Capgemini Consulting

The Foundations of Corporate Innovation in the Digital Age
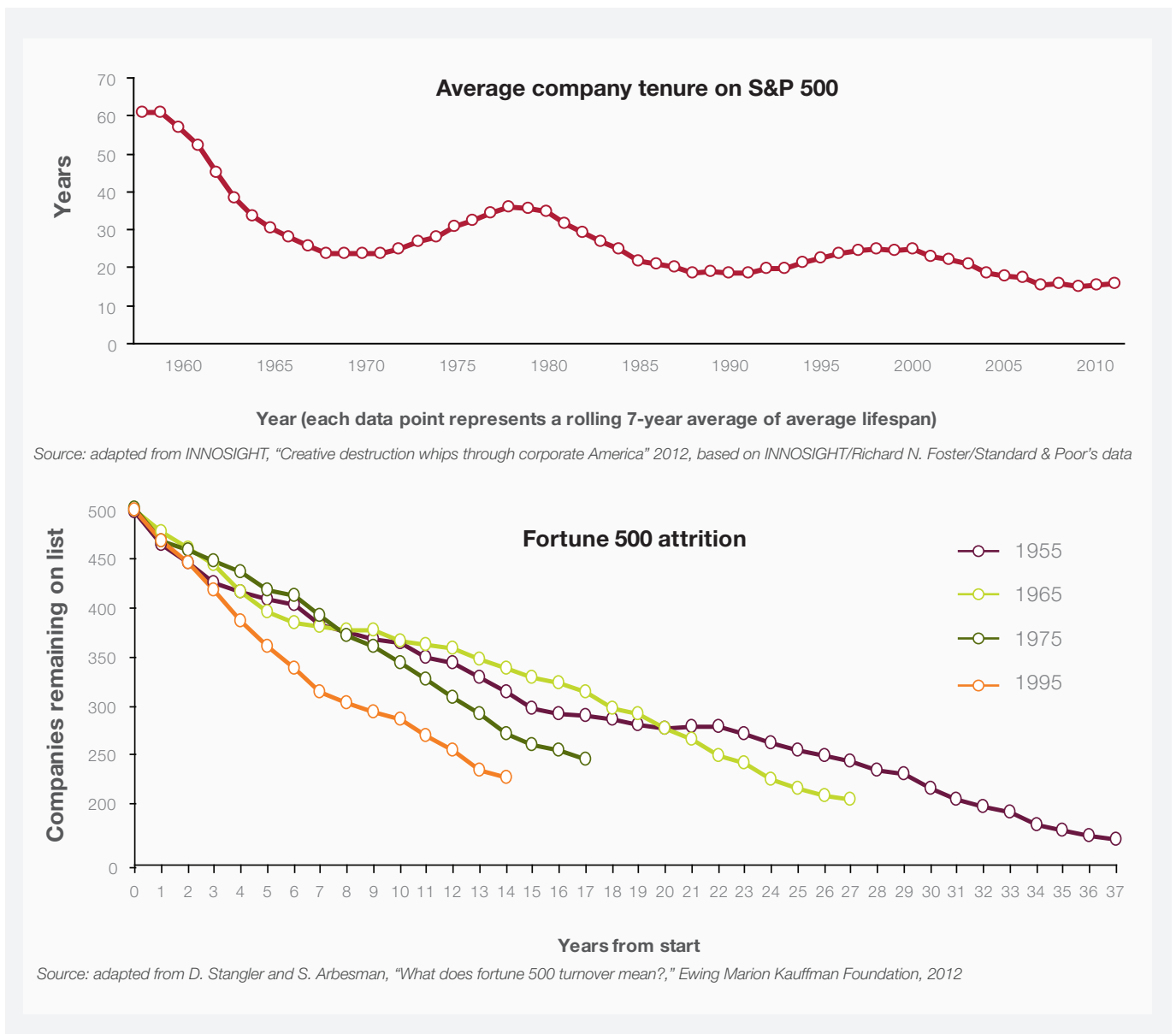
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Introduction

The need to adopt digital technologies is forcing companies to re-think their approach to corporate innovation. For several decades, starting in the 1960s, innovation was concentrated in R&D centers at large firms [1] which gave those firms a competitive advantage in setting the direction of innovation and harvesting its benefits. However, starting in the 1990s, this model began to be disrupted by the confluence of new digital technologies, venture capital and increasingly-fast consumer adoption of new technologies. Companies started to build innovation ecosystems that evolved into an "open innovation" model. This was particularly valuable because many digital technologies are general-purpose, and thus the best experts are often outside the firm, and in other industries.

As new digital technologies are introduced at ever-faster rates, there will increasingly be opportunities to capture new markets and unseat incumbents. For large corporations, this scenario is double-edged; while they have an opportunity to unseat others, they also face the risk of being unseated themselves. Figure 1 shows the historical acceleration of this churn in leading firms in terms of a decrease in the average tenure of firms listed in the S&P 500 and the Fortune 500 [2] [3].

Figure 1 (a) Average company tenure on S&P 500 Index and (b) Fortune 500 attrition

Average company tenure on S&P 500

Year (each data point represents a rolling 7-year average of average lifespan)

Source: adapted from INNOSIGHT, "Creative destruction whips through corporate America" 2012, based on INNOSIGHT/Richard N. Foster/Standard & Poor's data

Fortune 500 attrition

Years from start

Source: adapted from D. Stangler and S. Arbesman, "What does fortune 500 turnover mean?," Ewing Marion Kauffman Foundation, 2012

Digital technologies don't just threaten large corporations, they can also be a source of immense value-creation. Thus, since adoption rates for new technologies have accelerated in recent decades (Figure 2) [4], there is increased potential for rapid value-creation and value-capture for firms that can bring innovative solutions to market.

