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Nokia: An Historical Case Study

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Abstract – Nokia is a Finnish company largely known for its telecommunication technologies. However, in recent times it appears to have lost some ground to competitors, primarily in the smartphone market, such as Apple and Samsung. In this historical case study, we explore the origins of Nokia and their progress toward breaking new ground in telecommunications technology. We also look at some of the pitfalls they encountered and how perhaps things could have been done differently. In particular, we focus on the aspect of their mobile phone interface design evolution and improvements.

Keywords – *Nokia, telecommunications, history, device interface, mobile phone*

I. INTRODUCTION

The name, ‘Nokia’ actually originated from a Finnish town called Nokia, and also the Nokianvirta river. It is a multinational corporation first started in 1865 by Fredrik Idestam, at first as a ground wood pulp mill. Later, with his close friend Leo Mechelin, there was a joint venture and he changed his small firm into a share company, Nokia Ab. At the beginning of 20th century, Nokia had established a rubber business after Eduard Olon’s Finnish Rubber Works (Suomen Gummitehdas Oy). It included also electricity generation to its business after Idestam retired. Nokia was then expanded to cable and electronics business when it joined Finnish Cable Works (Suomen Kaapelitehdas Oy).

In 1967, all of the three companies (Nokia Ab, Suomen Gummitehdas and Suomen Kaapelitehdas) which were jointly owned since 1922, merged as a new industrial conglomerate known as Nokia Corporation. Its first President, Bjorn Westerlund, had been responsible to set the organisation’s first electronics department in 1960, for the birth of telecommunications business. To summarize, Nokia was involved in various industries, from paper products, to vehicle tires, rubber boots, communication cables, plastics, aluminium, chemicals, electronics, computers, electric generation devices, robotics, capacitors and also military equipment [1]. Figure 1 shows Nokia’s toilet paper produced in the 1960s whereas Figure 2 shows an example of Nokia’s capacitor. Figure 3 shows the first Nokia logo in 1865.

As Nokia started its telecommunications equipment business in 1960, the business focused on the production of radio-transmission equipment at Finnish Cable Works. And as the European Union relaxed business regulations over telecommunication industries, Nokia further stepped

up to new challenges in mobile telecommunication devices as competition and demands increased [1].



Figure 1. Nokia Toilet Paper [2].



Figure 2. Nokia Capacitor [3].



Figure 3. Nokia 1865 Logo [4].

II. NOKIA'S IMPACT ON THE WORLDWIDE TELECOMMUNICATIONS INDUSTRY

In the 1970s, Nokia got more involved in producing telecommunications devices such as network equipment and digital switches for the telephone exchange. Later in 1982, Nokia claimed that they produced the first fully digital local telephone in Europe and first car phone for Nordic Mobile Telephone (NMT) with a network standard of 1G. The Finnish state sold its company called Telefonno (which was previously owned by Nokia network equipment production) and shares to Nokia, and in 1992, its name changed to Nokia Telecommunications. One of Nokia's breakthroughs in telecommunication technologies was the development of a Global System for Mobile Communications (GSM 2G), the second generation for network standards that can transfer both voice traffic and data.

With GSM technology, Nokia had launched many types of mobile phones, both prototype and complete products worldwide. GSM supports for text messaging service (Short Message Service or SMS) and high quality voice calls made it dominant in the mobile telecommunication industry in the 1990s. Nokia was the world's largest mobile phone manufacturer until 2012. In 2007, Nokia combined with Siemens Network to lead the global telecommunications infrastructure to focus on mobile broadband technology and services.

Nokia also joined with Microsoft to enhance its position in the smartphone market to rival iOS and Android in 2011, by adopting the Windows Phone operating system. Currently, Nokia and Alcatel-Lucent together combined to create the next generation technologies and services for an IP connected world (April 2015) and is expected to close the transaction in early 2016.

III. NOKIA MOBILE PHONE HISTORY AND CHANGES IN INTERFACE DESIGN

The Mobira Senator, introduced in 1982, was considered perhaps the first true mobile phone in box form, weighing 9.8 kilograms. The antenna protrudes conspicuously and the whole body consists of covered electronic parts and battery cells with a handle to let users carry it around. Its top part is where the number pad and other function buttons are operated without any display screen. At first glance, it may look like a digital household telephone connected on top of a modern-day dry car battery cell.

