7. Platforms rules: multi-sided platforms as regulators

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INTRODUCTION

In 1983, the videogame market in the USA collapsed, leading to bankruptcy for more than 90 percent of game developers, as well as Atari, manufacturer of the dominant game console at the time. The main reason was a 'lemons' market failure: because it had not developed a technology for locking out unauthorized games, Atari was unable to prevent the entry of opportunistic developers, who flooded the market with poor-quality games. At a time when consumers had few ways to distinguish good from bad games, bad games drove out good ones. The videogame market was resurrected six years later only when Nintendo entered with a set of draconian policies to regulate third-party developers more tightly. Central to Nintendo's strategy was the use of a security chip designed to lock out any game not directly approved by Nintendo.

Twenty-five years later, in the summer of 2008, Apple launched the iPhone store (a digital store of third-party applications for its immensely popular iPhone) at a time when lemons problems had become less of an issue, with widely available reviews and ratings available on the Internet. Even so, Apple reserved the right to verify and exclude any third-party application it did not deem appropriate. And it exerted that right swiftly by taking down an application named 'I Am Rich', which cost $999 (the maximum price allowed by Apple), while doing nothing more than presenting a glowing ruby on the buyer's iPhone screen. Apple also kicked out Podcaster, an application that would allow users to download podcasts without going through iTunes store.

The Atari, Nintendo and Apple examples illustrate instances in which non-price instruments were a critical part of strategy for multi-sided platforms (MSPs) – platforms that enable interactions between multiple groups of surrounding consumers and 'complementors'.[2] This chapter provides a general and basic conceptual framework for interpreting non-price instruments, which analogizes MSPs as private regulators; and

provides evidence in support of this view: MSPs regulate access to and interactions around MSPs through nuanced combinations of a long list of legal, technological, informational and other instruments – including price setting.

MSPs are characterized by interactions and interdependence between their multiple sides. For example, more participation on one side attracts more participation on the other side(s) and vice versa, and thus network effects will often emerge (Katz and Shapiro, 1994; Rochet and Tirole, 2006). For this reason, the thrust of prior work has been on the question of how to get the different sides around an MSP 'on board' in large numbers, while setting up a pricing model that maximizes platform profits (e.g. Caillaud and Jullien, 2003; Parker and Van Alstyne, 2005; Rochet and Tirole, 2006; Armstrong, 2006; Eisenmann et al., 2006; Hagiu, 2007). Empirical work on MSPs has largely focused on quantifying network effects and their impact on platform adoption and use (e.g. Nair et al., 2004; Rysman, 2004; Clements and Ohashi, 2005; Lee, 2008). Overall, the literature has emphasized arm's-length pricing as the central strategic instrument used by platform owners to intermediate the ecosystem of users and complementors surrounding an MSP.

A number of provocative analyses, however, have suggested a richer picture of the role of MSPs and limitations to arm's-length market interactions. Perhaps most broadly, metaphors of 'open' and 'closed' platforms convey something of how restrictive or liberal a platform may be in its dealings with surrounding constituents (Shapiro and Varian, 1998; West, 2003; Hagiu, 2007; Boudreau, 2008a; Parker and Van Alstyne, 2008). Several studies have also begun to document a variety of roles played by platform owners, including assuring 'coherent' technical development and coordination among contributors to an MSP ecosystem (Gawer and Cusumano, 2002); designing the technical architecture that frames interactions (Prencipe et al., 2003); encouraging complementors to make investments (Farrell and Katz, 2000; Gawer and Henderson, 2007); and generally 'managing' and 'maintaining the health' of the ecosystem (Iansiti and Levien, 2004). Gawer and Cusumano (2002), in particular, point to several non-price levers, their 'four levers of platform leadership', including: firm boundaries and internal organization of the platform owner; product technology; and relationships with platform participants.

The nature of these activities clearly goes beyond governing economic activity solely within the boundaries of platform owners and extends to rule making and regulating the conduct of firms beyond their economic boundaries, as suggested by several authors. For example, Rochet and Tirole (2004) characterize MSPs as a 'licensing authority'. Iansiti and Levien (2004) suggest that a platform (in their language, 'keystone')

'regulates connections among ecosystem members' so as to 'increase diversity and productivity'. Farrell and Katz (2000, p. 431) go as far as to speculate that 'the monopolist [platform owner] plays a role like that of a "public interest" regulator. The monopolist has some incentives to shape the market for the complementary component efficiently because the firm captures many of the efficiency benefits . . .'

The primary contribution of this chapter is to present evidence supporting these notions of a regulatory role of MSPs that goes well beyond price setting and includes imposing rules and constraints, creating inducements and otherwise shaping behaviors. These various non-price instruments essentially solve what would otherwise be (multi-sided) 'market failures'. We use four primary case studies to illustrate these points. Two case studies are digital MSPs: Facebook and TopCoder. To emphasize some level of generality of our analysis, we also examine two non-digital platforms: the Roppongi Hills 'mini-city' and Harvard Business School.

We find that the scope for market failures in all of these cases is rather extensive, involving externalities, information asymmetries, complexity, non-pecuniary motivations and uncertainty. Thus 'getting the prices right' was not nearly enough to assure the proper functioning of the MSP ecosystem on its own. In the case studies, regulation of access and interactions around MSPs was quite clearly implemented by applying a variety of contractual, technical and informational instruments – rather than simply price setting. Thus it was clear that MSPs were also rather effective in the regulatory role within their ecosystems. We found no conclusive evidence of excessive profit taking or a deadweight loss associated with platform regulation.

Apart from their direct implications for platform strategy, these findings also contribute to the longstanding debate on whether network effects imply externalities and market failures – and a concomitant need for regulation (e.g. Chou and Shy, 1990; Liebowitz and Margolis, 1994; Merges, 2008; Spulber, 2008; Church et al., 2008). The cases here show clear non-pecuniary externalities that could neither be internalized through spontaneous coordination of agents nor through (just) price setting by a central coordinating platform. Further, the potential coordination problems went well beyond just adoption and participation to an endless array of distributed actions and decision making of agents already 'on board' a platform. Unlike this earlier literature, which emphasizes the role of public authorities, our emphasis is on the role the MSP itself plays in regulating the surrounding ecosystem. This chapter also contributes evidence on the precise microeconomic workings of network effects and how these deviate from canonical models (in which network value simply increases with adoption and usage), as have several other contributions (e.g. Suarez, 2005, Boudreau, 2008b; Tucker, 2008).

In the next section we lay out a basic and general conceptual framework for interpreting 'platform regulation' in a large ecosystem. This framework is used to guide and interpret the case studies. The following section contains four case studies to investigate whether the principles highlighted in the conceptual framework regarding platform regulation do in fact appear in practice. Then we discuss the broad insights drawn from the case studies, and conclude.

