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Mutualism and the dynamics of new platform creation: A study of Cisco and fog computing

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Abstract

Research summary: How firms respond to the emergence of dominant platforms that undermine their competitiveness remains a strategic puzzle. Our longitudinal study shows how one incumbent, Cisco, responded to such a challenge by creating a new platform, Fog, without undermining the dominant platform, Cloud, where it played a complementor role. By developing a process model we reveal how a firm in a peripheral role in a platform ecosystem can reposition itself through a dynamic mix of material, symbolic and institutional actions to develop and legitimize an alternative platform. This can be done first through symbiosis with the dominant platform, then partial competition with it. We theorize the value of a mutualistic "rising tide lifts all boats" strategy in contrast to hostile "winner takes all" approaches.

Managerial summary: The increasing pervasiveness of digital platforms are driving established firms to reboot their strategy to embrace emergent forms of competition, collaboration, and mutual coexistence.

Fearing disruption in their traditional business models, firms may decide to jump into the platform game. However, this is not straightforward since they do not want to go head-to-head with existing platforms and alienate their partners and customers by being perceived as encroaching on their turf. We describe one way that established technology firms are overcoming this dilemma through a "rising-tide-lifts-all-boats" strategy to cultivate new platforms. We show the value of seemingly inconsistent and dynamic approaches toward strategic communication and investments firm can use to lead new platforms without facing backlash from others.

KEYWORDS

Cloud and Edge computing, digital transformation, platform ecosystem, strategy process, symbolic strategies

1 | INTRODUCTION

Established firms increasingly face the challenge of having to make up lost ground when they have been left behind by a new technological development (Ansari & Krop, 2012; Christensen & Bower, 1996; Danneels, Verona, & Provera, 2018; Eggers & Park, 2018; Tripsas & Gavetti, 2000). Digital technologies and platforms have amplified these challenges (Cusumano, Gawer, & Yoffie, 2019; Thomas, Autio, & Gann, 2014; Van Alstyne, Parker, & Choudary, 2016) and have left many incumbents either disadvantaged (Eisenmann, Parker, & Van Alstyne, 2011; Gawer, 2014), disrupted (e.g., Kumaraswamy, Garud, & Ansari, 2018), or struggling to grow at the rates that markets expect (Benner & Ranganathan, 2017; Greve, 1998). While a few studies have examined these challenges (e.g., Cozzolino, Verona, & Rothaermel, 2018; Seamans & Zhu, 2013), we still know little about how incumbents respond strategically to prevalent platforms in which they are not leaders.

When the odds are against a firm being able to assume a leadership position in a dominant platform ecosystem, it may respond by joining the platform to capture value; Toys R Us joined Amazon, for example, rather than creating its own online distribution channel (Zhu & Liu, 2018). This can potentially lead to deterioration of the firm's core capabilities and prevent it from having a voice in the platform's architecture (Baldwin, 2018; Jacobides, MacDuffie, & Tae, 2016; Schilling, 2009). A more competitive response might be to create a new platform by either acquiring a platform (e.g., IBM acquiring Red-Hat to provide hybrid Cloud platforms) or establishing its own platform—as Apple did with iOS—using technology leapfrogging, for example, (Schilling, 2003). The risk here is that it may fail to outcompete or "dethrone" the rival platform, despite extensive investments (Cusumano et al., 2019; Suarez & Kirtley, 2012). In this paper, we study how an incumbent firm in networking, Cisco, attempted to reconcile these risks when formulating its platform strategy.

Although creating an alternative platform based on a firm's strengths may seem like an appealing strategic choice for an established firm trying to regain leadership in a platform ecosystem (Gawer & Cusumano, 2002; Iansiti & Levien, 2004; Nambisan & Sawhney, 2011), it is hard to compete against dominant platforms protected by strong barriers (Katz & Shapiro, 1985; Klemperer, 1987). Moreover, creating a new platform requires not just developing a distinctive and novel value proposition, but also ensuring that the platform is perceived as legitimate by powerful actors, who may resist or reject a new platform unless it aligns with the prevalent platform (Adner & Kapoor, 2010; Masucci, Brusoni, & Cennamo, 2020; Ozalp & Kretschmer, 2019; Zhu & Iansiti, 2012). This legitimacy challenge is compounded when the established firm also needs to safeguard its position and stay legitimate within an existing platform ecosystem from which it also benefits.

Our interest in how incumbents respond to a dominant platform emerged inductively during research on the rise of Cloud computing. At that time, Cisco was a hardware complementor to leading firms in the rapidly growing category of Cloud platform ecosystems (e.g., Amazon Web Services, AWS, the market leader in public cloud) based on a *centralized* computing architecture (managing data using central servers instead of onsite hardware). However, rapid growth in the "Internet of things" (IoT) (connected devices) fueled the need for decentralized data processing closer to devices. Hardware companies saw an opportunity to lead this fundamental shift in the computing paradigm and to regain "lost territory" from Cloud leaders (Economist, 2018) through a range of technologies broadly referred to as Edge computing. Leveraging its core strengths, Cisco created a decentralized technology platform, Fog (managing data via distributed "mini-clouds" located near the physical devices), while remaining a viable complementor in the Cloud ecosystem.

Our study provides three contributions at the intersection of platform ecosystems and strategic management (Jacobides, Cennamo, & Gawer, 2018; McIntyre & Srinivasan, 2017). First, by examining how an incumbent in a peripheral position in an established platform category creates a new platform to reposition itself as a leader (Wang & Shaver, 2014), we theorize a mutualistic "rising tide lifts all boats" (Chen & Miller, 2015) platform creation strategy that contrasts with more hostile or predatory "winner takes all" approaches, where value is derived at the expense of others (Cennamo & Santalo, 2013). Drawing on ecologists' notions of symbiosis and commensalism in interpopulation relations (Aldrich & Ruef, 2006; Barnett & Carroll, 1987; Hawley, 1950), we show how instead of trying to compete head to head, the new platform creator first complements the existing platform to gain a footing, and then switches to partial competition, once the platform has gathered steam. Second, by explaining the dual legitimacy challenges that arise from participating in interrelated ecosystems (Aldrich & Ruef, 2006), we show how a firm resolves a key dilemma: how to legitimize a new platform among targeted members and, at the same time, neutralize resistance from powerful players in the existing platform in order to protect its ongoing business. Third, our processual view of creating a new platform without attempting to undermine an existing platform shifts the focus from competitive dynamics at a given point in time to processual dynamics over time. We reveal the value of deploying a dynamic mix of symbolic and material actions to reconcile the strategic tensions (Kunisch, Bartunek, Mueller, & Huy, 2017) that arise in the process of initiating and expanding a platform.

2 | THEORETICAL BACKGROUND

Creating a new platform is one option for established firms that have lost ground to a growing wave of platforms, from firm-specific (e.g., Facebook in social media) to industry-wide (e.g., 5G in communications; Thomas et al., 2014) that involve multiple companies and consortia (Gawer & Cusumano, 2008; Tiwana, Konsynski, & Bush, 2010). While creating a de novo platform is an uphill battle for any firm, it becomes particularly challenging for an established firm that has stakes in the existing platform ecosystem (Bennett, Seamans, & Zhu, 2015) as a client, partner, or complementor and does not want to undermine its position in that ecosystem. For instance, when an infrastructure leader such as Ericsson is aspiring to create a new digital platform (e.g., in transportation), it seeks legitimacy in the new ecosystem by providing distinct value but it does not want to undermine its legitimacy in its existing ecosystem where its key customers (e.g., a mobile operator) are targeting the same market (Khanagha, Ramezan Zadeh, Mihalache, & Volberda, 2018).

To avoid the new platform being rejected, the company needs to legitimize it among targeted adopters (Vasudeva, Spencer, & Teegen, 2013), while also preserving legitimacy in the existing ecosystem (Aldrich & Ruef, 2006) on which it also depends. Gaining legitimacy matters, as the very concept of an ecosystem is based on the idea that every organism is interdependent on other organisms within the system and gaining acceptance from them is therefore crucial (Moore, 1996). To secure legitimacy, a platform creator needs to identify opportunities for mutual coexistence, whereby the new platform enhances the viability of the dominant platform. Ecological concepts (Mars & Bronstein, 2018; Moore, 1993, 1996) are highly germane to understanding the increasingly complex relationships in interdependent ecosystems. Drawing on Hawley (1950), Barnett & Carroll (1987 p. 401) described two distinct bases for such relationships: "symbiosis" and "commensalism." While symbiosis is a purely mutualistic approach, where organizations provide complementary value by targeting nonoverlapping market niches, "commensalistic relationships range from full competition, through neutrality, to full mutualism" (Aldrich & Ruef, 2006, p. 245). Thus, while commensalism can include cooperation, it has been argued that the "most common expression of commensalism is competition (Aldrich & Ruef, 2006, p. 43)." This includes partial competition, where organizations target market niches that overlap to some extent (Dobrev & Kim, 2006).

