The Mobile Handset Industry in Transition

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Synopsis: In an award winning article published in Business *Strategy Review* in 2004, Jamie Anderson and Bryn Williams described the process of value chain evolution in the Mobile Network Operator (MNO) industry, and how this evolution was causing wrenching changes for incumbent firms. In this latest article, Anderson writes with Martin Jonsson to explore how similar challenges are now facing firms in a closely related sector - the mobile handset business. Just as is the case in the MNO industry, the mobile handset value chain is in the process of unbundling from vertically integration towards an ecosystem of specialized firms. This transition will require mobile phone manufacturers to adapt their value chain approaches accordingly, and to rethink the basis for future competitive advantage.

Introduction

In an award winning article published in *Business Strategy Review* in Autumn 2004, Jamie Anderson and Bryn Williams described the process of value chain evolution in the Mobile Network Operator (MNO) industry, and how this evolution was causing wrenching changes for incumbent firms. This paper builds on that earlier article to explore how similar challenges are now facing firms in a closely related sector - the mobile handset business. Just as is the case in the MNO industry, the mobile handset value chain is in the process of unbundling from vertically integrated structures towards an ecosystem of specialized firms. And just has been the case for MNOs, this transition will require mobile phone manufacturers to adapt their value chain approaches, and to rethink the basis for future competitive advantage.

A short history of the mobile handset industry

During the late 1980s and into the 1990s large firms such as Motorola, Ericsson, Nokia and Siemens pushed the frontiers of mobile handset performance, and the industry was considered to be a classic case for a vertically integrated industry. These vertical integrators not only controlled the design, production and marketing of mobile phones, but also the mobile communications infrastructure business.

Evolving their products from a suitcase-sized device with limited appeal beyond a very narrow niche of business and professional users, these vertically integrated firms invested huge sums in research and development to improve the performance and reduce the size of mobile phones. As was the case with the earliest PCs, software components, hardware components and operating systems were produced in-house, and assembled together in interdependent product architectures. The resources required to enter the fledgling mobile phone industry were beyond the means of most small and medium sized players.

But the world has changed. As was the case in the PC industry in the 1980s and 1990s, the mobile phone handset industry is today 'unbundling' with increasingly specialized firms entering the market with components and software that are assembled by branded manufacturers and ODMs into finished devices. Now, as then, there seem to be several motivating factors at the heart of this process: evolving technological standardization, gains from specialization driven by differences in the evolving knowledge bases across the industry, and gains from trade emerging from the emerging differences between specific firms. But powerful buyers – the mobile network operators – are also exerting an important influence on the break-up of the mobile handset value-chain by demanding manufacturers to integrate certain standards-based technologies, software operating systems and/or applications.

Recent trends in mobile – the value chain unbundles

Like PCs, mobile phones are becoming increasingly sophisticated and most advanced devices now incorporate microprocessors, memory, operating systems, applications and core components such as LCD screens and keypads. End-users and operators are demanding applications and functions from the PC industry. Given this complexity, it is virtually impossible for any single handset manufacturer to retain industry leading expertise across the rapidly evolving spectrum of hardware and software technologies.

What is inside a mobile phone?

The core technology inside a mobile phone is typically based on a chipset existing of three or more main components (Integrated Circuits) designed to collectively provide a complete functionality for communication and running applications. The Radio Frequency Circuit (RF) sends and receives voice or data signals to the mobile phone, while the Mixed Signal Circuit converts the signals from digital to analog and vice versa so that the information can be managed by the Baseband Circuit (BB). The BB can be seen as the phone processor where both the application software and the communication software is managed. The difference between Application Software and Communication Software is that the latter is real time critical, which means that it is live and functioning constantly. The software can be managed by a common Real Time Critical Operating System (RTOS), which is the industry standard in entry-level phones. The key difference between an entry-level phone and a smartphone is that a smartphone uses two operating systems, one for the real time critical communication part and one for the applications. Examples of these application operating systems are Microsoft and Symbian. Smartphones also typically incorporate a dedicated application processor that provides enhanced performance of the applications.

