

Open architectural competition strategy: Google's approach to innovation through standardization

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Abstract. The realization and diffusion of web applications is the result of the HTML5 standard. Google succeeded in making HTML5 the W3C standard by attracting end users and other browser vendors. Google had utilized open technology developed by other stakeholders, and outside activities for the purpose of realizing and diffusing web application innovation. They supported collaborative development activities and promoted the benefits of functions provided by the specification solely with the development of add-on software. They succeeded in diffusing a runtime environment for web applications by contributing to an open standard. Key success factors of innovation through standardization are 1) utilizing any technologies developed by any party, 2) attracting customers from the multi-sided market fast and 3) adopting an implementation-oriented process of standardization.

Keywords: innovation through standardization, implementation-oriented policy, platform, voluntary standards development organization, HTML5

1. Introduction

Software ecosystems consist of various kinds of software based services. Distributed sensors, devices and applications share vast amount of data to work together over the Internet. The Internet and the World Wide Web has been developed and maintained under the principle of open and distributed.

Self-driving cars, smart cities, the Internet of Things – most of modern technological trends are designed on the premise that everything share data over the Internet and work together. Therefore, it is necessary to realize interoperability to add new functions to ecosystems. Any innovation must be realized as new standardized specifications. However, they also face the challenges that arise from the fact that standardization tends to prevent innovation [1][2].

There is a few cases that have overcome the dilemma; difficulty to satisfy both of interoperability and innovation. Web applications are web services such as spreadsheets that run on servers instead of client hardware (**Fig. 1**). Web applications

work only when all components operate together according to common specifications named as HTML5.

HTML is an acronym for “Hyper Text Markup Language”; fundamentally, this means that HTML is a mere language for composing documents hyperlinked to other documents. Upgrading to “HTML5” means converting the material of stable documents into a runtime environment for applications. HTML5 is one of the most important specifications for web applications that are used to realize interoperability among web browsers. Web applications are a typical example of innovation through standardization.

In the case of web applications, web browsers assume the OS role of acting as an architecture platform. Performance of web browsers restrict web applications. Moreover, the functions of browsers are determined by the application programming interface (API) specifications of the web standard. This was necessary to ensure browser compatibility with more standardized APIs, thus making it possible to diffuse and improve upon web applications.

The standardization of HTML5 was conducted by corporations among vendors of web browsers, such as Microsoft, Google, Mozilla, Opera and Apple. However, they had conflicting business interests (Fig. 2). A typical web application is the spreadsheet. Google launched their version of the spreadsheet in 2006. Anyone with a Gmail address can use it without charge; thus, this popular service has increased the number of Google accounts and given Google access to more personal information. On the other hand, Microsoft has earned vast profits from sales of Microsoft Excel, a native application of the spreadsheet. Google’s spreadsheet competes against Microsoft Excel. The development of HTML5 and the diffusion of the web application was not welcomed by Microsoft. The innovation and introduction of this web application represented an architectural competition [3] between Microsoft, with its native application-based business model, and Google, with its web application-based business model.

We have depicted the hypothesis of an interpretive case study where “web applications” are realized with the HTML5 web standard. The web application is an emerging case of innovation through standardization. Its success was realized by coordinating stakeholders with conflicting interests. In other words, the web application is a result of architectural innovation [4] based on open collaboration [5]. This study intends to identify the key success factors for innovation through standardization.

