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From product system to ecosystem: How firms adapt to provide an integrated value proposition

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Abstract

Research Summary: Ecosystems represent a key challenge for established firms, shifting their focus from products to system-level collaboration around integrated value propositions. This longitudinal case study of a machine manufacturer reports how an established firm created an ecosystem to enhance its focal product. Drawing on an activity system lens, we develop a model how firms can achieve fit around an integrated value proposition through mutual adaptation of product and ecosystem activities. This strategic transformation is supported by a shift towards collaborative organizational design. We elaborate on how firms can create non-generic complementarities between products and the emerging ecosystem through product adaptations, demonstrate the role of internal and external collaboration in developing ecosystem orchestration capabilities, and highlight data generation and processing as critical factors in realizing complementarities.

Managerial Summary: Digital ecosystems that enable new integrated value propositions pose a challenge for established firms, as these new activities often fundamentally conflict with the existing product business. Our case study of a machine manufacturer shows how a firm can leverage its product-focused activities to establish itself as an ecosystem leader through the mutual adaptation of its product and ecosystem activities. The focal firm

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modularized its products and enhanced their information-processing capacities while simultaneously embedding them in an integrative platform with open interfaces for partner components. The firm was thus able to realize data-driven complementarities between the platform and its components. Supporting the ecosystem-creation process required a shift of the organizational design towards collaboration, both internally and with partners.

KEYWORDS

activity system view, ecosystem creation, longitudinal case study, organizational design, strategic change

1 | INTRODUCTION

In many industries, the sources of competitive advantage shift from superior standalone products and services¹ to integrated value propositions based on an ecosystem of interdependent products from multiple, independent firms (Adner, 2017; Hannah & Eisenhardt, 2018; Kapoor, 2018). Ecosystems provide a coordination structure for participating firms to realize value propositions that rely on non-generic complementarities (Jacobides, Cennamo, & Gawer, 2018). By establishing an integrated value proposition in the market, emerging ecosystems can thus disrupt the competitive position of firms with product-focused strategies and force them to adapt (Ansari, Garud, & Kumaraswamy, 2016; Jacobides, Macduffie, & Tae, 2015; Snihur, Thomas, & Burgelman, 2018).

Extant literature shows that established firms can create ecosystems by opening their focal products and enabling innovation from complementary partner products (Gawer & Cusumano, 2008; Hagi & Altman, 2017; Zhu & Furr, 2016). To this end, established firms need to build up new activities to cope with system-level technological interdependencies and inter-organizational relationships in the ecosystem (Helfat & Raubitschek, 2018; Nambisan & Sawhney, 2011; Wareham, Fox, & Giner, 2014). These new activities differ from their core product business, as they focus on inter-organizational cooperation rather than competition (Gawer & Phillips, 2013), dynamic control of ecosystem dynamics rather than static control of market positions (Dattée, Alexy, & Autio, 2018), and system innovations rather than component improvements (Baldwin & Woodard, 2009).

However, little is known about how product-focused activities *inside* an established firm interrelate with the ability to create and manage an emerging ecosystem. Extant literature has focused on ecosystem activities separated from an established firm's core business (Cozzolino, Verona, & Rothaermel, 2018; Dattée et al., 2018; Gawer & Phillips, 2013), neglecting how activities and organizational design inside the focal firm influence its ability to cope with interdependencies in the ecosystem (Kapoor, 2018). There is a lack of understanding of how a firm can *adapt* its focal product activities to support the emergence of an ecosystem (Ganco, Kapoor, & Lee, 2020). We need to supplement the focus on non-generic

¹For ease of reading, we henceforth use the term "product" to mean "products and services."

complementarities at the ecosystem level with detailed empirical knowledge of how firms cope with complementarities between products and the emerging ecosystem (Jacobides et al., 2018; Shipilov & Gawer, 2020). Such knowledge could enhance understanding of the processes and mechanisms underlying the adaptation (or failure) of established firms facing new integrated value propositions (Altman, Nagle, & Tushman, 2022). Therefore, we ask: “How can a firm adapt its existing product business to support the creation of an integrated value proposition?”

To study this question, we expand on an activity-system view (Gavetti & Rivkin, 2007; Porter & Siggelkow, 2008; Siggelkow, 2002) of ecosystem creation. An activity-system view depicts a firm as a configuration of interdependent activities, elaborately portraying the elements underlying an organization's competitive advantage and influencing its change dynamics (Porter, 1996; Siggelkow, 2001). A fundamental tenet of this view is that firms must achieve external and internal fit by renewing their activity system (Albert, Kreutzer, & Lechner, 2015; Siggelkow, 2001). Thus, it can contribute to a complete understanding of ecosystem creation by revealing how changes at the inter-organizational level originate from and interplay with organizational change processes (Jacobides, 2005; Jacobides et al., 2018).

We elaborate this activity-system view with an in-depth case study of a machine manufacturer that has successfully adapted its product-focused activities to establish itself as a leader in an emerging ecosystem. We conducted a longitudinal analysis of the firm's transformation in the context of changes in its sector (Burgelman, 2011; Siggelkow, 2007; Vaara & Lamberg, 2016). The focal firm (hereafter identified under the pseudonym CASTER), a provider of aluminum-processing machines, introduced an integrated value proposition based on an ecosystem that includes products from multiple industries adjacent to the machine, such as robots, presses, or furnaces, and thus attained a market-leading position. We develop a process model of such transformation through mutual adaptation of product and ecosystem activities. The firm discovered it had to adapt its focal product to make it a connected, modular component aligned with the ecosystem. This reconfiguration process was supported by a shift of the focal firm towards a collaborative organizational design, that is, an open strategy process as well as internal and external collaboration. The focal firm exploited data from the emerging ecosystem to realize complementarities between products and platform, improving ecosystem performance as well as its own and partners' value capture.

Our study complements and contextualizes the emerging literature on ecosystems by introducing the concept of mutual adaptation (Leonard-Barton, 1988) as a mechanism to align established product *and* emerging ecosystem activities. While prior literature has focused on a transition from a focal product towards a platform with non-generic complementarities at the ecosystem-level (Gawer & Cusumano, 2008; Hagi & Altman, 2017; Zhu & Furr, 2016), we show how mutual adaptation enables the focal firm to cope with super-modular complementarities, which are based on increasing returns, between product and the ecosystem (Jacobides et al., 2018). Through our analysis of the ecosystem creation process, we provide empirical support for ecosystem theory by showing how ecosystems emerge as an appropriate meta-organizational form (Jacobides et al., 2018; Kapoor, 2018). Furthermore, our study shows that the focal firm's transition was enabled by a shift towards internal and external collaboration, thus adding to the scarce literature on organizational design for ecosystem orchestration (Joseph & Gaba, 2020; Kapoor, 2018). We show how a collaborative organizational design inside the focal firm helps establish resource and communication flows that can form an orchestration capability of an established firm (Helfat & Raubitschek, 2018). Finally, we suggest conceptualizing ecosystems as meta-organizational

information-processing structures where data generation and control are critical to building the strategic knowledge required for ecosystem leadership (Brusoni & Prencipe, 2006; Brusoni, Prencipe, & Pavitt, 2001).

2 | RELEVANT LITERATURE

2.1 | Ecosystems and adaptation of product-focused firms

Strategic management literature distinguishes between several meta-organizational forms to create value for customers and promote competitive advantage: focus on a product-market, system integration, and ecosystem orchestration (Jacobides et al., 2018). When a firm focuses on a product-market (Porter, 1985), it provides a standalone product with a specific function to consumers (Henderson & Clark, 1990), who then combine different products for their use. When a firm follows a system integration strategy (e.g., Brusoni et al., 2001; Hannah & Eisenhardt, 2018), it shifts the focus from offering single products to providing an integrated value proposition based on multiple products over which it maintains hierarchical control. Conversely, when a firm pursues an ecosystem-based strategy (Adner, 2017; Jacobides et al., 2018; Kapoor, 2018), it focuses on aligning complementary products around an integrated value proposition by coordinating its independent partners' activities, for example by establishing sector-wide standards or platforms. Ecosystems thus enable firms to cope effectively with non-generic complementarities underlying a comprehensive and integrated value proposition. This arises either from unique complementarities between co-specialized components, or as supermodular complementarities between components that provide increasing returns when used together (Jacobides et al., 2018).

The literature shows that firms creating an ecosystem can disrupt competitive positions in a product-market and replace established market leaders (Ansari et al., 2016; Snihur et al., 2018) by creating superior customer value through integrated solutions with complementarities transcending the value created from standalone products (Jacobides et al., 2018; Kapoor, 2018). An ecosystem also reduces the coordination costs between independent firms through platforms with modular interfaces, allowing them to realize complementarities efficiently (Baldwin & Clark, 2000; Gawer & Cusumano, 2014). Firms that gain a central position in the emerging ecosystem tend to capture a large share of the ecosystem's value (Hannah & Eisenhardt, 2018; Jacobides & Tae, 2015), whereas actors providing peripheral products via (or outside of) the ecosystem are often at a disadvantage in terms of value capture (Zhu & Liu, 2018).

