An Example of Engineering Success and Failure.

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Abstract

Engineering played a large part in human history. In the early time we designed primitive tools for hunting and farming. We began with simple thought process for what the tools looked like and how they were best used. The simple thought process became more complex in time due to our increasing ability to adapt to our surrounding in addition to the need to survive and succeed in such surrounding. As a result, we gathered our knowledge through learning from the success and failures of our designs. The wealth of our past knowledge, coupling with our exceptional learning capability, gives rise to a wonderful engineering world that we continue to see it working so marvelously today.

However, engineering is a continuous process of applying trial and error and scientific methods to deliver the desirable outcome. There is immeasurable risks associated with such process that were overlooked in the past, causing failures in various degrees. The Titanic design is an obvious example. A well-planned engineering project usually provided adequate time for risk analysis in addition to future expansion of current design. The result is a long lasting product in the market over time. The Smartphones deserve to be an example of this engineering success.

An Example of Engineering Success and Failure

A Successful Engineering Product

It is not easy to have a successful product. As a means to succeed, enough engineering time is needed upfront to consider many important factors. For example, core functional requirement, environmental requirement, safety and reliability requirement, cosmetic and aesthetic requirement, to name a few. After a careful series of steps taken, the outcome is an engineering product specification, which is a blue-print paving the way to implementation and testing subsequent steps to verify and validate the integrity of the design at all levels, including material strength, core and feature functions, construction quality, and usability. Skipping any of these steps will lead to massive field failure, prohibiting profit earning, including business closure. Product failures are not necessarily financial failures, although bankruptcy may be the final result. "Berry, Defining product and brand failure, p.1".

The Smartphone Success Story

The smartphone was conceptualized back in the mid-1970s. Despite its inception, manufacturers did not mass produce it right away because wireless technology, including infrastructure, were still under development. Two decades later IBM released a smartphone device code name Simon Personal Communicator to business class users in 1992. The Simon PC was quite simple, having a black and white resistive touch screen, a stylus pen, and a charging station. The battery technology back then only allowed for roughly one hour of use per charging. The main users of the Simon PC were business executives or senior-level managers of large corporations, enabling them to send and receive emails and faxes, and marking the beginning of the smartphone era.

Still in the 1990s, Nokia, a Swedish telecommunication company, made a bold adventure into the smartphone market space, releasing its Nokia 9000 Communicator to public use. This device has a full keyboard, a 1.5-inch thick, almost 400 grams, and a black and white display. The Nokia 9000 had more capabilities than its IBM Simon PC counterpart. It was capable of browsing the word-wide web. This was the selling point for Nokia.

Through the turn of the 21st century, more companies hopped on the smartphone bandwagon. Qualcomm and Ericsson combined personal digital assistant (PDA) functions with smartphones. They all were vertically design with latches or hinges between layers to enable flipping or sliding the layers for more input/output user interface functions. However, smartphones were still unpopular in consumer electronic product space in this time.

It was the impact from outside the US that popularized the smartphone. Countries like Japan, Sweden, and France upgraded their infrastructures to enable public wireless communication that brought smartphones to the hands of their consumers. In this same period, US companies continued to manufacture enterprise-centric smartphones. In the next couple years, companies like Palm, HTC, HP, BlackBerry, Samsung, Nokia, Motorola, and Audiovox released their first batch of smartphones to US wireless carriers with the aim at the consumers. It is unfair to give credit only to the hardware side of the smartphones because the software side, particularly, the operating system side, deserve proper credit. Companies like Microsoft, Symbian, and Palm started to see potential gain in the smartphone market. They worked hard at making their mobile operating systems user-friendly to gain the selection from smartphone makers. As a result, smartphone makers tweaked their design to support different mobile operating systems such as Windows Mobile Phones, Symbian OS phones, and Palm OS phones to make smartphone products more appealing to the consumer market. The period from 2004 to

2007 marked a dramatic rise in smartphone usage. Smartphone makers such as BlackBerry, Samsung, Palm, and Motorola began to release their handset into the hands of everyday customers. Wireless providers such as Sprint, AT&T, Verizon, and Cingular began offering more powerful smartphones along with different data plans. The smartphone fever spread out to the consumer space.

