

White Paper

History of Tablet Computing

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Introduction

Although tablet computers are perceived as an invention of recent years, the tablet concept has existed in rudimentary forms since the 1960’s. The modern tablet has evolved from these original concepts and in some cases has taken quite divergent paths.

The tablet-computing concept has its origins in the 1960s as a rough concept first put forward by Alan Kay. This original idea was termed the Dynabook but was not put into any production at the time. The idea however set the early groundwork for the idea of a highly mobile computing device for mass consumption. Tablets and smaller devices have continuously evolved since these early designs and have led to the current set of devices that dominate the market. Each generation can be seen to have slowly increased the adoption rates but key features have certainly created large spikes in adoption rates over time.

Inputs & Form factors

Pen based

The first commercial portable computers that most resembled the tablets of today used a pen based input methodology. Effectively a pen replaced the mouse to allow the user select items on the screen and input text onto a displayed keyboard when needed. Both PenPoint OS and Windows for Pen Computing were available on the market in the early 90s, but both were basically a one to one migration from what a user could perform on a laptop computer of the time. Neither of these systems gained the level of traction seen today in the market, due to a variety of reasons, but the foremost was still the need for some sort of tether to synchronize data between the device and other systems.

At this same time Apple began to work on the Newton device. This was another pen based mobile tablet packaged with a specific operating system (Newton OS) for mobile computing. Although the project began as a general-purpose computing device, it was re-engineered as a personal digital assistant (PDA) device and began that specific market.

Size

The early tablets were released from the late 80s to mid 90s and due to the technology of the time the form factor and relative size was generally quite larger than the devices of today. Most devices gravitated toward the ruggedized form factor with screen sizes being between 7 and 12 inches.

Operating Systems

Initially, the tablet or pen based computing devices either used a Microsoft variant of Windows (3.1 through to XP) or a specific operating system that provided an personal assistant style devices. Microsoft released several pen-based operating systems through the 90s, but each of these releases merely served to provide pen input on top of the standard Windows release of the time.

The second branch of tablets moved toward a set of PDA based operating systems. These systems included the Newton OS from Apple, Palm and several smaller players. These operating systems provided a more streamlined experience for the user who was primarily concerned with using a tablet style device as an electronic metaphor the datebooks of the time.

Small PC vs. PDA

The tablet market generally originated as a truly mobile concept of a general computing device but quickly split into two separate lines. Microsoft and some Linux platforms pushed the generic computing path and the PDA path was pushed by Palm and Apple with their respective platforms.

Newton (1993)

Apple's Newton platform truly originated the PDA market. The CEO John Sculley gave the personal digital assistant name to the device. The Newton focused primarily on pen based input into specific applications that would aid a user in organizing facets of their life such as address book entries, notes and calendar appointments. Applications could be written for the device in a scripting language, but these applications were not at the level of diversity we see in today's marketplace.

**Form and Progression**

The Newton family of devices like many other devices started as a fairly large device. The first devices to be released on the Newton platform was the MessagePad H1000 and weighed in at 1.5 pounds with a screen size of 7 by 4 inches. Each subsequent devices released on the platform was generally lighter than the previous but screen sizes varied over time from smaller devices to much larger screens. The resolutions remained around 320 by 240 pixels to 480 to 320 with gray scale displays. This limited resolution and lack of color certainly limited the types of applications that could be considered truly useful on this platform.

Apple eventually canceled the Newton line in 1998. There have been many reasons given for this, but the most plausible is the dismal sales of the device gave the company no reason to keep spending large amounts of R&D on its development. Adoption numbers are hard to determine for the Newton because its release in 1993 pre-dates much of the information that is now on the Internet. Anecdotally, many sources state that Apple spent roughly 1 billion US Dollars on the project from 1993 to 1998 and only made roughly 250 million dollars in sales over that period. If we assume an average price of $800, then that would show that 312,000 units were sold. Other evidence from former Apple employees states that somewhere around 30,000 to 50,000 devices were sold per year.

Figure : Newton Devices Sold

Palm

The Palm Pilot was released as the first generation device from Palm computing in 1996. This device was similar in may regards to the Apple Newton platform in that it was a PDA style device with a pen input and an operating system tailored to the tracking of every day tasks. The Pilot and its successors were quite a bit smaller than the Newton devices and were well received at the time by the corporate sector.

