own significant physical resources; thus, we do not consider physical resources, such as factories, in our study. In other industries, physical resources are likely to be more important and may factor into successful configurations. Third, although we suggest a great deal of nuance in the paths to exit, more complexity may be considered in the future. We focus here on the resources that are acquired during the first 3 years of a venture's development and their subsequent impact on the venture. Follow-up studies could delve deeper into the complex interdependencies between the resources in each configuration by considering the sequence in which the resources are

acquired, the impact of different resource configurations on the relationship dynamics with resource providers, and the effects of a changing environment on configuration development. Finally, as noted in the data section, due to the importance of human capital, we consider it as part of the resource bundles analyzed. Although we started with the population of MIS firms, we only study firms for which we could find systematic founder data after an exhaustive search of secondary data sources. Future research may focus on studying human capital in more comprehensive ways, which may require primary data collection or new sources becoming available.

6 | CONCLUSION

Our study highlights that, contrary to the common portrayal the path to entrepreneurial exit, there are many resource configurations that can ultimately lead to success. By showing that even relatively constrained early resource portfolios can put young firms on the path to exit, we join a growing body of work that highlights entrepreneurs' discretion in guiding their ventures on the paths to eventual success. Our research also indicates that a broader set of methodological tools that allow for rich qualitative insights may allow scholars to garner a more nuanced understanding of complex entrepreneurial phenomena. We also hope it will inspire future research to examine some of the early theoretical insights offered by scholars regarding the importance of bundles of resources to firms and how the unique bundles relate to other important firm outcomes.

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ENDNOTES

[1] We thank our reviewers for pointing out the need to account for environmental conditions at the time of exit. As our results show, their theoretical "hunches" were correct.

[2] While information on the founders was limited, data on the other quantitative factors (patent count, product count, and funding level) of firm resources were available and are not statistically different between the sample of 198 firms and 132 firms. The categorical factors (exit, location, and VC status) were not meaningfully different either. This provides confidence that the subsample of 132 used is sufficiently representative of the entire MIS sector.

[3] Following prior works using fsQCA (e.g., Campbell et al., 2016; Fiss, 2011), a small constant (0.000001) was added to all the exact values of 0.50 to ensure that these observations were not dropped for technical reasons.

[4] As a robustness check, we used a crisp calibration where the operating and bankrupt firms were coded as 0 (fully out) and exit was coded as 1 (fully in); the solution was generally consistent with the fuzzy calibration.

[5] In the larger global medical device industry, exits via acquisitions and IPOs occur frequently. One study identified 674 acquisitions and 130 IPOs of medical device firms around the world between 1996 and 2006 (Ohashi, 2007). Another study on medical technology acquisitions—which included hospital supplies and electromedical equipment companies in addition to medical device firms—identified 400 acquisitions in a single year (Wei & Clegg, 2014).

[6] Other studies have found mixed impacts for having MDs involved with innovation in medical device firms, depending on the role of the MD at the firm. Thus, we did explore whether any member of the founding team had an MD degree, but found that including this factor did not significantly impact the results.

[7] The full truth table was omitted due to space considerations but is available from the authors upon request.

[8] This ensures that our solutions are not driven by exceedingly rare cases. Robustness checks were performed varying the frequency threshold from 1 to 3 and the solutions remained consistent.

[9] For an extended discussion of counterfactual analysis, see Fiss (2011).

[10] Following Dwivedi et al. (2018), we report these peripheral conditions in the spirit of transparency, but do not focus on this distinction in our interpretation.

[11] Additional treatment of human capital is available from the authors, but no other specifications we experimented with offered more compelling results—empirically or conceptually. For instance, modeling the two types of experience separately substantially lowered overall coverage as well as made path interpretation more complex.

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