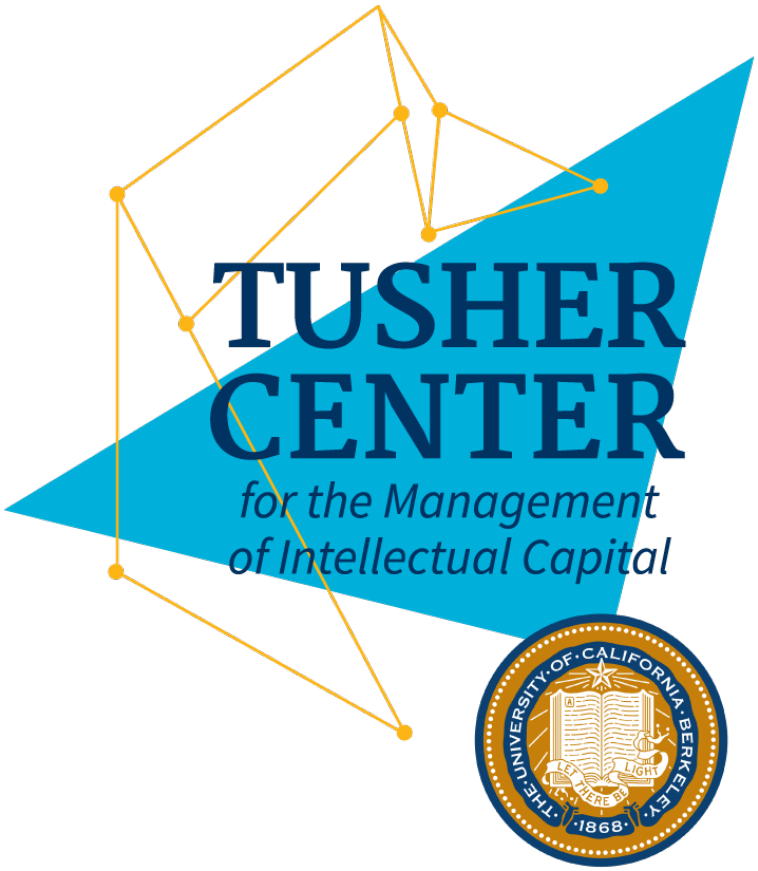

Working Paper Series No. 17

Dynamic Capabilities and (Digital) Platform Lifecycles

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5 December 2017

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Table of Contents

I. Introduction

Most of us still revert to the word "industry" when we think of groups of firms performing similar activities and competing or cooperating with each other. While this concept has a certain appeal, and lives on in official statistics, it is less and less aligned with the way firms think about themselves.

In the digital economy, firms see their role less in industries and more in business ecosystems. Business ecosystems are made up of organizations and customers working together to create and sustain markets and products. The coevolution of the system is typically reliant on the technological leadership of one or two firms that provide a platform around which other system members, providing inputs and complementary goods, align their investments and strategies. Some ecosystems may involve multiple platforms at different levels of the value chain.

A platform provides common standards, interfaces, and tools to leverage core technologies in order to increase the productivity and profitability of a company, a set of companies, or users. The term was initially used in relation to internal product platforms such as automobile chassis or unit-bodies, which permitted multiple products to be generated around the same basic inputs (Robertson and Ulrich, 1998). The definition was then expanded to apply to settings where one company provides a hub that other companies utilize in their own businesses (Gawer and Cusumano, 2002). More recently, it has

been applied to N-sided market infrastructure that connects buyers and suppliers (Iansiti and Levien, 2004). All these uses remain relevant (Gawer, 2014).

In the wake of the notable success by new economy firms such as Ebay, Uber, and Airbnb, the focus of platform studies has increasingly been on internet-based, multi-sided markets (Parker, Van Alstyne, and Choudary, 2016). However, many firms today are concerned more with attempting to position themselves as a hub within a new or existing ecosystem, and it is this broader platform concept that will be used in this chapter.

A strategic management approach that has emerged in roughly the same time frame as the platform construct is the dynamic capabilities framework (Teece, Pisano, and Shuen, 1997).[2] Dynamic capabilities are the firm's ability to integrate, build and reconfigure internal and external resources (including the firm's ordinary capabilities) to address and shape changing business environments. All firms, especially those in Silicon Valley, perform these activities to some degree. Firms with strong dynamic capabilities do so very well and consistently. Dynamic capabilities can be weakened through poor diagnosis of competitive opportunities and vulnerabilities, neglect, thoughtless restructuring, and many other management missteps.