Form and Progression

The Palm devices evolved along the lines of connectivity and storage through the late 90s into the 2000s where the Palm OS was mostly used on smart phone devices. Products such as the Palm Tungsten PDA did make some inroads into the smart phone marketplace but at this point the Apple iPhone held the dominant position. The Palm VII device was one of the first to include wireless (Wi-Fi) capabilities, but was still hampered by the lack of screen size of simplicity of the Palm OS at the time.

Microsoft Tablet PC

Microsoft released a series of variants of the Tablet PC operating system from 2002 on to the present (Surface can be traced from these beginnings). The operating system has generally been a pen based offering of the current iteration of Windows and has followed each of the major releases from Windows 3.1 through to Windows 8. In 2002 Microsoft released hardware design specification for OEMs to create tablets to run their platform and several tablets and convertible style notebooks were released to the market.

Form and Progression

OEMs produced many variants of the Microsoft platform over the years in form factors comprised of devices more akin to traditional tablets to booklet styles devices with keyboards attached and convertible style laptops that could be used as either a traditional laptop or a slate to write on using the included stylus.

These tablets did enjoy some success in vertical markets such as healthcare but the many disadvantages, not limited to cost, weak video capabilities and poor ergonomics kept the devices from achieving any critical mass needed for them to move into the wider consumer marketplace. Without an operating system that was developed completely around the human interaction of a stylus or touch input, no application development companies bothered either and the movement fizzled out.

Modern Tablets

Modern tablets have truly become mobile general purpose computing devices. With the addition of both WiFi and mobile wireless capabilities these devices have allowed customers to access the web and run many of the same style of application they would normally use a laptop computer.

Progression from iPod Touch and iPhone

While not a tablet in the current sense of the term, the iPod and iPhone devices from Apple certainly set the standard for mobile computing. Starting with the iPhone, Apple added a very important piece of technology to a mass produced consumer device -- multi-touch. Multi-touch technology had been in development by smaller companies for some time, but the iPhone in 2007 was the first such device to bring this to a large number of consumers. While most of the early devices had used a pen-based approach for input, the iPhone was the first device to allow a user to interact with the device with multiple fingers at the same time. This allowed for new metaphors of interaction such as pinch to zoom, spin to rotate, etc. These are all in fact still under patent protection from Apple.

Similar to the Tréo line of devices from Palm, the iPhone's ability to use both WiFi and mobile wireless technologies allowed a user to access the same set of information they would normally have used either at home or the office and this certainly had a large impact on the adoption of the product.

Apple iPad

The first iPad was released April 3, 2010. Apple took the known formula from the successful iPhone and iPod Touch line of devices and scaled up the interface, boosted the storage capacity and added higher performance processors. The iPad included the same range of sensors as the iPhone, excluding the camera, which was added in the iPad 2 models that was released in March of 2011.

The iPad line included models with Wi-Fi and 3G wireless connectivity and the Apple App Store was well established from the time of the iPhone SDK release. This gave the iPad an immediate advantage over past competitors because users were immediately given access to a very large quantity of applications that could be run on the iPad at the time of the launch. In addition to these existing iPhone application a large number of iPad specific apps were released that took advantage of the larger screen size and propelled the sales numbers of the iPad devices.

Battery life of the devices cannot be overlooked either. The stated life of the lithium polymer batteries in the iPad gave the user 9 - 10 hours of usage while accessing the network over Wi-Fi or 3G (later LTE as well). This gave the tablet an immediate advantage over the smaller laptops of the time, which could deliver at best 7 hours of usage on a single charge.

Interface

The iPad uses the same input mechanism as the iPhone, which is the capacitive mutli-touch system, patented by Apple. This system allows the user to use multiple fingers to control the device and applies heuristics to determine user intent to avoid phantom touches or device border touches.

Apple iOS itself interprets the touch commands and allows the user to perform the full set of multi touch gestures. One change that the iPhone and iPad as well as most of the newer tablets have made over the earlier style of devices is the inclusion of a virtual keyboard for inputting text into the system. Many earlier devices used handwriting technology that was considered by most to be difficult to learn.

Touch technology has most certainly been a large factor in the success of the iPad as well as other tablets. Games in the various app stores are routinely the #1 sellers and touch input has created completely new genres of gaming. Older game system makers such as Nintendo and Sony have both seen their sales numbers plummet in recent years and each have sited the tablet devices as major causes of their troubling sales figures.

App Store

Apple launched the App Store on July 10, 2008. The store allowed developers of applications to upload their applications through the store and be available after a review process to any user of on of the iDevices. Although the store launched with around 500 applications, as of 2013 Apple reports that there are approximately 800,000 applications available for download. (http://www.apple.com/pr/library/2013/01/28Apple-Updates-iOS-to-6-1.html).

