



**Principles that Matter:  
Sustaining Software  
Innovation from the Client  
to the Web**

**Marco Iansiti**

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# **Principles that Matter: Sustaining Software Innovation from the Client to the Web<sup>1</sup>**

Marco Iansiti  
David Sarnoff Professor of Business Administration  
Director of Research  
Harvard Business School  
Boston, MA 02163

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## 1. Overview

The information technology industry forms an ecosystem that consists of thousands of companies producing a vast array of interconnected products and services for consumers and businesses. This ecosystem was valued at more than \$3 Trillion in 2008.<sup>2</sup> More so than in any other industry, unique opportunities for new technology products and services stem from the ability of IT businesses to build new offerings in combination with existing technologies. This creates an unusual degree of interdependence among information technology products and services and, as a result, unique opportunities exist to encourage competition and innovation.

In the growing ecosystem of companies that provide software services delivered via the internet - or “cloud computing” - the opportunities and risks are compounded by a significant increase in interdependence between products and services. This means that competition is increasingly driven by platforms - common technologies and capabilities that are shared among members of the ecosystem to enable the creation of new products and services. Firms like Amazon and Facebook which have launched internet platforms to enable the delivery of software services, have not only achieved unprecedented adoption rates, but also erected strong advantages over competitors in a very short period of time. Despite the current popularity of internet software products and services, continued innovation in this sector is not assured. Sustaining innovation will depend on the conduct of those firms that wield the most competitive influence.

Cloud computing is different from traditional software in a variety of ways, as I discuss below. Despite the differences, it is useful to examine the lessons learned from the personal computer (“PC”) and “desktop” software industry. This paper focuses on the importance of certain patterns of behavior, which I describe here as “principles”. These principles were important in the growth of PC software and in the overall health of the information technology ecosystem.<sup>3</sup> The same principles will shape competition in internet software.

Economic analysis often reviews the role of principles - such as respect for intellectual property rights - in driving innovation. Given the interdependent nature of innovation in information technology, three core principles have emerged that work together to ensure that complementary, interconnected products coexist and compete. These core principles are particularly important when applied to platforms, which have played a central role in enabling the development and distribution of the variety of applications and services that drive the popularity of software. The first principle focuses

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<sup>2</sup> Gartner, “Gartner Says Worldwide IT Spending On Pace to Surpass \$3.4 Trillion in 2008” <http://www.gartner.com/it/page.jsp?id=742913>, accessed on November 30, 2008

<sup>3</sup> M. Iansiti and R. Levien, The Keystone Advantage (Harvard Business School Press: 2004).

on enabling *choice*: firms should allow consumers and partners to have a real choice between complementary products and services from otherwise competing firms (e.g., a browser should enable a consumer to choose a home page provided by a competitor). The second principle focuses on *opportunity*: specifically, opportunity that is facilitated by giving developers platform access and the ability to innovate and build on platform technologies to create new products and services. The third principle focuses on *interoperability*: vendors should enable products to work together so customers can realize the full benefit of complementary products offered by competing vendors. Following this principle enables products to connect to each other in appropriately defined ways, and ensures that users can port their data between products securely and reliably.

The principles of choice, opportunity, and interoperability should shape policy, strategy and design decisions for new software products and services. It should be noted that application of the principles is not black and white, as the principles can often create tradeoffs with other important criteria, such as a product's performance, ease of use, or a consumer's overall integrated experience. Still, the principles of choice, opportunity and interoperability should factor in each decision since they have an important impact on protecting competition and driving innovation.

The principles have well established roots in the growth of the PC industry and the success of desktop software. During the 1980s and 1990s, the PC industry succeeded because of its innovative ecosystem, composed of thousands of software, hardware, and services vendors. Innovation in the PC ecosystem stemmed from the availability of platforms with broadly published and used application programming interfaces or "APIs," (see Glossary for definition), tools, and technology building blocks that provided developers with unprecedented opportunity to create new products and services. This resulted in thousands of complementary (and interoperable) products and technologies, which in turn provided a vast selection of software and hardware combinations for consumers and created trillions of dollars of value for investors.

Leading companies observe the principles to varying degrees and in various ways. With respect to the Windows platform, Microsoft's approach was the subject of significant legal and public scrutiny in the past. Microsoft has since gone beyond the terms of the Consent Decree<sup>4</sup> it negotiated with the US government in 2002 by publicly and voluntarily agreeing to adhere to a version of choice, opportunity, and interoperability known as the "Windows Principles" for future versions of the Windows desktop. Microsoft has also announced "Interoperability Principles" that apply to such best-

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<sup>4</sup> United States v. Microsoft, Final Judgment, November 12, 2002, accessed at <http://www.usdoj.gov/atr/cases/f200400/200457.htm>, on November 25, 2008

selling products as Microsoft Office, as well as “Privacy Principles” for its online search advertising offerings.<sup>5</sup>

The current wave of innovation in the technology industry integrates new internet based software applications and new hardware devices (such as smart phones) with traditional desktop computing. Specifically, internet software complements the power of the personal computer by integrating traditional desktop software with applications and services that reside on remote computers accessed over the internet. Driven by consumer demand for ubiquitous access to applications and information, for extensive integration between technologies, and for interoperability between complementary products and services, this market is slated to reach \$100 billion by 2011.<sup>6</sup> Compared to traditional desktop and business software, the confluence of internet and personal computing experiences is developing at an unparalleled pace.

Should companies follow the concepts of choice, opportunity and interoperability in designing browsers and building internet software platforms?<sup>7</sup> Do the principles apply to internet software? If so, can a company follow this framework and create successful, innovative products while also ensuring that a competitive internet software industry is preserved? Already, many companies – Amazon, Apple, Google and Microsoft to name a few - are making substantial investments in internet software. Amazon promotes a flexible, accessible internet software platform for developers and users and also appears to be making a strong effort to implement the choice, opportunity and interoperability principles.<sup>8</sup> Microsoft, criticized for other efforts in the past, seems to be following in the Windows Principles footsteps, particularly with its Windows Azure offerings.<sup>9</sup> And while many of Google’s products support interoperability through common standards, other products - such as Google’s AdWords advertising platform – have a history of limiting data portability and restricting access to

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<sup>5</sup> Microsoft’s Interoperability Principles that govern interoperability for six of its most widely used products, and its Privacy Principles govern its online search and advertising initiatives. <http://www.microsoft.com/interop/principles/default.mspix>, accessed November 3, 2008. <http://www.microsoft.com/issues/essays/2007/09-11OnlinePrivacyPrinciples.mspix>, accessed November 3, 2008.

<sup>6</sup> Kash Rangan et al., “The Cloud Wars: \$100+ billion at stake,” Merrill Lynch, May 7, 2008.

<sup>7</sup> Microsoft, <http://www.microsoft.com/presspass/press/2008/oct08/10-27PDCDay1PR.mspix>, accessed October 28, 2008.

<sup>8</sup> Amazon, <http://aws.amazon.com/ec2/>, accessed 01/21/2009 describes how their EC2 offering is “designed to make web-scale computing easier for developers” and how they “work with our partners and community to provide you with the most choice possible. You [developers] are also empowered to use our bundling tools to upload your own operating systems”. Amazon, <http://aws.amazon.com/s3/>, accessed 01/21/2009 describes how their S3 offering “aims to maximize benefits of scale and to pass those benefits on to developers.”

<sup>9</sup> Microsoft, <http://www.microsoft.com/azure/whatisazure.mspix#Whatis>, accessed 01/21/2009 describes Azure as a “flexible and interoperable platform [that] can be used to build new applications to run from the cloud or enhance existing applications with cloud-based capabilities. Its open architecture gives developers the choice to build... Azure provides an open, standards-based and interoperable environment with support for multiple internet protocols, including HTTP, REST, SOAP, and XML”. PC Magazine, “Windows Azure for IT Pros”, December 8, 2008, at [http://apcmagpro.com/windows\\_azure\\_for\\_it\\_pros.htm](http://apcmagpro.com/windows_azure_for_it_pros.htm), accessed 01/21/2009, quotes Greg Stone, CTO of Microsoft Australia, as saying, “software plus services and our cloud computing push in general is built around interoperability. It’s a critical component” and “With Windows Azure, interoperability has been built in through the adherence to several open standards, through APIs which have been made generally available and are heavily described for developers to get proprietary technologies talking with each other.” On Windows, Azure realizes Microsoft’s cloud vision”, October 31, 2008, <http://www.onwindows.com/Articles/Azure-realises-Microsoft%E2%80%99s-cloud-vision/3054/Default.aspx>, quotes Ray Ozzie, Microsoft’s chief software architect, as saying, “we’re delivering a game-changing set of technologies that bring new opportunities to the global community of developers.”

interfaces.<sup>10</sup> Practices and policies clearly diverge, not only between competitors, but also across a single competitor's different offerings.