Dynamic capabilities are relevant for the management of platforms and their associated ecosystems because platforms have their own dynamics, and the constituent elements must respond to changes in the business environment. Anticipating changes, adjusting business models, and aligning complementarities are among the activities encompassed in the dynamic capabilities toolkit to sustain platform viability.

Dynamic capabilities are not just about making the right bets; they also drive the execution of those bets. This includes the development of new products and processes that sustain competitive fitness as markets evolve.

The chapter begins with brief reviews of the capabilities approach to strategic management and the dual concepts of platforms and ecosystems. The main section of the chapter introduces the platform lifecycle and the roles that different dynamic capabilities play in each of the four phases. A short conclusion discusses avenues for future research.

II. Capabilities: Ordinary and Dynamic

A capability is a set of activities that enable an organization to produce a particular outcome. Ordinary capabilities are rooted in the skills that engineering and business schools have historically taught in support of greater productive efficiency. However, a single-minded and relentless focus on efficiency

[2] Longer descriptions can be found in Teece (2007) and Teece (2014).

coupled with spreadsheet infatuation can destroy creativity and block necessary change. Incrementalism quickly becomes the norm.

The fact that ordinary capabilities can be taught and absorbed with a high degree of reliability undermines their potential as a source of competitive advantage, even though they may be critical for participating in the business. No matter the level of efficiency a firm achieves in a given activity or process, it is only a matter of time until a rival matches or exceeds it. Sometimes the delay can be decades, as in the case of the Toyota production system in the auto industry. But, in highly competitive environments, it is more often a matter of a few years at best.

More importantly, ordinary capabilities are how a firm executes and administers its current production plan. In sharp contrast, dynamic capabilities are forward-looking. Instead of governing what the firms is currently doing, they involve facing up to external and internal challenges and opportunities, deciding what the firm should be doing in the future, ensuring access to the resources the firm will need, and implementing the appropriate organizational design. Elsewhere, I have summarized these in the three categories of sensing, seizing, and transforming (Teece, 2007).

Whereas ordinary capabilities can usually be tuned to match industry best practices, dynamic capabilities are more idiosyncratic. This is partly because they involve managerial cognition (Adner and Helfat, 2003). But they are also embedded in organizational routines that are rooted in the company's culture and history (Teece, 2012). Companies with strong dynamic capabilities tend to have their own, unique "signature processes" (Gratton and Ghoshal, 2005). The history-bound (and often tacit) nature of these processes makes them difficult for rivals to imitate. Provided the advantages of this history don't become excess baggage (i.e., maladapted to a changed business environment), signature processes can provide a foundation for competitive advantage. The bulk of activities that make up an organization's dynamic capabilities cannot (and should not) be outsourced.

For dynamic capabilities to be strong, managers must be entrepreneurial (Teece, 2016). This means they must develop and test conjectures about emerging technological and marketplace trends, devise and refine new business models, make the necessary R&D and related investments, and creatively assemble and orchestrate the required assets inside and outside the organization. And this entrepreneurial approach must be infused throughout the enterprise.

Strong leadership is also critical, especially when difficult organizational changes need to be implemented or corporate culture has to be revamped. Leadership is particularly needed to propagate a vision, achieve unity of purpose, and produce consistency of action.

As mentioned earlier, strategy is not a direct outcome of dynamic capabilities. Dynamic capabilities, if strong, align the resources required for the chosen business model in congruence with the business environment and the demands of agile operation. It is then the task of strategy to specify in greater detail how the firm's assets will be deployed to implement its business model. Table 1 gives some examples of these differences.

In practice, however, the "strategy" label is often applied to dynamic capabilities. This should not be surprising because strategy and a dynamically capable organization are interdependent elements of a successful enterprise. This interdependence was implicit in a comment by Lou Gerstner when he was starting as CEO of IBM: "you have to be fast on your feet and adaptive or else a strategy is useless" (Sellers, 1993). The exercise of a firm's dynamic capabilities must be coupled with effective strategizing to bring about competitive advantage.