The mobile application store has truly changed the landscape of software sales for consumers as traditionally, applications were sold at prices far above the now average price of 99 cents at most mobile app stores.

Adoption

In addition to technical improvements driving eventual success, the overall acceptance of technology and its involvement with the "every-man's" daily life may have eventually prompted the tablet's success even more than any commercial developments. In previous decades calculator watches were only for nerds. In the late 90s and early 2000s, the PDA was the geek's toy of choice, but when the PDA became a valued business tool, it progressed from geek to "geek-sheik" and acceptable. Cell phones too started as ridiculous technical accessories with giant battery packs that made them far from tolerable for the common man, but when technology allowed them to fit in a person's pocket, they too became valued tools. The eventual combination of the PDA and the cell phone is the most crucial point in the technical evolution that lead to tablet computing's acceptance.

Figure 2: Apple Unit Sales in Millions

The smart phone resolved two critical elements. First of all, the technical ability to be connected to the Internet all of the time was created for the smart phone. Access to e-mail, browsing the web, access to news and other information all became useful once the capability to have all of it literally at your finger tips was available. Secondly, the immersion of the average consumer into the information age through smart phones and their enabling technologies made people desire more. While ringing cell phones were originally considered an intrusion at dinner tables, restaurants and stores, today they are commonplace. Even early owners of Blackberries felt that having e-mail notifications pinging all the time was too much, but now people race to their phones for text messages and Tweets. The smart phone facilitated an insatiable appetite in people for the latest information, but eventually there was too much information for a 3-4 inch screen to contain and people craved more. The tablet that had failed in the past re-surfaced with all of the technical updates that smart phones had spurred and was finally ready for success.

A very important item to note with regards to adoption of tablets is the numbers as they relate to the corporate market. Most of Nielsen’s applications are consumed by corporate workers and thus the adoption and usage of tablets by tis group is an important one to track. Data from 2012 suggests that the adoption rate within large companies is contuing to grow and as it does in the consumer marker, Apple is generally favored.

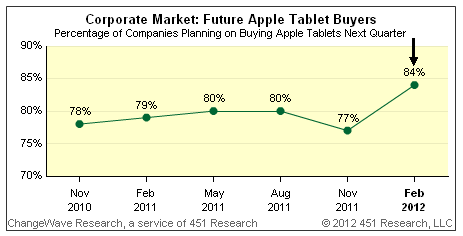
Input (pen, stylus, touch)

Figure 3: Corporate Tablet Adoption

Progressing from pen and stylus input to natural touch inputs was one of the most important elements of the smart phone revolution. Interestingly, pen and stylus inputs are still often useful with tablets, but without smart phones being able to evolve without them, tablets may not have become mainstream.

Mobile OS Specific

iOS

Apple quickly commenced iOS development and innovation on the iPhone. The same elements that found success with the iPhone were quickly adopted in the iPad, but the innovations have always been lead by the iPhone. Most recently iOS has brought OS level services that can be leveraged by other applications, but iOS is limited to only common services as they are exposed by the operating system. While this allows Apple to ensure simple interfaces, the limitations are often considered the weak side of their extremely successful operating system.

Android

Android, on the other hand, did not meet massive success in their initial launch. Android has had more of a traditional lifecycle. Initially, Android was more accepted by the early adopters. It's Linux foundation was something that those were attracted to, but the limited application availability stifled broader acceptance. A few years into development; however, Android began to expand application offerings and its acceptance has grown. Possibly, the largest difference between iOS and Android is the state of the ecosystem. While Apple prefers limited interfaces to focus on quality, Android has allowed application developers to manage their own levels of quality and simply open everything.

Android struggled with their initial tablet launches. One of the downfalls to the open solution that Google created was that screen sizes could be anything that manufacturers could manufacture. In the end, the operating system did not scale well. While Apple solved the problem through controlling the ecosystem, Android floundered and failed, in their first release, to manage these scenarios. As with the smart phones, Apple used this to seize the tablet market by focusing on quality and not trying to have every feature possible available in the first release.

Apps

Apps make the phone. It doesn't matter how the call quality compares. The first iPhone was very well known to have one of the worst microphones in a cell phone. It was a running joke that it was a cool device, but a terrible phone, but that did not seem to matter. Casual games, photo applications, mapping and navigation apps, news, social media, audio and video apps all converged on smart phones and now tablets to allow these devices to do just about anything the user desires. iOS still maintains lead for most apps sold, but Android is catching up. On the other hand, Windows Mobile and Blackberry are struggling with lack luster app stores.