1. CONCEPTUAL FRAMEWORK AND HYPOTHESIS DEVELOPMENT

Following the afore-mentioned accounts and casual observation, the strategies used by MSPs to manage relations in the surrounding ecosystem may involve a long list of instruments beyond just setting prices. In the case of computer platforms, for example, non-price instruments include establishing technical standards and interfaces, rules and procedures, defining the division of tasks, providing support and documentation, sharing information and so on and so forth. Rather than attempt to develop a guiding framework that attempts to contemplate these particulars, we instead lay out a very basic and general set of principles to guide the following empirical analysis.

The gist of our argument, further elaborated in following discussion, is as follows: (1) the markets around MSPs are inherently riddled with externalities and other sources of coordination problems, creating economic scope for regulation; (2) MSPs are in a unique position to be focal, private regulators by virtue of the one-to-many asymmetric relationship between them and the other players; and (3) owners of MSPs have ample instruments, incentives and resources to carry out the task of regulation.

2. MULTI-SIDED MARKET FAILURE AND THE LIMITS OF 'GETTING THE PRICES RIGHT'

The most fundamental hypothesis that sets forth our analysis is that 'getting the prices right' may not be enough for assuring efficient distributed production and contributions around an MSP. Groups of complementors and consumers around MSPs are, by definition, riddled with externalities. At the very minimum, this is because individual agents do not wholly internalize the effect of their own decisions to participate in a particular MSP on other users and complementors (i.e. network effects). Hence there should be scope, in principle, for a 'central player' to help

coordinate other players to achieve a better outcome than would be achieved in ungoverned production. This point has been made in relation to the use of pricing and subsidies in research on 'strategic sponsorship' of ecosystems (Katz and Shapiro, 1986; Shapiro and Varian, 1998), 'internalizing complementary externalities' in multi-component systems (Davis and Murphy, 2000; Farrell and Weiser, 2003), multi-sided markets (see references above) and a stream that focuses on the question of whether network effects are in fact network externalities (Liebowitz and Margolis, 1990, 1994; Clements, 2004; Church et al., 2008).

But price setting may not always be enough. To start with, in the presence of network effects, self-fulfilling expectations can give rise to multiple stable equilibria of participation levels on an MSP for a given set of prices (Katz and Shapiro, 1994, Farrell and Saloner, 1992; Hagiu, 2008). Prices are then clearly insufficient for inducing the desired market outcome. Recent work suggests much more scope for market failures around an MSP that cannot be resolved through price setting alone. For example, detailed descriptive analysis of Intel's role as a platform leader in personal computing, provided by Gawer and Cusumano (2002) and Gawer and Henderson (2007), suggests that profound coordination problems are forever looming. These go well beyond assuring adoption and relate to particular actions taken once complementors and consumers have adopted or entered the ecosystem: investments and design decisions, timing of product introduction and upgrades, etc. Aside from externalities and interdependencies, the complex web of activities going on around an MSP will create a great deal of information asymmetry and strategic uncertainty. Therefore it may be a challenge simply to maintain 'coherence' (Gawer and Cusumano, 2002) of an ecosystem, let alone any sort of optimal behavior. These points lead to our first two hypotheses:

Hypothesis 1: Markets around MSPs are riddled with externalities and other sources of coordination problems.

Hypothesis 2: Price setting and subsidies are insufficient to attain the best possible ecosystem performance from the MSPs' perspective.

3.   REGULATING AN ECOSYSTEM

We now turn to outlining essential characteristics of MSP ecosystem production and how this might be governed, to guide the case studies to follow. To interpret a potentially wide array of strategic instruments an MSP might use to shape conduct in the surrounding actors, we analogize

the MSP to a private regulator. It proves useful to begin by contrasting 'ecosystem production' by autonomous firms and regulation by a public authority before clarifying what platform regulation should involve.

Basic Terms

In simplest terms, a business ecosystem may be viewed as a collection of (many) firms engaged in joint production, whose choices and actions are interdependent. Let A denote the cumulative set of all payoff-relevant decisions or actions to be taken by all ecosystem participants. Actions might include decisions regarding entry, investments, technology and design choices, pricing, advertising, and a potentially very long list of other decisions taken across the ecosystem. In stressing the governance role of MSPs, we assume that the platform owner does not directly take actions itself. The total value created by the ecosystem, V, is the sum of value created by individual firms, indexed by i, $V = \sum_i v_i$. Value is a function of A. Decision making is distributed: we may think of all actions A as partitioned across firms. The subset of actions performed by firm i is a_i. Interdependence is synonymous with the presence of externalities: a participant's choice of private action(s) a_i impacts the returns to taking other actions, other participants' payoffs, and therefore overall value creation.[3]

Benchmark I: Autonomous, Unregulated Firms in an Ecosystem

Left to make its own choices, an individual firm in an ecosystem will naturally maximize its own private value, v_i, which amounts to choosing actions according to $argmax_{\{ai\}} v_i$.

Obviously, in this context the combination of actions that leads to greatest surplus, the 'first-best' solution, will almost never be attained. The usual problems of colluding, cooperating and coordinating – whether through formal or informal commitments – should only be more difficult in an ecosystem with potentially vast numbers of firms engaging in distributed decision making across a wide body of decisions. Further, where it is the heterogeneity of firms from which the ecosystem largely derives its value, direct transfers of decision rights will likely not be practicable; the inalienability and non-transferability of underlying organizational assets and knowledge should preclude transferring underlying decision rights. Economic outcomes might not even reach the 'second-best' outcome – in which all parties act in a self-interested fashion while strategically anticipating each others's actions – given the aforementioned complexity, strategic uncertainty and asymmetry of information.

Benchmark II: Public Regulator of an Ecosystem

The inability to achieve first- and perhaps even second-best outcomes opens up the possibility of value-enhancing public regulation. A perfect public regulator, with its powers to prohibit, compel and coerce (Stigler, 1971), may set up rules or restrictions. This effectively amounts to directly choosing actions, A, in our framework. In contrast to autonomous firms, the public regulator will therefore – in principle – attempt to implement actions leading yielding the first-best outcome, or $\arg max_{\{A\}} V = \sum_i v_i$.

However, there are well-known limitations to regulation by a public authority. Even in the best of circumstances, public regulators tend to have access to just a few blunt instruments. Thus the public regulator will not be able to influence, let alone control, the full set of a_is, A. Typical instruments include regulating entry (often when the public controls a scarce resource, such as radio spectrum), regulating price schedules to customers, setting simple quality and service standards and imposing non-discriminatory trade practices (Kahn, 1988; Laffont and Tirole, 1993; Armstrong and Sappington, 2007). In implementing just a subset of A, the public regulator must also anticipate (many) firms' (many) responses to its imposition of rules and regulations (for the unregulated a_is). This should add considerable complication to the regulatory task.