Figure 2 Technology adoption cycle
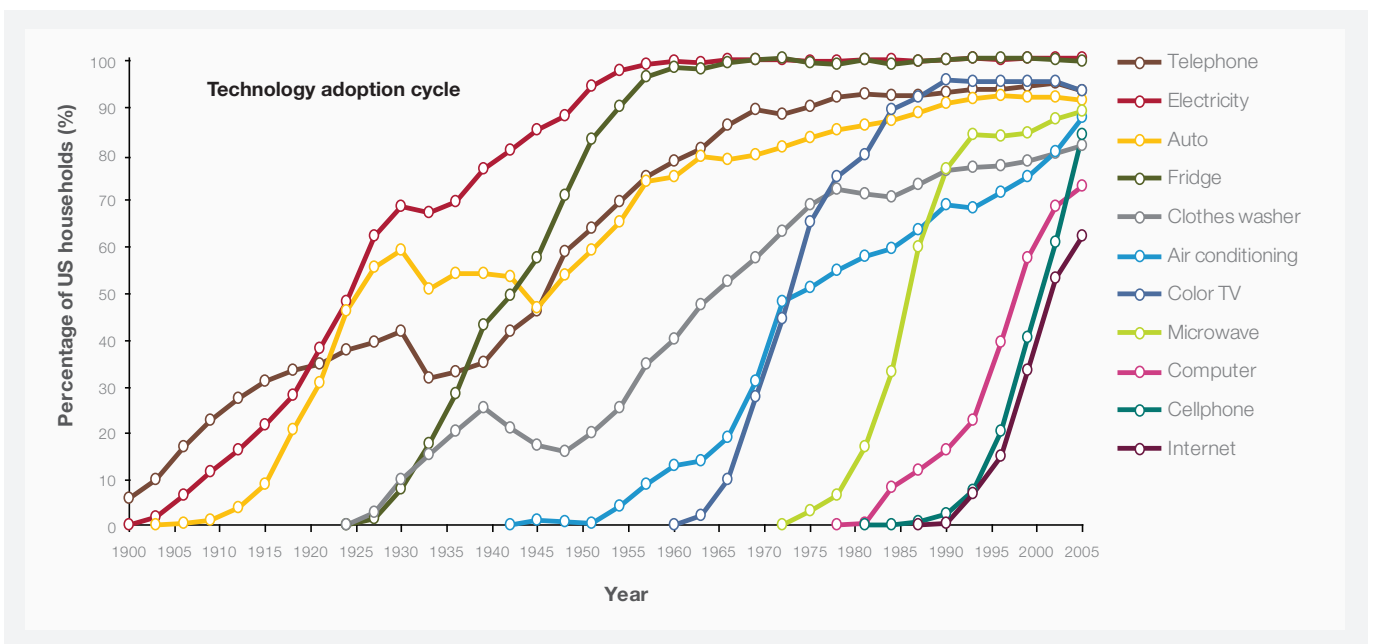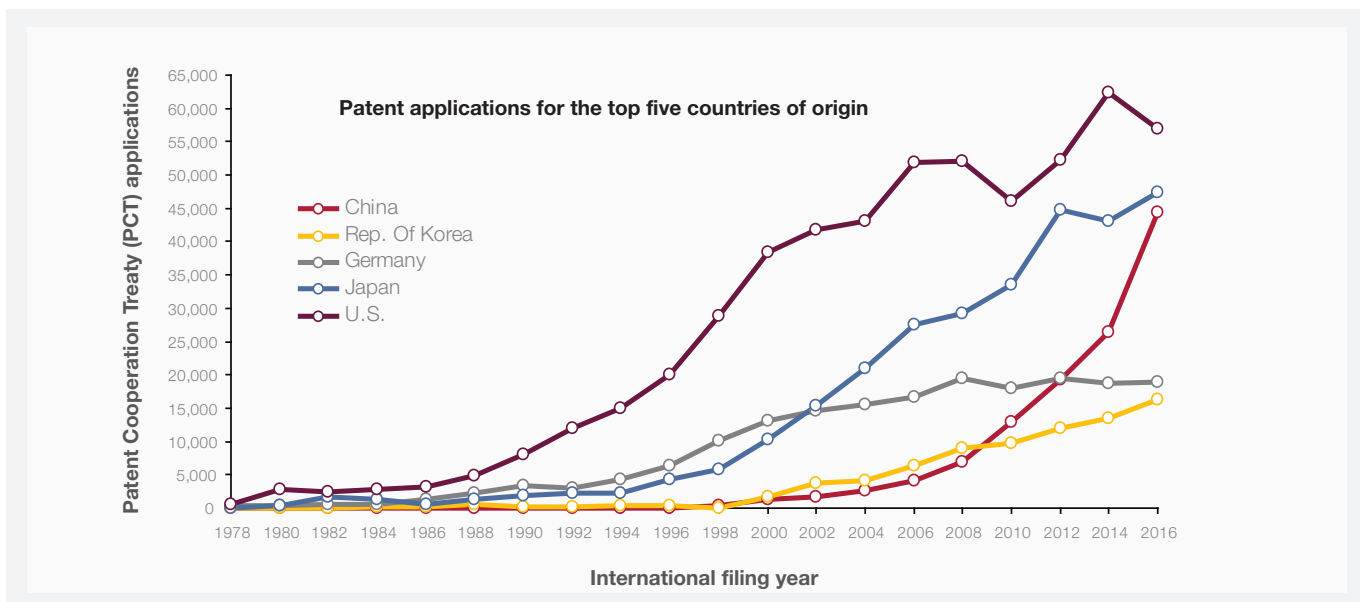

Technology adoption cycle

X-axis: Year (1900–2005)
Y-axis: Percentage of US households (%)

Legend: Telephone, Electricity, Auto, Fridge, Clothes washer, Air conditioning, Color TV, Microwave, Computer, Cellphone, Internet

Figure 3 Patent applications for the top five countries of origin

Patent applications for the top five countries of origin

Legend:
- China
- Rep. Of Korea
- Germany
- Japan
- U.S.

Y-axis: Patent Cooperation Treaty (PCT) applications (0 to 65,000)

X-axis: International filing year (1978 to 2016)

Faced with these trends, large firms must re-consider their approach to innovation. But how? One answer, which is already clear in the data, is that firms are increasingly using patents to protect innovations (Figure 3) [5]. However, our research reveals that, faced with the array of opportunities created by digital technologies, large firms want to do more than just protect the innovations they are already producing: they want to generate more innovation, and to do so as quickly as possible. To rigorously navigate through the many practices proposed by strategists and used by innovative companies, Capgemini Consulting has partnered with the MIT Initiative on the Digital Economy (IDE) to study how large companies can improve their corporate innovation practices in the digital age. In this report, the first of a series, we outline the important lessons that can be learned from the academic and business literature as well as lessons learned from interviews with executives in many of the world's most innovative firms.

Corporate Innovation: A Quick History

1960s - 1980s: A Battle Among Giants

The study of corporate innovation was initiated by Cole in 1959 [6], who built on Joseph Schumpeter's 1934 definition of "innovation" from his influential book "The Theory of Economic Development" [7]. Schumpeter defined innovation as the step where the intellectual creativity of invention is instantiated in "business action" [8]. Cole advanced the study of innovation by focusing on organizations in his work on entrepreneurial change in firms [6]. Since Cole's work, a flurry of research has emerged on corporate innovation. In the 1960s, researchers initiated studies on the internal logic of the innovation process [9], the innovative behaviors of organizations [10], and the measurement of technological innovations through patents [11]. Scholars also noted that companies in stable industries had different organizational approaches to innovation than those in newly created industries (e.g., electronics) [10].

During this period, innovation was mainly confined to researchers in R&D departments and laboratories, who steadily pushed the boundaries of technology in support of the firm's next generation of offerings. "Internal R&D was viewed as a strategic asset and even a barrier to competitive entry in many industries. Only large companies with significant resources and long-term research programs would compete." [1]

Since 1990: Digital Disruption and the Rise of Open Innovation

In the 1990s, online opportunities emerged due to the growth of the Internet, which allowed firms to reach a much larger audience more quickly. Software also scaled faster than offerings from traditional industries, e.g. manufacturing. And the venture capital model was instrumental in funding innovative startups [12]. The combination of the digital revolution, venture capitalism, and fast-changing consumer behavior enabled market disruptions. Several great companies that had dominated their respective industries for decades failed to adapt. For example, Sears, the dominant retailer in the U.S. between the 1930s and 1970s, reported a loss of $3.9 billion on revenues of $52 billion in 1992 [13], and never recovered, as the company missed the discount-retailing and home-center wave. Similarly, Xerox, the leading player in the high-volume photo-copying industry, started to decline when it missed the market move to small tabletop photocopiers.

The research that led to Christensen's 1997 book "The Innovator's Dilemma" [14] further sounded alarm bells for large companies around the world, and highlighted that even "well-managed companies that have their competitive antennae up, listen astutely to their customers, invest aggressively in new technologies, may still lose market dominance" [14].

Corporate innovation was also shaped by increasing mobility for skilled employees [1], who could carry human capital out of large company labs to new startups.

To guide firms through these transitions, various schools of corporate innovation strategy have emerged. Geoffrey A. Moore argues that parts of a business should be treated as cash cows to enable other "rising star" opportunities to grow and thrive [15]. Wharton professor George

S. Day advocates the importance of having a disciplined process of setting growth objectives, finding and selecting the best opportunities, and configuring culture, capabilities and organizational structure to support innovation and growth [16]. Govindarajan and Trimble emphasize the execution side, and argue for the importance of building the right team and running disciplined experiments [17]. In addition, various works have provided new perspectives on innovation, including concepts such as ambidexterity (remaining competitive in a core market, while also progressing in new domains) [13], the development of innovation ecosystems [18], and the next generation of corporate and innovation structure [19].