Some firms within the mobile phone industry, such as Ericsson and Qualcomm, have sold or hived off upstream or downstream businesses to focus on activities within the value chain that they consider to be their core competence. Others vendors such as Nokia continue to own but are de-coupling upstream from downstream operations, taking the former to sell to competitors and new entrants, and the latter to purchase components from third party suppliers when necessary to maintain competitiveness.

There has been the emergence of reference design houses, created mostly from the internal radio frequency platform development groups, internal software houses and/or semiconductor businesses of the established players, that integrate software components, hardware components and an operating system into a tested and verified system solution that can be used to build a mobile phone. These firms now license their designs to both original device manufacturers (ODMs) and original equipment manufacturers (OEMs), and work closely with their customers to minimize perceived design and manufacturing risks. As of mid 2005, Nokia was virtually the only remaining manufacturer that did not rely on third-party platforms to some extent, with reference designs and platform solutions still developed in-house across all product segments.

Qualcomm was one of the first companies to split up its vertical structure, selling off its handset division in 1999 to focus on CDMA baseband chipsets and other technology components which now form the basis of third-generation wireless networks. Today the company receives royalties from the shipment of any CDMA handset, and in 2004 alone, Qualcomm spent almost USD 1 billion, or 19 percent of its revenue, on research and development. Around one-third of the company's 2004 revenues (and 60 percent of its profits) came from royalties on all equipment that uses CDMA technology; the remainder came from selling the chips that rely on that intellectual property, where it has a market share of 80 percent.

Siemens, recently acquired by BenQ, also acted early to break-up its integrated structure through the creation of Infineon (hardware solutions) and acquisition of software developer Comneon as reference design houses to provide platform solutions. Motorola Inc. has remained an end-to-end supplier from silicon to software. But in February 2004 the original handset division was split into Motorola PCS (Personal Communications Sector) and Freescale (a mobile platform provider), which was subsequently divested from Motorola Inc and listed as an independent company. Freescale remains the main platform provider to Motorola, and Freescale's platforms are also used by Motorola's ODMs partners. Since 2002, Motorola has licensed its handset designs to at least 12 other manufacturers.

Ericsson created Ericsson Mobile Platforms (EMP) at the time of the creation of the Sony Ericsson joint-venture in 2001 as a platform provider to license complete, end-to-end interoperability tested mobile platform designs to other vendors, both established and new entrants. Today, EMP offers total system solutions for both 2.5G and 3G that includes hardware (RF & BB) and software (RTOS, OS, Applications), reference design, development tools, support and documentation. Key customers include Sony Ericsson as well as a number of Korean, Japanese and other East Asian manufacturers. Other platform suppliers include Qualcomm, Agere, Texas Instruments (TI), and Broadcom. At the time of writing, Nokia did not yet offer its hardware platforms to third parties, but was actively developing its Series 60 application framework (see below). The general set-up for platform providers can range from hardware design only with standard ASICs, to a total system solution that includes hardware, software, customer support and customer training to help manufacturers quickly start developing their products.

Established OEMs also now work with ODMs such as Flextronics who are contracted for 'Ready To Launch' (RTL) product development. These devices are typically based on a product specification developed by the brand owner and reference design house, and the ODM is contracted for manufacturing. But some specialized ODMs such as Arima, HTC, Compal, and Bellwave are also moving to offer product design and integration, meaning that a complete functionality related design and implementation of operating system, applications and hardware components is created, either done by the specialized ODM or in collaboration with the OEM. So today, a brand owner can be a traditional handset manufacturer, mobile network operator (for example T-Mobile's MDA smartphone produced by HTC or any other company having the ambition to market and sell mobile handsets – a significant shift from the situation even a few years ago.