Many successful product-focused firms struggle to adapt to emerging ecosystems in their sector because ecosystems entail activities that differ from or potentially conflict with product-focused or system integration activities (Altman & Tripsas, 2015; Gawer & Phillips, 2013). The literature identifies, in particular, three major tensions between product-focused and ecosystem activities: competing to maximize the focal firm's value appropriation vs. cooperating to increase value creation of all firms in the ecosystem (Nambisan & Sawhney, 2011; Wareham et al., 2014), maintaining static control over a firm's industry position and unique resources vs. dynamic control over the evolution of an entire multi-partner ecosystem based on a limited asset base and superior partnering skills (Dattée et al., 2018; Hannah & Eisenhardt, 2018), and improving cost and quality of a well-defined component vs. innovating at the system-architecture level (Baldwin & Woodard, 2009; Gawer & Phillips, 2013).

The literature also shows that some established firms can adapt and achieve a leadership position within emerging ecosystems by structurally separating new ecosystem activities from the established activity system. This separation allows firms to reduce and manage internal and external conflicts between the existing product and new ecosystem activities; the product business is primarily a barrier to ecosystem creation. For example, Gawer and Phillips (2013) report that Intel structurally differentiated the historical product logic (“job 1”) from the ecosystem logic (“job 2”). The groups labeled as “job 1” competed by improving microprocessor products, whereas “job 2” groups collaborated with rivals in the microprocessor industry and shared intellectual property. Owing to structural separation, confrontational arguments between the groups were eventually resolved by Intel’s top management in the interest of the entire corporation. Furthermore, structural separation can help established firms build external legitimacy; a separated ecosystem unit can optimally align the firm’s actions with the interests of ecosystem partners and establish the firm as a trusted agent (Garud, Jain, & Kumaraswamy, 2002). Structural separation also allows established firms to react dynamically to ecosystem developments and engage in controlled experiments with new ecosystem-based value propositions (Dattée et al., 2018).

Hence, established firms can turn their core product into a platform that enables complementary innovations from partners (Hagiu & Altman, 2017; Zhu & Furr, 2016), a process referred to as “coring” (Gawer & Cusumano, 2008). Firms with products central to a technological system are most likely to establish themselves as ecosystem leaders (Shipilov & Gawer, 2020). Several studies, however, show that a complete transition from product to ecosystem, combined with separation of ecosystem activities, can be insufficient or even counterproductive, especially when interdependencies exist between the emerging ecosystem and the product business. These interdependencies can stem from the technological function of the product in the system (e.g., Baldwin, 2018; Hannah & Eisenhardt, 2018) or the knowledge of interactions between products (e.g., Brusoni & Prencipe, 2006). Therefore, anecdotal evidence suggests that established product activities can provide leverage to create an ecosystem. Davis (2016: 7) found that large established firms may have “sufficient resources to attract partners and engage in significant R&D, making collaboration probable,” and Dattée et al. (2018) observed that established firms used their market power and client access to support the creation of an ecosystem. In sum, studies show that product and ecosystem activities can complement each other and that firms can engage in the strategic renewal (Brown & Eisenhardt, 1997; Huff, Huff, & Thomas, 1992) of their established activities to become sector ecosystem leaders. However, the research provides only limited insight into *how* product-focused firms can adapt to create an ecosystem.

2.2 | Towards an activity-system view of ecosystem emergence

To address this gap in ecosystem research, we draw on the activity-system view of strategic renewal (Gavetti & Rivkin, 2007; Siggelkow, 2002). In this view, competitive advantage is achieved through the internal consistency of the activity system and external consistency with environmental conditions (Porter, 1996; Rivkin, 2000; Siggelkow, 2001). While established firms can suffer a loss of external fit through environmental changes, the activity system’s tight, complex interdependencies may hinder a departure from the status quo (Albert et al., 2015; Leonard-Barton, 1992; Siggelkow, 2001). Despite that, firms can renew their activity system to achieve new internal and external fit (Albert et al., 2015).

Theories on the reconfiguration of an interdependent activity system inside a firm can be extended to an interdependent ecosystem consisting of multiple products (Ganco et al., 2020). In this context, firms search for better products and better configurations of these products in an ecosystem (Ethiraj, 2007; Ethiraj & Levinthal, 2004). Depending on the environment and the technological system, different organization designs support a focal firm's search for consistent activity systems (Rivkin & Siggelkow, 2003; Siggelkow & Levinthal, 2003; Siggelkow & Rivkin, 2005).

Beyond simulation studies, however, there is limited knowledge about *how* managers can reconfigure activity systems to enable system-wide renewal (Albert et al., 2015) towards an ecosystem (Altman et al., 2022; Joseph & Gaba, 2020). Even when managers of an established firm perceive the need to change their core business, they often struggle to find appropriate reconfigurations for their activity system (Danneels, 2011). The activity-system view complements creating external fit with achieving internal fit by elaborating on how firms can influence and adapt to ecosystem emergence dynamics through internal changes.

3 | RESEARCH CONTEXT AND METHOD

3.1 | Research design and case selection

We draw on a single case study (Siggelkow, 2007) to inductively build and extend theory. Our focal company, CASTER, is a major supplier of die-casting machines and has extended its leadership position in an extremely dynamic and highly competitive industry, making it a theoretically interesting case study (Eisenhardt & Graebner, 2007; Yin, 2013). We studied the firm's adaptations to become an ecosystem leader in real time and retrospectively analyzed its strategic evolution to understand its historical embeddedness. Die-casting uses a system of multiple asset-heavy pieces of equipment, assembled in a “cell”² that includes the die-casting machine, furnaces, presses, and robots, to manufacture aluminum parts, overwhelmingly for the automotive industry (see Figure S1 for a graphical illustration). Headquartered in central Europe, CASTER has about 550 employees and revenues of about €300 million (2019 data).

During our study, CASTER maintained and expanded its initial position as a leader in the machine industry by addressing a new integrated value proposition spanning established industry boundaries. CASTER was a first-mover in introducing such integrated value propositions in the die-casting industry. Core to this new value proposition was a combination of an optimized die casting cell, co-designed and co-offered with an ecosystem comprising multiple partners, and CASTER's superior machine as a focal component in this ecosystem.

3.2 | Data collection

We collected data from 2000 to 2020, with real-time study from 2016 forward. Our contacts with CASTER's CEO provided us with unrestricted access to interview employees and gather archival material. We drew on interviews, participants' observations, and internal

²“Cell” is the respondent term used to designate all equipment used in the die-casting process at the client's site.

documents to develop a robust case description. Our 43 formal interviews with CASTER's current and former top and middle management, each lasting about an hour, were recorded and transcribed verbatim. We participated in nine full-day strategy workshops during which we informally interacted with more than 60 employees from all functional divisions, conducting multiple informal interviews to probe for frictions and conflicts during the change process. We triangulated this data with internal archival documents, such as management presentations, memos, and employee magazines. To complement those internal perspectives, we conducted seven interviews with managers of client and technology partners in the sector. We also attended the main sector trade fair and interviewed several industry participants. We analyzed articles from specialized industry press, company websites, and financial databases and referred to CASTER's internal annual reports to analyze strategic changes before its shift to an ecosystem. Those reports were compiled for internal use and thus contained frank and detailed assessments of CASTER's strategic situation and choices. To triangulate and complement this documentary evidence, we interviewed CASTER's former top managers about historical changes. Table 1 shows an overview of the data collection.

TABLE 1 Data sources and analysis

Data collection	Phase 1 (2016–2018)	Phase 2 (2018–2019)	Phase 3 (2019–2020)
Objective	Exploration of CASTER's long-term strategic success	Understanding activity system reconfigurations	In-depth analysis of product-ecosystem interdependencies
Analytical tools	Open-ended coding of interviews; developing timeline of events; writing thick description of case	Drawing activity system maps and discussing them with top management	Coding; visual mapping; iterating between ecosystem theory, activity system literature, and case data
Primary data sources	43 formal interviews, of which 36 interviews were conducted with CASTER's current and former top- and middle-management and 7 interviews with other actors in the sector (25 individuals) Participant observation in 9 strategy workshops (1 day each) with ca. 60 CASTER managers, including multiple informal interviews Trade fair visit and participant observation in meetings		7 formal interviews with CASTER's top management, and team leaders of product and ecosystem projects Visit to the client technology center of CASTER, informal interactions Validation and clarification of findings with interview partners from phases 1 and 2
Secondary data sources	178 pages of confidential internal annual reports 253 pages of confidential internal archival material 1,662 pages of public annual reports 246 pages of specialized reporting 113 pages of documents of competitors and partners 150 pages from internal employee magazines		110 pages of specialized reporting in industry magazines Webpages, white papers, and videos of CASTER communication to clients
Main insights	Strategic reorientation from product focus to system integration and eventually to ecosystem	Activity system lens to study the evolution towards internal and external fit	Model of mutual adaptation of product and ecosystem activities

3.3 | Data analysis

The data analysis combines extended case methods for analyzing strategic change processes in the evolution of single firms and their industry (e.g., Burgelman, 1991; Danneels, 2011). In the first phase, we conducted an initial open coding (Corbin & Strauss, 1998) to identify the main themes underlying CASTER's long-term development towards ecosystem leadership. An analysis of this strategic shift required a comprehensive understanding of developments at the sectoral and organizational levels, so we built a detailed timeline of events within CASTER and in the sector. This event chronology helped us build a thick narrative that we complemented with further interviews. Real-time analysis started shortly after CASTER formally adopted the ecosystem-based strategy; we concluded our work after CASTER established an open platform with its partners in the market.

