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Strategic Management of Open Innovation: A Dynamic Capabilities Perspective

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SUMMARY
Open innovation has become well established as a new imperative for organizing innovation. In line with the increased use in industry, it has also attracted a lot of attention in academia. However, understanding the full benefits and possible limits of open innovation still remains a challenge. We draw on strategic management theory to describe some of these benefits and limits. More specifically, we develop a dynamic capabilities framework as a way to better understand the strategic management of open innovation, which can then help to better explain both success and failure in open innovation. With this background, as guest editors we introduce select papers published in this Special Section of *California Management Review* that were originally presented at the fifth annual World Open Innovation Conference, held in San Francisco, California, in December of 2018.

KEYWORDS: innovation, open innovation, strategic management, dynamic capabilities, business models

Research and practice on open innovation have come a long way since it was originally introduced in 2003 as a new imperative for organizing innovation.[1] The main idea behind open innovation was that firms can and should use external ideas as well as internal ideas as they look to advance their innovations. While elements of this perspective have a long lineage in the literature on innovation (e.g., Mowery, Pisano, Mitchell, and Teece), the modern formulation is more robust and has deeper more fully thought through implications for management practice. Chesbrough and Bogers have recently redefined open innovation as "a distributed innovation

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process based on purposively managed knowledge flows across organizational boundaries, using pecuniary and non-pecuniary mechanisms in line with the organization's business model."[2]

Much research has been conducted on open innovation since the term was introduced[3] and extant research has looked into a wide variety of issues, ranging from the "human side"[4] of open innovation to project-level attributes[5] to platforms and ecosystems[6] to public administration and societal issues more generally.[7] The widening interest in open innovation is also reflected in the editorial for last year's Special Section on open innovation in *California Management Review* (*CMR*), which was coauthored with European Commissioner Carlos Moedas.[8] The article focused on linking research, practices, and policies on open innovation—for example, highlighting some key trends such as digital transformation, challenges such as uncertainty, and potential solutions such as European Union (EU) funding programs.

This year's Special Section follows this growing body of research by presenting selected papers from the fifth annual World Open Innovation Conference (held in San Francisco, California, in December of 2018). And we are joined by one of the keynote speakers to the World Open Innovation Conference held in 2017, David Teece. This introduction integrates his insights from his keynote address[9] with selected papers that were submitted to the conference for the following year.

Open Innovation Is an Imperative Today

While open innovation was first introduced as a robust concept in 2003, developments since have rendered open innovation an imperative in today's world. The first is that sources of knowledge have dispersed in many different places, and the geographic footprint of innovation is changing dramatically. Although patent quality is problematic, China in 2012 accounted for the largest number of patents filed throughout the world.[10] According to the 2015 Global Innovation 1000 study, 94% of the world's largest innovators conduct some components of their research and development (R&D) activities abroad.[11] This means that companies should not rely solely on their own ideas and in-house research, but should also invite external sources to contribute. This is the Outside-In branch of open innovation—also referred to as inbound open innovation.

A second development is that intellectual property (IP) has become a critical enabler to access external ideas and let others use one's own ideas. Strengthened IP rights (IPRs) facilitate open innovation adoption. In the early 1980s,[12] IPRs were strengthened in the United States, which bolstered the market for know-how. The rise of open innovation does not mean the role of IPRs is no longer important. Often, it is just the opposite. An intriguing recent study even showed that solar photo-voltaic makers were more collaborative *after* they had received their first patent than they were before they received the patent.[13] Thus, strong and certain IP protection and collaboration are complements, not substitutes, in aiding the innovation process.[14]

IP protection also matters for the other branch of open innovation: the Inside-Out branch—also referred to as outbound open innovation. One way to stimulate greater adoption of one's own technology is to provide others with access via licenses with reasonable royalties. Developing and scaling technologies requires a significant amount of risk-taking and capital, Inside-Out approaches can in many cases broaden the base of revenues to achieve this. Licensing regimes are supported with royalties at levels sufficient to draw forth the investment needed to make open innovation succeed.[15]

