

Strategy and the Complex Dynamics of Information

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1.0 Introduction – Harvard Business Review and the Internet

A decade ago, Philip Evans and Thomas Wurster wrote a groundbreaking article on business and the internet entitled “Strategy and the New Economics of Information”.¹ Evans and Wurster, who were, respectively Senior Vice President of the Boston Consulting Group in Boston, MA and Vice President of the Los Angeles office of the Boston Consulting Group were also the co-leaders of BCG’s Media and Convergence practice. Their article aimed at setting a new paradigm for business strategy based on the universal connectivity offered by the internet. In many ways they were very advanced observers. Their 1999 Harvard Business Review Article, “Getting Real About E-Commerce” essentially anticipated the dot.com bust, understanding as they did the fondness of poorly regulated capital markets for funding “the idea for an internet business” whether the underlying technology, strategy, market delivery methods or sustainable sources of income were there or not, would someday evaporate, or as Jasper Arnold (1986), in another Harvard Business Review article would describe it, “the capital market window would slam shut”.

This kind of market behavior, while shocking to investors, is not all that surprising to the authors. We have argued elsewhere (Fellman, Post, Wright and Dasari, 2004; Mertz, Groothuis and Fellman, 2006; Fellman, Groothuis and Mertz, 2006) that often, new technologies appear not in a kind of “Cambrian explosion” as described by Stuart Kauffman (1993, 1996), although Evans and Wurster’s first article makes a very good case for this in 1997, but rather that new technologies evolve through the development of self-organizing networks which follow a kind of punctuated collapse, or the inverse of a punctuated equilibrium or Cambrian explosion, (Fellman, Post, Wright and Dasari, 2004). In this context, the dot.com shakeout, like biotech shakeout and PC industry shakeout before it, was inevitable. What nobody predicted, but what nonetheless follows from the best of Evan’s and Wurster’s analysis is either the size or the complexity of the emergent systems and markets of internet users which would appear after the dot.com shakeout subsided and growth returned to the industry.

In some ways, perhaps, pervasive computing, Software as a Service (SaaS), communities and ecosystems and open source technologies provide better indicators for how one should expect markets to evolve under conditions of convergent technology (universal connectivity, exponentially increasing information handling speeds and modalities, a shift from product-centric to service-centric consumption models, cross-functionality between computing, broadcasting and telephony, etc.) than a dichotomous producer-user relationship characterized by companies which sell things and customers who buy them. Indeed, Norman and Ramirez address this in their 1993 Harvard Business Review article, “From Value Chain to Value Constellation”, but they missed the computing angle. This is hardly surprising, since in their day, mobile code had yet to be perfected and widely distributed, what few web pages existed were largely static, rather than interactive (Hilton Corporation, for example, paid over \$250,000 in web design fees for what was essentially a single page HTML billboard on the internet of the mid-1990’s) and most of the internet landscape which we know today did not yet exist. Yet, Norman and Ramirez were still providing an accurate characterization of the dynamics which would come to play so large a part in internet commerce – they focused on the user contribution of the “value constellation”.

If one applies their concept to the internet, then above and beyond Evans and Wurster’s dicta “every business is an information business” and their study of “the deconstruction of the value chain”, they would have been looking for, and we should be looking today at user-driven contributions to value clusters and user driven exchange formats (which is why we mention pervasive computing, SaaS, and communities and ecosystems, including open source technologies). It would have been difficult to predict specific milestones on the cyberspace roadmap due to the evolutionary nature of internet adoption, and the shift towards services-oriented architectures and away from the top-down product-based development and consumption models of the previous three decades. Again, there are growing areas based on service-centric models and collaborative code development which Evans and Wurster could have hardly been expected to know about, such as software as a service, yet the demand for SaaS and use of open source components is significant and rapidly growing. Software developers worldwide now extend the concept of reach by contributing to the open source code base for both application and infrastructure software within custom projects and packaged vendor offerings (see Appendix II for a discussion of open source in the public

¹ Evans, Philip B. and Thomas S. Wurster, “Strategy and the New Economics of Information”. Harvard Business Review, September-October 1997, pp. 71-82.

sector). The power and vastness of these broader communities, whether self-evolving or initiated and nurtured by members, software vendors, and their surrounding ecosystems, have far exceeded the original expectations of early social network analysis or even the authors' description of "hierarchy", which more than a decade later is still not "thoroughly understood."² Both these trends will impact business internet usage and profitability deeply over the next decade, as increasing availability of broadband connectivity, higher user maturity levels, and pressures to reduce costs and increase profitability on both the supply and demand side escalate.