The hook (where the microphone and speaker components are located) is similar to the household telephone design at that time without any buttons to operate. Unfortunately, there is lack of available information about its interface descriptions. Figure 4 shows the Nokia Mobira Senator model.

In 1984, the Nokia Mobira Talkman was made as portable car phone since it could be recharged from the car's cigarette lighter socket. It weighed about 4.7 kilograms and could store 184 contact numbers. The idea of having dial buttons and a mono-coloured display on the hook where the microphone and speaker are located is that it would be easier for users to see which buttons are being dialled. Additionally, the keypad facing opposite from user's face also had the added advantage for comfort (no rubbery effect from keypad buttons) when talking.

The battery could last about 10 hours on standby and 60 minutes for talk time. Since its weight is half of its predecessors, it was considered more portable since it can be used and recharged while on a vehicle anywhere at that time. Figure 5 shows the Nokia Talkman NMT450 model and Figure 6 as it was used in the 1987 motion picture, *Lethal Weapon*.



Figure 4. Nokia Mobira Senator 1982 Mobile Phone [5].



Figure 5. Nokia Mobira Talkman NMT450 [6].

Nokia Mobira Cityman brick-form mobile phones starting in 1987 until early 1990s were considered one of the first 'compact' mobile phones ever made. It was released for the NMT network service, weighing about 760 grams (almost just a quarter of Talkman's) with dimensions of 183mm x 43mm x 79mm, reduced significantly from previous models since it used 1000mAh Nickel-Cadmium (NiCD) battery technology. Talk time is however reduced to 50 minutes and only 14 hours standby time, while having to charge for about 4 hours.

It has a hands-free design (no more attached wire like previous models) and has both table and car charger accessories, adding more to the portability factor. As shown on Figure 8, the functions are straightforward such as; lock and release phone lock, last dialled number, talk time duration, keyboard and display lighting control, display own number, signal strength and battery indicator. Some functions are also displayed for quick and easy access to them such; CLR (clear), END, SND (send), SEL (select), PWR (power) and VOL (volume). Other functions are also combine with numbering keypad such as STO (store) on star, LCK (lock/unlock) on 0 digit, and RCL (recall) on hash.



Figure 6. Nokia Talkman in Lethal Weapon [7].

Figure 7 shows the front and side views. Also notice that the texture on left and right side of the phone enhance handgrip friction to the phone while talking or holding. The brick size phone still was not comfortable when using

since the gripping felt unnatural (not ergonomic due to its depth) especially for small-sized hands, compared to the Talkman's hook design.



Figure 7. Front and Side Views of the Cityman [8]

Still, the portability concept significantly improved as battery technology changed to NiCD and the introduction of charging dock that use the PWR60N standard (input 220V, output 18V). The size of keypad seems comfortable and straightforward enough to use the buttons without confusion compared to modern-day compact designs, except touch-screens, which depends a lot on the user.

The 1990s version of the Nokia Cityman PT version is also in brick form but the size is smaller and more features are included. The dimensions are similar 180 mm x 55 mm x 40 mm, and weighing 500 grams; the monochrome display and can store up to 40 contacts. Figure 8 shows the significant change on how the dimensions on the hand grip area changed for better portability. Notice that the main functions (select, recall, power, send, clear and end) are located on top part of keypad with different coloured buttons for quick identification.

Number buttons are now included with alphabets to type the names for contacts. This version also has the ability to automatically redial for speed dialling. Figure 9 shows the isometric view of the PT version and also the smaller size of the NiCD battery after been detached from its back (the charging port was missing). In 1992, Nokia Analogue 101 was introduced in the form of a 'candy bar', and considered the best-selling phone of the early 1990s. Nokia research showed that even though people wanted smaller phones, they also wanted it to be as easy to use as bigger phones of the time.

Frank Nuovo became Nokia's chief designer in large part due to his idea to highlight the ergonomic aspect of mobile phone design. He mentioned that the keypad layout should be well-spaced, and placed in a way for easy and natural use. Other competitors at the time tried to over-crowd the keypad with too many functions and complicated designs. Nokia 101 introduced the green and red-coloured keys for answer and reject functions. It also had a backlit keypad for use in the dark. The distance between the mouth and earpieces is also considered improved (since it is smaller) and had a comfortable distance.

