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Open Innovation and Industrial Dynamics—Towards a Framework of Business Convergence

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5.1 INTRODUCTION

The central proposition of this chapter is two-fold: First, industrial dynamics must increasingly be conceived in terms of convergence and divergence rather than industry-bounded trajectories. Second, these dynamics represent central drivers for more open and industry-transcending patterns of innovation.

Three widely used key frameworks assume stable industry boundaries as context for strategic management and innovation. These are the Product Life Cycle (PLC), the Five Forces, and the Innovation Life Cycle. The PLC model, grounded in industrial economics, presents a systematic sequence of stages in the evolution of the economic structure of industries (Gort & Klepper, 1982; Klepper, 1997). In the embryonic stage, volume is low, product design is experimental, and many firms enter. In the growth or “shake-out” stage, volume growth is high, product design stabilizes, and large-scale operations lead to lower entry, intensified exit, and an oligopolistic market structure. This stage is followed by stages of lower growth and decline. Porter’s Five Forces framework is likewise grounded in industrial economics (Porter, 1980). It identifies five forces framing the competition and strategic attractiveness of industries (rivalry, supplier power, buyer power, substitutes, and entry barriers). The Innovation Life Cycle (ILC) is rooted in Schumpeterian economics and innovation studies. It is complementary to the PLC in that it points to changing patterns of innovations as key drivers in the evolution of industries. The early stage of industries is characterized by technological discontinuity, radical product innovation and rivalry among a diversity of product designs. This stage ends when a dominant design is selected by the market. Radical
innovation in production processes leads to scale economies and high growth followed by incremental product and process innovation within the constraints of the dominant design.

These frameworks have been particularly effective in explaining evolving market structures and innovation dynamics in many manufacturing industries (e.g. the automobile, bicycle, or television industry) characterized by well-defined and stable boundaries making the notions of life cycles meaningful. However, three generic tendencies have weakened their scope of validity:

- First, business dynamics are to a decreasing extent confined to single-product industries that behave according to the PLC and ILC. Instead, business dynamics are characterized by increasingly open boundaries associated with dynamics of industry and product market convergence, and divergence into disaggregated (sub-) markets.
- Second, the increasing prevalence of convergence/divergence makes the collaborative nature of the firm-environment relationship more central to strategic management than what is reflected in the Porterian “industry analysis” with its exclusive focus on competitive bargaining relationships. While the competitive game remains vital in business dynamics, the collaborative game and its interplay with competition has become equally decisive (Brandenburger & Nalebuff, 1996). This means that the Five Forces is insufficient in assisting firms’ strategies.
- Third, convergence and divergence dynamics imply other types of innovation than those addressed in the ILC (radical versus incremental innovation, and product versus process innovation). These categories cannot grasp the particular dimensions of innovation that are embedded in convergence and divergence processes, in which innovation must open up for ideas, technologies, designs, and market features residing in other—often unfamiliar—industrial contexts.

This chapter presents a framework for understanding the business dynamics of convergence and divergence. It serves four purposes. First, it offers a systematic way of analyzing business and innovation contexts that are not well explicated by the Five Forces framework. Second, it proposes a theory of the generative mechanisms underlying convergence and divergence, and a new “life cycle” model, the Convergence Life Cycle. Third, the framework contributes to explain the increasing prevalence and particular patterns of open innovation, and fourth, it enlightens the relations between open innovation and the notion of dynamic capabilities in strategic management (Teece et al., 1997; Teece, 2007).

These theoretical and analytical endeavors take their point of departure in the business dynamics of the IT security sector.
5.2 THE CASE OF IT SECURITY

One dark side of the Internet and related information and computer technologies has been an explosion of different types of security problems such as viruses, spyware, pitching, and hacking. These, again, have given rise to swarms of firms exploring the commercial opportunities of offering safeguarding measures. We have witnessed the emergence of a large range of new security products and services and the creation and hyper-growth of a new complex and volatile sector. IDC estimated global IT security revenue to reach $35 billion in 2003, reflecting a doubling of revenues since 2001 (IDC, 2003) and comparable to the size of the global market for recorded music. Just 15 years before, this sector did not exist. IT security entails software- and hardware-based products and systems on the one hand, and large variants of services on the other. These services assist users in selecting, implementing, and managing security products, and in adopting organizational procedures for safeguarding. IT security products and services are dedicated to alleviate IT security problems of different kinds. But despite this commonality, the enormous diversity of IT security doesn’t lend itself fruitfully to being analyzed as one industry. Rather, it must be conceived as an ecosystem of evolving and interrelated product markets or submarkets.

For the period 1988–2004, we have identified three partly overlapping stages of business dynamics. The late 1980s and early 1990s saw the formation of numerous product markets based on specialized firms’ development of autonomous security products, each responding to specific types of upcoming security problems. While product market formation continued after the mid-1990s, even if with decreasing intensity, two trajectories of convergence-based dynamics came to dominate. One associated with the bundling of two or more products, the other with the integration of products into broader platforms and systems. In the following, we provide an overview of these trajectories. In the context of open innovation, we maintain that these strategic leaps from one trajectory to another impose particular requirements on innovation management to reach out for integrating technologies and business models from unfamiliar business contexts. The case is based on our study of the evolution of IT security (for details, see Christensen, 2011) and other research on the sector.