2.0 The Old "New Economics of Information"

Evans and Wurster began their analysis by proposing, what for the time, were probably fairly radical questions, at least for their inherently conservative and not terribly technical audience. These included ideas such as, "What will happen to category killers such as Toys "R" Us when a search engine gives consumers more choice than any store? What will be the point of having a supplier relationship with General Electric when GE can post its purchasing requirements on an Internet bulletin board and entertain bids from anybody? Their "shock value" response to their own questions was: "*Say hello to the momentous choices facing companies in the age of connectivity. Even if you never thought of your company as being in the information business, it is today. Which is why strategy has never been more important.*" These notions are a good lead-off for the average business executive in the 1990's, who grew up without computers and to whom the computing environment, much less the internet, was probably relatively alien. Businesses at that time could hardly begin to envision the subsequent effort required to create and maintain a successful multi-channel strategy spanning numerous elements of sales, marketing, and customer service and support. They could also not envision the extent to which the pace of change accelerates, nor the implications of instantaneous worldwide information and availability of rich content which can now make or break brands and businesses at near lightening speed. However, they are not scientific questions. Evading the low quality scientific content of Evans and Wurster's opening by arguing that they are writing to the business community rather than the scientific community begs the question. Their questions aren't invalid, per se, but in retrospect, particularly when seen from a scientific perspective, a lot of what they were discussing as hot new issues in 1997 are commonplace now, and they were obvious then to those who had some sense of what was going on at Intel® and Microsoft®, companies which were on the producer end, directly shaping the industry, or, as we have argued from a complexity standpoint, if one were tracking the emergent properties of the internet and the ways in which users were driving the configurations of internet communications and service channels.³

Evans and Wurster's first effort, in "Strategy and the New Economics of Information", is to explain how the internet has removed the traditional marketing tradeoffs of "richness" and "reach" and what this means in terms of business structure, profitability, assets and liabilities. This explanatory section is the strongest part of their argument and remains a valid and important message today. In their words (Evans and Wurster, 1997):

² Ibid. p. 75.

³ As an interesting aside, if the authors switch gears and put on our physicist's hat, in 1997, when Evans and Wurster were asking about the impact of General Electric, ostensibly a high-technology giant, putting their purchasing requirements on an electronic bulletin board, David Meyer was addressing the New England Complex Systems Institute on quantum game theory in nearby Nashua, New Hampshire (incidentally, a Gartner analytical headquarters). There's something either terribly wrong, or terribly naïve about the Harvard Business Review just catching on to primitive questions about how technology will drive the next several generations of markets in the late 1990's. Nor can Evans and Wurster or the Boston consulting group be blamed for this amazing lag in market intelligence. Harvard Business School Publishing nearly put itself out of business by initially refusing to publish cases from other business schools, or in their words "to act as a clearing-house for business school cases". Harvard had depended on the exclusivity of their name and their faculty (as authors) to drive their case publishing business since the 1920's. They very nearly lost their entire market position in the late 1990's as the universal connectivity delivered by the internet allowed competitors (such as the Ivy School of Business at the University of Western Ontario) to offer business school cases from virtually any school in the world (including Harvard and its near competitors, Stanford and MIT) at competitive prices, on-line and from a single unified catalog. The more general implication here is simply that not only businesses, but schools of business, including some of the leaders in the field, have been woeful late-comers in joining the technology revolution. This is not an encouraging example of how to gain and secure competitive advantage.

Information has two basic elements:

- Reach means the number of people, at home or at work, exchanging information.
- Richness has three components: bandwidth (the amount of information that can be moved from sender to receiver in a given time); customization (whether the information is tailored for an audience of a particular size); and interactivity (the extent to which the involved parties can converse).

