The MIT Center for Digital Business

A research and education initiative at the MIT Sloan School of Management

Platform Networks – Core Concepts

Executive Summary

(May 6, 2007)

Paper 232

June 2007

Thomas Eisenmann
Geoffrey Parker
Marshall Van Alstyne

For more information,
please visit our website at **http://digital.mit.edu**
or contact the Center directly at **digital@mit.edu or 617-253-7054**

MIT Sloan

The MIT Center for Digital Business

Platform Networks – Core Concepts

Executive Summary

Thomas Eisenmann, Geoffrey Parker & Marshall Van Alstyne[1]

06-May-2007

This whitepaper provides answers to 10 key questions regarding the understanding and management of network platforms. Analyses reflect a literature review of more than 250 articles and interviews with key Cisco executives. An abbreviated bibliography is included at the end of this article and a complete bibliography is available upon request form the authors. The questions addressed here include:

1) **Platform Definitions**
   a. What defines a network platform? Can they be measured in terms of openness, extensibility, network effects, scale, and modularity?
   b. What ecosystem attributes lead to platform emergence?
2) **Platform Control**
   a. Should a platform be controlled by a sole sponsor or should it be jointly sponsored? Should a platform be open? Should it be exclusive?
   b. When should a platform sponsor license to multiple providers? Should it seek exclusive relationships that preclude select users from affiliating with rival platforms?
3) **Network Business Model**
   a. How should a firm price a platform? Should you use penetration pricing to establish a platform? Can you avoid cannibalizing existing products?
   b. When competing to establish a platform, should a network platform race to acquire users?
   c. If a platform is shared, how should a firm compete? When should platforms interoperate?
   d. When should the platform sponsor vertically integrate into the applications layer?
4) **Platform Evolution**
   a. How is innovation affected in platform environments? Is a platform transition different from normal technological advancement?
   b. How do you attack or defend a platform?

The authors are extremely grateful to Charles Giancarlo, Guido Jouret, Don Proctor, and Shah Talukder for their thoughtful commentary and time in interviews. This work would not have been possible without their input. Invaluable research assistance has been provided by Ray Fung and Jason Amaral.

This is version 1.2. Please send comments to marshall@mit.edu

[1] Harvard Business School, Tulane Univesrsity, and Boston University & MIT respectively. Analysis includes excerpts from *Managing Networked Businesses: Course Overview for Educators*, Harvard Business School Dec 5, 2006 teaching note 5-807-104 by Thomas Eisenmann and from *Strategies for Two-Sided Markets* Harvard Business Review Oct 1, 2006 by Eisenmann, Parker & Van Alstyne.

The MIT Center for Digital Business

Network Platforms – Core Concepts

Thomas Eisenmann, Geoffrey Parker & Marshall Van Alstyne

1) Platform Definitions

a. *What defines a network platform?* Can they be measured in terms of openness, extensibility, network effects, scale, and modularity? What properties are essential? What properties help them become successful?

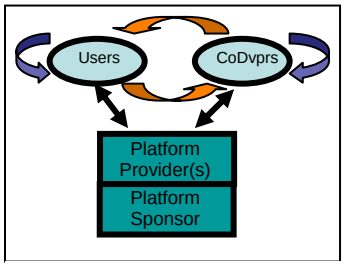


Fig. 1 – Platform business models involve a triangular set of relationships, allowing co-developers to transact directly with users across the platform.

A "Network platform" is defined by the subset of components used in common across a suite of products (Boudreau, 2006) that also exhibit network effects. Value is exchanged among a triangular set of relationships including users, component suppliers (co-developers), and platform firms (see Fig. 1). We focus on platforms where users experience network effects to emphasize the mutually reinforcing interests of participants in the platform ecosystem. In contrast to a traditional linear supply chain, a network platform involves interdependent three-way value streams. Various business partners or co-developers, associated with the platform, transact directly with consumers across the platform affecting its total value.

Platforms are not necessarily created and maintained by a single firm. We distinguish between three supply roles: provider, component supplier (co-developer), and sponsor. *Platform providers* mediate network users' interactions; they serve as users' primary point of contact with the platform. *Component suppliers* make available essential goods and services that are not offered directly by platform providers. They also provide convenience, customization, and integration, adding value out on the "Long Tail" (see Fig 2). *Platform sponsors* exercise control rights. They can modify platform technology and determine who may participate in the network (Katz & Shapiro, 1986). Sponsors may license multiple platform providers to spur innovation (see shared platforms Fig 3) or keep this role for themselves. Despite network effects, sponsors can deliberately limit the number of network users to ensure quality or to extract value by granting exclusive trading rights.

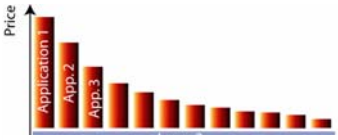


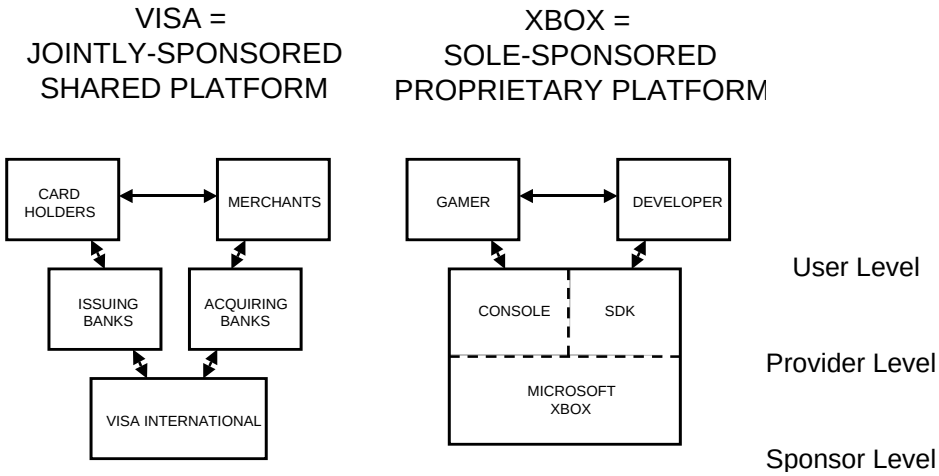
Fig. 2 – A handful of the most valuable platform applications represent the "short tail" to the left. Niche "long tail" applications extend far to the right. The platform is represented by the bottom layers, components used across multiple applications.

Network effects are *demand* side economies of scale such that the value to existing consumers rises in the number of subsequent consumers. They influence user willingness to pay (WTP), user adoption, and thus a platform's value (Shapiro & Varian, 1999b). Network effects are distinct from *supply* side economies of scale that come from high fixed / low marginal costs, as in the case of semiconductor manufacture, where average costs decline as production volume increases. Scale economies for both demand and supply commonly occur in high technology but must be conceived of and managed differently.

Cross-Side network effects refer to demand economics of scale from one network group to another (e.g. from Users to Developers). The orange arrows, for example, could represent the effect of doctors and patients who both want to affiliate via the same HMO. *Same-Side* network effects refer to effects of one user group upon other members of the same group. The blue arrows, for example, could represent the positive network effects that PC gamers enjoy from additional users of the same game, or the negative effect on drivers of congestion on a highway.

A platform's sponsor and provider roles each can be filled by one company or shared by multiple firms. Examples of platforms with a *sole* sponsor include Apple's Macintosh and the American Express credit card. Alternatively, multiple parties may *jointly* sponsor a platform, typically under the auspices of an association (e.g., VISA, which is controlled by 21,000 member banks). At the provider level, platforms are either *proprietary* or *shared.* With a proprietary platform, a single firm serves as platform provider (e.g., Monster.com, Xbox). With a shared platform, multiple firms serve as rival providers of a common platform (e.g., VISA's issuing and acquiring banks, who support cardholders and merchants, respectively). *Rival providers of a shared platform* employ *compatible* technologies; any network user could switch providers (e.g., from a Dell PC to a Compaq PC in the case of Microsoft's Windows platform) and still interact with the same partners as before (i.e., all Windows-compatible applications). By contrast, *rival platforms* employ *incompatible* technologies (e.g., Playstation vs. Xbox, VISA vs. American Express). Joint sponsorship usually leads to a shared platform (e.g., Linux, VISA), whereas sole sponsors usually operate proprietary platforms (e.g., eBay, Apple Macintosh). Occasionally, however, a sole sponsor licenses multiple providers. For example, American Express granted 3rd-party banks such as MBNA permission to issue American Express-branded credit cards. Figure 3 illustrates these contrasting alternatives.

Figure 3: Comparison of VISA and Xbox Platforms



Platforms provide a standardized solution for the problems below the applications layer. Factors that contribute to network platform success include openness, extensibility, and modularity (abstraction & encapsulation), and quality control (note that these are critical success factors, not attributes of a definition). Each attribute varies along a continuum and can have non-linear effects on platform success. For example, more "open" platforms do not uniformly outperform less open platforms. A perfectly closed network retards 3rd party innovation, which disqualifies it as a platform. A perfectly open platform, for example viral free software, offers very little basis for building a business. This curbs investments by business stakeholders, a key player in the ecosystem.

Successful platforms have extensive mechanisms for quality assurance. The openness that fosters decentralized innovation must also separate wheat from chaff. This is as true of open source projects with peer review (Benkler 2006) as it is for hardware products and routers. For example, the Atari gaming platform failed, in part, because poor quality games flooded the market and tarnished the brand.

b. *What ecosystem attributes lead to platform emergence?* When does a business find itself in a network platform market? Why does a platform become dominant? Can a firm shift a non-platform market to become a platform market where it can be highly competitive?

Factors that favor network platform emergence include disconnected heterogeneous networks and broad unmet market need.

At least two conditions favor the emergence of network platforms. When existing networks are highly fragmented, a system integrator can serve as the glue that holds the networks together. For example, TC/IP served to integrate several proprietary and heterogeneous networking protocols including those of Apple and IBM.