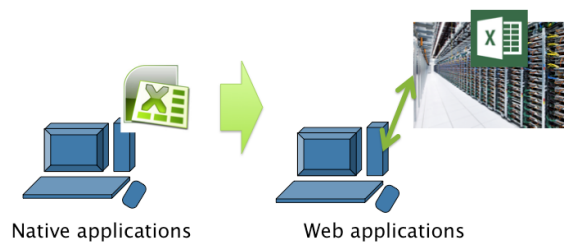


Fig. 1. Dominant design transfer from native applications to web application

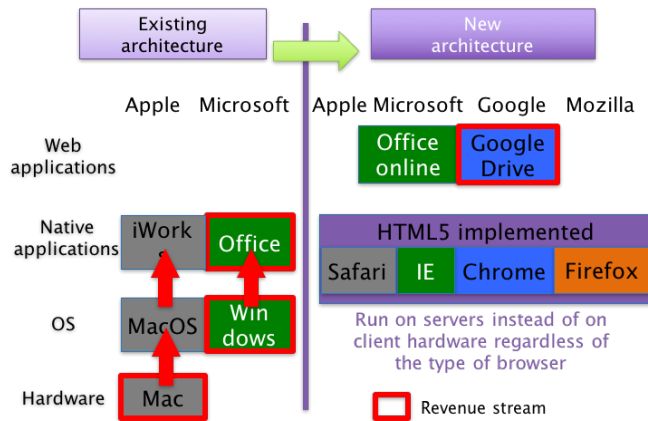


Fig. 2 Architectural competition between existing and emerging architecture with business models

2. Literature Review and Conceptual Framework

2.1. Dilemma between Innovation and Standardization

There are various types of standards. Grindley categorizes standards into interface / compatibility standards and quality standards according to roles [6]. David and Shurmer classify standards into a) reference and measurement standards, b) minimum quality and performance standards, including product safety standards and c) compatibility and interoperability standards [7]. HTML and most of the standards for information infrastructure are compatibility standards.

The web cannot provide benefit without compatibility. Thus, it is difficult to compete with technological differentiated specifications based on de facto standards because the direct network effect causes the lock-in effect [8][9], and switching costs prevent users and complement goods suppliers from adopting more effective or sophisticated specifications [10]¹⁴. Excess inertia is being rocked into nonoptimal technology such as the QWERTY keyboard [11]. On the contrary, enforced transition to new standards with unnecessary costs resulting from changes in models or supplier strategy is referred to as excess momentum [12].

Innovation tends to emerge through competition [13], and standardization usually causes excess inertia [12], which discourages transition between versions. Baldwin and von Hippel [14] presumed that regulations and standard setting tend to decrease the value of innovation opportunities.

2.2. Strategy for Standard as Platform

HTML5 is not just a standard to realize compatibility; it also works as a runtime environment for web applications in the way that operating systems do for native applications. Rochet and Tirole [15] defines a platform as the components or services that mediate transactions between two or more groups of agents. Baldwin and Woodard [16] defines a platform as a set of stable components that supports variety and evolvability in a system by constraining the linkages among other components (pp.19). The platform is a component commonly used by multiple complements [17][18][19]. HTML5 is a runtime environment for web applications. Therefore, it has the features of a platform as a standard, even though Cusumano [20] noted that standards do not always play the role of a platform.

There are two alternative strategies for platformers; one is to monopolize the market for the adjacent layer, and the other is to allow access to the platform interface. If a platformer chooses an open strategy, he or she must attract others to provide complements and thus create benefits for end users. When the choice is made to open the platform, platformers face a two-sided market [21][22][23] of complementors and end users.

The success of the platform is not determined solely by the technological competence of the platform itself but also by the number and quality of complements. Diffusion of HTML5 can be realized only by attracting web applications/ web content developers and end users of HTML5-compatible applications/ content. In other words, the W3C and the proposers of the specification faced the two-sided market of developers and end users.

Platform envelopment is a strategy for the two-sided market that extends the function of the platform of the adjacent layer to what a certain complement provides. A typical example of platform envelopment is Microsoft Windows Media Player. Microsoft added Media Player to the Windows OS and removed a competitor, Real Player, which was also provided to the Mac OS on the basis of a multi-homing strategy [24].

Some platformers provide a toolkit to encourage the development of complements and innovation [25][23]. Platformers tend to sustain coordination costs in realizing cooperation among developers and from seeking out innovations by complementors [26].

Cooperation between platformers and complementors is determined by the specifications of the API. The API and other resources are provided to complementors and are referred to as boundary resources [27].

Occasionally, a tying strategy to develop and provide complements to the adjacent layer [28][29] is adopted. Tying helps to develop a competitive advantage and discourage competitors from entering the market [30][31] by monopolizing certain layers [32].

2.3. Features of the W3C Standard

De facto standard is composed of the specifications selected by market mechanism. Some de facto standards are sponsored by certain firms or joint ventures such as Microsoft Windows and Blu-ray disc. On the other hand, there are unsponsored standards developed by voluntary standardization organizations (VSOs). No one is obligated to adopt such standards under contract [33]. VSOs have to struggle to persuade prospective users to voluntarily choose their standard. The HTML and web standard are unsponsored. The W3C refers to standardized specifications as "*Recommendations*".