A third development that has in some cases required the adoption of open innovation is the decline in in-house R&D. Since the 1990s, many leading companies have significantly reduced their investment in research. Some critics blame shareholder activism and short-term focus, while others point to the rise of research-intensive startups funded by venture capitalists.[16] Short-term investors might pressure companies to adopt a shorter time horizon, and managers may cut R&D expenses when shareholder activists emerge on the horizon demanding cost cutting. As breakthrough innovation developed at corporate in-house labs becomes rarer and technology cycles decrease, it has become quicker and less expensive for these labs to rely on external sources for R&D, such as local universities and suppliers.[17] This is an adverse trend for innovation in general that could also create problems for the use of open innovation. To be clear, we do not advance open innovation as a panacea for reduced investments in R&D. Clearly, if R&D expenditures are declining everywhere, open innovation is at best a stopgap. Sooner or later, there will be a decline in inventive activity and research findings and discoveries from which others can draw. We are very clear that in-house R&D and open innovation ought to be viewed by management as complements. The one without the other is unlikely to succeed. This has been shown to be historically the case.[18] The absorptive capacity needed to recognize, comprehend, and transfer advanced technology from external sources is rooted in deep internal technology and know-how.[19]

A fourth general development is that digitization has dramatically changed the ease and nature of information flows. More specifically, a recent trend is that digital convergence further renders open innovation an imperative. The techno-business environment has changed since the widespread adoption of the Internet. Digital platforms are ubiquitous. Digital data and signals provide a common (0,1) base for handling diverse types of information, including words, sounds, and images.[20] Widespread use of common standards allows connectivity among diverse information devices. "Multi-invention" and "co-innovation" contexts are more common (e.g., there are more than 100,000 patents involved in the iPhone).

Digital convergence requires greater connectedness and platform engagement. Few firms can dominate all of the value chain activities in the era of digital convergence. The Internet of Things (IoT) is being rolled out across industries such as automobiles (e.g., flying cars requiring a convergence of technologies) and Smart Cities. IoT business models demand the orchestration of many partnerships to deliver solutions. Systems integration is both easier and more necessary with open innovation. Toyota has formed the e-Palette Alliance, an ecosystem of software and hardware support to develop a modular, and driverless vehicle designed for multiple purposes at once (e.g., logistics, delivery, and passenger travel). The alliance includes Uber, Amazon, Mazda, and Pizza Hut. Toyota uses a "plug-and-play" open platform for developing its mobility services. Management of ecosystems and access and control of complementary assets may now be more important to competitive advantage than installed base/switching cost considerations.

Although these trends have added reason why companies have to become excellent in open innovation, organizations have always, as noted earlier, relied to some degree on the external sourcing of ideas and innovations. As early as 1714, the British government offered the Longitude Prize to anyone who could develop a method for determining a ship's longitude. Rewards valuing £20,000 were given in the form of encouragements.[21] Even in 1969, in studying R&D labs, Allen and Cohen argued that "no research and development laboratory can be completely self-sustaining. To keep abreast of scientific and technological developments, every laboratory must necessarily import information from outside."[22] In the United States, 100 years ago, open innovation was not an imperative because there were so few internal R&D labs. Contract research was the norm.[23] During the heyday of large corporate R&D labs (1920s-1980s)[24] and U.S. technological dominance (1940-1990), habits of thinking became quite parochial. Some companies even today remain caught in the "not invented here" trap.[25]

Although the external sourcing of innovation is thus not new, the current open innovation model is different from previous ones. In almost every firm today, the best ideas and people lie elsewhere. This is partly a function of the globalization of business and advances in education and technological catch up. Companies are now able to connect with large and global technical communities quickly, which inevitably results in a more efficient ways to find the right solutions for problems that otherwise might have been hard to solve.[26] More and more work activities have become digitally connected, and new patterns of cross-functional collaboration have emerged. Timely access to domain and technology expertise is critical to firm-level competitiveness. As in line with the dynamic capabilities perspective, active engagement by practically all firms in sensing/outsourcing of technology is now required. Scouting/sensing tools need to be developed. Seizing/orchestration/integrating skills are now paramount. So fundamental are these developments that today's open innovation is qualitatively and quantitatively different from that of the pre-Internet era.