In the second phase, we iterated between data and theory to develop an activity-system view to explain the process of ecosystem emergence (Langley, 1999; Siggelkow, 2007) and identify the mutual adaptation of product and ecosystem activities. We identified which of CASTER's core activities (following Siggelkow, 2002) were highly interdependent and influenced organizational development. After top management feedback, we created multiple activity system maps reflecting different time points and analyzed the firm's actions to derive the processes and mechanisms underlying the activity system reconfiguration (Gioia, Corley, & Hamilton, 2012).

In a final third phase, we used process analysis tools (Langley, 1999), particularly visual mapping, to integrate our concepts into a dynamic process model of mutual adaptation. We discussed and confirmed this model with CASTER's managers by, for instance, using the results as the basis of co-teaching with them. Furthermore, we conducted additional interviews and data analysis to elaborate on the interdependent relationships between product and ecosystem activities.

4 | FINDINGS

Based on an activity system analysis, we found that CASTER's ecosystem emerged from a configurational change that involved a reorientation of the firm's strategy, which guided a dynamic reconfiguration and alignment of ecosystem and machine activities. This core process was supported by adaptations to CASTER's organizational design. Before we elaborate on these three changes, we provide a brief introduction to CASTER's initial industry context, strategy, and organization. The data structure in Figure 1 summarizes the key concepts that emerged from our analysis.

4.1 | Historical industry context, strategy, and organizational design

Before 2001, clients purchased die-casting equipment separately from specialized firms and combined them into a manufacturing system. The different pieces of equipment in this die-casting cell, despite being part of a sequential technological flow, had few mutual interdependencies. Often, workers would manually transfer the semi-finished aluminum parts from one equipment to another in a step-by-step manufacturing process, for instance, using a ladle to pour molten aluminum into the machine.

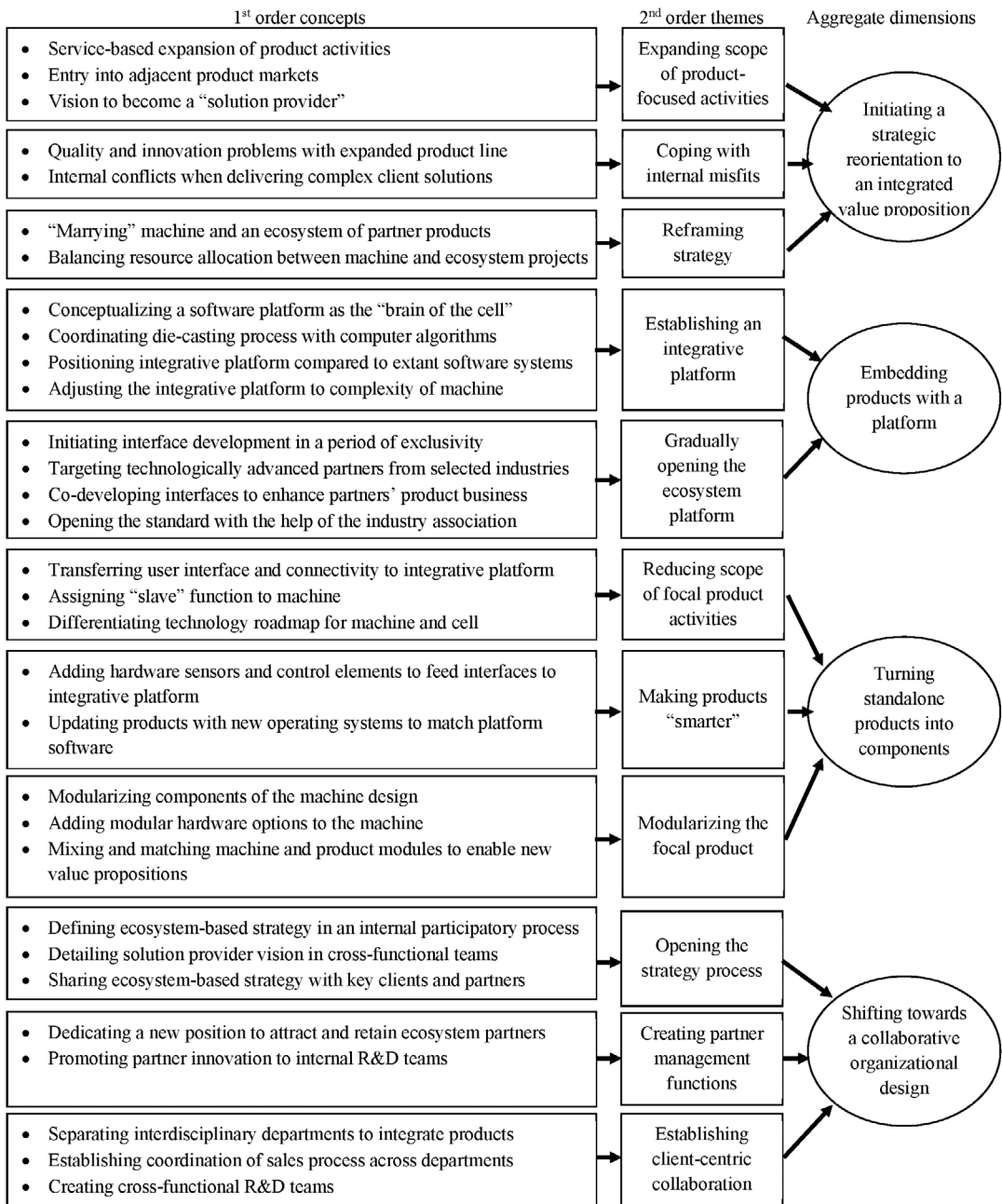


FIGURE 1 Data structure

CASTER's product-focused strategy matched the sector's structure focused on engineering and selling high-quality die-casting machines. Their R&D centered on the machine's technological design and software; machine hardware manufacturing was partly outsourced. The key performance metric was machine performance, measured by criteria like injection quality or machine speed. Another core activity was maintaining close service relationships with clients. CASTER was proud to “not leave the client alone” (Sales Manager) with machine installation

and maintenance. Clients perceived CASTER as the “Rolls Royce of die-casting machines” (Manager of client firm), intervening faster and more effectively than competitors.

CASTER’s organizational design matched its product-focused strategy. The functionally differentiated organizational design was structured along value chain steps of machine manufacturing, including R&D, production, sales, and finance (internal documents). Given that CASTER focused at this time on its own machine only, strategic choices were (and could be) made by top managers. This top-down leadership supported efficient choices and organizational alignment.

4.2 | Initiating a strategic reorientation to an integrated value proposition

4.2.1 | Expanding the scope of product-focused activities towards integrated solutions

CASTER’s strategic transformation started when its management recognized that low-cost competitors were increasingly able to match CASTER’s machine performance at a lower price. To sustain its premium margins, CASTER began expanding the portfolio of services offered to existing machine clients. These new service initiatives helped CASTER’s management identify that the clients’ main concern was improved efficiency of the entire die-casting cell rather than a standalone machine with better performance. CASTER’s management thus recognized early on that client demand would shift to integrated offerings that optimized the entire die-casting cell. A former R&D Head related this discovery as follows:

During these projects, we saw that the machine is only to a small part responsible for quality, and that other factors [...] play a role.

Driven to become a provider of integrated solutions, CASTER’s CEO decided to shift to a system integration strategy. CASTER’s R&D department engineered new product lines adjacent to the machine to provide a wholly improved die-casting cell. CASTER relied on its machine engineering know-how to develop these components and contracted suppliers to manufacture them according to their specifications.

4.2.2 | Coping with internal misfits

Coordinating the delivery of integrated systems through the existing organization, however, created internal conflicts and inefficiencies. Most of CASTER’s clients were initially reluctant to purchase an integrated system from CASTER. Small foundries, a core client group, were particularly hesitant to invest because an integrated system entailed fewer opportunities to customize the die-casting cell and provided lower differentiation potential. Therefore, CASTER had to customize its integrated system for each client and integrate products from other firms to achieve initial commercialization success. CASTER’s R&D struggled with keeping a large number of internally developed products up to date. Consequently, some of CASTER’s in-house products were withdrawn from the market soon after their release. The Head of Sales described this challenge:

We can consider the example of an in-house product [adjacent to the machine]. When we developed it, we were competitive with the features and the performance. However, after 2-3 years, these and additional features were included by our competitor, while we started lagging behind. The reason behind this failure can be attributed to the fact that the adjacent product was not part of our core competence.