A second opportunity for networked platforms to emerge is in a niche next to established, slowly-evolving industries where there is a broad, unserved market need that is initially addressed through inferior technology (Christensen 1997). Examples include IP telephony and digital photography that could have been controlled respectively by AT&T and Kodak but were missed opportunities.

A platform business model is an economic as opposed to a technical construct (GJ). Network platforms solve real business problems by consolidating basic layered functionality in a manner that provides economies of scale. Applications in Figure 2, for example, can assume the functionality available at lower levels of the platform (see network externalities below).

Mechanisms that facilitate a transition toward network platform markets include (i) integrating, vertically and horizontally, into markets that exhibit network effects, (ii) opening the platform so as to reduce lock-in and promote adoption, and (iii) sharing the wealth in order to increase third party investment.

To facilitate emergence, platform sponsors also need to manage developers. There is a range from opening APIs to allow other systems to interoperate, to providing software development kits (SDKs) and integrated development environments (IDEs) as Cisco does for its Unified Communications applications, to direct service and support of component suppliers as in the case of Microsoft. The ecosystem matters. IDC estimates that for every $1 spent on Microsoft Vista, there will be $9.75 spent on HW, $4.60 on SW, and $3.65 on services representing an 18:1 ratio of benefit to the ecosystem as a while.

Openness must be sufficient that third parties can gain the knowledge they need to design for the platform. CG

Openness must be sufficient that third parties can gain the knowledge they need to design for the platform. CG

Why do network externalities occur?

(i) *Reduced Transaction Costs*: Compatible standards reduce the transactions costs of trading or interacting across a network. After the dawn of the Internet, for example, compatible standards allowed email transfer across previously incompatible networks that could not share traffic. Likewise, E-Bay's web-based standards permitted trading across previously geographically disjointed classified ads markets.

Lesson: look for opportunities to reduce the transactions costs of trading across disconnected networks. These represent opportunities for substantial new markets.

(ii) *Costs of common platform infrastructure*: When vertical applications create enough value to justify acquiring the supporting platform, completely unrelated applications benefit. In Figure 2, for example, if applications in Microsoft Office (say applications 1-4) create enough value to justify acquiring Microsoft Windows, then the photo editing

package (say application 31) does not need to supply an operating system. Its developers can assume that users will have the OS.

Expectations, Externalities, and "Tippy" Outcomes. In both of the network externality causes above, shared expectations play a significant role. When users access a network on a recurring basis—as is usually the case—their WTP for participation is based not on the network's *current* scale, but rather on the number of users with whom they *expect* to be able to interact in the future. With fragmented demand, it can be difficult for prospective users to communicate expectations and coordinate behavior. Facing uncertainty about others' intentions, each prospect may defer adoption, even when network effects are strong. Consequently, networked markets are prone to either stall or tip rapidly toward high adoption rates. Since users' expectations determine which outcome will prevail, platform intermediaries work hard to shape them.

Network externalities contribute to "excess inertia" (Farrell & Saloner, 1985). Absent a way to internalize externalities (Katz & Shapiro, 1986; Liebowitz & Margolis, 1994), that is, to compensate (or charge) new users for the incremental benefits (or harm) they bring to other users, prospects are less likely to join the network. This happened in the 1980s with the VHS vs Beta competition and is happening again in Blu-Ray vs. HD-DVD.

Winner Take All Markets: Network effects and factors that support single platform dominance frequently lead to winner-take-all markets. At least three factors compound these effects:

- *Multi-Homing Costs are High*— "Homing" costs include all the expenses incurred by network users due to platform affiliation. For at least one set of users in Figure 1 these are high enough relative to benefits that they prefer to affiliate with only one platform. For example, most PC users rely on a single OS—usually Windows—because it is expensive to acquire the hardware and software required to use multiple operating systems. When multi-homing costs are high, users need a good reason to affiliate with multiple platforms.

- *Cross-Side Network Effects are Positive and Strong*—at least for the network side with high multi-homing costs. When this condition applies, users want access to all potential transaction partners on the network's other side. A sub-scale platform will be of little interest to them, unless it provides the only way to reach certain partners. The odds of winner-take-all (WTA) outcome also increase when *same-side* network effects are positive and strong.

- *Neither Side's Users Have Strong Preferences for Inimitable Differentiated Functionality***.** If there is little demand for special features, then users will converge on one platform. However, if different user segments have unique needs that are intrinsically difficult or expensive to serve through a single platform, then rival platforms can survive.

2) Platform Control

a. *Should a platform be controlled by a sole sponsor or should it be jointly sponsored? Should a platform be open? Should it be exclusive?*
Sole platform sponsorship creates an incentive to develop a platform while giving the sponsor control. Aren't margins better when the platform is closed?

Competition *for* the platform tends to be feature based, while competition *within* the platform tends to be price based.

Fight or Share?

If a new market seems likely to be served by a single platform, aspiring intermediaries must decide whether to fight for proprietary control or share the platform with rivals. Even if rival platforms are economically viable over the long term, aspiring intermediaries may still prefer to pool their efforts. Fighting increases the chances of leaving one firm with a Betamax when it could have shared in a VHS. Facing this decision, managers must calculate the impact of each option—fighting versus sharing—on *market size, market share,* and *margins.* Of course, the product of market size, share, and margin equals the firm's profit from the new business.

Market Size. A shared platform is likely to attract more users in both the short and long term. In the *short term,* some users may delay adoption during a WTA battle for platform dominance. Users will fear being stranded with obsolete investments if they back the loser. This uncertainty is currently hampering adoption of Blu-Ray and HD-DVD both. In the *long term,* if a single proprietary platform prevails, then monopoly pricing will reduce the number of network users, compared to a shared platform, for which pricing will be more competitive. Likewise, due to network effects, if rival platforms survive—whether shared or proprietary—then their aggregate market size will be less than the user base would be for a single shared platform.

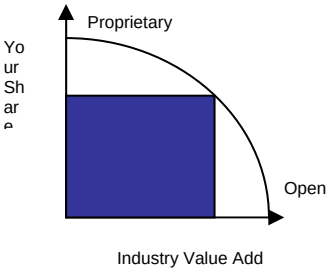


Fig 4 – Reward = Industry Value Add x Your Share (source: Shaprio & Varian 1999b)

Market Share. While jointly developing a platform can build market size, it cuts into each firm's market share. When a *shared platform* evolves through the consensus-based processes of a standards-setting organization (SSO, e.g., the World Wide Web Consortium), firms will find fewer differentiation opportunities. Market shares are more likely to be determined by firms' relative strengths in distribution and manufacturing. With a *WTA battle,* market share will tend toward either 100% or 0%, so managers must estimate their realistic odds of winning. This will be determined by cost and differentiation advantages, including access to proprietary technology and/or inimitable scarce resources, and by at least four other factors (Shapiro & Varian, 1999a):

- Firms gain an edge when they have *pre-existing relationships* with prospective users—often in related businesses.
- Users' expectations influence momentum, so a reputation for prowess in past platform wars yields an advantage.
- In a war of attrition, deep pockets matter.
- First-mover advantages are often significant in platform battles, but they are not always decisive. When the market evolves slowly, late-mover advantages may be more salient, including the ability to: 1) avoid the pioneer's positioning errors; 2) incorporate the latest technology into product designs; and 3) reverse engineer pioneers' products and beat them on cost (Schnaars, 1994; Tellis & Golder, 2002).

In Platform markets, you need to give in order to get. Controlling most of a multi-billion dollar business is better than controlling all of a million dollar business.

Platform providers must determine how much of the value created through network interactions they should seek to capture and from which users. From Figure 1, consider who adds the most value. A bigger network served by a single platform can create more value in aggregate, but users may worry that a dominant platform provider will extract too much value. Likewise, when the participation of a few large users is crucial for mobilizing a network (e.g., movie studios vis-à-vis new DVD formats), conflict over the division of value between platform providers and "marquee" users is common.

Levers to consider are open versus closed platform models and margins for extracting revenue.

Openness invites innovation but also competition. Selectively open the layers where you need new features most and can afford the most competition.

"Open" or "Closed"? A market size versus share framework implies a tradeoff between *improved adoption odds* and *reduced appropriability of rents* when sharing a platform (Shapiro & Varian 1999b, West, 2003). Figure 4 suggests how opening the platform encourages value-adding developer investment and user adoption but reduces residual proprietary options for charging. Platform owners sometimes mistakenly assume that maximum control provides maximum value but this is generally not the case. Be willing to open a platform and reduce one's market share so long as the growth in market size is net profitable.

Confusion sometimes exists over "open" versus "shared" based on the rapid growth of open source software (e.g., Linux) and content created through collaborative communities (e.g., Wikipedia). In analyzing platforms, one should not conflate the two simply because platform-mediated networks involve both users and co-developers. Participation within one set may be open while participation in other sets remains restricted, that is, closed. Consequently, we insist on specificity: *open for whom?* More importantly, we stress that some platforms are very successful with open/shared models while others prosper with closed/proprietary models, as shown in **Table 1**.

Table 1: Comparison of Degree of Openness Across Platforms (source: West, 2003).

	Linux	Windows	Macintosh	Xbox
User Side #1 End User	Open	Open	Open	Open
User Side #2 Developer	Open	Open	Open	**Closed**
Platform Provider (hardware/OS bundle)	Open	Open	**Closed**	**Closed**
Platform Sponsor	Open	**Closed**	**Closed**	**Closed**

Margins can be higher in the ***long term*** when the platform is not shared and the victor in a WTA battle reaps higher rents. However, in the ***short term,*** winning a WTA battle requires a proprietary platform provider to invest heavily to build its user base, either through penetration pricing or aggressive spending on marketing. Likewise, a proprietary platform provider must shoulder the entire cost of inventing platform technologies, whereas shared providers can spread their collective R&D burden. Thus for growth, adoption, and winning standards battles, it helps to share the wealth.