In pursuing legitimacy, a platform creator needs to assure targeted adopters that there will be enough users and complementors. It must also convince them that the platform offers novel value and differentiated functionalities that will meet user needs that are underserved by the existing platform (Jacobides et al., 2018). To alleviate fears about possible lock-in, it may also need to reassure potential members about the platform's openness, while also maintaining the required level of control to capture value (Boudreau, 2010). The new platform needs to show a sufficient degree of familiarity and alignment with the existing platform, because if it is perceived to be too novel, distinctive, or disconnected, cognitive legitimacy may be hard to gain (Hargadon & Douglas, 2001; Ozalp & Kretschmer, 2019; Zhao, Fisher, Lounsbury, & Miller, 2017). In addition, misalignment may draw resistance from members of the dominant platform, especially if there are clashes with that platform's technological architecture (Henderson & Clark, 1990) or threats to its dominance (Garud, Jain, & Kumaraswamy, 2002). However, ensuring familiarity may also undermine the platform's distinctive value (Zunino, Suarez, & Groda, 2019). Thus, when a platform creator still has dependencies on an existing platform ecosystem, contradictory strategies will often be needed to secure legitimacy in both the established and the emerging ecosystem.

In this situation, material actions such as making investments to signal credible commitment (Schilling, 2003) or forming ties with prominent actors (Vasudeva, Nachum, & Say, 2018) are vital, as are objective platform properties such as technological design and functionalities, but a firm also has opportunities to reinforce these through symbolic actions. This is because the technology is still emerging, and a firm has more scope to shape favorable perceptions of the platform by using nonmaterial assets (e.g., strong reputation) (*ibid*., 2003) and symbolic actions to assuage the concerns of existing stakeholders. Identifying the optimal level of openness and familiarity are important concerns in terms of legitimacy. Addressing these may require not only material actions, but also symbolic actions and framing to shape stakeholders' perceptions favorably (e.g., Gray, Purdy, & Ansari, 2015; Suarez, Grodal, & Gotsopoulos, 2015). To frame is to increase the saliency of an entity and to promote particular, often desirable, aspects (Entman, 1993). For instance, Facebook has tried to frame its new cryptocurrency Libra not as "a threat to the sovereignty of nations" but as a means of "defending the Free World from China." Indeed, symbolic actions can be used to help new initiatives gain legitimacy among ecosystem actors (Ansari, Garud, & Kumaraswamy, 2016; Snihur, Thomas, & Burgelman, 2018).

Symbolic and material actions work in consort but can be either congruent, resonating with one another, or compensatory, offsetting one another (Westphal & Zajac, 2001). For instance, when TiVo, a platform creator in the television industry, faced resistance from industry incumbents on whom it depended, it reframed itself as a complementary "connector," rather than as a "disruptor," in order to atone for undermining advertising business models (Ansari et al., 2016). Similarly, Microsoft often frames its application programming interfaces (APIs) as open but promotes the seamless integration of features across these applications to make them exclusive (Cusumano et al., 2019).

Finally, the platform evolution process has an inherent temporal dimension (Rietveld, Schilling, & Bellavitis, 2019; Teece, 2017), since changes and developments emerge as the firm tries to scale the platform. As the platform evolves, so too do user needs, complementors' roles (Gretz & Basuroy, 2013; Rietveld & Eggers, 2018) and the technology itself (Suarez, 2004). This is especially so in fast-changing technology markets. In addition, existing platforms may plug the gaps and may themselves incorporate the added value of the new platform through generational transitions (Kapoor & Agarwal, 2017), for example. Also, since the firm is active in multiple platform ecosystems with reciprocal relationships and plays varying roles in each (Pierce, 2009), coopetitive tensions have a temporal dimension—collaborative relationships may turn competitive and vice versa (Hannah & Eisenhardt, 2018). In order to create and capture value, a firm thus needs to dynamically manage coopetition in two ecosystems—collaborating and complementing versus competing and substituting (Ansari et al., 2016; Chen & Miller, 2015)—at different times. Also, legitimacy issues evolve (Fisher, Kotha, & Lahiri, 2016; Schilling, 1998), and at various points a firm may seek both to conform with existing understandings and expectations and to create as a unique and distinctive identity in order to gain legitimacy (e.g., Zhao et al., 2017). This requires dynamic adaptation of symbolic and material strategies. For instance, a platform may be opened up to spur wider adoption (Eisenmann, Parker, & Van Alstyne, 2009) or control may be tightened to capture value, and platform creators need to decide which of these two approaches may be more feasible, and when. Finally, material and symbolic actions in the initial stages, such as exerting technical control or developing a distinctive identity (e.g., being recognized as the platform leader), can have "lingering" cognitive effects beyond the initial period of deployment (Wittman, 2019). These carryover effects can enable managers to favorably influence stakeholder perceptions in subsequent periods.

A platform creator cannot anticipate all these twists and turns upfront when seeding the platform, and some strategies only emerge as the platform adapts to evolving market needs during scaling. We thus need to understand the dynamic deployment of material and symbolic strategies.

3 | RESEARCH SETTING AND METHOD

Founded in 1984 by pioneers of the local area network (LAN) concept, Cisco is a leading provider of telecommunications and networking equipment (nodes, routers, and switches). In 2009 the emergence of cloud computing, based on a centralized architecture (Khanagha, Volberda, & Oshri, 2014, 2017, provided growth opportunities for Cisco, but only as a complementor; it provided few opportunities for it to become a leader. Later, phenomenal growth in data generated from “smart” connected devices (IoT) gave Cisco an opportunity to revalorize its capabilities. To do so, it established a computing technology platform called Fog to address the emergent IoT market that was also being targeted by Cloud platform leaders, and other hardware companies like Cisco that were producing their own Edge computing variants. As we aim at nascent theory generation (Edmondson & McManus, 2007) to examine platform strategies, we conducted a longitudinal, field-based case study. We adopted a historical process research approach to data collection and analysis (Langley, 1999) to explore an established firm's platform creation efforts. In line with prior research (Danneels, 2011; Joseph & Ocasio, 2012; Paroutis & Heracleous, 2013), our processual view reveals key actions and intermediary phases that are likely to be missed in other methodological approaches. Specifically, we studied Cisco's activities between 2008 and 2019, a period characterized by the rise of cloud computing and the emergence of fog computing.

3.1 | Data collection

We gathered data from three sources: (a) three rounds of semistructured interviews with managers at Cisco and other manufacturers affected by cloud computing, conducted between September 2010 and September 2013, September 2017 and December 2017, and February 2019 and July 2019; (b) participant observations between July 2015 and December 2018 (see Figure 1); and (c) archival materials, such as presentations at OpenFog Consortium meetings and conferences.

3.1.1 | Interviews and observations

Between 2011 and 2013, we conducted 32 interviews with companies affected by cloud computing (Cisco, Intel and Ericsson, as well as Cisco's customers and complementors). We interviewed senior managers, experienced professional analysts from technology and service providers, and complementors. In 2015, we secured access to the OpenFog Consortium and participated in meetings to acquire first-hand insights and interact with senior managers and experts from Cisco and other consortium members. On six occasions, we met OpenFog Consortium members for group discussion sessions and conducted 9 formal interviews. We also frequently interacted with OpenFog board members and conducted 32 informal interviews.

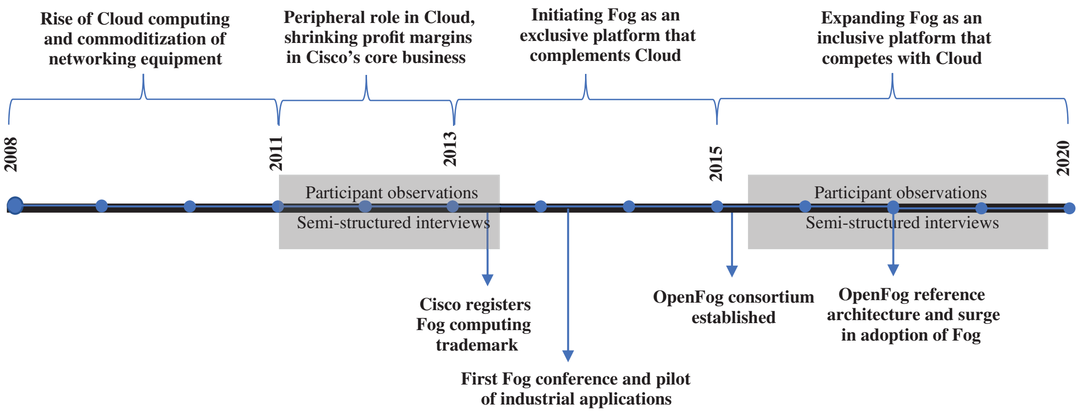

FIGURE 1 Timeline of events and data collection activities

3.1.2 | Archival data

We extracted analyst reports, news, and events relating to fog and cloud computing from two databases (Factiva and LexisNexis). We collected and transcribed publicly available presentations by Cisco CEOs and analysts' conference calls to trace Cisco's strategic challenges and responses. We used memos and observations from several years of research on cloud and fog computing strategies. See Table 1 for data sources, and Figure 1 for a timeline of our data collection.