At the same time, experimenting with a system integrator strategy produced new insights and growing market success for CASTER. CASTER learned that integrated solutions could be used to produce new, more complex, high-margin aluminum parts, such as large multi-cylinder motor blocks and thin-walled chassis parts. Thin-walled aluminum parts made cars lighter and more fuel-efficient, an important selling point in the context of new environmental regulations. Integrated die-casting systems also proved popular with clients in fast-growing emerging markets and with those lacking skilled personnel, as the COO of a European foundry, a client firm, highlighted:

We used to do most of the system integration ourselves. But one driver that pushes me towards automated cell solutions is the lack of qualified workforce. As I cannot find enough qualified operating personnel, I will have to rely more on solutions by the suppliers instead of designing and doing it in house.

4.2.3 | Reframing strategy

Confronted with these problems of the system integration strategy yet convinced of the growing market potential of integrated solutions, CASTER's top management team decided on a new strategy to become the orchestrator of an ecosystem of independent partners encompassing the entire die-casting cell. Unique to CASTER's strategy was, however, to center this strategy on its existing die-casting machine. CASTER's top managers invented "marrying" the machine and the die-casting cell as the metaphor guiding CASTER's strategic reorientation (internal strategy documents). While system-level integration had been an extension to the machine in the past, CASTER's management now established it as its own, self-contained level of activity and emphasized the aspiration to establish an integrative platform with an ecosystem of partners and the existing machine business as complementary activities.

4.3 | Reconfiguring and aligning product and ecosystem activities

Implementing this strategic reorientation, CASTER adapted both product-focused and ecosystem activities. CASTER created a new integrative platform aligned with its machine and opened this platform to partners, and also adapted its focal product to turn it into a central component of the emerging ecosystem.

4.3.1 | Embedding products with a platform

Establishing an integrative platform

The foundation of CASTER's ecosystem was the development of an integrative platform coordinating the entire die-casting cell, including machine and third-party components. The project

originated in 2014, when the top management team realized that “software integration” (internal strategy documents) of third-party components was essential to provide integrated cell solutions to clients. CASTER's approach in the novel software-based platform was to create a “brain of the cell” (internal strategy document 2014). The software of the integrative platform connected and coordinated the machine's data and all other components in the die-casting process, using new algorithms to coordinate the die-casting process. The team defined the core and optional functionalities of such a system, including a graphical user interface, cell data management, and cell automation. Building on these core functionalities, CASTER's R&D established multiple innovation projects to identify and realize complementarities in the die-casting cell, developing new digital services and platform interfaces that enabled major advances in die casting productivity.

Initially, the integrative platform's creation was met with indifference and skepticism by CASTER's machine engineers and salespeople. In 2017, for instance, the platform team complained about a lack of acceptance and cooperation from machine-focused R&D teams (notes from participant observation). CASTER's top management, in turn, facilitated the internal acceptance of the new ecosystem initiatives by forcefully communicating the vision of marrying machine and cell software (internal strategy documents). The machine remained an integral part of CASTER's strategy and was enhanced, not substituted, by the integrative platform, as a software engineer explained:

Our [integrative platform] is in a way a hybrid that consists, on the one hand, of platform interfaces, and on the other hand, of digital services. Whatever you need to make the cell function relies on the [interfaces] for control and automation. And building on that is the concept of ‘marrying’ [products and cell]. Because, all the products in the cell are highly integrated in terms of data. [...] And all our [digital services] are based on this data which are gathered by the integrative platform.

The team developing the integrative platform could define the platform's technological basis independently from the cell components' legacy systems and specifications, except for the machine. CASTER recognized that its advanced machine offered superior data compared to other components and that the platform had to adhere to certain standards to optimize data exchange with the machine, as a member of the platform development team highlighted:

We [the integrative platform team] can always set the standards and say: “Hey, these are the adaptations we need from you.” There is one exception, and that is CASTER's die-casting machine. In that case, we have to adapt. We have to acknowledge that the die-casting machine is a complex component of the cell. Currently, it contains the most amount of software, and its internal technological design is not as simple as with other products.

As a result, the internal acceptance of the new software-based platform as well as the status of the new team developing this platform increased significantly. In 2020, machine-focused R&D teams mentioned that their access to software development teams had become a bottleneck for innovation (fieldnotes, participant observation).

The introduction of the integrative platform also had implications for CASTER's clients, whose role of integrating all components of the die-casting process was partially replaced by the platform. Therefore, CASTER was confronted with client concerns regarding data security and data transfer. CASTER effectively communicated the security of its platform, as well as the need to adopt integrated value propositions to remain competitive against rival technologies, the

benefits of “Industry 4.0” technologies, and the need to overcome a lack of skilled employees with cell automatization. Hence, clients’ willingness to adopt the integrative platform increased.

Gradually opening the ecosystem platform

CASTER developed a standardized communication protocol with selected component manufacturers from adjacent industries to take the lead in the development of new industry-wide standards that were essential for shared cell solutions, and then opened this protocol to the entire industry to support wider adoption. CASTER approached as initial innovation partners eight market or technology leaders in their respective industries, such as the largest furnace manufacturer. As a leading machine manufacturer, CASTER had worked with all these partners in the past. This facilitated the formation of a multi-partner project, in which each partner represented one type of product and contributed complementary technological knowledge. The communication protocol did not specify how information was generated and used by components in the die-casting cell, a new competence that most product manufacturers had to develop and on which CASTER’s R&D relied:

The cell management system is only as clever as the products, or better, it can only reach its full performance when all products and partners in the cell participate and really cultivate that interface. That is the critical point. (Engineer Machine R&D)

Technologically advanced firms in niche industries, in particular, were interested in becoming lead partners of the emerging platform, adapting their products to gain a competitive edge in the market: “We are too small to become an [ecosystem] integrator ourselves. We want to be compatible with whoever becomes the orchestrator” (Project leader of partnering firm). CASTER’s technology leadership at the machine level was an additional argument for many partners to associate themselves with CASTER’s integrated solution. It was more difficult for CASTER to secure the commitment of large partners such as robotics firms. However, since the die-casting sector only constituted a small niche in their client portfolio, these partners’ attitude was closer to indifference rather than resistance.

After the initial development, CASTER and its partners opened the communication protocol specifications to the entire industry, including their competitors. Since several technologically advanced firms in the die-casting sector had participated in the communication protocol definition ahead of potential competing technologies, the industry’s standard-setting association adopted their guidelines as a sector-wide recommendation. However, few component manufacturers proactively adapted their products to the emerging standard, as its implementation required several weeks of development time. Most potential partners implemented the standard only when their products were used in a client-specific project with a CASTER solution. CASTER’s engineers approached those manufacturers and supported them during the implementation process. In case of resistance, for instance when a potential partner was not willing to provide the required resources, clients were a powerful source of leverage to convince such potential partners who initially blocked implementation.

4.3.2 | Turning products into components

Reducing the scope of focal product activities

To complement its integrative platform, CASTER also adapted its machine to turn it into a component fitting the platform. In one product adaptation, CASTER reduced the functional scope

of its machines and transferred critical functions of the machine (connectivity and client interaction) to the newly established integrative platform. For instance, instead of directly connecting other components of the die-casting cell to the machine, the communication from all components now passed through the integrative platform. The graphical user interface, used by die-casting personnel, also shifted from being part of the machine to being part of the platform.

CASTER started to distinguish explicitly between technology development at the product and ecosystem levels, leading to a transfer of technological responsibility from machine engineers to software engineers. The machine and all other die-casting equipment were turned into components communicating with the integrative platform. Machine engineers, however, saw this development initially as a down-grading of their machine. A machine engineer in R&D described this quite drastically:

The machine becomes a unit in and of itself and has a 'slave' function in relation to the entire cell, like a robot or a trim press. It means that the 'master' functions are performed by the cell control [system].

Machine R&D teams initially rejected the reduction in their R&D scope and started developing some of the same functionalities as the platform team. Upon discovering this months later, CASTER's management merged these projects in line with, and reinforcing, their overall vision to marry cell and machine.

Making products "smarter"

CASTER redesigned its machines to transfer data optimally to the integrative platform. For example, CASTER equipped its newest machine generation with the same programming language as the platform, one more advanced in data processing capabilities than the machine's legacy system. Furthermore, CASTER's R&D equipped the machines with new and better sensors to provide granular, real-time data to the integrative platform.