The W3C and organizations that propose the standardization of specifications attempt to diffuse standardized specifications widely. Specifications can be workable standards only when the majority of web developers choose them for the same functions. Approaches for certain functions are mostly regarded as the dominant design [34][35]. Funk defines a standard as a certain type of dominant design [36]. HTML5 changed the dominant design of applications. Applications had been distributed with physical media such as compact discs. Users had to purchase and install them on their own devices. Consumers had to pay for developers every time the applications were updated. The success of the software business used to be measured by the amount of license distribution. Web applications enabled by HTML5, however, are provided through the web and are free. Revenue is generated by displayed advertising. Users do not have to concern themselves with updates. Updates are completed on servers. Frequency of use is the most important metric to evaluate the success of a business because it is the basis for determining the number of advertisements viewed.

3. Research method

A case study approach [37] was used in this research because there are a few cases of innovation through standardization. This inductive hypothesis-building study attempts to develop generalizable conclusions from a rare event.

I analyzed Google's activities and responses of other stakeholders by an analysis of the official documents, press releases and news articles related to Google, the W3C and its relevant organizations. Many articles of web medias are deleted in years. Thus I utilize data of the Internet archive of some articles. I also conducted interviews with individuals from W3C staffs, member organizations and independent developers.

Moreover, I conducted fieldwork at the W3C office in Japan as an intern from April 2010 to March 2013 and analyzed the flow of the standardization process as defined by the mailing list archives of the working groups, the meeting minutes, technical documents and public relations materials. This analysis involved a study of internal documents and more than 230,000 emails from the archives issued since the standard-setting organization was established.

4. Case Analysis

4.1. Google's strategy

Google began as a research project for a search engine. The company was incorporated in 1998 but was still searching for sources of revenue. AdWords and other advertisement-based business models had experienced explosive growth.

Google sought other sources of revenue in parallel with developing the business model for a search engine. The Gmail development project was launched in 2001¹, and other services were developed such as the calendar (Google Calendar), spreadsheet, word processor and slide presentation tool (Google Drive, formerly Google Document), which could take the place of Microsoft Office and other native application-based tools.

One of the most distinctive features of Gmail is the user interface. It is not necessary to reload pages to compose, send, receive and read messages, unlike web mail services such as Microsoft's Hotmail and Yahoo! Mail. Such functionality was realized with Ajax technology. Ajax is an acronym for Asynchronous JavaScript + XML. XML is an open technology standardized at the W3C. JavaScript is also open standard of ECMA international. Moreover, XMLHttpRequest is an API used to transact XML data with JavaScript and was originally invented by Microsoft. Google has never affected the not-invented-here syndrome and tends to choose technologies, even those developed by competitors, with little hesitation.

It is rational for Google to use existing technologies to implement web applications because they run only when all components operate together. At the same time, the performance of web applications is limited by the specification of the web standard. Google did not have to improve upon their own technologies and also develop advanced standards. Google needed a variety of APIs for their website, that is, user interfaces for web applications. In other words, Google's strategy depended on basic improvements to HTML.

Google has done the following to enhance web applications and diffuse them: 1) contributed to the development of HTML5; 2) encouraged web browser vendors to implement HTML5; and 3) promoted HTML5 for web content developers and end users (attracting both of two-sided market).

4.2. Google's contribution to HTML5 development

4.2.1. Origin of HTML5

HTML was originally invented as a computer language for websites; stable documents were created by Tim Berners-Lee, later director of the W3C. Early

¹ McCracken, H. (2014, April 1). How Gmail Happened: The Inside Story of Its Launch 10 Years Ago, *TIME online*. retrieved June 4, 2015, from <http://time.com/43263/gmail-10th-anniversary/>

upgrades of HTML (up to 4.01) were incremental improvements based on the ideas of Tim Berners-Lee.

The attempt to transform the Web to a runtime environment for applications was begun outside of the W3C, for example, the Java runtime environment of Sun Microsystems and Macromedia / Adobe's Flash technology in the 1990s. Sun Microsystems and Microsoft developed JavaScript / JScript for programming languages to manipulate websites.