Strategic Choice Variables in Open Innovation

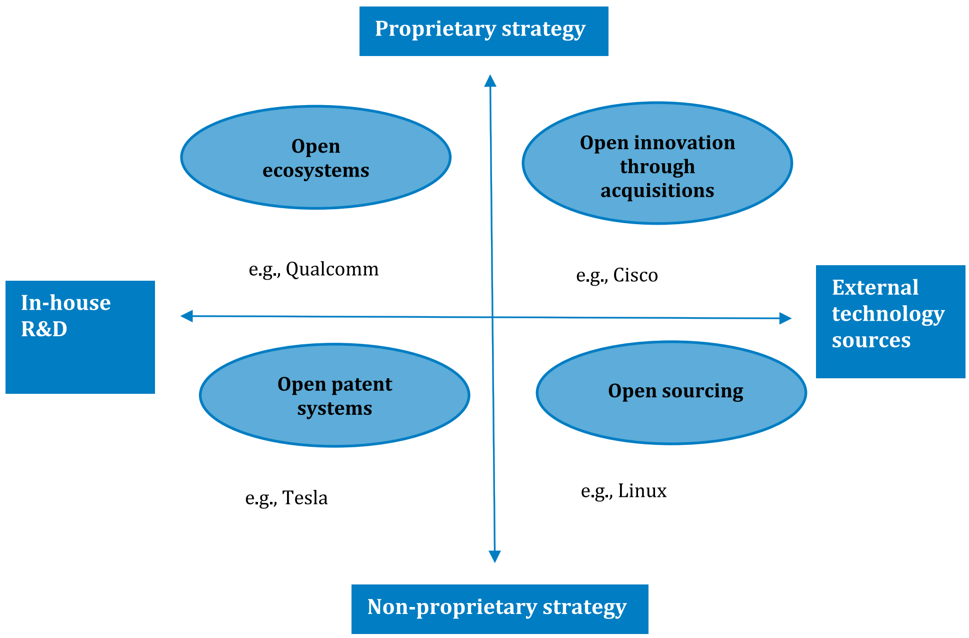
Open innovation has been used to describe a wide variety of activities, from open source software development to crowdsourcing to competitions and prizes, to licensing, to contract research, to industry-university collaborations and engagement between corporations and startups. In such a complex landscape, it can help to employ some heuristics. There are two fundamental choice variables with open innovation: the *technology development business model* (proportion of in-house versus contract R&D) and *IP strategy* (nonproprietary [open] versus proprietary). In almost every technology development context, there are many key issues along these two variables: Does one source the technology internally or externally? What (complementary) technologies does one need to bring together to produce desirable products/services? What other (complementary) assets does one need? Do I build a platform? What IP strategy/posture will I take? The two variables are somewhat interdependent, as a robust market for know-how depends on the existence of IPRs and the opportunity for unstructured technical dialogue.[27] These choices exist both for value creation and (separately) for value capture/commercialization. Firms may employ unique forms of property rights, such as modularity, where individual contributors and inventors, both internal and external to the firm, appropriate value.[28] See Figure 1 for an illustration of these choices.

Put differently, open innovation implicates business model choice and technology strategy issues. In reality, the "open" versus "closed" distinction is just a matter of definition and degree. Varying degrees of openness exist among firms.[29] Firms can decide which parts of the knowledge can be made open and which parts remain proprietary. Apple has used a combination of open and closed innovation. It developed its iPhone software with closed innovation, but it used open innovation for the initial hardware design, and also for its iPhone app store. Open versus closed innovation thus involves both business model design and IP strategy issues.