3.2 | Data analysis

First, we used content analysis to make sense of the data from multiple sources and we organized the data chronologically. We created a timeline of events relating to fog computing from January 2008 to July 2019. Second, we used open coding to identify and group relevant concepts into categories, and then axial coding to investigate the connections between the existing categories (Gioia, Corley, & Hamilton, 2012). We categorized raw data as first-order concepts and drew on second-order categories to develop our theoretical model of the temporal dimensions of platform development strategies. After every iteration, the exploratory findings and emergent themes identified by one author would be presented to the others, who acted as "outsiders." This enabled us to refine our analytical schemes (Evered & Louis, 1981). Third, we focused on disentangling the relationships between our aggregate dimensions to build a model explaining how an established firm initiated and scaled a new platform ecosystem. Specifically, we used "temporal bracketing" (Langley, 1999) to identify the effects of opposing forces that led to changes in platform strategies.

To ensure that our findings were trustworthy, we used: (a) prolonged engagement in the field, including presentation of our emergent interpretations to two managers' groups at the OpenFog Consortium and at a large technology company (Lincoln & Guba, 1985); (b) both retrospective and real-time data (Eisenhardt & Graebner, 2007) from several sources for triangulation, including spontaneous feedback on several presentations at major conferences attended by members of the cloud and fog ecosystems; and (c) thick description, and informant and outsider

TABLE 1 Data sources

Data sources	Details	Purpose	Analysis of data
Field observations and participation	Four years of close interaction with the OpenFog Consortium	In-depth understanding of the field and related trends. Informal conversations and participation in meetings and discussions	Field notes were used to support the development of first-order and second-order constructs.
Archival data	- All news and other hits from the Factiva and LexisNexis databases that referred to Fog and Edge, 2013–2019. - Presentation files (45 files, with almost 900 slides). - 640 min of video recording from meetings, internal communications, webinars, and strategy discussions. - Internal communications of the OpenFog consortium. - Cisco's blog. - Cisco's annual reports, 2009–2019; Cisco's publicly available histories of key events associated with Cloud and Fog technologies, including managers' appearances in the media. - Industry reports and analyst report specific to Cisco and OpenFog.	- To identify managers' strategy frames across different units and over time. - To identify major events and strategic challenges. - To gain additional understanding of the industrial context and secure an outsider view of the evolution of Cloud and Fog computing.	Chronological analysis to determine how Cisco's platform strategies evolved over time, how platform objectives were achieved and how the perceptions of different stakeholders changed during this period. - Quotations from reports were coded for first- and second-order constructs.
Interviews	- First round, transcripts (almost 850 pages) of interviews conducted between 2011 and 2013 with 32 senior managers and professionals from Cloud ecosystem actors. - Second round, 6 discussion sessions, 9 formal interviews, and 32 informal interviews, 2016–2019.	- First round, to understand the context of the industry, the drivers of revenue decline in Cisco and other similar companies, and to identify their strategic responses. - Second round, to achieve a fine-grained understanding of frames and strategic issues.	Interviews were transcribed and analyzed for first- and second-order constructs.

feedback to increase the validity of our interpretations (Langley, 2007). Figure 2 reports the data structure used to ground the core constructs. Online Appendix provides a table with representative data relating to our codes.

4 | FINDINGS

Our inductive study of platform creation strategy at Cisco reveals that this process can be divided into two phases: seeding and building initial momentum for the platform and scaling the platform. We also explore the period before and after the scaling stage. Our analysis suggests that Cisco created an adjacent platform through both material and symbolic actions to connect with and complement the established platform while also providing distinct value to the new platform members.

4.1 | 2009–2013: A peripheral role in a dominant platform ecosystem

Before the rise of cloud computing, analysts had believed that Cisco's hardware infrastructure (routers and switches) would become a commodity (TBR, several reports, 2007–2013). This was due in part to the emergence of Chinese suppliers, who introduced similar products but at 30% lower prices (Li Sun, 2009). Prior to 2013, despite revenue growth, Cisco's gross margin had gradually diminished (see Figure 3) and its market cap had shrunk from $220 billion in 2002 (#1 globally) to $110 billion in 2013 (#43 globally) (Forbes Global 2000, 2018). The company

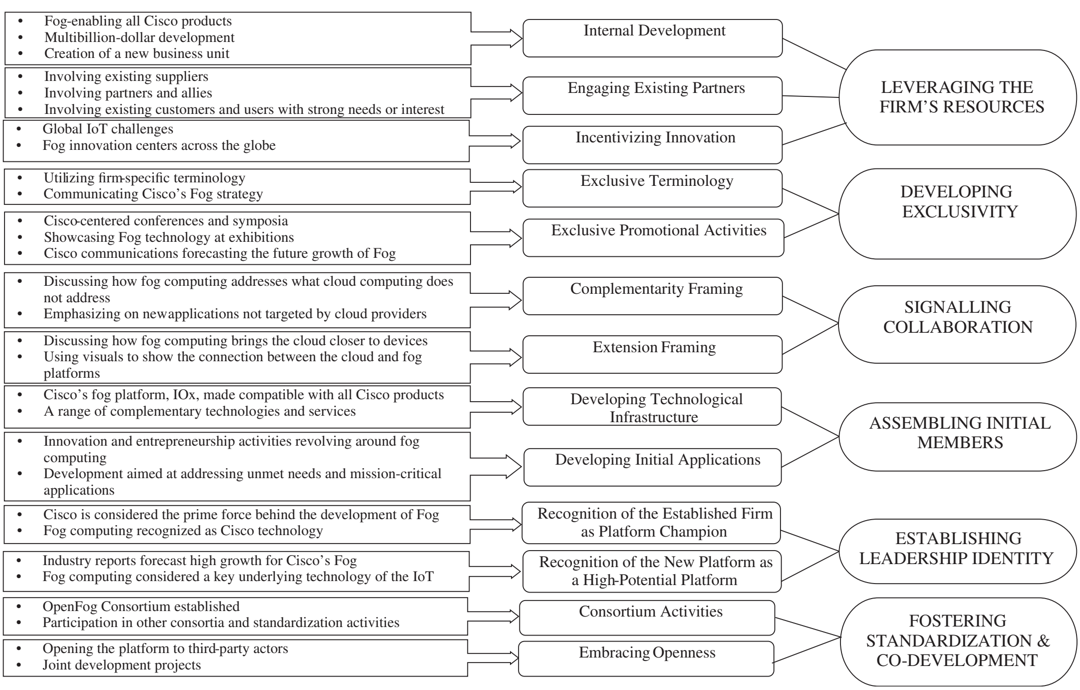

FIGURE 2 Coding structure

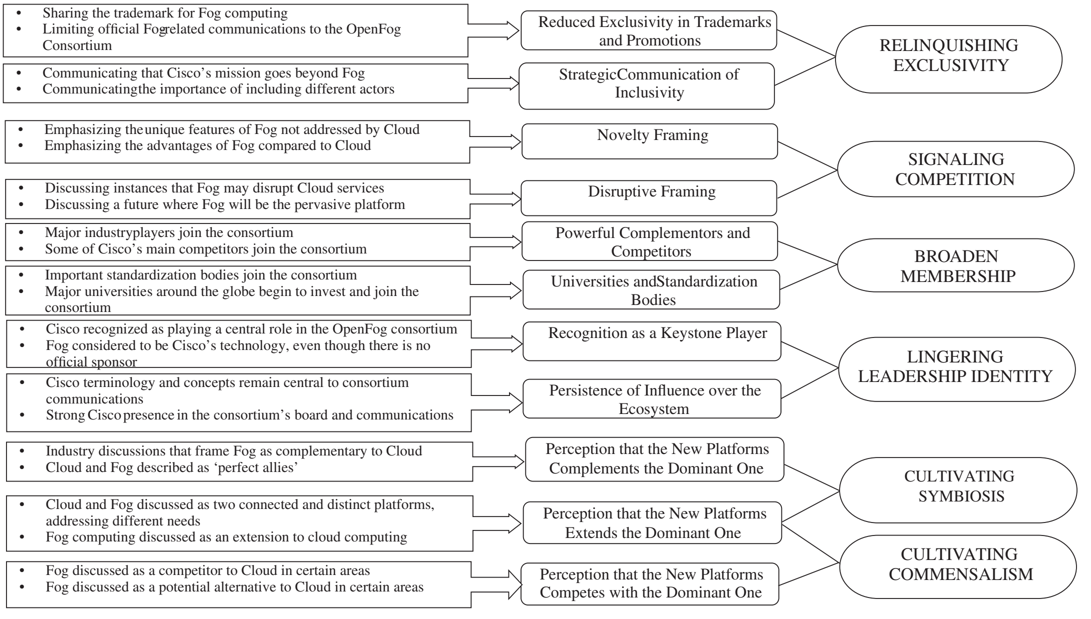

FIGURE 2 (Continued)

was thus under pressure from financial markets to show growth and increase its share price (The Wall Street Journal, May 2011).