The proposal of "XHTML Module: Extensions to Form Controls" on September 2003² was the first attempt³ to transform HTML into a runtime environment for web applications. Ian Hickson of Opera Software, a Norwegian browser vendor, composed the draft. The draft was renamed "Web Forms 2.0"⁴ and proposed to the W3C Workshop on Web Applications and Compound Documents held on June 2004 by Opera and Mozilla.

4.2.2. Participation to HTML5 development through employment of a leader

In the beginning, Google supported the Firefox web browser Mozilla, which was supported by an open source software developer community. Then, they took part in HTML5 and other web standard development projects at the W3C.

The W3C rejected the proposal of HTML5 from Apple, Opera and Mozilla, because they had already begun the standardization process of XHTML as the next version of HTML. Mozilla, Opera and Apple launched a specification development activity as a grass roots developers' community referred to as the Web Hypertext Application Technology Working Group (WHATWG) and continued to develop their specification separately. There came to be two standard candidates for the next version of HTML.

Ian Hickson became a central figure of WHATWG and continued as editor of the Web Forms 2.0 specification. He began developing a draft of "Web Applications Markup Language 1.0." The draft was renamed "Web Application 1.0" and integrated with Web Forms 2.0 into HTML5. HTML5 is a specification of HTML with advanced form functions, multiple APIs and backward compatibility with existing HTML.

Development of HTML5 was led by Ian Hickson with the support of Opera, Mozilla and Apple. Google employed him and has encouraged him to remain as editor of HTML5 at WHATWG. In other words, Google engaged support of WHATWG with Opera, Mozilla and Apple. Promotion of HTML5 was conducted through cooperation among Google and web browser vendors other than Microsoft.

² Hickson, I., (2003, September). *XHTML Module: Extensions to Form Controls - Opera Working Draft, September 2003*. Retrieved June 15, 2015, from <https://lists.w3.org/Archives/Member/w3c-archive/2003Sep/att-0014/hfp.html>

³ WHATWG, (n. d.). HTML snapshots. *WHATWG Wiki*. Retrieved June 15, 2015, from https://wiki.whatwg.org/wiki/HTML_snapshots

⁴ Hickson, I., (2003, September). *Web Forms 2.0 - Working Draft 5 February 2004*. Retrieved June 15, 2015, from <http://www.hixie.ch/specs/html/forms/web-forms-2>

4.3. Implementation-oriented process of the W3C

The standardization process management policy of the W3C is referred to as an implementation-oriented policy. This is based on the clause of the W3C's process document introduced in 1999 and excerpted below:

Shown that each feature of the technical report has been implemented. Preferably, the Working Group should be able to demonstrate two interoperable implementations of each feature⁵.

This means that no proposed specification is ever certified as a standard without more than two implementation cases. The W3C and proposers call on working group members for implementation at the middle stage of the standardization process. HTML working group has adopted a policy that opens every stage of the standardization process to the public. Therefore, specifications can be improved based on feedback from the implementations developed by non-WG members.

Most standards are developed and fixed first, and then compatible products or services are developed and supplied. To the contrary, The W3C encourages stakeholders to implement specifications while in discussion and presses the standardization process forward based on discussion featuring feedback from implementation cases (Fig. 3).

- Most existing standardization processes



- Process based on implementation-oriented policy at W3C

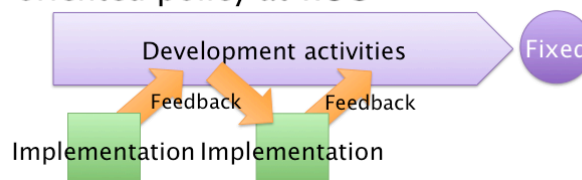


Fig. 3 Changes in the standardization process through the implementation-oriented process

⁵ Jacobs, I. (ed.). (2005, October 14). 7.4.4 Call for Review of a Proposed Recommendation. *World Wide Web Consortium Process Document 14 October 2005*. Retrieved November 28, 2013, from <http://www.w3.org/2005/10/Process-20051014/tr.html#cfv>

4.4. Ways to diffuse HTML5 compatible web browsers

4.4.1. Support for Mozilla's browser development

HTML5 was originally proposed by three browser vendors; Apple, Opera and Mozilla, and it stands to reason that they take the lead in implementing HTML5 in their own products. However, all of them lacked a competitive advantage in the web browser market. Microsoft dominated the web browser market with Internet Explorer in the early 2000s after winning the battle with Netscape navigator in the 1990. It was necessary for Google to build competence in web browsers in which HTML5 was implemented.