This paper argues that choice, opportunity and interoperability principles provide an important perspective with which to understand efforts in internet software, particularly as these efforts continue to develop at an unparalleled pace. This is especially true for platform products with a larger industry footprint, one measure of which is larger share. A rich and diverse internet software ecosystem of firms delivering complementary products and services will generate very significant value, and will positively impact all participants, large and small. The three principles, and their impact on complementary innovation, are therefore not only important to small start-ups, but also for the long term value of the larger competitors.

Let's start our analysis with a review of the history of the desktop software ecosystem, and the importance of these three principles in that ecosystem.

## **2. Competitive Principles and the Personal Computer Ecosystem**

Since the 1960s, the information technology ecosystem has relied on an increasingly large number of firms to provide interdependent and complementary software, hardware, and service offerings. The ecosystem evolved significantly during the 1980s and 1990s, with the advent of the personal computer. The personal computer succeeded in large part by providing unprecedented customer choice in the emergent desktop software category.<sup>11</sup> Leading software providers realized that the best way to create the necessary breadth of applications was to attract as many developers as possible, increase their productivity, and motivate them with significant market opportunities. As a result, companies such as Microsoft, IBM, Borland, and Apple invested in creating developer platforms and tools that enabled the rapid development and deployment of desktop software applications.

Microsoft helped drive the success of the personal computer by creating the most productive PC computing platform - the MS-DOS and Windows desktop operating systems - and by designing a large number of open interfaces, commonly known as APIs, which made it easy for developers to tap into the rich functionality of these two products. Figure 1 displays the growth in APIs for the DOS and Windows operating systems.

Microsoft preserved and encouraged opportunities for independent software vendors or "ISV"s and invested in the creation of popular developer tools such as Visual Basic, Visual C++ and Visual Studio. These tools were adopted by a vast community of developers which created thousands

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<sup>10</sup> Information Week, "Google drops the ball on Data Portability", Jul 1, 2008; accessed at [http://www.informationweek.com/blog/main/archives/2008/07/google\\_drops\\_th.html](http://www.informationweek.com/blog/main/archives/2008/07/google_drops_th.html) on November 20, 2008. In the article, HBS professor Benjamin Edelman is quoted as saying, "this harms competing platforms" by "preventing competitors from feature relevant ads."

<sup>11</sup> Iansiti and Levien, *The Keystone Advantage*, 2004

of popular desktop applications. Microsoft also worked on tools and “driver software” to enable an enormous variety of third-party hardware to plug in and interoperate with Microsoft software.

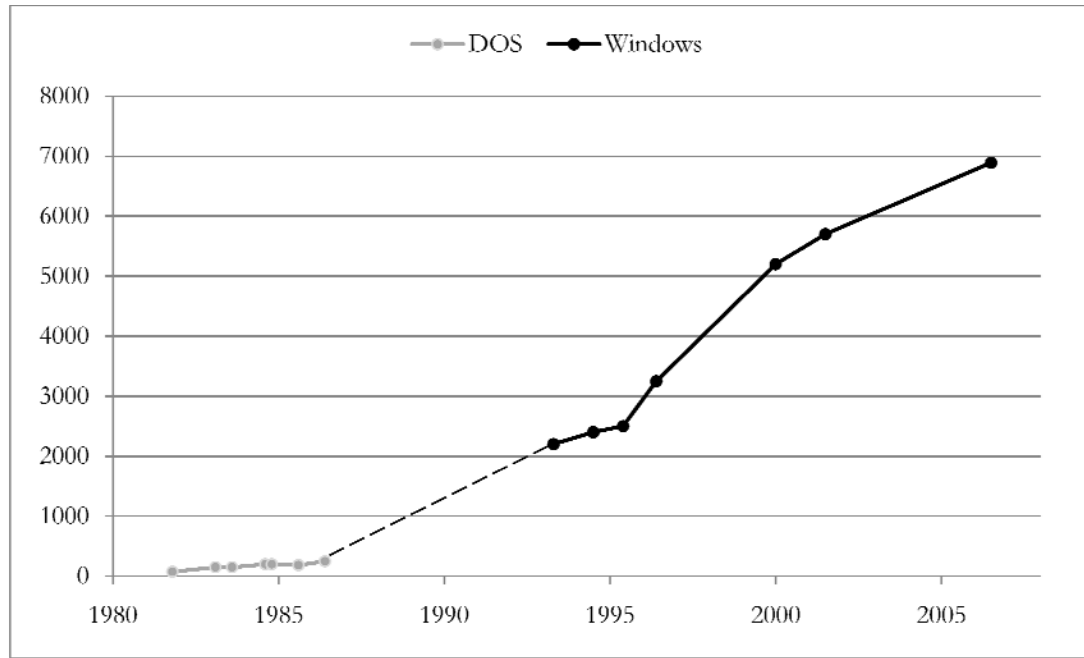


Figure 1: Growth in the number of separate interfaces open to developers in the DOS and Windows operating systems, measured by counts of Application Programming Interface (“APIs”). The dotted line connects two separate data sets.<sup>12</sup>

Microsoft’s strategies worked well. During the 1990s, Microsoft Windows became the platform deployed by the greatest number of software providers (see Figure 2), used by the greatest number of developers (five to six million)<sup>13</sup>, spawning the greatest number of applications (tens of thousands)<sup>14</sup>, and enabling the greatest number of hardware and device configurations (virtually infinite). During the same time period, the information technology ecosystem grew by over two trillion dollars in market capitalization.<sup>15</sup>

<sup>12</sup> Iansiti and Levien, *The Keystone Advantage*, 2004 & Microsoft, “Windows Vista Developer Story”, accessed at <http://www.microsoft.com/downloads/details.aspx?FamilyId=98613054-88E3-4C37-AD8B-B8376E737A3C&displaylang=en>, on December 1, 2008. For DOS and Windows NT3.1, NT4.0, and XP, API numbers for Windows were derived by adding the counts of the “function” and “interface” entries in the Win32API.Csv list of APIs supplied in Microsoft’s Software Development Kit for each full release version of its operating systems. For Windows Vista, the number of APIs was taken from the number of “New” APIs in the list of APIs available at “Microsoft Vista Developer Story”

<sup>13</sup> Craig Mundie, “The Commercial Software Model”, May 3, 2001, accessed at <http://www.microsoft.com/presspass/exec/craig/05-03sharesource.asp> on November 25, 2008

<sup>14</sup> Findings of Fact, *United States of America v. Microsoft*, Civil Action no. 98-1232 (5 November 1999): III.2.1.40