Cloud computing servers and data centers provided new business opportunities for Cisco, but only as an infrastructure and hardware complementor; it was unable to capture a sizable share of the booming Cloud business (IDC Research, 2018). Although Cisco made moves to become a Cloud provider, its attempts were not successful, and in 2016 it had to abandon its $1 billion cloud project, Intercloud. Cisco's head of cloud marketing stated bluntly: "That ship has sailed" (Network World.com, 2017).

While being left behind in Cloud was a major challenge for hardware companies, a silver lining appeared for Cisco. The emergence of the IoT increased demand for processing power closer to these connected devices, which exceeded the capacity of "generic" cloud computing systems (de Brito, Hoque, Steinke, Willner, & Magedanz, 2018). In an interview, a senior Cisco manager explained how this created an opportunity for Cisco:

> by that time, 2014 roughly, a lot of people were getting into it [IoT] and started to devote a whole lot of time [to it]. But it wasn't going anywhere very fast. [...] We started to realize that many people designing IoT solutions were playing within the

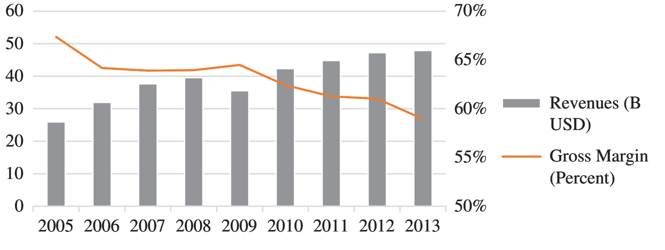

FIGURE 3 Cisco's revenue and gross margin prior to initiation of Fog

> confines of the current computing mode [Cloud]. They were trying to use the current method [Cloud] and force-feed them [methods] into IoT [applications].

Both Cloud and Edge technology providers tried to address the increased demand for processing capacity, but faced challenges. Cloud providers struggled to cope with the increased need for speed and security (e.g., Tan & Ai, 2011). For instance, in a self-driving car on a crowded road, reducing latency by a few seconds could mean the difference between life and death. Similarly, speed is critical in fast-moving robotic arms in factories or in heavy machinery on oil rigs. Centralized Cloud computing was not ready yet for applications where data processing needs were time-sensitive. In addition, managing data in cloud platforms like those used to store patient data outside hospitals raises significant concerns about security and timely availability. In the Cloud, it is not always possible to determine exactly where a piece of data is stored, since information is constantly being shifted across the globe to balance the load on various infrastructure components. This makes it difficult to determine who owns the data and can claim jurisdiction over it, which is critical for organizations working with sensitive information (e.g., defense contractors and healthcare bodies). While decentralized Edge computing was capable of providing speed, security and accuracy proximate to devices and terminals, it was ill-equipped to deal with massive data from numerous and dispersed devices. This created an opportunity for Cisco to leverage its capabilities to address the emergent and unmet need for processing power. To illustrate the value of Fog, a Cisco senior technology manager gave an example of an oil rig in an ocean:

> It's not feasible, economical or practical to take this data from out in the ocean and send it to the cloud. Nor is it possible to manage all data needs at the Edge (rig) … some larger oil rigs generate a couple of terabytes of data per day. So instead, you take cloud services and extend them to an oil rig. That's where fog adds value.

Another Cisco executive explained: "Cisco has always been the connector—they really are the bridge to the cloud to allow customers to move to and from the various cloud offerings. If you don't have a reliable network, you can't get to [Amazon's] AWS or [Microsoft's] Azure" (Interview with CRN technology analyst, 2019). Cisco was not alone in attempting to seize this opportunity. The need for processing power closer to devices and data-generating locations also created opportunities for hardware firms, such as GE, Ericsson, and Huawei. However, Cisco offered a unique platform that was designed to seamlessly connect Cloud and Edge computing. A strategy manager at Cisco noted:

> they (Edge) don't integrate with the cloud well, they don't integrate with each other well, and you're talking about basically, lots of proprietary things…And because they're doing it all in isolated manner, they're trying to develop yet another separate, isolated thing dedicated to the edge.

Thus, while the IoT promised many benefits, it needed other technologies to drive new value for customers. A Cisco executive explained the shortcomings of Edge:

> content distribution network (Edge) had been deployed and used all over the place […] people are starting to realize just moving content closer to users is not sufficient any more. […] There were very, very siloed nodes […], they're totally isolated from

> the cloud [...]. That means two separate computing platforms, two separate networks. They don't talk to each other, but they need to talk to each other.

Fog could fill this gap by connecting Cloud to Edge platforms and providing solutions such as predictive insights into high-velocity live data streams generated from on-premises and cloud data.

4.2 | 2013–2015: Initiating the fog computing platform and building momentum

In 2013, Cisco decided to develop a technological platform and assemble an initial group of users and complementors around it [CTO Forum, 2013]. As Cisco CEO John Chambers noted at the time:

> You're going to have your cloud, your data center, your wide area network, the ability to deliver from that down to local areas [such as] a branch bank, a community, an oil field[...]. We call that Fog. (Cisco 2013 CIO Summit).

The idea had been initiated two years earlier by Cisco researchers who believed that "computing will not just be in the cloud" (Interview with Cisco strategy manager). They pushed the idea of Fog computing internally for around 2 years before it became formally recognized as a key technological trend for 2014 (Cisco Tech Radar, 2013). Cisco's initial efforts to build momentum for the fog computing platform can be categorized into three types of activity: (a) leveraging its capabilities and partner networks to create an adjacent technology platform ecosystem; (b) establishing a distinctive identity in the nascent ecosystem; and (c) cultivating perceptions of complementarity between fog and the pervasive cloud computing platforms.

4.2.1 | Leveraging resources to assemble initial membership

In 2014, Cisco introduced an expanded fog computing strategy and its IOx platform—an architecture to enable data analysis on routers (Cisco press release, October 2014). CEO John Chambers articulated the vision for fog computing at a live event in San Francisco, claiming that the fog platform would help Cisco emerge as the "Internet of Everything" leader and would reverse the trend of commoditization:

> A few years ago, there was talk of Huawei and Avaya and Juniper eating our lunch...Nobody eats our lunch. (Cisco CEO, Cisco Live developer conference 2014).

Accordingly, Cisco invested heavily in IoT-related projects, providing $250 million to support start-ups (Cisco Newsroom, April 2014). It also expanded its fog-related activities (Cisco press release, October 2014). This included adapting existing products to fit the requirements of fog, developing new software, and creating a dedicated IoT business unit for fog computing.

A group of complementors joined Cisco in developing supporting technologies for fog (Cisco press release, October 2014). Suppliers and collaborators such as Itron, Tieto, and ARM, who had longstanding relationships with Cisco, adopted the fog terminology and developed technologies for the fog platform (Computer Weekly News, October 2014). Cisco also attracted innovators from outside its network to help promote the new platform to users. It opened seven innovation centers globally to encourage start-ups to develop applications based on fog computing (ENP Newswire, May 2014). In 2015, the firm announced a global IoT challenge, offering a prize of $2.5 million for the top submissions in fog computing and related IoT areas (Dow Jones Institutional News, May 2014). In collaboration with rail system operators, Cisco initiated projects to showcase the benefits of fog computing (M2 Presswire, November 2014). It also began to collaborate with manufacturers around the world, including Toshiba, to incorporate fog technologies into their manufacturing processes (Daily Tribune, November 2014). To further promote the platform, Cisco guaranteed that it would integrate fog computing services with all of its other offerings (Cisco press release, January 2015).

Fog's initial membership excluded Cisco's competitors and was limited to its close partners, financially incentivized members of its innovation centers, and users with needs unmet by cloud computing. Overall, at this stage Cisco exerted strong control over the design of the fog platform.

4.2.2 | Developing exclusivity to establish a leadership identity

While other companies such as HP, Huawei, and Ericsson also were trying to develop alternative decentralized platforms, Cisco was one of the few (along with GE, with its Predix platform) to develop firm-specific trademarks and terminology for their platforms. It trademarked the “Cisco fog platform” in the US (Justia Trademarks, 2013) and other regions, including Australia (Australian Government News, 2013), and allowed third parties to develop new applications for the platform. During this period, several conferences on fog computing featured speakers mostly from Cisco, and targeted participants from universities and business (Business Wire, October 2014). In addition, Cisco participated in major industry exhibitions to showcase the company's vision and its initial fog computing applications (Cisco blog, May 2014).

When unveiling its IoT systems at a corporate conference in 2015, Cisco predicted that “40% of IoT-created data will be processed in the fog by 2018,” and also announced that “Over 25 of Cisco's network products are enabled with Cisco's fog computing or edge data processing platform, IOx.” (Cisco press release, June 2015). Such announcements were widely circulated in the media, attracting users, complementors, and developers who attempted to make their offerings compatible with the fog platform. Several research reports claimed that there would be exponential growth in the demand for fog computing (ENP Newswire, June 2015). Overall, Cisco promoted the term “fog” in a way that would enable people to recognize the technology platform as being pioneered and driven by Cisco.

