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Carliss Y. Baldwin

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The New Organization Design Problem

The so-called "modern corporation" has long been the central focus of the field of organization design. Such firms can be likened to nation-states: they have boundaries that circumscribe citizen-employees, and they engage in production and trade. But individual organizations are no longer adequate to serve as the primary unit of analysis.

Over the years, systems of distributed innovation[1] – so-called business ecosystems – have become increasingly prevalent in many industries (Moore, 1996; Malerba, 2002; Iansiti and Levien, 2004; Chesbrough, 2006; Jacobides, Knudsen and Augier, 2006; Pisano and Teece, 2007; Adner and Kapoor, 2010). These entities generally encompass numerous corporations, individuals, and communities that might be individually autonomous but related through their connection with an underlying, evolving technical system (Langlois and Robertson, 1992). In the future, I believe the key problem for organization design will be the management of distributed innovation in such dynamic systems. Specifically, how should diverse entities be integrated into a coherent network that generates goods in the present and new designs for the future? To answer that question, organization designers must think about how to distribute property rights, people, and activities across numerous self-governing enterprises in ways that are advantageous for the group as well as for the designer's own firm or community.

[1] The term "distributed innovation" was coined by von Hippel (1988) to describe a system in which innovation emanates not only from the manufacturer of a product but from many sources including users and rivals. He later argued that distributed innovation naturally arises when knowledge is dispersed and "sticky" (von Hippel, 2005; Lakhani and Panetta, 2007).

Distributed Innovation as the Unintended Consequence of Modularity

Organization design always reflects the material culture of a given time and place and is thus fundamentally constrained by technology (Heilbroner, 1967; Chandler, 1977; Galison, 1987; Hughes, 1987; Latour, 1987; MacKenzie, 2009). Of particular importance are the technologies of communication and information processing. Communication technologies matter for obvious reasons: they change the degree of real-time adaptive coordination within an organization. Information-processing technologies play a subtler role: they change the degree to which an organization can experiment to discover new and better practices.[2]

When communication and information processing are slow and costly, organizations tend to be small and locally specialized. Standardization across geographically dispersed units is feasible but expensive. Hence, it must confer the organization with a very large competitive advantage (think of the Roman legions); otherwise, it will be impractical. And managers in the field must be given great discretion in responding to day-to-day challenges. When communication is faster but information is still precious and expensive, large organizations become more feasible yet they will tend to be risk-averse and not innovative once their basic configuration has been established (Bohn and Jaikumar, 2005).

In the Information Age, the cost of information processing has plummeted, and this supports innovation in two distinct ways. First it speeds up the evaluation of new designs by making it possible to compute the impact of design changes without having to build physical prototypes (Thomke, 2003). Second, and less obviously, cheap information processing makes it feasible (and even desirable) to modularize designs, that is, to subdivide them into nearly independent components that can be modified

[2] Information and communication technologies (ICT) are often viewed together, but they are conceptually distinct. In the late 19th century, instantaneous communication became possible via the telegraph. But information-processing capacity remained limited, and thus real-time messages were constrained to be very short — hence the word "telegraphic."

separately without compromising the whole (Simon, 1962; Clark, 1985; Langlois and Robertson, 1992; Baldwin and Clark, 2000). In other words, when information is cheap, designers and engineers can codify the architecture of a technical system -- specifying the way the parts will fit together -- and begin to experiment with both the component modules and the architecture. In contrast, when information is expensive, such experimentation is not practical.

Not surprisingly, the rise of modular systems occurred hand-in-hand with the upsurge of ever-cheaper information technology in the second half of the 20th century. Such systems made highly distributed innovation not only possible but, in a value-seeking economy, inevitable (Heilbroner, 1994). Interestingly, distributed innovation was an unintended consequence of modularity. In fact, it was not even envisioned as a possibility by the first designers of modular systems. Consider the IBM System/360 computer. In using a modular design for that product, IBM was seeking enhanced customer satisfaction, economies of scale, and reduced complexity in manufacturing. But distributed innovation unexpectedly emerged in the form of competition from the manufacturers of plug-compatible peripheral devices like disk drives. At the time, IBM executives were surprised -- and greatly dismayed -- by the rise of that business ecosystem (Pugh et. al., 1991; Baldwin and Clark, 2000).

Even when the possibility of an ecosystem is apparent, managers cannot necessarily anticipate the pathways to profitability. For IBM, the saga of unintended consequences continued with the PC. After their experience with the System/360, executives at the company actively sought to create a PC ecosystem to reduce their cost and to enhance the new product's appeal. They assumed that IBM would profit from every PC system sold and control the growth of the market to protect IBM's minicomputer franchise. This worked in the short run, but then the ecosystem became flooded with PC clones, which destroyed IBM's profits and cannibalized its minicomputer business (Langlois and Robertson, 1992; Ferguson and Morris, 1993).