<sup>15</sup> Compustat

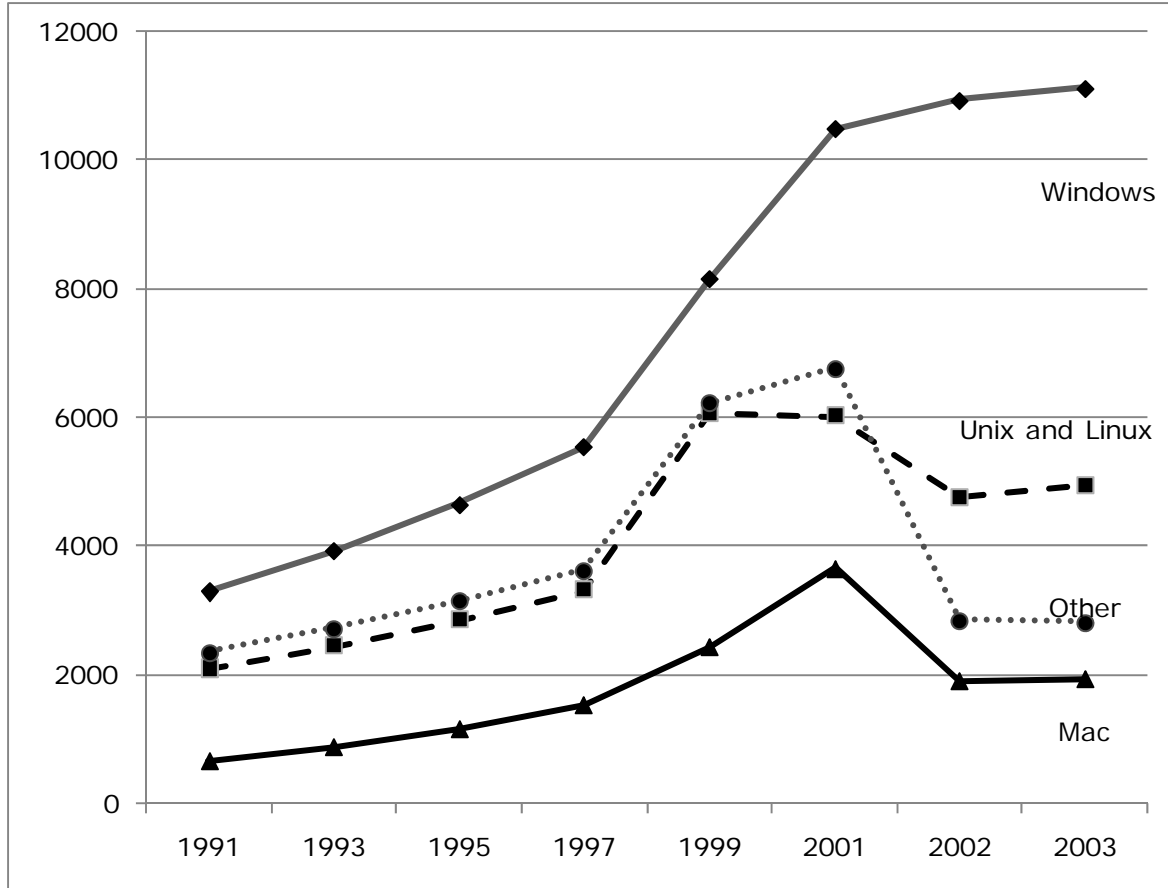


Figure 2: Desktop software providers during the 1990s. The figure shows the number of developer firms that target a given software platform. The top line represents the number of firms that target Windows. (Source: Iansiti and Levien, 2004).

The history of the personal computer ecosystem shows the importance of choice, opportunity and interoperability to technological innovation as disparate firms delivered interdependent products that worked well together and added to each other's value. Clearly, the successes of the 1990s did not happen without setbacks, both for the industry and for Microsoft.<sup>16</sup> The evidence, however, shows that despite instances of behavior that did not follow the principles, the widespread existence of choice, opportunity, and interoperability for developers and consumers enabled the growth of an enormously successful ecosystem. In fact, the Windows business model was and continues to be based on the strength of its ecosystem.<sup>17</sup>

The importance of the principles of choice, opportunity and interoperability to the success of the personal computer ecosystem also has a foundation in academic research. Economics and business

<sup>16</sup> United States v. Microsoft, Final Judgment, November 12, 2002, accessed at <http://www.usdoj.gov/atr/cases/f200400/200457.htm>, on November 25, 2008 and EU Commission Decision of 24.03.2004 relating to a proceeding under Article 82 of the EC Treaty (Case COMP/C-3-37.792 Microsoft), accessed at <http://ec.europa.eu/competition/antitrust/cases/decisions/37792/en.pdf> on November 25, 2008

<sup>17</sup> Iansiti and Levien, *The Keystone Advantage*, 2004



strategy literatures capture how innovation in an interdependent, platform-based setting depends on certain fundamental patterns of behavior<sup>18</sup> and shows how the principles of choice, opportunity and interoperability create a foundation for complementary innovation.<sup>19</sup> In an ecosystem of interconnected products, where innovation depends on the benefits achieved by combining a large variety of complements, these principles preserve the ability to combine and recombine technologies. In essence, the whole can be *much* more valuable than the sum of its isolated parts.<sup>20</sup>

This general paradigm of recombination holds true for the internet software market. Customers benefit greatly by combining new technology with technology they already use (accessing your Facebook page on your mobile phone *and* your computer). At the same time, firms benefit greatly from combining their technology with complementary platform technologies provided by others (you don't have to build your own browser to develop a new internet application). In essence, the principles illuminate three basic requirements for platform-based technological recombination to work well:

1. Firms need to have the opportunity to provide new products that build on common existing platforms (preserve *opportunity* for developers);
2. Customers need the flexibility to choose which product combination is best for their needs (preserve *choice* for customers);
3. Platform products and services should be designed to enable a variety of product combinations to work together reliably and securely (preserve *interoperability*).

These principles are important in an ecosystem where platform products and services are interconnected, an importance that increases significantly when applied to a product that has a significant industry position and wields a major impact on its ecosystem of complements.

The principles are also individually important. A software provider who follows the principle of choice allows customers and distribution partners to choose between different providers of complementary capabilities and services. Following this principle means giving customers and partners access to products, and services from other providers, and the ability to select those other providers' offerings as their primary choice for a complementary capability. By doing this, the software provider commits to a substantial technical investment – to ensure that its product works with features, products, and services from other firms. For instance, Microsoft Windows enables a PC to work with

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<sup>18</sup> Teece, Profiting from technological innovation: Implications for integration, collaboration, licensing and public policy, 1986; Moore, The Death of Competition: Leadership and Strategy in the Age of Business Ecosystems, 1997; Teece, Pisano and Shuen, "Dynamic Capabilities and Strategic Management", *Strategic Management Journal* 18:7, 1997; Gawer and Cusumano, Platform Leadership, 2002; Teece, Essays in Technology Management and Policy 2003; Iansiti and Levien, The Keystone Advantage, 2004

<sup>19</sup> Teece, Essays in Technology Management and Policy 2003

<sup>20</sup> Iansiti and Levien, The Keystone Advantage, 2004

Intuit's Quicken application, even though Microsoft has long offered its own competitive product, Microsoft Money. Choice preserves competition and innovation.<sup>21</sup>

A provider who follows the principle of opportunity designs its platform so that other developers have the opportunity to create complementary goods and services on that platform. Encouraging complementary innovation is central to notions of platform-based innovation, ecosystem competition<sup>22</sup> and "Open Innovation".<sup>23</sup> Some firms go even further and invest in tools and other resources to increase the productivity of developers who create complementary products and services, such as Microsoft's Visual Studio development tools or its MSDN portal for developers.

The principle of interoperability enables connections between different ecosystem participants and is important to both customers and developers. It is also crucial because it enables customers to exchange information securely and reliably with other computers, systems, and applications. Interoperability between two products can be thought of as a continuum, with neither perfect nor no interoperability necessarily being the desired solution.<sup>24</sup> <sup>25</sup> A technology provider who follows the principle of interoperability recognizes that his or her products need to work with and transfer data to and from other complementary (and even competitive) products. For example, to facilitate interoperability, a software provider can ensure that certain interfaces are documented and accessible to complementary providers. Additionally, the software provider can ensure that his or her products allow for customer data portability between complementary products.

Naturally, these three principles are not the only considerations in driving software innovation. Choice, for example, is often balanced by simplicity, as some consumers may prefer to have a narrower range of integrated options, which may optimize ease of use. And it is often the case that a company may decide to simplify the user's experience within a single, highly integrated product, at the expense of the opportunities provided by a more open design that enables a variety of complements provided by other firms. Additionally, interoperability is a vastly complex subject with many shades of grey, many product performance implications, and many ways in which an apparently "interoperable" product can still fail to create a level playing field for developers. But despite their subtlety, and despite the existence and importance of other considerations, choice, opportunity, and interoperability remain important foundations of innovation and competition, as the information technology sector becomes increasingly interconnected.

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<sup>21</sup> Iansiti, *Technology Integration: Making Critical Choices in a Turbulent World*, 1997

<sup>22</sup> Iansiti and Levien, *The Keystone Advantage*, 2004

<sup>23</sup> Chesbrough, *Open Business Models: How to Thrive in the New Innovation Landscape*, 2006

<sup>24</sup> While no interoperability is certainly not desirable, perfect interoperability between two systems is also not desirable since it would imply having two identical systems. The more one designs a product around interoperability, the more one introduces constraints in the design process, and potentially limits innovation or reduces the quality of the consumer experience. The objective, from a design perspective, is to design a product that works well with other products and services, but still maintains its own design integrity.

<sup>25</sup> Moore, *The Death of Competition: Leadership and Strategy in the Age of Business Ecosystems*, 1997

In sum, both history and academic research show the importance of the competitive principles of choice, opportunity, and interoperability in the IT ecosystem. These principles were important during the early history of the personal computer and of desktop software. Because of the high adoption rate and pervasive interdependence of internet software, these principles should remain important in the future.