5.3 TRAJECTORIES OF PRODUCT MARKET FORMATION AND THE ROLE OF TECHNOLOGY LICENSING

Early security technologies were not associated with commercial products but with university and government-sponsored research and development
especially in the U.S. (Giarratana, 2004). But from the late 1980s to the late 1990s, hundreds of security specialist firms were established based on product innovations or the invention of security technologies. Many have later exited or been subject to mergers and acquisitions. During the early years, in particular large IT enterprises and government institutions in the U.S. were important lead-users of innovative products and licensees of technologies provided by technology specialists (Giarratana, 2004).

Among the early examples of security innovations are antivirus, firewalls, Virtual Private Networks (VPN), vulnerability assessments scanners and services, authentication, and Intrusion Detection Systems (IDS), all invented and initially commercialized between 1989 and 1996. Each of these products (and numerous others) was subject to specialized product market formation, with many rival firms engaged in innovation to expand their capacity and performance. From the early start, numerous firms also developed a market for security technology. In 2002, technology licensing accounted for 17.4% of overall revenues in the software part of security, while revenues from products and services accounted for, respectively, 52.3% and 30.3% (Gambardella & Giarratana, 2007). One important security technology, encryption technology, is patent-intensive and applied in product markets dealing with encryption, network security, and authentication. These markets were also the most licensing-intensive. Sixty-five percent of firms entering these markets during the period 1989–2004 were based on in-licensing of encryption technology. This was only the case for 13% of new entrants in other security product markets such as firewalls, antivirus and anti-spam (Arora & Nandkumar, 2007). Technologies with more product market applications tended to be out-licensed to firms in markets different from those in which the licensors were operating implying that the latter avoided direct competition from the licensees (Gambardella & Giarratana, 2007). Thus, the technology market in IT security has contributed to enhance entry into numerous product markets and stimulate market fragmentation. At the same time the economic functioning of the technology market in IT security seems to have benefitted from the strong market fragmentation. This pattern of open innovation in the early stage of business formation in IT security reflects a dynamic division of labor between product/services companies and technology specialists in a context of high market fragmentation.

The ubiquitous tendency since the late 1990s to move ever-increasing volumes and types of data into ever-more distributed IT networks, have given rise to new forms of security breaches, which again have paved the way for new waves of security innovations (including anti-phishing, anti-spam, anti-spyware and various forms of biometrics). As employees and consumers increasingly operate from mobile devices (notebooks, tablets, smartphones) that were initially without the same safeguards as desktops, innovative endeavors have increasingly addressed security measures for these devices (Morgan Keegan, 2006).
5.4 Trajectories of Convergence Through Product-Bundling Innovation

The many and diverse products associated with product market formation were more or less complementary—sometimes with overlapping, sometimes with potentially synergistic features. In the early years, linking these products to form interoperable systems was either not attempted, or left to the IT departments of the customers, and assisted by security services firms that appeared in large numbers. For a time, competition was confined within narrow product markets. Only gradually did the specialized security vendors, together with their corporate customers and assisting services firms, accumulate precise knowledge of the complementary and synergistic prospects of the different products hence of opportunities for systemic innovation that would require a different pattern of open innovation than the one prevailing in the early stage. The trajectory of product-bundling innovation was initiated by a small group of security specialists, who over a few years transformed themselves into large security integrators.

The first steps were taken by Networks Associates (now McAfee) and AXENT Technology, which through numerous acquisitions developed a broad portfolio of security products. Both companies launched the first product suites (bundles) around 1998/99, but they were not well received by the market (Wall Street Transcript, April 23, 2001). Like the two first-movers, Symantec had acquired numerous security specialist firms during the late 1990s. In 2000 the company also acquired AXENT Technology enabling it to make a profound relaunch of product suites. Over the few years of acquisition-based growth and early trials in systemic innovation, Symantec expanded its core capabilities in numerous security technologies and products and also built powerful distribution assets and brand recognition. By 2004 Symantec was recognized as the leading product suite vendor in IT security. Several other specialized security companies, including Internet Security Systems (ISS), likewise embarked on product-bundling strategies (SG Cowen & Co., November 18, 2004, p. 24; Christensen, 2011).

Product suites evolved to include all or most of the following products: firewalls, VPN, Intrusion Detection, antivirus, content filtering, anti-spam and privacy control systems (Wall Street Transcript, June 2, 2004c). Also, the emergence of managed security services during these years reflects a move towards integrated solutions. Security managers like Counterpane and Cybertrust delivered unified operations, maintenance and updating of their customers’ security systems.

Such converged solutions responded to the rapidly expanding complexity for the customer in dealing with the ongoing add-on budding of new products and services and associated increases in security costs. The value proposition of the new solutions was clear: overall reduced costs and simplification for the
user in terms of implementation, multi-functionality, management, and (more or less) one-stop shopping. The professional customer, however, would face the potential disadvantage of being locked into a single vendor offering one or more weak functionalities in the package. The alternative would be to shop for autonomous products to get the best products for each specific function, in industry jargon “best-of-breed strategy.” However, the disadvantage of this strategy was the high costs incurred by the need to develop in-house expertise in searching, reviewing, selecting, negotiating, and contracting with the “best” vendors in different product categories, as well as the costs of integrating and managing the products to operate as one system.