On the basis of these two dimensions, firms can embrace open innovation in different ways (Figure 1). Qualcomm, developing proprietary technology mainly through in-house R&D, for instance, has embraced open innovation by building open ecosystems through licensing to its complementors, who in turn design and build final products for consumers. Qualcomm, Nokia, Ericsson, Motorola, IBM, and others built a number of technology platforms under ETSI (European Telecommunications Standards Institute)/3GPP (Third Generation Partnership Project) that fed an ecosystem that enhanced and combined proprietary core technologies.[30] This allowed the mobile phone industry to benefit from hundreds of thousands of engineers employed by thousands of firms, who have cooperated and competed to deliver solutions that were compatible across firms and continually improving across time. As noted elsewhere,[31] this may be the greatest example of cooperation in technology development the world has ever seen, mediated by ETSI/3GPP under an FRAND licensing regime. This coordination, while unusual, is a quintessential case of open innovation.[32] As Qualcomm notes, their business model

> is one of the greatest successes of open innovation in the world. Our business model has democratized access to mobile technology. We created mobile broadband . . . open innovation is the spirit of our licensing and chipset business. Our inventions span new market places and vibrant ecosystems. More and more

FIGURE 1. Different forms of open innovation by technology development business model and IP strategy.



Note: IP = intellectual property; R&D = research and development.

> companies are mobile first. Look at Uber, Snapchat, Waze, mobile banking . . . they sit on top of and are enabled by over 30 years of R&D in wireless . . . every time you touch your phone, you touch a Qualcomm invention. You may not realize it because it is being presented to you by our partners in open innovation.[33]

Similar to Qualcomm, Tesla has built proprietary technology largely through in-house R&D, but its IP strategy has departed from Qualcomm by shifting to nonproprietary strategy. Elon Musk noted that

> we felt compelled to create patents out of concern that the big car companies would copy our technology and then use their massive manufacturing, sales and marketing power to overwhelm Tesla . . . the unfortunate reality is the opposite: electric car programs (or programs for any vehicle that doesn't burn hydrocarbons) at the major manufacturers are small to non-existent, constituting an average of far less than 1% of their total vehicle sales.[34]

Whereas Tesla's revenue model is primarily product based, Qualcomm is both product (in particular, modems) and technology (IP) based. The latter element is now likely injured by clumsy interventions by antitrust authorities in several countries where the courts and/or regulators seem to know little about open innovation and almost nothing about technology licensing. With limited competition and sales in the electric vehicle industry, Tesla adopted an open patent system, as it could not produce enough electric cars to solve the carbon crisis by itself. In his post in 2014, Musk pledged that Tesla would not initiate patent lawsuits against anyone who, in good faith, wanted to use its technology.[35] He also commented, "We believe that applying the open source philosophy to our patents will strengthen rather than diminish Tesla's position in this regard."[36] IBM took a similar open patent strategy by establishing the Eco-Patent Commons, where solutions may be easily shared to accelerate implementation to protect the environment and may lead to more innovation.[37]

Cisco is an example of a firm that used open innovation through acquisitions. Whatever technology the company needed, it acquired from the outside, usually by partnering with or investing in promising startups. In this way, Cisco kept up with the R&D output of perhaps the world's finest industrial R&D organization, all without conducting much research of its own.[38] Cisco recognized that the best ideas can come from outside the company. John Chambers, chairman emeritus of Cisco, who completed 180 mergers and acquisitions during his 20-year term, said, "Learn about tech M&As or the future might happen without you."[39]

Another form of open innovation is open sourcing. Linux is an open source operating system, developed by thousands of programmers collaborating around the world. The Linux Foundation works on downstream uses, such as government and academia, to help it understand how to use open source. It also works with upstream industry users and individual contributors to foster adoption of open source solutions. For example, studios started sharing software as open source through Linux in the fields of animation and visual effects and also used Linux for blockbuster films (e.g., the *Lord of the Rings* trilogy, and *Titanic*).[40] The corporate world has caught on to this, with Microsoft acquiring the open source repository GitHub for $7 billion in 2018, and IBM acquiring RedHat (the leading distributor of Linux) for $34 billion in 2019.

A Dynamic Capabilities Approach to Managing Open Innovation

It is clear that the open innovation approach sometimes does not require strong IPRs but it often does. Markets for know-how simply do not work well without strong and clear (i.e., certain) IPRs.[41] Open innovation almost always requires one to combine external and internal sources of know-how. Accordingly, open innovation requires new management approaches and deep (systems) capabilities in technology "integration." A strong commitment to open innovation will dramatically expand the number of technology partners one has to evaluate and work with. Open innovation often requires assembling a portfolio of IPRs. Partnerships can often lead to leakage of trade secrets. End-to-end integration is harder and requires extensive collaboration. System integration is a major challenge.[42] Studies have found considerable heterogeneity in open innovation performance among companies, depending on their ability to master these challenges associated with openness.[43] The articles in this special section further develop these challenges in managing collaborations with external sources of innovation.

