

STRATEGIC ANALYSIS OF FRONTIER HANDSET R&D ORGANIZATION

By

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EXECUTIVE SUMMARY

Frontier Communication Corporation (“Frontier” or the “Company”) is a worldwide supplier for mobile handsets. Being a leader in the market for years, the company is facing new challenges to differentiate its products and improve return of investments. The R&D organization is Frontier’s key function tasked with creating new products. Accordingly, Frontier is adopting a new product creation process to create better products in shorter cycle time at lower cost. The goal of this study is to evaluate Frontier’s new R&D product development and associated processes, cross reference with an external market analysis, internal analysis and propose improvements of focus areas.

In general, the belief is that the new process is well suited for the dynamic nature of the market (Section 2), and is aligned well with Frontier’s organization structure. However some key potential weaknesses have been identified.

- Cascading process can lead to a loss of the original goal of the product creation program;
- Risk of communication and planning gaps as each stage progresses and cross functional activities expand;
- Process may result in lack of ownership and accountability, which can lead to quality problems and project delay.

The handset R&D project also demonstrates the intrinsic risks of technology projects as per findings from lesson learn workshops hosted by experienced program managers in Frontier:

- Challenging project scope management;
- Complicated project planning;
- Project budget overrun;
- High risk of project schedule slippage;
- Risk of high quality cost;

The Recommendations are:

- Strong “Vision” ownership. A product champion, that engages the team and senior management, is needed from the early road mapping, concept phase to mass production;
- Have a clear communication plan and enable knowledge collaboration;
- Adopt a dynamic Balanced Score Card system across the entire lifecycle that links the product vision to the milestone targets at each stage;
- Apply proper project management strategies to reduce the intrinsic risk of R&D projects;
- Adopt process management and partnership strategy to improve operational efficiency and reduce quality risk.

DEDICATION

I would like to thank my family and my friends for their support throughout the program and this project. Your encouragement has enabled me to pursue my dreams and aspirations.

I also dedicate this paper to my dearest son Ryan, who spent so much lonely time as a four year old when mom was reading and writing. Your unconditional love lights up my world.

Meggie Hou

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GLOSSARY

ASP	Average Selling Price
BSC	Balanced Score Card
CSF	Critical Success Factor
CDMA	Code Division Multiple Access
EDGE	Enhanced Data rates for GSM Evolution
HW	Hardware
IIP	Investment on Individual Performance
IP	Intellectual Property
KPI	Key Performance Indicator
ROI	Return of Investment
R&D	Research & Development
SI	System Integration
SW	Software
3G-WCDMA	3rd Generation Wideband Code Division Multiple Access
UI	User Interface
WiMax	Worldwide Interoperability for Microwave Access

1: INTRODUCTION

1.1 Company Background

Frontier Mobile Corporation (abbreviated as Frontier¹) is a mature, multinational communications corporation that focuses on wireless and wired telecommunications. According to 2007 data, the organization employs 112,262 personnel in 120 countries, has sales in more than 150 countries with global annual revenue totaling 51.1 billion EUR. As the world's largest manufacturer of mobile handsets, Frontier takes approximately 38% of global mobile handset market. Frontier produces mobile phones for every major market segment and protocol, including GSM, CDMA, and W-CDMA.

Frontier has its R&D sites, manufacturing facilities and sales offices in many countries throughout the world. As of March 2008, Frontier had R&D centers in 10 countries employing 30,415 employees or about 27% of the company's total workforce.

Frontier's product family includes devices, service & software, market, and telecom networks. The research of this paper will focus on its devices (handset) products.

¹ The name of the company has been disguised to preserve anonymity.

1.2 Organizational environment

As wireless technologies evolve, the coming mobile revolution will bring dramatic and fundamental changes to the world. This revolution has already begun and is gaining momentum.

Looking forward, the mobile communications market will continue to be very competitive, changing extremely fast, with new players entering all the time, new technologies creating new opportunities. These factors leave mobile service/product providers more challenges to meet the on-going changes that the market requires. Under these circumstances, it is crucial to link changing business targets to R&D capabilities in order to optimize resources and to differentiate products from competitors with a focus on a quick time to market. To achieve that target, businesses need to implement an optimal product creation strategy to gain, preserve or enhance leading positions in the market. This report starts with an industry analysis and internal analysis of Frontier's R&D operations, introduces the new product creation process for Frontier's R&D organization, followed by an evaluation of the major implementation challenges of the new product creation process. Based on the analysis, recommendations will be provided on how to reduce the risk of product creation programs by focusing on major areas that contribute to the success of the new process. These recommendations will help the organization to improve its R&D operation efficiency and effectiveness, as part of the organization's strategy to improve the returns of its R&D investment.