Despite the virtues of opening a platform, economic theory suggests that platform development cannot be totally decentralized. Platforms need leaders for at least three reasons (Parker & Van Alstyne, 2005b): (i) platform leaders invest in enhancing and promoting the platform (ii) they internalize the network effects that would be mis-priced if managed separately, and (iii) they orchestrate often fractious developers whose competitive instincts can otherwise lead them to advance their individual interests at the expense of overall platform value. Platforms need sponsors; you cannot get order from chaos without a control mechanism.

Managing developers is like refereeing soccer. You don't tell them how to play but you set and enforce the rules – ST

The point is to encourage growth through openness but to index your share of the profits to platform expansion in a low friction way that that does not limit growth (GJ). The difference with a traditional model is that you share the wealth in order to increase a platform's popularity.

b. *When should a platform sponsor license to multiple providers? To attract network users, should platform providers seek exclusive relationships that preclude select users from affiliating with rival platforms?*
Apple played the no licensing game in operating systems and lost; it is playing the same game again in music and winning. When does licensing multiple providers work and when does it fail?

Having decided to open the platform, the licensing issue is not either/or but rather how broadly and at what time. In both examples above, Apple likely pursued the correct strategy initially only to keep too much control for too long.

Always license at least the interfaces, otherwise you're not open enough to let others design to your product – CG

There appear to be two broad but complementary strategies to licensing in platform markets. One is to license narrowly initially and broadly later. The second is to offer default license access, the equivalent of Application Program Interfaces (APIs), with access to platform functionality as a means of capturing decentralized innovation. These are not mutually exclusive.

License narrowly initially, broadly later – GJ

Narrow early licensing helps support a price premium that promotes investment by co-developers (GJ). If you can't start a market when you have sole control you won't find it any more profitable when you relinquish control. Partners can be hand-selected to have deep technical proficiency and can target early adopter customer segments. Partner skills can also help to ensure quality. However, maintaining quality can require a reduction in the number of partners as shown when Cisco decertified a number of business partners in an effort to maintain platform quality. *After* growth starts and a platforms has a lead, it can be taken to standards organizations like IETF for broader dissemination. The tradeoff is to bring the most innovative protocols before standards bodies early enough to drive adoption and reduce lock-in but late enough to develop and sustain competitive advantage. The goal is to ride the crest ahead of the crowd as the market rolls in.

*Exclusivity***.** Securing users' exclusive affiliation—that is, their agreement not to affiliate with a rival platform—can accelerate a platform's growth (Armstrong & Wright, 2004). For many years, such exclusive licensing arrangements were at the core of Visa's marketing campaigns ("…and they don't take American Express"). Exclusive contracts with marquee users (Rochet & Tirole, 2003)—parties with whom many other users wish to interact—are especially valuable, for example, major Hollywood studios in the case of rival high-definition DVD formats. To gain exclusivity, platform intermediaries typically must offer price concessions to users. Specifically, the intermediary must compensate the user for foregone gains from trading on other platforms, less multi-homing costs avoided.

Non-Exclusivity: Several factors can motivate sponsors to license multiple providers:

- *Users' Preferences for a Second Source.* Network users (e.g., the cable operators who buy Scientific-Atlanta converters) may prefer that a platform provider with proprietary technology license a second source, to reduce vulnerability to holdup and supply interruptions. Intel has licensed its chip designs for this reason (Farrell & Gallini, 1988). Government agencies may also insist on "no sole source" contracts in order to limit such problems.
- *Licensees' Marketing Strengths.* When platform goods are sold into established channels (e.g., American Express's credit cards), a sponsor may boost platform adoption by harnessing incumbents' marketing resources and relationships.
- *Opportunities to Increase Platform Variety***.** Platform providers often

adapt platform technologies to create product varieties that meet users' differentiated needs (Schilling, 2002; Boudreau, 2006). For example, Microsoft's policy of licensing Windows has spawned a greater diversity of PC designs than Apple has been able to achieve as the proprietary provider of Macintosh computers.

The non-exclusive decentralized model has the virtue of identifying products that you didn't consider. Customers do not always know what they want until they've seen it: did customer groups articulate the need for TiVo or Skype or did radical entrepreneurs take the approach of "build it and they will come"? Increased use of prediction markets may also be a means of identifying these potential trends.

A key tension is the tradeoff between greater openness that promotes decentralized innovation and adaptation far out on the long tail versus maintaining quality control. One means of achieving balance is to invite widespread participation in development but only selective participation in deployment.

Licensing, while open, must provide clear boundaries as to who owns what. Confusion in these boundaries discourages investment (CG).

Recent economic work suggests that "fair" licenses – those that reward in proportion to contribution – increase the rate of innovation (Clarkson & Van Alstyne, 2006). Ownership is sufficient to ensure reward for tangible goods but *not* for intangible goods. Because ideas and information cannot be taken back if shared, people with ideas need guarantees that their contributions will be compensated. Such guarantees are extremely difficult in any kind of inventive activity. When ownership is insufficient, people hoard their information.

For any platform to be successful, you must find a way for everyone to be successful. – ST

Mechanisms that increase fairness, such as reputations for integrity, increase the willingness to contribute vital information that leads to innovation. Basically, it becomes economically rational to commit to sharing the spoils in order to stimulate innovation.

Fairness may well play a role in the economic growth of California relative to other states. California limits the terms of onerous employee non-compete agreements. Because employees can leave more easily, firms must compensate them more equitably i.e. in proportion to the wealth they create. This motivates them to create more wealth.

3) Network Business Model

c. *How should a firm price a platform? Should you use penetration pricing to establish a platform? Can you avoid cannibalizing existing products?*

To win a standards war, firms must sometimes offer low initial prices to establish the platform. In other cases, a firm's technological lead gives it sufficient strength to avoid less profitable approaches to standard setting such as discounting. Pricing rules in such markets often violate traditional economics, such as marginal cost pricing and value-based pricing. How should these be managed?

Pricing, licensing and innovation are all tied together – one reason that managing network platforms is so complex. Pricing considerations entail:

- Market establishment & expansion goals
- Product replacement goals within your product portfolio
- R&D recovery
- Competition
- Long term pricing

A classic conjecture by Nobel economist Ron Coase argues that if you price high initially with the intention of going low later, customers will wait until prices fall. Because intertemporal price discrimination is difficult, sellers of durable goods have limited market power (Coase 1972). The earliest adopters, however, are the least price sensitive (Stokey 1979). The highest value customers in Figure 2, for example, will pay a premium so it is frequently possible to price discriminate by lowering prices over time.

Over time, platform margins at a given layer asymptote to zero as the ecosystem adds new layers on top and the lower strata become undifferentiated background.

Initial prices must provide profits sufficient for product development. You need to amortize your R&D and your co-developers need to fund their development. Mature platform pricing dwindles asymptotically to zero as new layers supersede old ones. Ethernet switches cost thousands of dollars several years ago but now sell for $50 at Best Buy (GJ). Firms make money on the recent additions that customers care about, not the embedded layers everyone takes for granted (GJ). Platform margins at a given layer erode as the ecosystem adds new layers on top and the lower strata become undifferentiated background.

As competition drives prices to marginal cost on existing features, your price for performance based on innovation must keep ahead of price erosion. IBM lost its lead in networking protocols, especially token ring, because it was unable or unwilling to drive innovation faster than prices were eroding. You price as high as you can then ensure that you can innovate ahead of price erosion (GJ).

To avoid cannibalizing existing markets with new products, consider "surgical insertion" pricing. – DP

New product generations introduce tradeoffs in growing new markets and cannibalizing old ones. To avoid cannibalization but facilitate growth, consider a form of *surgical insertion pricing*. Put the new product in a new narrowly defined category with premium pricing. Transition only those customers most in need of a transition then broaden the installed base over time (DP). Cisco used this method to introduce a new router that would have cut into a billion dollar business.

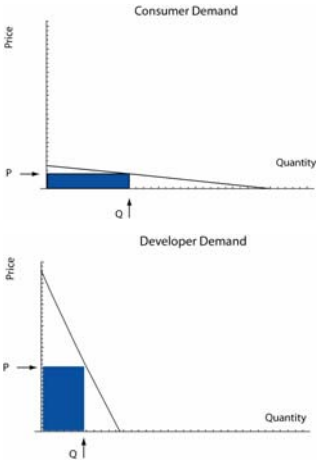


Fig. 5a-b: Using traditional value-based or marginal cost pricing, a firm prices for the top users in each, capturing standard profits under the demand curve (see also 5c-d below).

Network markets also exhibit unique pricing behaviors based on balancing the interests of the user groups in Figure 1. To engage both consumers and co-developers can require a firm to solve chicken-and-egg adoption problems. No one wants an HDTV, for example, unless there is HDTV content but no one wants to produce such content unless people have HDTVs. The solution is to use various forms of 2-sided pricing.

Two-Sided Network Pricing

In two-sided networks, a platform provider with market power may price to one side below the rate it would otherwise charge if that side were viewed as an independent market, rather than part of a two-sided network (see Fig 5.a-d). In many cases, platform products are priced below marginal cost or even given away. Unlike the case of "low then high" penetration pricing, this discount is permanent. It serves to attract more users to the network's "subsidy side." Due to network effects, this boosts users' WTP for platform affiliation on the network's "money side." The platform provider exploits this by charging a premium to money-side users that more than offsets subsidies to the other side Rochet & Tirole (2004); Parker & Van Alstyne, (2000, 2005a).