Two particularly influential works were Henry Chesbrough's [1] "open innovation" recommendation for companies to leverage external sources of innovation rather than relying exclusively on their internal R&D, and Eric Ries' "lean startup" proposal, which encourages startups and incumbents to accelerate the innovation process by building a "Minimum Viable Product" and then performing frequent tests of the product and its market viability [20].

The digital revolution has brought numerous other opportunities. Big data and machine learning facilitate the understanding of customer needs; mobile technology allows businesses to interact with their customers on a 24-7 basis; dematerialization (e.g., CAD, digital design) makes concept development more efficient and allows geographically separated participants to collaborate, and modular components and standardized interfaces make it possible to build on existing products and integrate different components. Many of these advances were important in more than just one industry. This meant that becoming a leader in these areas wasn't about out-innovating just your competitors, but about out-innovating leading technology firms across the economy. Faced with such challenges, open innovation wasn't just an option; it was a necessity.

How Can Corporate Manage Innovation in the Digital Era?

Nowadays, company reliance on digital technologies for innovation has progressed to the point where, for many, 'digital' and 'innovation' have become synonymous. There have been numerous changes in the way corporations address innovation and the technologies that they incorporate into new offerings: backbone systems, cloud, and computer-aided design are used to improve innovation efficiency, and technologies such as mobile, machine learning, artificial intelligence and the Internet of Things (IOT) are leveraged to create the next generation of offerings or even change business models. Thus, companies must constantly look outside their core business to identify the next big opportunities and manage competitive threats.

Based on our analysis of the previous literature, as well as interviews with many of the world's most innovative companies, we can summarize our findings in three questions that are key to innovation in a digital world:

1. **Innovation Architecture** - How can a firm best balance the exploitation of existing core assets and the exploration of new businesses, and organize effectively around this balance?

2. **Innovation Sources** - How can a firm best source innovation, either from within the firm or outside of it?

3. **Innovation Capabilities** – What capabilities are critical to support corporate innovation in the digital age?

1. Innovation Architecture

Traditional strategic thinking argues that companies should identify their competitive advantage, stick to it, and work hard to protect it from competitors [21]. However, a myopic focus on existing competitors can lead firms to miss opportunities for value-creation that emerge from outside their industry. Fearing that they will become the next victim of disruption, some companies are now flipping to the other extreme—they try to act like a startup by abandoning broader coordination in favor of local nimbleness. At the extreme, firms may build a portfolio of forward-looking acquisitions, even if they fit poorly with the existing business model, for the strategic options that they provide. However, such approaches fail to take advantage of existing company resources and capabilities, and can risk considerable damage to the company reputation if part of their portfolio tarnishes their overall brand.

In the field of strategic management, research on ambidexterity and dynamic capabilities focuses on this topic. Ambidexterity is defined as "(t)he capability of growing core business and actively searching for new breakthroughs simultaneously" [13], while dynamic capabilities are defined as "(t)he firm's ability to integrate, build, and reconfigure internal and external competences to address rapidly changing environments" [22]. Over the past few years, these two concepts have gradually merged in the sense that solutions identified by ambidexterity research are understood as dynamic capabilities [23].

The key for businesses is to find the right middle ground between coordinating (which can provide more value) and independence (which can speed innovation). O'Reilly and Tushman summarized this in their book "Lead and Disrupt" [13]:

> *For organizations to survive in the face of change requires their leaders to do two critical but contradictory things: exploit existing assets and capabilities through continual incremental innovation and change and explore new markets and technologies where their existing assets and capabilities can give them competitive advantage over new entrants.*

Yet, simultaneous exploitation and exploration presents a difficult managerial balancing act. First, the two tasks are different in nature: exploitation requires discipline, productivity and efficiency, while exploration focuses on flexibility, innovation and potential growth. Exploitation of an existing core business is often repeatable and predictable, while exploration usually relies on learning by doing and constantly adjusting plans based on uncertain situations. Second, the gains from exploitation are clearer and easier to forecast. Managers are drawn to predictable increases in efficiency and steady product improvements because they offer clear short-term business and career benefits. Exploration requires risk-taking, and it can be difficult to get managers and employees excited about a project that may not succeed [24].

For these reasons, the tension between exploration and exploitation must be carefully managed within firms. Predefining a balanced innovation portfolio that is aligned with an innovation strategy can be very helpful in terms of guiding a company's innovation investments. The innovation portfolio should cover three types of innovation (Figure 4) [25].

Figure 4 Three types of innovation [25]
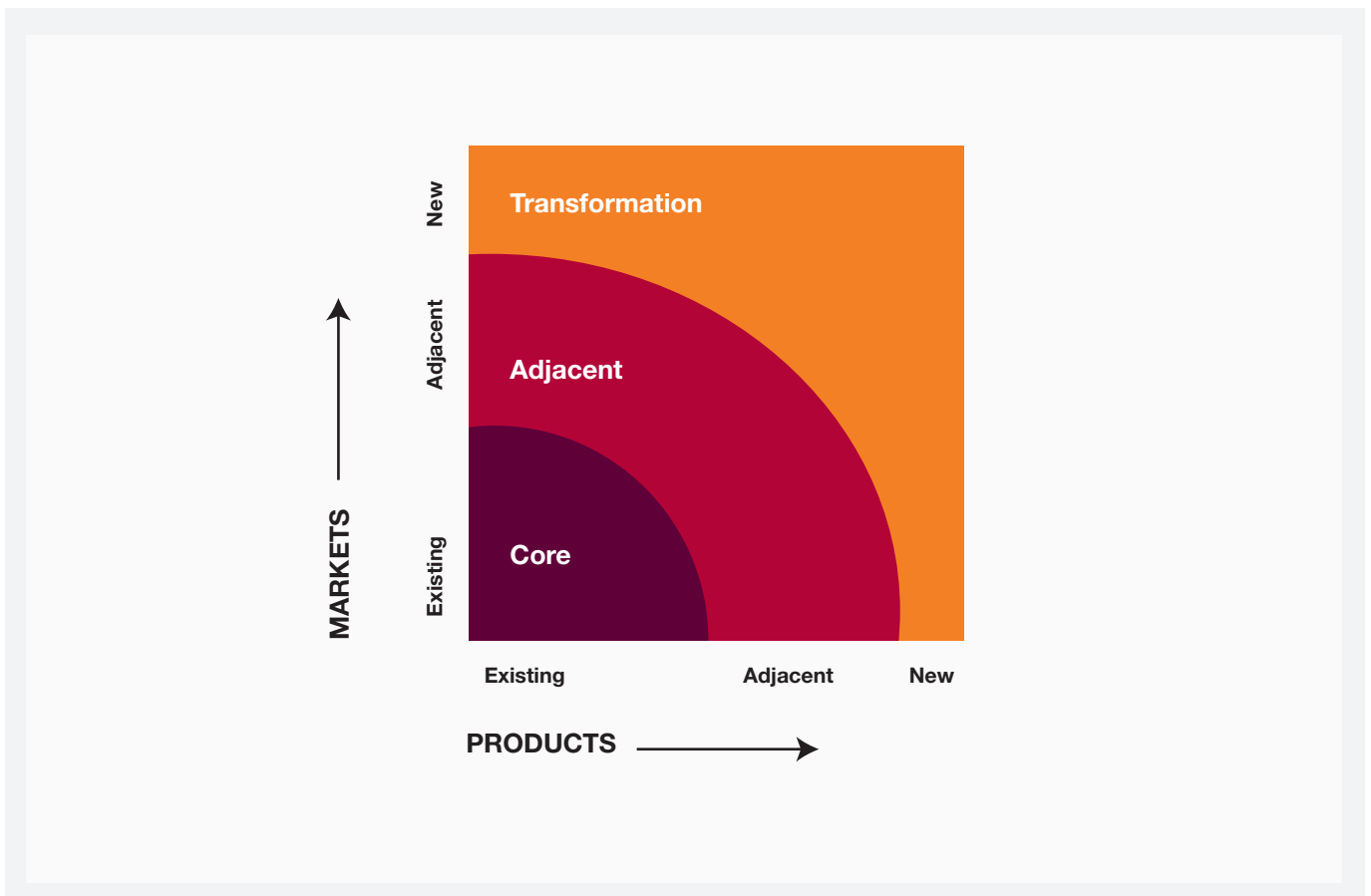
CORE

Innovation at the core is incremental innovation that is based on existing products/services as well as on processes. *As an example, Monsanto, a global modern agricultural company, recently innovated how they could reduce volatility in demand, which helps optimize their supply chain. Machine learning models were used to better predict market demand and reduce excess inventory across products and brands.* Most large firms are good at innovating at the core.