By 2004 the best-of-breed strategy had primarily survived in some high-end segments such as in the military and financial sectors with a high-risk profile (Wall Street Transcript, April 26, 2004a, and May 19, 2004b). Companies like Counterpane (managed security services) or CipherTrust (messaging security), for example, had positioned themselves as among the best in their respective product markets. By far the largest share of the overall market—the mid- and low-end segments—was controlled by security integrators providing product suites, while specialized providers of autonomous products maintained strong positions in parts of the high-end segment.

The pattern of open innovation took a different course during this transformation. While technology in-licensing was an important way for new entrants to gain a foothold in specialized product markets, acquisitions of firms became a dominant lever for incumbents engaging in product-bundling. They not only needed access to technologies but also to the particular market knowledge and business models associated with the unfamiliar product markets to be integrated. Therefore firm acquisitions became a key means for realizing product-bundling opportunities.

5.5 Trajectories of Convergence through Context-Embedding Innovation

Convergence through product-bundling contributed to drive the highly fragmented security sector or ecosystem in the direction of a unified (even if still fragmented) industry in which leading firms began to compete against each other with rivalling product suites. By contrast, the trajectory of convergence through context-embedding innovation contributed to undermine this “unification” process because security in this trajectory became embedded features of other offerings (IT networks and platforms) rather than dedicated security products with business opportunities in their own right (Morgan Stanley, January 5, 2005). Both convergence tracks responded to user needs for reduced complexity associated with the surge of autonomous products.
Obviously private users want simple solutions that are practically invisible. But also professional users prefer reduced complexity. “They are looking for plug and play appliances that require little installation expertise and hence are less prone to configuration errors—especially for offices with little to no on-site security staff” (Morgan Keegan, July 21, 2006). Context-embedding innovation gained momentum around 2000 and subsequent years. It signified a tendency for security to become built into every layer of the IT infrastructure, from the network up through the application. The agents driving this trajectory were incumbents in established industries, especially network and systems vendors and Internet service providers. Two of the most prominent examples were Cisco and Microsoft, whose security strategies are briefly outlined below.8

Cisco, with its strength in network equipment (especially routers, switches, and dial up access servers), early on took an offensive stance in providing security at the networks level. From 1995 to January 2005, Cisco acquired ten security firms, primarily specialists with autonomous products across a broad spectrum of IT security. This made it possible for Cisco to introduce an increasing number of network-embedded security offerings (e.g. firewall, VPN, and Intrusion Prevention functionalities).9

Microsoft began actively to engage in IT security around 2002. This happened against the background of increasing vulnerabilities in operative systems. Microsoft’s response was to implement more secure coding standards and design more inherently secure software using threat-modelling, filtering, and penetration testing. In addition, Microsoft began to integrate security functionalities into its systems.10 Key to this endeavor was the acquisitions of three security firms, GeCAD (2003), a small Romanian anti-virus company, Giant Company Software (2004), an anti-spyware firm, and Sybari (2005), an anti-virus and data protection specialist. Specialized security knowledge from these firms was applied in the OneCare subscription service, aligning anti-virus (based on the GeCAD technology), anti-spyware (based on technology from Giant Company Software), firewall protection and PC cleanup tools to Windows private users. Microsoft’s security strategy during this period was to offer users basic security and to enhance user convenience by providing security systems that were simple to use and with automated updating. By 2004, Microsoft also began to emphasize the creation of partnerships with security vendors, networking companies, and Internet service providers (Morgan Stanley, 2005; Morgan Keegan, 2006; SG Cowen & Co, 2004). Thus, several of Microsoft’s competitors (i.e. in firewalls, anti-virus, and anti-spyware) also became partners, invited to build extended security solutions on Microsoft platforms and services for users with more specialized security needs.11

Even if the two convergence trajectories identified in this case reflects rival strategies (e.g. bringing Symantec into competition with Microsoft), they also represented a division of labor in terms of product specialization and
market orientation, making it possible for both trajectories to run in parallel, rather than having one fully replace the other (e.g. Symantec also became a Microsoft partner).

Like the case in product-bundling convergence, the acquisition strategy in context-embedding convergence signified that the pioneering firms not only needed to have access to unfamiliar technologies but also to the broader market knowledge of the acquired firms.

5.6 TOWARDS A FRAMEWORK OF CONVERGENCE-BASED BUSINESS DYNAMICS

IT security is not an industry, hence cannot be explained by industry-bounded frameworks. IT security must instead be understood as a collection of complementary product markets and adjacent industries with changing boundaries shaping the context for convergence and divergence dynamics.

During the pioneering phase of the IT security in the 1980s and into the 1990s, business dynamics were driven by innovative start-ups targeted at autonomous products to cover an expanding array of security holes of IT systems (here and in the following we use the term product to also refer to specialized services). Competition was segmented within narrow product markets. According to the PLC and ILC models, one would predict that each product market (e.g. firewalls, anti-virus) would undergo a stage of design rivalry, resulting in a dominant design, paving the way for an era of incremental innovation and the build-up of operations, distribution, and marketing systems necessary to establish and sustain mass markets. Indeed, we can trace such dynamics in the trajectories of product market formation. Within each product market, different solutions were tried out, one or a few designs came to prevail in the market, their underlying technologies were stabilized, and a few successful companies managed to bring these designs into leading positions for mainstream markets. Product market formation was dominated by small entrants often using technology in-licensing as a key means of innovating their products. Other firms specialized in developing security technologies and gained their revenues from out-licensing these to product firms.