Another interesting feature is its intuitive and easy to learn menu system [10]. Later in 1994, Nokia released the almost similar interface and sized model 1011 for the GSM digital handset. It had a retractable antenna/aerial in

the analogue version. The main difference between the two models is the diamond-shaped earpiece [11]. Weighing about 300 grams, the dimensions are; 168 mm x 60 mm x 20 mm. The hash and star buttons were not included with specific function indications. The screen size and large font size were considered readable with both battery and signal strength indicators. New cursor keys (up and down) are designed in such a way that user can easily browse and choose options. The menu button was now storing all the functions, unlike the previous approach that exposed some frequently used functions on numbered keypads.



Figure 8. Nokia Citiman PT612 Keypad [9].



Figure 9. Nokia Citiman PT612 and Battery [9].



Figure 10. Nokia Citiman PT612 Back View.



Figure 11. Underneath the Nokia Citiman PT612.

The power button (on/off) was also introduced with a new red-coloured symbol (easily recognizable when first encountered), and no longer indicated by a 'PWR' labelled button. The new location for both call and reject buttons on the middle area of keypad suggested that both are the most important main functions on the phone and easily identified. Overall, the minimalist keypad layout design is considered user-friendly, easy to learn and understand.



Figure 12. Nokia 101 Analogue Phone [12].



Figure 13. Nokia 1011 GSM Model [13].

The Nokia 2110 series was also famous in 1994, including the first Nokia ring tune ever introduced in their mobile phone products. The second generation of the GSM phone was considered a best-selling business phone from 1994 to 1997 due to its light weight (236 grams), small size (56 mm x 148 mm x 25 mm depth). The interface design was significantly changed from the previous model. Due to its small size, the navigation and 'select' keys are grouped together within the display screen in an oval shape, separating the call/reject keys just below it. Such a layout indicates that users will first access the menu or memory functions in order to recall numbers, send messages or choose other functions.

It is reasonable that the navigation and select keys are located close to the display for easy browsing and reference. In Figure 14, notice that the power button is also relocated to another location (upper side just below

the antenna, almost embedded) to separate it from the keypad area for better visibility and to minimize accidental actions during travel or talking. The antenna is retractable and similar to previous version.



Figure 14. Nokia 2110 [14].

Referring to Figure 15, the Nokia 6110 was the next generation of the same model 2110, in which both interface layouts are almost similar, except that 6110 does not have both a cancel and alphabet toggle button, and it also is significantly reduced in size and weight. Not long after the Nokia 2110 series received positive feedback from customers, the revolutionary curved design Nokia 8110 Banana phone was released (1996) as one of the first 'slider' phones ever innovated; a slimmer design and fits in most pockets.

The curved design has the advantage of fitting the natural form of the user's face and had better voice quality with a microphone that was located nearer to the mouth. The interface design of the keypad and display was still similar to its predecessor. Figure 16 shows the 8110 model as it was used in the 1999, 'The Matrix' movie, and Figure 17 shows its sliding ability. To receive call from others, one just needs to open the slider, and to end the call, to close it. The slider can also be adjusted to suit the position of the mouth [16].

One of the most popular and successful phones in history was the Nokia 3210 GSM phone released in 1999. It had a weight of 153 grams, with dimensions of 123.8 mm x 50.5 mm x 16.7-22.5 mm. It was also considered the first mass market phone to accommodate lower and middle class users in the European region.



Figure 15. Comparison between the Nokia 2110 and 6110 [15].



Figure 16. As seen in the 1999 The Matrix movie [17].



Figure 17. The slider can be adjusted [18].

Designed by Alastair Curtis in Nokia's Los Angeles Design Centre, its famous features are the absence of an antenna and customizable fascias (clip-on) [19]. Its casing construction may be the reason for high durability compared to other manufactured phones. It had slightly

curved sides to follow the shape of the palm, allowing the fingers and thumb to easily manipulate the buttons.



Ben Stiller as Derek Zoolander parodying the small phone craze at the turn of the millennium.¹



Figure 18. The Nokia 3210 [20].