ADJACENT

Adjacent innovations are typically new products or services developed for existing customers who the company understands well, or existing products or services launched in new markets. Most large firms also excel in this type of innovation, and use it to generate quick financial return. *Ant Financial, an affiliate of the Chinese e-commerce giant Alibaba, is actively exploring machine learning and AI technologies to generate new services for its 450 million active users. For example, the company will soon launch a car insurance claim service that will allow car owners to provide a photo of the accident, and the AI system will automatically process the claim with the insurer.* The key here is to leverage existing customers or rely on existing capabilities and put them to new uses [18].

TRANSFORMATIONAL

Transformational innovation is the company's bet on the next big thing. This type of innovation is often long-term and high-risk, as both the technology and market are new to the company. *As an example of transformational innovation, Uber is actively exploring the technology of flying cars, and is planning a launch in Dubai in 2020. While this technology currently sounds like science fiction, it could have the potential to transform the whole automotive and transportation industry.* Many large companies usually struggle with this type of innovation, as the technology is often not mature and its business applications are still unclear.

In a cross-industry study conducted in 2012, Nagji and Tuff [25] found that high-performing firms usually allocate 70% of their innovation resources to core innovation, 20% to adjacent innovation, and 10% to transformational innovation. This ratio differs for different companies, but the idea is that part of the budget should be earmarked for exploration and not diverted because of pressures for short-term financial performance. Of course, the rate of failure increases when moving to the upper-right corner of the graph in Figure 4 [16], so firms must ensure that the potential gains are commensurate with this greater risk. Evidence suggests that firms feel that these investments are worth it. A 2014 survey [26] showed that companies planned to increase the share of their R&D budget in adjacent and transformational innovation from around 40% to around 60% over the next 10 years. *Roche Diagnostics is one of the companies that carefully distribute its innovation budget. Dr. Jochen Hurlebaus (Head of Central R&D Services of Roche Diagnostics) stated that in his Business Area "Centralized and Point of Care solutions" there is a dedicated budget (approximately 5% of the total R&D budget) to research new products and new technologies, "they (the business leaders) have accepted that they can only get access to that budget if they actually bring out long-term topics or innovative ideas" he said.* GE Transportation CTO Dominique Malenfant revealed that GE uses a similar strategy: *"We always reserve part of our budget for disruptive technologies, where we don't necessarily get a solution or a product in mind, but we experiment. We learn about the technology and from there we decide if it's worth to have a more substantial investment on it.".*
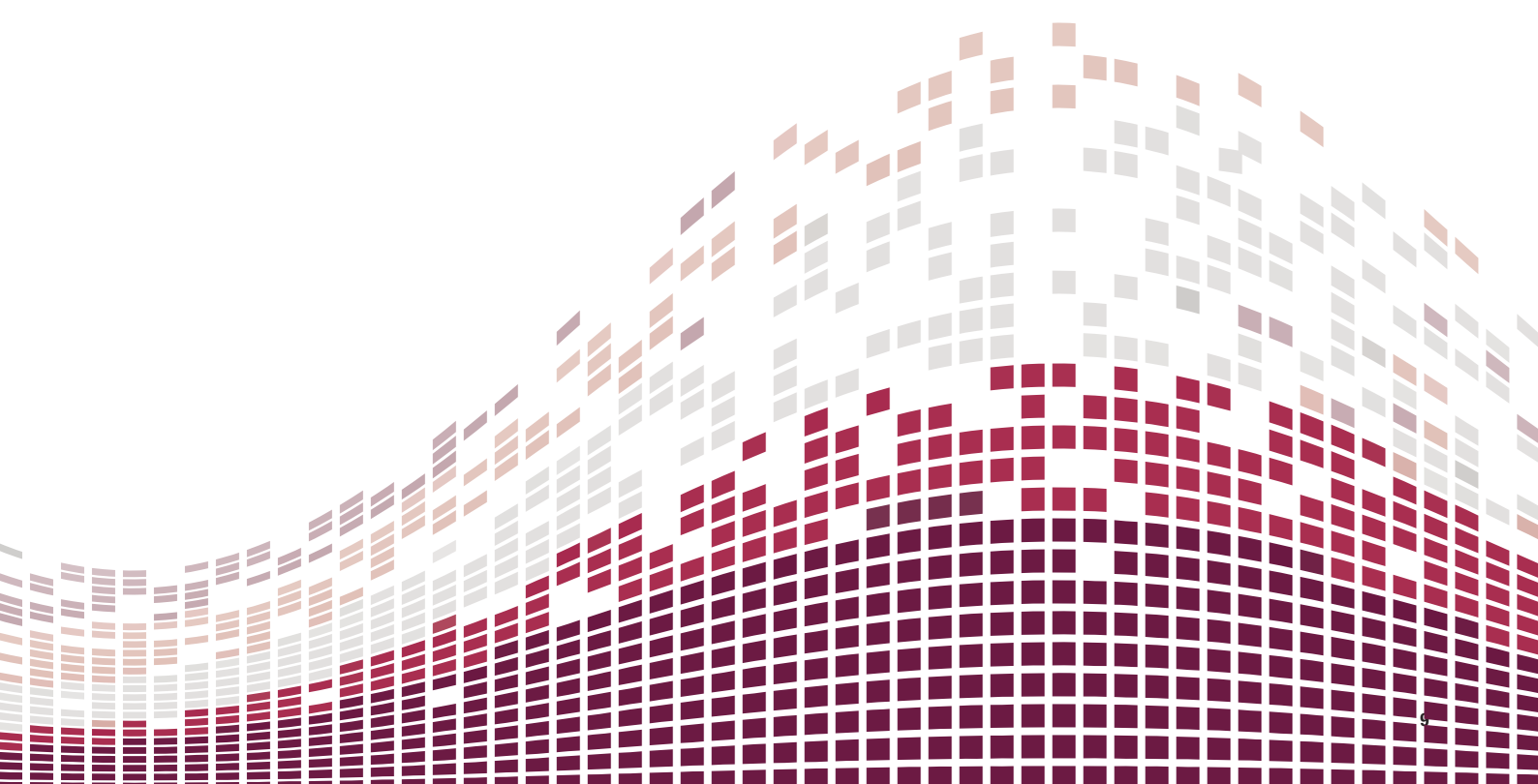
Three-layer Innovation Architecture, a structured approach to Innovation

Anthony Newstead, Coca-Cola Global Group Director of Emerging Technologies & Strategic Innovation talks about an approach to Innovation

Didier Bonnet: Through your work at Coca-Cola, what in your opinion would be a best practice approach to Innovation?

Anthony Newstead: : I believe an optimum way to approach innovation within a corporation is to first of all avoid defining innovation as purely blue-sky thinking, disruptive, big-bets. All forms of change, from a more streamlined way to produce your 'end of month reports' to a new product category are in my opinion examples of innovation.

In addition, I believe that for innovation to survive and thrive within an organization it needs to demonstrate tangible value that justifies the investment and builds trust in the approach. The three-layer Innovation architecture offers a structured approach to address these needs.