Public authority governance creates its own challenges. For example, the resources allocated to implementing (costly) regulation may have little correspondence to the returns to doing so. Bureaucracy may stifle incentives and information sharing. There may also be a threat of regulator capture by private interests.

'Platform Regulation'[4]

Where an ecosystem is organized as an MSP with surrounding complementors and consumers, the platform owner effectively controls a 'bottleneck' essential to other players (Rochet and Tirole, 2004; Jacobides et al., 2006).[5] In so far as an MSP represents a scarce, critical asset that facilitates interactions, there will necessarily be an asymmetric one-to-many relationship that emerges between the platform owner and surrounding parties. The usual 'power of exclusion' associated with legal asset ownership is much stronger in this case. MSP ownership conveys 'bouncer's rights' (Strahilovetz, 2006)[6] in the sense that control over the platform also conveys the power to exclude from the ecosystem as a whole. The power to exclude also naturally implies the power to set the terms of access (e.g. through licensing agreements) – and thus to play a role somewhat analogous to the public regulator.
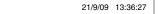
But what might be a platform owner's motivations for regulating their ecosystems? MSP owners' profits are directly tied to the economic value of their ecosystems. This is because the MSP is at the nexus of bilateral relationships with most other parties in the ecosystem and may capture a share of value created via each relationship (e.g. through 'taxing' each party, complementary platform sales etc.) (cf. Jacobides and Billinger, 2006). We denote by σ_i the share of agent i's value extracted by the MSP. Therefore, while the ability to implement rules and regulations across firms should be closely analogous to that of a public regulator, an MSP is attempting to implement actions that maximize its own profits, or $argmax_{\{A\}} \sum_i \sigma_i v_i$.

> **Hypothesis 3**: Platform regulation will be distorted away from pure value creation in the ecosystem, towards actions that lead to higher platform profits.

Given this possible distortion from a pure value-creation orientation, the relative efficiency of platform regulation then depends on how effective the MSP owner is in the regulatory role. While it surely will also not have full control over A (just like the public regulator), the question is whether it has greater control. To begin with, a platform regulator may have superior information and incentives. Unlike a public regulation bureaucracy, the platform regulator will directly derive profits to the extent that its regulation is successful. This should result in 'high-powered incentives' to regulate – something not typically associated with public regulation. These include incentives to acquire and study industry information in order to understand how best to engage in regulation. MSP owners should also have information advantages simply through their position at the nexus of bilateral relations in the ecosystem.

Platform regulators may also have access to a wider menu of regulatory instruments to implement desired actions. Apart from licensing, property rights assignment and other traditional contractual and legal instruments, platform technologies and design are themselves understood as a means of virtually imposing 'laws' (Lessig, 1999) and design 'rules' (Baldwin and Clark, 2000). Accentuating this advantage, MSPs are most often found at the core of the technical design, defining system architecture and technical relationships. The unique position and properties of the platform owner within the ecosystem should also better allow them to be 'leaders' (Gawer and Cusumano, 2002) of other firms by providing access to 'soft' instruments of coordination such as communication, signaling and relational contracting. For example, Intel's implemented 'Moore's Law' simply by declaring it so. These points lead to our final hypothesis:

Hypothesis 4: Platform regulators benefit from extraordinary access to instruments, information and incentives in performing the regulatory role.

4. CASE STUDIES

The remainder of this chapter presents four cases studies intended to investigate the hypotheses developed here. Two case studies – Facebook and TopCoder – are digital platforms; two others – Roppongi Hills and Harvard Business School – are non-digital.

Facebook

In broadest brushstrokes, Facebook[7] can be viewed as following traditional multi-sided platform strategies in its goals of encouraging a critical mass of adoption, while 'monetizing' the installed base. However, platform strategy here is distinctly shaped by idiosyncratic features of network effects acting in this platform. A first challenge is that members care only about their relevant network rather than the aggregate network. Thus growth is about expanding a mosaic of social networks rather than scale *per se*. A second challenge is that Facebook must then activate the 'social graph'. Beyond simply establishing linkages among members, it must keep these linkages active, fresh and compelling. Third, Facebook has the challenge of minimizing negative interactions on its platform, ranging from irrelevant interactions, those that are inappropriate to the context, all the way to 'fraudsters' and illicit activity.

Growth through restricted access
These idiosyncrasies of network effects among members have led to somewhat counter-intuitive interventions by Facebook – including restricting access so as to promote growth. Indeed, in the first two-and-a-half years after launching in February 2004, Facebook was not accessible to all Internet users.

Initially, the social network was accessible just to the Harvard College community. Within just 24 hours of launch, 1200 students had signed up. In just a month, half of Harvard's undergraduates had joined. In March 2004, access was expanded to students at Stanford, Columbia and Yale – then to other Ivy League and Boston-area colleges in April. The Boston College network grew to 2500 members, roughly a fifth of all students, in the first week (Cooke, 2004). In this fashion of adding institutions Facebook membership grew past one million members by

year-end 2004. Roughly one thousand institutions were added by 2005. Support was extended to US high schools by September 2005. This new high-school community, however, was designed to be segregated from the main university platform, so as to preserve the integrity of the social milieu while serving distinct groups. The success of this gradual approach revealed that restricting access was a useful means of increasing the likelihood of relevant connections, enhancing word-of-mouth dynamics, and avoiding negative interactions with unknown and potentially undesirable members.

In just about 18 months, the education market for social networking had essentially tipped to Facebook. The market was even becoming saturated by 2005, with as much as 85 percent of students at supported institutions already on board (Arrington, 2005). The imperative to maintain and restore growth pushed Facebook to open more broadly in April 2006 – first to 'work networks' at targeted companies, and then essentially to all comers by September 2006 when Facebook dropped most access restrictions altogether.

Facilitating and imposing member interactions
But opening up the platform wide to all comers created important trade-offs. Incumbent student members might, for example, have preferred to keep the network closed to their own demographic group. When the platform was opened to a wider public, concerns for privacy and undesirable interactions became more prominent. Not surprisingly, then, the opening of the platform to a broader public appeared in combination with the launch of added privacy controls on News Feed, Mini-Feed and other services that most obviously could have led to broadcasted personal information. Privacy controls have since rapidly evolved to provide greater amounts of flexibility and customization, given apparent heterogeneity in users' tastes for privacy. For example, at the time of writing this chapter, there are separate privacy settings for Profile, Search, News Feed and The Wall, and Applications. Each of these categories offers roughly ten adjustable parameters (a relatively large number) to specify individual tastes for privacy.

One key reason for Facebook's incentive to stimulate active usage of the network is monetization through advertising. At the same time, the company also has to make sure that it provides its users with the means to ward off unwanted approaches and protect their privacy. This is a delicate balancing act which has led the company into at least one *faux pas*. In late 2007, Facebook launched a program called Beacon, which aimed to leverage advertising opportunities from a feature that let users know which products and services their friends were buying. This ill-advised foray into

'social marketing' drew a backlash from users, who disliked their invasion of privacy, and in March 2008 CEO Zuckerberg apologized for the program and moved to limit its scope.