However, when the products approached the stage of dominant design and shakeout, the rules of the game changed in the direction of convergence. This first materialized in product-bundling innovation, and subsequently, with a time-lag of a few years, in context-embedding innovation—proliferations of cycles that are not accounted for in the PLC and ILC models. During that transformation, many specialized firms exited or were acquired by a smaller group of “integrators” taking the driver’s seat in shaping these trajectories. During the period 1993–2005, we registered 291 acquisitions of IT security
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firms (Christensen, 2011). By far the largest share was specialized security firms taken over by product-bundling security integrators, or, especially after the turn of the millennium, by large network and systems vendors. By gaining control over requirements for adaptations at the specialized product level of expertise, these acquiring firms became better able to address the particular challenges of boundary-crossing innovation.

Although the early stages of segmentation and stabilization around dominant designs along the PLC can be identified in early security product markets, the subsequent dynamics became dominated by convergence across product markets. Likewise, while a stage of radical product innovation and experimentation along the ILC can be traced in each of the product markets, the subsequent dynamics after the settlement of a dominant design became driven by systemic innovation, reflecting convergence across rather than process innovation within product markets. In order to conduct such systemic innovation, a radical form of in-bound open innovation was needed, namely acquisitions of specialized firms—sometimes supplemented by technology licensing.

Despite the dominance of convergence, the specialized product markets tended to live on. But rather than continuing into the mature stages of the PLC/ILC implying scale-intensive provision of commodities, they positioned themselves towards high-end niche markets while the vendors of converged products came to lead mainstream markets.

In order to understand business dynamics characterized by convergence and radical requirements for open innovation, we need a conception of the business environment that goes beyond the classical industry conception, and we need a theory that specifies the contingencies under which convergence and divergence come to reside.

5.7 A THREE-PRONGED CONCEPTION OF THE BUSINESS ENVIRONMENT: ECOSYSTEMS, PRODUCT MARKETS, AND INDUSTRIES

In recent strategy literature the notion of “industry” as the organizing context for business strategies and innovation practices has increasingly been replaced by the more open-ended concept of business or innovation “ecosystems” (Adner, 2006; Iansiti & Levien, 2004a; Moore, 1996; Teece, 2007). Teece (2007, p. 1325) defines business ecosystems as “…the community of organizations, institutions, and individuals that impact the enterprise and the enterprise’s customers and suppliers.” Adner (2006, p. 98) defines innovation ecosystems as “…the collaborative arrangements through which firms combine their individual offerings into a coherent, customer-facing solution.” Compared to the classical industry concept, the ecosystem implies a more rich and flexible
understanding of the business environment and two analytical “turnarounds.” First, while the industry view tends to emphasize the exogenous state of the environment that firms should take for given and adapt to, the ecosystems view underscores the symbiotic and co-evolving relationship between the strategies and innovations of firms and their business environment. This view sometimes leans towards the “endogenous” position that proactive firms contribute to shape the business environment, rather than reactively being shaped by it. Secondly, while the industry view in Five Forces exclusively addresses the competitive bargaining game, the “ecosystems” view addresses complementarities and associated collaborative arrangements.

In order to more fully understand the environmental side of the dynamics of convergence or divergence, we must consider both the competitive and the collaborative arenas. Thus, we cannot simply replace the industry concept with the ecosystem concept. However, the competitive arena needs a differentiated typology of concepts (see Figure 5.1) that, unlike the industry concept, does not assume robust boundaries and long life cycles. Therefore we use the term “product market” to signify the emergent context for competition among firms with identical or similar categories of specialized products. A product market may evolve along the PLC/ILC, hence eventually prove to become a “real” industry, or it may undergo more or less frequent and concurrent dynamics of convergence or divergence. Or it may eventually vanish. Thus, while “product market” here denotes the emergent context for product-specific rivalry, the term “industry” refers to mature product markets reflecting well-established patterns of competition and typically dominated by large incumbents. Like product markets, industries may also be subject to convergence (e.g. the convergence of the cell phone and the camera industry) and divergence (e.g. the widespread outsourcing of services and components in many industries). Finally, we use the concept of “ecosystem” to address the evolving collaborative context for product market or industry convergence or divergence. In this sense IT security constitutes an ecosystem of evolving clusters of complementary product and technology markets among which convergence may take place.

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<th>Nature of inter-firm business relations</th>
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Figure 5.1 Conceptions of business environment
From both a theoretical and managerial perspective, there are advantages gained from using this three-pronged conception of the business environment. Theoretically, the combined use of these concepts provides complementary lenses for analyzing business dynamics associated with, respectively, rivalry (the product market, the industry) and coordination (the ecosystem). The realization of convergence prospects within an ecosystem implies the creation of integrated product markets forming new bases for competition. The realization of divergence prospects within a product market or an industry implies the creation of specialized (sub-) markets and new coordination requirements between these and the residual players in the original product market or industry.