Imagine a pyramid with three layers in it. The bottom layer is what I term, **Foundational Innovation**. This is a broad layer, horizontal across the business in its reach, that focuses on incremental change, executed through a process of questioning all aspects of operational processes. Does an evaluation agreement really need to be so exhaustive? Can our IT gate processes be flexible and sensitive to the needs of each initiative evaluated, rather than a fixed approach? Are there any ways in which we can streamline our respective areas of scope? Encourage everyone to question everything around them so that collectively changes can be applied, which can make the company more efficient at a lower cost, driving value. This layer can quickly provide real value to the company and also energizes employees, who have a sense of being given permission to think differently as they see their senior leaders taking the initiative and establishing innovation as a strategic pillar of the company.

The Foundational Layer enables a company to be nimble and streamlined enough to engage and absorb young, eager startups into their organization, which is why it's important to go through the Foundational layer first. Having established a Foundational layer of innovation, we can next gravitate to the **Transformational Innovation** layer. This is where the company reaches outside of its four walls and connects into startup ecosystems around the world, exploring innovative solutions that can solve tangible business needs. The key to maintain trust in the process of innovation at this layer (that has been established through the Foundational Layer process), is to ensure startup engagement is business driven, rather than technology driven. Startups should be solving an identifiable business need that has been prioritized by the relevant business area. This helps to ensure the program is in a 'pull-mode' championed by the business areas and not a 'push-mode' driven by IT, with easily identifiable methods of measuring value over time, based on successful business challenge resolution.

The final layer is the **Disruptive Layer**. This is where a small team is focused on what's coming over the horizon that could impact the business: e.g. AR, VR, the age of autonomous vehicles, robotics, crypto-currency solutions, societal impact of these new technologies etc. exploring new business models with the potential to disrupt the status quo. This has a more longer-term value proposition but will feed into and provide guidance to the Transformational and Foundational layers below and is an important element of an overall innovation strategy.

I believe the key to a successful corporate Innovation strategy is fundamentally to approach it in this structured fashion. Each layer provides value to the company: initial immediate low-hanging fruit wins that develops trust in the innovation process through the Foundational layer, which provides an energized workforce empowered to innovate and ready to engage with business-driven startups targeted in the Transformational layer, bringing additional value that further develops trust in the Innovation process and, together with the Foundational layer, provides support for moonshot initiatives with uncertain but important long-term value explorations of new business models in the Disruptive layer.

Each stage does require in addition a deeper-dive into cultural change initiatives, ensuring innovation is inclusive to all, rather than the preserve of the few, ensuring everyone has a voice and feels empowered to participate, to collectively develop an entrepreneurial mindset across the entire organization. It is also important to define an over-arching vision as to why you are innovating in the first place, that ties in all three layers into a narrative that can inspire.

However, with an inclusive approach and a vision in place, I believe a three-layer innovation architecture, with a prioritized sequential approach provides a solid structure to support and – critically – continue to sustain an innovation drive within an organization, demonstrating positive ROI throughout.

Executives often find managing exploitation and exploration within one organizational structure difficult [22], However, during our interviews, we identified three typical innovation architectures that companies find to be effective for addressing their needs:

1. Central R&D that covers both internal and external innovation

This model uses a centrally funded R&D entity to leverage both internal innovation sources (to focus on the firm's internal expertise) and external innovation sources (to leverage the innovation ecosystem). While some companies allocate the internal and external functions into one entity, others split the two into separate, but centrally funded, organizations. In this model, the central R&D entity is in charge of adjacent and transformational innovation, while incremental innovation is usually done by employees as part of their daily jobs.

KONICA MINOLTA, which, in 2017, was recognized by the Japanese government as the Japanese company with the best innovation practices, adopted this model a few years ago. The company has centrally funded R&D centers in four locations that focus on developing their internal expertise. In addition, the company established an entity called the "Business Innovation Center" in 2014. The Center now has five locations and is in charge of developing new business through collaboration with customers, startups, partners, and universities. To enhance the innovation culture and encourage incremental innovation among employees, the company has a Technology Innovation Program (TIP) that allows employees to use 10% of their work time for 6 months to work on new approaches to solve future business challenges.

2. Within-unit R&D plus innovation facilitation platform

This model is composed of "within-unit R&D," normally built for each of the business lines, and a centralized digital innovation platform that provides innovation methodologies, processes, training, specific capabilities, and connects the company to external innovation sources. It is most often found in multi-business companies, such as Schneider, since the innovation cycle and requirements for each of their business lines are so different that a centralized R&D entity becomes untenable. Similarly, financial services companies often use the model in order to allow different business lines deal with specific regulations in an individual manner that suits them best.

Schneider Electric is leading the digital transformation of energy management and automation across the data centers, buildings, industry, and energy infrastructure markets. Due to differing customer needs across these markets, each line of business oversees its own R&D. However, for a transversal technology such as the Internet of Things, Schneider has a centralized platform to scale digital innovation in order to solve specific customer challenges. Cyril Perducat, EVP of IoT & Digital Offers, noted that, "We facilitate the development of digital solutions across the company, leveraging advancements in sensing, mobility, cybersecurity, analytics, and cloud. Providing both business consulting capabilities and technology expertise to our businesses, we co-innovate digital offers with our community of customers, partners, and technology partners to accelerate innovation—including connectivity, AI, and machine learning advancements— in a very business-relevant way."

Barclays employs a federated innovation model and the Group Innovation Office (GIO) provides the platform to facilitate innovation across the company. Nick

Kerigan (Managing Director of Future Payments in Cards & Payments) explained the structure: "The platform in its broadest sense includes the physical platform, Rise - that's sites we have around the world, together with our fintech collaboration platforms such as the Accelerator programs, and the innovation processes we use. The innovation teams in Barclays are then organized by business area: we have an innovation team with an innovation lead within it. Then also there will be clusters of colleagues involved in innovation further down in sub-businesses."

3. Independent innovation lab

This model encourages an innovation team built with cross-functional full-time employees that is independent enough so that it doesn't get constrained by legacy decision-making processes. However, it is important for the team to benefit from the resources of the core business (e.g., capital, technology, partnership, channels, existing market, etc.) with strong leadership support, since this is the biggest advantage that large companies have over small firms [13].

IKEA has an innovation lab called "Space 10", the purpose of which is to invest in the future of urban living. Although IKEA funds the lab centrally, it operates independently in organizing "labs" with external designers around the world to test new ideas and share prototypes with customers. McDonald's also has an innovation lab, where new ideas are tested for its 37,000 restaurants around the world. "In this lab we develop and test emerging technologies and new solutions, especially how they would work in a restaurant. From there we graduate these solutions to an owned restaurant with real customers, which allows us to leverage actual customer interactions and feedback to help shape the solution before we rollout and scale." explained Farhan Siddiqi, Chief Digital Officer of McDonald's Corporation.

2. Innovation Sources

The identification of efficient sources for different types of innovation is another challenge for innovation leaders. Historically, companies relied heavily on their internal talent to generate innovative ideas, and to transform these ideas into real products and services. However, there are always more people with good ideas outside the company than within, so firms are increasingly using "open innovation" models, where "firms can and should use external ideas as well as internal ideas, and internal and external paths to market, as the firms look to advance their technology" [1]. The most commonly used innovation sources nowadays are shown in Table 1.

