

# THE OPEN INNOVATION MODEL



> RESEARCH PAPER 2

By Jennifer Brant and Sebastian Lohse



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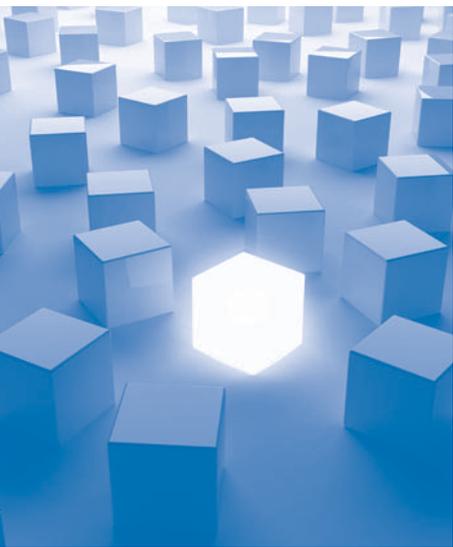
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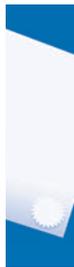
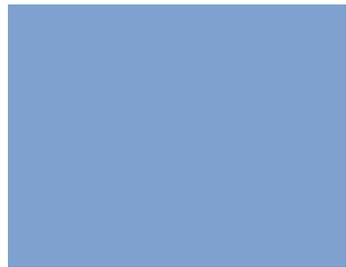
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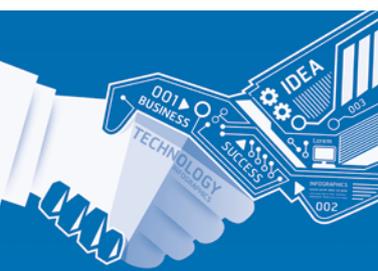
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## The Open Innovation Model

The present briefing paper aims to inform policy-makers and other stakeholders about the open innovation model, and to draw their attention to certain recent trends related to its use. The first part of this paper describes open innovation, including its origins and evolution, contrasting it with the traditional approach to R&D. In addition, it explains this model's attractiveness for businesses in light of changes in the innovation environment, and reviews prerequisites for successful collaboration. The second part focuses on the importance of strategic knowledge management in the context of open innovation. In particular, it shows how intellectual property rights (IPRs) can facilitate the sharing of technology and of know-how, thus supporting collaborative innovation.



## Introduction

A range of factors, including globalization, advances in information and communications technology (ICT), and growing technological complexity, has induced businesses to engage increasingly in innovation collaborations. The collaborative approach to innovation, termed “open innovation”, may be contrasted with the traditional “closed” approach to innovation, which entails the complete integration of research and development (R&D) within the boundaries of a firm.

Open innovation enables firms to integrate external knowledge and expertise into their innovative process, improving their offerings while cutting costs and more effectively managing risk (Granstrand 2011). What is more, it can enhance absorptive capacity at the firm as well as macroeconomic levels, while accelerating technology development and diffusion.

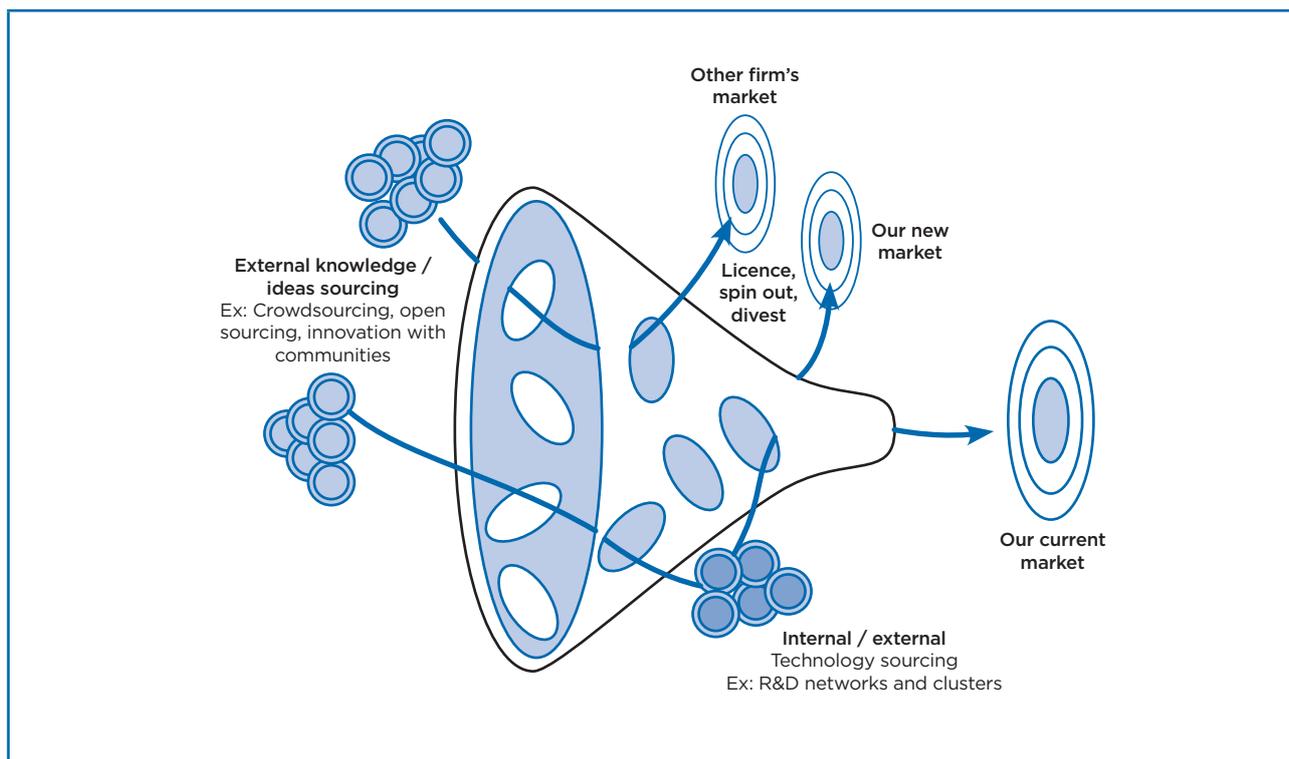
## Open innovation defined

Open innovation is the use of “purposeful inflows and outflows of knowledge to accelerate innovation internally while also expanding the markets for the external use of innovation” (Chesbrough 2006).<sup>1</sup> This model involves strategic, managed exchanges of information with actors outside of the boundaries of an organization, aimed at integrating their resources and knowledge into the organization’s own innovative process (Figure 1). Open innovation is not limited to the private sector, and this model may be adopted by innovative entities other than firms, including universities and not-for-profit organizations. This paper focuses predominantly on use of open innovation models by firms, as they are the focus of much of the literature on this topic.