The power button is on top of the phone with main blue button in the middle to choose options. The 'C' (cancel) button is also an undo action, together with navigation buttons (up and down) located on the 'horse-shoe' shaped display frame. The ergonomic simplicity of the keypad layout design of the Nokia 3110-3310 series should be a good example of blending 'art-and-science' in designing and developing complex devices. Its successors (Figure 20), the Nokia 1100 series was also the world's best selling handphone since about 2003. It was targeted toward developing countries and users who do not need advanced features other than making calls, saving contacts, sending messages, alarm clock and a few others. The keypad and front face were designed to be as dustproof as possible, together with non-slip material for

¹ "Derek Zoolander Ditched His Tiny Flip Phone for a Giant Samsung"; <http://www.theverge.com/2015/11/10/9708870/zoolander-2-samsung-selfie-smartphone-product-placement>.

humid weather. All buttons are available on the keypad, including the power button [22].



Figure 19. Curved sides of the Nokia 3310 [21].

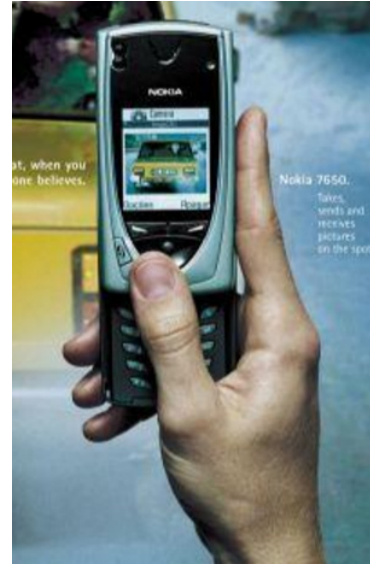


Figure 21. Holding the Nokia 7650 [24].



Figure 20. The Nokia 1100 [22].

In 2002, Nokia released the first European phone with a built-in camera, weighing 154 grams with sliding ability between the keypad and display screen. The dimensions were 56 mm x 114 mm x 26 mm. It was also known as the first phone to use the Symbian OS, with a colour display embedded with general packet radio service (GPRS), multimedia messaging service (MMS), infrared and Bluetooth connectivity. The Nokia 7650 (Figures 21-23) can be considered a smartphone since it had an operating system that offered messaging, internet access, image management, calendar, to-do lists and other advanced features.

To access the 640x480 pixel camera, one simply slid open the keypad. Most of the menu browsing and selecting items can be accessed via the joystick [23]. With the joystick, the user can choose all four directions (up, down, left, and right) and select objects or functions on the screen. However, gripping may be an issue during single-handed operation since the thumb has to be in a lower position compared with the other four fingers.



Figure 22. The Nokia 7650 against a matchstick [25].

The clamshell Nokia 613-133 smartphones released in 2006 included a 1.3 megapixel digital camera, a slot for a microSD Card, 240 x 320 Quarter-VGA colour (16.7 million colours), 128 x 160 Thin-Film-Transistor Liquid-Crystal Display (TFT) external screen (262,144 colours), and Enhanced Data rates for GSM Evolution (EDGE) for faster internet access. Nokia 613-613 phones had also other features such as customizable the phone features using the Nokia PC Suite (from 613), adding MP3 files as ringtones (612), and the first phone ever embedded with near field communication (NFC) capability (613).

In terms of design, the soft plastic is pleasant to touch and comfortable to grip. The famous Nokia 'horse-shoe' decoration can be seen by silver frame on the front encompassing the external display screen, logo and camera; this time without any buttons. The weight was 112 grams and the top half gets thinner towards the edge (20 mm) and does not reach the bottom part (creating an interesting optical effect when phone is closed), as seen in Figures 24 and 25, with 92 mm length and 48 mm width.



Figure 23. The Nokia 7650 keypad [25].



Figure 24. Nokia 6131 front view (closed).

Peripheral buttons (on/off and camera buttons on the right side, and volume control buttons on left side) were rather small and maybe difficult to recognize by touch. One significant complaint about this phone is the rather sensitive camera button that can be accidentally activated when the phone is opened or closed. To close the camera application, the user has no choice but to open the phone again. The opening mechanism is well-built but closing the phone with only one hand can be a problem for some people. The four-way navigation key stands out with a chromium-plated frame with smooth and easy touch orientation. The function keys are considered large enough for finger control and other main keys such as call/reject and context buttons surrounding the navigation key are also consistent with previous keypad layout designs [26].