Unable to compete, IBM was forced to make an ignominious retreat from the ecosystem it had nurtured. But the model of distributed innovation based on modular architectures was here to stay.

The Advantage of Business Ecosystems: Joy's Law and Creative Problem Solving

Innovation is fundamentally the result of creative problem solving. But creativity is a delicate creature, and nurturing it in organizations is a topic much discussed in both the academic literature and the popular press (Amabile et. al. 1996, Amabile and Kraemer, 2011). A basic challenge is that creative problem solvers are extremely diverse in their habits of thought and action. As such, an organization that supports one person's excellence will drive others to despair and distraction. And the best individuals to solve a particular problem could literally be scattered around the world (Lakhani and Panetta, 2007). As Bill Joy, a co-founder of Sun Microsystems, once famously said, "Most of the bright people don't work for you -- no matter who you are. [So] you need a strategy that allows for innovation occurring elsewhere."[3]

Consequently, organization design must take into account that creative problem solvers can choose from among many different work environments. Some individuals may form startups to tackle a particular problem; others might choose to work by themselves and dedicate their efforts to answering a research question; and still others may seek out a community of like-minded individuals. A key issue here is how to induce such diverse individuals to apply their skills to a given set of problems in ways that allow their efforts to be linked and aggregated into a coherent whole. Some problem solvers might prefer working on their own problems while others may choose to solve problems for others, all motivated by intellectual curiosity, financial compensation, fame, or any combination of those and other factors (von Hippel, 2005). Whatever the case, there are two common threads that distinguish these diverse individuals from agents

[3]As quoted by Surowiecki (1997). Gilder (2000) dates the quote to a speech by Joy in 1990.

who work under standard employment or supply contracts: autonomy in problem selection and control over their own creations (Lakhani and Wolf, 2005). The latter issue can be addressed by allocating property rights to problem solvers, giving them control over their creations. Such control could be used to generate profits or to ensure that a creation remains "forever free."

In summary, many creative problem solvers will not (or simply cannot) work effectively under standard employment or supply contracts. To paraphrase Sun Microsystem's Joy, not all bright people work -- or even want to work -- for you. Moreover, no single setting can attract all types of creative people. And that's what makes distributed innovation in a business ecosystem such a desirable organizational form. The ecosystem provides a large tent that can encompass creators who value autonomy and want to exercise control over their ideas. Indeed, the delicacy of creativity -- the fact that it withers quickly in the wrong environment -- makes diverse business ecosystems not only desirable but increasingly necessary to remain competitive in many industries.

Organization Design of Business Ecosystems

If business ecosystems are the key to attracting the efforts from a wide range of creative problem solvers, what are the principles of their design? Modern property rights theory provides some insights (Hart and Moore, 1990). First, though, the underlying technical system needs to be understood in greater detail.

Technical systems are essentially made up of components, which can be both modules or rules (Arthur, 2009). In general, modules are present in the finished system, while rules influence and constrain how the modules are made. One important type of rule is standards, which specify how the modules will interoperate. Without such rules, the system as a whole could not function.

At the broadest level, a given technological component (either a module or rule) can be either "optional" or "core" (Baldwin and Henkel, 2012). A system might be able to function without an optional component, but it needs some version of every core module and rule to achieve any functionality at all.[4] Not all systems have cores, but many do. In a computer system, for example, the processor and operating system are core components; peripheral hardware and application software are optional. By contrast, a living room with furniture has no core modules and few rules (other than the law of gravity).

Core components are essential to the system -- and to one another.[5] According to modern property rights theory, a profit-seeking owner of a core component[6] can claim a fraction of the value added by each and every optional component. The logic here is simple: without a core component, the optional component has no value, while in the presence of the core it does. In the simplest bargaining framework,[7] if there are N core components with different owners, each owner of a core component can claim $1/(N+1)$ of the optional component's value. The creator of the optional component gets what's left over: the residual $1/(N+1)$.

This observation leads to the first principle of organization design for business ecosystems: in general, the ability to attract problem solvers is inversely proportional to the number of for-profit owners of the core components. The reason is because dividing ownership of the core between two or more for-profit firms increases the "tax" levied by

[4] This definition of "core" is similar but not identical to the concept of "core" offered by Tushman and Rosenkopf (1992) and Murmann and Frenken (2006) in the literature on dominant designs. It combines Hart and Moore's (1990) definition of a "strict complement" with Chen and Nalebuff's (2006) definition of a "one-way essential complement."

[5] The definition of the core can differ across users. What is essential to one user might be optional to others. To streamline the argument, I ignore this complexity although it can matter in specific cases.

[6] "Owner" here means an entity with the *de facto* ability to prevent others from using the component. This may or may not correspond to legal ownership. Importantly, employees and suppliers working under state-enforced and/or relational contracts are not owners under this definition (Baker, Gibbons and Murphy, 2002).