They go on to explain that “before the days of connectivity, the informational components of value were constrained by the physical value chain that delivered a product or service. If you wanted to deliver a lot of highly customized, highly interactive information to people, you either had to pay a lot of money or settle for communicating with a limited number of people. You had to sacrifice reach for richness, or vice versa. But now no such tradeoff is required. Everyone is able to have incredibly rich communication with everyone else. And communicating with customers can occur without the costs of building and maintaining sales forces, branch systems, and the like. The strategic and competitive implications are huge...”

Where Evans and Wurster’s analysis goes South, is both in their audience and then in their choice of examples. Let’s consider the audience first. Most of these readers are, not surprisingly, probably managers in businesses which by 21st century standards would be considered to be rather old-fashioned. During that time, however, the general public usage of the Internet was not nearly as pervasive as today: most users either resided within specific areas of the business community, the government, or academic and research organizations, which limited the authors to more universally recognized examples. Often these businesses were built on relatively simplistic and non-technological principles and have followed strategies which were largely historically driven. In fact, critics of Evans and Wurster’s approach have generally taken the attitude that the internet doesn’t matter. From their perspective, many problem groups, say, for example, Australian aboriginal natives living under primitive conditions in Western Australia with little access to capital, technology or modern medicine still have to live “in the real world” under those harsh conditions and the internet does little or nothing to deal with their problems. To the extent we will engage with this kind of argument at all, we would have to answer that in large part this paper is a marketing strategy paper dealing with internet technology and low-access, socially disabled groups while of general interest are not the focus, or if you will, our target market segment.

To return to critics of “the internet age”, critics of the utility of computing in general or critics of Evans and Wurster’s approach specifically, it seems that these are a combination of individuals and firms which, for a variety of reasons, appear to be more backward looking rather than forward looking, even when they believe they are being forward looking and are incorporating the latest features of “management science”. There is an important marketing point to be made here, and that is that Evans and Wurster are doing their best to convince old-fashioned, pure product or service companies (i.e., companies which have not learned to bundle solutions consisting of unique mixtures of products and services to obtain a distinct strategic competence and sustainable competitive advantage in return for the tradeoffs of specialization) who largely conceive of their businesses strictly in terms of their physical value chain, that they are in fact, in an information business.

To put it more bluntly, the information revolution and the internet, with its universal connectivity, has put these businesses into an information/business environment which they cannot avoid and which if they do not understand it, will siphon off the bulk of their high value added informational components (in many cases making the physical elements of the business impossible to sustain as an independent enterprise, i.e., forcing bankruptcy). Evans and Wurster are not wrong when they tell these business, especially business which have historically depended on “the mechanics of intensive selling” (i.e. a highly trained physical sales force with its attendant support services, including offices and equipment as well as support personnel) that what were once their greatest assets may, in the information age, become, often overnight, their greatest liabilities or sources of liabilities (particularly since new entrants can use the internet to access the customer base without having to realign, repurpose or otherwise dispose of the sunk costs entailed in an expensive sales force and physical plant).

Evans and Wurster’s normative approach is entirely correct. However, one suspects that they are whistling past the graveyard. By the late 1990’s, not to mention the early 21st century, a significant number of businesses which did not understand the information revolution were already dead (and in the 21st century they are still dead). In the small business segment, many of them were killed by eBay®, a

company which did not have any significant market presence at the time of Evans Wurster's article, but which went on to exceed their subsequent projections for the size of the entire e-commerce market in 2010 (see Appendix I).

For example, at the time of Evans and Wurster's original article, upper New England had a flourishing antiques trade which was driven by summer tourism and tourism centered around the "Fall Foliage" season. The economics of these businesses depended on tourist foot traffic during high season for profitable sales of various New England antiques and curios specific to the region. However, these businesses, because they depended on a physical location for the exhibition of goods and the transaction of sales, generally had to carry overhead on a year-round basis, even though revenue was restricted to three to four months. In addition there were uncertainties attached to revenues which constrained prices all along the local supply chain. Local sellers were limited by what dealers at the next upward node of the market were willing to pay, which in turn was constrained by the above-mentioned fixed costs.