Designing a marketplace for widget innovation

The role of Facebook as rule maker and regulator for the ecosystem around its platform is equally seen in its relationship with developers of 'widgets', software applications that can be installed on members' profile pages. A large fraction of widgets are inherently social in nature[8] in the sense that using and sharing widgets will itself lead to building, activating and refreshing the social graph. That the population of over 30,000 widgets has been installed over 900 million times already suggests that they convey considerable value to the platform, both enhancing network effects among members and helping attract new members to the platform.

There are essentially two main challenges to assuring a compelling and regularly refreshed set of applications in Facebook's case: fostering experimentation and encouraging high investments in quality. Wide experimentation is required because unlike in, say, the case of producing 'another' word processor or database, much remains unknown concerning preferences and technical approaches to social applications. To encourage wide experimentation in parallel (cf. Boudreau et al., 2008), Facebook has adopted a strategy of free access and low barriers to entry for widget developers through various measures, including: open and well-documented application programming interfaces (APIs); support for multiple development languages; free tools and test facilities; support for communication among developers within Facebook developer forums and conferences.

Extraordinarily broad entry could, however, result in excessively intense competition, which would then drive down profits and incentives to invest around the Facebook platform (Boudreau, 2008b). This risk is however mitigated by purposeful design choices made by Facebook. Indeed, the company has taken steps to induce a sort of winner-take-all structure in the market for widgets, at the level of application niches (for instance, the niche of chess games includes over 20 widgets but is dominated by just two games – 'Chess' and 'Chess Pro' – which jointly capture 95 percent of all usage). The deliberate encouragement of applications that are social in nature (through the design of APIs and the design on the platform itself, certification programs, funding awards and other means) encourages market concentration by word-of-mouth dynamics and encouraging users to standardize on a particular application to allow interactions. Network effects at the application level then tend to tip niche markets to one or few widgets.

The dissemination of information on Facebook's 'Application Directory'

also encourages niche concentration. Although there are thousands of applications, the 'Application Directory' encourages downloads of just the top several dozen applications by displaying titles in a vertical list with only several per page. So important is this dissemination of information that numerous developers reported that they shifted their development attention to higher quality and greater interactivity when Facebook began ranking applications by the (flow of) usage rather than the (stock) of downloads (Naone, 2007).

TopCoder[9]

From the perspective of its clients, TopCoder is a vendor of outsourced software projects. But what sets TopCoder apart is the company's organization as a platform, one that effectively brings together buyers of software on one side of its platform, with a stable of roughly 20,000 actively contributing developers spread across 200 countries. Internal TopCoder benchmarking estimates show dramatic efficiency improvements on standard software development practices, with increasing potential savings with increasing project complexity. Lending credence to these claims, the company achieved no. 13 rank on *Inc* magazine's fastest growing software companies in 2008.

TopCoder's 'community' of software developer 'members' compete in regularly scheduled contests to provide solutions to individual software challenges based on software buyer demands. Winners are awarded pre-announced cash prizes for their contributions. Prizes can vary quite widely: most often they are of the order of hundreds or low thousands of dollars but can go all the way up to six figures.[10] Top developers can make hundreds of thousands of dollars per year (Leibs, 2008). Most members, however, are often employees of other firms or students and devote a fraction of their time to TopCoder contests.

Regulation to enhance competition

Let the world compete on your next application.

TopCoder website

A key ambition of TopCoder is to orchestrate an environment of unbridled competition among its developers. While prizes (fundamentally a price instrument) are a clear feature of relationships with the competitor-coders around the platform, this price mechanism is deeply embedded within a rich system of rules and regulated behaviors. A most obvious rule that transforms the price mechanism here from a typical market arrangement

is that prizes are presented *ex post* (as opposed to having competitors engage in *ex ante* bidding and selecting a winner prior to the production of the solution). This ensures intensive rivalry throughout the competition, rather than just up to the 'bidding' stage. Furthermore, awarding prizes *ex post* is a means of overcoming uncertainty regarding who in fact is the best supplier of a given software project. Thus, at the crudest level, the price mechanism and the rule of *ex post* rewards is the foundation of TopCoder's selection mechanism.

A range of other non-price instruments is complementary to *ex post* awards. For example, TopCoder actively shares information within contests to heighten rivalry in the pool of competitors. A 'heads-up' display on competitors' computer monitors displays the identity of all competitors, their skill ratings (based on performance in past contests), history of any submissions and competitor performance. TopCoder develops a barrage of formal and objective testing measures for each of its contests and is thus able to assign objective scores on the code that is created by every competitor. What is more, these scores are publicly shared and go into the public record as part of a competitor's skill rating. Thus TopCoder orchestrates a context of cut-throat competition.

Harnessing non-pecuniary incentives

Unbridled competition and *ex post* selection might again raise the concern for quashed investment incentives (as in the Facebook case). Further, *ex post* selection might seem to create enormous wasted and redundant efforts that might translate into reduced efficiency and lower profits for the platform owner. But this sort of analysis fails to recognize that TopCoder is, in effect, harnessing value created by a wide variety of motivations that are typical of coder communities, e.g. intrinsic motivations for doing the work or learning from the work, career concerns, status and recognition in the community or simple affiliation with the community (Lerner and Tirole, 2002; Lakhani and Wolf, 2005). Thus profit opportunities and monetary awards are but one aspect of prizes. Following this logic, 'redundant costs' may in fact be the effort devoted to learning; participation itself may enhance one's affiliation with the broader coder community; posted scores are an opportunity to signal capabilities to prospective employers and to achieve status; objective evaluation can be a useful means of self-improvement. TopCoder has also found that the extreme competition and rivalry (in a behavioral or game-playing sense, rather than an economic sense) is itself a great motivator for coders. Thus the platform is designed to internalize and capture value in non-pecuniary incentives – something a price system on its own would clearly fail to achieve.

Imposing a system of production

TopCoder's basic selection mechanism is able to function as it does by imposing several broader choices around the MSP business model. Most profoundly, TopCoder imposes its control over all interactions with customers: software developers do not interact with final customers. This is clearly a necessary choice in governing the software development process as a set of contests. Thus all communications, transfer of assets, payments and other forms of interactions are effected through the platform itself. Doing so further necessitates that software development be a sequential and planned process in contrast to other popular approaches to programming such as 'extreme' or 'agile' programming, in which developers iterate between experimentation, design and evolving requirements.