CASTER also encouraged other manufacturers of cell components to improve their products for data exchange. For instance, the integrative platform struggled to connect to components without a built-in operating system, as such basic products could not provide a rich amount of granular data. CASTER thus relied on third-party manufacturers to adapt their products to support the integrative platform. Adaptations, such as installing sensors to measure data, remained in the component manufacturers' exclusive intellectual domain, as the following quote illustrates:

The communication protocol specifies which and how much information we are sharing, but not how this information is generated. For instance, it specifies the trim press pressure level, but not how this pressure level is measured. This knowledge, on how to measure, rests with the product manufacturer. (Partnership Manager)

Optimization of the machine to the integrative platform created a differentiation potential for CASTER's machine, as certain functionalities of the integrative platform were only possible with the data granularity of CASTER's machine. This further enhanced the performance of CASTER's integrative platform because CASTER had the most advanced machine that could easily provide a rich amount of detailed data, as an R&D manager explained:

The advantage [of a CASTER machine] is quite obviously that we can provide [...] more information to the [integrative platform] compared to a competitor machine.

Likewise, components with full connectivity constituted a potential competitive advantage for CASTER's partners versus their respective competitors, who would not be able to connect their products as seamlessly.

Modularizing the focal product

CASTER's management reduced the number of machine lines from seven to two (internal annual report) and then modularized the remaining machine lines to increase their versatility for various applications in different client-specific integrated offers. Initially, CASTER's R&D team perceived the modularization of the machine design as a way to increase efficiency in machine manufacturing. The sales team advocated for a modular design to lower the entry price for a basic model, thus increasing machine sales. Soon after, the utility of a modular machine for cell solutions became apparent to engineers working on ecosystem innovations. First, a modular machine facilitated continuous innovations because hardware adaptations required for integrated value propositions became faster and cheaper. For instance, clients who wanted to produce more complex parts, such as large thin-walled chassis elements, could simply activate pre-installed functions rather than having to change or refurbish the entire machine:

The client cannot only decide at the moment of purchase, but also later. He can decide: Okay, I want to buy a [basic version of the machine and products]. If he realizes after two years that he wants to produce different aluminum parts or make more complex parts, he can buy only [a few additional modules]. You thus offer a range of options at the date of purchase that the client can activate later. (Engineer Machine R&D)

Second, CASTER's engineers could build on modular machines to develop better cell configurations, mixing and matching the best components into integrative solutions tailored to the specific client needs. For example, one technology reduced thermal imbalances by optimizing heat and pressure across the multiple cell components with the help of the integrative platform. The modularization of all components, including the existing machine, was critical for such innovation projects because hardware adaptations to support an integrated and innovative client solution became more cost-efficient and flexible.

4.4 | Shifting towards a collaborative organizational design

CASTER adjusted its organizational design to support the reconfiguration of product and ecosystem activities. As main changes in CASTER's organization, the firm included key employees and clients in an open strategy process, facilitated collaboration with partners through dedicated functions, and supported the delivery of an integrated value proposition through cross-functional collaboration.

4.4.1 | Opening the strategy process

CASTER's CEO developed the ecosystem-based strategy in a participatory process with middle and lower-level managers. He initiated discussions among top and middle managers on

concrete cases of failed system integration attempts. These joint deliberations created consensus among the involved managers to shift from offering integrated solution in-house to an ecosystem approach. Subsequently, interdisciplinary working groups, spanning hierarchical levels, were set up to define initiatives that implemented the new strategy. This participatory process increased the “understanding of [the new] strategy across [the] organization” (workshop feedback documents) and resulted in reprioritized resource allocation. Based on the inputs of the participative process, CASTER’s top management shifted its key strategic projects from three machine-centric initiatives to three customer-centric initiatives that combined the machine in cell solutions for specific client groups (internal strategy documents).

Second, CASTER’s top management began discussing previously confidential details of their strategy with clients, for instance conducting joint strategizing sessions to focus on common challenges facing the die-casting sector, such as digitalization and e-mobility. Clients were willing to enter these exchanges because of CASTER’s reputation as an innovation leader and its important role as a machine supplier. CASTER’s willingness to share confidential information about, for instance, its innovation pipeline or market forecasts, further helped to build trust and to initiate open, strategic discussions with clients:

The discussions [with clients] have evolved. We used to go out and ask questions [about our products]. Now, [...] we go to customers and share our strategy [...]. And that opens up an incredible amount of discussion with our customers who are eager to take a look at [our reasoning]. (CEO)

In these client meetings, CASTER advocated its vision to “think of the [die-casting] cell as one system, rather than a machine equipped with a lot of peripherals” (white paper communicated to clients and partners). In particular, the argument to increase the competitiveness of die-casting as a whole and relative to other technology sectors resonated with many clients. The CEO of a client firm saw a clear win-win situation for both following this approach:

[Despite many contentious negotiations,] there are enough areas [...] where we can collaborate to reach common goals [with CASTER]. For example, we can discuss how to make the die-casting process more efficient in order to make the overall “cake” bigger.

4.4.2 | Creating partner management functions

CASTER also established a dedicated function for the management of external partners. This new team coordinated partners and their interactions with CASTER’s internal departments, and actively searched for new partners. The team also developed an explicit partnering strategy that stated requirements, but also benefits for ecosystem partners, such as co-branding and access to pre-developed software libraries. This was, according to CASTER’s CEO, critical to win ecosystem partners for CASTER’s integrative platform:

There was some concern [among partners] that long-term we would like to be able to handle the service of the cell [ourselves]. So, they were saying, “CASTER, are you going to be taking away parts of revenue from us?” The main thing that’s worked is, we’ve sat down with them to explain...to make sure that they understand

that we're not trying to take away their business. We're just trying to make their business even more attractive for the customers because it facilitates life for them in the future, and it also facilitates the life of the customer.

The new partner management also helped CASTER to foster collaborative innovation. CASTER won innovative product manufacturers, such as laser markers or X-ray scanners, as partners for its integrative platform. CASTER established framework contracts with these partners to align their products with CASTER's machine in consistent client-facing solutions. The new partner management also fostered the willingness of internal departments to incorporate external innovations from partners and develop shared cell solutions, as the R&D head explained:

We now need to better align with partners. [It is easy when] you do develop everything internally. But if you have partners, they have their own ideas and strategies. And that has to align [with what we do internally]. That is why you need the partnership manager, who helps to open the doors [to our partners' ideas].

4.4.3 | Establishing client-centric collaboration

CASTER further adapted its organizational structure in three dimensions to support a client-centered delivery of integrated value propositions. First, CASTER created interdisciplinary departments that facilitated an alignment between CASTER's machine and other components in integrated offers. Creating these departments in addition to the partner management function was essential for developing and consolidating the specialized know-how for the technological integration required to fulfill client requests. Establishing these new departments outside from the existing R&D also facilitated the differentiation in R&D practices at machine and ecosystem level. While traditional R&D projects lasted around 1–2 years and were directed at fundamental innovations, projects to develop integrated, customized cell solutions were implemented in a few weeks or months in close ongoing interactions with the client and partners.

Second, CASTER created a so-called “offer conference” (respondent term, used in interviews), a process where the new departments coordinated with sales and other departments, like product management or machine production, before the final offer was sent to the client. The design and delivery of integrated value proposition required significantly more cross-department coordination to address the interdisciplinary facets of a complex and customized die-casting system that included a machine, third-party components, and the technological integration of both. The head of product management explained that the new coordination mechanisms helped to reduce inter-departmental conflicts:

Today we have a process for [developing an integrated offer], which is implemented on a daily basis. [...] [The engineers] and the salespeople conduct an offer conference and discuss the following: What can we offer and what is impossible? When everything [in the ecosystem configuration] is defined together with the engineering team [...], it works, even if it is not our standard system.

Third, CASTER restructured its R&D department, moving from a technological competence structure, such as electrical or software engineering, to a more customer-focused structure.

Multifunctional teams were created to work on client-specific issues, requiring close interactions between machine projects and ecosystem projects to create a consistent customer offer:

The [integrative platform] needs data for predictive maintenance, so we have to build in the appropriate sensors. Another example, when we embed a product in a client solution, the [integrative platform] has to be ready. [...] So these projects are closely tied together. We have weekly meetings between machine and platform R&D. But these are quite challenging. (Engineer Machine R&D)

The focus by top management on better cross-functional collaboration reduced intra-organizational conflicts between the departments involved in providing an integrated value proposition to clients.