Table 1 Innovation Sources[1]

	Innovation source	Description
Internal	Top management	Innovation steering committee, Chief Innovation Officer or other senior executives, who set the strategy and direction of innovation.
	Central R&D	R&D entity that is centrally managed and financed by the company.
	Within-unit R&D	R&D entities that are located at different business levels of the company.
	Innovation lab	Innovation lab consisting of a cross-functional team to carry out independent innovation or to serve as an innovation hub in an innovation hot spot such as Silicon Valley.
	Intrapreneur	Employees who work on their own innovation projects (usually part-time) with the support of the company.
	All employees	Includes all employees of the company who work on innovation either full-time or part-time.
External	University/researcher	Universities or researchers who are sponsored by the company or have an innovation agreement with the company.
	External opinion leader	Policy makers or opinion leaders who are part of the company's external advisory board.
	Consulting/design firm	Consulting or design firms that provide innovation-related insights and services.
	Extended enterprise	Firms that are in the value chain of the company, such as the company's suppliers.
	Technology vendor	Vendors of advanced technologies, such as Internet of Things technology providers.
	Startup	Startups that are solicited through innovation scouting, incubation, acceleration, corporate venture capital, acquisition, etc.
	Other firms	Other big firms that innovate with the company through collaboration, licensing, joint venture, etc.
	Independent innovator	Independent innovators who can be reached through 3rd party or corporate innovator networks.
	Crowd	Crowds that can be solicited via crowd-sourcing platforms, Hackathons, innovation competitions, or developer networks.
	Customer	Customers who provide feedback regarding the company's innovation, and participate in co-creation or proof-of-concept.

[1] MIT-Capgemini corporate innovation analysis (from literature review and interviews)

Several of the sources listed in Table 1 have drawn increasing attention from strategists and companies in recent years—for example, there is a trend for building innovation labs near innovation hot spots such as Silicon Valley and London. The goal is to closely monitor technology trends and get access to startups where innovation happens. A recent Capgemini Consulting study [27] looked at 340 firms with revenue greater than 1 billion dollars and found that 87% have a lab or similar space dedicated to innovation. The number of innovation labs nearly doubled from 2015 to 2017.

Another interesting source of innovation is crowd-sourcing, which can be an effective and cost-efficient way to source innovation from people with useful skills but who are outside the company. Research by Kevin Boudreau and Karim Lakhani [28] showed that technical solutions obtained from such online platforms can sometimes outperform the solution generated by experts from laboratories, since a problem in one domain might have already been solved in another. *An example of crowd-sourcing is P&G's "Connect + Development" platform, where P&G publishes its current needs across P&G's business (products, technology, in-store, ecommerce, and supply chain) on a website, and anyone who has created an account can submit a solution to address the need.*

One of the fastest growing sources of innovation for big companies is startups, which can take many forms. Companies build incubators/accelerators to help early-phase startups convert their ideas into real products, or create corporate venture capital programs to invest in small existing companies. Research [29] shows that, among the top 30 companies in seven industries, 44% had accelerators or incubators in 2015, compared to only 2% in 2010. This research also showed that 40% of these companies had corporate venture capital programs in 2015, compared to 27% in 2010.

Another rising source of innovation in large firms is intrapreneurship, which refers to when employees with an entrepreneurial mindset and who are passionate about starting their own innovative projects are supported by the firm. *In 2015, Lenovo initiated an intrapreneur program called "the Dream Lab" to support employees in their startup projects. A committee composed of Lenovo executives and external investors selects the most interesting projects during a road show, and the selected projects are given a four-month acceleration service by the Dream Lab. The graduated projects are then either integrated into Lenovo's core business or operated as independent companies.*

With all these different sources of innovation, what should a company focus on? In part, the answer can be guided by the type of innovation the company is interested in. If we map previous academic research, as well as the results of our interviews with innovative companies, to Nagji and Tuff's Core-Adjacent-Transformational framework, we see that certain sources are more effective for particular types of innovation (Table 2):

Table 2 More effective innovation sources for different innovation types[2]

Innovation Type	Innovation Sources to Leverage
Core	All employees [30], Customer [31]
Adjacent	Independent innovator, Crowd [32], Startup, Technology vendor, Intrapreneur, Extended enterprise, Other firms
Transformational	Central R&D, University/researcher [32], Extended enterprise [11], Innovation lab

[2] MIT-Capgemini corporate innovation analysis (from literature review and interviews)

Sources for core innovation

Core innovation provides continuous improvement of a company's offerings or internal operations. According to Govindarajan and Trimble [30], this is the type of innovation that can make every employee of the company feel that they are part of the innovation process, thereby promoting a culture of innovation. They suggest that core innovation should be part of a company's day-to-day operations and sought by employees as part of their routine jobs, sometimes with a team of full-time employees in a supporting role to connect people working on similar innovation projects or performing analyses to identify opportunities for improvement. Another important source for core innovation is the customer [31]. Most of the companies that we interviewed closely collaborate with their customers to improve their existing offerings. The most-leveraged approaches are customer data collection and analysis, as well as customer co-creation. *Blablacar (the world largest long-distance carpooling company) uses customer feedback to constantly improve its offerings: "The improvement of our App is never finished. Our Community Relations team and Research team constantly gather customer feedback to provide guidance to the project managers and engineers", said Verena Butt d'Espous, Head of Corporate Communications of the company.*

Sources for adjacent innovation

Adjacent innovations are shorter-term than transformational innovations and can generate quicker financial returns. Therefore, the key is to identify market needs, find the sources of innovation and quickly integrate innovation back into the company to launch the products or services. Especially for cross-sector or general-purpose digital technologies, it is usually more efficient to find external partners to get access to the technologies needed. Technology vendors and startups are usually efficient sources for this type of innovation; intrapreneurs, the extended enterprise, and other firms are also places to find good ideas or expertise. Greg Satell [32] also suggests soliciting the crowd and independent innovators, since the problem to be solved is usually well defined. *IKEA has found it efficient to leverage the expertise of suppliers to solve specific problems. Drew Smith (Manager Data Analytics & Information Governance) and James Collis (CIO Office) gave us an example of finding a solution for a foldable metal drawer: "That was an impossible challenge when you have people who don't have the time or the focus to really crack that problem. Much of the product development puts a lot of energy into important, but iterative improvements. For big leaps forward we have a set aside innovation department who can focus and leverage our working relationships with a wide array of suppliers across categories. In this case the innovation team could tap into the talents of 10 other suppliers (besides 'drawer' suppliers), including machinery suppliers who might have never made a drawer, but have high competence in folded metal. So it's a great combination, you have the focus of the internal innovation team, an enormously diverse supplier base and the ability to look at things with an entirely fresh perspective."*

Sources for transformational innovation

Transformational innovations are long-term and represent a company's bet on the next big thing. It is important that transformational innovations are free from pressure to provide a short-term return [32]. Effective sources for transformational innovation include central R&D, innovation labs, universities/researchers, and the extended enterprise. Technology-intensive companies such as Microsoft and IBM, as well as many healthcare companies, actively conduct basic research internally in dedicated research centers. In industries such as high-tech and manufacturing, companies collaborate with their suppliers or other parties within the extended enterprise to develop the next cutting-edge technologies. Many firms establish long-term collaboration with universities and researchers to carry out transformational innovation. *iFLYTEK (the global leader in computer speech technology) is a good example of integrating internal R&D with academia. The executive president of iFLYTEK, Dr.Yu Hu, told us that iFLYTEK was established in 1999, and iFLYTEK Research was established in 2005 for the purpose of aggregating innovation from all universities around China. On top of the research center, iFLYTEK also has multiple joint labs with top Chinese universities. "The director of each lab is usually a professor from the university, and we also send our experts from iFLYTEK research to join the lab and work with them", said Dr.Hu. The labs work on emerging technologies and long-term innovation that is aligned with iFLYTEK's innovation strategy, but do not necessarily have a direct link to the current company offerings.*

3. Innovation Capabilities

What innovation capabilities are the most critical in this digital age and how should they be used to support innovation? In our interviews with executives at many of the world's most innovative companies, five key capabilities stood out:

1. Establish leadership commitment and a culture of innovation
2. Engage in agile development in the most effective way
3. Measure innovation
4. Educate your people before they innovate
5. Streamline the foundation and build technologies into your employees' day-to-day lives

1. Establish leadership commitment and a culture of innovation

Leadership commitment is the first step toward successful corporate innovation. Many of the executives we interviewed found that top leadership's dedication sets the tone for innovation for the whole company. *For example, a CIO of a major US consumer bank told us that: "Every four weeks [we do] a full ninety minute debrief of everything that is happening in terms of innovation with the CEO and his team. That means something in terms of importance, dedication, and a willingness to learn and to adjust."*

In addition, we found that when top management had clearly defined innovation strategies or focused themes, it was helpful to align the whole company around those priorities. *The General Manager of New Digital Business at BBVA, Teppo Paavola, expressed similar sentiments, saying that BBVA has 6 priorities for innovation set by the CEO, including "better customer experience".* This prioritization helps ensure that day-to-day financial pressures don't squeeze out innovation, or push it toward only short-term goals.