### **3. The Principles at Work in Internet Software**

In recent years, internet software has attracted billions of dollars in investment from leading technology companies<sup>26</sup> and generated a proliferation of new product and service offerings. The new offerings range across three major categories of internet software: Internet Software Platforms, Internet Applications and Web Browsing Technologies. Each of these software categories offers unique possibilities (and threats) to customers and developers, and all are evolving at an unprecedented pace.

#### ***A. Internet Software Platforms***

Over the last few years, companies have invested billions of dollars in the creation of internet software platforms, creating virtually unprecedented opportunity for software innovation. Internet software platforms consist of tools, technologies, and infrastructure that enable developers to design and deploy internet applications. They include hardware, networking, software and even business tools. For example, Amazon Web Services and Microsoft Windows Azure provide developers with the physical and networking infrastructure to deploy, host, and manage the internet applications they create. Other platform providers such as Facebook and Salesforce.com give developers software and business components to develop, distribute, and sell applications more efficiently.

In recent years, because of the nature of internet software and the opportunities it provides, the economics have changed, and the number of successful software platforms has multiplied. Well-known technology companies (Google, Hewlett Packard, IBM, Microsoft, Salesforce.com, Sun), venture capital-backed start-ups (EngineYard, GoGrid, Heroku), and internet companies with extensive internet infrastructure (Amazon, Facebook) have invested billions of dollars in physical infrastructure, data centers, software, and R&D to make it easier to build, deploy, and maintain internet applications.

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<sup>26</sup> CompuStat Company 10-Ks

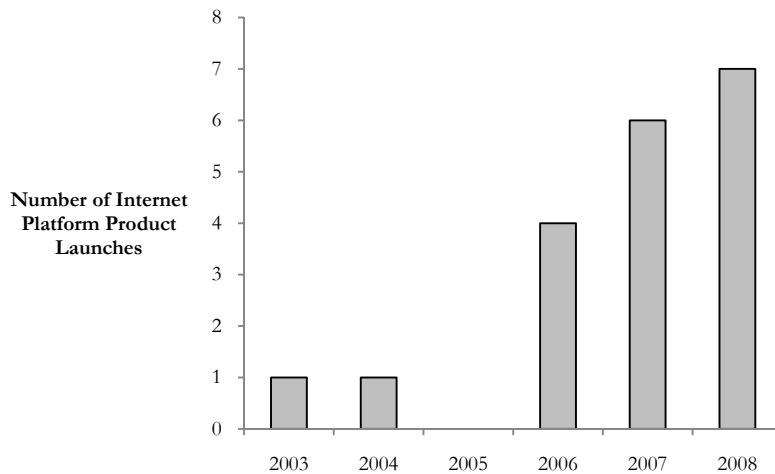


Figure 3: Internet Software Platform Launches, 2003-08<sup>27</sup>

The infrastructure investment to scale an internet platform business to substantial volume is high. A high volume internet platform business requires large capital expenditures to build and maintain the required data centers and technology infrastructure.<sup>28</sup> But while internet platforms are more capital intensive than traditional manufacturing companies, we’ve seen significant growth in the number of internet platform product launches during the past few years (see Figure 3). Part of the opportunity here is that infrastructure heavy internet platforms (such as Amazon AWS and Microsoft Windows Azure) can share access to their own data centers with other, incipient platforms, which dramatically lowers entry barriers for them.

Internet platforms are intrinsically focused on expanding developer opportunity. Internet platform providers shape and pursue explicit strategies to build their business by attracting developers. Amazon’s Elastic Compute Cloud communicates on its web site how it “is designed to make web-scale computing easier for developers.”<sup>29</sup> Facebook promises third-party developers opportunity by telling them, “Developers just like you have built applications on the Facebook Platform that millions of people use every day. Join our developer community and help make the web even more social,” and “Build a business by offering users valuable experiences.”<sup>30</sup> The success of Internet software platforms

<sup>27</sup> Michael Miller, “Cloud Computing: Web-Based Applications That Change the Way You Work and Collaborate Online,” Que, August 21, 2008; Internet Software Platform Vendor List, <http://cloudcomputing.qrimp.com/db.aspx?t=Clouds&pagesize=1000&orderby=1,1>, accessed September 24, 2008; Internet software platform Vendor List 2, <http://www.johnmwillis.com/cloud-computing/cloud-vendors-a-to-z-revised/>, accessed September 24, 2008; Markus Klems, <http://markusklems.wordpress.com/2008/07/10/classification-cloud-computing/>, accessed, September 24, 2008; Keystone analysis.

<sup>28</sup> Compustat for the capital expenditures for Amazon, Google, Microsoft, and Salesforce.com

<sup>29</sup> Amazon, <http://aws.amazon.com/ec2/>, accessed October 26, 2008

<sup>30</sup> Facebook, <http://developers.facebook.com/>, accessed October 26, 2008

from companies such as Amazon, Facebook, Google, and Salesforce is reflected in the large number of developers they have attracted, shown in Figure 4.

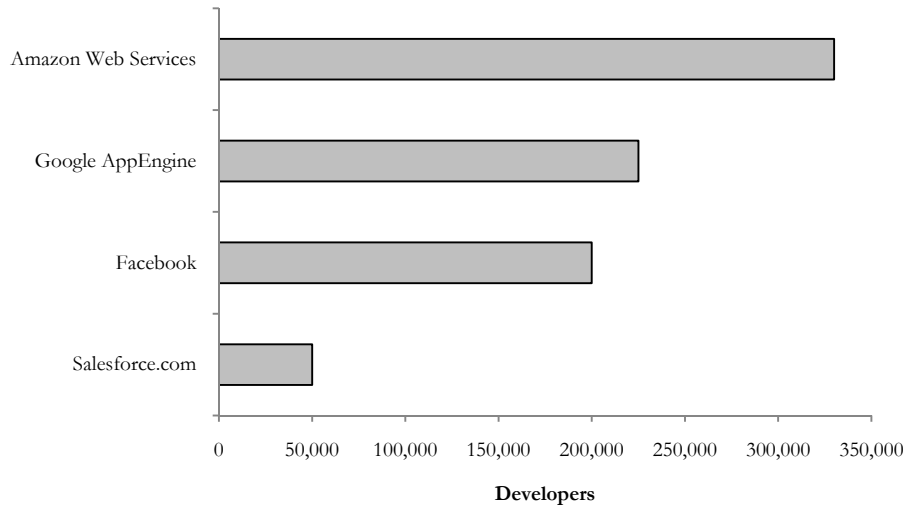


Figure 4: Developers by Internet Software Platform<sup>31</sup>

Internet platforms can create developer opportunity in different ways. Several internet software platforms offer the software tools and technical infrastructure needed to develop and deploy third-party internet applications. Amazon Web Services provides an economical starting point for developers who need infrastructure such as storage, databases, servers, and datacenters with reliable high speed internet connections. Microsoft unveiled a technology preview of its internet software offering, Windows Azure, in late October 2008. Windows Azure provides developers many of the building blocks needed to create and deploy internet applications. It supports “developers in their choice of [development environment], language and technology,”<sup>32</sup> including open source software development using popular programming languages like Java and Ruby.<sup>33</sup> Ray Ozzie, Microsoft’s Chief

<sup>31</sup> Keith Regan, “Amazon Gives Developers a Fixed Spot in the Cloud,” eCommerce Times, March 28, 2008, <http://www.ecommercetimes.com/story/62333.html?wlc=1222359964>, accessed, September 24, 2008; Juan Carlos Perez, “eBay to Open up Merchant Tool to Developers,” PC World, June 16, 2008, [http://www.pcworld.com/businesscenter/article/147109/ebay\\_to\\_open\\_up\\_merchant\\_tool\\_to\\_developers.html](http://www.pcworld.com/businesscenter/article/147109/ebay_to_open_up_merchant_tool_to_developers.html), accessed, September 24, 2008; Mark Hendrickson, “Ruby on Rails Startup Heroku Gets \$3 Million,” TechCrunch February 7, 2008; Adnomics, <http://adonomics.com/>, accessed, September 19, 2008; Sean Ammirati, “Google App Engine Announces Pricing Plan, APIs, Open Access,” ReadWriteWeb, May 27, 2008, [http://www.readwriteweb.com/archives/google\\_app\\_engine\\_announcements.php](http://www.readwriteweb.com/archives/google_app_engine_announcements.php), accessed, September 23, 2008; Salesforce.com, <http://wiki.apexdevnet.com/index.php/Membership>, accessed, September 18, 2008.

<sup>32</sup> Sam Ramji, “Opening Day: Azure Platform Debuts,” Port25, October 27, 2008, <http://port25.technet.com/archive/2008/10/27/the-azure-platform-debuts.aspx>, accessed, October 27, 2008.