From a management perspective, this conceptualization can contribute to a more adequate understanding of the context for what we may term Open Business Dynamics. It provides a systematic way of specifying the arena for both competition and coordination, whether addressing firms in emergent product (sub-) markets or in mature industries. It offers an analytical perspective on strategically thinking ahead of current competition and collaboration and out-of-the-box, that is, across the boundaries of current product markets and industries. Finally, it offers an industrial dynamics perspective for explaining changing patterns of open (and less open) innovation.

5.7.1 The Concepts of Convergence and Divergence

Convergence is here defined as the process of full or partial integration of two or more product markets or industries that were previously not interconnected through competitor or supplier relations. This means that some firms begin to integrate product functionalities from their own product market or industry with those of others through systemic product innovation and subsequent production and sales of converged products. Such “producer-based” convergence gives rise to new forms of “user convergence,” that is, opportunities for joint use of the constituent product functionalities. The prototypical case of convergence is that taking place over the last couple of decades across the broad array of computer and telecom product markets and industries (Yoffie, 1996).

Divergence refers to the reverse process of full or partial disintegration of one product market or industry into one or more new specialized product markets or submarkets. This means that some firms carve out a market by specializing in the provision of functionalities that were previously developed and produced as an integrated part of a product or system. The evolution of the PC industry provides a widely studied example of divergence. Another example is the emergence of a specialized submarket providing class D digital amplifiers (or components) replacing class A/B amplifiers that were (and to some extent still are) integrated by incumbents in the consumer electronics industry.
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Dynamics of divergence has been widely researched under the headings of outsourcing and vertical disintegration of large companies (Langlois, 2003). In recent years, convergence and divergence have in particular been studied in regard to software-based dynamics under themes such as platform strategy and the integration of “complementor” products or applications. Such applications may originally constitute end-product markets comprising specialist vendors with no concern for user convergence as we have witnessed in the IT security case. Alternatively, application vendors may from the beginning be “complementors” providing their products as dedicated to and sold via a platform controlled by a platform leader. For users of the particular platform, this assures a basic level of user convergence without producer-based convergence. One example is TomTom’s early provision of applications (e.g. personal financial planners, cooking guides, and eventually route navigation) to become embedded in and sold via a PDA (Personal Digital Assistant) platform like Psion or Palm Pilot. A higher level of user convergence may be obtained through innovation strategies that pursue synergistic features between particular applications. This requires the co-specialization of these applications so that they can “speak together” and obtain added functionalities beyond being accessible as autonomous products in a platform. Thus, for example, the camera functionality in a smart phone gains added value because the photo’s exact location can be determined by the GPS facility and be uploaded through the phone and sent directly to friends or an archive. If successful, this strategy may threaten the existence of independent product markets. For example, Microsoft’s integration of word processing with its Office package has to a large extent eliminated a distinctive word processor market. But perhaps more commonly, converged and stand-alone products may co-exist for extended periods. In IT security converged products did not eliminate autonomous products, but constrained their growth and relegated them to niche positions. Likewise, smartphones with embedded camera functionalities did not eliminate the camera industry but reduced the size of its mass consumer segments as reflected in the recent collapse of Kodak.

Converged products for centrally controlled platforms may eventually undergo divergence resulting in the formation of numerous more or less distinctive markets. The divergence of the IBM PC platform is the most well-known example. Another example relates to GPS-based route navigation. In the 1990s, navigation became embedded either in the telematics platforms of automobile manufacturers or in PDA platforms. However, they suffered from performance flaws from being integrated into overtly complex automotive systems or crammed into low-powered, small PDAs. In the early years of the new millennium, Garmin and TomTom pioneered radical divergence strategies implying the creation of stand-alone navigation products that did not suffer from the deficiencies in the previous contexts. They could be easily
mounted on any car and more easily upgraded than was previously possible. This became a thriving product market for a few years until it was severely constrained due to a new wave of context-embedding convergence—this time linked to smart phones with navigation functionalities offered by, among others, Google and Apple.

5.7.2 Towards a Theory of Convergence and Divergence

Which are the contingencies or generative mechanisms that can explain the dynamics of convergence and divergence? In the following we shall first compare the economic mechanisms driving product markets into the shake-out and mature stages of the PLC/ILC with those driving product markets into convergence. Thereafter, we compare the economic drivers of convergence and divergence.

In the PLC/ILC model, the mechanism driving new product markets into the shakeout stage is process innovation that leads to substantial reduction in cost of production. Since the value of cost reductions is proportional to the volume of production, larger firms profit more from process innovation than smaller firms (Klepper, 1996, p. 565). As some firms grow and benefit from process innovation, industry prices are pushed down with the result that smaller firms are forced out of business (“shake-out”) and entry barriers are increased (Klepper, 1997, p. 151). On this background two key factors can explain non-PLC/ILC dynamics. One is lack of or weak opportunities for scale economies through process innovations. Such a context is prevalent in software and many knowledge-intensive service sectors, including IT security. The other factor is that major product innovation may disrupt existing PLC/ILC and shape new patterns of development. This is a well-known phenomenon in contexts such as biotechnology, in which the nature and boundaries of products are less fixed at an early stage.