With the advent of on-line marketplaces in general and eBay in particular, almost all of these businesses have been driven out of the market. The residual elements of this industry are generally either focused on furniture and items too large to be easily sold and transported through the eBay system or to a few very large multi-dealer antique malls where, like in an insurance risk pool, a significant amount of the fixed costs can be laid off across a large number of participants. However, even these multi-segment, multi-user businesses are not doing particularly well as they face a constantly shrinking supply base. eBay provides the former suppliers of most of these antique stores with a quick, reliable and price efficient mechanism to determine if old items, curios, souvenirs and estate property is valuable and a rapid indication of what, exactly is the market value of these items. Shipping has been routinized and the longer eBay remains in business the more of these market inefficiencies they are able to root out, so that the process of participating in the electronic marketplace becomes not only more valuable for groups who have been the antiques market's historical suppliers but also an easier process than working through the traditional distribution channels.

The story of eBay and the New England antiques market is just one example of this kind of business model "phase transition". Scientific information sharing is another example. While the university textbook business model has been able to incorporate universal connectivity as an appendage of the historical business model, there are many technical areas of both scientific research and high technology business information management where on-line models have replaced traditional, physical based systems. For example, systems administration manuals for many computer applications are no longer distributed through a physical publisher, simply because by the time a publisher would commission a manual, receive the finished product, edit and proofread it, typeset the manual, print and bind it and then move it to the warehouse for distribution to clients, the software for that system (Unix applications for defense contracting are a typical example here) is already into the next release and requires a new manual. This has forced software developers in a number of areas to move directly to the electronic distribution of technical material. This shift has been accelerated by increasingly virtual research and development communities, whose borderless initiatives demand immediacy of information exchange in order to remain commercially competitive. On a more general level, electronic publishing is gradually displacing paper journal publication in the physical sciences. The best example of this is the ArXiv, <http://www.arXiv.org> formerly at Los Alamos National Laboratory and now run as joint venture between Cornell University, The National Science Foundation and the U.S. Department of Energy.⁴ In many cases, the ArXiv, as a distribution network for scientific research is able to reduce the average costs of publication of scientific research papers from an average of approximately \$50,000 to as little as \$5.00.

3.0 New Ideas – Old Examples

The examples which Evans and Wurster chose to make their case were important at one time, but today look rather dated. In the field of publishing, they choose the area of encyclopedias. Having chosen encyclopedias as their competitive ground,⁵ they then look at the near bankruptcy of Encyclopedia

⁴ See Paul Ginsparg, "Creating a Global Knowledge Network" Los Alamos National Laboratory, Los Alamos, NM <http://people.ccmr.cornell.edu/~ginsparg/blurb/pg01unesco.html>

⁵ In fairness to Evans and Wurster, a major reason for this choice was to illustrate the mechanics of intensive personal selling. Encyclopedias are hardly a product category at all in the modern world. We would more likely think of databases or search engines. But back in the day, when knowledge was primarily in print and distributed in ways which were often difficult or impossible to access,

Britannica®. They compare Britannica with Microsoft Encarta in the PC market, suggesting some of the ways in which Britannica could have used the internet to create a competitive advantage which would have staved off the company's near destruction and possibly even forced Microsoft to acquire them. It's an interesting example but a product choice which is essentially irrelevant for today's markets. While it is a convenient foil for demonstrating the defects of "the mechanics of intensive personal selling" Britannica was probably a poor example even Evans and Wurster were writing the article. Intensive personal selling is not a tragic flaw per se: complex systems businesses today⁶ are dependent upon relationship-based, high-touch sales efforts conducted by a seasoned, professional sales force. The death knell for Britannica occurred when their sales force was disintermediated by technology and when the competition to their formerly high-value content could be rapidly and easily accessed on an anytime-anywhere basis without incremental cost. At the time, studying the real tradeoffs would have involved comparing not just stand-alone books to stand-alone computers or stand-alone software packages, but rather the entire stand-alone encyclopedia function to on-line search engines (AltaVista and Lexis-Nexis® would have been the dominant models at the time, today Google® and Wikipedia® would be the relevant comparative models). The article loses a great deal of its initial force by not illustrating the point with more-relevant examples,