4.5 | Outcome: Emergence of integrated value propositions and ecosystem competition

Through this strategic transformation that established an ecosystem enhancing its existing machine, CASTER was able to offer integrated value propositions that realize non-generic complementarities together with partner firms in the die-casting sector. An increasing number of clients approached CASTER with open-ended requests for optimizing the entire die-casting cell. One client described this as follows:

[Our management team] gathers together around the table [with the team of CASTER]: ‘This is our [die-casting] problem that we would like to solve. Do you have any ideas on how we could approach this issue?’ (COO of a client firm)

Following this trend, firms such as competing machine producers, robotics firms, and entrants from other sectors started rival initiatives for integrated solutions, thereby challenging CASTER's leadership position:

There is a race to be the master of the cell, and no one yet knows who will be the future cell leader. It could be a [die casting] machine company, a robotics company, or some big player like Siemens or GE. (Portfolio Manager of Robotics Producer)

CASTER, however, established itself as the almost uncontested leader of integrated cell solutions offered in collaboration with other firms between 2001 and 2020 (internal competitive intelligence data). Many competitors abandoned or scaled back their ecosystem initiatives to focus on their struggling core business; thus, by 2014, CASTER had become the largest company in terms of market share, while also achieving record-high margins (cf. Figure 2). At the end of our study in 2021, CASTER's value capture still came mainly from machine sales, but about half of its revenue was achieved in connection with integrated solutions (interviews and internal documents). CASTER reached this leading position because it developed a new integrative platform around its existing machine and leveraged its adapted machine as a central component of the new platform, as was emphasized by the CEO:

They tie very much together; they work in unison. This ensures that the die-casting machine gets the most out of [the integrative platform].

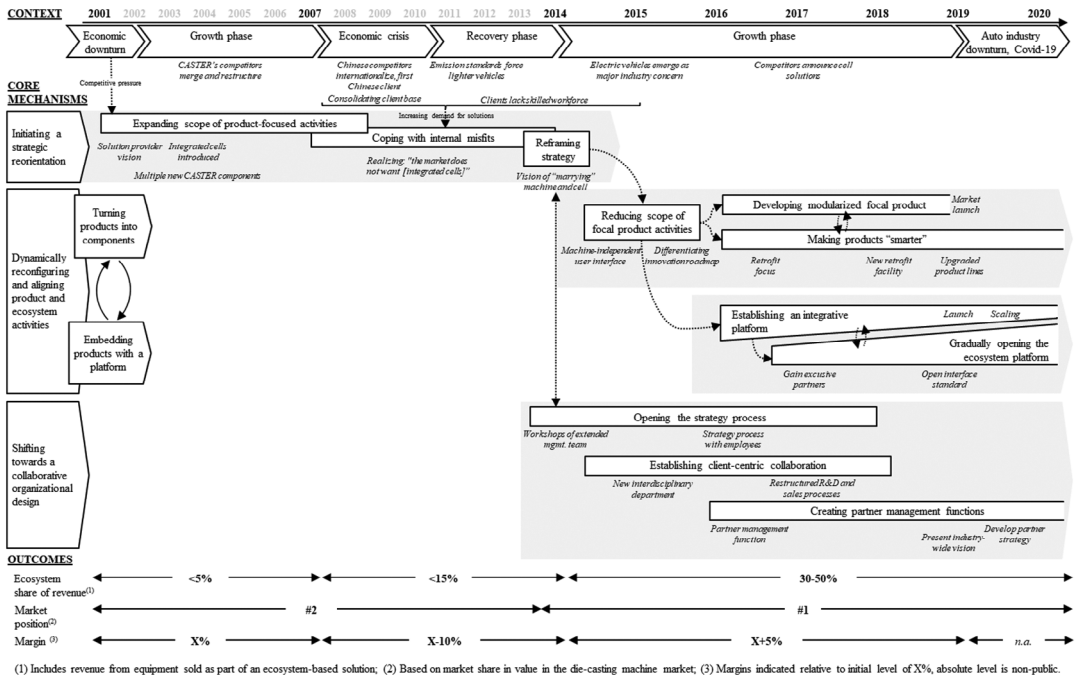


FIGURE 2 Process model of mutual adaptation with critical incidents (in italics), second-order themes (boxes), and their dynamic relations (arrows)

Core to the new strategy was using data from its own and partner products to realize complementarities. One of the first applications for the integrative platform was a predictive maintenance algorithm that used multiple data points from diverse partner products in the cell to predict when a component was likely to malfunction. Granular data over a long period from each component were critical to implementing this algorithm. Such new value propositions gave CASTER and its partners a lead vis-à-vis competing firms in the die-casting sector, and, according to the CEO, represented a key mechanism for sustaining its leadership position in the long term:

We believe that the differentiation in the cell will not be the interface. The differentiation will be how you take the data, which are brought in from the machine and how you use that. That's where the differentiation will be. It's not the interface. The interface allows it to connect, which is better when everybody connects, because it's better for us, and it's better for the industry. If everything is interconnected, great, but then how you take all that information, how you use it, how you bring value to the customer, that's where the differentiation is.

5 | ECOSYSTEM CREATION THROUGH MUTUAL ADAPTATION: A PROCESS MODEL

The analysis presented above suggests that the emergence of integrated value propositions that transform an established sector can occur in a process of mutual adaptation of product and

ecosystem activities. We define mutual adaptation as the dynamic reconfiguration of product-level and ecosystem-level activities to achieve alignment around an integrated value proposition. Figure 2 summarizes the core mechanisms structured by the second-order concepts that emerged from our coding, the process with a timeline of critical incidents, and the outcomes. We elaborate upon them in the next sections (please refer to Table S1 for additional data and Figure S2 for a concise overview of the interplay of the core mechanisms).

The main concern for established firms engaging in mutual adaptation is to embed their focal product in an integrated value proposition and to maintain a differentiated position towards clients. With this strategic reorientation, the firm contributes to (and is part of) a convergence of multiple industries towards competition between integrated offers, enabled by an ecosystem of independent partners as a meta-organizational form.

Mutual adaptation is one option for ecosystem creation in an established sector that can overcome the well-documented conflicts between product and ecosystem activities (Gawer & Phillips, 2013) through configurational changes. Triggered by a strategic reorientation, the focal firm reconfigures its activity system, supported by a more collaborative organizational design. Mutual adaptation of product and ecosystem activities can enable an aspiring ecosystem orchestrator to achieve alignment between the product activities at an ecosystem's core (Dattée et al., 2018), by turning them into ecosystem components, and the new ecosystem activities, by embedding established products with an integrative platform (Ansari et al., 2016). The alignment of product and ecosystem activities supports the creation of supermodular complementarities, that is, increasing returns of products and ecosystem integration.

5.1 | Strategic reorientation triggering configurational change

Our results show that the established market position of a product-focused firm can support the reorientation towards an integrated value proposition, explaining why an ecosystem can emerge as the best form to realize this value proposition. Confronted with competitive pressures and decreasing marginal returns on innovation, a central firm like CASTER may realize the limits to its existing product focus and sense in interactions with existing clients a beginning shift towards integrated value propositions that span traditional industry boundaries. The established firm may then extend the scope of its activities from improving the focal product to creating positive interdependencies between products (Ganco et al., 2020). The strategic rationale for this extension is that an integrated value proposition, building in multiple interdependent components, leads to higher performance (Lenox, Rockart, & Lewin, 2007) when the performance of the established product activities is diminishing. The extension to an integrated value proposition, however, can create internal misfits in the form of negative interactions between established product activities and new system-level activities. At CASTER, misfits mainly arose because the firm maintained an unchanged focal product and a hierarchical, functionally differentiated organization design, and therefore struggled to reflect the complexity of the integrated value proposition internally. These misfits initially outweighed the benefits of an integrated value proposition as CASTER struggled to update its multiple internally designed components, resulting in slow adoption by clients. Coping with these internal misfits and learning from client interactions, the focal firm may then gradually shift the governance of the integrated value proposition from hierarchical control to an orchestration of partners, eventually moving towards an ecosystem. In our case, this complex strategic reorientation entailed both deliberate

managerial interventions and emergent strategizing. CASTER's management reacted to unanticipated misfits arising among the firm's activities, and to macro-trends such as digitalization and environmental regulation, that further fostered the emergence of integrated value propositions.

While struggling with arising misfits, an established firm may also learn from initial experiments with system integration. In our case, CASTER discovered new client applications, gaining product knowledge, and establishing first partner contacts. Our single-firm case study thus indicates that experimenting with a system integration strategy, even with limited initial success, can be a precursor to a shift to an ecosystem-based strategy. Research on the modularization of systems provides further support for this argument by showing that an initial over-emphasis on integration can be beneficial for adapting to ecosystem competition (Ethiraj & Levinthal, 2004). For example, Siggelkow and Levinthal (2003: 652) found that "it can be beneficial not to decompose—i.e., modularize—the system from the beginning," and that initial integration leads to higher long-term performance, especially in slow-changing environments.

CASTER hesitated multiple times to formally initiate its strategic ecosystem pivot (see for instance Dattée et al., 2018, for a similar observation). As our model shows, a successful strategic reorientation may require simultaneous changes in strategy, product, and system-level activities, as well as in organizational design.

5.2 | Reconfiguring and aligning product and ecosystem activities

At the core of the mutual adaptation process are dynamic reconfigurations of product and ecosystem activities that create internal consistency in the activity system (Siggelkow, 2001), which, in turn, can enable the delivery of integrated value propositions and a leadership position of the established firm in the emerging ecosystem. The alignment of products and integrative platform leads to positive interdependencies in the ecosystem (Ethiraj, 2007). Thus, the focal firm contributes to a modified technological architecture that applies to all products concerned by the integrated value proposition (Baldwin & Clark, 2000), effectively embedding them with a digital platform, and at the same time turning them from standalone products into components.