Companies that have successfully capitalized on open innovation are characterized by the organizational flexibility required to restructure their existing business models to accommodate open innovation strategies.[44] In other words, smart "asset" orchestration involving the combination of internal and external technologies to align with one's business model is what makes open innovation work. In a world of widely diffuse useful knowledge, much of the real value can be gained not from developing yet another piece of knowledge, but rather from creating systems and architectures that combine these disparate pieces of knowledge together in useful ways that solve real problems. This "systems integration" or systems architecture capability is of particular value in an open innovation environment.[45]

We can perhaps better understand co-invention/co-innovation opportunities and strategic choices by integrating the open innovation concept into the dynamic capabilities framework. Dynamic capabilities are the firm's ability to integrate, build, and reconfigure internal and external competences to address rapidly changing environments in which there is deep uncertainty.[46] In the dynamic capabilities perspective, a key to sustained profitable growth is the ability to recombine and reconfigure assets and organizational structures as the enterprise grows and as markets and technologies change.[47] This "orchestration" process involves the modification, addition, divestment, and alignment of tangible and intangible assets. This requires shifting resources such as talent and money to where they will deliver the most value.[48]

Dynamic capabilities are undergirded by three sets of organizational processes: sensing, seizing, and transforming capabilities. These three clusters of dynamic capabilities can help companies effectively reap the full benefits of open innovation (see Table 1 for an overview).

Outside-In open innovation requires sensing, sense-making, and the filtering of externally developed technologies. The sensing capability can assist companies in identifying and evaluating valuable external knowledge, and establishing cross-boundary collaboration outside the business. It is critical to be able to attract lots of ideas, and then evaluate, select, and remove the bad ones. For example, Kraft Foods Australia hosted a public naming contest for its new Vegemite-based cheese snack. It initially chose iSnack 2.0 from the submissions and encountered widespread ridicule, and eventually abandoned it. The company instead let consumers choose a name among submissions and the company picked the most popular one, Vegemite Cheesybite.[49]

We have established that open innovation is not about primarily outsourcing R&D to somebody else. It is about leveraging and enhancing internal capabilities, either to enhance one's own business model (Outside-In open innovation) or to explore a new business model (Inside-Out open innovation).[50] Also, ideas alone are not worth much if not executed well. To successfully use knowledge from external sources, companies need to employ various organizational practices such as extensive delegation, intensive lateral and vertical communication, and rewards for knowledge sharing.[51] Moreover, many solutions from the outside are

TABLE 1. The Interrelation of Dynamic Capabilities and Open Innovation.

Cluster of Dynamic Capabilities	Sensing	Seizing	Transforming
Related open innovation strategy	Discover licensing out opportunities	Invest in internal R&D	Do not let R&D fall victim to cost reduction
Examples of related activities	Identify and evaluate valuable external knowledge	Put processes into place to commercialize ideas Set good governance mechanisms Establish cross-boundary collaboration outside the business	Realign the organization to integrate external knowledge Develop a culture that promotes collaboration Adjust the mix of internally developed and externally developed technologies to reflect changing needs and opportunities

Note: R&D = research and development.

not "plug and play" with internal technologies, systems, and services. Significant adaptation and integration are required to take them to market. Therefore, successful open innovation also requires the seizing capability.

Companies also need to realign their organizations to integrate external knowledge sources, which often requires transforming capability. Integrating external knowledge may cause disruption and require a cultural change. Open innovation success depends largely on developing a culture that promotes collaboration and overcomes the not-invented-here and not-sold-here syndromes.[52] For example, Lego's creative culture is rooted in its efforts in fostering open innovation and heeds the wisdom of crowds in creating new products.[53] Many companies are willing to build a collaborating culture that is open to external ideas, but it is not always obvious how to make the shift.[54]

Both Outside-In and Inside-Out open innovation strategies are needed to advance the transforming capability in dynamic capabilities. Chesbrough et al.[55] employ open innovation strategy and the dynamic capabilities perspective to explain the performance difference among the high-speed rail, semiconductor, and automobile industries in China. They find varying levels of application of open strategy across the industry and conclude that open strategy is critical to succeed and to effectuate the dynamic capabilities of the party, which in turns helps develop and maintain the dynamic capabilities of innovating firms.