<sup>33</sup> Sam Ramji, “Opening Day: Azure Platform Debuts,” Port25, October 27, 2008, <http://port25.technet.com/archive/2008/10/27/the-azure-platform-debuts.aspx>, accessed, October 27, 2008.

Software Architect, has emphasized Azure will allow third-party developers to make several dollars (he estimated between \$7 and \$9) for each dollar Microsoft makes on platform software.<sup>34</sup>

Internet software platforms also provide significant benefits for developers. First, they help developers connect with their customers, helping them gain “eyeballs” while dramatically reducing distribution costs. Facebook’s platform strategy generated considerable public attention when it was announced in the spring of 2007. In the ensuing period between May 2007 and September 2008, the Facebook platform attracted over 200,000 developers who contributed 40,000 applications,<sup>35</sup> which were installed over 700 million times by Facebook’s user base. Facebook thus created a very significant software market, virtually overnight. The most popular third-party application, iLike, gained nearly *400,000 users just a couple of days after launching*.<sup>36</sup>

Second, internet software platforms give developers a mechanism to distribute their applications. For instance, Adobe’s AIR Marketplace and Google’s Solutions Marketplace and AppEngine application gallery, are online marketplaces that allow developers to create and distribute internet applications. Internet software distribution works for both consumers and enterprise customers. Salesforce.com, an internet platform focused on helping developers create and deploy enterprise applications, has accumulated a network of 50,000 developers, who distribute their products through an internet marketplace called AppExchange.<sup>37</sup>

Finally, internet platforms help developers generate revenue quickly, by making it easier for them to use a range of revenue models, such as subscription pricing and advertising-funded software. The advertising-funded revenue model is widely used and generates revenues per user comparable to traditional desktop applications. Because these revenue models are more quickly implemented on internet software platforms, developers generate faster returns on their investments.

There is little doubt that internet software platforms can provide opportunity for developers. The challenge will be to preserve at least some degree of interoperability. Ensuring the portability of data between different platforms will be important, such as sharing contacts information between email and instant messaging across different clients. However, even if the data portability problem is solved, platforms can still limit developer options, and make it difficult for their applications to ] work with multiple platforms. Although it would be unreasonable to demand that different platforms offer identical interfaces, proprietary programming languages and restrictions on which development tools

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<sup>34</sup> Forbes, “Interview: Microsoft sees Windows Azure profitable,” October 27, 2008, [http://www.forbes.com/reuters/feeds/reuters/2008/10/27/2008-10-27T225010Z\\_01\\_N27346373\\_RTRIDST\\_0\\_MICROSOFT-OZZIE-INTERVIEW-UPDATE-1-PIX.html](http://www.forbes.com/reuters/feeds/reuters/2008/10/27/2008-10-27T225010Z_01_N27346373_RTRIDST_0_MICROSOFT-OZZIE-INTERVIEW-UPDATE-1-PIX.html), accessed November 21, 2008.

<sup>35</sup> Adnomics, <http://adnomics.com/>, accessed, September 19, 2008.

<sup>36</sup> Josh Kopelman, “mySpace v. Facebook: It’s Not a Decision. It’s an IQ Test,” TechCrunch, May 27, 2007, [www.techcrunch.com/2007/05/27/myspace-v-facebook-its-not-a-decision-its-an-iq-test/](http://www.techcrunch.com/2007/05/27/myspace-v-facebook-its-not-a-decision-its-an-iq-test/), accessed September, 24, 2008.

<sup>37</sup> Salesforce.com, “Salesforce.com Delivers New Salesforce Platform Edition - Heralding the Arrival of Salesforce.com as both a Platform and an Applications Company,” April 23, 2007, <http://www.salesforce.com/company/news-press/press-releases/2007/04/070424.jsp>, accessed, September 24, 2008.

will work with a platform can pose significant challenges to developers and create lock-in.<sup>38</sup> Commentators have underscored long-term risks as they contrast Google's AppEngine with other platform providers: "Although Google App Engine offers some clear advantages and lowers the barriers to entry for startups and independent developers, the potential for lock-in creates risks that could prove more costly in the long-term. The constraints of the service could make it look considerably less appealing than Amazon's more open-ended EC2 service."<sup>39,40</sup> For cloud platforms to be successful in the long term, it will be important to balance the need for each platform to differentiate, with the broader benefits of interoperability.

The broad range of solutions offered by platform providers to developers also creates additional options for "controlling" developer opportunities, effectively reducing access to market for some developers. The business opportunities generated by platforms may not be available to all developers or all applications in the same way. For example, Salesforce.com exerts control through editorial recommendations. There is no doubt that some editorial control may ultimately improve quality available to consumers – still, the lack of transparency in the editorial process has caused some complaints. Salesforce staff has selected eight applications to be "AppExchange Essentials for Everyone", and four of those eight were written by Salesforce, leaving limited slots available for third-party developers.<sup>41</sup> Similarly, Google has an approval process that restricts which applications are listed in their marketplace.<sup>42</sup>

These examples highlight the fact that competition between the platform providers will be important to continued innovation. The principles of choice, opportunity, and interoperability provide a useful lens with which to examine the competitive efforts of various providers.

### ***Internet Applications***

Internet applications represent the principal way most people experience the power of internet software. These applications use the communications power of the Internet and the processing power of remote computers ("servers") to enable users to communicate with each other, personalize news pages, share pictures with friends, download music, and access data almost anywhere. Familiar

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<sup>38</sup> Neil McAllister, "Cloud Computing on whose terms?", InfoWorld, July 31, 2008, [http://weblog.infoworld.com/fatalexception/archives/2008/07/cloud\\_computing.html?source=NLC-DAILY&cgd=2008-07-31](http://weblog.infoworld.com/fatalexception/archives/2008/07/cloud_computing.html?source=NLC-DAILY&cgd=2008-07-31), accessed October 27, 2008.

<sup>39</sup> Clint Ecker, "Analysis: Google App Engine alluring, will be hard to escape," Ars Technica, April 8, 2008, <http://arstechnica.com/news.ars/post/20080408-analysis-google-app-engine-alluring-will-be-hard-to-escape.html>, accessed November 24, 2008.

<sup>40</sup> Other restrictions are less obvious. For instance, Google's AppEngine development is restricted to a single programming ("scripting") language, Python: Ray Valdes, "Google App Engine Goes Up Against Amazon Web Services," Gartner, April 11, 2008, G00157128, p.2; Kash Rangan et al., "The Cloud Wars: \$100+ billion at stake," Merrill Lynch, May 7, 2008.

<sup>41</sup> Salesforce.com, <https://www.salesforce.com/appexchange/essentials.jsp>, accessed October 26, 2008

<sup>42</sup> Google, [http://www.google.com/support/a/bin/static.py?page=faq\\_marketplace.html](http://www.google.com/support/a/bin/static.py?page=faq_marketplace.html), accessed September 24, 2008.

examples include Internet-based email such as Yahoo Mail, video sharing services such as YouTube, and data synchronization services such as Microsoft's Live Mesh that allow users to access the same data across multiple PCs and other devices. The evolution of internet applications such as Yahoo Mail and YouTube showcase the importance of choice and opportunity in the internet software ecosystem.

A key factor in the rapid growth and evolution of internet applications is the unique distribution advantages offered by the internet. Internet distribution has emerged as a viable and more cost-effective alternative to conventional software distribution channels such as retailers and original equipment manufacturers. By dramatically lowering software distribution costs, choice and competition has flourished. Customers no longer just use the software applications pre-installed on their PC or those available at the local retailer, but choose from the vast range of products that they can easily download online.<sup>43</sup> With this transformation in software distribution possibilities, internet applications have proliferated. Indeed, virtually every business and consumer category of software now features internet-based software alternatives, from established categories such as office productivity applications to new computing experiences not previously possible in PC software, such as social networking and video sharing. Table 1 looks at popular client and internet based applications across a variety of software categories based on IDC's software taxonomy.