Table 1: Sample differences between dynamic capabilities and strategy

Dynamic Capabilities Questions	Strategy Questions
Which possible products are most likely to benefit from projected technology trends?	Which marketing channels will bring our product to the attention of its target audience?
Is our business model imitable?	How are our competitors likely to respond to our business model?
Which geographic markets will fit with our product and/or business model?	What is the best sequence for entering different markets?
How do we design and build the products of the future?	Should our R&D and product development be in-house or outsourced?

III. Platforms and Ecosystems

Platforms can take a variety of forms. For example, they might impact consumers directly, as in the case of smartphone operating systems; or they can be behind the scenes, like the software that a manufacturing company uses to coordinate and monitor its suppliers.

There are two basic types of digital platform, with numerous hybrid combinations (Evans and Gawer, 2016). A *transaction platform* facilitates exchanges by otherwise fragmented groups of consumers and/or firms. The paradigm here is eBay, which allows huge numbers of individual sellers and buyers located anywhere in the world to find one another with an ease that was previously unimaginable. Such platforms can have network effects, so that growth in the number of users further increases the platform's desirability. While digitization has enabled transaction platforms in a growing range of industries, this transactional type of platform is not entirely new. For example, the credit card industry has long provided a viable payment option that merchants will accept, that banks will join by issuing cards and processing transactions, and that cardholders find of value.

An *innovation platform*, by contrast, provides a base technology and distribution system to which other companies can add their own innovations, increasing the value for the system as a whole. Apple's "app" ecosystem is the paradigmatic example of this. Innovation platforms fit perfectly within the original Profiting From Innovation (PFI) framework, which emphasized the need to selectively access particular complements. While the relationship is less obvious in the case of transaction platforms, successful examples such as Amazon need to attract transactors (e.g., Amazon Marketplace vendors) in much the

same way that they must attract key partners (e.g., delivery services), by providing a sufficiently attractive platform whose participants will reach a critical mass of buyers and sellers.

Platforms are usually proprietary in that the technologies on which they are based are protected by patents or copyright, but they can differ in the extent to which other organizations are allowed to act as complementors. They may be completely closed to third-party access, which would be typical for a product platform meant only for in-house use. At the other extreme they can be open, like Facebook's open server standard that was released for use by other firms to stimulate complementary activities and lower prices. Many hybrid models are also used, such as Alphabet's Android operating system, which can be used and enveloped by smartphone firms but modified only by Alphabet. While openness adds the power of alliances, it often also reduces the opportunity for value capture through direct means. While Alphabet makes little or no money directly from the use of Android by phone makers, it captures significant value from advertisers and, increasingly, from consumers transacting within Android-based apps.

The level of vertical integration by the platform leader is an important variable. For example, while Google's Android platform is limited to software, Apple's iOS platform integrates the operating system tightly with Apple hardware like the iPhone and iPad. Vertical integration brings control and ownership of all rents at the expense of the accelerated innovation that an alliance built around modular technologies can often achieve since the various software and hardware elements able to evolve independently. A platform with a large number of ecosystem members may also be more attractive to users because it allows them to tap into a diverse array of complements and add-ons. On the other hand, modularity and a fragmented ecosystem without strong leadership can undermine the ability to generate systemic (or architectural) innovation (Teece, 1984; Henderson and Clark, 1990). This may account why Apple, a vertically integrated product development company, has excelled at creating breakthrough product innovations, while the fully modular ecosystem that has grown up around Google's Android OS has excelled at imitation and incremental innovation. While there are large and time-varying quality differences among handset competitors on the Android platform, Apple has maintained a leadership position at the high end of the market since the 2007 launch of the iPhone. By one estimate, Apple accounted for more than 90% of smartphone (operating) profits in the third quarter of 2016 (Sui, 2016).

Platform leaders take responsibility for guiding the ongoing technological evolution of the system (Gawer and Cusumano, 2002). Beyond innovating the underlying platform technology itself, the leader will establish some rules for ecosystem participation. There are simply too many potential conflicts to allow a completely self-organizing approach. The rules will typically benefit the hub firm in some way, such as ensuring a payment stream or the quality of the customer experience, but astute rules will strike a balance between self-enrichment and ecosystem attractiveness and vitality (Iansiti and Levien, 2004). In other words, creating and capturing value requires a mix of openness (to attract complementors) and control (to ensure a good user experience).