Open innovation is grounded in the recognition that firms can harness knowledge from multiple sources to enhance innovation and thus deliver additional value for customers. Put differently, when relying on an open innovation model, a company does not strive to generate the best ideas entirely by itself. Rather, it seeks to utilize internal and external ideas in an optimal manner, to be more effective at managing cost and risk and to accelerate technology development. Sources of knowledge typically include suppliers, research centres, universities, customers, competitors, and companies with complementary offerings (Von Hippel 1988). Moreover, through approaches such as crowdsourcing (e.g. through innovation challenges) a company may engage with a broad range of innovators wherever they may be located.

Appropriation, a company’s effort to capture the value of its innovation, forms an integral part of open innovation. As a consequence, businesses adopting this innovation model need to engage in proactive intellectual property (IP) management in order to exploit their own and other firms’ knowledge and innovations in a strategic manner (Herzog 2008). More specifically, they use IPRs, whether registered rights such as patents, or unregistered rights such as trade secrets, to clarify ownership and control over resources that will be shared with or transferred to external actors in the context of the collaboration. In addition, firms establish knowledge management processes to ensure that expertise is shared outside the firm in a managed and strategic way.

1 This comprehensive definition proposed by Chesbrough has been widely adopted in the academic literature.



**Figure 1:** The innovation funnel  
 Sources: Wheelwright & Clark (1992) and Chesbrough (2003)

Authors identify three forms of the open innovation model:

- “Inbound” open innovation refers to the use within a firm of external sources of innovation. For instance, a firm may in-license a technology developed elsewhere, integrating that component into its own technology solution rather than seeking to develop an equivalent in-house.
- “Outbound” open innovation refers to the use of external pathways for the purpose of developing and commercializing innovations (Chesbrough & Growther 2006). For example, a firm may out-license its product to another firm that can help to further develop the product, for instance by obtaining necessary regulatory approvals. Or a firm may out-license an invention for distribution.
- The so-called “coupled innovation process” combines the inbound and the outbound dimensions: rather than sharing existing resources and expertise, firms work together to develop new knowledge and solutions (Gassmann & Enkel 2004). This type of collaboration can involve close integration, for instance a joint venture, or a looser affiliation such as engagement through an innovation competition.

Firms may adopt open innovation for defensive reasons, that is, to manage and reduce costs and risks associated with product development. More frequently, they collaborate for offensive reasons, that is, to proactively leverage innovations and knowledge from outside the firm in order to improve their own offerings and stay ahead of competitors (Chesbrough & Growther 2006; Van de Vrande *et al.* 2009).

Companies have always integrated knowledge from outside of their boundaries into their product development to some extent (Huizingh 2010; Pénin *et al.* 2011). For instance, Edison's Invention Factory at Menlo Park, which pioneered the commercial development of electric lighting in the late nineteenth century, relied on multi-disciplinary teams (Pénin *et al.* 2011). In the real economy, the distinction between open innovation models and the traditional “closed” approach to innovation, described below, is not as clear-cut as sometimes presented. In fact, businesses frequently employ hybrid approaches (Dahlander & Gann 2010; Lichtenthaler 2011).

Innovation can be thought of as a continuum of openness rather than a stark choice between closed and open. A key feature of the open innovation model is its flexibility. There are different forms that companies can use to pursue this innovation model, including bilateral collaboration, networks, and innovation “ecosystems” in which participants retain their knowledge and collaborate informally (Williamson & De Meyer 2012). Open innovation also offers a variety of ways in which an idea can be developed and taken to market, such as in-licensing, out-licensing, cross-licensing, joint R&D agreements, corporate venture capital, joint ventures, and inorganic growth through acquisition (Table 1). These channels generally depend on clear, predictable IP arrangements. Other activities include incubation, as well as spin-offs or spin-ins and crowdsourcing (Chesbrough 2006; Pénin *et al.* 2011).

Processes, products, or both may be exposed to collaboration. For instance, through its “Connect & Develop” program, Procter & Gamble opened its innovative process while keeping the outcome closed: the company sources ideas externally but retains control over commercialization of the products developed (Huizingh 2010). Most firms tend to engage simultaneously in open innovation and internal R&D. Evidence indicates that large firms can benefit from collaborations with small and medium enterprises (SMEs), including spin-offs (Christensen 1997). For example, although the leading pharmaceutical companies have large R&D budgets (equivalent to some 15-20 per cent of sales revenues), they rely increasingly on external research and integrate niche actors into their pipelines (Bhattacharya & Guriev 2005). Relying on a combination of open and in-house innovation enables firms to benefit from collaboration while ensuring they retain adequate absorptive and innovative capacity (Dahlander & Gann 2010).

Under the traditional model, R&D activities occur internally, yielding products that will be developed and commercialized exclusively by the firm (Chesbrough 2006). Closed innovation rests on a number of assumptions, namely the need for a firm to: a) discover, develop, and market a new product entirely on its own; b) recruit and rely on exceptional internal talent to deliver innovation; c) adopt a restrictive IP management practice so as to prevent other companies from benefiting from its technologies (Chesbrough 2003). To sum up, the traditional approach to innovation centres on “picking a man of genius, giving him money, and leaving him alone” (Chesbrough 2003).<sup>2</sup>

While it has generated impressive research achievements, as evidenced by AT&T Bell Labs and Xerox PARC, this inward-looking model has some serious shortcomings. First and foremost, a firm bears the entire cost and risk of product development, which is becoming increasingly untenable as offerings become more complex, and as globalization progresses. Also, internally organized innovation structures are often prone to budget cuts and survive only for a short period of time (Wolpert 2002). In addition, the internal project pipeline may halt promising ideas if they do not fit the current business strategy or capacities, resulting in missed opportunities.