- **Ability to collect tolls.** Discount pricing will be wasted if your network's subsidy side can transact with a rival platform provider's money side. If your platform builds a bridge between both sides, you need to be the one collecting tolls. Netscape lost money subsidizing browsers in hopes of selling web servers. But, the whole point of the *Inter*net is *intero*perability and website operators bought from rivals.
- **User sensitivity to price.** Generally, it makes sense to discount the price-

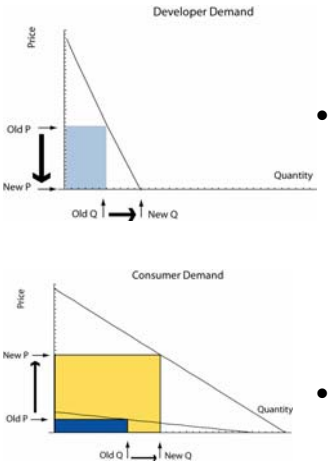


Fig. 5c-d: Using 2-sided network pricing, the firm discounts one market to stimulate network effects in the other. Discounted operating system tools for developers (5c) is a critical way to raise value, demand, prices & profits among consumers (5d)

sensitive side and charge the price *in*sensitive side. Credit Card companies bring choosy consumers to their platform by offering frequent flyer points and cash back rebates; but this allows them to charge merchants.

- **User sensitivity to quality.** Charge high fees to the side that supplies quality in order to segment the market based on quality. This strategy is evident in video games where Microsoft and Sony restrict deployment on their platforms. Atari failed to do this and tarnished its brand. This phenomenon may also explain "Ladies Night" in restaurant platforms (i.e., women are admitted free; men pay). Asked about Ladies Night, one of our students quipped, "It's simple: men prefer quantity, women prefer quality!" His admittedly sexist logic: men are less discriminating, so the biggest possible pool of women suits their needs. A nightclub then covers costs by charging the men.
- **Low Variable costs.** Discounts make considerably more sense if they take the form of a digital good such as software or a cheap service such as otherwise-idle computer time. High marginal cost goods should not be used. FreePC learned this lesson in 1999, when it provided computers and Internet access at no cost to consumers who agreed to view Internet-delivered ads that could not be minimized or hidden. FreePC abandoned its offer after incurring $80 million in losses.
- **Value Adding or Marquee Users.** Network users are not created equal. The participation of high brand value or considerable development talent users can be especially important for attracting participants to the other side of the network. Marquee users may be exceptionally big buyers, like the U.S. government, high profile suppliers, like Hollywood movie studios for DVDs, or major developers like Electronic Arts in games. Of course, it can be expensive—especially for small platforms—to convince marquee users to forfeit opportunities in other networks. When the participation of a few large users is crucial for mobilizing a network, conflict over the division of value between platform providers and large users is common.

d. *When competing to establish a platform, should a network platform race to acquire users?* More users attract more developers and more developers attract more users. But buying users comes at a cost.

In a new networked market, a platform provider often has economic incentives to invest aggressively in building its user base, due to: 1) increasing returns to scale engendered by network effects or learning effects; or 2) high switching costs (Spence, 1979; Lieberman, 1987; Klemperer, 1987; Noe & Parker, 2005; Eisenmann, 2006). Firms may race for scale by spending a lot on marketing, acquiring rivals, or discounting heavily—often pricing below marginal cost. After they amass scale, firms can raise price, exploiting users' increased WTP to participate in a larger network or "locked in" users' reluctance to incur switching costs. Alternatively, firms can maintain price but improve margins by increasing volume, thereby leveraging learning effects or fixed costs. They also need to balance marketing efforts directed at both sides of a two-sided network

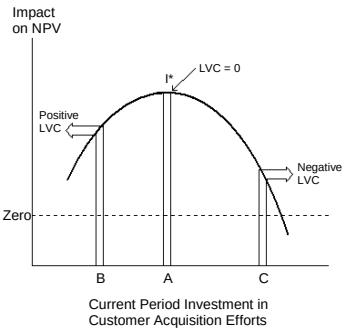


Fig.6: When racing to acquire a user base, firms can dangerously under and over – invest.

If network effects and switching costs lead to market concentration and racing, then platform sponsors need ways to accelerate growth. The function relating long-term returns to current period investments in customer acquisition typically has an inverted "U" shape (Blattberg & Deighton, 1996). Up to some point—I* in **Figure 6**—increasing investments should boost the total payoff, but at a diminishing rate as the cost of acquiring additional customers rises. *Lifetime customer value* (LCV) should reflect a new user's impact on existing users' WTP Beyond the value maximizing point it costs more to acquire customers than they are worth, so the lifetime customer value (LCV) becomes negative. Put another way, if a firm races too hard, or not hard enough, it will depress long-term returns.

Scalability constraints can also drive up costs or cause quality problems when firms pursue racing strategies (Oliva, Sterman & Giese, 2003). Rapid growth is more likely to be feasible when products and services: 1) leverage general-purpose production and distribution facilities; and 2) involve straightforward customer service interactions. Rapid growth may also strain organizational processes and contribute to dysfunctional decision making (Cusumano & Yoffie, 1998; Perlow, Okhuysen & Repenning, 2002; Sterman et al., 2006).

e. *If a platform is shared, how should a firm compete? When should platforms interoperate?* Interoperability increases network effects and grows the installed base. It also raises the attractiveness of development at the applications layer. *But*, it weakens a sponsor's competitive position vis-à-vis other sponsors who control a substitute.

Strategies for Competing on a Common Platform
firms use several strategies to advance their individual interests while simultaneously cooperating with rivals to develop a shared platform.

- *Proprietary Extensions***.** Standardized products can become undifferentiated, low-margin commodities. To avoid this outcome, firms often add proprietary extensions to industry standards. For example, 802.11 ("Wi-Fi") access points using chipsets from Atheros communicate with laptop cards using other vendors' 802.11-compliant chipsets at industry-standard speeds ("Atheros Communications," HBS #806-093). However, when an access point and laptop card *both* contain Atheros chipsets, they can communicate in "Turbo Mode" at much higher speeds, leveraging Atheros's proprietary protocols. However, when firms push proprietary extensions too far, they risk "forking" or "splintering" their common standard to the point where their products are no longer interoperable.

- *Optimal Timing.* When firms introduce proposals in standards-setting organizations, timing is crucial to their odds for success. If a project is proposed too early, before other SSO participants understand its technical merits or before market demand is apparent, the project is likely to be ignored. On the other hand, if a firm submits finished work to an SSO, rivals are likely to block progress by proposing amendments or stalling in different ways. Rivals will be worried that the sponsoring firm will have a significant time-to-market advantage in launching new products.

- *Forum Shopping***.** When contributing technologies to a shared platform, firms sometimes can choose between SSOs (e.g., in the case of Web services technologies, W3C versus IETF; see "Sun Microsystems: Web Services Strategy," HBS #805-095). SSOs differ along dimensions that are relevant when firms are "forum shopping," most notably: 1) provisions for the disclosure and licensing of intellectual property; and 2) via their membership and voting requirements, the degree of control conferred to sponsoring firms over agenda setting (Lerner & Tirole, 2004; Chiao, Lerner & Tirole, 2005).

- *Special Interest Groups.* Subsets of firms that compete on a common platform frequently form separate associations or "special interest groups" to advance mutual interests. These groups exert influence over larger bodies that retain responsibility for standards formulation.

Special interest groups are often formed by key platform participants to: 1) resolve impasses caused by political maneuvering in larger bodies; 2) protect themselves from "majority rule" outcomes in larger bodies; 3) exclude their closest rivals (Axelrod et al., 1995); or 4) ensure interoperability of different firms' implementations of common standards. In some cases, groups may threaten to secede from a governing SSO unless their priorities are addressed. Of course, coalitions may provoke a backlash from other platform participants when they wield power in this manner.

Converters -- Interoperability is achieved through the use of *converters* (also known as adapters or gateways: see David & Bunn, 1988) that modify one platform's functionality to allow its users to interact with those of another platform. We review several properties of converters:

Converters can be *costly.* Their expense is usually borne by the weaker platform's users. Due to technical compromises required to achieve interoperability, cross-platform interactions sometimes suffer *quality degradation,* compared to intra-platform interactions.

Interoperability is *not necessarily binary:* providers may deliberately limit the scope of cross-platform interactions to maintain differentiation (Cremer, Rey & Tirole, 2000). For example, when routing traffic, a backbone ISP might give precedent to its own customers' packets over those of its rivals' customers.

Converters may be developed *unilaterally* or *bilaterally,* depending on engineering considerations and intellectual property protection. If a unilateral converter is technically and legally feasible, then an increase in *either* platform provider's profitability is sufficient for its introduction. If technical or legal constraints preclude unilateral efforts, then an increase in total industry profits is a sufficient condition for interoperability, assuming the possibility of side-payments between platform providers (e.g., licensing fees). Absent side-payments, an increase in *both* platform providers' profitability is necessary for interoperability (Katz & Shapiro, 1985).

Converters can be *one*- or *two-way.* For example, vintage Macintosh computers could read DOS-formatted floppy disks, but the reverse was not true. Conversely, Microsoft Word can both read and save files in WordPerfect format.

Interoperability with Established Rivals. During network mobilization, leading platforms are likely to view their incompatibility with smaller rivals as a strategic advantage. Once platforms are established and user acquisition rates slow, however, it may make sense for rivals to reconsider compatibility policies—especially if their market shares approach parity.

Market Size. If network effects are positive and strong, then users' WTP for platform affiliation should increase when interoperability provides access to a larger collective user base. However, increased user WTP does not automatically translate into increased industry revenue as it may be divided across more players. Also, interoperability may eliminate the motivation for multi-homing, resulting in fewer total subscriptions for the industry.

Market Share. Post-interoperability, market shares will depend on several factors, including: 1) the extent to which platforms are differentiated in

terms of the standalone properties unrelated to network size; 2) switching costs; 3) multi-homing costs; and 4) converter costs.