What then drives some product markets away from the PLC/ILC track towards convergence? We contend that a convergence trajectory is triggered when prospects for economies of scope19 or synergy through product and technology integration across product markets or industries are perceived as higher than prospects for economies of scale or other specialization economies within the individual product markets. While economies of scope refer to cost advantages from joint development, production, sales etc., synergistic economies refer to added value from converged devices as compared to the value from stand-alone devices. While process innovation in the PLC/ILC track gives rise to scale economies, shakeout and lower entry, systemic product innovation in the convergence track—implying radical forms of open innovation—gives rise to disruption of the life cycle dynamics within the constituent product markets and to economies of scope and/or synergies. These economies are likely
to be captured by those few first-movers that mobilize the boundary-crossing resources for systemic and open innovation and for integrative business development. This is especially likely to be the case if they not only have innovative assets, but also build strong commercial assets that can shape mass markets for their systemic innovations (Christensen, 1995; Teece, 1986). In manufacturing domains, commercial assets involve scale-intensive production systems, while in software and service domains they are rather linked to sales, distribution, and services, as well as marketing and branding. Even if this convergence process does not involve a shakeout in the same sense as implied by the PLC, the outcome, namely the dominance by few firms, remains the same.

Three empirical factors have contributed to create a tendency for new product markets to eventually converge rather than remain on the PLC/ILC track.

First, the central driver of the PLC/ILC, scale economies through process innovation, is especially prevalent in manufacturing sectors that account for a decreasing share of the national economies in the rich part of the world, while it is less prevalent in software and many service sectors that represent an increasing share of these economies (Möller et al., 2008). Second, the opportunities for interlinking functionalities of different products have significantly improved as a consequence of advancements in information and communication technologies and digitization of an increasing array of products. In particular, software-based interface systems have made the interlinking of such products technically feasible and increasingly cost-effective.

However, there is more to convergence than the interlinking of products by means of interface technologies. Convergence also involves the alignment of in-depth knowledge of each of the converging product markets, product functionalities and core technologies. Since most firms that engage in convergence initially only have deep knowledge of one product market, namely their own, they will need access to core knowledge from “the other side.” The third factor that has enhanced the tendency for product market convergence is the improved effectiveness of markets for M&As, technology and ideas. M&As and technology licensing have become widely used tools for gaining access to complementary knowledge, hence for realizing convergence strategies. Both are management tools for open innovation, even if the post-acquisition and licensing innovation activities take place in-house. More broadly, we can also assume that convergence strategies have been accommodated by the growing experience that many firms have obtained in open innovation management beyond technology licensing and M&As.

We can hypothesize that convergence is more likely to be initiated via an M&A process than through internal development or technology licensing when two conditions apply. The first is that the competencies underlying the two (or more) converging product markets are highly dissimilar. The second condition is that the supply of small (affordable) firms in the complementary market is abundant, and this condition is more likely to exist in emerging...
product markets than in established industries. Technology licensing may especially drive or supplement convergence if the initiating firm needs access to a core technology that is patent-protected by another firm willing to out-license this technology. Technology licensing may also be relatively more attractive if no feasible opportunities for M&As exist. In the IT security case we have seen that technology licensing has played a significant role in enhancing entry of new firms into a diversity of product markets.

What then can explain the reverse dynamics of divergence? We contend that a divergence trajectory will be triggered when prospects for specialization economies, including scale economies and technological differentiation opportunities within component-based submarkets (e.g. microprocessors for PCs) or diverged markets (e.g. TomTom's navigation devices) become perceived as higher than economies of scope and synergy. Divergence may result from two partially interrelated processes, the weakening of scope or synergistic economies, and the enhancing of specialization economies. The former will take place when interfaces between components, reflecting relevant user functionalities, become subject to standardized modularity and accessible by other firms than the ones who created the interfaces. This may happen as a non-voluntary “natural” process of standardization, simplification and increasing opportunities for replication of what may originally have been proprietary standards (Chesbrough & Kusonoki, 2001). Or it may reflect a strategic decision to create open standards (Sanchez, 2008). Once interfaces have become standardized and open, specialization economies can more easily be accommodated especially when the “diverged” component/product possesses opportunities for high growth, scale economies, and radical technological progress. Large platform providers may open up access to such interface standards in order to stimulate innovation on their platforms. This creates scope for specialized innovators that may be less open in terms of their core technologies while being open in terms of cooperating with platform leaders.

5.7.3 A Convergence Life Cycle

Convergence and divergence can be depicted as alternative cyclical patterns to the PLC/ILC. We term such patterns the Convergence Life Cycle (CLC). In Figure 5.2 the conventional PLC/ILC and the new CLC are integrated into a unified framework. On the vertical axis it specifies three “life cycle” stages along a convergence/divergence track: Product market/industry formation, convergence, and divergence. The horizontal axis distinguishes two units of analysis or the key stages in the PLC/ILC: The emergent product market reflecting the embryonic stage, and the established industry reflecting the shake-out and mature stages. The CLC is illustrated as the movement from the top towards the bottom as a product market or an industry evolves, merges
with other product markets or industries, and in turn, diverges into more specialized submarkets.

Product market formation (upper left box) involves the creation and commercialization of genuinely new products corresponding to the embryonic stage in the PLC/ILC. At this stage it is uncertain whether the product market will move into the subsequent stages of the PLC/ILC to form an industry (the arrow pointing into the upper right box), move into some convergence or divergence track—or eventually vanish.