The approach of mobile phone manufacturers to working with ODMs has varied, but the overall trend has been for manufacturers to outsource an increasing share of their production. Growth in the volume of ODM handset manufacturing exceeded 40% in 2004, and this trend is likely to continue. Siemens has chosen to focus internal development on the entry segment, and retained internal capacity for product design and integration, production, distribution, marketing and sales of low-end products, while using ODMs for the design and production of high tier handsets. Sony Ericsson has relied on ODMs such as Flextronics for outsourced manufacturing across some of its mid-tier products and smartphones, and has outsourced both development and production in the lower segments. Motorola PCS has used ODMs for some development and production of handsets, especially in the lower segments, with about 20% of the company's handsets made by third-party contractors during 2003. The company planed to increase that total to 30% by end of 2005. Nokia has tended to use 3rd party contract manufacturers only for volume production at the end of a product lifecycle. Both Samsung and LG undertake manufacturing in-house.

In addition to the growth of outsourced manufacturers, there has been a proliferation of firms specializing in the design and development of specific hardware components. Some of these companies manufacture dedicated and proprietary hardware components such as radiofrequency chips (Skyworks, RF Microdevices, Philips and Agilent), power management and audio components (Analog Devices, Dialog, Renesas, and National), and application processors (TI, Intel, Freescale and Samsung).

Other companies specialize in the manufacture of key peripheral components such as displays, camera modules, memory and batteries. Example of key peripheral suppliers include Intel, Samsung, and TI in memory; Seiko, Philips, Samsung, Sony, and Toshiba-Matsushita Display in LCD displays; Sony, Agilent, Panasonic, Micron, and Samsung in Cameras; Panasonic, Hitachi, Sony, and Sanyo in batteries and; RFMD and Skyworks in radio. Many of these components need to be customized to be able to be used since there are few standardised interfaces, but there is now a strong push within the industry towards developing the conditions for modularity – specifiability, measurability and predictability of component attributes and interfaces. Standard hardware components such as resistors, capacitors, filters, duplexers have already evolved in this direction.

Very recently some component suppliers have sought to develop and market subsystem rather than individual components. A good example of this is RFMD, a company that previously developed power transistors before starting to integrate them in power amplifier modules and subsequently complete radio frequency (RF) subsystems. To succeed, RFMD has attempted to work with handset manufacturers to create standard interfaces between its modules and other product components. Some chipset suppliers are moving in the same direction.

Another group driving the development standardization of components and interfaces have been the suppliers of cloned or “copycat” components. These firms have grown by basically cloning existing components, but to achieve volume advantages have recognised the need to develop products that can easily replace any ODM component. That means that the cloned component needs to be modular and produced to fit many different interfaces. This can be done for subsystems, such as an LCD or camera system.

But perhaps the most significant move towards the creation of the conditions for modular product architectures has been the creation of the Mobile Industry Processor Interface (MIPI) Forum, founded by ARM, Nokia, ST Electronics and Texas Instruments. This Forum has the explicit objective of aiming to create open specifications for interfaces between mobile application processors, displays, cameras and other components.

There has also been a trend towards the outsourcing of operating systems and applications software, and there are several separate mobile phone software components, controlled by international standardization bodies or proprietary groups which need to be integrated into a system to make a mobile phone. An operating system is also needed to run both the system and applications.

To run a mobile phone a manufacturer needs a real time operating system (RTOS) to run the communication related parts. The RTOS can also be used to run applications, however it is not necessary, as a non-RTOS (Open application OS) can also be used for this purpose. RTOS vendors in the mobile phone industry are ENEA, Wind River, Green Hills – Integrity, Esfia RedBlue.

The main open operating system suppliers are Symbian, Microsoft and Nucleus. Smaller competitors include Linux and Palm. The OS is typically composed of three layers: the OS kernel, the system layer and the application engine. The lowest layer is the kernel which provides the interface to the device hardware. All major vendors are competing with somewhat different OS strategies. Nokia is the main owner of Symbian, with companies such as SEMC, Motorola, BenQ, Siemens, Samsung, Lucky Goldtsar Electronics (LG), Sendo, Lenovo, and Panasonic being major licensees. HTC, Samsung, Motorola, Panasonic and a number of other suppliers, have licensed the Microsoft.OS. Nucleus is used in many handsets manufactured for Japanese MNO DoCoMo.