2 Quote from James Bryant Conant (1893-1978), American chemist and President of Harvard University.

Table 1: Open innovation – forms of technology sourcing

Technology sourcing method	Typical Duration	Advantages	Disadvantages
Internal R&D	Long term	<ul style="list-style-type: none"> <li>Build absorptive capacity</li> <li>Exclusiveness of technology and knowledge exploitation</li> </ul>	<ul style="list-style-type: none"> <li>May not always be sufficient to keep pace with speed and complexity of technological developments in high-technology industries</li> <li>High commitment</li> <li>Low to medium reversibility</li> </ul>
Licensing	Fixed term	<ul style="list-style-type: none"> <li>Fast technology access</li> <li>Lower development cost</li> <li>Less technology and market risks</li> <li>Low commitment and high reversibility</li> </ul>	<ul style="list-style-type: none"> <li>Loss of control over decision-making due to contract constraints</li> <li>Competitive advantage may depend on exclusive licence</li> </ul>
Joint R&D agreements	Medium to long term	<ul style="list-style-type: none"> <li>Explore emerging technologies</li> <li>Define and establish standards</li> <li>Access to public funding</li> <li>Reduced risk</li> <li>Exploit established technologies</li> <li>Develop system solutions</li> </ul>	<ul style="list-style-type: none"> <li>Potentially limited flow of technological knowledge</li> <li>Knowledge leakage</li> <li>Opportunism risk</li> </ul>
Innovation challenge	Short term	<ul style="list-style-type: none"> <li>Crowdsourcing broadens base of potential collaborators</li> <li>Cost-effective</li> <li>Reduced risk due to arms-length affiliation</li> </ul>	<ul style="list-style-type: none"> <li>In-house, follow-on R&amp;D may enhance control over technology developed</li> <li>IP management may be more complex with many contributors</li> </ul>
Corporate venture capital	Flexible	<ul style="list-style-type: none"> <li>Window on technology</li> <li>Option to defer high commitment of resources</li> <li>High reversibility</li> </ul>	<ul style="list-style-type: none"> <li>Information asymmetries between new venture and investing firm</li> <li>Modest control over development of technology</li> </ul>
Joint ventures	Long term	<ul style="list-style-type: none"> <li>Technology convergence</li> <li>Define, establish standards</li> <li>Smoother information flows</li> <li>Coordination and control</li> <li>Exclusivity of technology ownership</li> </ul>	<ul style="list-style-type: none"> <li>Organizational risk</li> <li>High commitment</li> <li>Low to medium reversibility</li> </ul>
Acquisitions	Long term	<ul style="list-style-type: none"> <li>Hierarchical control over new technology, know-how</li> <li>Short-cut to new technologies</li> </ul>	<ul style="list-style-type: none"> <li>Highest degree of commitment</li> <li>Low reversibility</li> </ul>

Source: Herzog (2008) & authors

What is more, only a few companies are able to realize the potential of every new finding, or have the necessary resources to exploit them (Wolpert 2002). As a result, under the closed innovation model, projects not selected for further pursuit may sit on a shelf for years – or forever – unless an internal champion of the project leaves the company to develop the idea elsewhere (Chesbrough 2003). In this case, the technology may be developed, but the entity that invested in the initial research does not benefit financially from its outlays. In the past, the unused by-products of R&D were seen simply as a cost of doing business.

Since the 1980s, initially in high-tech firms but increasingly in other sectors as well, companies began relying upon open innovation in order to overcome the aforementioned limitations of the traditional model – even as they continued to rely on internal innovation, depending on the circumstances. Open innovation gained momentum as globalization intensified, resulting in more competition and new opportunities. At the same time, products were increasing in complexity, making R&D more difficult and risky, and technically more challenging to retain completely in-house. As outsourcing of manufacturing became commonplace, companies began to recognize the potential value in outsourcing other functions as well, including certain aspects of R&D, and of using external channels to market for their own inventions (Chesbrough 2003).

## The evolving environment for innovation

The external environment for innovation has changed markedly in recent years, affecting firms in virtually every sector. Several factors in particular may induce innovators to adopt open innovation strategies:

- **Globalization**, defined as the integration of economic activity at the international level, reduces barriers to international collaboration and facilitates the entry of international competitors. It confers a comparative advantage to businesses that innovate more rapidly and adapt better to new opportunities (Gassmann 2006). At the same time, globalization entails increasing mobility of skilled labour, which fosters knowledge distribution. Firms benefit from access to knowledge and experience globally, working with the best talent regardless of location (Herzog 2008).
- **Product complexity** has increased to the point that even the largest companies can no longer afford to do everything in-house (Gassmann 2006; Pénin *et al.* 2011). A case in point is the automobile sector, where today an estimated 80 per cent of the innovation is based on electronics and software (Wallin & Von Krogh 2010). At the same time, companies face growing pressure to focus on their core competencies. As a result, firms tend to partner to obtain the resources and knowledge they need to compete effectively, without the complexity and cost of attempting to do everything in-house (Williamson & De Meyer 2012).
- **Industry convergence**, which is the “blurring of technical and regulatory boundaries between sectors of the economy” (OECD 1992), gives rise to new inter-industry segments. To successfully compete in new segments, firms must combine knowledge from different entities, across sectors. An example is the convergence of the food industry and the pharmaceutical industry, which has yielded the new segment of nutraceuticals and functional foods (Box 1). Empirical evidence indicates that open innovation models are most common in sectors that are characterized by technology fusion, globalization, and technology intensity, such as biotechnology (Huizingh 2010).

## BOX 1: Convergence and open innovation – the nutraceuticals and functional foods sector

In the early 1990s, the new inter-industry segment of nutraceuticals and functional foods (NFF) appeared at the intersection of the food and pharmaceutical sectors. Its emergence was driven by technological progress in areas like genomics and crop science, by customer demand, and by new regulations in the United States (US) and European Union (EU) governing health claims made on foods. In the years following the emergence of this new sector, several R&D networks were established to facilitate collaboration, such as the Institute of Nutrition and Functional Foods (INAF) in Quebec City and the EU-funded Nutrigenomics Organisation (NuGO).

Food and pharmaceutical companies adopted new collaborative strategies to take advantage of opportunities in this new segment. However, food companies tend to have limited R&D expertise as only a few of them maintain a distinct research department, and they generally have no experience running clinical trials and engaging with health regulators. On the other hand, pharmaceutical companies may lack the necessary skills for adapting products to consumer preferences. For some companies, partnership was therefore the route to obtaining necessary complementary expertise to compete in NFF. For instance, the Dutch chemicals company DSM successfully collaborated with a consumer goods company specialized in sports nutrition to commercialize a whey protein that improves utilization of glucose by muscle cells.