When one platform competes with others, adoption and commercial success is likely a function of which one can recruit the most (and the best) complementors. The firms in a successful ecosystem can

collectively dominate rival ecosystems, as in the case of the Microsoft Windows-based personal computer ecosystem that nearly eliminated Apple's Macintosh and its complementors in the 1990s. Ecosystem members will also continue to compete against each other horizontally, with this competition adding to the strength of the ecosystem as a whole.

With regard to capturing value, "[s]trategy becomes vastly more complex as firms consider dynamic interactions of a multi-layered ecosystem" (Parker and Van Alstyne, 2015: 5). This is not to say that firms considering ecosystem membership must commit exclusively to a single one. While this may be a technical or contractual part of the ecosystem design in certain cases, such as an exclusive distribution agreement by a content provider with a digital media outlet, it is often the case that a complementor (e.g., application software provider) can participate in multiple ecosystems (e.g., iOS and Android).

There are numerous ways in which a business ecosystem can be poorly managed. For example, Microsoft's tendency in the past to undermine independent application developers, by integrating their product features into its Windows operating system, discouraged developers and may have resulted in slower innovation in the Windows ecosystem. Similarly, when Twitter decided in 2012 to change the rules for its application programming interface to limit the ways that third parties could access its service, it undermined its relationship with the developers who had done so much to expand the service's user base. While such decisions make sense from the perspective of the platform owner's income statement, there may be ways to avoid entirely cutting out the affected partners, such as switching to a revenue sharing business model. The primary concern should be the health of the ecosystem, not the platform leader's short-term profits.

Some firms may be slow to recognize that they have even created an ecosystem which they need to orchestrate. When Syngenta introduced a strain of corn that was resistant to certain pests in 2010, it had obtained regulatory approvals in the United States and Latin America, but not in China (Bunge, 2014). This gave China the opportunity to block the import of the genetically modified grain in 2013 when it harvested a record domestic crop (Gullickson, 2014). The Syngenta-based corn was necessarily commingled with other corn on its way to market, so that non-modified and non-Syngenta (modified but China-approved) corn exports were also impacted. The resulting loss of trade disrupted the global corn market and reportedly cost U.S. exporters and farmers several billion dollars, leading to a lawsuit. The turmoil could potentially have been avoided if Syngenta had viewed itself not simply as a seed vendor but as the guarantor of an ecosystem based on its core technology (the genetically modified seed) to which its customers were adding incremental value.

IV. The Platform Lifecycle

Even a well-managed ecosystem will go through periods of competitive strength and weakness as external circumstances change, and these dynamics also need to be managed by the platform owner.

James F. Moore, credited with introducing the idea of the business ecosystem, described (1993) an ecosystem lifecycle consisting of four phases:[3]

Birth: A value proposition is devised to capture value from an innovation.

Expansion: Scale and refine the business while closing out rivals.

Leadership: Keep customers and partners engaged while maintaining a controlling position within the ecosystem.

Self-Renewal: Bring new ideas into the ecosystem.

This model provides a useful framework for thinking about how platforms and dynamic capabilities interact.

a. Birth

In the birth phase, an entrepreneur or manager looking to profit in a particular technology area needs "generative sensing" through which various hypotheses about the underlying state of consumer demand are tested until a set of options can be validated (Dong, Garbuio, and Lovallo, 2016).

Many opportunities are abundantly plain, so that some emerging fields will be crowded at the outset. In the Internet of Things space, for example, companies such as HP Enterprise, GE, and Cisco are offering competing platforms for managing and analyzing the massive amounts of data generated by the "smart" devices deployed by customers such as electric utilities.

Once an opportunity has been sensed, or at least chosen, the next step is to design a business model (e.g., software licensing versus service provision). The most profitable business model may not be immediately apparent. A useful set of concepts for developing a business model around a core technology is known as the Profiting From Innovation (PFI) model (Teece, 1986, 2006). In the PFI model, a fundamental requirement for profiting from an innovation is to take into account the appropriability regime that applies to the given innovation. Unless the inventor/innovator enjoys strong natural protection against imitation and/or strong intellectual property protection, then potential future streams of income are at risk. The weaker the appropriability regime, the more the innovator needs to rely on the control of complementary assets to secure an adequate return. When appropriability is strong, the innovator is more likely to be able to safely rely on the complementors in its ecosystem. Another consideration is whether the complementary activities are competitively supplied or might become a bottleneck that can command a larger share of value, akin to Intel or Microsoft's position in the personal computer market. Certain complementary activities may be worth internalizing if they generate special knowledge for evolving the platform or if they generate data useful for capturing value.