2: EXTERNAL ANALYSIS

2.1 Market overview

During the past five years, the mobile handset market has experienced steady year-over-year growth due to a prosperous economy, growing customer needs and the development of new technology. During the past decade, the market also experienced several major consolidations, including the merger of Sony & Ericsson and Siemens' disposition of its mobile handset business. Contrasting to early years of the mobile handset market (mid 1990s to late 1990s), where the market growth centred on first-time buyers, demand from handset replacement will soon surpass the New Adds² market, signalling ever-increasing market maturity. In the current market, manufacturers such as Frontier can no longer easily reap the high gross margins as they did many years ago. Rather, manufacturers have to find new ways to lower costs to cover the lost margins due to lower ASP (Average Selling Price). Table 1 indicates the trend of industry average ASP during 2005-2010 according to data consolidated by Cowen Consultancy.

² New Adds: First time purchase.

Mobile Phone Demand Model(MM)	2005	2006	2007	2008	2009	2010
Global Units	2,171.5	2,687.6	3,333.1	3,974.0	4,545.0	5,009.9
Net Adds (First time buyer)	441.8	516.1	645.5	640.9	571.0	464.7
Replacement Market Units	415.2	503.3	534.8	661.7	833.9	1,009.7
Churn Units	198.7	220.9	238.7	318.7	426.4	487.6
Upgrade Units	216.5	282.3	296.1	343.0	407.6	522.1
Market Demand	857.1	1,019.4	1,180.2	1,302.6	1,405.0	1,474.4
Industry ASP (USD)	\$142	\$136	\$132	\$129	\$129	\$128
Industry Revenue(Bil USD)	\$120.5	\$139.8	\$153.5	\$168.9	\$180.9	\$188.1
Industry Operating Profit	11.9%	11.4%	12.3%	12.0%	13.1%	15.4%

Table 1: Global Handset Model (2005-2010E). Data Source: Cowen Consultancy Financial Report

Additionally, new entrants and increased competition require that handset manufacturers constantly invest in product development to make sure they create appealing products to capture more of the replacement market's savvy users. With the current financial crisis and the slowed economy, more and more organizations have started to feel the pressure from both internal operations and the slowing external market. Furthermore, with the recent delays in the release of some of its new products, coupled with compelling product releases from new competitors such as Apple (iPhone), Frontier has indicated a potential drop in volume production for the first time in Q3 2008. Investors and the financial market responded quickly, resulting in a sharp drop in its share price. Given all the above factors, it is more critical than ever for the business to invest R&D dollars effectively and efficiently to secure market share.

2.2 Major changes in the handset market

2.2.1 Impact of the Growth strategy on the new product development process

Although the market is maturing, global mobile market is still expected to grow due to the increase in the replacement market, penetration into new emerging markets, and the evolution of technologies such as EDGE, 3G-WCDMA, CDMA to the next generation enablers (WiMax, 4G) that will further enable a host of mobile services to the end user.

With this in mind, handset manufacturers are facing the following complexities:

- Various technologies implemented in the network infrastructure;
- Strong regulation in and migrations towards 3G, 4G;
- New Players entering in the market (Apple, Google, Microsoft, RIM);
- Fierce competition between players and the myriad of services they offer to the users.

Current handset users are demanding more and have become more aware of technological advances that can improve their everyday life. The market environment poses a great growth opportunity for manufactures, but how they gain market share depends on whether a business can differentiate their products from the competitors, meet customer's expectations (features, quality) and be first to market. One key to success here is to reflect the market requirements as early as possible into the product creation process.

2.2.2 New Markets and new ways of interfacing with current markets

The traditional approach for differentiation will continue as vendors try every possible combination of technological and ergonomic features to entice buyers. However,

as new players join the competition, especially those vendors who bring with them new user experiences, services and integration with internet and social networking, the incumbent phone manufacturers have to battle against this new business model that combines services and devices. At the low end, new entrants, namely Asian manufacturers who co-brand their products with the Telecom operators, also bring in new pressures in the market. Due to new technology enablers such as 3G, WiFi, GPS, etc, mobile handsets nowadays can facilitate many sophisticated functions such as web browsing, synchronized email, on line games, digital map, GPS etc. To develop and market such products, the phone makers need to explore consumer experience and customer expectation in related consumer products such as stand alone digital cameras, music players, PDAs, Personal Navigation Devices (PNDs), office applications (including email), internet service, and certain online social network applications and try to integrate many well accepted features into one single handset. Such handsets are not simply pieces of hardware that facilitate some basic communication functions, but they integrate applications and services that validate and optimize customer experience. To amplify the user experience and develop side products, phone manufacturers have even started to develop and sell related services to end users. One example is the on-line music store where smart phone users can download their favourite music.