The use of these applications has grown rapidly. This year, YouTube had over 300 MM unique visitors, who viewed over four billion online videos during the month of March 2008 alone.<sup>44</sup> mySpace has over 100MM users<sup>45</sup>, competing against Facebook, which has more than 110MM active users.<sup>46</sup> Over a period of less than a year, users installed new Facebook applications over *700 million* times.<sup>47</sup> A deeper look suggests that internet applications comprise a large portion of overall internet usage. An examination of the top one hundred Internet properties most visited by US internet users shows that internet applications account for more than one-third of the time US internet users spend on top websites.<sup>48</sup> Internet applications form a very large and important industry.<sup>49</sup>

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<sup>43</sup> Electronic software distribution has given consumers direct access to downloading applications online and has transformed competition. For example, C|Net's Download.com aggregates over 60,000 software applications online, and reports 2.5 million software downloads per day worldwide, far exceeding the approximately 175,000 units sold in the US retail channel according to market research firm, the NPD Group. Recently, Google has also effectively used ESD – according to some sources, Google's Chrome web browser captured 1% market share in a single day To date, there have been over 850 million Firefox downloads, and Mozilla recently set a new Guinness Book of World Record with over eight million downloads within twenty-four hours of the launch of Firefox 3.0. See "Mozilla Sets New Guinness World Record with Firefox 3 Downloads" Mozilla Press Release (Mountain View, Ca, 2 July 2008), <http://www.mozilla.com/en-US/press/mozilla-2008-07-02.html>, accessed 12 April 2009..

<sup>44</sup> Forbes, "GoTube", June 16, 2008, at <http://www.forbes.com/forbes/2008/0616/050.html>, accessed October 26, 2008

<sup>45</sup> News Corporation Earning Call Transcript, 2006, as reported on <http://seekingalpha.com/article/15237-rupert-murdoch-comments-on-fox-interactive-s-growth>, accessed October 26, 2008

<sup>46</sup> Facebook, <http://www.facebook.com/press/info.php?statistics>, accessed October 26, 2008

<sup>47</sup> New Media Review, <http://www.etcnewmedia.com/review/default.asp?SectionID=10&CountryID=93>, accessed November 4, 2008

<sup>48</sup> In our analysis, we categorized each of MediaMetrix's top one hundred websites as an internet application or a content/commerce site. The total minutes of use of these two categories of internet sites was then compared. This underestimates the fraction of application usage since many content and commerce sites had application-like functionality on many pages. MediaMetrix, Key Measures Report, September 2007.

<sup>49</sup> Pew Center for Internet Research, "Use of Cloud Computing Applications and Services", September 2008, accessed at [http://www.pewinternet.org/pdfs/PIP\\_Cloud.Memo.pdf](http://www.pewinternet.org/pdfs/PIP_Cloud.Memo.pdf)



Table 1: Client-Based and Internet-Based Applications by Software Category<sup>50</sup>

SOFTWARE CATEGORY	CLIENT-BASED APPLICATIONS	INTERNET-BASED APPLICATIONS
Home Education and Reference	<u>Reference</u> : Merriam-Webster, Microsoft Encarta <u>Mapping</u> : Microsoft Streets & Trips <u>Languages</u> : Instant Immersion Translator Deluxe, Rosetta Stone	<u>Reference</u> : Dictionary.com, Encyclopedia Britannica Online, Merriam-Webster Online, Wikipedia <u>Mapping</u> : Google Maps, Mapquest.com, Microsoft Live Search Maps, Yahoo! Maps <u>Languages</u> : Google Translate, Microsoft Windows Live Translator, mylanguageexchange.com
Games and Entertainment	Rockstar Games Grand Theft Auto Electronic Arts Sims	Lord of the Rings Online Final Fantasy XI Star Wars Galaxies World of Warcraft
Personal Finance and Tax	Intuit TurboTax, Quicken Microsoft Money	Expensr Mint.com TurboTax Online Quicken Online
Social Networking	N/A	Facebook MySpace Microsoft Live Spaces Friendster LinkedIn Twitter
Collaborative Applications (e.g., Email, Messaging, Conferencing)	IBM Lotus Microsoft Outlook Mozilla Thunderbird WebEx	AOL Email Google Calendar Google Gmail Microsoft Exchange Online MSN Calendar Windows Live Hotmail Yahoo! Mail Yahoo! Calendar Zimbra
Content Applications (Authoring Software, Content Management)	Adobe Acrobat Microsoft Office Open Office	Adobe Buzzword Google Docs ThinkFree Zoho
Enterprise Resource Management (ERP)	<u>Financials</u> : Oracle, SAP, Sage <u>Human Capital Management</u> : Oracle Peoplesoft	<u>Financials</u> : NetSuite <u>Human Capital Management</u> : Taleo, SuccessFactors, Workday
Supply Chain Management (SCM)	i2 Oracle Microsoft SAP	E2Open Elemica Procuri
Customer Relationship Management (CRM)	Amdocs Oracle/Siebel SAP	Microsoft CRM Online Salesforce.com
Storage	EMC Network Appliance Symantec	Amazon Simple Storage Service JungleDisk Live Drive Mozy

<sup>50</sup> Keystone analysis

Choice and interoperability can make an important difference in internet applications. Windows Live provides an example. Windows Live is a suite of applications that includes Messenger (instant messaging), Hotmail (email), Spaces (social networking), Toolbar (internet search tool) and Mesh (internet-based data synchronization). Microsoft supports consumer choice in various ways, including the manner in which the Windows Live product suite is distributed. Windows customers can choose between Windows Live as well as a variety of internet software applications that compete with Windows Live, which fuels diversity in the ecosystem.<sup>51</sup> Interoperability is also important. Windows Live Messenger, for example, is already interoperable with other instant messaging software such as Yahoo Messenger<sup>52,53</sup>, and third-party reports comment that interoperability with other instant messaging clients may be coming in the future.<sup>54</sup>

Yahoo's My Yahoo provides another example. The application allows users to collect their preferred content and applications onto a single web page. On a single My Yahoo! page, a user can access Yahoo Mail, Google Gmail, a mail account from a third-party provider using the POP mail protocol, and Facebook. Being able to add and simultaneously access email on My Yahoo! from providers who compete with Yahoo's own email product fosters consumer choice. Yahoo does not force My Yahoo! users to select Yahoo! mail as the default. Each email provider has to compete to be added to users' My Yahoo! pages.

Media applications provide additional examples. Over its history, the media industry has fostered the development of many successful mass-market formats and networking technologies, developed in accordance with the principles of choice, opportunity and interoperability. Examples include LP records, compact disks, DVDs, USB standards, Bluetooth, and Wifi— each enabling a breadth of choice for consumers and interoperability across a variety of applications and devices.

For several years, Internet distribution, with Apple as the already clear market leader, has been poised to displace many of the more traditional forms of music and video distribution. However,

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<sup>51</sup> In addition to preserving access to a broad selection of competitive internet applications, Windows Live also gives its users choice in how they sign in to the service and store their personal information. As announced <http://dev.live.com/blogs/devlive/archive/2008/10/27/421.aspx> and reported [http://www.readwriteweb.com/archives/microsoft\\_windows\\_live\\_openid.php](http://www.readwriteweb.com/archives/microsoft_windows_live_openid.php), in October 2008, Microsoft announced Windows Live will support OpenID by enabling users of Microsoft's own log-in service, Windows Live ID, to sign-into any web site that allows users to sign in with an OpenID log-in. OpenID is a free, open source, and standards-based technology<sup>51</sup> that allows users to maintain a single log-in name and password across multiple websites (c.f. <http://openid.net/what/>). A few days after Microsoft's announcement, Google followed suit by announcing its own support for OpenID. (c.f. [http://www.readwriteweb.com/archives/google\\_is\\_now\\_an\\_openid\\_provider.php](http://www.readwriteweb.com/archives/google_is_now_an_openid_provider.php)) For internet application users, Microsoft and Google's support for OpenID is a positive sign as their actions promise customers greater choice and interoperability in the internet applications and technologies available to them. They can use Microsoft's or Google's services with any combination of internet applications that accept OpenID without the hassle of maintaining and remembering multiple log-ins and passwords.

<sup>52</sup> Marshall Kirkpatrick, "IM Interoperability: not just a dream anymore," Techcrunch, July 12, 2006, <http://www.techcrunch.com/2006/07/12/windows-live-yahoo-im-interoperability-begins-public-tests-today/>, accessed October 16, 2008.

<sup>53</sup> Microsoft, <http://www.microsoft.com/presspass/press/2006/jul06/07-12IMInteropPR.msp>, accessed October 16, 2008

<sup>54</sup> Marius Oiaga, "Windows Live Messenger 9.0," Softpedia, November 1, 2007, <http://news.softpedia.com/news/Windows-Live-Messenger-9-0-69708.shtml>, & Sean Aune, "Google Talk and Windows Live Messenger 9 Get Friendly", <http://mashable.com/2007/12/23/google-talk-and-windows-live-messenger-9-get-friendly/>, & <http://www.liveside.net/main/archive/2007/10/31/messenger-9-gtalk-integration-messenger-api-new-client-for-mac-os-x-news-unveiled-at-georgia-tech-presentation-whew.aspx>, accessed October 16, 2008.

when we compare the success of internet distribution to the ubiquity of CDs and DVDs, it is clear that the potential of internet applications for music distribution and playback still remains largely unfulfilled. This is at least partly due to the lack of interoperability, which limits user adoption as well as opportunity for third party developers and content providers.