[3] Parker, Van Alstyne, and Choudary (2016) present a 3-stage "life cycle of the platform" (p.187) that covers a startup phase, a growth phase, and a maturity phase. Because Moore's framework includes a self-renewal phase, it is much better aligned with the dynamic capabilities framework.

The strategic decision to internalize particular activities may entail the building of new or extended (ordinary) capabilities. In cases where time is of the essence and the capabilities exist elsewhere, an acquisition might facilitate the expansion, provided that integration of acquired businesses is an organizational strength. In other cases, the hiring of experienced personnel able to guide the in-house development of the needed capabilities may lead to a better-integrated outcome.

Management's ability to develop and refine business models is a core microfoundation of dynamic capabilities. A successful business model solves a problem for an identifiable group of potential customers who can support a high enough price to cover all costs and leave a satisfactory profit. The elements of a business model include a **Value Proposition** (the product or service, the user need(s) it satisfies, the identities of the initial and potential customer base); a **Revenue Model** (a pricing strategy, distribution channels, customer communication channels); and a **Cost Model** (the necessary assets and capabilities, the operating structure, the network of complementors).[4] Together, these should map out a logic for value capture.

Once the initial boundaries of the platform (and the firm) have been decided, asset orchestration is required to ensure the smooth coordination of in-house and external physical, human, and logistical elements. Systems must be in place to feed lessons learned from outside contacts back into the model design and strategizing process.

b. Expansion

The expansion phase is where seizing and transformation capabilities come to the fore as the business model is implemented, refined, and scaled. Platform governance (openness and/or control) must be decided. Evaluation metrics should be chosen to evaluate the features of the business model relevant to capturing value.

If market conditions do not demand faster development, the initial introduction of the platform can be done in a limited way to allow time for feedback cycles during which the platform and business model are fine-tuned or even fundamentally altered in response to lessons learned. For example, Instagram, the popular photo sharing app, started out as one feature of a smartphone app called Burbn that allowed users to leave location-specific messages. After a mixed reception of the somewhat complicated Burbn app, the founders of Instagram determined that photo sharing was what excited Burbn users most. The newly refocused and renamed app attracted 10 million users in its first year and was sold for $1 billion to Facebook less than two years after launch.

The business model must often be fixed rapidly, especially in the case of digital products. Speed of execution is essential in situations where competition is likely to produce winner-take-all outcomes such as when there are large demand- or supply-side scale economies, multi-homing costs, and no room for niche specialization. Instagram was not the first app for the sharing and modification of smartphone photos, but it offered a simple yet useful interface that made it easy for users to reach as wide an

[4] adapted from Schön (2012) and Teece (forthcoming).

audience as they chose. It started out in the Apple ecosystem; when it introduced an Android version six months later, it was downloaded more than one million times on the first day. The company rapidly added new features to maintain its momentum, although popularity did not translate to revenue, much less profit, until Facebook added advertising to the service.

In established companies, the agility to rapidly adjust a new business may come from segregating the new activities in a way that insulates them from bureaucratic routines or multiple layers of management. The ability of established firms to pursue new businesses while not undermining their existing advantages (and revenue sources) has been called ambidexterity, which is one element of the dynamic capabilities framework (O'Reilly and Tushman, 2008). Ambidexterity works best when the members of the top management team readily share information and collaborate well on strategic issues (Lubatkin et al., 2006). A well-integrated management team is more generally important for enabling active strategy formation and agile implementation in fast-moving competitive settings (Chen, Lin, and Michel, 2010).

c. Leadership

Once the platform has established a strong, steady position, then sensing capabilities come to the fore in order to be aware at the earliest possible time of strategic threats and new opportunities. Seizing capabilities are important to the extent that the business model need to be modified or replaced.

This leadership phase of a platform lifecycle falls more in the realm of strategy, which, as mentioned above, is distinct from dynamic capabilities. Strategizing is used, for example, to counter moves by rivals by modest moves such as targeting new market niches or making product extensions. If the strategy adopted involves change, then transformation capabilities may be called upon to realign resources.