4.2.3 | Signaling complementarity and collaboration to cultivate positive interdependence

Rather than positioning fog computing as an independent platform to rival cloud computing, Cisco emphasized the close relationship between the two. The new platform's name clearly conveyed the connection with Cloud. Just as fog resides below the clouds, the fog platform was designed to provide an *interim* stage of data processing a layer below the cloud computing platform. The term fog seemed effective in serving Cisco's purpose by initially positioning this platform as a "perfect ally" (Yannuzzi, Milito, Serral-Gracià, Montero, & Nemirovsky, 2014) and complement to cloud computing that could extend cloud computing to devices. A senior director of technology development at Cisco explained the rationale for choosing the term:

> [We chose fog] because everyone knows cloud and it's easy to explain even to my non-technical people what fog is. Fog is bringing the very same elements of cloud lower, where they are needed, thus a fog cloud vs. a high cloud. (OpenFog congress documents, 2017).

A former Cisco executive explained to us that "fog can actually be viewed as extending cloud [...] I would describe it as a stretching the cloud. And [getting] closer and closer down to Earth." He noted: "So the [Cisco] cloud people were searching for a strategy. We said, 'Here [Fog] is the strategy'." Cisco relentlessly promoted Fog as an extension of Cloud, even though many analysts considered it to be an *alternative* to it. One report stated, for example, that industry actors may need to "forget about the cloud" because "the future of computing lies in the fog." It was argued that "asking our smart devices to, for example, send software updates to one another... could make the fog a direct rival to the cloud for some functions." The author of that report went on to assert:

> Stop focusing on the cloud, and start figuring out how to store and process the torrent of data being generated by the Internet of Things...Marketers at Cisco Systems Inc. have already come up with a name for this phenomenon: fog computing. (The Wall Street Journal, May 2014).

This view, shared by many experts in the field, suggests that fog computing was an emerging rival to cloud computing and that "cloud computing may concede to fog computing" (The Nation, March 2015). However, Cisco relentlessly countered this claim through market communications and industry events to explain how fog computing complemented cloud computing by addressing unmet user needs and providing mission-critical applications. Even in visual representations of fog computing, a positive connection to cloud computing was always emphasized. An executive from Cisco explained to us:

> Rather than cannibalizing cloud computing, fog computing enables a new breed of applications and services, and there is a fruitful interplay between the cloud and the fog, particularly when it comes to data management and analytics. (Interview with senior executive).

During our field observations, we found no evidence to suggest that Cisco and its partners had positioned fog computing as a threat to cloud computing. Industry analysts and thought leaders took the view that that Fog was an extension to Cloud, not a rival. An academic at a conference noted:

> Fog does not replace cloud computing. It extends the cloud to the edges of the network. If properly integrated, the resulting infrastructure would provide reduced latency, geographic awareness, improved data streaming, and access to commodity resource pools. (Twentieth Americas Conference on Information Systems, Savannah, 2014).

This approach allowed Cisco to maintain its position as a complementor in the cloud ecosystem, which could have been undermined, had fog computing been framed as a rival or disruptor to cloud computing. In 2014, Cisco was perceived to have a "clear lead in public cloud infrastructure," with around 15% market share (Synergy Research Group, 2015). At the same time, it started to emerge as a leader in the IoT landscape. An industry analyst noted:

"There was, for a time, significant doubt over – how exactly – Cisco would manage this market transition. It was near on impossible for traditional vendors to compete with cloud-native companies in an increasingly software dominated landscape. The Internet of Things hysteria was exactly what Cisco needed to *reverse its fortunes*." (MicroScope Research, 2016).

4.2.4 | Triggers of strategic changes

Although each of the three actions we have described were beneficial in seeding the platform, they began to create scalability problems. First, there were limits to the number of members and users that Cisco could enroll by mining its own network or providing direct incentives. As indicated in a post on its blog, Cisco faced three important problems at that time: interoperability issues concerning fog technologies and applications from various vendors, a need for collaboration and partnerships with vendors and academia, and a need for increased awareness of Fog's benefits and applications in a wider set of industries. A Cisco technology manager explained in an interview, "the problem was too complex to be handled by Cisco." Expanding the platform required incorporating other companies' technologies and involving players beyond the initial membership. A company-specific technology platform was unlikely to attract the resources and complements needed to scale up. A respondent explained:

> It was time that we needed to rethink our strategy ...this [Fog] was an industry-wide thing, [...] not just a Cisco thing. And it wasn't going well. First of all, it [Fog] is too complicated and it involves a lot of companies and no single company will be able to do it, and [second] it involves domain knowledge that no single company will have. These issues were actually what triggered us to revitalize the effort.

Moreover, although developing a company-specific technology and securing centrality in a platform ecosystem has significant benefits, it can also deter others averse to being locked into a platform provided by a single (perhaps even rival) large company. In a contribution to a popular technology blog, Mike Kirkwood explained the challenge of using Cisco's name:

> Like religion itself, Cisco is a company that evokes deep emotions. Many IT leaders believe in Cisco and bet their operations on the company. And to unbelievers, using Cisco gear is one of the deadly sins. (ReadWrite, February 2010).

Second, we observed that many companies did not want to participate in fog computing because it was seen to be Cisco's exclusive technology. In an interview with us, a senior strategy executive from a Cisco rival said that they had been warned against using Fog because it was known to be a "Cisco term" [Interview with Head of IoT unit at a Cisco rival]. Although owning the fog computing brand and having architectural control helped Cisco to attract an initial set of users to the new platform, it also limited its further expansion. Notably, the scientific community did not participate actively in the fog platform, and industrial applications remained limited to those in which Cisco had made direct investments. Third, to expand beyond the initial membership and attract more application developers required Cisco to focus on opportunities that were also targeted by Cloud providers. A heavy focus on cultivating perceptions of complementarity with Cloud during the seeding of the platform led to fog computing being perceived as redundant and nothing "new," which impeded its future prospects.

4.3 | 2015–2018: Scaling the fog computing platform

The scaling stage of platform creation was dominated by three strategic actions: (a) fostering standardization and codevelopment, (b) cultivating perceptions of distinctiveness, and (c) relinquishing exclusiveness. These differed considerably from (and even contradicted) the strategic actions taken during the platform seeding stage.

4.3.1 | Fostering standardization and codevelopment to encourage broader membership

In 2015, Cisco began to redirect its efforts. To scale the platform and facilitate wider adoption, Cisco ensured that its technological architecture was included in industry standards and in discussions with the scientific community. In a blog post, Cisco's senior technology manager explains the rationale:

> Our goal is to accelerate the deployment of fog technologies by developing an open architecture and core technologies that can be leveraged across industries in many different IoT scenarios. (Blog.cisco.com, November 2015).

Cisco began participating in industry groups such as the Wireless IoT Forum, which focused on IoT standardization, as Cisco's chairman noted in his opening address in 2015: "Without widely-agreed open standards, we risk seeing pockets of proprietary technology developing independently, preventing the benefits of mass-market scale" (TechWorld, July 2015). With a similar goal, Cisco established the OpenFog Consortium. A Cisco senior manager explained in an interview with us:

> We—a small team of Princeton academics and Cisco—met initially to discuss the options and we realized that it was bigger than one company could do and one company could handle. It needed a wider approach. We could not do this by ourselves—we learned from cloud computing that you need more partners to make it work. We decided to create a consortium and gradually more companies started joining…Cisco had a trademark for 'Cisco fog' and that meant we could use fog/OpenFog. (Interview with Cisco senior representative at OpenFog).

Major players, including ARM, Cisco, Dell, Intel, Microsoft Corp., and the Princeton University Edge Laboratory, joined forces to develop the platform, and announced they would be creating an architecture "that brings seamless intelligence from the cloud to the IoT endpoints using an open standardized approach" (EFY December 2015). In 2016, a Chinese firm, ZTE, joined the consortium, thus broadening geographical participation in the platform (ZTE press release, 2016). State bodies like the U.S. Congress also recognized the importance of fog computing (SEC Wire, May 2016). As the platform expanded, the OpenFog Consortium initiated a geographical structure and established a country team in Japan (ibid). Cisco meanwhile continued to deploy the platform, and showcased fog-related products in bi-monthly industry events. It took part in urban management projects (e.g., a smart city initiative in Barcelona) to promote fog computing (ENP Newswire, 2016).

During a presentation at the 2017 OpenFog World Congress, a Cisco manager explained why the term "open" was added to the consortium's name: "Open is a given, since we have taken a very cooperative approach toward working with and leveraging our bodies of work. Also, we wanted a diverse group of members, including academic institutions, to help drive innovation." The standardization of fog computing was the key mission for Cisco and the other members of the OpenFog Consortium. A Cisco senior manager told us: "You have hundreds of legacy protocols and many competing standards. Our strategy is to build a complete portfolio to drive standardization." Another senior manager stressed the importance of user needs and standardization:

> We need to keep up the pace of new standards progress—we need to have frequent focused deliverables so people who are under pressure to achieve value can get that, and others who expect the right time also have that provided. (Interview with Cisco strategy manager).