Where It Stands

Today Android has surpassed iOS in their global sales and many former Apple devotees have explored and converted to Android. Many have cited application interaction as one of the driving forces. While Apple’s closed interface does not allow applications to communicate except in limited and system owned service points, Android apps can communicate in much more direct ways. Photos can be edited with a single click from when they are taken. iOS requires the camera app be closed, the editing app opened and the photo which the user wishes to change or share be searched for and found. For this reason, just as apps drove Apple’s early success, apps may very well be its downfall. Apple's strong market dominance and focus on quality and design may justify their premium price, but consumers are always looking for a deal.

Tablet cannibalization of PCs

While tablet sales have taken a large percentage from the total PC sales, the emergence of the Microsoft Surface tablet that runs a full version of Windows may be the single biggest threat. Casual PC users may eliminate their home computer completely if the tablet is able to fill the need while adding the secondary benefit of portability.

Current Market Share

Apple still owns the US market for tablets, but internationally Google's Android operating system is making strong gains. Windows Surface tablets may take another piece of the market, but other contenders like HP's Touchpad and Blackberry's Playbook have completely failed due to the lack of applications in their ecosystems. Apps will continue to drive the success and failure of new products, but between iOS and Android, apps alone no longer drive success. Time will tell, but trends are moving towards Android surpassing iOS as Apple's tablet and smart phone capabilities are overtaken by the larger, more open community that is Android and Google.

Native v. HTML5 Applications

Figure 4: 2012 Tablet Market Share

Application development for mobile platforms has seen a variety of changes over the years. Native application development always has the most capability, but with many apps that are simply serving content via a connected collection of web based services, HTML5 based applications have taken off. Why build something this way when native development can do more? The answer is simple. Tablets are a growing market and are becoming a complete replacement for computers for many people, but there is no clear winner and neither iOS nor Android appear to be taking over in the near future. In order to support more than one ecosystem, development needs to be focused on a solution that can facilitate both ecosystems. HTML5 offers an open development platform that facilitates more than one mobile platform as well as web applications.

Where Is It Going

Knowing where things are going in the short term is fairly straightforward. Android and iOS will continue to strongly compete for at least another 5 years, but in the end the tablet's life span will be short. Smart phones will win out simply because we carry them around with us. The more complete immersion of technology into our daily lives will not be satisfied with tablets. They are an interim step in the evolution of this relationship. Even now, smart phones are getting bigger and tablets are getting smaller. These "phablets" have limited popularity because they fulfill neither the phone and tablet needs as well as the originals. The extensions of smart phones that integrate more easily into the lives of the average consumer will become the replacement for most of the tablets on the market today. Google is looking into eyewear such as their developer only Google "Glass" but augmented reality and wearable devices have already proven weak in their long-term acceptance.

More likely is the smart phone with built in projection capabilities that can put a larger screen on a wall and a larger keyboard projected onto the desk. Battery limitations and a few more technical gaps are the only things holding manufacturers from releasing devices like this. Mobile operating systems will be around for a long time, but the tablet itself will probably fade out over rest of the decade.

One final chart shows an analysis of Google searches on terms related to both tablets and smart phones. The current trend does show that interest in smart phones does outweigh tablets in general and this might be continue.

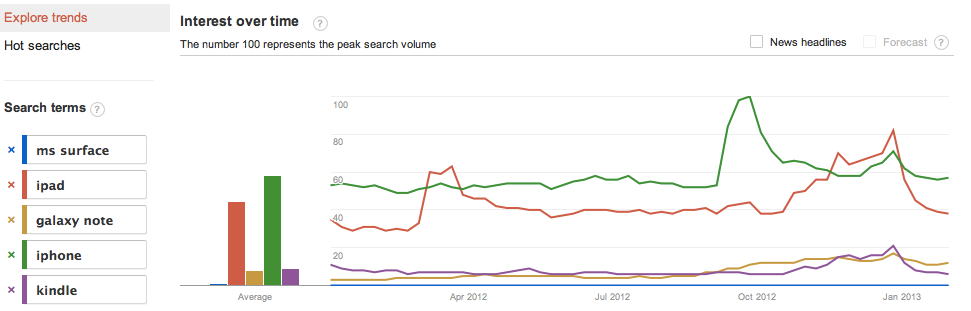


Figure 5: Google Search Trends