

# Innovation in the Software Industry

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**Abstract**—This study explores the methodologies and strategies adopted by industry leaders in software development that allow these companies to dominate the market, find new directions, lead in innovation and thrive financially. Apple Inc., Microsoft, Facebook, Dropbox and Google are examined in detail to reveal their recipes for success. This study will serve as a general idea to what makes a company successful and the challenges that companies face with staying as innovation leaders, as similarities and differences alike will arise; each will be outlined within.

## I. VISION AND NEW IDEAS

Software companies that succeed in the industry have found a recipe that allows them continue innovating and developing new software that pushes technology farther than before. They must be creative enough to continue making exciting advances in the technology, while still staying true to a unique vision that separates them from competitors. In each case below, the strategies adopted by Apple and Google are analyzed and compared.

### A. Case Study: Apple

Apple has shown that it can be very innovative, stunning the market with many products, such as the iPod and the iPhone that use a very tightly coupled software/hardware ecosystem. This type of product development has proven advantageous for Apple. By developing everything in-house, product quality, and fluidity between hardware and software can be very tightly regulated [1]. One area where Apple needed to step out and allow 3<sup>rd</sup> party development was in applications. This invites developers that have registered with Apple to access important developer tools and contribute new ideas and innovation to Apple products. Apple has benefited from this kind of openness from the application side of development. In December 2013, the Apple App Store was reported making \$18 million per day from purchases made which gives them 63% of the yearly world app spending [2], almost all due to 3<sup>rd</sup> party development.

Not only does Apple benefit financially from 3<sup>rd</sup> party innovation, it has been speculated that many of the

new features and styles which are integrated into OS updates are derived or borrowed from applications noted by in-house software engineers. In October 2013 it was reported that a 3<sup>rd</sup> party developer's app, Any.do, was on a list of "forward-looking" apps given to Apple's head designer, Jony Ive. The clean, flattened appearance of the application may have served as an inspiration for the OS updates given to all of Apples products shortly thereafter. [3] The mining of innovations and ideas from the App Store is a clear advantage of allowing 3<sup>rd</sup> party development while still controlling the core product. The App Store is a great way for Apple to find ways to improve their software, but has potential to dilute the company vision. Finding inspiration from too many sources could take away from the clean, intuitive software that Apple has built. As we will see in Google's case study below, their policies are very similar in nature and the mining of ideas from Google's 'Play Store' is also possible.

### B. Case Study: Google

Google has recognized one major factor that can stifle creativity within the workplace is a rigid environment that does not allow its employees to innovate. Google has allowed its engineers 20% of the workweek to work on company-related projects that interest them [4]. By doing this, Google has opened up time for its employees to think freely and creatively, essentially feeding an innovative pipeline of ideas to management. Many of these "20 percent" projects have evolved into well know products, such as Gmail and Google News [5]. Although this methodology has given birth to many great Google products, it is an expensive policy to uphold, and the benefits must consistently outweigh the costs. Recently, Google has announced that it will structure the "20 percent" time to direct energy and efforts in a more efficient manner. This is in an effort to increase value of each "20 percent" project, Thus overall, making their "20 percent" policy much more economical [6].

Google's search for creativity and innovation is also seen in its Android software, which is offered open source to customers and developers alike. Android is a Linux based software platform and operating system written in Java language and designed for mobile devices [7]. An advantage that comes with offering the software open source is that it opens up the floor to the public to add to and adjust software components that add and change functionality of the base package. For example, developers can then create new apps for the software and sell them through the Google Play store. This methodology of 'openness' is one that fuels innovation, essentially giving anyone with the right skill-set a chance to try new ideas and evolve the product. This all benefits Google, as revenue is generated from selling new apps developed by 3<sup>rd</sup> parties. A report from December 2013 reveals that Google makes about \$12 million per day from Google Play Store purchases, which over a year, represents 37% of world wide app spending with the other 63% belonging to Apple as mentioned earlier.

## II. HIRING PROCEDURES

A big part of what allows companies like Google and Facebook to dominate the market is their ability to collect and secure the right people for the job. A company's hiring process is an incredibly important aspect of the company. It is the means by which they recruit the people with the potential to make or break the company. Ultimately, no matter how great a leader you might have, the whole is only as great as the sum of its parts. Good employees are an absolute necessity for any company wishing to succeed.