Apart from dividing production sequentially and by software modules, TopCoder also divides labor functionally. Apart from contests for software development (the actual creation of modules), individual contests are held for software architecture, software design (i.e. specifications, requirements, functionality of modules), software assembly (creation of applications on the basis of created modules) and testing (creating test scenarios to assess robustness of software). (Bug fixing has been added as a function, but not via a contest mechanism.) Thus more than creating just a 'multi-sided market', TopCoder's platform effectively defines and governs an entire value chain.

Roppongi Hills[11]

Roppongi Hills is a sprawling 12-hectare 'mini-city' shopping center and multi-purpose complex that was opened in April 2003 in the center of Tokyo. It was developed and is managed by Mori Building, one of Japan's most prominent real-estate developers. The center encompasses a large retail space filled with shops ranging from Louis Vuitton, Banana Republic, Diesel and Zara to a range of smaller brands, an eclectic mix of Japanese and foreign restaurants, coffee shops and a cinema. Apart from retail, Roppongi Hills includes an outdoor arena, a television studio, a luxury hotel, commercial office real estate and two residential buildings. Its landmark is the imposing Mori Tower, an elegant 54-story steel-and-glass construction that serves mostly as office space but also contains a library, an observatory and an art museum dedicated to modern art exhibitions on the top floor. The vision for the complex was based on the belief that offices, residences, shopping, entertainment and cultural facilities could not only coexist in close proximity, but also that 'synergies' (in other words, network effects) could be found in such a multi-purpose project.

This mini-city platform has been an unusual success among development

projects (and shopping centers, in particular), with over 40 million visitors drawn every year; office and retail space have doubled since opening. While any shopping mall can be viewed as a (at least) two-sided platform between retailers and shoppers (Rochet and Tirole, 2004), Roppongi Hills is exceptional in the extent to which Mori Building actively regulates its mini-city platform.

Enforcing novelty and cultural themes
On the retail side, Roppongi Hills encompasses about 250 retailers (restaurants, shops and various service providers). Each retail tenant paid Mori Building 15 percent, on average, of their sales revenues as rent. Mori Building received a total of about 2000 applications for its desirable 213 locations it had opened initially. However, Mori Building exercised considerable discretion in deciding which retailers they would accept and the positions they would take in the mini-city. This quite clearly deviated from simply always selling to the highest bidder. For example, in Mori Building's quest to ensure that Roppongi Hills remained a novel, fresh and unique environment, they decided to allocate the largest space (3000 square meters) to Estnation, a relatively new and trendy apparel store rather than larger and more prominent brands.

Arguably the boldest space allocation decision regarded the most valuable real estate of the entire mini-city – the top five floors of Mori Tower. On these floors, Mori Building chose to place Academy Hills (a multipurpose education facility), an observatory deck, an art museum (Mori Art Museum) and an art gallery (Mori Arts Center Gallery). The art museum was placed on the top floor – the most prestigious location of all. In so doing, Mori Building was intent on clearly signaling the concept of a 'cultural heart' of its mini-city,[12] thus elevating the cachet of Roppongi Hills as a whole, rather than simply allocating the space to the highest bidder (which would have likely paid a large sum).

Also in the pursuit of novelty and originality, Mori Building believed it was essential to periodically refresh its retail offerings, while tailoring them to the special requirements of the mini-city. To this end, it constantly encouraged retail tenants to renew the designs of their stores. More forcefully, Mori Building actively replaced underperforming stores or those found not to 'fit' with the mini-city environment. For example, by two and a half years after opening already 26 percent of the retail space had changed hands.

Importantly, however, Mori Building has since seen churn reduce to half these levels. The company expects that once features of its platform business model are solidified, it should take less active intervention to achieve its goals. Roppongi Hills' Grand Hyatt's manager further suggested that

it will be only after reducing active interventions and allowing the model to stand on its own that true advantages of distributed and autonomous decision making around the platform can take hold: 'I feel that one could improve the attractiveness of such mixed-use developments in the future by allowing them to grow more naturally, instead of designing them as purposefully as they are now.'
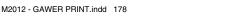
'Town Management'

Unlike many real-estate developers, Mori Building did not view its job as ending after the final choice of the tenant mix and their positioning within the mini-city. The company decided that in order to help materialize the 'synergies' – the premise upon which its 'multi-purpose' project had been built, it had to actively manage the complex on an ongoing basis. To do so, it created an internal unit, called 'Town Management' (henceforth TM), whose primary mission was to create a strong, consistent Roppongi Hills brand image and to strengthen the sense of community. In the words of its senior general manager: 'Because there are so many different constituents interacting with each other, effective town management is critical. It is essential to manage Roppongi Hills as a whole. While each constituent has their own agenda, our job is to consolidate, coordinate, and promote a unified image.'

One of the first initiatives of TM was the Community Passport, a loyalty program that allowed subscribers to accumulate points at shops, restaurants and the movie theater, which could be converted to discounts. 'Insiders' (i.e. office and retail employees) were entitled to special advantages through the Community Passport: automatic 10 percent discounts at stores and restaurants within the complex, information about 'secret sales' three days before the sales were opened to the general public etc. TM also regularly came up with initiatives designed to attract traffic and create a stronger sense of community. For instance, it handled certain events for the Tokyo International Film Festival throughout the complex and worked with restaurants and shops to engage them in the selection of themes for the museum's exhibitions.

These policies resulted in tailoring of offerings, even from well-known international brands. For example, the Grand Hyatt hotel was one of the most recognizable brands in Roppongi Hills. The hotel's design and operations were specifically tailored to Roppongi Hills: among other things, its restaurants remained open later than in its other locations in order to attract business customers (which made up 70 percent of the hotel's clientele), it offered discounts to employees of office tenants, and it provided catering for private parties of the Roppongi Hills offices and residents. The hotel even sacrificed some short-term revenues for the larger benefit of the

Roppongi Hills community. For instance, it reserved its banquet rooms for the Tokyo International Film Festival, hosted by Roppongi Hills every year in October, a period that coincided with Japan's biggest wedding season, typically a major source of income for hotels and other establishments, which could easily generated ¥40 million or $340,000 per month.

A key focus for TM was the implementation of the 'only one' policy for retail, consistent with its broader goal of novelty and originality. This policy was introduced in order to differentiate Roppongi Hills from other shopping destinations: not only did Mori Building executives aim for a diverse mix of stores, they went a step further by demanding that retailers produce stores unique to Roppongi Hills. This could take many forms, such as a requirement to stay open late in order to achieve a '24/7' city image, or a requirement to carry different merchandise from other storefronts owned by the same chain in Tokyo. TM worked closely with retailers in order to achieve the 'only one' goal. One of the most noteworthy achievements could be found in the Roppongi Hills Gate Tower. Its main tenant, Japan's largest DVD and CD rental store chain Tsutaya, had agreed to open a store on the lower level of the building and to share the space with a Starbucks coffee shop. This resulted in a popular corner location where residents as well as visitors could browse movies and music, relax with a book or magazine, and drink a cup of coffee. Conversely, the 'only one' policy could also trigger a retailer's exit, such as that of Mikimoto, a world-renowned jewelry retailer, which had to vacate its Roppongi Hills storefront after two years of disappointing sales.