2.2.3 Industry consolidation

Due to the fierce competition in this industry, vendors that failed to keep up with the changing market requirements suffered from losing market share and deteriorated profits. As a result, the mobile handset industry witnessed a major consolidation in recent

years: Sony and Ericsson merged in 2001 with a 50/50 arrangement. In 2005, Siemens, who suffered major losses from its mobile handset division, divested its mobile section and formed BenQ-Siemens that focuses on 3G handsets, in 2006 Ben-Q closed its factory in Germany. Motorola has tried unsuccessfully to sell its mobile handset business, with speculation growing that this division is in major trouble. Some smaller vendors in Asia (e.g. Bird Sagem Electronics), have experienced declining market performance in recent years and are now seeking divestment strategy to pay off their debts and improve operation performance. Under such a fiercely competitive landscape, the market structure and key players change often in real time. On the one hand, the change brings opportunities to the market leader before the merged players gear up and act as one integrated player. On the other hand, such changes create pressures to the market leader to defend its leading position as these new entities' combined strategy poses more threats than the previous single vendors did.

2.3 Customers

In Europe and Asia, the direct customers of the handset manufacturers are major handset distributors. Frontier also delivers some of the handsets to the telecom operators directly but the volume only adds up to a small portion of the total delivery. To market its new products and new services, Frontier also operates its own specialty stores. Sales channels in North America are dramatically different from that in Asia and Europe, as the telecom operators are among the major customers due to the bundled selling model (phone & service/plan). Quite often, the handsets need to co-brand with the wireless provider's brand and the pricing of the handset has to align with the wireless operator's

strategy. Frontier's North American sales face the challenge of trying to maintain market share, proper alignment with the major operators and keeping control over its brand and pricing strategy.

2.4 Competitors

The mobile handset market is volatile. During the past decade, the market has experienced dramatic restructuring with the market leader position moving around among the major market players. Although still holding the market leader's position, Frontier is facing intense competition from other vendors such as Samsung, Motorola and Sony Ericsson. Furthermore, new Players such as Apple, RIM and Google (Android phone platform) have created new threats to focused areas of Frontiers product portfolio. Using The Complexity Grid Model (SFU BUS 759), the market competition can be broken into two categories. For the low-end products, classified as commodity products, the competition mainly focuses on low cost, low price and some of the fashion features such as colour, size, industrial design etc. For high-end products (smart phone and more advanced multimedia handsets), classified as super value goods (high-end feature rich) or consumer durables, the competition is more focused on enhanced functionality and innovation of technology and product design. Major manufacturers are striving to improve time to market without sacrificing product quality.