Applications are important differentiators for handset manufacturers and operators, and differentiation is created either by tangible features, services or introduction of new functionality. To run applications the handset requires an application engine, which can handle the distribution, downloading and payment of applications. This kind of software is also evolving towards standardised interfaces, due partially to the fact that the development speed is very fast even in the entry segment and most (new) suppliers of integrated platforms or products do not have the strength to do all of their application engine software development in-house.

Another significant driver for standardization in the area of OS and application engines is the evolution of the mobile network operator industry, with some MNOs pushing towards working with fewer vendors and a narrower range of OS and application engines in an effort to reduce costs and complexity. Vodafone and Japan's NTT DoCoMo have been particularly influential, and at the time of writing several other multinational operators had also begun to implement plans to limit the number of vendors and platforms with which they worked. A standardized platform can provide numerous cost savings opportunities for operators through areas such as device verification, service creation, device provisioning, customer care and training. It has been reported that porting applications or services across a platform-based phone can take 95% less cost than porting applications across feature phones using proprietary platforms. Overall operator cost savings on the 2nd platform-based phone can amount to up to 40 percent, and the platform based-handset projects can shorten rollout times by up to a third, thereby lengthening the overall lifecycle of the phone resulting in higher revenues per phone.

Qualcomm is the major supplier of application engines for the CDMA standard, with its binary runtime environment for wireless, or BREW. At the time of writing, no GSM handset vendor had announced plans to incorporate BREW into their handset designs although Qualcomm was working to promote its application engine directly to MNOs in Europe. Main suppliers of application engines to the GSM market included Nokia Series 60, Microsoft Windows Mobile, Openwave and Sun Microsystems. Motorola is also expected to launch its own content platform by end 2006. The main difference between the BREW platform and other application engines is that Qualcomm software is proprietary while most other application engines are open. The Qualcomm technology only supports applications developed for the BREW environment, while application engines such as Series 60 will support third party applications developed on alternative technology platforms. But at the time of writing Qualcomm had announced the development of a modular BREW application engine that would untether its content delivery and management platform from its content and service library, and support other content formats aside from its own proprietary runtime environment.

In the past few years the industry has seen the evolution of application providers who offer their applications directly to original device manufacturers (ODMs) and original equipment manufacturers (OEMs), and the commercial models used in this case are generally license or certification. Applications are handled by the handset's application engine, and can be either proprietary developed or 3rd party developed using a modular environment. Example of application developers include Teleca, Openwave, Sasken, Convergelabs and Access. A more recent development in response to the rollout of higher bandwidth 3rd Generation (3G) networks has been the move by vendors such as Nokia to integrate Internet search engine software such as Yahoo! into their devices.

Additionally, basic software components might be added to a mobile phone. Examples of basic software components include codecs (MP3, AAC, Microsoft WMA, RealAudio, and Sony Atrac3), Radio interface protocol stacks (TTPCom, UbiNetics, Condat, Convergelabs) and Java engines (Esmertec, Savaje, Aplix, Kada).

Finally, beyond manufacturing, component and software outsourcing many mobile phone manufacturers have also started to outsource logistics, warehousing, stock replenishment and operator branding services. United Kingdom-based 20:20 Logistics is a value added distributor for mobile phone brands such as Nokia, Siemens and Sony Ericsson, supplying dealers, retailers and network operators. The company has grown from USD 70 million in revenues in 1996 to more than USD 2 billion in 2004. A related company, Dextra, Solutions, specializes in customized packaging, point of sales solutions and product communications for both OEM and ODM accessory products. With sales of more than USD 800 million in 2004, the company was the largest distributor of mobile phone accessories in Europe.