TM was also in charge of monetizing the unique Roppongi Hills complex and brand name by attracting advertisers and sponsors. It sold event sponsorship opportunities and leased the advertising space within the complex – an important source of income. For example, an advertiser (e.g. BMW in 2005) would have to spend ¥50–100 million for a two-week campaign covering the entire mini-city (i.e. monopolizing the publicity channels within the complex).

The strategic use of architecture and design
The aforementioned instruments of control and regulation predominantly rely on outright contracting and traditionally legal mechanisms. This would seem to be in contrast to the heavy reliance on technical design in the earlier case studies of digital platforms that were used to impose rules. However, there are abundant examples in the case of Roppongi Hills where rules embedded in design also played an important role.

For example, the Mori Tower was Tokyo's largest office building in terms of rentable space, with 380,000 available square meters, i.e. roughly one-and-a-half football fields for each floor. This was a daring design

decision that specialized this office space to a select set of target tenants, since few companies could use such large floor space. In particular, Mori Building was intent on targeting sectors and firms for which the unique infrastructure would be appealing, particularly foreign financial institutions who were aggressively expanding in Japan, and information technology companies. Indeed, among the first tenants to come on board was Goldman Sachs, which Mori Building had had to persuade to move from its nearby Ark Hills location (an older Mori Building complex). Other tenants included Konami (one of the largest videogame developers in Japan), Livedoor, Rakuten and Yahoo! Japan (the top three Internet companies in Japan in 2003).

Another noteworthy design decision regarded the layout of the complex and the choice of locations of the various uses. To convey a feeling of exploration akin to that found in real, organic cities, the architects opted for a maze-like structure in which visitors and residents could wander around for hours, and 'discover' new shops and restaurants along the way. Thus the layout necessarily guided and increased the likelihood of commercial interactions. The structure was thought to benefit those visitors who enjoyed wandering around and looking at shops and restaurants, although corporate tenants were less pleased with lack of clarity, and some expressed concerns that it might be confusing.

Harvard Business School[13]

Business school education arose as an institution in the early twentieth Century. The Wharton School of the University of Pennsylvania was founded as the first American business school within the broader university in 1881. Several European schools of commerce had been opened earlier. Harvard Business School (HBS) was started in 1908 and has since been synonymous with business education and has been particularly successful in fostering a product and reputation to maintain a high ranking.

In the early twentieth century, HBS's education 'platform' was largely 'one-sided' in the sense that it catered to a single group: its students. Graduates received a certificate and were then essentially on their own. When it launched career services decades later it became a two-sided platform that effectively began to internalize the matchmaking process between graduates and recruiters. Today, HBS and the most successful of other business schools are in fact multi-sided platforms. They attract and balance communities of students, faculty, alumni, recruiters, capital providers, community and industry linkages – and enable them to interact in myriad ways. Thus, while the core 'product' of HBS – its teaching

delivered in the classroom – remains a key function, the strategy of the institution goes far beyond this.

The central role of HBS's MSP strategy in the overall success of the institution might immediately be understood in remarking that brand name and reputation are widely accepted as the key drivers of business schools' success. But brand and reputation are in turn determined precisely by the participation of the constituents themselves. For instance, an attractive school for students is one that has renowned faculty, a powerful alumni network and that offers access to desirable recruiters. Conversely, recruiters are drawn to the schools with the best students. Capital providers (private donors as well as corporate sponsors) also prefer to bestow their financial support on schools with remarkable students and faculty. Thus the success of a business school hinges on the same sort of chicken-and-egg problems well known to other MSPs. And managing brand and performance can in large part be understood as a matter of managing network effects across different sides of the HBS platform.

Students, alumni and donors on a rather mature and stable MSP
Perhaps the most important and at the same time most difficult aspect of building a business school is the challenge of attracting valuable parties to the platform. HBS solved its chicken-and-egg problem of attracting good students to establish a reputation (and vice versa) some decades ago and has consistently attracted a large number of exceptional students. In the 2008 rankings, for example, HBS and Stanford students tied for top GMAT® (Graduate Management Admission Test®) scores. This is particularly notable given HBS's large class of roughly 900 students (per year). The stable, high quality of HBS applicants over the decades has allowed the institution to develop the other parts of its MSP.

The school was among the earliest and most sophisticated adopters of certain practices now common among leading business schools. This particularly relates to management of the alumni and donor networks. The alumni side of the MSP is of course inevitably populated by intakes of past students and is arguably the most valuable side of the HBS MSP given its sheer size and prominence: it contributes reputation, career opportunities and donations. Since its early history, HBS has focused on training business 'leaders' and has sought to maintain strong relationships with this network (through active communication, mailings, organization of events and local HBS clubs distributed around the world). Similarly, HBS actively pursued large donors from its early history and now maintains an endowment of several billion dollars. Its 2006 capital campaign alone – targeted to fund financial aid, faculty development, global outreach, teaching and technology, campus renewal and other programs – raised $600 million.

HBS publishing: facilitating interactions, imposing rules

Apart from early adoption and small advantages in initiative, HBS made several decisions with multi-sided implications that may have enhanced its network effects. For example, the school's emphasis on training for positions in the highest levels of management may have led to more prosperous careers, a more active and attractive alumni network and more generous donations – at least historically.

Another area was in relation to publishing by another side of the MSP, its professors. While the use of the case study method in the classroom was arguably just another instance of early adoption by HBS, a more fundamental decision was that HBS also became the leading producer of business cases. This deepened relationships with the corporate world (the industry side of the HBS MSP), while also enhancing the classroom experience through more relevant material, presented by the cases' authors (and sometimes protagonists) themselves. Conversely, being the subject of an HBS case started to carry significant value for companies who were attracted to the HBS MSP.

Thus enhanced alumni and industry relations were complementary with superior classroom experience and the advancement of professors' research and careers. A similar logic applied to the creation of a practitioner journal in 1922, the *Harvard Business Review*, which professors could contribute to (the *Review* publishes articles by professors and practitioners from any institution, not just HBS) and alumni could learn from. The wider distribution to a broader management public would also sustain and grow the reputation of HBS in the broader business world. Thus HBS Publishing (which oversaw the publication of cases and the *Harvard Business Review*) was a feature of the HBS MSP business model that intensified network effects among the various sides of the HBS MSP.