Mergers and acquisitions (M&A) were another instrument used to obtain expertise and knowledge specific to the new sector. Between 2007-2010, some 120 M&A transactions were recorded in the global food ingredient segment including antioxidants and functional bio-ingredients (Frost & Sullivan 2011). For example, Nestlé, which has its origins in the food industry, began acquiring start-ups, such as CM&D Pharma, in order to boost its innovative capacity in the medical nutrition space. This resulted in the establishment of a separate division, Nestlé Health Science, offering a wide range of Food for Special Medical Purposes (FSMP).

*Source: Bröring 2013*

- Advancements in **information and communications technology** (ICT) reduce the perceived distances between actors, thereby enabling integration of new actors into the product development process (Gassmann 2006). ICT solutions make it easier to identify appropriate partners, and to pursue partnerships across borders (Pénin *et al.* 2011). More particularly, they allow firms to create effective systems to involve or “dock” external collaborators in their internal processes. In addition, advancements in ICT and connectivity have given rise to totally new approaches like crowdsourcing, innovation competitions and challenges, and prizes (Wallin & Von Krogh 2010).
- Increasing **tradability of intellectual property rights** has simplified the exploitation and sharing of knowledge and investments in innovation (Granstrand 2011). Firms can more easily “transfer” knowledge and rights to use their inventions. As in the past, patents are used to protect innovations and to secure freedom to operate (FTO). Increasingly, they are also

viewed as being more than mere protection methods. They are strategic assets, supporting out-licensing and the systemic commercialization of internal expertise outside of the firm (Gassmann 2010). Whereas, under the old innovation model, unused outputs from the R&D process were written off as a cost of doing business, they can now be sold or monetized through licensing. IP protection and licensing strategies can also be used to prevent exclusive appropriation of specific outcomes of collaborative efforts, while providing access to complementary innovations for mutual benefit, such as in the case of some open source software development (Lippoldt & Strykowski 2009).

- The growth in **private venture capital** makes it easier to create start-ups, increasing the tendency of individuals to establish firms to commercialize inventions originating in enterprises or research centres (Herzog 2008). Small firms are likely to overcome size-related liability by opening up their innovation process and partnering, particularly during the commercialization stage (Enkel *et al.* 2010). Evidence indicates that one factor in the success of the “born globals”, a class of SMEs that are quickly active on the international stage, is their ability to leverage their intellectual assets in order to engage in successful collaborations (Enkel *et al.* 2010).

## The value of collaboration

Collaborative R&D may be particularly well suited to the current globalized, interconnected innovation environment. Scholars have identified several advantages that may accrue to businesses that engage in open innovation:

- **Shorter time to market with less costs and risk.** Obtaining complementary skills and technology from external sources dispenses the need to invent all inputs, thereby reducing costs and risks associated with product development (Huizingh 2010; Wallin & Van Krogh 2010). Especially if they work with start-ups, which must innovate – and quickly – in order to survive, large firms can develop new offerings at a faster rate than normal through collaboration.
- **More innovations over the long term.** Across industry sectors, early integration of suppliers into the innovation process has been found to considerably enhance innovation performance (Hagedoorn 1993, 2002). Access to specialized knowledge that a firm does not already possess can stimulate the development of new, better products and services. In fact, a survey of OECD countries found that suppliers and customers are the most sought-after open innovation partners (OECD 2008).
- **Increased quality of products and services.** Integrating feedback from downstream and upstream partners into the innovative process can enable a company to better target its R&D efforts. In particular, the integration of users into the innovation process, especially during the early phases, permits a firm to capture potential customers’ latent requirements and hidden application knowledge (Box 2) (Von Hippel 1986). Open innovation can help a business to overcome cultural bias and the tendency to do things the way they have always been done, thus increasing the likelihood of generating disruptive innovations.
- **Exploitation of new market opportunities.** Connecting previously distinct fields of R&D, within and also across organizations, allows the identification of new opportunities (Dahlander & Gann 2010). Collaboration can enable firms to access markets in places where partners are active, but where their own participation is limited. Small firms can increase their exposure and attain new distribution channels by working with firms more experienced in

commercializing solutions. This same dynamic enables firms of all sizes in emerging countries to gain access to mature markets.

- **More flexibility.** Against the backdrop of rapidly changing market conditions, open innovation permits firms to be more flexible, in particular to adapt their knowledge base according to shifting commercial needs (Pénin *et al.* 2011). Companies can attract top talent on a project basis, creating and disbanding teams as necessary.
- **Improved absorptive capacity and innovation processes.** In addition to the transfer of technological know-how *per se*, open innovation generates long-term advantages for companies, which gain collaboration structures and benefit from organizational learning. Dynamic benefits can be seen over time as the knowledge base within the company grows and as processes for innovation are improved and fine-tuned (Lichtenthaler 2011). Open innovation can also allow companies to profit from their partners' assets, including reputations and investor relationships. As trust develops between partners, sharing and collaboration may deepen, opening up new opportunities.
- **Monetized spillovers.** Knowledge from R&D activities that is not selected for further exploitation in-house can be used to create new commercial opportunities. Projects that once may have sat on a shelf may be pursued through and with partners (Pénin *et al.* 2011). Open innovation can enable a firm to extend its business model or to spin off a technology (Chesbrough 2006). Through open innovation, universities and research centres can monetize their R&D investments, while increasing the chances of their ideas reaching the market. This may be done through licensing or the creation of spin-offs.

## BOX 2: Better healthcare through open innovation – the case of Tiatros

A San Francisco-based start-up founded in 2010, Tiatros Inc., has developed an innovative collaborative care management solution called Tiatros. This solution addresses problems that arise when doctors around the world use hundreds of time-consuming and error-prone clinical workflow processes to share information and coordinate their clinical activities. Tiatros moves these processes to a private, secure mobile cloud, streamlining the management of health data, eliminating inefficiencies, and enabling truly collaborative healthcare.

Incubated at the University of California, San Francisco (UCSF), the company produced its solution in alliance with over 300 senior medical faculty, clinical researchers, and experts in IT, systems integration, tele-health, medical device, privacy and security, and legal affairs. These experts wanted to work with Tiatros in order to optimize the company's platform for their own eventual use.