Limits to Open Innovation

There are cases, though, when, in order to achieve dynamic capabilities, open innovation cannot be employed. The limits to open innovation need a great deal more scholarly attention, so we will simply sketch out some initial ideas and discuss two specific companies, Qualcomm and SpaceX, to illustrate them.

Qualcomm is a company based in San Diego, California, that specializes in cellular and wireless telephony. It is best known for its CDMA (Code-Division Multiple Access) technology that provided a more efficient way to utilize scarce airwave capacity to support a higher number of cellular phone calls. Today, the company is a global leader in wireless telephony technology for 5G applications, and it just won an important design competition against Intel to sell in the next generation of mobile telephony chips at Apple for its 5G iPhones starting in 2020.[56]

Qualcomm did not initially achieve its success through open innovation, however. When the company won its first contract in the 1980s to design a satellite messaging system, they chose to utilize a clever technique to get more capacity out of a slice of the airwaves (called spectrum) used to communicate with the satellite. This technology became known as CDMA technology. It was incompatible with earlier wireless telephony technologies, including one that was beginning to gain real volume in the cellular market, known as TDMA (Time-Division Multiple Access). At the time, none of the companies in the cellular business that Qualcomm talked to had much interest in CDMA. They felt that the technology was unproven. While it looked good in theory, it might not work in practice. And there was the alternative TDMA technology that was already working.

At this time, open innovation probably would not have worked, because the required technology did not exist, and the leading suppliers of the dominant technology of the era felt that this new approach would not be feasible (we will see this pattern again with SpaceX below). This meant that Qualcomm had to vertically integrate. It built the handsets and the cellular phones themselves. It had to build the base stations that relayed the cellular signal from tower to tower to handle the call. It had to develop all of the software to make the hardware work. It had to finance the development and deployment of multiple demonstrations of the technology, both in Los Angeles in 1989 and in New York City in 1990.

In 1991, Qualcomm got its first customer, who turned out to be the Korean Electronics and Telecommunications Research Institute. By 1993, it began to receive its first real royalty revenues for CDMA technology, eight long years after Qualcomm started on the satellite messaging project. It was only much later, once CDMA technology was deployed at dozens of telecommunications companies around the world, that Qualcomm downscaled its vertical integration approach. CDMA has proven itself in dozens of carriers around the world, and Qualcomm is leading efforts to further advance the technology, to 5G and beyond. It now faces key competition (and some cooperation) from Huawei and other technology leaders, but is now able to utilize open innovation far more extensively than it could 30 years ago. The governance provided by ETSI/3GPP is key to the success of open innovation, and the U.S. antitrust apparatus (the Federal Trade Commission [FTC]) has positioned itself (unwittingly) as an enemy of that model.[57]

Open innovation is not always the best path forward for technological development. There was no way for Qualcomm to partner with outsiders to create CDMA, because the technology was too unproven and required coordination of many subtle interdependencies. There were few potential partners. Qualcomm had to go it alone and it did.

The public data sources that have tracked important moments in the history of SpaceX provide another powerful illustration of these points. According to some accounts,[58] Musk's vision of space exploration began with the goal of trying to launch some living organism from Earth to Mars. In pursuit of this goal, he and a colleague went looking for a rocket to propel the organism. While they began in Europe, at Arianespace, they found those rockets to be prohibitively expensive. During their conversations with European sources, they heard of a possibility of purchasing some "repurposed ICBMs" from Russia to use as a rocket instead.