The introduction of the 2007 Nokia N series (Figure 26) would be the starting point of interface design weaknesses, even though compacted with all sorts of advanced features added such as; built-in GPS system, 5 megapixel Carl Zeiss optics camera, video and still image

editors, built-in WiFi, accelerometer, up to 8 GB internal memory and larger displays (2.6 inches). The form factor is a two-way slider, in which the left side is for multimedia keys and right side for numbering/typing (keypad). The size is considered large (99 mm x 53 mm x 21 mm) and rather heavy (120 grams).



Figure 25. Big sized display and keypad (opened) [21].

Overall, its external design interface failed to live up to Nokia's previous concept of simplicity, minimalism and elegance. There are too many buttons for different functions located on almost all sides, not to mention the unnecessary multimedia keys. Referring to Figure 26, notice how the main navigation button is surrounded by multiple functions at same time, introducing difficult touch orientation with the risk of accidentally pushing the wrong buttons while navigating. Call and reject buttons are improperly sized and not distinct enough from other context buttons. Four new buttons (edit, undo, menu, home) are included near the navigation button, adding to the confusing interface. The power button is on the left side whereas the speaker, earphone jack and microSD card slot on the bottom, camera at the back, and camera, video gallery and volume rocker at the top.

The Nokia N97 (as shown in Figure 28), as the successor of N95, was released in 2009 with a touchscreen and tilt slide-out QWERTY keyboard. The totally changed design interface was due to the space used by its touchscreen. The simplicity of the keyboard layout design can be clearly seen with previous navigation keys no longer situated on front screen, except for the call/reject keys and home button.

Between 2010 and 2012, Nokia focused on touchscreen smartphones, no longer bearing its famous buttons or keypads, except for power, volume control and camera buttons, as seen in Figure 29. The Nokia X series was released in early 2010, and the X6 model was considered a more tactile and comfortable device to handle, either by stroking with a finger or swiping with the thumb across the screen since the display size is relatively small (3.9 inches).

The almost curved trapezoidal shape fits and sits comfortably in the hand even though some people complained of the cheap and easily bendable feel of the back cover. The front side of the phone included the call/end and menu buttons with different backlight colours

for each button. It operated on the Symbian OS and weight about 120 grams. To unlock the touch screen, the key-lock slider on the right side had to be pulled toward the base (it may have been too stiff and at an uncomfortable location). The volume at the top and camera shutter at the bottom right is considered Nokia's typical design for smartphones [30]. The last of the Nokia N series released in early 2012, the N900, was also the last flagship Nokia smartphone before merging with Microsoft Corporation (in later years, the Lumia is known as a Microsoft smartphone instead of Nokia).

The N9 series (Figure 31) runs on the Linux-based MeeGo "Harmattan" OS (no longer in operation) in order to compete with iOS and Android. Its minimalist external design made the N9 as Nokia's finest smartphone design

to date: 854 x 480 pixel resolution, 3.9-inch AMOLED display, 135 grams in weight, scratch resistant curved glass, polycarbonate casing for high durability, 8-megapixel camera, NFC capabilities and no buttons on the face of the phone [31]. The curve of the front display surface is to improve the quality of the screen by bringing it closer to the glass, and at the bottom right is the front-facing VGA camera, unlike any other common smartphones design. There is no more physical camera button to reduce wobbliness when taking a snapshot. The only physical buttons are volume control and the power button on right side. The main criticism of this phone is the lack of software capabilities, slow response (especially when swiping or sliding) and a lack of compatibility with many internet graphical plug-ins due to the MeeGo OS.



Figure 26. The Swiss Army knife Nokia N95 model [27].



Figure 27. Comparison between iPhone and Nokia N95 [28].



Figure 28. Nokia N97 [29].



Figure 29. View angles of the Nokia X6 [32].



Figure 30. Slightly curved to the edge for a comfortable grip [30].



Figure 31. Nokia's last flagship smartphone, the Nokia N9 [33].