An unbundling mobile handset value chain – implications for firm strategy

Given these developments, any firm wishing to compete as a mobile phone manufacturer in the future will need to develop strong systems integration capabilities. But as was the case in the PC industry, as the world of mobile handsets moves towards a higher degree of specialization, the barriers to entry for new entrants will fall. Variable rather than fixed costs will become more significant, and core R&D capability will not be a requisite for competitive advantage, but successful firms will still need overlapping technological knowledge with suppliers to understand technological developments, to select the right partners and to be able to integrate suppliers' inputs effectively.

The cost structure of non-integrated design/assembly firms tends to be dominated by variable rather than fixed costs. Because it is high fixed costs that give rise to steep scale economies, assemblers of modular products are able to compete on relatively flat scale curves, small competitors will be able to enjoy similar costs to larger ones .There will be a rush of new entrants from China, Taiwan and other countries that have perfected low cost manufacturing of modular products such as consumer electronics and PCs.

As was the case in the PC industry, as entry barriers fall, profitability is likely to flow away from handset manufacturers to manufacturers of key performance enhancing components and modules (both hardware and software),. Just as in the PC world, the OS, software applications and microprocessor subsystems are likely to be critical in determining the performance of future mobile devices, so the battle to control these elements will be intense. Other component manufacturers, like the manufacturers of peripherals and components that have eventually overshot the performance requirements of the mass market in the PC world, are unlikely to reap substantial profits in the longer term as industry standards are established and technologies mature. The exception here might be external memory and display technologies (LCDs), which continue to fall short of evolving customer requirements.

It will become increasingly difficult to compete primarily on product functionality in the mobile handset industry as different vendors gain access to the same or similar components and modules. First mover advantage is likely to be short lived for competitors coming to market with higher performing digital camera modules, higher memory capacity or LCD screens, as competitors are also likely to be able to source these components within a relatively short period of time. As was the case in the PC industry, 'complementary assets' or resources that can raise the value of a firm's technological innovations will therefore become increasingly important as a means of strengthening the appropriability of profits.

Innovations often only reduce the value of technological resources and knowledge, while leaving the value of complementary assets such as operational efficiency, brand and customer relationships untouched. Indeed, these complementary assets can *increase* the value of a firm's technological innovations. Mobile phone manufacturers should take note that Dell, the highest performing PC manufacturer in the world today, has built its dominance upon complementary assets such as supply chain efficiency, customization and customer service rather than product innovation.

Similarly, Apple Computer has had phenomenal success in selling what is essentially a commodity product (an MP3 Player is little more than a hard drive combined with a simple operating system) based upon its iPod brand, user friendliness and consumer experience (iTunes). The rapid growth and success of 'service intermediaries' in the mobile phone industry such as 20:20 Logistics and Dextra also point to opportunities to create value beyond the core product, and supports research that suggests fragmentation in the upstream value-chain can create opportunities to vertically integrate downstream assets.

Examples of complementary assets in the mobile phone industry include capabilities such as consumer branding, industrial design capabilities, manufacturing and supply chain efficiency, hardware and software customization, time to market and service provision. These dimensions of performance are likely to become increasingly important, especially in the mid- and high-end segments. Newer industry entrants such as Samsung have already demonstrated the power of marketing, brand management and excellence in industrial design; even in the absence of core expertise in mobile technology such as radio platforms.

Given that complementary assets are often not affected by the changing nature of technological innovation (for example the evolution from integral to modular product architectures), they can sometimes insulate established firms against the threat of competition from new entrants. Realizing that capabilities in brand management and consumer-centric design are becoming important complementary assets in the face of ongoing industry change, Motorola has recruited industrial designers from Apple and Nike and expanded advertising efforts, spending more than USD 200 million on its "Intelligence Everywhere" and "Hello Moto" campaigns since 2002. Nokia is another handset manufacturer that has invested heavily in brand building, spending more than EUR 2.5 billion (5% of sales) on advertising and promotion in 2003-2004. In 2005 the company also expanded a major industrial design initiative, recruiting designers from fashion houses and sponsoring a major industrial design fair in Helsinki.