First, Google employed Ben Goodger⁶ and Darin Fisher⁷, who worked at the Mozilla Foundation as developers of Firefox browser in January 2005. They continued to work for Firefox development after Google hired them⁸.

The development of web applications and the management of the open source web browser project were to develop competency by corporation between platformer and complementor based on the strategy of divided technical leadership[38].

Google finally launched its own browser business with Chrome on September 2nd 2008⁹. However, the plan to enter the browser market began about seven years earlier. Larry Page and Sergey Brin, the founders of Google, proposed a plan to enter the browser market to Eric Schmidt, the executive chairman, in March 2001¹⁰, when Schmidt transferred to Google¹¹. Google's emergence in the browser market brought with it a browser that suited web applications. End users can utilize Google's web applications in an optimal environment.

4.4.2. Promoting benefits by providing open source software

Few developers or end-users are interested in specifications themselves. What are possible to do with specifications are much more important than their design. Google chose the strategy to implement as an add-on program; the Gears is as independent development project.

⁶ Wagner, J. (2005, January 25). Goodger Goes to Google. *InternetNews*. Retrieved March 15, 2014, from <http://www.internetnews.com/dev-news/article.php/3463841>

⁷ CNET News. (2005, January 27). *More Mozilla talent Google's way*. Retrieved March 15, 2014, from http://news.cnet.com/More-Mozilla-talent-Google's-way/2110-1032_3-5553877.html

⁸ Mozilla Digital Memory Bank. (2006, June 12). *Interview with Darin Fisher*. Retrieved March 15, 2014, from <http://mozillamemory.org/detailview.php?id=946>

⁹ Google. (2008, September 2). *Google Chrome: A New Take on the Browser*. Retrieved March 11, 2014 from Google News announcements: http://googlepress.blogspot.jp/2008/09/google-chrome-new-take-on-browser_02.html

¹⁰ Levy, S. (2008, September 2). Inside Chrome: The Secret Project to Crush IE and Remake the Web. *Wired*. Retrieved March 15, 2014, from http://www.wired.com/techbiz/it/magazine/16-10/mf_chrome?currentPage=all

¹¹ CNET News. (2001, March 26). *Novell's Schmidt joins Google at critical time*. Retrieved March 15, 2014 from <http://news.cnet.com/2100-1023-254750.html>

Google's strategy was to promote the benefits of HTML5 first. Google had implemented functions, including offline and geo location APIs to enhance web applications, in Gears with the support of Opera and Mozilla¹².

Google launched the service to provide search results based on location information after Geolocation API had been implemented in Gears¹³. Developers and end users came to recognize the benefit of such functions through Google's open but private technologies before being converted to open standard.

Google gave a presentation on the introduction of Gears at Google I/O 2008 and addressed the relationship between Gears and HTML5.

HTML5 is a new set of proposed extensions to HTML that radically improve the capabilities of web applications. However, without implementations in a majority of browsers, these proposals remain just that, and out of reach for developers.

The Gears mission is to begin implementing these APIs today, across as many browsers as possible, as quickly as possible. In this talk, I'll explain why we are doing this, what our motives are, and show how implementing web standards is good for Google and good for the web¹⁴.

Takahito Kawauchi, software engineer at Google Japan, had the following remarks.

The standardization process of HTML5 based on existing specification takes long time. Although developed functions come to be adopted by browser vendors in turn, it takes long time till new versions to which functions are implemented. We choose and implement functions with high possibility to be integrated into HTML5, and excluded from the draft of HTML5. There is possible for functions implemented to Gears to be adopted to HTML5 later¹⁵.

The aim of the Gears project was to make it possible for users to utilize functions that would be adopted as standard later, to enhance the function of HTML5 and to diffuse HTML5 widely.