Convergence is likely to be pursued under the economic and technological conditions discussed above. It takes place within an ecosystem that catalyzes opportunities for systemic innovation of converged products, hence the creation of new integrative product markets. Convergence may be driven by product market players, typically smaller firms (mid left box in Figure 5.2), or by larger industry incumbents (mid right box). As witnessed in the IT security case, convergence was initially driven by younger firms pursuing product bundling strategies. However, later on the initiative was taken over by incumbents in established industries seeking to embed products from distinctive product markets into their platforms. In other industrial domains we have witnessed product bundling taking place across already established industries, for instance the camera and the mobile phone industry. Divergence (the low row in Figure 5.2) implies the narrowing of the scope of product markets or industries and the resultant formation of new specialized product markets.
Markets that are born out of divergence may again signal the beginning of a new PLC/ILC or CLC. The CLC framework does not assume a fixed sequentiality of stages in industrial evolution. It is a contingency framework and a taxonomy for understanding various options for trajectories of product life or convergence/divergence cycles, rather than a model that assumes one universal pattern of evolution. As such, it can be operationalized for particular firms in particular markets as a framework for strategic management and innovation strategy.

CONCLUSION

For three decades strategic management has been strongly influenced by an industry-bounded paradigm associated with the Five Forces framework, the PLC, and the ILC. While this paradigm remains effective in explaining business dynamics in some fields, its scope of relevance has been substantially reduced due to the increasing prevalence of convergence and divergence and the underlying patterns of open innovation.

This chapter has presented a framework for understanding business dynamics that do not behave according to the industry-bounded paradigm. It contributes to scholarly and managerial work on strategic management and business dynamics in three ways. First, it offers a systematic way of analyzing boundary-crossing business dynamics. Second, it offers a taxonomy of industrial arenas reflecting the need to align arenas for competition (product markets and industries) and arenas for convergence (ecosystems). Third, it offers a contingency theory explaining “life cycles” that do not follow the classical prescriptions of the PLC/ILC but “derail” into convergence or divergence.

We argue that three factors have contributed to make convergence a more frequent and “patterned” phenomenon: 1) The decreasing importance of radical process innovation that is critical to the PLC/ILC, 2) the digitization of ever more products making interlinking of products increasingly feasible and cost-effective, and 3) the improved effectiveness of markets for M&A and technologies making external acquisition of even very dissimilar complementary knowledge easier and less costly. The increasing significance of convergence and divergence has implied increasing needs for firms to engage in these and other practices of open innovation. However, the competence-building in open innovation practices more generally over recent decades has most likely also contributed to further reinforce trends and opportunities for convergence and divergence.

Thus, the framework provides a contextual complement to the open innovation perspective. In a business world that is characterized by convergence and divergence, firms are faced with challenges of crossing existing boundaries,
collaborating and competing with unfamiliar enterprises, institutions and knowledge domains, and these challenges require increasing capacities within and across firms to mobilize open and collaborative modes of managing innovation.

The proposed framework also throws light on the relationship between open innovation and dynamic capabilities (Teece, 2007) in the context of convergence. In the IT security case a few firms exercised dynamic capabilities, involving fairly dramatic features of open innovation, by changing their identity from being innovators within a single-product market to becoming convergence-oriented product-bundling innovators. This transformation required a commitment to move beyond product-specific core capabilities through a series of acquisitions of firms and technologies, a consistent engagement in systemic innovation, and the leveraging of commercial assets for brand-building and large-scale marketing and distribution. Through this diverse set of long-term investments, companies like Symantec and ISS managed to expand from specialized niche positions into broader positions as providers of product suites. Other kinds of dynamic capability were practiced by incumbents in established industries driving context-embedding systemic innovation. Their core competencies were grounded in other fields than IT security, but they were determined to build integrative competencies (Christensen, 2006), including capacities for systems integration, platform development, and complementary assets in distribution, marketing, and brand-building for mainstream markets. Context-embedding innovation aligned infrastructural knowledge situated in these firms with specialized knowledge of security products and technologies.

The firms driving the convergence trajectories in IT security demonstrated commitment to build Dynamic Capabilities by transcending existing boundaries and engaging in new challenges of systemic innovation and market creation. On the innovation side, this has involved an intricate balance and change between exercising different forms of open and more closed innovation. These firms’ engagement in acquisition-based integration of specialized security knowledge initially reflects an Open Innovation practice in the form of searching, accessing, and acquiring specialized knowledge from external sources. But it also reflects the need for substantial in-house control over the subsequent innovation process—in other words the need to practice a more integral form of managing innovation.

Innovation research on other sectors has demonstrated that the need for in-house coordination of innovation is likely to decrease over time as interfaces across components/technologies become standardized, hence more ready for modularity and distributed forms of innovation (Chesbrough & Kusonoki, 2001, and Brusoni et al., 2001). This triggers a process of divergence creating new opportunities for specialist firms. During the last year of our investigation of IT security (2004), the leading drivers of context-embedding
innovation had begun to encourage partnering strategies with IT security specialists indicating that the previous integral mode of managing systemic innovation was beginning to give way to a new form of open innovation that would rely more on partnership and outsourcing than on acquisitions and technology licensing.24

This chapter points towards a new paradigm of open business dynamics, not to replace but to supplement the hitherto dominant industry-bounded paradigm. The dynamics of open (and more closed) innovation seems to be closely linked to dynamics of open (and more confined) business dynamics. However, just as open innovation has become more prevalent than stable and introvert modes of innovation, open business dynamics have become more prevalent than stable industry-confined dynamics. And for both, the role of markets for firms (M&As), technologies, and more broadly ideas, have become crucial. Future research should address the relationship between open business dynamics and open innovation and in particular the trade-offs between using markets for technology and markets for firms (M&As) as a means of mobilizing outside-in knowledge flows in different stages of industrial dynamics, whether associated with the classical PLC/ILC, or with processes of convergence and divergence.