*Margin***.** The impact of converters on platform pricing is not clear-cut. With homogenous platforms and elastic demand, prices may decline (Katz & Shapiro, 1985). However, in a growing market, converters may blunt the drive to race for new users. Also, when converter costs are borne by a weaker platform's users, the dominant platform has an incentive to raise prices (Farrell & Saloner, 1992). Finally, dominant platform provider's margin may improve if it can license interoperability rights to weaker rivals. **Figure 7** illustrates the economic impact of interoperability between established rivals. It shows one network user's utility from affiliating with three rival platforms, pre- and post-interoperability. The platforms vary in terms of the network effect-related utility they offer as well as their standalone utility, but platform prices (equivalent to homing cost, represented by the dashed line) are assumed to be equal.
In the left panel, before interoperability, the user multi-homes with platforms A and B, but cannot justify affiliating with C. Post-interoperability, the user weighs switching costs incurred in abandoning A and/or B (not depicted in **Figure 7**) against the standalone utility offered by each platform. Differences in network effect utility are no longer relevant to the user's platform affiliation decision, because all platforms now provide access to a common, larger user base. Assuming that switching costs are utility, despite the fact that A had the largest pre-interoperability user base.

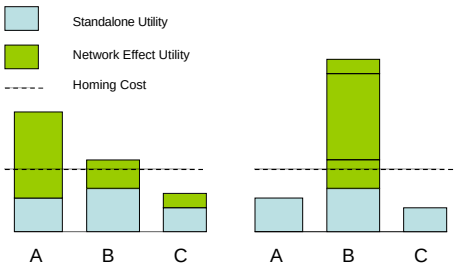


Figure 7: Interoperability between established platforms implies they compete on standalone value.

Incompatibility to Deter Entry. The framework above can also be used to guide incumbents' decisions about whether to interoperate with entrants. The classic case involves an entrant with a superior proprietary platform but no installed base (Katz & Shapiro, 1992; Xie & Sirbu, 1995; Matutes & Regibeau, 1996). If the market is still young and expected to grow substantially, then prospective users are more likely to favor the entrant's superior proprietary platform. By contrast, if the market is mature and little growth is expected, then the entrant will only be viable if the incumbent offers interoperability. Under these conditions, a credible commitment to avoid interoperability may deter entry.

Backward Compatibility. Likewise, the framework above can be adapted to decisions about backward compatibility when launching a new platform generation. Optimal strategy will also depend on whether platform intermediaries can price discriminate between existing and new users (Fudenberg & Tirole, 1998). With backward compatibility and no price discrimination, existing users will ignore network effects in their decision to adopt the new generation platform. They only will adopt the new platform if its price is less than the increase in standalone utility it offers, compared to the current generation. Consequently, if technical improvements are large, then the intermediary should market an incompatible next generation platform to both existing users and unaffiliated prospects. If improvements are modest, then the intermediary should offer a backward compatible next-generation platform at a price that will appeal to prospects but will be ignored by existing users (Choi, 1994).

Interoperability favors the company that does it best. CG.

f. *When should the platform sponsor vertically integrate into the applications layer?* Certain functionality can be critical to perceived platform value. Thus, it can behoove the platform sponsor to control key functions at this layer. At the same

time, if developers perceive a threat of takeover, they will fail to innovate on this platform in favor of competing platforms.

Vertically integrate into the applications layer:
early if you need to prove market viability.
late after multiple independent solutions solve the same problem.

Sometimes you must provide enough of an applications layer yourself to prove market viability. This is a tough balancing act. Controlling the platform, and having entered this market, co-developers can then avoid the market fearing the platform sponsor's advantage.

Embed features into the platform once multiple independent vendors provide similar solutions to the same problem (GJ). If one partner provides functionality, you do not want to coopt it. But if multiple vendors provide it, competition reduces margins anyway and the ecosystem benefits from having a common platform feature (GJ).

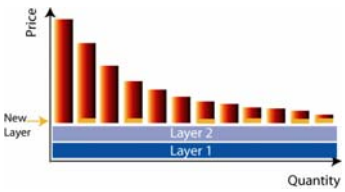


Fig 8 – When many different verticals provide different solutions to the same problem, it's time to integrate it into the platform as a standardized function.

Once a capability has become mainstream, a part of the standard solution, it should be integrated into the platform. Application developers know this. They do not like it but they understand. One way to make money is to take one vertical application in one market then adapt it to new vertical markets. When there are few such markets, profits and the ecosystem benefit by allowing adaptation across such vertical markets.

Basically, apply the long tail versus short tail test for vertical content. When applications are out in the long tail where they apply to a few customers, keep them as distinct verticals. But, when common solutions develop that everyone uses, they have moved to the short tail, then fold them into the next layer of the platform. An example was the evolution of graphics on the PC (CG). Figure 8 illustrates.

The migration of intelligence and services into a network is governed by this same property. When features provide enough value to enough vertical applications, the ecosystem benefits by moving them a layer deeper to make standard protocols available to everyone.

Integration into User Role – To resolve "chicken-and-egg" dilemmas, platform intermediaries sometimes step into the user role on one side of their network, producing complements valued by users on the other side. Chicken-and-egg dilemmas are more acute when users must make platform-specific investments in order to participate in a network. Complement suppliers are not likely to invest unless they can be assured access to a critical mass of end users. End users, in turn, will not affiliate with the platform until they are confident that enough complements will be available. Faced with these chicken-and-egg dynamics, platform providers may produce complements in-house, as Microsoft's Xbox unit did with Halo. However, by integrating into the user role on one side of its network, a platform provider may discourage the participation of prospective users on that side. Prospects may fear that a first-party rival will have unfair advantages, for example, early knowledge of planned platform upgrades.

*Conditions Encouraging Integration***.** When ongoing platform innovation depends on the availability of co-specialized complementary assets (Teece, 1986), can the platform sponsor share enough value with owners of these assets to elicit their supply? Alternatively, should the sponsor integrate into the supply of complementary assets?

Conditions that encourage integration often prevail in platform-mediated networks: asset-specificity, uncertainty, and small-numbers bargaining (Williamson, 1975). Network users and third-parties that supply complements and components must make platform-specific investments in the face of rapid technological change. Their products are often nested platforms (e.g., PayPal vis-à-vis eBay; Netscape vis-à-vis

Windows) which, given WTA propensities, implies that a dominant complement/component supplier often will bargain with a single platform sponsor.

Essential Complements. As platforms evolve, complements once perceived to be discretionary may come to be viewed as essential. For example, only leading-edge users had web browsers in 1994, but by 1999 browsers were standard features that shipped with every new PC. When a complement becomes essential, platform sponsors must decide whether to continue to rely on network users/third-parties for its supply. The alternative is to integrate the complement into platform goods distributed by platform providers. In decisions about integration, sponsors will weigh both efficiency and strategic concerns (Farrell & Weiser, 2003, Nalebuff, 2003). There are several arguments for integrating on efficiency grounds (Davis, MacCrisken & Murphy, 2001):

A single engineering team may be able to develop a superior interface between the platform good and complement. Integration reduces shopping costs for network users. Also, the sponsor can avoid the impact of double marginalization when two monopolists sell perfect complements.

Integration may also be motivated by strategic concerns (Whinston, 1990; Church & Gandal, 1992a; Carlton & Waldman, 2002). By bundling an essential complement with its platform good, the sponsor may be able to deter entry and weaken existing platform rivals. If the sponsor's platform is dominant, it will be difficult for a standalone complement provider to compete against the bundle. If standalone complement providers are not viable, then costs will rise for rival platform providers, who must also integrate into the essential complement.

*Platform Leadership***.** Our analysis of the role of integration in platform evolution is informed by the research of Bresnahan & Greenstein (1999), who observed that the PC ecosystem was once characterized by *divided technical leadership* from several firms, each powerful within their respective horizontal layers (e.g., Intel in CPUs; Microsoft in operating systems; IBM and Compaq in computer manufacturing; WordPerfect and Lotus in applications). Over time, Microsoft displaced many leading application providers and computer makers were relegated to an assembly role. Consequently, technical leadership in personal computing became concentrated in the hands of Microsoft and Intel; in tandem, these firms captured a greater share of industry rents.

Bresnahan & Greenstein suggest that network effects and switching costs engender periods of stable platform leadership, which are punctuated by episodes of epochal change (see also Tushman & Anderson, 1986; West, 2006). Such change results in new platforms and the reallocation of technical leadership roles—and rents—within existing platforms. Epochal change can occur in at least two ways. First, a platform that serves a new or peripheral market may improve to the point where it can satisfy an established platform's users (see also Christensen, 1997). Second, with divided technical leadership, a dominant player in one layer can help usurp or diminish leaders in another layer, either by sponsoring another party's entry into the target layer or by entering itself.

In this view, managing relationships with complement and component suppliers—and deciding when to supplant or absorb them—is crucial to a platform sponsor's success. In developing these ideas, we draw on work by Gawer & Cusumano (2002; see also Gawer & Henderson, 2005; Casadesus-Masanell & Yoffie, 2006; and Yoffie & Kwak, 2006) who describe organizational structures and processes used by Intel and other platform sponsors to manage relationships with complementors.

4) Platform Evolution

g. *How is innovation affected in platform environments?* Is a platform transition different from normal technological advancement?

A single firm cannot out-innovate an entire market. Innovation in platform markets must be sufficiently decentralized to capture ideas wherever they occur.

Platform innovation is enhanced by structuring the ecosystem to allow market partners to provide ideas. The pace increases due to harnessing numerous 3rd party contributions that extend the rate of change feasible to the platform sponsor alone. Keeping up feels like "running in place." Lead innovations often come from outside the platform firm itself. Often, the first use of a platform technology is not the one later discovered by the market. RCA originally sold radio for point-to-point communication to large firms and not the masses (Hanson 1999). Edison sold phonographs for people to record their last will and testament. You need to be a good platform custodian for partners to fill the potholes in your foundation (GJ).

Skype's internet telephony success is a classic instance of Christensen's observation that disruption occurs when competitors meet an unaddressed market need through initially inferior technology (GJ). They make no quality of service guarantees but the market is willing to accept this service level. Given the number of consumers who have already bought Internet access, demand is huge. They are coupling with a larger platform.