So then how does a company go about finding these people? Some large companies, such as Facebook and Dropbox, hire a large number of people based off referrals. Studies have shown that on average new hires recommended by existing employees produce 25% more profit and are 20% less likely to quit the company than other hires [8]. Existing employees, especially those who have been with the company for a long time, tend to have a very good idea of what is needed to succeed in the company, often selecting candidates who would make a good fit.

Interviews are still by and large the means companies of any size use to size up potential employees. The question then becomes, what do they look for in an employee? Google defines four specific attributes they look for in the people they interview. Leadership, Role-Related Knowledge, Thinking Process, and "Googleness" [9].

Leadership is the first attribute. In the highly team based work environment of software development, the ability of a person to take charge and coordinate a group effort is highly valued. Whether or not a person is actually given a leadership role in a group, the ability to keep a group organized and moving will ultimately serve to benefit a project.

Role-Related Knowledge is naturally another thing companies look for while hiring. They want their employees

to have at least some experience with the type of work they'll be doing, the more the better. It kind of goes without saying you probably won't want to hire someone who has never used a computer to do a job centered around coding.

Thinking Process basically boils down to how you would go about solving problems. Companies that look for this generally test potential employees by asking open ended questions with no "right" answer. Ultimately, companies gather a variety of different types of thinkers in establishing their teams. The wider variety of problem solvers you have, the wider variety of solutions your team will be able to come up with to solve a specific problem, giving you a wider variety of options to choose from. Though there is no real "correct" type of thinking companies are looking for, many tend to favor more "outside the box" thinkers, as these types of people are generally more likely to lead to new ideas or innovations.

Google defines "Googleness" as essentially how well a person will likely integrate into the work environment. While this term is specific to Google, other companies also look for similar traits in the people they hire. Different companies function in different ways and it's very important for them to look for people who will mold well with the existing system. What companies specifically look for depends very much on the company and their independent structure. At the end of the day, employers want employees who will be able to get along and work well with each other. This is a crucial element for software innovators as team based environments form the core of their innovative impact.

While these four traits show what a good company looks for, it is also good to keep in mind things not to look for when hiring new employees. Many companies tend to put too much emphasis on rather irrelevant details when hiring new staff and as a result sometimes make poor choices.

Google has stated that in the long run, GPAs and test scores don't really predict anything as far as how well an applicant will fit a position. They've said the same thing about brainteasers, questions that don't really have much of anything to do with the job in question [10]. Ultimately how a person performed in school is irrelevant in relation to how well they will perform a specific job, as both require a different skillset.

Another mistake many companies will make is looking for someone who can already do the job required and being unwilling to train any new employees [11]. Every company functions differently, even if a person has worked in the field before it's unlikely they have worked in the field the same way your company would like them too. Essentially you're setting yourself up for failure if you look for new hires based on these criteria.

### III. COMPANY CULTURE

Company culture is a determinant factor when it comes to the success and longevity of any organization. Different software companies use a variety of strategies to assure their employees are happy and comfortable while making sure that they stay motivated and passionate about the work that they do. Apple and Facebook are two notable technology companies yet their corporate cultures differ immensely.

#### A. Case Study: Apple

At Apple, the work culture is driven by a passion for innovation and new products. Even though the company is regularly criticized for the extensive measures taken to ensure secrecy, this obsession with confidentiality has allowed Apple to stay ahead of its competitors and become a market leader in its domain.

Since Apple seeks to hire individuals who are at the top of their field, these individuals are usually driven by the simple desire to overcome challenges and develop innovative products. To be able to release beautiful products year after year, the notion of perfectionism is deep-seeded in the company culture. Employees understand that there is little margin for error and they continually pursue perfection in their work.