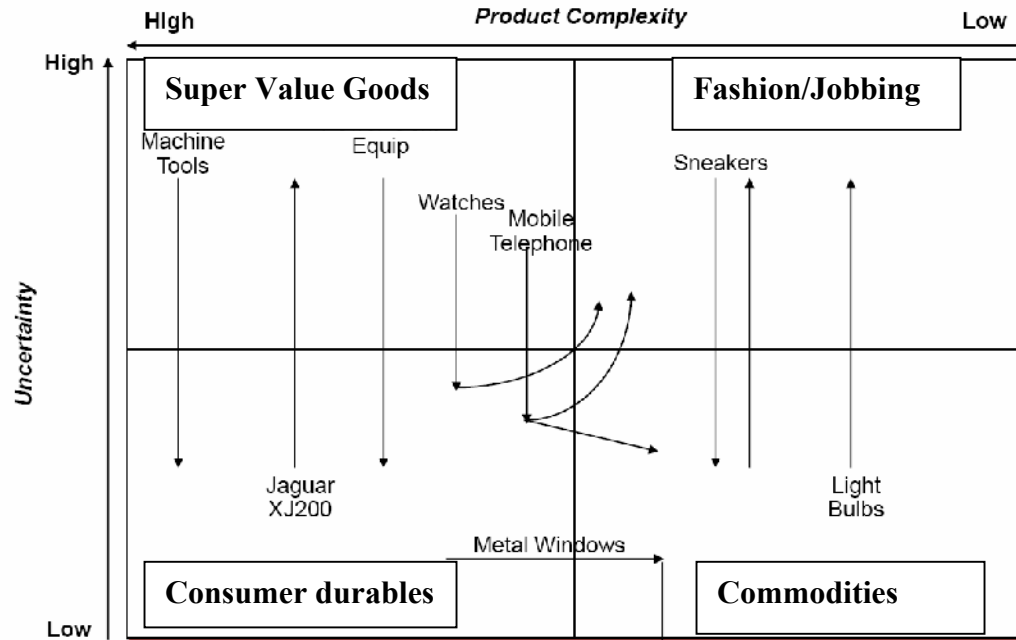


Figure 1: Complexity Grids Maps for major products (trend) Information Source: SFU BUS759 lecture notes)

2.5 Competitive Analysis

2.5.1 Entry barriers (Moderate to High)

New market entrants are mainly from companies who are strong with other high tech products and/or services and have started to diversify by entering the handset market. Some of these market entrants have substantial capital and experiences in product development; they have developed sales channels, technology assets and management assets to facilitate a fast ramp-up into creating new products in the mobile device market. As mentioned earlier, these new entrants include Google, RIM, Microsoft and Apple. These new entrants pose an immediate and serious threat for the existing market players.

2.5.2 Threat of substitutes (Moderate to High)

Major substitutes for a mobile handset include traditional landline or cordless phones, as well as other mobile devices such as laptop computers, notebook computers and the emerging Mobile Internet Devices (MIDS). In these later devices, VOIP technology and wireless network are the key enablers that provide a substitute to cellular communications. Whereas these features that offer communication functions through the internet become a threat, Frontier along with many other players also offer VOIP and WLAN in their portfolio. The threat of these substitutes is material in certain customer segments such as the low-end segments where customers are more price-sensitive.

2.5.3 Bargaining Power of suppliers (High)

Suppliers to a handset manufacturer include the main engine suppliers (board, chips etc.), the plastic parts suppliers, software platform suppliers (such as Symbian etc), other Intellectual Property Owners, Software testing/qualification subcontractors and all other major suppliers relate to the R&D organization's operations. The major suppliers who provide the key components technologies have strong bargaining positions, as they are usually high volume players in the specific market, and quite often supply to multiple handset manufacturers. However, over many years, Frontier has formed strong relationships with its major suppliers. This cooperation starts early in the product design and planning stage, building commitment and trust, which is one of the factors that contributes to a faster time to market.

2.5.4 Bargaining power of customers (High)

In the early stages of the mobile handset market, only a few manufacturers dominated the market, including Ericsson and Motorola. At that time, customers did not have many choices in handset models and functionalities. As a result, the price range was narrow. Recently, as new vendors in the market can provide competitive and compelling products, manufacturers and distributors have drifted towards price wars in some segments to enhance or increase their market share at the cost of their Average Selling Price (ASP). Now customers not only have the freedom of choosing from different products, but their feedback and demands have started to influence product creation and distribution models. To compete for the market, telecom operators have to provide more flexible plans, lower the handset and service price to lock in more clients in their network. As a result, the average selling price for handsets has been driven down in recent years (Table 1 shows industry average ASP dropped from \$142 in 2005 to \$132 in 2007). The result has also been that brand loyalty weakened as the customer jumps from one deal to another.

2.5.5 Rivalry between competitors (High)

The level of competition is highly influenced by the bargain power of suppliers and customers. During the early stage of the competition when the gross margin of single products was high and market penetration levels were low, low cost was not one of the major strategies for handset manufactures. However, the price war across many market segments is driving down the ASP each year. Cowen Handset market data (Cowen Consultancy market research) shows that, the Year-over-Year ASP change ranges from -5% to -3% during the past a couple of years, even while the overall revenue was

experiencing strong growth. To maintain their profit target, phone manufactures have to find ways to reduce costs through optimizing the R&D process, streamlining vendor selection, and outsourcing certain work and components.

In 2003, Samsung stated that their strategy is to either be the first with something or be later but be the best. In recent years, the public’s expectations are that a manufacturer needs to be first and the best. The challenge lies not only on how “cool” the product is, but also lies on how quick the product can hit the market before similar products appear. Leads in innovation, technology, features and services may offer some initial head start. However, these gaps tend to close quickly by competition so manufactures must continue to innovate, to produce leading edge products quickly. Phone manufacturers need to adapt their product creation processes to stay ahead of the competition and get to market fast.