According to one of the co-founders, it is thanks to this open innovation strategy that Tiatros was able to create a superior and easy-to-use product that responds to the myriad technological, administrative, and regulatory needs of doctors, patients, and other stakeholders. Today, Tiatros is in commercial use across the extended University of California Health System, and at other major medical institutions in the United States. Customers continue to provide expert input that enables the company to continue to extend and optimize the platform. The company patents the proprietary elements of

the platform, and derives a competitive advantage from the extensive body of know-how – gleaned from the involvement of hundreds of collaborators – that contributed to its development.

*Source: Interview with CEO and co-founder Kimberlie Cerrone (November 2013)*

In addition to the effects at the level of individual innovators, open innovation can produce systemic benefits that stimulate technological advancement and innovation. First and foremost, by combining complementary resources and knowledge, firms can push the technological frontier outward more quickly. Accelerated development of better and more cost-effective technology solutions can benefit consumers. In addition, as knowledge flows among the participants in a collaboration or innovation network, absorptive capacity can be improved at the macroeconomic level.

Open innovation furthers the division of labour and hence specialization in R&D (Pénin *et al.* 2011). This provides opportunities for niche actors, and for those entities that lack the non-core business expertise required in order to commercialize a new solution. Collaborative innovation models are particularly relevant for SMEs, which may develop a valuable niche technology but lack the expertise to bring it to market. Collaborative innovation, underpinned by greater connectivity and globalization, can also generate new opportunities for firms located in places that are less well-endowed, enabling them to participate in global innovation networks (Pénin *et al.* 2011). Finally, it offers new openings for engagement by non-commercial actors such as universities in innovation networks (Enkel *et al.* 2010).

## Prerequisites for successful collaboration

Depending on their internal characteristics, including commitment by the firm's leadership, investments in organizational learning, and capacity to effectively manage the risks associated with greater openness, certain firms may benefit more than others from the adoption of an open innovation model.

Open innovation requires that a firm have sufficient **absorptive capacity** to identify valuable external information, to integrate it into the internal innovation process, and to exploit it commercially (Cohen & Levinthal 1990). Absorptive capacity, which is the ability of a firm to identify and use relevant external knowledge, falls into a technology-related and a market-related dimension (Bröring & Leker 2007). These derive to a considerable extent from the firm's internal R&D capacity and knowledge base, and existing market knowledge, respectively (Rosenberg 1990).

Firms with better absorptive capacity may be expected to extract more value from collaboration, since they are more likely to successfully identify and internalize key developments from the external environment. At the same time, open innovation can benefit those firms that are unable to generate sufficient absorptive capacity on their own, since firms can establish strategic alliances to gain necessary knowledge and expertise (Chesbrough 2006).

For all firms, open innovation generally requires significant **organizational changes** specific to the organization's corporate strategy and culture and, ideally, driven by the firm's leadership (Box 3). These include the establishment of decision-making pathways and the development of processes

to manage the intellectual assets of different partners (Lichtenthaler 2011; Hagedoorn & Ridder 2012). Specifically, managers must identify the critical knowledge associated with each step of their firm's innovative process, and institute processes for integrating that knowledge into their collaborative efforts (Gassmann 2010; Wallin & von Krogh 2010). Firms may wish to establish joint steering committees that will manage every aspect of the development, manufacturing, IP management, and commercialization of innovations. Such efforts require significant, long-term investments (Huizingh 2010).

Collaboration over time is required in order for firms to develop trust, which is critical to sustained collaboration and which makes it possible for partners to share their most valuable know-how. Creating groups, composed of internal and external experts, to solve problems is one way to build relationships and institutionalize an open innovation approach (Wallin & von Krogh 2010). In addition, management must foster a cultural shift to openness within the firm, working with employees to overcome the “not invented here” mindset, that is, reluctance to further develop and commercialize others' solutions (Lichtenthaler 2011). The external environment can support certain aspects of open innovation; for instance, the existence of effective trade secrets protection can facilitate sharing among partners.

### BOX 3: Transitioning to open innovation – the case of Italcementi

Until the early 1990s, Italcementi was a virtually uncontested market leader in the cement market in Italy, concentrating on the domestic market where both competition and demand for product innovation were relatively weak. Based on strong but very narrow scientific expertise, Italcementi's research activities were confined to the company's in-house technical support centre, and were aimed at improving internal production processes and product reliability for general construction uses. Rare attempts to launch innovative products failed to generate meaningful customer interest.

With the advent of globalization, in particular after the lowering of entry barriers to national markets following changes in EU legislation in 1991, Italcementi's leadership sensed a need to fundamentally alter its approach to innovation. As an initial step, they pursued the integration of expertise from leaders in other markets and adopted new strategies to maintain competitiveness through innovation. In 1992, Italcementi acquired Ciments Français. The company created new innovation facilities, including a distinct R&D unit, a strong network of academic researchers, an IP function, and a scientific committee composed of academic professors.

In 1995, facing enhanced competitive pressure resulting from intensified M&A activity in the industry, the Italcementi leadership further developed its strategy to distinguish the company through innovation, launching a major project to enhance its innovative potential. The TX Project was premised on the idea of mixing traditional cement with photo-catalytic elements able to capture and neutralize carbon oxide from the external environment. It had considerable market potential, especially in large cities committed to reducing air pollution.

To obtain the necessary chemical knowledge for this project, the company engaged in outside-in open innovation by establishing formal relationships with a number of leading Italian research institutions (e.g. Politecnico di Milano). Research projects multiplied, requiring the company to adopt new ICT systems to more effectively manage cross-functional teams across different countries, as well as to search databases of scientific publications and patents for useful technical and strategic information. It strengthened the in-house IP function and began filing for patents. Following the success of TX, Italcementi further embraced an open innovation paradigm when it opened a new research centre in scientific park near Bergamo, aimed at exploiting cross-fertilization in the presence of research labs of firms from different industry sectors (e.g. automotive, aerospace, biotechnology).

Since 2006, Italcementi has increased considerably the involvement of customers in its innovation activities, creating new organizational units that allow the company to evaluate the commercial potential of innovation products, to receive rapid feedback on their practical use, and to co-develop ad hoc solutions if necessary. The company also began designing long-term IP strategies, making them an integral part of its business development plans. Once it had fully institutionalized and demonstrated the value of the outside-in dimension, Italcementi began a process of implementing also an inside-out strategy built around licensing.