NOTES

1. The innovation life cycle was pioneered by Abernathy and Utterback in the 1970s and later further developed by Utterback and other scholars of innovation. See in particular W. J. Abernathy and J. M. Utterback (1978), P. Anderson, and M. L. Tushman (1990).

2. Mounting empirical research has over the last decade demonstrated that the classical life cycle models do not explain the evolution of a large and increasing number of industries. See S. Klepper (1997), F. Malerba, L. Orsenigo, A. Fosfuri and M. Giarratana (2007), and A. Bergek et al. (2008).

3. Business dynamics are also increasingly characterized by tendencies for convergence across technological paradigms (see D. J. Teece, 2008), an issue that will not be addressed in this chapter.


5. For a statistical account of the increasing product markets fragmentation of IT security, see Gambardella and Giarratana (2007). For empirical evidence of the innovative improvements of security products, see Christensen (2011).

6. One example is Certicom's invention of elliptic curve cryptography, see Arora and Nandkumar (2007).

7. Over time, complexity has not only become untenable to manage even for the most professional customers, it has also directly contributed to aggravate security vulnerabilities as it leads to flaws in technical systems coherence, and to configuration weaknesses in systems and applications.
8. Apart from the written sources referred to, these case vignettes are based on interviews with Kim Mikkelsen (Chief Security Advisor, Microsoft Denmark).

9. While Cisco was a pioneer and leader in network-based security, it was not the only one. Juniper Networks, a leading Internet backbone provider, and 3Com, a leading network hardware supplier, likewise engaged, via large acquisitions of security specialists in building IT security functionalities into the network (Morgan Stanley, 2005).

10. In 2004, Microsoft released Service Pack 2 for Windows XP marking improvements in the security of the underlying software (Selzer, 2006).

11. In 2009, Microsoft announced the exit of the OneCare service implying an exit from paid consumer security. According to Hallawell et al. (2009), this step signified the difficulties Microsoft had in positioning this service against offerings from dedicated security vendors. OneCare was replaced by a free consumer anti-virus and anti-spyware offering which eventually contributed to spur the competition to increasingly offer free security products.

12. For an analysis of this perspective on the business environment (even if the term ecosystem is not used), see Pisano and Teece (2007). For a more explicit management perspective, see Adner (2006).

13. This notion of industry is close to the one Porter (1983) uses when exemplifying his Five Forces framework.

14. We do not pretend to monopolize the definition of ecosystem, only to specify the key aspects of relevance for understanding business dynamics that are not industry-confined. To be useful for management, a more rich and firm-specific operationalization is needed, see Iansiti and Levien (2004a).

15. User-based convergence may also take place in the absence of producer-based convergence. This may take two forms. First, coordination between producers of different products with respect to standardization of modular systems and interfaces may make user-based convergence easy and cheap without direct producer-based convergence (see R. Sanchez, 2008). Second, the users themselves may incur the development costs to make possible integrated use of two products provided by firms in different product markets or industries without producer-based efforts to make such integration feasible. In particular in the early stages of the IT security sector, producer-based convergence was often predated by user-based integration attempts.

16. For an overview see Iansiti and Levien (2004a).

17. For central contributions to platform analysis from a management perspective, see Eisenman (2008) and Gawer and Cusumano (2002).


19. Economies of scope implies a reduction in costs associated with integrated or coordinated production, development, marketing, and advertising of two or more products (spreading fixed costs across more product markets). This may give rise to new opportunities for revenue through selling complementary products as converged devices, bundled packages or platform-embedded systems to the same customers. Customers may experience benefits from “one-stop shopping,” from
reduced interoperability problems and user training costs (see Cottrell and Nault, 2004; Tanriverdi and Lee, 2008).

20. “Core technology” is here used in contrast to “interface technology” to signify a product’s or a component’s central internal (“inside-the-box”) technology.

21. We here assume that no modular and open (non-proprietary) standard interfaces exist across the product markets prior to the initiation of a convergence process. If open standard interfaces exist or are shaped ex ante, the alignment of product markets can take place as autonomous market processes by producers or customers “mixing and matching” diverse products/components without needing to have deep knowledge of each of the two products (Sanchez, 2008). This would thus make user-based convergence possible without further producer-based convergence, and at the same time allow for a range of divergence processes to evolve.

22. With respect to M&As, see Cantwell and Santangelo (2006) and Colombo and P. Garrone (2006). With respect to markets for technology, see Arora et al. (2001a); Davis (2008), and Lichtenhaler (2007).

23. The market for ideas is increasingly provided by such platforms as Innocentive aligning “innovation seekers” and “innovation solvers.”

24. For another example see Grunwald and Kieser (2007).