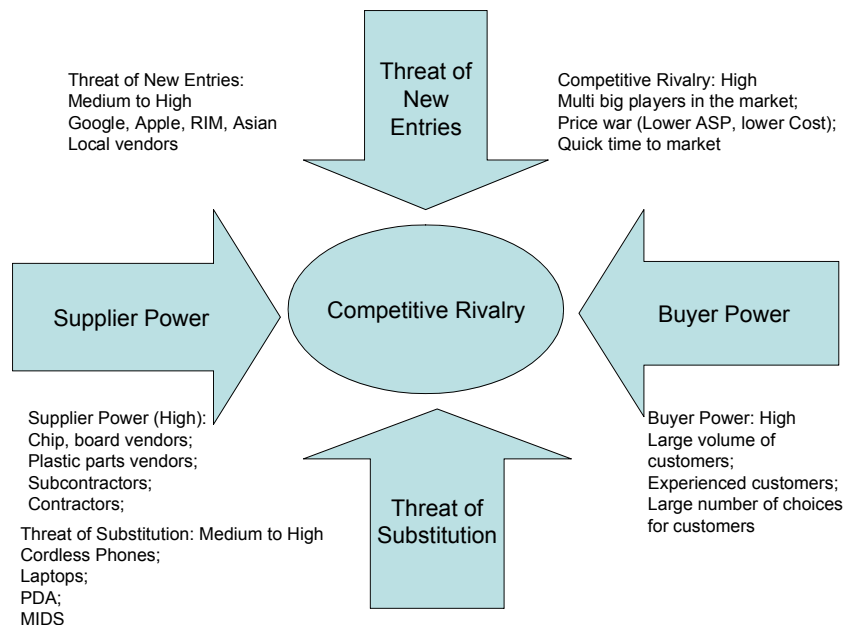


Figure 2: Five Forces Analysis. Data Source: Based on Michael E. Porter, Harvard Business Review, “How competitive forces shape strategy”, Mar-April 1979.

2.6 Critical Success Factors

The key success factors are the important variables that enable the business to remain competitive and be profitable. Based on above analysis, the critical success factors of mobile handset organizations are:

- Time to market;
- Cost effectiveness;
- Leading technology and sound product quality;
- Market oriented product creation process.

2.6.1 Time to market

Most of the handset manufactures base their product on a certain portfolio that allows re-use of certain technologies across a range of products. The effect is that, if executed correctly, the life cycle from starting a new product concept to a market version phone is shorter. Since most of the competition follows a similar approach, even when new technologies are involved, it takes shorter time for a competitor to match the innovation. It is during this period when manufactures have a “lead” that they can demand the highest ASP for a device.

In general, the gross margin for new products that offer new and market leading technology or features is very high due to the high price charged when the products first hit the market. The price then decreases over time during the product life cycle as the competition matches the feature set. So even as the overall ASP declines across the industry as a whole, being first to market often with new compelling devices allows a manufacturer to grasp the lions share of the high ASP segments. Thus, time to market not

only means greater efficiency to improve the investment return, it also is a critical factor that helps the manufacturer to gain market share and take first mover advantage for new products. This is a key focus in Frontier's new product creation process.

2.6.2 Cost effectiveness

As the ASP declines in general, cost effectiveness becomes a very important factor for the success in the mobile handset market. When competing for market share, rivals also use lower price to gain more customers. Price wars will become more rampant as product differentiation becomes more difficult especially across the mid to lower range segments. In order to remain profitable, firms must reduce their costs and improve return of major investments such as R&D investments. Through innovation, phone manufacturers also strive to find more cost efficient components and optimize product design to achieve this low cost strategy.

Price competition also creates another major challenge for the businesses in terms of product quality. Sacrificing quality for cost or time to market has a negative effect on overall profits due to increased warranty costs and loss of customer retention. Businesses need to plan appropriate working procedures and processes during their product creation stage to find the right balance between customer quality expectations, costs and time to market. In that sense, simply reducing R&D cost in itself is not a solution. A reasonable level of R&D investment is still required to overcome the competitive challenges listed above.