*Source: Chiaroni et al. 2011*

An open innovation model may entail a number of **transaction costs**, including the need to engage in efforts to find the right partners, to coordinate exchanges, and to manage complexity and risk (Enkel *et al.* 2010). Investments are needed to build routines and trust with partners over time, as well as to put in place and manage effective processes for knowledge and IP management (Pénin *et al.* 2011). A particular difficulty in open innovation is the valuation of knowledge; in this regard, uncertainty can complicate licensing and other technology transactions (Dahlander & Gann 2010; Enkel *et al.* 2010).

Because open innovation strategies require that firms manage multiple innovation interactions with partners of all sizes, collaboration may be particularly challenging for resource-constrained SMEs, despite these actors potentially having the most to gain from collaboration (Huizingh 2010). Innovation survey data underscores the difficulty: large companies are four times more likely than SMEs to collaborate on innovation (OECD 2008). In reality, management of multiple innovation interactions under this model represents a non-negligible cost for all innovators embracing open innovation.

Another key challenge associated with open innovation is **appropriation risk**. Built on opening flows of knowledge, this innovation model inherently exposes a firm to the risk of its technological and commercial know-how being misappropriated by others (Chesbrough 2006). Firms must develop knowledge management processes, to guide determinations as to how much to reveal to partners and under what conditions (Box 4). Integration of sound intellectual asset management practices into such processes, including judicious use of registered rights and complementary approaches like secrecy, is critical. IP management enables sellers of technological and other information to disclose and to trade their technologies and know-how without losing control over them. Registered rights

in particular can help firms to overcome the “disclosure paradox”, that is, the reluctance on the part of firms to share knowledge despite this being necessary for successful collaboration (Arrow 1962).

It should be noted that open innovation is not necessarily suitable for every firm in every situation (Gassmann 2010). Depending on the project, internal R&D may be preferable to opening, enabling a company to more easily streamline and control innovation processes while nonetheless pulling together multi-disciplinary teams (Dahlander & Gann 2010). If a firm is strongly inward looking, or lacks adequate knowledge management processes, an open innovation model may be ineffective, unless far-reaching organizational changes occur (Huizingh 2010). Depending on both external and internal factors, internalizing linkages between different activities and specialists may be the best way for a firm to innovate, while also effectively managing risk, uncertainty, and transaction costs.

An example of a successful, relatively “closed” innovation process is the controlled approach adopted by Apple to develop its core hardware platforms (Williamson & De Meyer 2012). Apple then leverages its closed proprietary innovation with open complements, including certain software components, in a strategic manner (Linden *et al.* 2007; Lippoldt & Stryzowski 2009). In the real economy, firms often adopt a hybrid approach to innovation, strategically utilizing closed and open approaches as appropriate to the project at hand.

As reflected in the broad range of open innovation strategies pursued, there is no optimal way to execute an open innovation model. Rather, the approach adopted by a firm is shaped by external conditions and also by its organizational culture.

## Knowledge management: key to open innovation

*“We are doing open innovation not public innovation... Our goal is to come up with results that we share with some partners and keep secret vis-à-vis others.”<sup>3</sup>*

The attribute “open” used to characterize the collaborative innovation model may be deceptive, as it seems to imply “free” (Granstrand 2011). Indeed, some have argued that truly open innovation requires that the information and technologies generated must be public goods, freely available to all (Pénin *et al.* 2011).

In reality, firms adopting an open innovation approach must, like companies relying on other innovation strategies, find ways to capture the value of their investments in knowledge creation. Appropriation, a key element of innovation management, is especially important in the context of open innovation (Candelin-Palmquist *et al.* 2012). Firms may adopt: a) informal appropriation strategies, relying on lead-time or first mover advantage; b) formal appropriation strategies, grounded in IP protection and management; or, c) ideally, a combination of these approaches (Friesike 2011; Huizingh 2010).

Because open innovation entails sharing knowledge with partners, it may generate significant uncertainty and risk for firms. Collaboration could result in leakage of a company’s inventions and know-how to its competitors. Companies must be strategic about protecting their technologies and proprietary know-how within collaborative relationships lest they lose their competitive advantage (Lichtenthaler 2010; Pénin *et al.* 2011). To this end, they generally engage in selective sharing with partners, licensing some registered and unregistered IPRs, while opting to keep other information

<sup>3</sup> Quote from a manager of firm engaged in open innovation (Hagedoorn & Ridder 2012)

strictly internal. In sum, effective knowledge management systems are a crucial component of successful open innovation.

#### BOX 4: Selective sharing in open innovation – the case of Lindt & Sprüngli

Lindt & Sprüngli, a world leader in the market for premium chocolate, takes a graded approach to open innovation. Mindful of the unique knowledge it has accumulated over more than 150 years, the Swiss company follows a strategy of opening only certain aspects of the innovative process to collaboration. Lindt's innovation process comprises four elements: product concept, recipe, product packaging, and product-specific machinery.

While the company develops new product concepts entirely internally, it does integrate outside information gathered by its marketing unit from customer focus groups, fairs, and vendors into the process. Recipes are protected as trade secrets and, within the company, only very few people – the so-called *mâitres chocolatiers* – know them. Yet, innovating recipes supposes some degree of cooperation, especially with ingredient suppliers. In the area of flavours, for example, Lindt has developed an elaborate system of collaboration. In fact, based on a list of preferred suppliers for each type of flavour, the company works using an iterative procedure until the suitable blend is obtained. In order to protect all information exchanged during this collaboration process, the company has developed effective knowledge management systems, requiring for instance that partners sign non-disclosure agreements (NDAs).

During the experimentation phase, in order to evaluate how the product fits with the relevant concept, the chocolate manufacturer works with a panel of selected expert consumers that represent the target market and that have a long-term relationship with the company. Collaboration is also part of packaging innovation. In order to find a packaging material that can preserve the product, easily and safely transport the product, and effectively communicate the concept of the product, Lindt collaborates with a number of graphic design agencies and consumer focus groups.