Nokia has also invested in improving the efficiency of its supply chain. The company was ranked 2nd only to Dell in a 2004 AMR study of supply chain efficiency, and ahead of companies such as Wal-Mart and Procter and Gamble. In the 3rd quarter of 2004 the company reported that it had captured an additional EURO 215 million in profit by being able to respond quickly to above forecast demand that required the assembly of 4.7 million additional phones and the integration of more than 1 billion additional components. Despite a declining market share and ASP, the Finnish company has leveraged its operational efficiency, an important complementary asset, to maintain amongst the highest profitability in the industry.

Mobile handset vendors should learn from the PC industry and make sure that their future strategies are not made simply on the basis of cost optimisation or speed to market. While this logic might appear to make compelling sense in the short-term, experience suggests that this logic can result in a firm outsourcing those elements of value-added in which most of the industry's profits will be made in the future – and to retain activities in which it is difficult to maintain long-term advantages versus competitors. Witness IBM's outsourcing of the PC operating system to Microsoft and chipset to Intel in the 1980s.

Value chain design should be recognized as a strategic activity that will determine the fate of a mobile device manufacturer, and of future profits and power distribution in the industry. Systems integration capabilities will become increasingly important, and phone manufacturers will also need to look to those complementary assets which will help them to win in a world in which product differentiation built upon functionality will become difficult. In particular, mobile handset manufacturers should act quickly to build those complementary assets – brand equity, manufacturing efficiency, supply chain efficiency, service and other dimensions of value - which will provide points for future competitive advantage.

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Exhibit A: Typical Value Chain for a Mobile Phone Manufacturer in the1990s – Highly Vertically Integrated