IV. USER AND MARKET VIEWS ON NOKIA PHONES

The following is the impression and feedback of the Nokia user market for phones and smartphones between the 1990s until about 2011:

- a) In 1996, the Nokia 9000 Communicator was considered consumer friendly and having amazing innovative breakthroughs. It had all-in-one capabilities (email, fax, internet, word and spreadsheet), but was not commercially successful. In the same year, the Nokia 2100 series was famous for the first Nokia tune ringtone and sold around 20 million units worldwide [34].
- b) In 1997, the Nokia 5110-6110 series was famous for the Snake game, fluid system menu, text messaging, organic ovoid design, snap-on covers with a wide range of colours, internal antennas, email and a big display [34].
- c) In 1998, nearly 41 million units of the Nokia 6100 sold, as it was a success compared to Motorola, and Nokia became the top mobile phone maker [35].
- d) In 1999, the Nokia 3110-3310 series with many ringtones, games, MMS and SMS was versatile and a pleasure to use. It was also considered as one of the most popular phones in history and sold around 160 million units. By the end of 1999, Nokia sales increased 50% year-on-year, and profits shot up nearly 75%. Their stock price reached 220% [35].
- e) In early 2000, the budget-friendly Nokia 1100 series sold around 250 million units and was also considered the best selling phones in the world [35].
- f) In 2007, the specification differences between the Nokia N95 and iPhone were perhaps too obvious; i.e. the lack of 3G support, poor camera quality, small screen, no touch capabilities, complicated and cumbersome interface, slow and sluggish Symbian OS, no user-friendly app customization, and difficult to use compared to new touchscreen devices [36]. Although it was among the most feature-packed phones at that time, with iPhone coming about, the brand failed to impress customers [37].
- g) As Apple launched its first iPhone generation in 2007, Nokia introduced its first all touch smartphone in 2008 as 5800 Xpress Music with the Symbian OS. Although it sold around 8 million units, it didn't manage to compete with iPhone's quality as the touch-experience was sub-par [35]. Nokia was at its peak in 2007, but the market sat at 15% market share due to low-end basic phones models.
- h) In 2008, Nokia sales decreased 3.1% as the first Android version was launched. It was also reported that Nokia was slow in the mobile phone market to satisfy customer expectations compared to other smartphone manufacturers at that time. To make matters worse, 46 million faulty phone batteries were also identified between 2005 until 2007 [35].
- i) Between 2010 and 2012, users entered the world of touchscreen smartphones with the X and N series. After partnership with Microsoft, the Nokia Lumia 920 series (although with Windows Phones OS) were considered among the best-selling phones at Amazon.com due to high build quality, good camera quality and a top-notch suite of integrated apps. However, many customers sold off their Lumia

phones for other brands due to its missing third-party app support, heavy bulk and thickness, overheating issue, short battery life when using GPS or Maps, blurry captured images, slow picture taking, difficulty to transfer video to YouTube, and with a relatively high price for its specifications. In short, it was still unable to compete with the iPhone and Samsung brands even with such innovations [38].

In 2000, Nokia's market was valued around 210 billion USD (over 40% market share in US), and 30.6% global market share, followed by Motorola (13.3%), Ericsson (9.7%) and Siemen (8.6%). In 2005, Nokia's market value shrunk to 75 billion USD and down 14% in US market share outperformed by Motorola. After 2010, Nokia's global market settled to about 28%, indicating the general decline of the Nokia smartphone business [39].

V. IMPACT OF NOKIA PRODUCT DEVELOPMENT ON STAKEHOLDERS

Due to stiff competition in the consumer electronics market, there was a sharp drop in the company's profits after 1987. Nokia's Chairman Kari Kairamo committed suicide by hanging himself probably due to the stress, and under new leadership, Nokia was divided into units. In the 1990s, Nokia sold almost all of its other divisions, and changed focus only to mobile phone production [35]. In the years between 1990 until early 2000s, 'Nokia' became a household name for mobile phones.

In 1998, Nokia overthrew Motorola as largest phone manufacturer. Embracing "Nokia DNA", a concept that has a distinct but consistent look, Nokia engineers and designers experimented with multiple designs and engaged in extensive research. However, the refusal to

change the design turned out to be one of the reasons of Nokia's decline. Nokia abandoned the US market for customized products, reducing the production of flip phones which were common in the 2000s. Tuong Nguyen, one of the Gartner analysts commented that, "*Nokia wasn't delivering, or not delivering quickly enough. The Korean vendors could deliver it faster, and they were able to pick up on (Nokia's) weaknesses*" [39].