A focal firm can embed its central product, and partner products, with a platform, thus creating a common technological architecture underlying the integrated value proposition. To this end, the focal firm may *create a software platform* that coordinates all components in the ecosystem. The focal firm can design this technological platform initially to enhance its core product by, for example, adjusting the platform to product idiosyncrasies.

Integrating products via this new platform requires adjustments from clients who used to integrate individually purchased products internally and who may therefore react with initial inertia and resistance to ecosystem activities of the focal firm. Framing and positioning the integrative platform as one that will enhance established products and be compatible with clients' other software systems can support client adoption.

The focal firm then can *gradually open the interfaces* of the integrative platform to other product manufacturers, eventually moving towards a sector-wide technological standard. To encourage the adoption of the ecosystem by potential partners, CASTER opened the platform in a stepwise process. It first co-defined interfaces with key partners before opening the technical specifications to the entire sector. This approach can create incentives for the selected partnering firms to invest in the ecosystem early on (Jacobides et al., 2018), because partners can

differentiate their products by adapting them better to the ecosystem than their respective rivals do. As our case indicates, the smaller initial set of technologically advanced partners may support fast development of the platform, which, in turn, may motivate further complementors to join.

We observed three types of product adaptation that a focal firm may use to turn its established products into components aligned with the emerging ecosystem. (1) As an initial step, the focal firm can *reduce the scope of its product activities*, establishing an explicit technological hierarchy between product and ecosystem activities. In our case, CASTER's management transferred key functions from the focal product to a newly established integrative platform, which served as the ecosystem's technological basis. The firm could thus build on its knowledge of established product activities when initiating ecosystem activities. (2) Furthermore, the focal firm can *make products "smarter,"* that is, enhance the information processing capabilities of its own and partner products by, for example, adding sensors or upgrading operating systems. The quality and granularity of information exchanged between product and ecosystem can influence the integrated value proposition's performance and can even become a differentiating factor for the products in the ecosystem. (3) Finally, the focal firm can *modularize its focal product* to support its integration into the ecosystem. A modularized product is not only able to adapt more easily to ecosystem-level innovations concerning the technological flow or interdependencies in the ecosystem (Ganco et al., 2020), but also can adapt more quickly to ecosystem-level innovations, such as new monetization schemes that replace one-off purchases.

5.3 | Organizational design changes supporting ecosystem creation

To enable the strategic reorientation entailing dynamic reconfigurations of product and ecosystem activities, the focal firm may have to adapt its organizational design towards collaboration. These changes can include strategic decision-making and organizational structure (Joseph & Gaba, 2020). The firm can thereby establish resource and communication flows to cope with interdependencies between product and ecosystem. A collaborative organizational design can facilitate the integration of ecosystem-wide knowledge (Brusoni & Prencipe, 2006; Helfat & Raubitschek, 2018) and has been found effective in fostering activity system adaptation, particularly in relatively stable but complex environments (Siggelkow & Rivkin, 2005) like the die-casting sector. We observed three dimensions of collaborative organizational design that facilitate the transformation towards ecosystem leadership.

Opening the strategy process to employees, selected partners, and key clients can contribute to the acceptance of the new ecosystem-based strategy, mainly through an increased understanding of the vision of the integrated value proposition. While fundamental strategic pillars were not up for debate in this open strategy process, an increase in transparency and participation helped mitigate employee and client resistance, leading to a higher understanding and acceptance of the strategy. An open strategy process can help frame the ecosystem not as a threat to the established product activities but as a way to enhance value creation for all participants (Ansari et al., 2016; Gurses & Ozcan, 2015), which in turn can help to mediate potential conflicts with participating firms.

Creating dedicated partner management functions can support adoption of the ecosystem by partners. At CASTER, a position not directly associated with internal R&D, newly created in the organizational chart, helped to address *external* partners in a neutral and dedicated manner and to mitigate concerns about a potential collaboration. However, a dedicated partner management

function may also help to alleviate resistance against partner innovation *inside* the focal firm. At CASTER, the functional departments were reluctant to collaborate with partners who were often perceived as technologically inferior. The partner management function facilitated eye-to-eye collaboration and helped transfer external innovations to internal functional specialists.

Finally, *establishing client-centric collaboration* between functional departments inside the focal firm can help identify and implement ecosystem innovations. Furthermore, the firm can create collaborative processes through formal decision-making procedures and clearly defined communication channels. For example, CASTER focused on collaboration among its technology teams and established systems for collaboration such as the offer conference between sales and R&D teams. When providing ecosystem solutions to clients, increasing collaboration reduces internal conflicts and helps coordinate innovation activities between ecosystem and product teams. Such clear rules and systems that structure information flow across the organization facilitate activity system change (Albert et al., 2015).

5.4 | Realizing non-generic complementarities in the ecosystem

Our study shows that mutual adaptation can be a source of incumbent advantage and can enable an established firm to take the leadership role in the emergence of a new ecosystem. A focal firm can realize through this strategy non-generic complementarities not only among the various partner products embedded in the integrative platform but also between the platform and its focal product. The focal firm can identify these complementary relationships by coordinating product innovation and ecosystem-wide innovation to optimize their interdependencies (Ganco et al., 2020).

Our study highlights the critical role of data in establishing positive, self-reinforcing feedback loops between products and the ecosystem platform. The analysis of data patterns from multiple connected products with an integrative platform can enable the identification of positive, information-based feedback loops that result in supermodular complementarities (Jacobides et al., 2018). For clients, increasing investment in “smart” products can create increasing returns on ecosystem innovation and vice versa. In our case, these complementarities were driven mainly by increasing the quantity and quality of data exchange between products and the ecosystem, rather than the network effects of a growing installed base. Product and ecosystem leadership can facilitate the focal firm's value-capture from these complementarities by both increasing the margin of established products and introducing new monetization mechanisms at the ecosystem level, as the record-high profits of CASTER illustrate (cf. Figure 2).

6 | DISCUSSION

Our study contributes to the emerging literature on ecosystems through an in-depth longitudinal study of ecosystem creation driven by a product-focused firm (refer to Table S2 for an overview). The empirical context of our case study complements the predominant focus of prior literature; we analyzed the emergence of an ecosystem in a mature rather than a nascent sector (Dattée et al., 2018; Hannah & Eisenhardt, 2018), a slow-moving rather than a high-technology industry (Gawer & Phillips, 2013), led by an established firm rather than a disruptor (Ansari et al., 2016; Snihur et al., 2018). Our work complements studies about how firms create

ecosystems to disintermediate an established industry structure and disrupt product businesses, including their own (Ansari et al., 2016; Cuzzolino et al., 2018; Snihur et al., 2018).

(1) We extend research on ecosystem creation by revealing a process of mutual adaptation through which an established firm can establish ecosystem leadership based on adaptations to its existing product activities (Gawer & Cusumano, 2008; Hagiu & Altman, 2017; Zhu & Furr, 2016). Extant literature shows that a firm can open its existing products to other firms, turning them into central elements of a new ecosystem by enabling partner innovation (Dattée et al., 2018; Gawer & Phillips, 2013). Our in-depth case study elaborates this finding by showing that creating a new ecosystem around existing products may entail two mutually reinforcing change processes at product and ecosystem levels. The focal firm (a) co-creates a new integrative platform with partners in which its existing products are core elements and, at the same time, (b) adapts these products, turning them into components aligned with the emerging ecosystem. The concept of mutual adaptation extends findings from prior research, which showed that firms can turn their products into components of an ecosystem by using standardized interfaces (Baldwin & Clark, 2000; Brusoni & Prencipe, 2006), by elaborating how to facilitate this process by transferring functionality from product to platform, improving product-platform data exchange, and modularizing the components inside the product. We introduce the concept of mutual adaptation, originally proposed as a dynamic process to resolve misfits around an innovation (Leonard-Barton, 1988), to emphasize that firms can align product and ecosystem activities across internal and external organizational boundaries. A strategy of mutual adaptation may support the creation of a high-performing ecosystem where the focal firm takes a leadership position, because it can enable the creation of supermodular complementarities, or complementarities with increasing returns (Jacobides et al., 2018), *at multiple levels*—among the focal product and products of ecosystem partners (the focus of prior research) and between a focal product and the platform (the focus of our study). While prior research theorizes that ecosystems emerge to cope with non-generic complementarities (Jacobides et al., 2018; Kapoor, 2018), our depiction of the mutual adaptation process shows one specific way and specific tactics a firm can use to create such complementarities by adapting its existing product business. Our study is the first to show empirically the processes and mechanisms a firm can use to create complementarities between products and platform. We confirm that the presence of an ecosystem leader can benefit other firms in the sector (Jacobides & Tae, 2015) and elaborate on prior literature by showing how this presence can benefit product manufacturers. By sharing a vision of enhancing product performance with the ecosystem, a focal firm can attract strong partners, leading firms in their respective industries, to co-develop its platform (Ansari et al., 2016). The potential increase in performance of individual products through ecosystem integration can encourage cooperative standard-setting with selected partners (Kerstan, Kretschmer, & Muehlfeld, 2012). Each initial partner expects to capture value from an enhanced integration of its products (Miller & Toh, 2020; Toh & Miller, 2017), which in turn enables them to maintain a differentiated position in their established product markets (Ranganathan & Rosenkopf, 2014).