In cases where new products require technological modifications in the production process, the chocolate manufacturer generally involves a very restricted number of suppliers of machinery to assess the feasibility of the envisaged changes and to implement them. However, there are exceptions. For instance, in the 1990s, Lindt decided to renew an Easter chocolate that it had been producing in limited editions for decades. A key challenge was identifying a plant to manufacture the product, which had only been made by hand until then. Because the few companies constructing these types of plants worldwide are in close contact with Lindt's competitors, the risk of losing control over critical information about the recipe and treatment was particularly high. As a consequence, it was decided that this part of the innovation process would remain completely closed.

*Source: Lazzarotti & Manzini (2013)*

Without clear ownership of and protection for knowledge, in the form of IPRs, the “open” exchanges required under open innovation may never occur (Lee *et al.* 2010; Candelin-Palmquist *et al.* 2012). By enabling firms to diminish the risk of free-riding or misappropriation by partners, IPRs facilitate and encourage sharing, stimulating flows of information and knowledge. IPRs may also be used to prevent exclusive appropriation, as in the case of some open source software or creative commons projects. In this context, IP protection can be used to build a base upon which firms develop and commercialize proprietary features and services (Box 5) (Lippoldt & Stryszowski 2009).

As a consequence, the concept of open innovation relies in large part upon markets for intellectual capital, underpinned by effective IP protection systems that enable companies to protect and enforce IPRs (Mowery & Graham 2006). Legal certainty and predictability are critical enablers of open innovation in this sense. Interviews with firms confirm that IPRs are central to the protection of their innovative capabilities when engaging in collaborative R&D (Hagedoorn & Ridder 2012).

Patents are particularly important contributors to open innovation across fields of technology, playing a dual role: they simultaneously protect and disclose an invention (Cohendet & Pénin 2011). Patents considerably facilitate interactions between innovators and other actors by assuming an important “coordination function” (Cohendet & Pénin 2011). At the market level, patents can be used to signal the market potential of their holders’ innovations. They can help firms to identify potentially useful technologies, knowledge, and partners, and to pursue formal and informal collaborations. At the level of individual transactions, patents facilitate technology transfer through licensing and other arrangements, and they prevent competitors and potential licensees from free-riding on other firms’ investments.

Through cross-licensing, use of inventions protected by one firm’s patents can be exchanged for the use of another firm’s patent-protected inventions. The same holds for trade secrets and know-how, which may similarly be licensed and cross-licensed. Depending on the complexity of the technologies and the number of partners and innovation interactions comprising a project, managing the various patents and other IPRs that relate to the project can be a challenge. Identifying which rights relate to the different components and outcomes of a project may require significant resources and expertise. This may compromise the ability of those entities with fewer resources or experience with intellectual asset management to successfully collaborate with external partners (Huizingh 2010).

Contracts negotiated among partners help to order engagement, setting out rules governing ownership, resource commitments, termination conditions and rights, exclusivity, and IP management (Hagedoorn & Ridder 2012). Management of IPRs is often central in open innovation contracts which: a) identify what each party brings to the table; b) set out how resources will be shared and managed during the collaboration; and, c) determine how any outcomes should be managed, including control over the acquisition and management of any new IPRs (Lee *et al.* 2010). According to companies engaged in open innovation, getting the terms of the contract right is fundamental to the success of any collaboration.

Because the outcome of collaboration cannot be fully anticipated, these contracts tend to be quite flexible and open-ended (Hagedoorn & Ridder 2012). IPRs provide a degree of predictability and certainty to the participants, provided certain challenges can be overcome. For instance, difficulties related to the valuation of registered or unregistered rights may complicate the negotiation of open innovation agreements (Enkel *et al.* 2010). The development of improved methodologies

for valuation of intangible assets could facilitate partnerships, by improving the functioning of technology markets.

IP management is best considered starting very early in the open innovation process, before the market or technology potential of the project can be known (Huizingh 2010; Hagedoorn & Ridder 2012). Defining the IP position of each participant, and clarifying in advance the expectations and agreement as to how IP will be managed and shared by the partners, makes it easier for innovators to engage in open innovation.<sup>4</sup> Firms tend to engage in intensive due diligence about a partner's IP position even before agreeing to collaborate on a project (Hagedoorn & Ridder 2012). A strong IP position makes it more likely that partners can effectively appropriate in the event the collaboration leads to success in the marketplace.

IPRs can help level the playing field for new or small players in particular. In general, SMEs, which tend to develop niche technologies, require collaboration to commercialize their inventions (Pénin *et al.* 2011). Without a strong IP position, small firms may fail to attract investors and partners. In addition, when partnering, small firms may face a higher risk of free-riding – especially by more powerful actors – if they do not have an effective intellectual asset management strategy (Pénin *et al.* 2011).

Under the traditional innovation approach, firms accumulated registered IPRs primarily to ensure FTO and to avoid costly litigation (Chesbrough 2005). This was not always an optimal strategy as firms may not end up relying on all the patents obtained, and also because certain patents may be of little practical value to a firm (Chesbrough 2005). Through outbound open innovation, a broader range of investments may potentially be monetized, whether by firms or other entities such as universities.

In the context of open innovation, intellectual assets are increasingly used for more than protecting competitive advantage, ordering transactions, and signalling the value of an invention to potential partners and the market. As noted above, IPRs also have the potential to become new classes of assets that can deliver additional revenue (Chesbrough 2005). The outcome of promising projects that have been halted for whatever reason may, under open innovation models, be licensed out or sold for further development.

### BOX 5: Appropriation in open innovation – the case of open source software

Open-source software (OSS) development is one form of open innovation. Software, including OSS, constitutes an ever-increasing part of new product development. Many firms rely on both proprietary and open-source models for software development, depending on their needs. Due to the complex nature of software, and commercial pressures to enhance functionality, mobility, and reliability while ensuring security and interoperability, collaboration is increasingly a key feature of the business models and innovative strategies of firms in this field.

4 IP position refers to the extent to which a firm has effectively protected its most valuable intangible assets in relevant jurisdictions.

Under the OSS model, firms, suppliers, and customers collaborate to pool know-how and more specifically, the software implementations that result from application of such know-how, thereby producing technology which generally is available at no or at low cost (West & Gallagher 2006). As a form of open innovation, OSS aims at incorporating external knowledge in the innovative process, often from a global community of developers. A firm using an OSS approach provides access to its copyrighted software and, in return, gains developmental input that it would otherwise have had to develop on its own.