Ultimately, the Russian sources did not provide any rocket to Musk. But his experience with trying to purchase a rocket from them prompted him to decide to build his own rocket.[59] His key insight was that, in order for interplanetary space travel to become affordable, rockets would need to be reusable. While this was sensible, it went directly against all of the prior history and design paradigms of rocketry, from the ballistic missiles of World War II to the Soyuz and Apollo missions of the world's leading aeronautics manufacturers, the Soviet Union and the United States.

This situation reminds us of an obvious limit to open innovation. When all of the useful, abundant external knowledge available is built upon an outdated (e.g., TDMA) or obsolete (e.g., disposable rockets) "business" model for what Dosi and others have called a "technological paradigm,"[60] there may be no way to employ open innovation to advance one's technology. Musk's decision to commit to a reusable rocket also committed SpaceX to the use of vertical integration to achieve this objective. There were no preexisting ecosystems around low-cost reusable rockets, so he had to create one with SpaceX. Open innovation requires a rich technological commons.

SpaceX has continued to go its own way in its technology development and continues to closely coordinate complex technologies. On other occasions, it has occasionally found itself facing a second limit to open innovation, that of small numbers bargaining situations. SpaceX works with suppliers such as Alcoa, who had critical capabilities that SpaceX needed to fabricate the aluminum domes in its launch vehicles. When Alcoa greatly increased its prices to SpaceX, Musk tried to invent around Alcoa's capabilities, so that SpaceX would not become hostage to these sources.[61] This is managerial action straight out of transaction cost economics.[62] It reminds us that complex technologies that feature subtle interdependencies require internal administrative processes to orchestrate these complexities. Similarly, when there are very few sources of critical technologies, companies may do better by doing things themselves, rather than utilizing open innovation processes to achieve those objectives.

From another perspective, though, SpaceX embodies open innovation quite well. For over 50 years, National Aeronautics and Space Administration (NASA) relied on a form of quasi-vertical integration to develop, organize, and deploy launches into space. The rise of SpaceX has presented NASA with an external partner to provide launch services. Indeed, NASA's leadership now describes its mission as being focused on the development of a private space industry for the rest of the twenty-first century, partnering with Space X, Boeing, and other companies instead of doing it all itself.[63]

The Articles in the Special Section on Open Innovation

In the above, we introduced some key attributes of how open innovation works in general and how it can be considered from a dynamic capabilities perspective. While this may offer some building blocks for a framework to better understand (and manage) open innovation, it also shows that open innovation may be a (strategic) balancing act among a complex set of factors. This is also evident from the papers that were selected for the Special Section based on the fifth annual World Open Innovation Conference in December of 2018, as we briefly summarize below.

The importance on ensuring the success of an open innovation project (and avoiding its failure) features explicitly in the article by Rouyre and Fernandez on "Managing Knowledge Sharing-Protecting Tensions in Coupled Innovation Projects." The authors build on a case study of Galileo, a European project launched in 2001 to develop a satellite positioning system, to show how the organizations in the project managed the tension between knowledge sharing and protection—also known as the open innovation paradox. They find that the coopetitive[64] nature of the relationships in a so-called coupled open innovation process required a more formal strategy that included a centralized project structure that enables formal knowledge sharing to avoid unwanted knowledge transfers between competitors.

This tension nicely deepens an earlier point we made about connecting open innovation with dynamic capabilities. Each side in a deep collaboration like Galileo has a strategy, and achieving a successful innovation result requires considerable knowledge sharing on one hand and some means for limiting the sharing of other knowledge on the other hand. IPRs help manage this tension, but Rouyre and Fernandez remind us that organizational design and collaboration design also have important roles to play in managing appropriability between partners in a complex open innovation project. Put another way, IPRs can protect codified knowledge, but deep collaboration requires the sharing of tacit knowledge as well, and organizational design may be a more effective way to prevent any unwanted tacit knowledge leaks.

Similarly, the article by Schmeiss, Hoelzle, and Tech, "Designing Governance Mechanisms in Platform Ecosystems: Addressing the Paradox of Openness through Blockchain Technology," also addresses this paradox of when to share knowledge, which they frame as the tension between value creation and capture in joint innovation. Although they also consider the governance mechanisms in such a context, they approach this problem from another angle by considering how blockchain technology may be used to design novel governance mechanisms. With a specific focus on startups that aim to build a new platform ecosystem, they derive a framework that highlights how blockchain technology may be used to address issues of access, control, and incentives. These issues are embedded in the technical architecture of the platform and enable the standardization of interactions across the ecosystem.