Platform transitions have whole new suppliers, complementors, and routes to market. An ecosystem supplants another of a different kind. An analogy is the transition from chemical to digital photography. Film, processing, chemicals, and photo paper yielded to embedded memory, inkjet cartridges, screen display, and software. New players are unencumbered by Christensens's innovator's dilemma and meticulous tradeoffs. DP

While normal technological advancement tends to be incremental, we associate platform transitions with *S-curve growth.*

With positive network effects, the relationship between user WTP and network size tends to follow a logistic ("S"-shaped) function. After an initial period of accelerating growth, WTP eventually increases at a decreasing rate due to: 1) budget and attention constraints; 2) the fact that late adopters conduct fewer transactions, and are valued less as transaction partners by existing users; and 3) fewer non-adopters remain to adopt. Due to latter-stage concavity, strategies based on principles like Metcalfe's Law, which states that a network's value increases with the square of its user base, can be seriously flawed (Briscoe, Odlyzko, & Tilly, 2006).

Innovation also comes from platform envelopment, which is often called "convergence" Networked industries are rich with envelopment opportunities because platform providers that serve different markets often have overlapping user bases. By leveraging overlapping user relationships, one platform provider can move into another's market, offering a bundle that includes both platforms' products. The targeted platform provider is vulnerable because it cannot match the attacker's offer. Dominant firms that otherwise are sheltered from entry by standalone rivals may see entry barriers collapse in the face of an adjacent platform provider's envelopment attack. We explore these strategies in the next section.

Effect of Platform Sharing on Innovation. If rival platforms survive, their relative performance over the long term will be determined in part by their respective rates of innovation (which would be reflected in the "market share" and "margin" components of the calculation above). The impact of shared versus proprietary platform models on innovation is ambiguous (Boudreau, 2006). On the positive side for shared

platforms, since several firms can share the R&D burden, their collective spending might exceed R&D investments by a proprietary platform. Also, competition among firms to incorporate their respective technologies into a common standard may result in survival of the fittest proposals. Finally, open processes for jointly developing technologies invite ongoing feedback, which may yield higher quality products (Chesbrough, 2003; West, 2006).

On the negative side for shared platforms, innovation in standard-setting organizations and similar forums may be slowed by political maneuvering and complex coordination processes (Simcoe, 2006). Also, "least common denominator" dynamics in SSOs may yield lower-quality standards due to "tyranny of the majority" voting (e.g., when most participants lack the manufacturing skills to handle one firm's leading-edge technology) or due to vested interests (e.g., when incumbents reject an entrant's innovations in order to protect their sunk investments). Finally, with a proprietary model, engineering choices are subject to hierarchical direction rather than multi-lateral negotiation. Proprietary platforms may have more tightly-integrated components and may out-perform shared platforms

h. *How do you attack or defend a platform?* Having established a platform, the sponsor cannot rest but must continue to evolve and mitigate threats. What strategies have been used to attack a platform? How can one defend against them?

Attack Strategies:

At least two strategies have been used to attack platforms. To hijack a platform, a competitor works within the ecosystem to wrest control of the platform. To envelope a platform, a competitor arrives from a parallel ecosystem and absorbs the key profit generating functions.

Two strategies differ based on whether an attacker works within a platform ecosystem or outside it and by whether the attacker is the main sponsor or an interloper. Working within the platform ecosystem, both Microsoft and IBM have sought to hijack Java either by intentionally forking the code and fragmenting the network, or by providing enhanced functionality, tools, and better leadership, to coopt the developer pool and direction of platform growth. The "Eclipse" project, for example, is quite specifically targeted at wresting control from "Sun." Internal division is one risk of opening a platform that needs to be met with careful quality control and strong leadership.

Working within the platform, the platform sponsor has several strategies for pursuing growth and dominance.

1) *Subsidize creation of value on the long tail* – As in Fig 2, one of the means of adding platform value is to open the platform and provide tools and resources to component suppliers who can marshal additional resources on your behalf. Cisco, for example, provides considerable support to business partners.
2) *Vertically integrate into critical components* – This ensures that key sources of consumer value are available on the sponsor's platform. Creating these in-house develops expertise. Acquiring them can secure these resources quickly and deny them to competing platforms.

In platform markets, defense *is* innovation. – ST

3) *Develop strategic alliances with manufacturers and distributors* – As always in platform battles, having key channel partners can provide an edge in reaching key markets. DoCoMo partnered with railways in Japan to bring its payment system to an enormous commuter population.
4) *Advertise heavily to create the expectation your platform will win* – Competition between platforms can lead consumers to delay purchasing until a clear victor has emerged. This has clearly happened in the HD-DVD versus BluRay standards battle. Editorial reviews have specifically advised against purchasing for this reason. Market perceptions can help sway the market.

5) *Pursue "Marquee" users* – Certain large consumers can signal the market that a given platform has established critical mass. Courting large consumer groups such as governments can tip the market in favor of
6) *Reduce switching costs for consumers of competing products* – Consumers of a specific technology can become "locked-in" by incompatible technology, training, and other large sunk costs. Developing converters from competing systems to yours can help. That Macintosh computers now offer dual boot capability significantly reduces PC lock-in.
7) *Pursue stronger network effects* – Since platforms depend on "demand economies of scale," one useful strategy is to extend network effects. In computer gaming, for example, online user-to-user interaction has much stronger network effects than solo play. Xbox moved aggressively into online play, ahead of Sony, to shift users away from Playstation.

Working outside the platform, a second strategy is to "envelop" the target platform with functionality from a parallel and usually larger platform (Eisenmannn, Parker & Van Alstyne 2006). Microsoft has frequently used a variant of this strategy call "embrace and extend" in which they match proprietary content, then extend it with improved functionality. Look for envelopment attacks when industry observers talk about blurring market boundaries and convergence (Yoffie, 1997).

The effects of bundling products into the core platform are nicely captured in a visual analysis by Nalebuff (2003). Consider two separate standalone goods, for example, Applications 1 and 2 from Figure 2. In the case of the Windows operating system, a classic platform good, these could be MS Word and MS Excel. Neither product was superior to Wordperfect or Lotus 123 respectively at the time they were introduced. Standard pricing practices suggest pricing to the top half of consumers in both cases, represented by the blue area in Figures 9a & 9b. A competitor, however, can price a substitute spreadsheet product below the individual price and take half a market as in Figure 9c. The yellow profits shift to the competitor. Suppose, now that the platform sponsor bundles the two goods and prices them to the top half of both markets as in Figure 9d. Profits are again the blue area. The bundled good now substantially defeats price competition from a competitor. Because consumers value *both* goods, pricing an independent good to steal market share is much harder because any consumer who values the word processor already has a spreadsheet and does not need another. The bundled spreadsheet already feels as if it is free so the competitor's market share is cut substantially.

Successful, dominant platforms may be sheltered from direct entry by standalone rivals, yet still face competitive threats from larger adjacent platforms bundling their functionality. A classic example is the bundling of streaming audio into the Windows operating system. RealNetworks pioneered streaming media, however, when Microsoft bundled both the content creation and content consumption tools into the operating system, they absorbed RealNetworks' market. Envelopment via a dominant platform can invite antitrust scrutiny as occurred in the US and Europe.

Reasons for attack:

Strategic Foreclosure **–** The target provides an essential complement for the enveloper's platform. The attacker either eliminates or acquires the standalone complement provider, in either case foreclosing rival platform providers' access to the essential complement. eBay's BillPoint was an unsuccessful foreclosure attack on PayPal

Efficiency Gains **–** The target's platform is one of many discretionary complements to the enveloper's platform that take advantage of overlapping user relationships

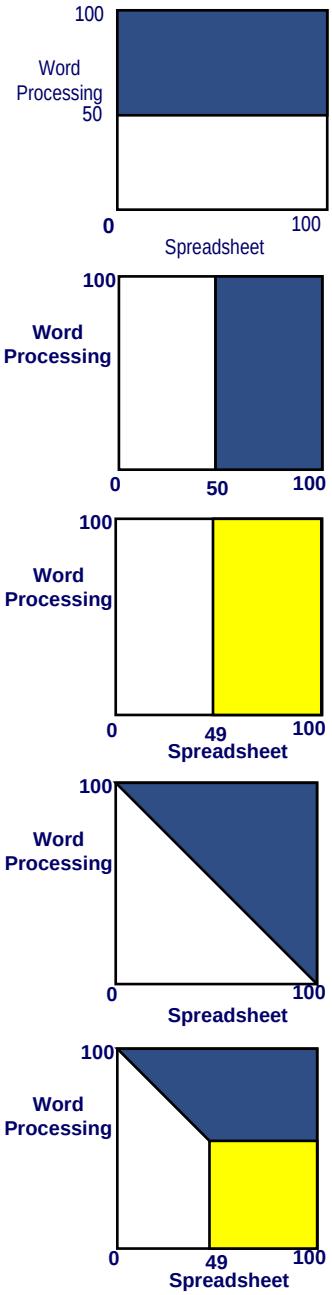


Fig 9a-e: These frames show how bundling goods into a platform hurts competitors. If two goods are priced independently (a & b), a competitor can lower price and take market share with a substitute (c). But, if a firm bundles two goods and charges for both (d), then because one good is "already paid for" a competitors sales are cut in half. (source Nalebuff 2003).

production cost synergies. Larger user bases can also stimulate greater network effects. Examples include Cisco bundling proprietary networking protocols (such as IBM's SNA) into its operating system and Yahoo! offering services such as Yahoo! Music (enveloping RealNetwork's Rhapsody) or Yahoo!'s Flickr (enveloping Shutterfly) as well as cable TV system operators and local phone companies entering each others' markets.

Substitution Effects – Before envelopment, the target and enveloper are weak substitutes: they provide similar functionality, but through fundamentally different technologies. For example, LinkedIn and Monster.com both help their respective users find jobs, but in different ways: LinkedIn users rely on social networking; Monster users search its job listings database.

Organizing for Envelopment. Launching an envelopment attack requires an unusually high level of cross-unit coordination. Engineers must integrate the two platforms' functionality and marketers must formulate joint pricing and targeting strategies. In most companies, achieving such cross-unit cooperation is a difficult challenge, because managers can fear a loss of autonomy.