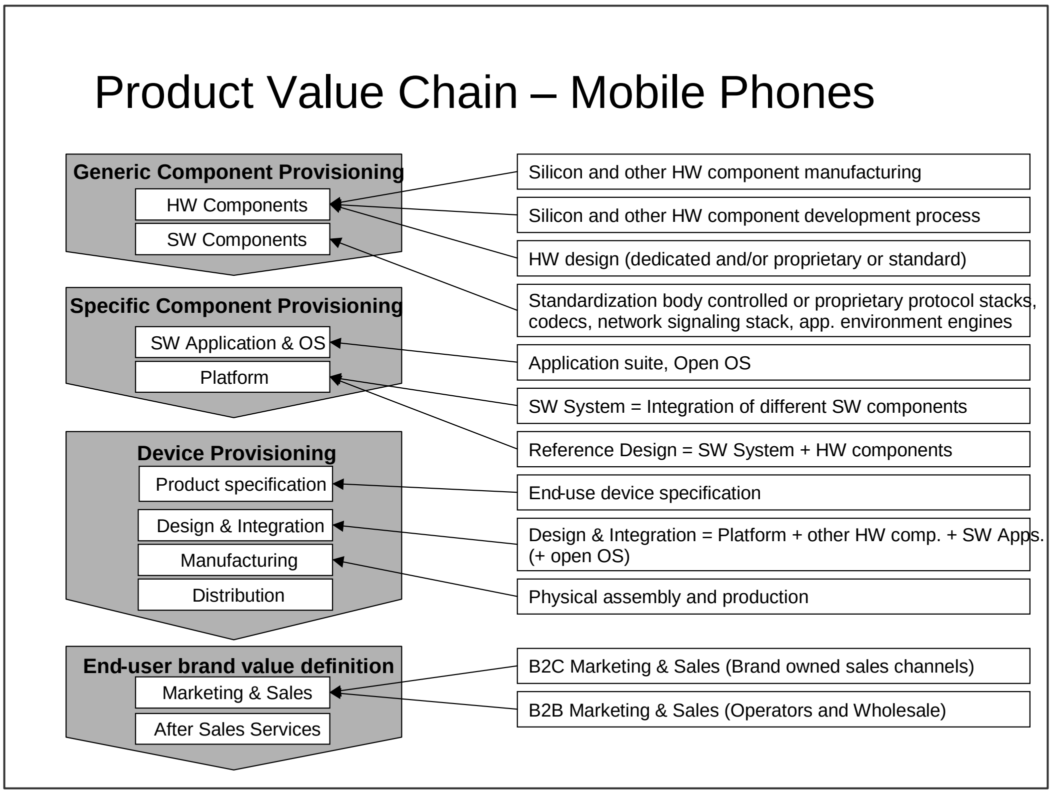
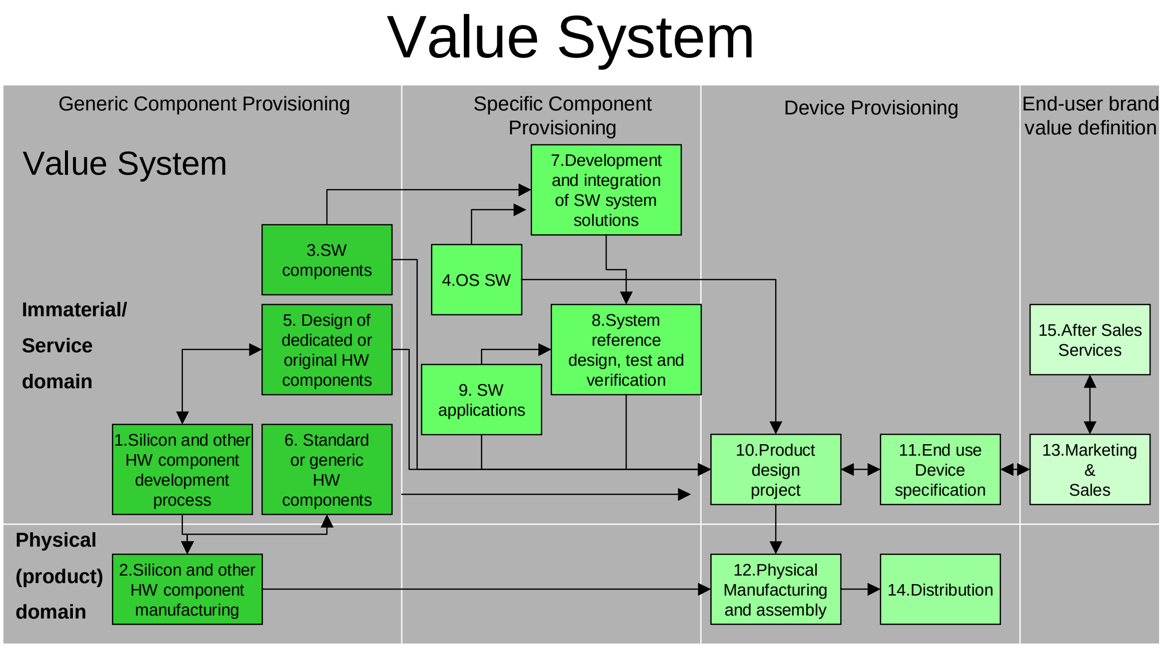


Exhibit B: Typical Mobile Phone Manufacturer Value Chain in 2005 – Emergence of Vertical Specialisation



1. TI, ST Micro, Philips
2. TI, ST Micro, Philips, 3rd party fabs
3. Codecs (mp3), network signaling stacks (GPRS) , protocols (IP, TCP), application environment engines (Java) etc.
4. RTOS (ENEA, Wind River, Green Hills), Open OS (Win CE, Linux, Symbian), Use IF SW (UIQ, Series60)
5. BB ASICs, RF ASICs, BT chip, app processor
6. Display, memory, camera, battery, filters, capacitors, resistors, duplexers etc.
7. Integration of protocols, network signaling stacks, codecs, and RTOS into a working SW system solution.
8. Integration test and verification of SW system + HW components + SW components
9. Application development and integration into application suite
10. Integration of platform + other HW comp. + SW apps. (uses RTOS if integrated phone or open OS if smartphone)
11. Product planning and specification of functionality, segmentation, positioning etc.
12. Conducted either by OEM, ODM or EMS
13. B2C Marketing & Sales (Brand owned sales channels), B2B Marketing & Sales (Operators and Wholesale)
15. Customer services etc.

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