Leadership support from the beginning was found to be essential for getting continuous support and preventing unexpected change in the middle of a project. The most common practice is to set up an innovation top-management board that meets regularly to review innovation strategy and balance the innovation portfolio among different horizons. *A CIO of a major US consumer bank told us that: "We have now one committee for our company, what we call the New Business Initiative committee. We said, let's have thirty minutes, every initiative that comes in with a press release. So what is it that you try to announce? What is it that you try to accomplish? What will you say to the market when this is done? And based on that press release, we do the risk assessment, and we make decision."*

A culture of innovation, especially the willingness to experiment and tolerate failures, was also highlighted as being key for innovation success. *Nucor CEO John Ferriola told us that "one of the things that I think is important, that is core to our company and core to spurring innovation, is that we have a policy where we absolutely encourage our teammates not to fear failing… if we, through our actions, encourage our teammates to fear failing, they simply will not stretch the limits of their capabilities or the limits of their imaginations."* As a born-digital company, Uber has an experimentation culture that is deeply ingrained into the DNA of the company. *Janelle Sallenave (Head of Customer Support at Uber) told us that: "This is a company that is obsessed with what we call experiments. Everybody is encouraged to, whatever it is that they're working on, reimagine how it could be better, different, cheaper, faster, whatever it might be… I think one of the signs of a company beginning to enter a phase in which maybe more innovation comes through, is when the culture begins to be accepting of, and*

frankly celebrating, failure. Because you can't innovate without failing! That's what you're doing. You're failing until you succeed!"

In established companies, building a culture that tolerates failure requires more work. *Konica Minolta's Senior Executive Director Yuji Ichimura explained to us the magic that he uses to encourage a tolerance for failure in innovation: "One unique thing for us is, we count the failed projects the same as projects going forward or are in progress, so that team doesn't hesitate to fail, or openly discuss the appropriate timing to bring the project to the market."*

2. Engage in agile development in the most effective way

Traditional innovation was often performed in stages: engineers worked to perfect a product, and only then would it be introduced to customers. This process can work well if the desired product and development process are well understood. However, for many potential products, they aren't, and so a staged process can waste time by developing features, or even whole products, that inspire little interest in the market. Inspired by lean manufacturing, design thinking, customer development, and agile development, Eric Ries proposed the lean startup methodology [20]. Originally, the lean startup theory was mainly applied in software development, where it is easier to build a minimum viable product, test it with customers, gain validated learnings, and decide to preserve or pivot the strategy. Now, with the development of digital design, 3D printing and other tools, this strategy can be applied to many types of products. *GE Transportation uses an approach called "Fast work", which is very similar to the Lean Startup approach. The CTO of GE Transportation, Dominique Malenfant, explained to us*

the advantage of this method compared to the traditional waterfall approach: "No matter which kind of process you're in, there are half a dozen things that if you don't pass that bar, the project is going to get killed, it's just that you only find out about them later with the waterfall process. Also, in the waterfall case, as you have a lot of money invested already in the project, so that you don't want to stop and kill it right away because you want to report back what you achieved with the money you spend. With the agile method, when your assumption is not validated early in the game, it's much easier to kill and also most likely you have an opportunity to pivot and address your assumptions to something that still makes sense and then you continue but in a different direction."

To use the agile approach effectively, it is critical to build cross-functional teams with the right capabilities. *In 2017, BBVA's mobile banking App was recognized by Forrester as "the best mobile banking App in the world." The head of digital banking, Gonzalo Rodríguez, who is in charge of the development of this mobile App explained the importance of having the right team: "It is very important to bring the right people from minute one. And by the right people, I mean business, engineering, UX (user experience), and data working together for every single solution. When we started this journey three years ago, we had only business and engineering… Now we have 600 people from design, UX, engineering, business, and data working together in 45 scrum teams… we are working at a pace that is unthinkable three years ago."*

Beyond cross-functional team capabilities, it is also crucial to adapt traditional decision-making processes to fast-track progress. *A CIO of a major US consumer bank explained their way of organizing decision making for an agile project: "The way we have set it*

up was, and that's now becoming the model for most of the change that we are driving, that there is a product owner, who's on General Manager level, that person is what we call the "Director of Everything"… She owns risk, control, finance, IT, marketing, design, everything around the initiative is in her hands. And she gets a mandate, and she can go up directly to the CEO of the company, She has an open line with everybody if she needs help. But what we basically do is empowering our own teams to listen to her and to nobody else. Otherwise in a matrix driven organization, if you don't watch out, you'll end up in a matrix system, meaning 60 people having their ideas and opinions around everything, meaning you get stuck in every decision."

3. Measure innovation

In performance management, it is widely believed that "we are what we measure" [33]. However, in our interviews, even the world's most innovative companies find it extremely difficult to measure their innovativeness and the success of a particular innovation initiative, especially for adjacent and transformational innovations. The root cause of this difficulty is the long lag between the initiation of an innovation project, and when the outcome becomes clear. *The CTO of GE Transportation expressed his concern regarding innovation measurement for long-term innovation projects: "The problem is that, in our industry, often the innovation is taking longer before generating the profit. Therefore, the measurement can steer you into the wrong direction because you feel that you're not making progress but eventually the progress / outcomes will show up a few years later. I think this type of measurement is providing more efficiency in very short development cycles, which is unfortunately not our case."* For longer-term innovation, we found that it is more important to have the right process and architecture than

to have a sophisticated measurement process. Managing the process does not mean doing away with metrics, but the successful companies we talked to seem to apply measurement at very precise points in the innovation process; e.g., measuring experimentation. *Dr. Jochen Hurlebaus (Head of central R&D service of Roche Diagnostics) told us that, "In our industry, if we want to measure innovation in numbers, we would have to measure 10-12 years backwards, and it is very difficult, therefore we don't have fixed KPIs for long-term innovation projects. Alternatively, we try to control the innovation process with clear milestones so that at least we manage the input side."*

Luckily, innovation measurement is much easier and time-efficient for incremental innovations, especially with the help of digital channels and technologies. Most of the customer-facing companies that we interviewed said that they gather real-time customer feedback through online channels to understand whether an innovation is successful: A/B testing, MVP (minimum viable product) customer usage, and NPS (net promoter score) are the most commonly measured parameters. Business-to-business companies also use client feedback as the most important measure of their innovativeness.

In addition, companies also join international competitions or analyze their patent and licensing numbers to see how they are doing compared to their competitors.