While open-office workplaces have become the norm amongst today's technology companies, Apple applies a more traditional office set-up where teams are separated so that they can only focus on their assigned projects. Since the company is exemplified by its intense work ethic and strong commitment to deadlines, this closed-office design allows employees to be more productive since there is less distraction from others. The closed-office design also ensures that important projects are kept secret. Consider Apple's industrial design lab, where the physical appearance of all Apple products are designed. With its heavy locks, tinted windows and surveillance cameras, it is arguably one of the most guarded corporate offices in the world [12]. Only a handful of employees have access to the lab or know what goes on in there. Employees are not only expected to keep quiet about their work outside the company but dependent on the type of work that they do, they may not be allowed to discuss project details with other employees. This strong insistence for secrecy has led Apple to perform extravagant product releases year after year, which gives them a big marketing advantage.

#### B. Case Study: Facebook

Facebook places a lot of emphasis on openness. From the open-office work environment to the open-sourced data center design, openness is at the core of Facebook's values. Being founded by a 21-year-old college dropout, the company also promotes taking risks in a fast-paced work environment.

During an interview with Kate Aronowitz [13], Facebook's Director of Design, Aronowitz stated, "If you want to build openness and collaboration, then the office must reflect that". She discussed that at Facebook, engineering, management and other teams often physically move around their desks to collaborate on fresh ideas in person rather than moving back and forth from permanent office spaces. With many moveable walls and comfortable furniture, Facebook offices are designed to be "homey" and have many open meeting areas to promote face-to-face communication and better collaboration.

The value of openness is also displayed in Facebook's Open Compute Project [14], which is an initiative to open-source its own server designs in an effort to create better and more efficient data centers. By releasing their plans, anyone can criticize and improve upon Facebook's designs. This will not only benefit Facebook but it will also benefit the whole industry by making these high level plans available to other companies to use.

Facebook is also known for its fast paced work environment. This is portrayed in the company's philosophy, "Move fast and break things" [15], which encourages employees to act quickly and to take risks, even if their actions might create problems. This shows that the company prioritizes shipping products faster rather than shipping perfect products. This proved to be crucial in allowing Facebook to grow rapidly and stay ahead of its competitors in the social-networking space.

Even in a fast paced work environment, employees are encouraged to participate in social activities together outside of work. The company offers many happy hours; intramural sports teams, clubs and an annual outdoor field day for all employees. All these benefits keep employees happy and healthy. Furthermore it attracts the best engineers and developers in the industry to come work at Facebook.

### IV. CHARACTERISTICS OF SUCCESSFUL SOFTWARE FUNDERS

Many successful software companies were able to outshine the competition not only by implementing wonderful software solutions to our problems but also making sure those solutions reached us in the most favorable way. These software companies developed the ability to merge both the technical aspects and business aspects into one discipline that allow to them to become financial and technological superpowers. Companies like Google and Facebook continually develop strategies that allow them to expand and reach millions of users around the world [16].

It is the belief of many people, that successful software founders were successful due to the fact that they possess a high intellectual capability that stamps them as geniuses. In fact, some of the great founders did not have a fancy education and very little technical skills such as Steve Jobs who did have an in depth knowledge of programming [12]. Although they possess the technical and intellectual knowledge to carry out their venture, those skills were not the decisive factors that allowed them to become successful. These founders also possessed other soft skills such as passion and the ability to identify people's problems that allow them to truly expand and become the famous companies that we know today.

In early stages, successful software companies embark on what startup companies know as opportunity identification. Founders are dissatisfied with the way things are done and decide to take actions to solve the problem. Usually these innovative individuals implement a solution that satisfy their own personal problems without thinking of the gratifications that they would gain by taking it to market. However, when they discover the potential of their product through other user's feedback, they are compelled to make it their contribution to society. For example Apple's founder Steve Jobs who despite how "deeply cynical we have grown about product launches, there is no doubt about how genuine the enthusiasm was in the auditorium" [17] the day of first Macintosh's launch. From a software engineering perspective, these individuals go through their own software development process without even knowing. Their first personal version can be considered the first prototype, and their friends and family can be considered their first set of unpaid customers. These entrepreneurs stand out from the rest due to the fact that they are able to recognize a problem that other individuals did not even consider. They are able to spot an opportunity and use their passion and initiative to create a solution. Therefore, from an innovation perspective, successful software companies stand out from the crowd due to the fact that they are able to solve people's problem their own way, without waiting for a user's request.