In April 2016, IEEE, the world's largest professional organization for technology advancement with more than 423,000 members in over 160 countries, joined the consortium (IEEE official announcement), a clear sign that the new platform was gaining attention in the scientific community. The consortium established a framework for cooperative, open and interoperative fog systems across AI, 5G, and IoT deployments. Research institutes and universities began using fog technologies in their own R&D. In 2017, OpenFog released its Reference Architecture—a framework aimed at promoting industry standards for fog computing (OpenFog press release, June 2017). In 2018, OpenFog was embraced as IEEE 2018:1934 standard, becoming an industry standard and marking a major milestone in the Fog computing initiative.

4.3.2 | Relinquishing exclusivity and relying on lasting recognition as the platform leader

After many of Cisco's activities had been transferred to the OpenFog Consortium, the company tried to widen the platform's scope by repositioning itself as a comprehensive provider of IoT solutions. This shift in focus is reflected in Cisco's SVP response to a technology analyst:

> You actually have heard a lot about fog computing, [but] we didn't want to be associated with the fog company. But if you look at our announcements on, let's say, data centers, Chuck [CEO] talked about moving from data centers to centers of data. [...] A lot of the things that we talked about, our Edge innovations, I think we just haven't put the word fog on it. (CQ FD Disclosure, November 2015).

In company communications, there were few signs of fog computing being promoted beyond the activities of the OpenFog Consortium. Cisco's senior director explained in a presentation at the 2017 OpenFog World Congress that they welcomed the multiple agendas of consortium members:

> [The] focus on commonalities minimized the differences. No tech religion. Focus on the architecture, focus on things that are important to the industry as whole such as openness and interoperability. Multiple ways to skin a cat, doesn't have to be [from] a particular company's perspective.

Creating a shared trademark, OpenFog, helped to encourage broader membership of the OpenFog Consortium. However, in our interactions in OpenFog meetings and discussions with Cisco's rivals we noted that some major players such as Nokia and Ericsson still chose not to participate, because they lacked control over the platform's architecture. Cisco, however, made its own collaborative agreements with companies such as Ericsson to ensure alignment (Cisco press release, November 2015) and strengthen Cisco's central role in the fog platform ecosystem.

Even though Cisco had shared the Fog trademark with consortium members and relinquished some of its control over the fog platform, industry experts continued to associate OpenFog with Cisco (Forbes, 2016). During our conversations with field experts, they frequently referred to Fog as Cisco's platform. For example, as late as 2018 and two years after the Fog trademark had been abandoned, a reputable industry analyst still considered Fog to be part of Cisco's technology portfolio:

> Cisco is positioned as a leader in the IDC MarketScape for IoT platforms. Based in San Jose, California, Cisco is a provider of networking, security, datacenter, and collaboration solutions. Cisco's IoT portfolio includes edge and fog infrastructure… (IDC report, 2018).

At this point, potential rivals became less averse to developing fog applications, because it was no longer a company-specific technology. Even direct competitors such as Dell joined the consortium.

4.3.3 | Signaling distinctiveness and competitiveness with Cloud

The OpenFog Consortium focused on defining the relationship between cloud and fog platforms. Discussions at the OpenFog Atlanta Member Meeting (January 2018) were dedicated to discussing Fog versus Cloud questions. In the beginning, and much as Cisco had done in 2013, the consortium framed fog computing as complementary to cloud computing. However, the consortium gradually started to emphasize the platform's strengths and its potential to shift value from cloud-based business. For example, it claimed that Cloud was not meant for IoT use:

> Cloud networking is an extremely valuable architecture that has ushered in a powerful new generation of computing for the 21st century. However, the Cloud was designed for IT—not IoT. Distributed IoT networks across a variety of industries—

> discrete and process manufacturing, power and energy, utilities, connected cars, and so on require operational efficiencies with zero downtime, ultra-low latency. Plus, enormous data loads from billions of streaming devices requires processing power that is closer in proximity to the 'things.' Fog computing fills this gap between cloud and things. (openfogconsortium.org, December 2016).

To advance the idea that fog could also compete with Cloud, Cisco, and its partners identified and implemented applications where fog-based technology was replacing cloud-based technology (for example, in health informatics) (OpenFog news, 2018). These efforts were aimed at fostering perceptions that fog could do some of the things that Cloud does, but more efficiently and securely They also focused on distinguishing between fog and alternative concepts such as "Edge" computing:

> Fog computing also is often erroneously called edge computing, but there are key differences. Fog works with the cloud, whereas edge is defined by the exclusion of cloud. Fog is hierarchical, where Edge tends to be limited to a small number of layers. In additional to computation, fog also addresses networking, storage, control and acceleration. (OpenFog reference architecture document, 2016).

They claimed that Fog computing could ensure data collection and analysis at the most efficient and logical places between the Edge and the Cloud. Thus, industry actors began to perceive Fog as neither purely complementary to Cloud nor redundant, but as providing unique value not offered by Cloud.

> Fog computing's potential to disrupt the flourishing cloud computing model is really about economics. As many people said at Fog World Congress, the volume of data generated by edge devices is already in the zettabytes. That volume will increase exponentially as more devices come online. And guess what? Most of that data is junk. Transporting all of it up and down from cloud providers costs money. Fog computing can help triage data, deduplicate redundant bits, and make the cloud and edge more efficient. (the2112group.com, October 2018).

Figure 4 illuminates how Cisco initially framed Fog's relationship with Cloud computing and how it later adopted a more competitive but nevertheless mutualistic approach, in which Cloud and Fog needed to work in tandem to provide seamless connectivity in the computing continuum.

By 2018, fog computing had become a major platform for developing IoT infrastructure (Economist, 2018) involving academic institutions and governments. It was also adopted as an IEEE industry standard (IEEE Standard Association, 2018).

In 2019, the platform ecosystem grew even bigger as the OpenFog consortium merged with the Industrial Internet Consortium (IIC) of which Cisco was a founder member. "The Industrial Internet Consortium and OpenFog Consortium have agreed in principle to bring the OpenFog members into the IIC organization so that the Industrial Internet Consortium can continue the progress OpenFog has made toward accelerating the adoption of fog computing" (IIC Website). While Cisco is not leading this merged platform, it is recognized as a "visionary leader in the IoT analytics space" which is helping to facilitate real-time governance and enable immediate decision making (IDC Analysis, 2018). Fog computing still features prominently in numerous

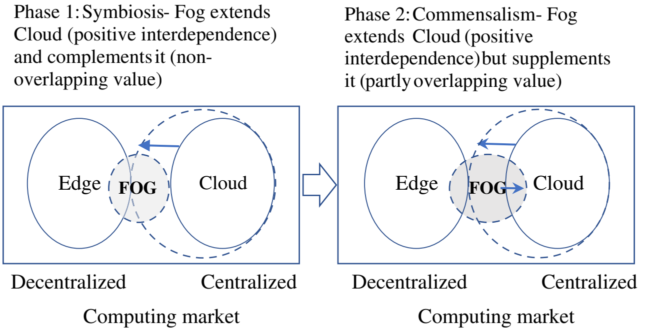

FIGURE 4 The relationship between Fog and Cloud. Solid lines represent boundaries of the ecosystem and dashed lines represent the intended boundaries of the Fog and Cloud according to Cisco and OpenFog

scientific articles and analysts' reports, even though parallel terms such as distributed cloud are also becoming widespread. For example, in October 2019, the American Association of Manufacturing (AEM) explained the way it looks at Fog:

> The rise of the Internet of Things has sparked the emergence of the distributed cloud, otherwise referred to as Cloud 2.0 or 'fog computing' defined by Cisco as a 'highly virtualized platform that provides computing, storage and networking services between end devices and traditional cloud computing data centers,' its name serves to explain how the technology works by alluding to the idea that fog is a cloud that is close to the ground. (AEM website).

Hence, Cisco has connected Fog to one of the largest consortia with 258 members, even if at the expense of not having Fog in the consortium's title. Fog continues to be deployed and codeveloped by users and complementors and Cisco enjoys the position of being seen as one of the key leaders in the vast IoT landscape (Bloomberg, October 9, 2019).

5 | A PROCESS MODEL OF NEW PLATFORM CREATION BY AN ESTABLISHED FIRM

Building on our findings, we explain the key elements of an established firm's efforts to become a leader in a new but adjacent platform ecosystem while safeguarding its position as a complementor in an established platform ecosystem. This process is bounded by two conditions. First, the process is less applicable in cases where it is not vital to enlist the support of powerful actors in the existing platform. For example, Apple was able to establish its new mobile operating system without needing to gain legitimacy in the existing Symbian ecosystem on which it had little dependence. Second, the established firm needs to have a stake in the existing platform, even though its technological architecture and business model make it unlikely to become a leader in that platform. This model is less applicable to a firm with few stakes in the existing platform, or to a start-up that may need a more distinctive framing upfront to attract attention, rather than beginning unobtrusively by emphasizing complementarity. See Figure 5 for a theoretical model of this process.