What makes these comparisons weak is that while they might be easy to understand for clients (and there appears to be a presumption, probably valid, that the Harvard Business Review readership will more or less resemble the conservative nature of the Boston Consulting Group client base) they are really very backward looking. In some cases they concern companies which simply had too short a shelf life to be meaningful examples of any kind of excellence. Nobody today wants to hear about Toys "R" Us or Quicken®. In fact, one of the major problems with this article is that while it gets the principles of universal connectivity generally right, it picks inappropriate and uninteresting companies and industries to analyze and most of the time it has been unsuccessful at predicting the future evolution of a company or industry.. Amazon.com did not get replaced by its suppliers moving downstream in order to pre-empt its function as a "navigator" of books and print materials. While Quicken® is still a relatively popular software product, it did not engulf the retail banking industry. In fact, the retail banking industry did not evolve at all down the path which Evans and Wurster predicted at all. What retail banking did, by and large, was simply to internalize the tools of universal connectivity, allowing interested retail customers to bank on-line from their personal computers without buying any specialized software. Investment advice exists on the internet, both in free and subscription forms, but what drives investment advising services is not "chat rooms" (again, something which was largely an artifact of the 1990's) but *validation*, a key internet concept which Evans and Wurster address only indirectly.

On the whole, while Evans and Wurster's examples might have been good for the purpose of explaining to technologically naïve readers in the 1990's why the internet was important, and why it would change the standard and currently familiar configurations of many businesses, they are not useful today, and they are not useful in any broader, more generalizable sense. As we have seen, when Evans and Wurster start to generalize about future business, not only have they picked uninteresting examples, but whenever they are specific, their predictions are wrong.⁷ Nor, when they are right, are they very daring. Their automotive example is very narrow, and also, in a sense, already old news. What would have been interesting, and quite a bit more daring, would have been to attempt to predict how emerging technologies like space based manufacturing or nanotechnology would be influenced by universal connectivity and changes in the enforceability of intellectual property law. Similarly, Evans and Wurster seem to think that universal connectivity won't really change the geographic or the global distribution of product suppliers and service providers.

the encyclopedia was a major knowledge-intensive product category. Evans and Wurster's point in choosing Encyclopedia Britannica was that despite its knowledge intensive nature as a product, less than 5% of the company's business expenses went to editorial functions. Approximately 95% of the firm's expenses were associated with the cost of sales.

⁶ Moore, Geoffrey A., "Strategy and Your Stronger Hand". Boston: Harvard Business Review, December, 2005, pp. 62-72.

⁷ One might compare this approach with the contemporary approach of Theodore Modis (1998), who does a much better job of explaining the evolution of underlying market dynamics.

4.0 SaaS offers both Richness and Reach

Consumption models of software have evolved through multiple cycles since Evans and Wurster's initial publication. During the late 1990's, a wave of Application Service Providers (ASPs) attempted to capture market share by offering hosted software solutions accessible by businesses remotely as an alternative to traditional on-premise installations. Many ASPs believed this deployment option would capture the hearts and minds (and subsequently cash) of the underserved small and medium business (SMB) market, providing a cost-effective entry point without significant investment required by technology infrastructure or the personnel to maintain and manage it. The model failed for numerous reasons,⁸ not the least of which was the "dot-com bust" at the end of the century which temporarily brought the entire industry to its knees. Though Evans and Wurster's concept of richness and reach was certainly applicable to the overall benefits of the internet, it was still early days and did not manifest itself in the ASP model at that time.

In contrast, software as a service has enjoyed increasing popularity over the past few years as both SMBs and now major enterprises are rapidly adopting the model. In 2007, projections indicate that revenues attributable to SaaS could reach \$1 billion in the customer relationship management (CRM) software market alone.⁹ Benefits of quicker time to deploy, reduced infrastructure costs, ease of use, and affordable pricing models initially attracted SMBs, then caught the attention of line-of-business enterprise application buyers who can now expense application functionality and avoid protracted procurement cycles and significant capital costs. The model extends Evans and Wurster's concept of richness and reach by making enterprise application functionality, and the option to participate in a community of users, available to a large audience of business buyers who were previously excluded due to high entry barriers. The increasing use of SaaS now benefits from several market and technology conditions which were virtually non-existent when the ASPs failed to penetrate the market in the late 1990's, including:

- Greater familiarity with the internet within both the business and consumer communities
- Increasing broadband availability on a global basis
- More-sophisticated security options, producing higher acceptance levels of internet transactions
- A more-savvy and demanding financial market funding emerging technology investments

Adoption of SaaS is not confined to CRM, but rather is spread across many software markets such as areas of Supply Chain Management (SCM), compliance management, collaboration technologies, and others.¹⁰ Within markets such as e-learning and Web conferencing, SaaS accounts for more than 60 percent and 70 percent of their respective total market revenue.¹¹ The market is poised for strong growth through 2011, when worldwide revenue is expected to reach \$11.5 billion.¹² Pure-play SaaS vendors are beginning to face competition from established on-premise players who are adding this deployment option due to increasing buyer adoption. While the majority of demand resides in North America, the reach is spreading to emerging geographic regions as market leaders initiate entry into countries in Western Europe, Latin America, and Asia Pacific. Ten years later, the environment envisioned by Evans and Wurster is at last taking shape as an alternative software deployment model in the enterprise application marketplace.

⁸ Other factors contributing to the demise of the ASP model in the late 1990's include market and vendor immaturity, limited (by today's standards) broadband connectivity, user unfamiliarity with technologies, and security concerns.

⁹ From ITPRO, <http://www.itpro.co.uk/information-management/news/124642/software-as-a-service-to-fuel-crm-boom.html>

¹⁰ Pring, Ben (2005) "Adoption of Software as a Service Is Happening Outside of CRM", Gartner Research, December 16, 2005 <https://www.vtrenz.net/imaeds/ownerassets/544/Gartner.adoption.of.software.as.a.service.1205.pdf>

¹¹ Press release, "Gartner Says Worldwide Software as a Service Revenue in the Enterprise Application Software Markets to Grow 21 Percent in 2007", Stamford, August 9, 2007.

¹² Ibid.

5.0 Conclusion

Universal connectivity is here to stay. While there may be many areas of social interaction which are not yet influenced by this connectivity, including some important economic areas, those issues are beyond the scope of this paper. What we have attempted to do is address the salient features of Evans and Wurster's original article, and perhaps update it a bit. First we recommend that in studying universal connectivity, everyone would probably be better served by steering away from rather dated, or backward-looking examples, including those examples which have subsequently turned out to be simply inaccurate predictions. Second, there are several emergent areas in IT markets, which have appeared both at the customer level, where eBay, for example, currently exceeds the entire predicted size of Evans and Wurster's e-commerce marketplace, as well as at the industry level, where new developments such as software as a service and open source software applications can be expected to play an increasingly important role in the future of the industry.

The globalization of connectivity will also eventually change the world's economic map. On the positive side, new technologies, like space based manufacturing and nanotechnology will probably enjoy a level of user access, all the way down to the product design level, which was impossible in traditional, capital-intensive industries because of high financial and physical barriers to entry. On the other hand, countries which depend on highly controlled local networks and supply chains for governmental regulation and tax revenues (this includes countries as different as Greece and Japan) are likely to see their traditional supply chains, and their traditional regulation and taxation arrangements shattered. In the latter case, it is entirely likely that as Japanese consumers globalize their consumption, the loss in revenues to the Ministry of Finance will be significant and that Japanese bureaucrats, who have already lost a substantial amount of their control over Japanese industry will witness the drying up of financial incentives and experience a further loss of control. The EU, in its turn, will probably have some very difficult choices to make about whether to attempt to continue its march towards operating as a single, integrated market and trading bloc or to pull back from some aspects of its intended economic union in order to access superior technology and obtain better prices on foreign goods. Finally, the U.S. may have to rethink some of its supply chain management and outsourcing practices, because universal connectivity, while possessing many positive attributes, is not necessarily either a universal good, nor is it necessarily universally efficient.