Eric Schmidt, then CEO, mentioned the following at the keynote of Google I/O 2009.

We have spent 20 years trying to build a programming model that is the right one. Then the Internet arrived. "It's time."

This is the beginning of the real win of cloud computing, of applications (on the web)¹⁶.

¹² Boodman, A. and Erik Arvidsson, E. (2007, May 30). *Going offline with Google Gears*. Retrieved March 8, 2014, from Gears API Blog: <http://gearsblog.blogspot.jp/2007/05/posted-by-aaron-boodman-and-erik.html>

¹³ Genera, P. (2008, September 11). *Introducing Mobile Search with My Location*. Retrieved March 8, 2014, from Official Google Mobile Blog: <http://googlemobile.blogspot.jp/2008/09/introducing-mobile-search-with-my.html>

¹⁴ Boodman, A. (2008, June 9). *HTML 5, Brought to You by Gears*. Retrieved March 13, 2014, from 2008 Google I/O Session Videos and Slides: <https://sites.google.com/site/io/html5-brought-to-you-by-gears>

¹⁵ @IT. (2008, July 14). *Gears enhancing web browsers with functions of HTML5*. Retrieved March 13, 2014, from <http://www.atmarkit.co.jp/fwcr/special/gdd2008/google01.html#03>

¹⁶ Siegler, M. G. (2009, May 27). Live From Google I/O 2009. *TechCrunch*. Retrieved March 17, 2014, from <http://techcrunch.com/2009/05/27/live-from-google-io-2009/>

He insisted that there would be a time when architecture compliance with enhanced web applications would be common.

Then, Vic Gundotra, a vice president of engineering who had moved from Microsoft, made the following remarks.

“Never underestimate the web.” At Microsoft (where he used to work) we thought web apps could never rival desktop apps.

“The web has won.” A more powerful web made easier.

New HTML5 standards. A chance to do things differently.

Almost half billion people now using modern open source browsers¹⁷.

He insisted that HTML5 was a key technology for realizing advanced web applications and that compatible browsers had already become widespread.

The diffusion of smartphones has encouraged users to perform searches with location information. Google merged with Android Inc. on 2003 and released the Android operating system and handset on 2005. Map and other web applications services that run with data gathered with Gears API had been developed and become popular. Some functions of HTML5 had already been popular among end users before they came to be built into the specification.

After Gears achieved popularity, they suddenly discontinued its development and diverted the Gears technology to the proposed HTML5. Google succeeded in gathering programmers’ interest in web applications and the functions of HTML5 by promoting Gears. Programmers who had previously recognized the benefits of HTML5 began to accuse Microsoft of not making an effort to implement HTML5 in their own web browser, Internet Explorer. Finally, Microsoft was forced to adopt HTML5 and launched a campaign encouraging users to upgrade Internet Explorer to the latest version, which implemented HTML5.

Google developed Gears as open source software because any specifications proposed and adopted as standards at the W3C must be open to the public. There is no need to be secretive about technologies intended for proposal to the W3C because any specifications are made public just after they are proposed to the W3C. It is more effective to open and promote technologies than to keep them closed and proprietary.

4.5. Microsoft’s adoption of HTML5

The W3C had already accepted the proposal of HTML5, and the standardization process there had been managed integrally with the activity of WHATWG. Ian Hickson was the specification editor of HTML5 at the W3C HTML5 working group.

Microsoft, a major web browser vendor that had never taken part in WHATWG, joined the HTML working group at the W3C on April 2007¹⁸. All major browser vendors and a web application provider were involved with HTML5 standardization.

¹⁷ *ibid.*

On the contrary, Microsoft had not implemented HTML5 in Internet Explorer. Moreover, Microsoft had developed and promoted a proprietary technology for a runtime environment for multimedia content named as Silverlight¹⁹.

Web site developers were irritated that Microsoft did not implement HTML5 in their product and instead promoted their proprietary runtime environment; they had to develop two types of websites, those for HTML5 compatible browsers and those for Internet Explorer. Google and colleagues' promotion of HTML5 succeeded in making the specification popular among website developers.