(2) Our study shows the complexity of ecosystem creation by revealing a configurational change for a focal firm (Meyer, Tsui, & Hinings, 1993; Miller, 1986), involving changes in the firm's product activities in combination with changes in strategy and organizational design. Extant research tends to neglect that the internal activities of participating firms are likely to facilitate or hinder ecosystem emergence (Altman et al., 2022; Kapoor, 2018). We show that changes in the firm's strategy and organizational design may support the alignment of existing products and new ecosystem activities and in turn the firm's shift to an orchestrating role in the emerging ecosystem (Puranam, Alexy, & Reitzig, 2014). While established firms may follow

multiple paths to adapt to ecosystem competition, future research could elaborate this configurational view of ecosystems by, for instance, exploring successful configurations of ecosystem-based strategy, activity systems, and organizational design under different circumstances.

(3) Our configurational view on organizational adaptation within ecosystem emergence supports and extends established views that ecosystem creation often combines deliberate and emergent strategy (Ansari et al., 2016; Dattée et al., 2018). We observed that a deliberate reorientation towards an ecosystem-based strategy was preceded by experiments with a system integration strategy. These experiments partially failed due to internal and external misfits in the activity system but also provided important insights into ecosystem technologies and client requirements, thus allowing the firm to capitalize on ensuing changes in its environment (such as legislation) and product markets (such as emerging client segments). Prior research showed that an initial over-emphasis on integration allows firms to cope better with interdependencies in the ecosystem (Ethiraj & Levinthal, 2004; Siggelkow & Levinthal, 2003). Our single case study cannot establish the general superiority of this temporal pattern; future research should advance a longitudinal view of the ecosystem emergence process by investigating long-term patterns of sequencing strategies and their relation to sustained firm and ecosystem performance.

(4) Our case study complements scarce research on organizational design issues in the context of ecosystems (Jacobides et al., 2018; Kapoor, 2018; Shipilov & Gawer, 2020) by showing that a change towards a collaborative design can enable adaption to ecosystem competition (Kapoor, 2018). As our case shows, the process of mutual adaptation may entail changes in the organizational design that establish sophisticated integration mechanisms both inside the focal firm and with external partners. These changes enable the information-processing procedures of the established firm to evolve (Joseph & Gaba, 2020), building a capability for cross-functional collaboration across internal and external firm boundaries and allowing management of new interdependencies in the emerging ecosystem (Henderson & Clark, 1990). We identified three changes in a focal firm's organization that can support the development of this capability. (a) Our finding of an open and participative strategy process adds to our knowledge about how an ecosystem emerges, particularly when it is not top management's initially chosen approach (e.g., Dattée et al., 2018). Our case provides interesting details on *how* firms may open their strategy process to enable ecosystem creation around a focal product. In our case, this opening was based on an intense engagement with a small number of key clients and partners with in-depth knowledge about the sector. This focused opening differs from large-scale idea generation with broad engagement of diverse stakeholders, the focus of previous studies on open strategy (Whittington, Cailluet, & Yakis-Douglas, 2011). More participation from and increased transparency towards selected internal and external constituents (Hautz, Seidl, & Whittington, 2017) can foster information flow about the emerging ecosystem by, for example, including experts from ecosystem projects and pioneering clients in long-term strategic decisions. This information flow is a key condition for successfully reconfiguring the activity system to support the new value proposition (Rivkin & Siggelkow, 2003). Furthermore, opening the strategy process can increase commitment to the new strategy from internal constituents as well as from key clients and partners and contribute towards overcoming tensions between product and ecosystem business (Ansari et al., 2016; Garud et al., 2002; Gawer & Phillips, 2013). Our empirical findings highlight ecosystem orchestration as a question of managing both inter-organizational relationships and cross-functional collaboration *inside* the organization. In our case, (b) the firm created a dedicated partner management function that not only helped manage relationships with key ecosystem partners but also encouraged the transfer of external innovation to product-focused teams. It also (c) established cross-functional collaboration functions

centered on client issues that helped manage arising interdependencies between product and ecosystem activities. These functions can develop and consolidate the required knowledge about product and ecosystem interdependencies in terms of both technology (Brusoni & Prencipe, 2006) and inter-organizational relationships (Dyer & Singh, 1998).

(5) Finally, our study shows that a focal firm can actively influence the realization of complementarities in ecosystems (Jacobides et al., 2018; Kapoor, 2018) through data management (Altman et al., 2022), generating and using strategically relevant knowledge through the integration of products and platform as well as across products (Gregory, Henfridsson, Kaganer, & Kyriakou, 2021). The collection, processing, and sharing of data in an integrative platform are critical to making previously hidden or tacit information about the technological interdependencies between products visible to all ecosystem participants (Baldwin & Clark, 2000). Extending prior ecosystem literature that has built on interdependence matrices to describe relationships between components statically (Ganco et al., 2020; Shipilov & Gawer, 2020), we suggest that adaptations to products, in terms of providing and processing data, can enable an integrative platform not only to understand and improve the complex technological system (Brusoni & Prencipe, 2006), but also to create dynamic feedback loops between products and ecosystem that eventually result in supermodular complementarities (Jacobides et al., 2018). Recent research has focused on supermodular complementarities stemming from an increasing quantity of ecosystem participants (McIntyre & Srinivasan, 2017; McIntyre, Srinivasan, Afuah, Gawer, & Kretschmer, 2020). According to our study, establishing an integrative platform accepted by all ecosystem participants (Adner, 2017; Adner & Kapoor, 2010) may be necessary but not sufficient to realize supermodular complementarities. In our case of mutual adaptation, supermodular complementarities arose from increasing the quality and quantity of data exchanged between products embedded in an integrative platform. The quality and quantity of data are linked to the number of participants but are much more dependent on the level of product-ecosystem integration. The ability to identify positive product-ecosystem interdependencies (Ganco et al., 2020), and the potential to realize complementarities on this basis, can change through the product adaptations of participating firms. We propose further exploration of how new ways of data exchange and processing can shift interdependent product systems (Ethiraj, 2007; Ethiraj & Levinthal, 2004) into ecosystems dealing with non-generic and eventually supermodular complementarities (Gregory et al., 2021; Jacobides et al., 2018). In sum, our results point towards viewing ecosystems as meta-organizational information-processing structures, where the capacity for knowledge generation and knowledge control is a critical factor for ecosystem leaders (Brusoni et al., 2001; Pavitt, 1998).

6.1 | Boundary conditions

The boundary conditions and limitations of our single case study need to be considered when interpreting and generalizing the findings. First, we studied a leading firm with a strong competitive position based on a central product; its specific history may have made it easier or more challenging to create a new ecosystem around an existing product, compared to firms with a peripheral or commoditized product. Competitive challenges by rival ecosystems and partners' resistance or influence were not major factors during ecosystem creation, even though we explicitly probed those aspects observed in prior literature. We do not know if our case is an outlier or whether these issues are inherently less problematic in mutual adaptation. Second,

the machine manufacturing sector is uniquely characterized by slow-moving, asset-heavy firms that may require strong technological interdependencies between product and ecosystem activities for mutual adaptation. We focused on an ecosystem that implemented an integrated value proposition; ecosystems geared towards other types of value propositions such as disintermediation might require different approaches. Future research is needed to investigate if and how firms with different types of products in different sectors can re-shape their sector architecture towards an ecosystem (Jacobides, Knudsen, & Augier, 2006). We cannot derive normative findings from our case study, as the emergent nature of the ecosystem-based strategy and the dynamic mutual adaptation process limited the role of top managers' rationality and intent. Additional research is needed to determine whether building an ecosystem through mutual adaptation is sustainable in the long run, as using an established product might have hindered more radical innovations and only provided short term competitive advantages through leveraging existing product activities.

7 | CONCLUSION

The ecosystem creation process through mutual adaptation of product and platform that we observed in the die-casting sector resembles developments in other contexts. Car manufacturers currently invest in mobility solutions, and electronic appliance producers invest in connected homes, two prime examples of sectors where established products become part of integrated value propositions. In the retail sector, digital platforms invest in physical stores and products, using system-level knowledge to improve products, which indicates that there might be different starting points for mutual adaptation. Our key finding, that the transformation process towards integrated value propositions can be supported by a process of mutual adaptation, therefore holds the potential to inform the understanding of ecosystem creation in multiple contexts.

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DATA AVAILABILITY STATEMENT

The data that support the findings of this study are available on request from the corresponding author. The data are not publicly available due to privacy restrictions.

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