One challenge to the HBS model – emphasizing practioner links and case study writing – that has appeared over the last 30 years is the rise (and now dominance) of academic, research-oriented faculty across business schools. The involvement with practitioners creates opportunity costs for faculty whose careers depend more on research performance. As a result, the positive externality created by case publishing and practitioner links can potentially create a negative externality with the faculty side of the MSP. This negative effect is to some extent mitigated by the fact that case development can be a significant component of tenure and promotion requirements. In fact, it is possible to pursue a tenure track at HBS on the basis of a teaching career. Furthermore, HBS provides ample support to its faculty (e.g. research assistance) in order to minimize the cost (mainly in terms of time) of case writing. Nevertheless, developing cases remains a relationship-specific investment that faculty make in HBS, which has significantly less value if a faculty member has to seek tenure at other institutions.

Restricting and regulating the job market

Another challenge of balancing positive and negative interactions stems from a fundamental tension inherent in managing renowned business schools. HBS and its peers are at the same time education institutions and – to some extent – intermediaries between students, recruiters and faculty. While business schools do recognize the value of matching their students with desirable recruiters, all of them aspire to be much more than mere job matchmakers, in which the most important function would be performed by the implicit certification of the admissions office. Similarly, the collaboration of school faculty with outside companies (in the form of research projects or consulting) is highly desirable, but only to the extent it does not compromise the engagement of faculty with students and research.

It is not surprising, then, that HBS and other business schools have put rules in place in order to regulate these two critical interactions. The faculty–outside companies interaction is simpler to deal with: it is usually regulated by imposing a simple maximal threshold on the amount of hours any faculty member may spend engaging in 'outside activities'. The students–recruiters interaction requires more complicated forms of regulation. First, in order to minimize the potentially negative externalities this matchmaking function may have on the educational function of the institution, business schools typically try to restrict the timing of on-campus recruiting events and ask recruiters to not make interview offers that require students to skip class. And while in principle any employer is free to court any business school's graduates, most business schools offer special opportunities for interacting with students (e.g. through information sessions and various campus events) to a select group of recruiters, usually in exchange for a fee. Not all recruiters have access to such opportunities, and recruiters can lose their privilege if they do not maintain good relations with the school (for example, this may be triggered by overly aggressive recruiting campaigns held on campus and not authorized by the school). Second, business schools also try to ensure that the 'internal' recruiting matchmaking market functions efficiently, which is why most of them impose rules on both recruiters and students regarding timing and deadlines of offers, limited ability to entertain multiple offers etc.

5. DISCUSSION

In Section 2 we hypothesized that the markets around MSPs should often be fraught with externalities and potential coordination problems (Hypothesis 1) that cannot be solved by price setting alone (Hypothesis 2). We argued (Section 3) that the platform owner would itself emerge as a

private regulator, invoking an unusually rich set of strategic instruments to influence the behavior of complementors and users around the MSP, while benefiting from privileged information and a privileged position within the ecosystem (Hypothesis 4). The platform owner might then act as an unusually effective regulator of the ecosystem as a whole; however, its goals might be distorted towards capturing profits rather than just increasing value in the ecosystem (Hypothesis 3). The four case studies presented in this chapter provide considerable evidence in support of Hypotheses 1, 2 and 4. The evidence in relation to Hypothesis 4 is less clear and suggests a more nuanced set of issues.

The Limits of 'Getting the Prices Right'

In relation to Hypotheses 1 and 2, the case studies provide clear evidence of coordination problems that would not be solved by pricing alone. For example, Facebook grew its member base by restricting access to certain social groups. This would have been impossible to implement with pricing alone. Using price to encourage particular sorts of interactions on the platform while discouraging others would have been more difficult still. TopCoder did not face this same level of complexity, but instead faced challenges of uncertainty regarding which competitors possessed relevant skills and approach, as well as the need to foster non-pecuniary motivations. In this case, while price (prizes) played an important role, it would have been utterly insufficient without the system of rules, inducements and restrictions built around it. Roppongi Hills used a mixture of subjective selection procedures, imposition of rules and architectural design decisions to foster an overall brand image and 'feel' to its mini-city that would have been impossible to replicate even with the most sophisticated price instruments (e.g. property rights bidding system). Harvard Business School found it necessary to carefully monitor and regulate the interactions between students and recruiters. These and numerous other examples readily convey a range of externalities, complexity, uncertainty, asymmetric information and coordination problems that imposed severe limits on what could be achieved by price instruments on their own.

Regulating Access to the MSP

In relation to Hypothesis 4, we observed clear and extensive interventions above and beyond price setting. These might be thought of as related to either regulating access to platforms or otherwise regulating interactions once on a platform. Fundamentally, the goal of regulating access was to make sure the MSP attracted the 'right' kind of participants on all sides.

For example, Facebook initially restricted user access to the platform based on demographics so as to maximize positive interactions while minimizing negative ones. The implicit assumption was that immediate unrestricted access could have resulted in an overall 'social market break-down' of the type illustrated by the Atari example in the introduction: undesirable users and connections crowding out desirable ones. Mori Building selected its retailers on its own discretion in accordance with the values of its mini-city. It also reviewed its selections every two years, based on performance and 'fit' with the overall theme of the complex. Harvard Business School selected students and other sides of the platform based on complementary characteristics, among which willingness to pay was not foremost – although the model fostered high willingness to pay among donors. Harvard Business School also restricted access of recruiters to certain times during the year to assure proper functioning of its interactions with students. The concern was a crowding-out of a standalone service (education) by the matchmaking function (recruiting). TopCoder did not outright regulate access, but did regulate interactions with clients *ex post*. Thus we observed rather nuanced regulation of access by number, time, type and even individual identity.

While traditional contractual instruments were clearly invoked to implement access policies, technological instruments were also used. For example, Facebook exploited web addresses as identifiers to bar entry to its platform, in addition to employing contractual user agreements. Roppongi Hills used architectural design as a means of attracting certain types of tenants.

Regulating Interactions on the MSP

Also in relation to Hypothesis 4, considerable rule making and regulation was directed towards achieving desired conduct of – and interactions between – platform participants once they were on board. In order for the potential value from network effects to materialize, MSPs put in place a series of sometimes rather nuanced controls and inducements. There were many examples. For example, Facebook's management of privacy – enabling users to restrict their interactions to trusted contacts – illustrates the most basic function that regulation of interactions serves: minimizing negative network effects. Mori Building's 'Town Management' unit for Roppongi Hills was an explicit attempt to drive positive network effects and synergies. To some extent, the issue there is a public-good investment problem: left to their own devices, individuals (i.e. retailers and tenants) would underinvest in public good provision (i.e. marketing to outside visitors, maximizing complementarities with events throughout the complex).

TopCoder profoundly influenced how its coder–competitors would relate to one another, by carefully designing how they would compete against one another and what they would know about one another. Harvard Business School devoted careful attention to interactions between students, faculty, capital providers, alumni and other groups. The list of precise ways and means of regulating interactions in the case studies was extensive and often extraordinarily nuanced, involving contracting, technology, information provision, investments, tools, inducements, culture and norms. The use of these instruments in concert allowed platform owners to strive to implement rather precise outcomes.