The success of internet applications will not sustain itself without implicit or explicit acceptance of the competitive principles noted above. The principle of choice drives innovation and competition in internet applications, as it allows customers to select between competing application providers, and not be forced to adopt one over the other by a particularly powerful industry player (or vertically integrated platform provider). The principle of opportunity facilitates that choice by allowing developers to create applications for a wide range of platforms. This preserves competition and drives innovation. The principle of interoperability enables customers to exchange data between different applications, and not be trapped into the services of one dominant provider.

### ***B. Web Browsers and Browser Plug-in Technology***

Internet applications reach end users through web browser technology and are usually displayed inside a browser window. Web browsers evolved considerably since the 1990's when they started out as simple programs that displayed the text of very basic web sites. Browser business models have evolved as well. Browsers have become a critical means of distributing ad funded search (and in some cases other technologies or services), which has become a major portion of the revenue for some of them (e.g. Firefox).

Browsers are increasingly fast and reliable, and browser improvements are enabling new experiences with internet applications.<sup>55</sup> Both Mozilla's Firefox 3 and Microsoft's Internet Explorer 8 have made changes that improve the speed of applications that run on them.<sup>56</sup> Additionally, the

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<sup>55</sup> For example, Internet Explorer 8 uses AJAX web technologies (which Microsoft supported since their early days) to support partial page refreshes, reducing bandwidth usage. Other Internet Applications like Gmail, Google Maps and Flickr use AJAX (Note: New toolkits for developers of website technologies have also become available. There are proprietary packages from Backbase, JackBe, and Tibco and open source packages from Dojo, Microsoft, Google, Atlas, Rico, Yahoo, and Zimbra. Tony Patton, "AJAX and the Microsoft approach," Builder AU, May 10, 2005, <http://www.builderau.com.au/program/ajax/soa/AJAX-and-the-Microsoft-approach/0,339028327,339212304,00.htm>, accessed, September 24, 2008.) to increase efficiency through faster navigation, reduced network latency, and parallel downloads (see IE7 Ajax support documentation at <http://www.microsoft.com/windows/products/winfamily/ie/features.aspx>; IE8 support documentation at <http://www.microsoft.com/windows/internet-explorer/beta/readiness/developers-new.aspx#ajax>). Other browser advancements enable more efficient use of resources. The Google Gears browser extension allows Internet applications to schedule resource-intensive tasks for when the user is not actively using the application (see Google, <http://code.google.com/apis/gears/>, accessed, September 24, 2008). Firefox also enables more efficient execution through support of JavaScript 1.8

<sup>56</sup> Mozilla, <http://www.mozilla.com/en-US/firefox/features/>, accessed, September 24, 2008, Mozilla, [http://developer.mozilla.org/en/Firefox\\_3\\_for\\_developers](http://developer.mozilla.org/en/Firefox_3_for_developers), accessed September 24, 2008, Microsoft, <http://www.microsoft.com/windows/internet-explorer/beta/features/overview.aspx>, accessed, September 24, 2008, and Microsoft, <http://www.microsoft.com/windows/internet-explorer/beta/readiness/developers-new.aspx>, accessed, September 24, 2008.

browser's own speed is also increasing.<sup>57</sup> A ZDNet writer's comparison of Internet Explorer 7 and Internet Explorer 8 indicates a performance improvement totaling almost a factor of three. The browser is also increasingly extensible. Many recent innovations are captured in "browser extensions" or "plug-ins" that can be provided by third parties and downloaded separately.

Browsing technologies affect choice, opportunity and interoperability. Browsers and browser extensions can influence the choices between complementary products and services available to consumers. Furthermore, their platform-like qualities can significantly impact developer opportunity by making it easier for them to develop applications, including client applications that take some advantage of cloud computing services as well as internet software applications that take greater advantage of the PC's computing resources.

Browsers and their plug-ins provide opportunity for developers. All popular browsers allow developers to create plug-ins that extend the browsers' capabilities and enable internet applications to run, look, and behave the same on virtually any web browser or PC operating system. Three prominent examples are Adobe's Flash player, Microsoft's Silverlight, and Sun's Java. These extensions have extremely wide reach and availability – Adobe claims that over 750 million PCs and mobile devices worldwide have the Flash player installed<sup>58</sup> and that it has achieved a 99.1% penetration of internet-enabled PCs.<sup>59</sup> Silverlight's system requirements page notes Silverlight is available not only for the Internet Explorer, Firefox, and Safari web browsers, but also for the Windows, MacOS, and Linux operating systems (the last through a collaboration with Novell).<sup>60</sup> Finally, Sun Microsystems notes that 91% of internet-connected PCs have Java extensions.<sup>61</sup> Browsers further preserve developer opportunity by enabling competing extensions, such as Flash and Microsoft Silverlight, to work side by side, which leaves it up to the internet application developer to choose which browser extension he or she wants to use to power the software. The end user, meanwhile, benefits by having the choice of a rich set of different innovative internet applications that use the diverse set of powerful browser extensions available today.

Moreover, browsers preserve choice for both end consumers and partners. The main way is by providing easy access to web sites and web applications worldwide. For example, Internet Explorer supports consumer choice by making it easy for users to reach a virtually infinite number of websites,

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<sup>57</sup> Internet Explorer 8's new script engine minimizes load times for web pages based on JavaScript or AJAX – two of the most commonly used technologies for Internet applications. Google's Chrome web browser comes with V8, a more powerful JavaScript engine "designed to run larger Java applications." These innovations are the latest in a trend to better Java performance in browsers.

<sup>58</sup> Adobe Systems Incorporated, <http://www.adobe.com/products/flashplayer>, accessed May 31, 2007.

<sup>59</sup> Adobe Systems Incorporated, [http://www.adobe.com/products/player\\_census/shockwaveplayer/](http://www.adobe.com/products/player_census/shockwaveplayer/), accessed October 25, 2007.

<sup>60</sup> Microsoft, <http://www.microsoft.com/silverlight/resources/install.aspx#sysreq>, accessed January 6, 2009.

<sup>61</sup> Sun Microsystems Incorporated, <http://www.sun.com/java>, accessed May 31, 2007.

many of which compete with Microsoft's own properties, or to find and select any desired home page.<sup>62</sup>

Finally, the principle of interoperability has long been essential to browser design. HTML, the language used to structure much of the information in a web page, is published by the Internet Engineering Task Force and the World Wide Web Consortium, and has been central to browser design for many years. The whole idea of a browser is to be able to interpret a vast diversity of web pages. As a result, browsers have long been designed to common standards.

Today, standards and interoperability remain a core part of the design of web browsers. Reviews generally agree<sup>63</sup> that Internet Explorer 8 is highly compliant with open internet standards. The importance of interoperability was underscored when Google's Chrome web browser launched without support for many popular browser extensions,<sup>64</sup> also denying many third-party developers the opportunity to innovate on top of the Chrome browser. While these interoperability concerns may be resolved in later releases, it's important to note that the development cycles of leading firms can often result in a lack of interoperability with new standards that do not make it into current release cycles.

Going forward, key engineers and CTOs from Internet Explorer, Firefox, and Chrome have all publicly supported "continued development of web standards."<sup>65</sup> This can be seen in the example of AJAX, a set of web technologies used for creating Internet applications. As AJAX gained in popularity with large and small application developers<sup>66</sup> and development tool providers,<sup>67</sup> leading technology providers formed the OpenAjax Alliance so that "Ajax fulfills its potential as the industry standard."<sup>68</sup> The Alliance is made up of over 100 technology providers, including browser providers Microsoft, Mozilla, and Google, each "dedicated to successful adoption of open and interoperable Ajax-based web technologies."<sup>69</sup>

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<sup>62</sup> Mozilla, <https://addons.mozilla.org/en-US/firefox/browse/type:4/cat:all?sort=name>, accessed October 27, 2008

<sup>63</sup> Peter Bright, "IE8 Beta 2 shows Microsoft is serious about playing catch-up," *Ars Technica*, August 28, 2008, <http://arstechnica.com/news.ars/post/20080828-ie8-beta-2-shows-microsoft-is-serious-about-playing-catch-up.html>, accessed, September 24, 2008. Ray Valdes and David Mitchell Smith, "Microsoft Chooses Standards Future with Internet Explorer 8," *Gartner*, March 12, 2008, G00156175.