In mid 2007, Nokia and the Symbian OS were on top before the iPhone was released. Symbian devices had a 65% market share. Symbian was considered a kind of Android before the actual Android (e.g. choices on the app store, games, supports touch, large-screen devices, UI, web browsing). According to a journal article written by former Symbian executive David Woo and Professor Joel West, the after-market software sales for Symbian smartphones remained low. For example, Apple managed to hit 100,000 apps in a year, compared to 7 years with 10,000 apps for Symbian. It was also reported that Nokia was unable to sell Symbian apps conveniently and as easy as the Apple store due to the fact that it did not have any app store.

It had a license fee, no unified and complete UI developed with the OS, a fragmented app community, was limited to legacy code, did not have flexibility for third-parties to develop Symbian apps, was very slow to decide on the open source issue, and was challenged to adapt to modern APIs and better development tools. Figure 32 shows the downfall of the Symbian market share. User experience was not competitive in the Series 60 and the UI was still behind competition. From this point, apps did matter a lot and Nokia's Symbian was found wanting; for example, there was no official Twitter app for Symbian. The problem-ridden Symbian OS made Nokia decide to stop the platform in 2011 and converted to Windows OS phones instead [39].

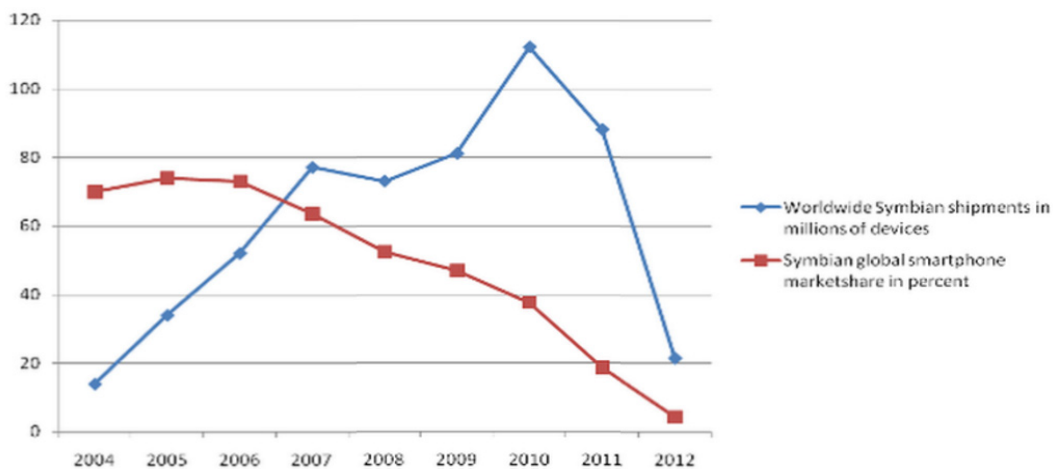


Figure 32. Symbian Market Share [39].²

² "Android before Android The long, strange history of Symbian and why it matters for Nokia's future"; <http://www.zdnet.com/article/android-before-android-the-long-strange-history-of-symbian-and-why-it-matters-for-nokias-future/>.

Due to decisions made in the year 2000, in which there was a need for as many 40 or 50 models a year, Nokia established component workshops and lost its product-catered approach. A former Nokia manager said that they forgot that the company was actually selling mobile phones for people; the product became characterless, standard fare devices combined together out of basic components and not really differing one from another in any meaningful way. Innovative and creative thinking was replaced by factory thinking (similar perhaps to how many universities and colleges are becoming more and more profit-oriented rather than focusing on the actual quality of education). In 2008, Nokia decided to discontinue the cellular modem and focus on the CPU and modem as one system-on-a-chip (SOC). In 2009, consumers were getting more conscious of what apps to expect in their phones, and many developers focused on iOS and Android platforms, moving away from Symbian.

Nokia still lacked the app store (a year after Apple App Store) and had a bad user interface design. The N97 model was among the worst due to its high price and low technical specifications compared with the iPhone, which had better specs and a cheaper price [39]. In the same year, Nokia laid off 1,700 employees worldwide. The mobile phone market had changed direction toward

Apple, Blackberry, and newcomers like HTC, LG and Samsung.

In 2010, 91% of developers were interested in developing for the iPhone, 82% for Android, 28% for Windows Phone 7, whereas Symbian dropped to just 13%. In the same year, Samsung and Sony Ericsson abandoned the Symbian platform. Since CEO Stephen Elop was appointed in 2010 and saw a rise in profits, job cuts continued aggressively. The MeeGo OS in 2011 was too late to compete with Android and iOS.