Appendix I: eBay Financials 2006¹³

eBay Inc. delivered nearly \$6 billion of revenue in 2006, representing a 31% year-over-year growth rate. Six in '06 was an internal goal we set for ourselves three years ago, and we are extremely pleased by the achievement of this milestone. We also delivered nearly \$2 billion in non-GAAP operating income and closed out the year with \$3.5 billion in cash, even as we repurchased \$1.7 billion worth of eBay shares.

On the payments side, we substantially grew PayPal's on eBay business around the globe and also made huge strides in expanding PayPal's business off eBay. This year, PayPal processed a record \$38 billion in total payment volume, more than doubled its number of available currencies and added close to 37 million accounts. PayPal also extended its global footprint through broad geographic expansion and increased its on eBay penetration rates around the world.

During 2006, we focused on effectively integrating the acquisitions we made in 2005 and also wisely used our capital to acquire new companies, allowing us to strengthen our leadership position in each of our three key businesses in the United States and abroad. We expanded our reach even more broadly. We now have nearly 222 million eBay users, 133 million PayPal accounts and 171 million Skype users.

¹³ Taken from Ebay CEO Meg Whitman's 2006 earnings announcement at <http://seekingalpha.com/article/25034-ebay-q4-2006-earnings-call-transcript>

Appendix II: Linux Adoption in the Public Sector: An Economic Analysis¹⁴

Hal R. Varian and Carl Shapiro

The Linux operating system offers information technology managers in both the private and public sectors an increasingly attractive option as a computing platform to run the powerful computer servers that are at the heart of computer networks, including the Internet itself. Platform software adoption decisions typically have lasting implications for subsequent adoption of *application* software as well as additional platform software itself. The significance of the Linux adoption decision is further magnified, and made more complex, by the fact that Linux is *open source software*, in contrast to *commercial software*. On top of all that, widespread public sector adoption of open source platform software can greatly affect the economic development of a country's entire software industry, a critically important consideration for public-sector decision makers.

We have been studying the economics of computer software markets for some twenty years, and are the authors of a widely-read book on the information economy, *Information Rules: A Strategic Guide to the Network Economy*. Given the complexity and importance of the decision whether to adopt the Linux operating system, we believe that an accessible discussion of the costs and benefits of adopting Linux, rather than a proprietary version of Unix or Windows, rooted in proven economic principles regarding software markets, will be helpful to public-sector decision makers. This paper is our contribution to that discussion. Our principal findings and recommendations are as follows:

- The Linux operating system has achieved a “critical mass” sufficient to assure users that it will be available and improved for years to come, reducing the risk to users and to software developers of making investments associated with Linux.
- The Linux operating system has a number of very attractive features for information technology managers in both the private and public sectors: users adopting Linux are less likely to face “lock-in” than those adopting proprietary platform software, and they retain greater control over their own computing environments. These benefits are especially salient in complex computing environments where large users benefit from the ability to customize their software environment, as often occurs in the public sector.
- Open source software, such as Linux, typically uses open interfaces. Some commercial software uses open interfaces, some uses proprietary interfaces. Open interfaces typically lead to a larger, more robust, and more innovative industry and therefore software with open interfaces should be preferred by public sector officials, as long as it offers comparable quality to proprietary alternatives.
- Because Linux is open source *platform* software, adoption of Linux can help spur the development of a country's software sector, in part by promoting the training of programmers that enables them to develop applications that run on the Linux platform. The adoption of the Linux platform may well promote the economic development of *commercial* software to run in that environment.
- Fears that the licensing terms associated with Linux discourage the development of commercial software are misplaced. The fact that Linux is open source software in no way requires that the development of application software running on Linux follow an open source model. Rather, we expect mixed computing environments – involving open source software and commercial software, that employ both open and proprietary interfaces – to flourish in the years ahead.

While focused on Linux, our discussion necessarily ranges more broadly into the economics of software markets and the differences between the traditional model of development of commercial software and the open source software model used by Linux, Apache, and other popular open source software. Background information on the economics of software markets is provided in the Appendix to this paper; readers seeking to explore these concepts in greater depth are encouraged to look at our book, *Information Rules: A Strategic Guide to the Information Economy* (www.inforules.com).

¹⁴ Taken from <http://people.ischool.berkeley.edu/~hal/Papers/2004/linux-adoption-in-the-public-sector.pdf>

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