<sup>64</sup> CNet News, "Google Chrome extensions: Not yet, but later", September 3, 2008; accessed at [http://news.cnet.com/8301-1001\\_3-10031764-92.html](http://news.cnet.com/8301-1001_3-10031764-92.html) on Nov 20, 2008

<sup>65</sup> Information Week, "Web 2.0: Google Chrome to Support Add-ons", September 19, 2008, accessed at <http://www.informationweek.com/news/internet/google/showArticle.ihtml?articleID=210602700> October 28, 2008

<sup>66</sup> ZDNet, "Ajax Spurs Web rebirth for Desktop Apps", Dec 1, 2005, accessed [http://news.zdnet.com/2100-9593\\_22-145838.html](http://news.zdnet.com/2100-9593_22-145838.html) October 28, 2008

<sup>67</sup> ZDNet, "Ajax sets off tool race", Jan 26, 2006, accessed [http://news.zdnet.com/2100-3513\\_22-146504.html](http://news.zdnet.com/2100-3513_22-146504.html) October 28, 2008

<sup>68</sup> Open Ajax Alliance, <http://www.openajax.org/overview.php>, accessed October 28, 2008

<sup>69</sup> Open Ajax Alliance, <http://www.openajax.org/index.php>, accessed October 28, 2008

#### 4. Conclusion

This paper examines the increasing importance of the competitive principles of choice, opportunity and interoperability as the information technology ecosystem fully embraces the internet. These principles, grounded in the fields of economics and business strategy, were important in the success of personal computer and desktop software and will continue to be important in the future.

Much has changed since the early days of personal computer software. The explosion of the internet as a distribution medium has dramatically reduced software distribution costs and expanded opportunities for software developers. These same developers can now also employ a variety of powerful platforms, hardware and infrastructure to create and deliver a new generation of applications, powered by remote computers on the internet and available anywhere, on a broad variety of hardware devices. The number of innovative applications has skyrocketed, and the choices available to customers have increased.

Born out of the necessities of an ecosystem of complementary, interdependent products and services, the competitive principles of choice, opportunity and interoperability are important in internet software, because of the increased variety of possible software and hardware combinations and the increased interdependency in the applications and services they deliver. Despite the current strength and promise of the internet software market, the future pace of growth and innovation is not assured. As software companies compete for continued growth and profitability, some may emphasize short term over long term interests. Some may limit consumer access to competitive applications. Others will foreclose developers from designing products that compete with their own products. Others still may trap consumers onto their applications by locking in their data. As the paper discussed, internet services providers have already attempted each of these behaviors.

Given the unprecedented speed at which the internet software industry is developing, the window of opportunity for public awareness and action is short. As we look forward, it will be important for consumers and the industry to watch carefully as different companies compete. The principles of choice, opportunity and interoperability should serve as an important lens, particularly when focused on companies with especially large footprints in the new markets. Perhaps most importantly, successful technology companies should not forget that innovation and growth in the technology sector is dependent on promoting a thriving ecosystem of complementary and interdependent products.

## 5. Appendix A: Glossary

Term	Definition
Adobe Integrated Runtime (AIR)	Adobe Integrated Runtime is a software technology that allows developers to create internet applications that resemble traditional desktop applications without needing the web browser
AJAX	AJAX stands for Asynchronous JavaScript and XML. It is a set of web development technologies that facilitates the improved production, management and hosting of interactive digital content, allowing developers to create internet applications that mimic the “look and feel” of traditional client applications
API	API stands for Application Programming Interface. The API is a convention that an application uses to interact with the operating system or control program.
ASP.NET	Framework created by Microsoft for developers to create web applications, services and websites.
Traditional Client Applications	Applications that install onto an individual laptop or desktop computer, as opposed to a web client (a.k.a. thin client) and which runs on a remote computer (server).
CRM	Customer Relationship Management is an information system designed to capture customer activity within an organization, including call centers, marketing, field activity and sales data.
CSS	Cascading Style Sheets is a language that describes the presentation of a document written in a markup language, such as HTML, that can be applied to any kind of XML document.
EC2	Elastic Compute Cloud is an Amazon.com web service that provides remote computational capacity.
ERP	Enterprise Resource Planning is an integrated information system that captures data across an enterprise and may include software for manufacturing, order entry, accounting, purchasing, warehousing or human resources.
ESD	Electronic Software Distribution is the distribution of new software and upgrades over the internet or a network as opposed to individual installations or via physical media from traditional retail distributors.
FBML	FaceBook Markup Language is a language that is specifically designed for Facebook application development to create a specific look and feel and to make it easy for Facebook's servers to read and publish an application.
Firefox	A browser from the Mozilla Foundation for Windows, Mac and Linux.
Gears	Gears is a software technology that can add additional features to a web browser, including the ability to use Internet-based applications offline.
Google's AppEngine	AppEngine is a cloud computing platform for creating, storing and delivering web applications on Google's infrastructure.
Google's BigTable	Google distributed database system provided as part of AppEngine and used by a number of Google applications, such as the company's web-based email service, Gmail.
Google's Chrome	Google's web browser first released in 2008.
HTML	HyperText Markup Language is the main language for website creation
HTTP	HyperText Transfer Protocol is the communications protocol that connects Web servers to the Internet or a local network in order to send HTML pages back to a user's browser; it may also be used to download files from a server to a browser or another application
IaaS	Interface as a Service is a type of cloud computing service. IaaS vendors seek to solve the hardware, distributed computing, and scalability challenges of deploying Internet applications by offering robust compute, database and storage services through simple application programming interfaces (APIs). These services are offered as a utility model, with built-in metering and service level agreements intended to improve the deployment economics for Internet application developers
IDE	Integrated Development Environment is set of programs sharing a consistent user interface for software development; it may include a text editor, compiler and debugger which are all run from a common menu.
ISV	Independent Software Vendors are companies that make and sell software
Java	Java is a commonly used programming language for the development of web applications

<b>Term</b>	<b>Definition</b>
JavaScript	JavaScript is a high-level scripting language mainly used for client-side web development and is widely supported by web browsers and web tools.
Mash-up	Web application hybrid that combines data from multiple sources into a single, new application.
OEM	Original Equipment Manufacturer, a PC maker such as Dell, HP, Lenovo, or Acer
OS	Operating System is a computer's main control software, e.g. Apple OS, Linux, and Windows.
PaaS	Platform as a Service is a type of cloud computing service. PaaS products and services provide developers an environment to develop and run Internet applications. They include a set of building blocks designed to reduce the time and effort to create an Internet applications
Perl	Practical Extraction Report Language is a programming language that can be used to write web server programs in order to automatically update user accounts or newsgroup postings, process removal requests, synchronize databases and generate reports
PHP	PHP Hypertext Preprocessor is a scripting language that is employed to create dynamic Web pages and commonly used to extract data from a database to be presented on a web page
Platform	A set of solutions that helps third parties build or run applications (e.g.; a cloud platform specifically facilitates the deployment of applications without the cost and complexity of buying and managing the underlying hardware and software layers)
RSS	Real Simple Syndications are web feed formats used to publish frequently updated reports such as blogs, news headlines, audio and video files into a standardized format
Ruby	An object oriented programming language similar to Perl in syntax
S3	Simple Storage Service is Amazon.com's unlimited storage solution for web hosting, image hosting and a back-up system to provide scalability for developers and companies
SaaS	Software as a Service is a type of cloud computing service. Software as a Service consists of Internet-based applications typically hosted in a centralized data center and consumed through a web browser
Silverlight	Microsoft Silverlight is a programmable web browser plug-in that enables features such as animation, vector graphics and audio-video playback that characterize rich Internet applications. Version 2.0, released October 2008 is compatible with multiple web browser products used on Microsoft Windows and Mac OS X operating systems
SCM	Supply Chain Management is an information system that tracks data to improve planning, implementing and controlling the supply chain
SQL	Structured Query Language is a programming language used for finding, modifying, extracting or processing data in a relational database
Windows Azure	Microsoft's Windows Azure is an internet platform or cloud services operating system that serves as the development, service hosting and service management environment for the Azure Services Platform. Windows Azure provides developers with on-demand compute and storage to host, scale, and manage Web applications on the Internet through Microsoft data centers.
Windows Live Mesh	Windows cloud platform that allows a user to synchronize and utilize applications across multiple devices including PCs, mobile phones and other internet-enabled devices