From both a business and software engineering perspective, the company's ability to spread the word and advertise their idea became a prominent factor of their success. From the business side of things they were able to attract much of their market due to the fact that they knew their target market before starting their software. Using Facebook as an example, the company's founders were college students that one day decided that technology and online authenticity can bring people together [18]. The reason why Facebook gained so much momentum in their early stages is because they were also part of the student community and could relate to their users expectations. Understanding their target market allowed them to clearly define customer's requirements that facilitated the software development process. Facebook founders understood that their website needed to provide social functionalities in a visually appealing user interface that even the most novice of user could navigate at ease. Their

understanding of their target market allowed them to develop crystal clear requirements that facilitated the software development process and created the necessary room for rapid expansion.

## V. PREPARE YOUR PAPER BEFORE STYLING

Development methods are instrumental to the efficiency of a successful and thriving company. The ability to apply the right framework that is used to structure, plan and control the process of developing can have a substantial impact. Different companies implement a wide variety of development strategies and two companies that demonstrate different development methods but both powerhouses in the software market are Google and Microsoft. While they both categorize themselves as data driven development companies they differ in that Google employs a unique iterative development strategy while Microsoft implements a more sequential approach.

### A. Case Study: Google

Google implements a wide variety of development tools and strategies to help improve their product and efficiency. The company is in a class of its own as it transcended the Internet. Mostly, Google is recognized as the "go to" search engine, but quite rapidly the company has taken over other markets. Google has expanded itself into an office suite (Google Drive), social networking (Google+), mobile platforms (Android operating system), and even traditional personal computers with the creation of the browser-only Chromebook. Google thrives because of their ability to adapt, develop, and create software extremely quickly.

What differentiates Google from other companies is the core of what make software what it is, the code. All of the code is developed on a single monolithic [19] code tree with a variety of languages. The main significance here is the scalability that this provides, as all of the builds are built from one source. This method saved an estimated 600 person-years in 2009 when compared to 2008[19]. The monolithic code tree also allows anybody to access any project within Google, which provides a unique approach to development. They also provide a unique set of tools to help improve the quality and efficiency of their work. The code review system is a web-based application that is in use across Google to help streamline development.

Google implements its own unique style of agile development that combines lots of iterations, little pair programming, and lots of collaboration. Unit testing, design documents and code reviews are the foundation of Google's success. The development philosophy at Google also distinguishes itself in that it doesn't follow what Steve Yegge calls "Date-Oriented Programming"[20]. Furthermore, there are no deadlines or conventional evaluations. The thought is that you can't rush quality. The development methods that Google employs are unparalleled because they're unconventional and to certain people unreasonable but they

work. Google looks at coding as more of an art form and they believe that the well being of their employees creates a productive development style.

### B. Case Study: Microsoft

Microsoft implements various development methods, metrics and review steps amongst its product groups. The commonality for development throughout nearly their entire diverse product like is the use of the waterfall methodology. While this is widely adopted process throughout Microsoft there are three distinguishing differences from the conventional waterfall methodology. Firstly, development cycles are divided into three of four milestones with each milestone containing its own coding, testing, and stabilization phases [21]. Secondly, Microsoft allows for requirements to change throughout the project. For each project an initial vision statement is written and this is used more as an outline for developing rather than a blueprint [21]. Lastly, Microsoft projects are built every day to ensure that the various pieces work together.

Within each project there are four phases respectfully, requirements phase, specification phase, development phase and testing to ensure efficient development cycles [21]. During the requirements phase a marketing team produces a vision statement for each project that address adding functionality and fixing issues. Next the project enters the specification phase the primary objective is to solicit inputs from all-important groups in hopes of getting a comprehensive strategy for implementation. Where it enters development in which Microsoft's unique waterfall methodology is used. Finally it enters testing in which the project is thoroughly tested using a variety of automated and manual tests. Throughout most of Microsoft's development groups there are a minimum of three checkpoints: schedule complete (the functional requirements are met), code complete, and releasing the project to manufacturing. Microsoft also employs metrics to help resolve conflicts and to help with decision-making. Some common metrics being bugs to date, code churn, clusters of defects, code test coverage, etc.