Enveloper's Cost Advantages. The likelihood of success for an envelopment attack hinges on: 1) the magnitude of production cost synergies (including expenses R&D and customer service) in bundling platform functionality; and 2) the nature of overlap between the target and enveloping platforms' user bases, which influences the appeal of the attacker's bundle and related marketing costs.

Defensive Strategies:

Changing Business Models. Ceding the targeted platform and redeploying into new markets may be an attractive option for some intermediaries. RealNetworks pursued this approach in response to Microsoft's envelopment. Real largely ceded its streaming media business. It leveraged existing relationships with consumers and music companies to launch Rhapsody, an online subscription music service. Another way for platform providers to change their business models in response to envelopment is to offer systems integration services, that is, help enterprises knit together diverse information technologies. Platform intermediaries are often well-equipped to serve as systems integrators, because facilitating users' transactions across a network builds the capabilities required for this role. Again, RealNetworks provides an example: before it launched Rhapsody, Real helped major music companies build online services.

Identify a defensible niche market: If consumers value a specific form of differentiation, it may be possible to defend a platform. This subnetwork is likely to be much smaller, however, and potentially lose certain scale benefits of a larger network.

Improved Technology: A limited response is to compete via technological evolution, i.e. to add features at least as valuable as those offered by competing platforms. This is feasible only for equivalent or inferior technology and one must carefully consider the growth trajectory of the competing platform. Minor evolution cannot compete successfully with major revolution. Analog photography added onscreen display, different size prints, and multiple speed films but could not compete with digital photography. In the 1800s, the pace of innovation in sailing ships quickened dramatically due to competition from steamships. Improved designs and adding sails, however, only delayed inevitable industry decline relative to powered shipping. Analog photography could easily have learned from precursors in analog music and analog HDTV. When fighting a losing innovation battle, good defense is delaying the

inevitable and optimally timing a transition of assets.

Mergers and Alliances: Partner to neutralize threats (DP). Platform intermediaries targeted for envelopment can merge with their attackers' rivals, who then can develop rival cross-platform bundles (e.g., Lotus + IBM; Scientific-Atlanta + Cisco). Alternatively, targeted intermediaries can pursue joint ventures with partners who wish to develop bundles (e.g., RealNetworks' partnerships with Cingular and Comcast). Size matters. Smaller platforms need to become part of an even larger platform.

Litigation: Antitrust law for networked industries is still under dispute (Nalebuff 2003; Evans 2003). Dominant platform providers that offer bundles or pursue penetration pricing risk being charged with illegal tying or predation. Firms targeted for envelopment can challenge their attackers on antitrust grounds—a successful strategy for several of Microsoft's victims, including Novell, RealNetworks, Sun Microsystems, and Netscape.

References

Armstrong M. 2005. Competition in two-sided markets. Economics Working Paper Archive: http://econwpa.wustl.edu/eps/io/papers/0505/0505009.pdf .

Armstrong M, Wright J. 2004. Two-sided markets, competitive bottlenecks and exclusive contracts. Available via SSRN (http://papers.ssm.com/sol3/papers.cfm?abstract_id=654187).

Arthur WB. 1989. Competing technologies, increasing returns, and lock-in by historical events. *Economic Journal* 99, (394): 116-131.

Axelrod R, Mitchell W, Thomas R, Bennett DS, Bruderer E. 1995. Coalition formation in standard-setting alliances. *Management Science* 41(9): 1493-1508.

Bahad E. 1987. Wishful thinking and objectivity among sports fans. *Social Behavior: An International Journal of Applied Social Psychology* 4: 231-240.

Baldwin C, Clark K. 2000. *Design Rules, Vol. 1: The Power of Modularity* MIT Press: Cambridge, MA.

Besen S, Farrell J. 1994. Choosing how to compete: Strategies and tactics in standardization. *Journal of Economic Perspectives* 8(2): 117-131.

Blattberg R, Deighton J. 1996. Manage marketing by the customer equity test. *Harvard Business Review* 74(4).

Boudreau K. 2006. Does opening a platform generate more innovation? MIT Sloan Research Paper No. 4611-06.

Brandenburger A, Nalebuff B. 1996. *Co-opetition,* Doubleday: New York.

Bresnahan T, Greenstein S. 1999. Technological competition and the structure of the computer industry. *Journal of Industrial Economics* 47: 1-40.

Briscoe B, Odlyzko A, Tilly B. 2006. Metcalfe's Law is Wrong. *IEEE Spectrum,* July.

Burt R. 1982. *Toward a Structural Theory of Action.* Academic Press: New York.

Burt R. 1992. *Structural Holes: The Social Structure of Competition.* Harvard University Press: Cambridge, MA.

Caillaud B, Bruno J. 2003. Chicken & egg: Competition among intermediation service providers. *Rand Journal of Economics,* 34(2): 309-328.

Carlton D, Waldman M. 2002. The strategic use of tying to preserve and create market power in evolving industries. *Rand Journal of Economics* 33(2): 194-220.

Casadesus-Masanell R, Yoffie, D. 2006. Wintel: Cooperation or conflict. *Management Science* forthcoming.

Choi J. 1994. Network externality, compatibility choice, and planned obsolescence. *Journal of Industrial Economics* 42: 167-182.

Chien-fu C, Shy O. 1990. Network effects without network externalities. *International Journal of Industrial Organization* 8: 259-270.

Church J, Gandal N. 1992. Integration, complementary products and variety. *Journal of Economics and Management.* 1(4): 651-675.

Church J, Gandal N. 1992. Network effects, software provision, and standardization. *Journal of Industrial Economics* 40: 85-103.

Church J, Gandal N. 1993. Complementary network externalities and technological adoption. *International Journal of Industrial Organization,* 11: 239-260.

Coase, R. (1972) Durability and Monopoly; Journal of Law and Economics 15(1) pp 143-149.

Cockburn I, Henderson R. 1994. Racing to invest? The dynamics of competition in ethical drug discovery. *Journal of Economics & Management Strategy* 3: 481-519

Cooper A, Woo C, Dunkelberg W. 1988. Entrepreneurs' perceived chances for success. *Journal of Business Venturing* 3: 97-108.

Chesbrough, H. 2003. *Open Innovation: The New Imperative for Creating and Profiting from Technology.* Harvard Business School Press: Boston, MA.

Chiao B, Lerner J, Tirole J. 2005. The rules of standard setting organizations: an empirical analysis. Harvard NOM Working Paper no. 5: http://papers.ssrn.com/sol3/papers.cfm?abstract_id=664643.

Christensen, C. 1997. *The Innovator's Dilemma: When New Technologies Cause Great Firms to Fail.* Harvard Business School Press, Boston, MA.

Cremer J, Rey P, Tirole J, 2000. Connectivity in the commercial Internet. *Journal of Industrial Economics* 47: 433-472.

Cusamano M, Mylonadis Y, Rosenbloom R. 1992. Strategic maneuvering and mass-market dynamics: The triumph of VHS over Beta. *Business History Review* 66: 51-94.

Cusumano M, Yoffie D. 1998. *Competing on Internet Time: Lessons from Netscape and its Battle with Microsoft.* Free Press: New York, NY.

David P, Bunn J. 1988. The economics of gateway technologies and network evolution: Lessons from electricity supply history. *Information Economics and Policy* 3: 165-202.

David P, Greenstein S. 1990. The economics of compatibility standards: An introduction to recent research. *Economics of Innovation and New Technology,* 1: 3-41.

Davis S, MacCrisken J, Murphy K. 2001. Economic perspectives on software design: PC operating systems and platforms. NBER Working Paper no. W8411: http://papers.ssrn.com /sol3/papers.cfm?abstract_id=278762.

Economides N. 1996. The economics of networks. *International Journal of Industrial Economics* 14: 673-699.

Economides, 2004. Competition policy in network industries: An introduction. NET Institute Working Paper no. 04-24: http://papers.ssrn.com/sol3/papers.cfm?abstract_id=386626 .

Economides N, Katsamakas E. 2005. Two-sided competition of proprietary vs. open source technology platforms and the implications for the software industry. New York University Law and Economics Working Papers, #31: http://papers.ssrn.com/sol3/papers.cfm?abstract_id=613601.

Eisenmann T. 2002. The effects of CEO equity ownership and firm diversification on risk taking. *Strategic Management Journal,* 23: 513-534.

Eisenmann T. 2005. Valuation bubbles and broadband deployment. In *The Broadband Explosion: Leading Thinkers on the Promise of a Truly Interactive World,* Austin R, Bradley S (eds). Harvard Business School Press: Boston, MA.

Eisenmann T. 2006. Internet companies growth strategies: Determinants of investment intensity and long-term performance. *Strategic Management Journal* 27: 1183-1204.

Eisenmann T, Bower J. 2000. The entrepreneurial M-form: Strategic integration in global media firms. *Organization Science* 11: 348-355.

Eisenmann T, Parker G, Van Alstyne M. 2006. Strategies for two-sided markets. *Harvard Business Review* Oct. 2006.

Evans D. 2003. The antitrust economics of multi-sided platform industries. *Yale Journal on Regulation* 20: 325-382.

Evans D, Hagiu A, Schmalensee R. 2004. A survey of the economic role of software platforms in computer-based industries. CESifo Working Paper no. 1314: http://ideas.repec.org /p/ces/ceswps/_1314.

Evans D, Hagiu, A, Schmalensee, R. 2006. *Invisible Engines: How Software Platforms Drive Innovation and Transform Industries,* MIT Press, Boston, MA.

Evans D, Schmalensee R. 2001. Some economic aspects of antitrust analysis in dynamically competitive industries. NBER Working Paper no. W8268: http://papers.ssrn.com/sol3 /papers.cfm?abstract_id=268877 .

Evans D, Schmalensee R. 2005. The industrial organization of markets with two-sided platforms. NBER Working Paper no. W11603: http://papers.ssrn.com/sol3/papers.cfm?abstract_id=804249 .