The view was also clouded by the “phone-first” concept, not what the web companies predicted (that the future will be about data, not voice). Nokia also reportedly did not understand the significance of apps, software and building an ecosystem around the apps. Additionally, they underestimated the importance of third-party apps in smartphones. Many consumers are attracted to smartphones that are more than just communication tools. However, Nokia assumed that downloading apps was only done by the minority of people [40]. Nokia’s specialty was in fact its hardware, not the software [39]. The management failed to foresee that the Android platform could catch up with it, as shown in Figure 33 below. In September 2013, Nokia sold its Devices and Services to Microsoft, ending its many years of mobile phones reign.

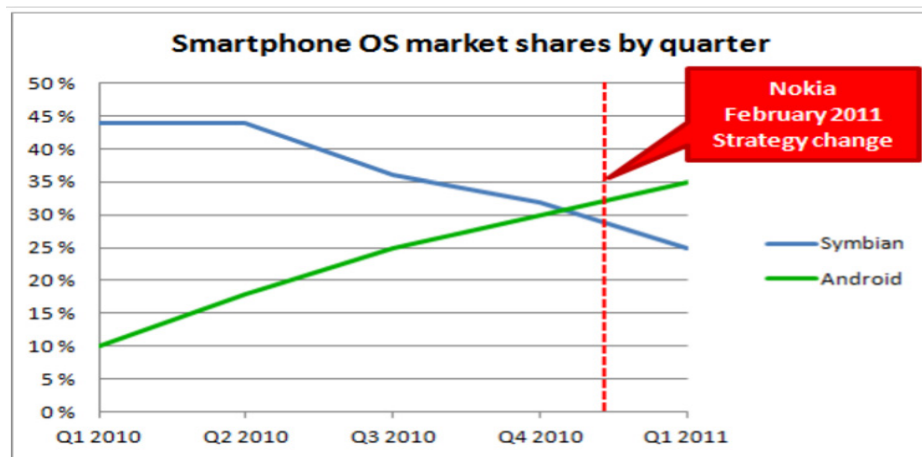


Figure 33. Android OS Market Share Compared to Symbian [39].

VI. LESSONS LEARNED BY NOKIA’S DOWNFALL

The year 2000 and later saw the decline of Nokia as wireless and internet technologies evolved quickly [35]. One author [41] concluded that Nokia failed to deliver after 2005 in two main areas; value proposition and marketing strategy. They did not seem to understand what their value proposition was; without a strong proposition, users do not have a reason to pay attention to it.

It should have something different and better; for example, Apple was about their prestige and Samsung about their versatility. Nokia did not have anything special (they tried to make state-of-art cameras but it was too late). Second, they do not know what marketing should be focused on. For example, Nokia’s messaging is

all over the place, lacks consistency, and people do not have any idea what makes Nokia better than other alternatives. It was as if they focused on just random factors of the moment.

Nokia took too long to embrace the smartphone revolution, with many mistakes in strategy, and an unwillingness to embrace drastic change (especially the touchscreen trend) when it was required the most. Apple’s iOS touchscreen-based software had revolutionized how people interact with their phones in comparison with Nokia’s Symbian OS. In the case of the Symbian OS, they tried to add a touch feature to it to compete with the iPhone, but unfortunately the patch failed to deliver a fluid user experience.

Unlike Nokia, Samsung for example, has shown that being a ‘fast follower’ is an important strategy to

compete. Nokia failed to realize how quickly they needed to change and how swiftly Google's Android would take over the smartphone market. Choosing Windows OS Phone over Android was also another flawed strategy that cost their business [40]. These days, Nokia is just a part of the Microsoft family.

VII. CONCLUSION

Nokia was truly famous for its physical interface design and other ergonomic elements of its mobile phones. They were creative especially in compacting such a complicated physical interface design into a small portable device. The transformation from clean and simple to complicated interface design indicated that as technological requirements become more advanced, so do the physical interface layouts.

The introduction of touchscreen technology replaced all these external interface design issues. Unfortunately for Nokia, the rise of downloadable and customizable apps on both the iOS and Android replaced their relatively unfriendly Symbian OS used in Nokia phones, leaving it unable to catch up in the modern smartphone market. Nevertheless, there were many lessons to be learned from this great company's history. In its prime, it was an example to all.

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