## VI. RISE AND FALL OF GREAT COMPANIES

Every company experiences the cycle of success and failures throughout their lifetime and it is no different when it comes to software companies. One may believe that achieving success in the technology world has become increasingly difficult, but in reality, holding on to the success one has achieved has shown to be even more so. Many large software companies have stayed at the top for years or even decades. However, as we move further into the digital age, the rapid changing world of technology and increasing competition has some companies unable to keep up and cause them to lose focus, direction and poorly execute their ideas. One company comes to mind in the recent past who has made multiple headlines questioning their goal and their future is Microsoft. We will take a look at this company and its rise to success and also its failures that ultimately left some deep marks on its image.

### A. Case Study: Microsoft

Microsoft's rise to success was primarily due to its Windows operating system, which was based off MS-DOS that was used in IBM PCs back in the early 80's[22]. Their vision from the start was to get a computer on every desk and in every home. They believed they could do it by providing an operating system with a graphical user interface that was flexible, easy to use, compatible with almost any system, and would cost a fraction of the price of what their competitors at places like Apple and Commodore were offering [22][23]. However, it was not until 1990 when they were truly able to deliver a great experience of the Windows operating system with Windows 3.0. Over the next decade, Microsoft began to soar with products like Windows 95, 98, Internet Explorer and Microsoft Office which gave users a seamless and integrated experience [22], while their competitors at places like Apple began to flop due to their lack of focus and direction.

However, at the start of the new millennium, Microsoft's momentum and success started to change with Bill Gates departure as CEO and the rise of software companies like Google with their search engine and Apple with products such as the Mac OS X, iPod and the iPod. Microsoft's silent failure with Windows ME was one small bump in the road but it was not the end of Microsoft. They continued to gain success with Windows XP, which became the bestselling operating system for years to come, and entered the console business with the Xbox, which successfully competed against systems by Sony and the Nintendo [24]. But the increasing pressure for innovation from the software industry and the growing success of Mac OS X had eventually led to one of the greatest failures in Microsoft's history with Windows Vista. Although Vista brought a clean new look and increased security features, the operating system was heavily bloated with features no one used which slowed performance, broke drivers and user applications.[23][24]

With the slow adoption rate of Vista and people switching back to XP, Microsoft had to come up with a better solution that brought the security and design of a modern operating system but also the performance and stability that was inherent in Windows XP. After taking the industry's feedback into consideration and understanding their requirements and needs, Microsoft was finally able to deliver that balance with Windows 7 which became their most successful product.

But as the industry began to shift from desktop to mobile in the later part of the decade, Microsoft's success started to decline once again due to competition and a growth in innovation from other companies. Products like the Zune began to flop due to lack of

investment in marketing, distribution and regular software/hardware updates, which were essential factors to Apple's success with the iPod [25][26]. Microsoft eventually started developing a new version of Windows Phone in order to compete with platforms like iOS and Android, but failed to gather a proper market share. They were late to the mobile market and the lack of innovative, game changing features along with a weak mobile application store, gave no incentive for developers and customers to switch from competing platforms [27]. This ultimately sealed the fate of Windows Phone.

Microsoft tried once again to get back into the game with the introduction of Windows 8 and the Surface tablet, but only to fall into another pit. The radical interface change with Metro and the loss of the start menu, was a great blow to customers who expected an even greater experience than Windows 7[28], and a more powerful experience than competing products like the iPad.

There were many factors that led to Microsoft's downfall as a technology leader, but what it ultimately came down to was the lack of direction, focus and execution, which ultimately hindered their chances at innovation. Microsoft tried to radically change their best-selling operating system in order to show innovation, rather than understanding their market and customer's needs. They had many opportunities to enter and seize markets but failed to until it was too late. Their change in direction from software to hardware and back to software had caused them to lose their focus. And products like Vista, Zune, Windows Phone and Windows 8 began to fail due to poor execution. Microsoft is one company that shows the difficulty of staying on top and the importance of having a focus, direction and good execution for innovation to happen.

## VII. CONCLUSION

In conclusion, there are many aspects that make Software companies and entrepreneurs innovative. We examined how the identity of major software innovators contributes to their success. Everything from hiring procedures, to vision is important in order to drive innovation. While there is no "dummies guide to software innovation" it how you establish your identity, or your companies brand, that paves the way for innovation.

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