Farrell J, Gallini N. 1988. Second sourcing as a commitment: Monopoly incentives to attract competition. *Quarterly Journal of Economics* 103: 673-694.

Farrell J, Klemperer P. Coordination and lock-in: competition with switching costs and network effects. Forthcoming in *Handbook of Industrial Organization*, Elsevier (latest version available at www.paulklemperer.org).

Farrell J, Saloner G. 1985. Standardization, compatibility, and innovation. *Rand Journal of Economics* 16: 70-83.

Farrell J, Saloner G. 1986. Installed base and compatibility: Innovation, product preannouncements, and predation. *American Economic Review,* 76: 940-955.

Farrell J, Saloner G. 1987. The economics of horses, penguins, and lemmings. In *Production Standardization and Competitive Strategies,* Gable, L (ed). Amsterdam: North-Holland.

Farrell J, Saloner G. 1992. Converters, compatibility, and the control of interfaces. *Journal of Industrial Economics* 40(1): 9-35.

Farrell J, Shapiro C. 1988. Dynamic competition with switching costs*. Rand Journal of Economics* 19: 123-137.

Farrell J, Weiser P. 2003. Modularity, vertical integration, and open-access policies: towards a convergence of antitrust and regulation in the internet age. *Harvard Journal of Law & Technology* 17: 86-118.

Fudenberg D, Tirole J. 1998. Upgrades, tradeins and buybacks. *Rand Journal of Economics* 29: 235-258.

Gantz J., Gillen A., Warmerdam M. 2006, “The Economic Impact of Microsoft Vista in the U.S.” Framingham, MA: *International Data Corporation*, Dec. (report sponsored by Microsoft).

Gawer A, Cusumano M. 2002. *Platform Leadership: How Intel, Microsoft, and Cisco Drive Industry Innovation.* Harvard Business School Press: Boston, MA.

Gawer A, Henderson R. 2005. Platform owner entry and innovation in complementary markets: evidence from Intel. NBER Working Paper, no. W11852: 1 – 36.

Granovetter M. 1973. The strength of weak ties. *American Journal of Sociology,* 78:1360-1380.

Iansiti M, Levin R. 2004. *The Keystone Advantage: What the New Dynamics of Business Ecosystems Mean for Strategy, Innovation, and Sustainability.* Harvard Business School Press: Boston, MA.

Katz M, Shapiro C. 1985. Network externalities, competition, and compatibility. *American Economic Review* 75: 424-440.

Katz M, Shapiro C. 1986. Technology adoption in the presence of network externalities. *Journal of Political Economy* 94: 822-841.

Katz M, Shapiro C. 1992. Product introduction with network externalities. *Journal of Industrial Economics* 40: 55-83.

Katz M, Shapiro C. 1994. Systems competition and network effects. *Journal of Economic Perspectives* 8: 93-115.

Khanna T. 1995. Racing behavior: technological evolution in the high-end computer industry. *Research Policy* 24: 933-958

Kindleberger C. 2000. *Manias, Panics, and Crashes: A History of Financial Crises.* Wiley: New York, NY.

Klemperer P. 1987. Markets with consumer switching costs. *Quarterly Journal of Economics* 102: 375-394.

Langer E. 1975. The illusion of control. *Journal of Personality and Social Psychology* 32: 311-328.

Lerner J. 1997. An empirical exploration of a technology race. *Rand Journal of Economics* 28: 228-247.

Lerner J, Tirole J. 2004. A model of forum shopping, with special reference to standard setting organizations. Harvard NOM working paper no. 04-35: http://papers.ssrn.com/sol3/papers.cfm?abstract_id=620904 .

Lieberman M. 1987. The learning curve, diffusion, and competitive strategy. *Strategic Management Journal* 8: 441-452.

Lieberman M, Montgomery D. 1988. First-mover advantages. *Strategic Management Journal* 9: 41-58.

Liebowitz S, Margolis S. 1994. Network externality: An uncommon tragedy. *Journal of Economic Perspectives,* 8(2): 133-150.

Liebowitz, S., Margolis S. 2001. *Winners, Losers & Microsoft.* The Independent Institute: Oakland, CA.

Matutes C, Regibeau P. 1996. A selective review of the economics of standardization: Entry deterrence, technological progress and international competition. *European Journal of Political Economy* 12: 183-209.

Moore G. 1993. Predators and prey: the new ecology of competition. *Harvard Business Review* May 1993.

Nalebuff B. 2000. Competing against bundles. In *Incentives, Organization, and Public Economics.* Hammond P, Myles G. (eds). Oxford University Press: London.

Nalebuff B. 2003. Bundling, tying and portfolio effects. DTI Economics Paper no. 1.

Nalebuff B. 2004. Bundling as an entry deterrent. *Quarterly Journal of Economics* 119: 159-187.

Noe T, Parker G. 2005. Winner take all: Competition, strategy, and the structure of returns in the Internet economy. *Journal of Economics and Management Strategy* 14: 141-164..

Oliva R, Sterman J, Giese M. 2003. Limits to growth in the new economy: Exploring the "Get Big Fast" strategy in e-commerce. *System Dynamics Review* 19(2): 83-117.

Parker G, and Van Alstyne M. W. 2000. Information Complements, Substitutes & Strategic Product Design. *http://ssrn.com/abstract=249585*.

Parker G, and Van Alstyne M. W. 2005a. Two-sided network effects: A theory of information product design. *Management Science* 51: 1494-1504.

Parker, G and Van Alstyne, M. W., 2005b. Innovation through Optimal Licensing in Free Markets and Free Software. (September 2005). Available at SSRN: http://ssrn.com/abstract=639165.

Perlow L, Okhuysen G, Repenning N. 2002. The speed trap: Exploring the relationship between decision making and the temporal context. *Academy of Management Journal* 45: 931-955.

Reinganum J. 1989. The timing of innovation: Research, development, and diffusion. In *Handbook of Industrial Organization, Vol. I,* Schmalensee R, Willig R. (eds). Elsevier: Amsterdam, Holland.

Rochet J, Tirole J. 2003. Platform competition in two-sided markets. *Journal of the European Economic Association,* 1(4): 990-1029.

Rochet J, Tirole J. 2004. Two-sided markets: An overview. Working paper available at author's website: http://www.idei.fr/doc/by/tirole/rochet_tirole.pdf

Rohlfs, J. 1974. A theory of interdependent demand for a communications service. *Bell Journal of Economics and Management Science* 5:16-37.

Rohlfs J. 2001. *Bandwagon Effects in High-Technology Industries.* MIT Press: Cambridge, MA.

Sahlman W, Stevenson H. 1985. Capital market myopia. *Journal of Business Venturing* 1: 7-30.

Scherer F, Ross D. 1990. *Industrial Market Structure and Economic Performance,* 3rd ed. Houghton Mifflin: Boston, MA.

Schilling M. 2002. Technology success and failure in winner-take-all markets: The impact of learning orientation, timing, and network externalities. *Academy of Management Journal* 45: 387-398.

Schnaars S. 1994. *Managing Imitation Strategies: How Later Entrants Seize Markets from Pioneers.* McGraw-Hill: New York, NY.

Shapiro C, Varian H. 1999a, The art of standards wars. *California Management Review* 41(2): 8-32.

Shapiro C, Varian H. 1999b *Information Rules: A Strategic Guide to the Networked Economy.* Harvard Business School Press: Boston, MA.

Shiller R. 2000. *Irrational Exuberance.* Princeton University Press: Princeton, NJ.

Shy O. 2001. *The Economics of Network Industries,* Cambridge University Press: Cambridge, England.

Simcoe, T. 2006. Delay and de jure standardization: Exploring the slowdown in Internet standards development. In *Standards and Public Policy,* Greenstein S, Stango V, (eds). Cambridge University Press: Cambridge, England.

Spence A. 1979. Investment strategy and growth in a new market. *Bell Journal of Economics* 10: 1-19.

Sterman J, Henderson R, Beinhocker E, Newman L. 2006. Getting big too fast: Strategic dynamics with increasing returns and bounded rationality. MIT Sloan working paper 4595-06.

Stokey, N. L. Intertemporal Price Discrimination. Quarterly Journal of Economics, August 1979, 355-71.

Teece D. 1986. Profiting from technological innovation: Implications for integration, collaboration, licensing, and public policy. *Research Policy* 15:285-305.

Tellis G, Golder P. 2002. *Will and Vision: How Latercomers Grow to Dominate Markets.* Free Press: New York, NY.

Tushman M, Anderson P. 1986. Technological discontinuities and organizational environments. *Administrative Science Quarterly* 31(3): 439-465.

Tushman M, O'Reilly C. 1996. Ambidextrous organizations: managing evolutionary and revolutionary change. *California Management Review* 38(4): 8-30.

Wasserman S. and Faust K. 1994. *Social Network Analysis: Methods and Applications.* Cambridge University Press: Cambridge, England.

West J. 2003. How open is open enough? Melding proprietary and open source platform strategies. *Research Policy* 32: 1259-1285.

West J. 2006. The economic realities of open standards: Black, white and many shades of gray. In *Standards and Public Policy*, Greenstein S, Stango V. (eds). Cambridge University Press, Cambridge, England.

Whinston, M. 1990. Tying, foreclosure and exclusion. *American Economic Review* 80: 837-859.

Williamson O. 1975. *Markets and Hierarchies: Analysis and Antitrust Implications.* Free Press: New York, NY.

Xie J, Sirbu M. 1995. Price competition and compatibility in the presence of positive demand externalities. *Management Science* 41: 909-.

Yoffie D. 1997. Introduction: CHESS and competing in the age of digital convergence. In *Competing in the Age of Digital Convergence.* Yoffie D. (ed.). Harvard Business School Press: Boston, MA.

Yoffie D, Kwak M. 2006. With friends like these: the art of managing complementors. *Harvard Business Review*, September 2006.