Schmeiss et al. consider blockchain from both a knowledge management perspective and a dynamic capabilities perspective as well. A distributed ledger can capture codified knowledge but will fail to incorporate tacit knowledge. Moreover, many blockchains have trouble evolving over time. The features that make them attractive—such as distributing the ledger, immutability of data entries, anonymity of the participants, and fixing the consensus mechanisms—also make them more difficult to change when new requirements or new possibilities emerge. The sensing, seizing, and transforming of dynamic capabilities mean that new blockchain designs must be able to adapt to incorporate each of these aspects into their formal structure in some way, lest the blockchain be overtaken by unanticipated future events and thus rendered irrelevant.

Finally, the article by Lee, Fong, Barney, and Hawk on "Why Do Experts Solve Complex Problems Using Open Innovation? Evidence from the U.S. Pharmaceutical Industry" takes a broader perspective on why or how firms choose to adopt open innovation. Using large-scale data from the pharmaceutical industry, they find that the complexity[65] under which firms tend to adopt a particular type of open innovation—in their case, they consider crowdsourcing, coopetition, science-based, and network forms of open innovation—moderates the relationship between project expertise[66] and the choice of open or closed innovation. This work offers important insights into the complex nature of the decision to adopt open innovation, which we need to better understand to find out what exact mechanisms determine success or failure from open innovation, and when open innovation should or should not be used.

Lee et al. thereby extend our knowledge of how to organize for innovation by allowing us to explicitly factor in expert sources of knowledge outside the boundary of the firm. It is important to treat these external sources with respect and to understand their motivations for engaging with firms who want to address complex problems. A firm with strong dynamic capabilities must, among other things, be capable of attracting highly intelligent outside experts and enticing them to work on some of their important problems. We would hasten to add that such a firm must still retain a strong, vibrant internal R&D capability, not only to attract these outside experts, but also to better comprehend and evaluate their output to determine whether that constitutes the best way forward for an innovation.

Conclusion

We have introduced some key considerations for how open innovation has emerged over time and in what ways it is currently relevant. We then explored two fundamental choice variables for managing open innovation—the technology development business model and IP strategy—that we linked to a dynamic capabilities perspective as an approach to better understand (and manage) open innovation. This provided some key attributes and an initial framework for the strategic management of open innovation, which should provide insights into when to use and when *not* to use open innovation. We further explored this perspective through some examples, which offer a basis for and future outlook on the practice and research of open innovation. Similarly, our discussion of open innovation and dynamic capabilities offered a basis to introduce the papers that were selected for this Special Section. Each of these articles has important implications by adding more fine-grained details on the strategic management of open innovation through their focus on issues such as coopetition, the paradox of openness, and the role of complexity and experience in the face of choosing open or closed innovation. These articles not only address aspects of the dynamic capabilities perspective on open innovation, but they also specifically explore both positive and limiting aspects of open innovation in differing contexts. Taken together, we believe there is great promise in further exploring the more detailed antecedents, mechanisms, outcomes, and contingencies of open innovation. Future research and practice in this domain should go beyond seeing open innovation as outsourcing R&D to somebody else and should rather focus on the particular attributes that are related to leveraging and enhancing internal capabilities, either to enhance one's own business model through Outside-In open innovation or to explore a new business model through Inside-Out open innovation. This should then provide a better understanding of the benefits and limits of open innovation to thereby provide a better grasp of how to strategically manage this new innovation imperative.

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Notes

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59. According to Junod (2012), op. cit., Musk’s knowledge was largely self-taught. “You know, whenever anybody asks Elon how he learned to build rockets, he says, ‘I read books.’ Well, it’s true. He devoured those books. He knew everything.” And Musk was able to find individuals who were willing to go along with him to try to build a reusable rocket: one important early resource was a propulsion engineer named Tom Mueller who worked for an aerospace company that was about to become part of Northrop Grumman, and also was a hobbyist for his own rocket engine creations.
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