In a dominant platform ecosystem, an established firm, whose legacy business capabilities do not allow it to gain centrality, can only support and complement the platform leaders. Playing a complementor role may secure profitability but may limit the firm's ability to capture

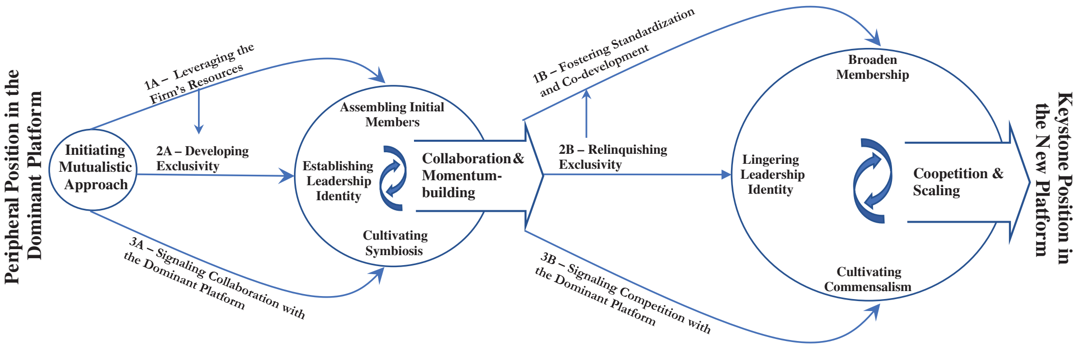

FIGURE 5 Process model of a mutualistic approach to new platform creation

maximal value compared to platform leaders. However, when there are unmet user needs in the existing platform ecosystem (Shah & Tripsas, 2007) and new opportunities arise (Agarwal, Moeen, & Shah, 2017)—in our case, computing needs that are closer to connected devices and that are not being fully served by Cloud—a firm may seize such opportunities to create an adjacent platform in which it plays a central role without relinquishing its complementor role. However, in doing so it faces several strategic tensions, which can be addressed through dynamic symbolic, material and institutional actions.

In the initial stage of platform creation, an aspiring platform leader focuses on leveraging its resources (1A) to encourage allies and partners in the firm's existing network and attract users with urgent unmet needs (e.g., high data security). Focusing on a select set of lead users and complementors who are aligned with its own technical goals of enables the platform creator to establish technical control over the platform architecture. At the same time, the firm develops cultural resources such as familiar and recognizable labels and novel concepts (2A) to nurture a distinctive leadership identity and gain mindshare among targeted adopters. At this point, users and complementors tend to be less concerned about the exclusivity of the platform, and tight control may not undermine its legitimacy. However, to safeguard its legitimacy in the existing platform ecosystem where it still has stakes, the firm can signal conformance with it (3A) by underlining complementarity (e.g., Fog as an extension of Cloud) to mitigate resistance from targeted adopters who still value that platform. Showing such positive interdependence allows the firm to gain legitimacy for the new platform while maintaining legitimacy in the existing ecosystem. The platform sponsor's overall approach at this stage is symbiotic, even though it is developing a high degree of technical control and a distinctive leadership signature.

While these strategies may work in the initial phase, they can also impede further expansion. First, late adopters who are not part of the firm's existing network (or even the firm's competitors) may be deterred by the firm's attempts to establish control and exclusivity. Second, continuing to conform with the existing platform may make it difficult to attract a more diverse set of members whose needs are not being met. However, having gained momentum, the new platform can now emphasize nonoverlapping aspects (e.g., Fog as a replacement for Cloud), rather than merely on its complementarity, and it can now even be framed as a viable alternative to the dominant platform.

Thus, in the scaling stage the firm shifts strategies and starts to promote standardization and codevelopment (1B) to attract a broader membership. Achieving this goal requires the firm to relinquish exclusive control over the platform's architecture and trademark (2B).

Nonetheless, the distinctive leadership identity or founder stamp established initially may not erode instantly, and its carryover effect (as with Cisco's Fog) may continue to benefit the firm if it is still seen as the new platform's pioneer. At the same time, the firm needs to differentiate the new platform from the dominant industry platform (3B) and frame it as a potential rival to that platform. Opening up the platform and fostering standardization and codevelopment enables the platform to attract late adopters, who value openness and inclusiveness; having gained a footing, the firm can now also afford to more brazenly differentiate the platform. The overall stance at this stage becomes more competitive, despite the opening up of the platform. However, the firm still maintains a mutualistic approach toward the dominant platform by continuing to serve and enhance it. Thus, to create a new platform while remaining dependent on an established platform, a firm needs to achieve a dynamic balance between the shifting legitimacy demands in the two ecosystems as technologies, competition, complementors, and user needs evolve, and to continually adapt its strategies to meet these changing demands.

5.1 | Wider implications of our model

While our study was based on a single case, our process model may be relevant in many other instances where former industry leaders have lost ground to thriving new platforms. Our model offers a way in which these incumbents can respond to dominant platforms (Cozzolino et al., 2018) by creating a new platform without undermining them. One such example is the WiMAX internet connectivity platform championed by Intel to offer long-range connectivity for mobile users (Burgelman, LaBrecque, & Schifrin, 2010; Holgersson, Granstrand, & Bogers, 2018). Although attempts were being made to provide long-range internet access using cellular technologies (e.g., LTE), Intel was not a key player in those initiatives. It thus decided to leverage computer-based wireless technologies (Leiponen, 2008) to develop an alternative platform, WiMAX, in line with its core capabilities and product portfolio. At the same time, Intel strove to secure legitimacy both in the existing cellular ecosystem, in which it had a peripheral role, and in the emerging WiMAX ecosystem, where it emphasized advantages such as flexibility, shorter time to market, and lower costs. In line with the premises of our model, Intel initially framed WiMAX as complementary to the dominant cellular platform ecosystem by emphasizing nonoverlapping value such as the possibility of using it in isolated communities or in business with dated internal communication systems. However, after gaining initial momentum, it switched to commensalism by emphasizing the distinctive features of its own platform and indicating that WiMAX could be a partial substitute for LTE. In 2008, Intel's CTO said that “WiMAX is here now to meet that demand. LTE is at least 2-3 years away,” and emphasized its distinctive features such as the platform's openness and cost effectiveness (Blogs.Intel.com). At the same time, he assured to stakeholders that Intel's support for LTE. Within the WiMAX ecosystem, Intel retained control as vital technology provider but engaged in institutional efforts to gradually shift part of the platform development to the WiMAX forum. At the same time, Intel developed a leadership identity as the prime advocate for WiMAX at industry symposia. This enabled it to be seen as WiMAX's champion, despite relinquishing control to the WiMAX forum and letting other companies such as Motorola and Samsung contribute to the WiMAX initiative. Even though WiMAX ultimately failed to replace 3G, it shows how a platform creator can make dynamic use of a mutualistic approach to gain legitimacy for its new platform while also maintaining legitimacy in the existing platform ecosystem.

Another example is the development of LiFi by Philips Hue to provide short range internet connectivity segment that was dominated by WiFi technology. Having lost its competitive edge in lighting systems, Philips found an opportunity to leverage its competence to develop an alternative platform, LiFi, which uses light to send wireless signals. As the visible light spectrum is 10,000 times larger than the radio frequency spectrum used by WiFi, LiFi offers higher capacity for data transmission and can provide internet access in places sensitive to interference by radio waves such as hospitals and airplanes. In creating this technology platform, Philips attempted to secure legitimacy both in the existing WiFi ecosystem, where it needed buy-in from telecoms and technology providers (e.g., KPN, Vodafone, and Orange), and with other players in the emerging LiFi ecosystem (e.g., Atea, Samsung, and Panasonic). As per our model, Philips initially framed LiFi as complementary to the dominant WiFi platform ecosystem, as Philips Hue's CEO explained: “Usage of Li-Fi is ideal in radio frequency sensitive areas, like hospitals, clinics, factories, and schools, or areas with poor or no Wi-Fi connection at all” (LEDs Magazine, February 2019). However, now that LiFi has gained traction, the firm is switching to address the broader WiFi market; its focus is on leveraging LiFi's distinctive features to provide partly overlapping value, even though it is still underscoring the positive interdependence between the two, for example by promoting hybrid WiFi/LiFi systems.

6 | DISCUSSION

The increasing pervasiveness of platforms has either disadvantaged or displaced many incumbents in a range of industries (e.g., Eisenmann et al., 2011). We examined how an established firm, which played only a complementor role in a thriving platform ecosystem and was under market pressure to demonstrate new opportunities for growth, was able to reposition itself. While unmet needs in a dominant platform category may encourage lagging incumbents to try to reposition themselves, prior commitments may impede such moves (Wang & Shaver, 2014). In our case, Cisco repositioned itself by establishing a new platform to gain market leadership without losing its legitimacy in the existing ecosystem. Such repositioning requires a firm to manage dual legitimacy and to navigate skillfully the shifting strategic tensions that arise in the process (Claussen, Essling, & Kretschmer, 2015; Dattée, Alexy, & Autio, 2018). It has not only to dynamically adapt material and symbolic actions, it must also attempt to shape the platform's coevolution by coordinating ecosystem partners and getting them to coalesce.