As an example of inter-platform competition between two leaders, consider the emerging market for digital home assistants. When Amazon introduced the first product in this new category in the form of its artificial intelligence-based Echo in 2015, Alphabet's subsidiary responded defensively by releasing a rival product, Google Home, the following year. While it could be argued that the Amazon Echo arguably represented the result of sensing and seizing an opportunity, it can more properly be viewed as an application of the company's existing hardware and software capabilities to bind users more tightly to its e-commerce platform.

To the extent that a platform leader's operations remain on a fairly steady track, this is the phase of the platform lifecycle that benefits from the application of standard management tools aimed at raising the efficiency of a firm's ordinary capabilities. This differs from dynamic capabilities, which are aimed at raising organizational effectiveness.

d. Self-Renewal

A handful of super-platforms, such as Amazon and Facebook, may have reached a scale such that they will continue indefinitely in a recognizable form. Many platforms, however, will, at some point, find that

the need for fundamental renewal becomes evident for reasons of technological change or major market shifts. Clearly the search for alternatives must begin well ahead of that point. In other words, sensing should be an ongoing process.

Once an inflection point has been identified, a new opportunity must be selected and a new business model devised. New capabilities and alliances may be necessary to build the new platform. In the meantime, the old platform must still be managed effectively, requiring the ambidexterity discussed earlier.

For example, long before Apple launched its mobile iOS software, it had the original Macintosh operating system (OS) launched in the 1980s. While it was revolutionary when introduced, the technological limitations of the old OS became evident as its chief rival, Microsoft's Windows, steadily advanced. When Steve Jobs rejoined Apple in 1997, he brought the advanced computing platform he had built at NeXT. Apple used the technology to develop "Mac OS X", which was first released in 2001, requiring major changes in third-party applications. During the transition years, Apple continued to release major updates of its old OS to keep consumers involved with the brand, pushed forward with development of OS X, and issued specialized software tools to developers to help them adapt to the forthcoming OS. And this occurred at the same time Apple was preparing to release the first model of the iPod, also in 2001. As history shows, Apple successfully weathered the transition, despite the headwinds of the dot-com bust, which also sharply affected revenues in the early 2000s.

Such ambidextrous transitions may not succeed, especially when rivals are pursuing the same new opportunities. Another challenge that can prevent bringing in a new platform is that it may conflict with the old one, which Bresnahan and Greenstein (2014) call "diseconomies of scope."

Platform renewal has implications for the larger ecosystem. In some cases, the platform leader may have sufficient autonomy to act unilaterally, but allowing for advanced notice to, and consultation with, key complementors is generally advisable. Indeed, some complementors may even have contractual rights that must be respected. Key business relationships are often held together by a "constellation of safeguards" that can only be unwound cooperatively (de Figueiredo and Teece, 1996).

Table 2 summarizes this discussion by listing the role of various categories of dynamic capabilities over the platform lifecycle.

Table 2: Dynamic capabilities over the platform lifecycle

Lifecycle Stage	Principal Dynamic Capability Requirements
Birth	Generative Sensing; Business Model Selection; Asset Orchestration
Expansion	Seizing; Learning; Transformation (implementation)
Leadership	Sensing for threats; Transformation (minor)
Self-Renewal	Sensing; Ambidexterity; Transformation (major)

V. Conclusion

Across all phases of the platform lifecycle, strong dynamic capabilities are needed to improve competitive outcomes, from organizational sensing in the "birth" phase to organizational transformation in the "self-renewal" phase. Platform entrepreneurship entails not only designing a product or service and the business model to make it profitable, but also building an adaptable organization to deliver—and grow with—the platform.

In a sense, the business problems facing managers across the platform lifecycle are those of any product lifecycle augmented by the need to attract and maintain a healthy ecosystem of complementors. In a platform setting, every decision has a collective dimension beyond the usual stakeholder issues. Complementors come to rely on the astute sensing and orchestration capabilities of the platform-leading organization.

There is still much to be learned about the role of dynamic capabilities with regard to each phase of the platform lifecycle—and even with regard to platforms more generally. This chapter has presented the salient interactions, but it is far from the last word, not least because the individual research streams on platforms and on dynamic capabilities will continue to swell for the foreseeable future.

Acknowledgments: I wish to thank Greg Linden for helpful comments and assistance.

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