[7] Following Hart and Moore (1990), I use the bargaining framework of the Shapley value to illustrate the argument.

the core on optional components. This, in turn, reduces the incentives of outside autonomous innovators. Put another way, a system with undivided ownership of the core will attract more outside investment in innovation than one with divided ownership.

That principle explains why *platforms* are both a popular business model and a highly successful organization design for business ecosystems (Gawer and Cusumano, 2002). A platform architecture divides the components of the technical system into two groups: the platform, which is core and provided by its owner, and optional components, which are provided by external complementors (Baldwin and Woodard, 2011). As a purely technical matter, most platforms can be subdivided into constituent parts -- both modules and rules -- but dividing the *ownership* of those core components is economically disadvantageous.[8] Notably, the most famous split-core system -- the Windows-Intel platform for IBM PCs -- came about not by design but through a series of mishaps and miscalculations (described in detail by Ferguson and Morris, 1993).

It is not necessary, however, for *any* for-profit firm to own the core components of a given system. Indeed, from the perspective of engaging the efforts of distributed innovators, the more attractive environment is when the components in the core are freely available at cost. Then the creators of optional components do not have to "pay to play" nor split their profits with the core provider. According to their own preferences, they can claim the value-added for themselves or assign it to a non-profit enterprise.

This leads to the second principle of organization design for business ecosystems: a "free" core will attract more investment by distributed innovators than a "proprietary" one. Linus Torvalds shrewdly used this insight to stimulate the development of Linux into a fully functional, open-source operating system (Raymond, 1999). Indeed, in many cases, "free" cores can create an overwhelming flow of

[8] An exception exists when ownership of core components is vested in a not-for-profit enterprise such as a public repository or an open source community—Merges, 2004, calls this a "property-pre-empting" move.

investment from distributed innovators. Think of the early growth of the Internet and World Wide Web in competition against the proprietary networks from IBM, Digital Equipment Corp., and others (Abbate, 1999; Berners-Lee, 1999). Compared with a system composed of free network protocols (rules) and cheap telephone service and modems (modules), the proprietary systems had little to offer and were soon abandoned (Irving Waldavsky-Berger, private communication).

Recently, new organizational forms have emerged for the express purpose of supplying "free" core systems. One example is open-source communities, such as the Apache Foundation and the Linux Development Community, which deal with both rules and modules. Another is standard-setting organizations, such as the Internet Engineering Task Force and the World Wide Web Consortium, which deal exclusively with rules. In essence, these types of organizations are mutually owned and regulated, governed for and by their members, which are very often the suppliers of optional components.[9]

Competition and Technological Evolution in Business Ecosystems

When organization design focuses on individual firms, the discussion naturally tends toward head-to-head competition among companies making similar products. Such competition has not disappeared from business ecosystems: firms still rise and fall on the value and appeal of their products and the efficiency of their operations. Entry into markets is common, and so is failure.

But while members of an ecosystem compete, the larger system itself will inevitably evolve, opening countless opportunities for recombination: the selection of one mixture of organizational elements from myriad possibilities. Consider Facebook. The key asset of the firm is a social network website with content supplied almost

[9] These organizations have interesting historical forebears in stock and commodity exchanges, which were founded and (until recently) owned and governed by member firms. Most exchanges have lately switched to becoming for-profit corporations. At the same time, the number of exchanges has grown, and thus no single exchange is an essential component in the global trading system.

entirely by users and with revenue generated from advertising. In some respects, Facebook is a classic, ad-supported business, but the company's operations have gone far beyond traditional, firm-centric organization design. To support the website and manage traffic, Facebook depends on the Internet and World Wide Web protocols (free rules); the Internet's physical infrastructure, both wired and wireless (regulated modules); personal computers and smartphones (low-cost modules); and four major open-source codebases (free modules). By recombining those and other components from the distributed innovation of a business ecosystem, Facebook was able to capitalize on lucrative opportunities in the emerging field of social networking.

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Business ecosystems of distributed innovation first became prominent in the high-tech and information-intensive industries, and they have since spread, sometimes to seemingly unlikely areas. In textiles and clothing, for example, W.L. Gore & Associates provides a platform -- namely Gore-Tex, a breathable, waterproof fabric, as well as the rules for its use -- that dozens of companies have licensed to create various products, including outerwear and shoes (Boudreau and Lakhani, 2009). But the extent to which business ecosystems will play an important role throughout different industries remains to be seen. To be sure, certain markets present inherent challenges. In heavily regulated industries, for instance, an integrated corporation that is responsible and accountable for any given product might be a more effective organizational form than a multi-agent, recombinant ecosystem. That said, the potential benefits of distributed innovation must be recognized, and the field of organization design must broaden its traditional focus on the individual firm to encompass this compelling new approach for creating value.

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