Some authors distinguish OSS from other types of open innovation, stating, for instance, that OSS is unique in not providing for any appropriation, or value capture (Chesbrough 2006). In practice, however, this is not the case. Companies engaging in commercial open source software development do emphasize appropriation. Moreover, OSS does not necessarily imply free revealing of all aspects of an innovation to customers and competitors.

Evidence indicates that firms using an open source innovation model for software development actively manage their intellectual assets – in the form of code – in order to capture value. They do so through selective sharing, within the requirements of the relevant OSS copyright licenses. In the context of OSS, IP protection (copyright) can be used to prevent exclusive appropriation under certain licenses such as the GNU General Public License (GPL), while enabling firms to develop and market proprietary features and services.

A case in point is Linux, which has become one of the three most widely used operating systems on devices. According to the GPL, the source code of derived work based upon OSS must be made available to all recipients of the software. As a result, customers buying devices with embedded Linux are entitled to obtain the source code of that software. Nonetheless, producers of devices embedding Linux have a range of means to protect their proprietary knowledge.

First, derived work must be disclosed to the restricted group of customers but not necessarily to the general public, thereby allowing the firm to manage diffusion of the software code. It should be noted, however, that such customers have the right to further distribute the code under the terms of the GPL as they wish. Second, producers can restrict know-how diffusion by providing the source code on a demand basis only and without active support, provided they comply with the GPL obligation to notify the availability of such source code to others who received the software from them. Finally firms may opt to make drivers only available as loadable binary modules but not as source code, though this practice appears to be declining in community acceptability.

*Sources: Henkel 2006; Chesbrough 2006; Lippoldt & Stryzowski 2009; West & Gallagher 2006*

## Summary and conclusions

Open innovation is expected to become the dominant innovation model of the twenty-first century, as changes in the external innovation environment induce firms to collaborate. Key factors driving the ascendance of open innovation models include accelerated globalization, increasing technological complexity, and greater connectivity resulting from ICT advancements.

Open innovation provides a number of important benefits. Collaboration can push the technological frontier outward and expand market opportunities, providing consumers with faster access to new solutions. It can also benefit firms, in particular through higher innovation performance, organizational learning, shorter time to market for inventions, and reduced R&D costs and risk. To successfully adopt an open innovation model, a firm's leadership must ensure adequate absorptive capacity and drive several organizational changes, including institution of an effective knowledge management strategy.

Under an open innovation model, a firm collaborates with external actors in order to enhance its innovative process. Technology providers must signal the value of their inventions in order to attract potential partners. When engaging with partners, firms must simultaneously disclose and protect their technologies and knowledge. A firm must also contribute to a collaboration without losing control over its intangible assets, while ensuring that it will own a fair share of the outcome. Effective intellectual asset management can help a firm to achieve these objectives.

Registered rights such as patents, in particular, can be used by a company to share knowledge and technology with partners, and to signal the value of R&D to the marketplace, without being exposed to the risk of free-riding. Moreover, patents can be used to structure and coordinate the different inter-organizational exchanges that constitute open innovation. For instance, through cross-licensing of patents, a firm can provide use of its proprietary technology and knowledge in exchange for use of others' inventions. Patents and trade secrets, which may also be licensed and cross-licensed, can facilitate the sharing of technology and of critical know-how, thus supporting open innovation.

Avoiding knowledge leakage and ensuring appropriation are two critical IP challenges in open innovation. Firms are advised to address IP management as early as possible when engaging with external partners. This includes thorough evaluation of the IP position of potential partners and agreement of contracts that clarify to the extent possible how IP will be shared, managed, and owned by the partners. Internally, firms must adopt effective strategies for selectively sharing their know-how and inventions with others. Even with early, in-depth consideration, IP management in open innovation is not without its challenges. These include uncertainty as regards the valuation of IPRs, and the complexity of managing many innovation interactions and IP assets related to a project.

## Policy actions to support open innovation

In light of the above, policy-makers can support the adoption of open innovation models in several ways. They can improve the functioning of the formal IP system, for instance by taking steps to **improve patent quality**. Ensuring that issued patents meet all requirements in the relevant jurisdiction can result in greater legal certainty and predictability. Quality IPRs, backed by appropriate enforcement mechanisms, enable innovators to engage with greater confidence

in licensing, cross-licensing, joint ventures, and other transactions that lead to technology and knowledge diffusion. Policy-makers can also take steps to **increase access to the patent system** for all inventors, particularly individual inventors and SMEs.

**Educating innovators about effective intellectual asset management** could help them to establish the strong IP position they need to attract partners and extract the most value from collaborations. Training could be provided through IP offices, public and private universities, or industry associations. All the above actions could help to ensure that patents effectively fulfil their coordination function in the context of open innovation.

To enhance the sharing of valuable know-how, policy-makers can ensure that adequate **trade secret protection** is in place. A licence to use a patented technology will enable a company to do only so much. Know-how and expertise are also generally needed to work with a technology solution. Once control has been lost over a trade secret, whether through mismanagement or misappropriation by another firm, it enters the public domain and its value is lost. Technology providers will be unwilling to share their most valuable know-how without a legal framework that provides clear guidance as to the parameters of trade secret protection, and offers adequate remedies in the event of a dispute.

Policy-makers can also support programs to **foster the creation of innovation networks and clusters**, and should enact policies to improve the integration of public research institutions in innovation networks (Kappos 2013). Innovation networks can facilitate collaboration in several ways. Notably, they foster contact and the identification of potential synergies among innovative entities. Moreover, sustained engagement among innovators over time can enhance trust and generate additional collaboration, benefitting the participating entities while also improving absorptive capacity and the state of technology more generally.

One way for governments to stimulate the exchange of technologies and know-how through open innovation is to require that recipients of public innovation grants work with several R&D partners, on the basis of an effective IP management strategy developed in advance for the project. Governments may also wish to establish programs that stimulate and promote the sharing of information between public research institutes and companies, in order to accelerate research and its application for the market.

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ICC is the world business organization, a representative body that speaks with authority on behalf of enterprises from all sectors in every part of the world.

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ICC has three main activities: rule setting, dispute resolution, and policy advocacy. Because its member companies and associations are themselves engaged in international business, ICC has unrivalled authority in making rules that govern the conduct of business across borders. Although these rules are voluntary, they are observed in countless thousands of transactions every day and have become part of the fabric of international trade.

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