The Objectives and Efficiency of Regulation

In relation to Hypothesis 3, there were limits to what could be concluded on the basis of evidence examined here. Whether platform regulation led to deadweight loss and distortive platform profit seeking was unclear, but the patterns hinted at a more nuanced set of relationships with factors going beyond those in our earlier hypothesis development. Take, for example, Facebook's interest in 'monetizing' its user–members with a platform function (Beacon) that allows the MSP to track and report users' behavior beyond the platform. Or, less controversially, consider Facebook's opening its platform beyond the education segment. Neither move appeared to be in the direct interest of (incumbent) Facebook members. Both appeared to be motivated by Facebook's commercial objectives. But whether or not imposing these changes would have had a net positive or negative effect on economic value created (even for members themselves) is *a priori* ambiguous. On the face of it, continued growth of Facebook would appear to have created enormous value while only slightly inconveniencing student members. It is also conceivable that the tracking service would have created more value for businesses than the value it destroyed for members. Alternatively, it may have even created value for members by bringing richer services. While the evidence is inconclusive, it hints at the possibility that platform regulation is as much about 'pleasing all sides' around an MSP, the outside options of MSP participants, switching costs, ability of participants to coordinate themselves as a group and so on – as much it is about platform profit seeking.

6.   CONCLUSIONS

This chapter presented arguments and evidence that platforms serve as rule-making governance mechanisms – apart from any functional value

of the platform itself. 'Platform regulation' involved using a wide range of strategic instruments (well beyond price setting) to regulate economic activity of surrounding platform participants. These instruments were applied in concert, often involving nuanced combinations of legal, technological, informational and other instruments (along with price setting) to implement desired outcomes. This combination of instruments was used to minimize costs associated with a range of externalities, complexity, uncertainty, asymmetric information and coordination problems the multi-sided platform was in a position to address. Perhaps most striking in the analysis was that the regulatory role played in these cases by multi-sided platforms was pervasive and at the core of their business models.

While the choice of disparate case studies should begin to suggest some generality of the findings, clearly wider and more systematic study is warranted. Patterns identified here, moreover, point to deeper questions necessary for understanding the economics of non-price mechanisms used by multi-sided platforms. For example, the findings invite clearer definition of the sorts of multi-sided market failures that can arise – and how particular combinations of platform strategic instruments might attend to these. An obvious starting point for this work might be to understand how price and non-price instruments coexist, interact and should be applied to different sorts of problems. The sheer number and complexity of instruments being used by platform owners (including investments, technology rules, information dissemination, contracting choices and pricing) is also clearly an empirical phenomenon deserving closer attention and clearer explanation. Why so many instruments? The basic terms and analytical framework set forth in the hypothesis development of this chapter also suggest that it may be productive to develop a contingent view of the role of private versus public regulators. The analysis here leaves open the question of whether there was in fact (much of) a deadweight loss associated with platform regulation and pointed to a variety of factors shaping profit taking by platform owners that should be further investigated.

These findings have important managerial implications. First, the scope of strategy for platforms is significantly wider than for normal firms: it is not limited to pricing, product design and technology, but also and critically includes control over interactions that do not happen at your firm's boundaries. Our analytical framework suggests a two-step approach for a platform owner: (1) maximize value created for the entire ecosystem; (2) maximize the value extracted.

Second, our analysis reveals the existence of a wide array of strategic instruments available to implement platform regulation, including contractual, technological and information design. The instruments observed here varied in their effects, whether they were easily reversible or not, and

their availability from one context to another. While more detailed analysis of these instruments remains an area of future research, it is useful to emphasize that even non-technology multi-sided platforms can and should use a sophisticated array of regulation instruments (cf. Roppongi Hills).

Third, our analysis begins to suggest that the need for and consequences of platform regulation may evolve over time. Active and early orchestration of the multiple sides of a business has the potential to set powerful network effects and complementarities into motion (cf. HBS). Establishing an MSP regulation model may be most difficult stage in early stages – particularly if a firm waits while competitors do so. By the same token, once a regulated ecosystem is successfully established, the advantages of distributed innovation and decision making may begin to truly take hold (cf. Roppongi Hills).

NOTES

1. We wish to acknowledge comments and suggestions provided by seminar and conference participants at Imperial College, the 2008 Academy of Management annual meetings and the Paris workshop on digital platforms held at LECG offices. Boudreau thanks Microsoft for funding that supported this work.
2. Platforms are products, services or technologies that serve as foundations upon which other parties can build complementary products, services or technologies (Gawer and Cusumano, 2002; Gawer, 2009). A 'multi-sided' platform or MSP (e.g. Sony's PlayStation, Visa credit cards, Microsoft's Windows, eBay) is both a platform and a market intermediary (Hagiu 2007). Thus distinct groups of consumers and 'complementors' interact through MSPs.
3. The following discussion focuses on interactions between traditional profit-maximizing agents. We do not in this chapter extend the analysis to highly socialized contexts, as in open source communities (Feller et al., 2007).
4. In setting out basic ideas, we do not consider here how the platform regulator might itself be regulated.
5. For example, Microsoft controls the Windows operating system in the PC ecosystem, eBay controls the information platform that facilitates trade, Visa controls the financial network, and shopping malls control the real estate and infrastructure.
6. We wish to thank Professor Robert Merges for drawing our attention to this useful distinction.
7. Facebook is among the leading social networking platforms, with over 100 million members in 2008. It brings together advertisers, content suppliers, commercial business members, applications software or 'widget' developers and individual 'members', who may display their profiles and link with other members. Here we discuss only facets of the business model that relate to the latter two groups.
8. For example, popular applications include enrichments of the basic social functionality of the platform (e.g. 'SuperWall'), applications intended to initiate interactions (e.g. 'Hug Me'), multi-player games (e.g. 'Texas HoldEm Poker'), means of broadcasting personal information and preferences about oneself (e.g. 'Movies'), means of broadcasting media and content (e.g. 'Slideshow') and other distinctly social applications (e.g. 'Compare People', 'Honesty Box'). See http://www.facebook.com/applications/.
9. This case study builds on insights drawn from research with Karim Lakhani and Nicola Lacetera.

10. This was based on a review of active contests in August 2008 on the TopCoder platform.
11. This case study builds on Elberse et al. (2008).
12. As explained by Minoru Mori, Mori Building's CEO: 'From quite early on, my vision was to create an unprecedented prototypical city. Creating 'a cultural heart for Tokyo' was the main concept for the city-making of Roppongi Hills. This cultural heart for Tokyo would serve as a new platform, new environment or new stage for creative talent who would be attracted to this city from all around the world, as they would benefit from a mix of high-quality residences, work places, shopping, relaxing, studying, and art and design facilities all within an integrated walking distance.'
13. This case study builds on Hagiu and Kester (2008).

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