Therefore, website developers launched a negative campaign against Internet Explorer, "IE6 Must Die". They displayed pictorial figures protesting Internet Explorer 6 on the icon of a Twitter account (Fig.)²⁰. Microsoft was forced to adopt and implement HTML5.

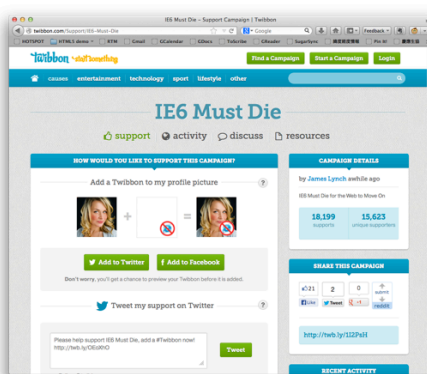


Fig. 4 Twibbon IE6 Must Die

Finally, Microsoft changed its strategy. Steve Ballmer, the CEO, made an announcement that the company would treat HTML5 as one of Microsoft's core cross-platform technologies at the "Professional Developers Conference 2010²¹":

With the work that we're doing with Internet Explorer, we're trying to make that a whole lot simpler for you. With Internet Explorer 9, we made our focus on a couple of things: No. 1, doing HTML5 — standards-based HTML5 — really, really, really well. And No. 2, asking the question: How do we improve on the user experience for

¹⁸ Wilson, C. (2007, April 4). *Microsoft has now joined the HTML Working Group*. Retrieved June 17, 2015, from public-html@w3.org mailing list archive: <https://lists.w3.org/Archives/Public/public-html/2007Apr/0202.html>

¹⁹ Microsoft. (2007, April 30). *Microsoft Lights Way for Next-Generation Web Development and Design at MIX07*. Retrieved May 4, 2013, from <http://www.microsoft.com/en-us/news/press/2007/apr07/04-30MIX07PR.aspx>

²⁰ IE6 Must Die - Support Campaign. *Twibbon*. Retrieved April 24, 2014, from <http://twibbon.com/support/IE6-Must-Die/>

²¹ Ballmer, S. (2010, October 28). *Steve Ballmer: PDC10 (record of keynote at Professional Developers Conference 2010)*. Retrieved May 4, 2013, from <http://news.microsoft.com/2010/10/28/steve-ballmer-pdc10/>

HTML5 applications based upon the fact that we know Internet Explorer runs on Windows? How do we integrate, if you will, applications and websites from a user experience perspective? How do we take advantage of the power of Windows and the Windows PC to improve the performance of HTML5-based applications²²?

Microsoft released Internet Explorer 9 just before Ballmer's keynote and promoted it as a highly HTML5 compatible product. HTML5 had been implemented in all major web browsers.

5. Discussion

The realization and diffusion of web applications is the result of the HTML5 standard. Google had utilized open technology and outside activities for the purpose of realizing and diffusing web application innovation. They succeeded in making HTML5 the W3C standard by attracting end users and other browser vendors.

They supported collaborative development activities and promoted the benefits of functions with the development of add-on software. Google succeeded in diffusing a runtime environment for web applications by contributing to an open standard.

Google always pursued cooperation with other stakeholders and the grass-roots developer community. Moreover, they never intended to earn revenue from the HTML-related technologies that they developed. They have pursued a definite strategy of developing and diffusing runtime environments for web applications and new architecture as rapidly as possible.

This case analysis enables us to depict hypothesis of key success factors of innovation through standardization as: 1) utilizing any technologies developed by any party, 2) attracting customers from the multi-sided market fast and 3) adopting an implementation-oriented process of standardization.

This hypothesis is derived by single case analysis. However, more and more standardization processes at the W3C has been open to the public with GitHub since then. The case of web application is a starting point of analysis. I will continue to research for reinforcing theory construction for innovation through standardization on software ecosystem

6. Acknowledgement

This analysis is the result of time spent in the internship program at the W3C/Keio office, a stay at W3C/MIT and many interviews. Special thanks to the staff at the W3C, member organizations and the developer community.

²² Ballmer, S. (2010, October 28). *Steve Ballmer: PDC10 (record of keynote at Professional Developers Conference 2010)*. Retrieved May 4, 2013, from <http://news.microsoft.com/2010/10/28/steve-ballmer-pdc10/>

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