Then a dramatic event happened in the wireless communication industry. In 2007 Apple released a smartphone with much more functions than any of its competitor. It included multimedia functions above other common features like email and web browsing previously found in other smartphone makers. Unlike other smartphones, Apple iPhone utilized capacitive multi-touch technology that enabled its users to type on the software keyboard, eliminating completely the bulky keyboard buttons found in the BlackBerry, Nokia, Samsung, and many other smartphones. The iPhone also had a high resolution color display. Its mobile operating system, the iOS, included many ground breaking features such as music player, video streaming, and third-party games. It was the iPhone that revolutionized the entire smartphone design and manufacturing industry. Since its release, the button interface keyboards disappeared in subsequent releases from other competitors. However, Apple faced a tougher competitor on the operating system front. In 2008 Google released the Android operating system to public domain along with its G1 Android OS powered smartphone for T-mobile carrier. The Android OS, while having all the features claimed by the iOS, is available in public domain as an open source. Since then, smartphone makers dropped other mobile operating systems from Microsoft, Palm, and Symbian. As of now there are only two major mobile operating systems: The Android OS and the iOS.

The outlook for smartphone is positive. Although the designers of smartphones seemed to hit the plateau in form, fit, and functions, the competition continues on for other parameters such as heat, thickness, weigh, and battery life. At the moment, computational power in all smartphones seem to enable their users to stay more in-touch with the world around them while having additional future support to faster speed by adding more communication channels by software. The smartphone is clearly a successful engineering marvel.

The Titanic Disaster

At the turn of the 20th century the largest steamship ever built named after the Greek giant deities, the Titanic, was released to the White Star Line. The ship weight more than 46,000 tons, almost 900 feet long, and a height of more than 25 stories. "*Bassett V. Causes and Effects of the Rapid Sinking of the Titanic, p. 2*". The Titanic was also equipped with modern design and technology, including sixteen major watertight compartments in her lower section that could be easily be sealed off should the hull be punctured somehow. These safety features gave the Titanic a self-proclaimed title of unsinkable [Basset, 2014].

On April 10, 1912, the Titanic started her voyage from Southampton, England, to New York, USA, with more than 2000 passengers and crew aboard. Among the passengers were some of the wealthiest and prestigious people at that time. Commanded by Captain Edward J. Smith, the ship wireless operators had received several ice warnings from other ships nearby, but the Titanic continued to sail at full speed into the darkness of the Atlantic Ocean. At 11:35 p.m., the lookouts spotted a massive iceberg less than a quarter of a mile off the bow of the ship. The engines were thrown into reverse immediately while the rudder was turning hard left. Due to a large mass of the ship and not enough clearance, the Titanic sideswiped the iceberg at 11:40

p.m., damaging nearly 300 feet of the right side of the hull above and below the waterline by iceberg piercing action. The water quickly flooded six of the sixteen major watertight compartments and dragged the Titanic front side slightly downward. By 1:20 a.m., the water had flooded through anchor-chain holes and submerging the front further downward. At 2:00 a.m., the front was submerged so much that the propellers were lifted out of the water. At 2:10 a.m., the stern was lifted out of the water almost 45 degrees. Due to the weight of the three propellers in the stern, the stresses in the Titanic's midsection increased tremendously, and at 45 degrees or more, the stresses in the midsection exceeded the ultimate stresses of the steel and the steel broke and tore the Titanic in half.

Material failure was the main contributor to the Titanic disaster. Brittle fracture of the hull steel indicated that the steel material was not properly selected to maintain structural integrity in cold water. Additionally, the rivets that held the ship together were not of the right grade of steel. The design flaws in the watertight compartments also contributed to structural failure by not accounting for the vertical dimension, allowing water to eventually flood the compartment in the vertical direction. Analysts believed that if either the rivets were made of proper grading material, or the watertight compartments were design to account for both vertical and horizontal dimensions, or the ship's body was made of better grading steel material, then the disaster would have been avoided.

Because of the Titanic disaster, stricter standards for safety regulations governing ships at sea were implemented, including mandatory electronic communication equipment, better lifeboat capacities, and sea-patrol for icebergs.

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