However, the measurement of long-term innovations remains a problem for all of the companies that we interviewed, as explained by *Tomio Pihkala (CTO of KONE): "We need to find some good early indicators, which are confirming we are going in the right direction. I would rather do right things a little bit slowly than do the wrong things very fast."*

Another area that was often mentioned was the lack of understanding by the financial community about how to measure a firm's innovativeness. The financial community seems to either use crude metrics, such as the percentage of sales spent on R&D, or treat new forms of digital innovation structures like labs and experimentation as a cost, which therefore works against financial performance. Several respondents highlighted that, through these innovation efforts, firms were also building a form of innovation capital, which was often discounted by the financial community. *Yuji Ichimura (Senior Executive Officer of KONICA MINOLTA) told us that: "Currently there is no good evaluation mechanism that relates innovation center type of activities to market equity value. When venture capitalists issue their report, they put unrealized profit, that helps investors to calculate their balance sheet… We don't have such structure in place right now, although we have a lot of unrealized value in each innovation project, they are shown as part of the expenses in the balance sheet and PL sheet, it's part of money spending side and capital spending side… Last year, I had a meeting with the investor relations analyst, industry analyst and media people, and I explained what we are doing in the business innovation centers, and even introduced several projects to them… some analysts came back saying they are very interested and they would like to keep hearing from us."*

4. Educate your people before they innovate

The human element is key to the success of innovation [34], and executives found that their employees are more creative when they are educated on how things work currently, and how digital technologies can be used to innovate. *GE Digital CIO Justin Greenberger described the importance of educating people before they go and innovate: "The biggest hurdle of innovation is actually education. At GE Digital, the commercial teams are focused on accelerating our time to revenue. In order for them to be innovative or creative around the process, they need to understand wing-to-wing how that process works. We were able to get a cross-functional group together from all over the company, bring in a data architect who modeled the data, and then educated the team on the wing-to-wing process. It started to create this constant flow of ideas that we're now working through a backlog to basically improve that process."*

Monsanto provides a continual learning environment for employees to develop digital know-how and help them explore digital opportunities. *Monsanto CIO Jim Swanson told us that: "we now work with HR to create business forums that provide digital tutorials; we call this effort developing digital fluency. Our intent is to apply this to every role in this company. Whether you're a marketer, a supply chain person, a breeder, it doesn't matter; we're actually helping to raise digital fluency across the enterprise to take full advantage of transformations in technology, data, and science. That goes to the foundation of how we make innovation part of the company. We've realized that foundation is so critical to our future, and we're investing in it."*

Velinda Cox (General Manager of the global major account division in Konica Minolta) reached the same conclusions: "Competitive advantage comes not just from the products you bring to market, but it also comes from your people and the environment with which you help your people be able to thrive, innovate and be creative."

5. Streamline the foundation and build technologies into employees' day-to-day lives

Supporting employees' day-to-day innovation activities requires building an organizational structure, operational processes, and backbone systems/platforms to support them. *Cyril Perducat (EVP of IoT & Digital Offers at Schneider Electric) described the importance of this point: "Digital transformation is about much more than just transforming the technology behind our products, solutions, services, and software. We take a holistic approach, considering how we transform our digital innovation framework—from governance and organizational structure to finance to the ongoing advancement of the company's high-performing culture within Schneider Digital itself."*

Companies have found that it is important to streamline existing processes before establishing fast-paced innovation initiatives, such as agile development or bringing startups onboard. *"For the innovation to be fast, it is important to align all areas including legal, compliance, security, and HR. At least, you'll have to ensure that you have a single point of contact inside each of those departments for your innovation initiatives." said Gonzalo Rodríguez (Head of digital banking in BBVA).*

In addition, executives have also found that it is important to embed innovation-supporting technologies into employees' day-to-day lives, *as explained by Monsanto CIO Jim Swanson: "You can have a model, and you can have data, but if you don't embed them into how people work, people never adopt it. An example being, a model we put in place to improve customer interactions is surfaced through Salesforce and the sales rep's account plan. So, sales reps don't have to learn a new tool, they're already embedded in [it]."*

Conclusion

With the increasing importance of digital technology throughout corporate innovation activities, firms are being forced to transform the way they organize for innovation. Our research points to three factors that are determinants of success: the right innovation architecture, the ability to manage multiple sources of innovation along different time horizons, and alignment of the right capabilities to ensure proper implementation.

We are only in the early phases of the digital revolution and, as general-purpose technologies such as IOT and AI continue to roll-out, corporations will continue to be challenged to rethink their models to access, organize and deploy these technologies to benefit all of their business units.
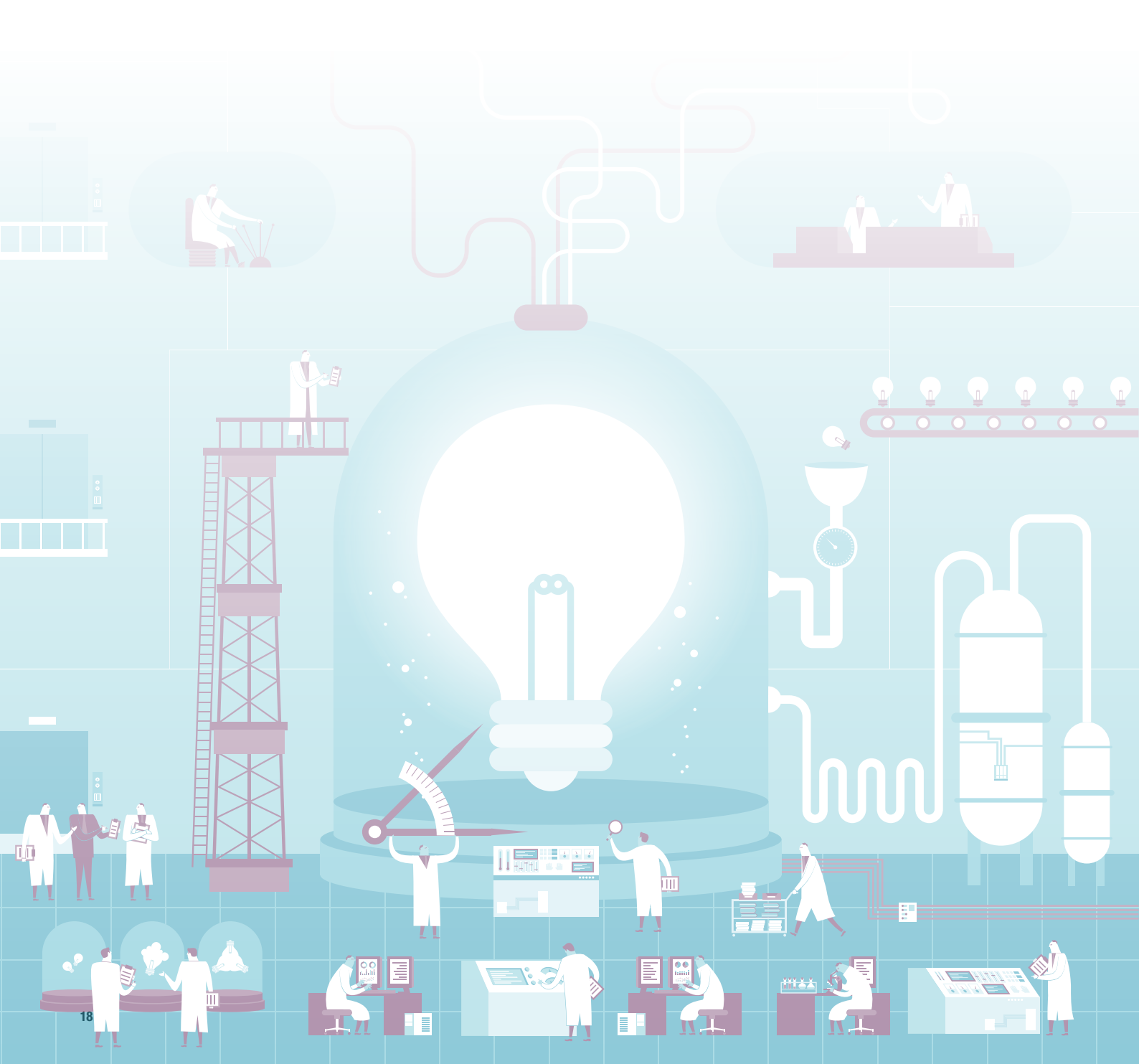
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