6.1 | Dynamic strategies to manage dual legitimacy

Our study reveals the use of a three-pronged approach to platform development. First, adoption is encouraged through material strategies such as building backward compatibility (Kretchmer & Claussen, 2016), embedding design features, creating an open architecture, and offering financial incentives (Evans, Hagiu, & Schmalensee, 2006; Van Alstyne et al., 2016). Second, symbolic strategies such as framing (Gurses & Ozcan, 2015; Snihur et al., 2018) are used to cultivate favorable perceptions among key stakeholders (Lounsbury & Glynn, 2001; Vasudeva, Alexander, & Jones, 2014), and developing cultural resources such as stories, analogies, labels and novel concepts creates a distinctive identity. Third, institutional strategies such as forming industry consortia to enroll other firms into the platform ecosystem are used to expand the platform. While the use of material and symbolic strategies in combination is well established (e.g., Zott & Huy, 2007), our study shows not only how a firm used such strategies variably over time, but also how it deployed them on a compensatory basis when seeding and scaling the platform. It also shows how the firm sought to strengthen the ecosystem by encouraging the creation of industry-wide standards in order to steer the future evolution of the platform (Delcamp & Leiponen, 2014; Vakili, 2016).

These strategies suggest the benefits of a mutualistic approach to new platform creation. By assuring other players in the dominant platform that the relationship will be one of symbiotic mutualism—(eating from different tables)—that is, a relationship in which new platform provides distinct but *nonoverlapping* value to a niche not served by the dominant platform—the platform creator can safeguard its new platform from hostile reactions. By invoking frames that suggest complementarity (e.g., Philips Hue framing the LiFi platform as one that addresses WiFi blind spots without posing a threat to WiFi itself) or by pursuing new market spaces that are not being targeted by the dominant platforms (e.g., Atos framing its FinTech platform as one that complements rather than competes with banks), key actors in a new ecosystem may avoid head-to-head competition. This is thus in line with a symbiotic approach.

While a symbiotic approach is effective for legitimizing a platform in the early phases, growth opportunities may begin to overlap with the areas being targeted by established platforms. A new platform may then pursue commensalism or "eating from the same table" (Hawley, 1950: 39) provided that the table is now large enough (Dobrev & Kim, 2006). Commensalism is in part competitive, in that both platforms are addressing partly overlapping market niches, but it does not necessarily imply predatory competition (Aldrich & Ruef, 2006). There is room for platforms to serve a larger market and enhance each another. For example, Fog and Cloud partly compete but also extend each other's reach. This switching from symbiosis to commensalism (i.e., from collaborative to partly competitive behaviors) while still maintaining positive interdependencies highlights the often "overlooked" temporal dynamics of coopetition (Hoffmann, Lavie, Reuer, Shipilov, 2018); these vary over time as the platform evolves and are manifested not just within a single ecosystem but also across adjacent ecosystems.

Although a dynamic mix of material, symbolic, and institutional strategies may enable a platform creator to navigate the challenge of dual legitimacy, it is still vulnerable to counterattacks once the new and the existing platform begin to compete in overlapping markets (Eisenmann et al., 2011). However, potential contenders may be constrained by the mismatch between their capabilities and the new platform's architecture (Helfat & Raubitschek, 2018; Moeen, 2017). For example, AWS does not have the same installed base of sensors and hardware expertise to draw on as Cisco. Competing with a network of firms such as a consortium may also be much harder than competing with a lone firm.

6.2 | Contributions

Given the increasing complexity of digital ecosystems and the associated challenges of establishing legitimacy for a new platform, firms need approaches other than pure competition. Ecological concepts (e.g., Moore, 1993, p. 97) can further a coopetitive approach in interrelated ecosystems. By showing how a firm may take a dynamic approach to new platform creation when another platform is already dominant, and by focusing on mutualism based on nonoverlapping value (symbiosis) and on partly overlapping value (commensalism), we make three contributions to the literature on platform ecosystems and strategic management. First, we reveal how an established incumbent repositions itself (Wang & Shaver, 2014) by creating a new platform ecosystem in which it becomes a leader, without trying to beat its rivals. It does so by using temporally variant and at times contrasting strategies that are rooted in a mutualistic "rising tide lifts all boats" approach (Chen & Miller, 2015) of collective value creation, rather than purely competitive, or even hostile, strategies such as "envelopment" (Eisenmann et al., 2011) and "forking" (Karhu, Gustafsson, & Lyytinen, 2018). In contrast to studies (e.g., Zhu & Iansiti, 2012) that focused on competitive dynamics and predatory strategies, we set out an alternative path that is rooted in positive resource interdependences across platform ecosystems.

Second, while participating in multiple platform ecosystems simultaneously is a challenge in itself—as in "multihoming," (Cennamo, Ozalp, & Kretschmer, 2018)—attempting to lead a new platform while still being dependent on actors in the existing platform requires legitimacy in both ecosystems. Navigating dual legitimacy involves a series of balancing acts: differentiating and conforming, asserting and surrendering control, and collaborating and competing with the existing platform at different stages in the new platform's evolution. Differentiation has been argued to provide a way of avoiding ambiguous competitive positioning (Cennamo & Santalo, 2013). However, we suggest that when platform creators are faced with dual legitimacy issues, they need to focus on both differentiation and conformance and to seek optimal distinctiveness (Zhao et al., 2017) at various stages in order to address the changing needs of stakeholders (e.g., early and late adopters) and shifting legitimacy criteria in the ecosystem (Rietveld & Eggers, 2018; Überbacher, 2014).

Third, our findings offer a processual perspective on platform creation (Bower & Gilbert, 2005; Burgelman et al., 2018; Dattée et al., 2018; Mintzberg, 1978) by showing how organizations use compensatory material and symbolic strategies to address changes in user needs, technology, and the nature of tensions. Potential loss of legitimacy arising from material actions to establish a novel alternative to an existing value paradigm can be offset by using *concurrent* symbolic actions that signal complementarity with it (e.g., Poole & Van de Ven, 1989). However, even when a shift is made to strategies that seem divergent (e.g., relinquishing exclusivity but becoming competitive), cognitive carryovers from the earlier stage can create compensatory effects (e.g., Gulati & Puranam, 2009). For instance, creating mindshare initially by establishing a distinctive leadership identity can later enable the platform creator to benefit from cognitive continuity (Wittman, 2019) by being seen as a leading proponent, even after relinquishing control over the architecture and brand. Deploying a unique mix of compensatory material and symbolic strategies that temper each other's negative effects enables the platform creator to open up the platform but still retain control.

In terms of how a platform creator navigates the open/closed tension, which entails tradeoffs between adoption and appropriability (West, 2003), our findings suggest that it may consider adopting a closed architecture initially (Toh & Miller, 2017) to steer the platform's technological development (Leiponen, 2008) and may then "surrender" part of the control (Alexy, West, Klapper, & Reitzig, 2018; Schilling, 2009; Van Alstyne et al., 2016). While it has been argued that opening up a platform increases adoption by target members (Boudreau, 2010), we show how simply granting access to the platform encourages complementary development but may not be enough to attract wider membership, particularly when an industry-wide standard is at stake. The platform creator may then need to surrender control over the platform itself and get others to coalesce around it.

Our study also offers insights for practitioners. Few companies, if any, can afford to go it alone in industries that are becoming increasingly complex; they may therefore want to consider taking nonrivalrous approaches such as pooling resources, enabling interoperability, ensuring seamless linkages among products and services, building consortia, and using other collaborative means to cocreate and capture value. Our approach has relevance for incumbents such as Ericsson, IBM and GE that have lost territory to increasingly dominant platforms. For example, TomTom, having lost its leadership in satellite navigation to companies such as Google, has arguably adopted a mutualistic approach vis-à-vis the dominant platforms by addressing underserved market niches in specialized navigation systems. Its system complements existing platforms (symbiosis) but also partly competes with them (commensalism). Also, failing to establish a distinctive leadership identity upfront may thwart subsequent attempts to become a leader. For instance, Ericsson has sought prominence in IoT ever since it introduced its DCP platform in 2013 but arguably is still not seen as central in the ecosystem, in part because of its failure to create a platform leadership identity.

Our study provides some fruitful avenues for further research. For instance, our processual view can illuminate how firms temporally manage ambidexterity (Knight & Paroutis, 2017; Raisch & Zimmermann, 2017). Scholars can also examine the interplay between multi-firm networks and firm-centric resources (Nambisan & Sawhney, 2011) and how this may generate novel forms of organizing within and across firm boundaries. With regard to policy makers, they may consider encouraging conditions that are conducive to symbiosis in order to nurture multiple platform ecosystems and that discourage monopolistic winner-takes-all approaches that have come under criticism.

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SUPPORTING INFORMATION

Additional supporting information may be found online in the Supporting Information section at the end of this article.

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