2.6.3 Leading technology and sound product quality

Quality is part of the customers' expectations. Although low-end mobile handsets are classified as commodity products, and high-end smart phones or convergence phones are taken as consumer durables or super value goods, quality and durability are still a major consideration when consumers make their purchase decision. In some cases, customers are a bit more forgiving with leading edge features; however, even in this area, customers' quality expectations are getting higher each year. As manufactures continue to add new technologies to gain early market share and ASP, the focus on quality is key as well. Due to the adoption of new technology applications and hardware, including Bluetooth, WiMAX, GPS, high-powered cameras, large high-resolution touch screens, complex software applications and services, quality versus functionality is a key focus.

2.6.4 Market oriented product creation process

During the early stages of the mobile handset market, consumers were not well educated about the product in the market. The initial lack of experience in using the product and the technology resulted in the consumer having few requirements on the creation of new products. This has changed dramatically as a new customer segment, composed of young, web2.0 literate users starts to dominate the user profile. In recent times, 'quality' issues are more related to not meeting user's expectations rather than the traditional "broken product" problem. The new quality problems are recorded in customer service centres as "No fault found" case while in fact the fault was rooted in the product design process when user's expectations were not met. Hence, a new product creation

process needs to focus on what the customers really need and expect, rather than purely based on adding the latest technology features.

2.6.5 Conclusion

In this fast changing market, R&D processes need to deal with the following challenges:

- Faster time to market is needed to capture maximum ASP and early adopter market share;
- R&D and product costs need to be reduced overall to deal with the falling ASP across the product range during the full lifecycle;
- The process must be consumer driven, which means bringing compelling products to the market meeting users' functionality, design and quality expectations.

To tackle above challenges, the organization needs to understand its own strengths and weaknesses and adopt appropriate development strategies for their new products.

3: INTERNAL ANALYSIS

3.1 Organization Structure

Within the organization, Frontier has also experienced certain consolidation of its major product divisions. Previously, the corporation divided its business into high-end and low-end product divisions, which created overlapping functions as each division operated independently. During the past couple of years, the corporation re-structured its operation and consolidated similar divisions: such as to combine its mobile phone and multimedia units into a single device division. Through the reorganization, overlapping supporting functions are eliminated and major core competence functions such as engineering product lines in R&D organization are integrated to a new platform that supports all product categories. From the product creation point of view, it becomes a lot easier to share best practices seamlessly in both the low-end product programs and the high-end product programs as they now operate under the same platform and follow the same process.

3.2 The Product Groups

The product family of Frontier's handset products can be classified into the following categories:

- Voice Phone
- WAP Phone

- Feature Phone
- Smart Phone
- Convergence Phone

Detailed specifications of the above categories are illustrated in the table below.

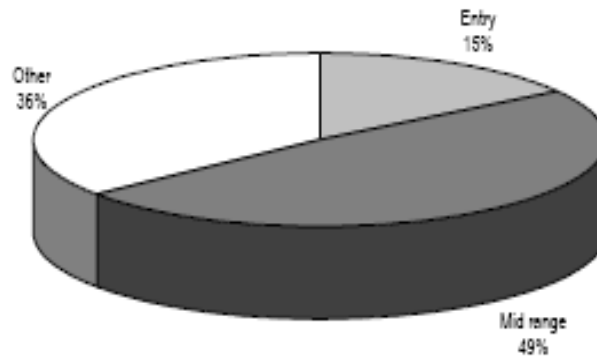
Access Technologies	Functionalities				
	Voice Phone	WAP Phone	Feature phone	Smart phone	Convergence Phone
	Voice & SMS	WAP browser, polyphonic ringtones, color	Speaker phone, MMS, camera, Java, MP3, email client, IM Client, M-wallet, PTT, Presence, PIM	OS-based, touch screen, QWERTY keyboard, video player, memory card, video conferencing	PDA, WLAN interface, DVB-H
2G/GSM	x				
2.5G/GPRS	x	x	x	x	x
2.75G/EDGE	x	x	x	x	x
3G/WCDMA	x	x	x	x	x

Figure 3: Handset classification as considered in the ECOSYS³. Data source: <http://www.netlab.tkk.fi/~renjish/Telektronikk.pdf>

For Frontier Mobile, its main revenue comes from the voice phone, feature phone, Smart phone and convergence phone categories. In general, voice phones belong to entry level products while smart phones and feature phones drop in the mid range. The corporation also invests heavily on high end convergence phone products. The volume and gross margin distribution among different phone categories is illustrated below:

³ *ECOSYS project*. December 10, 2004 [online] –URL: <http://www.celtic-ecosys.org>

device gross profit split by category (2007E)



device volume split by category (2007E)

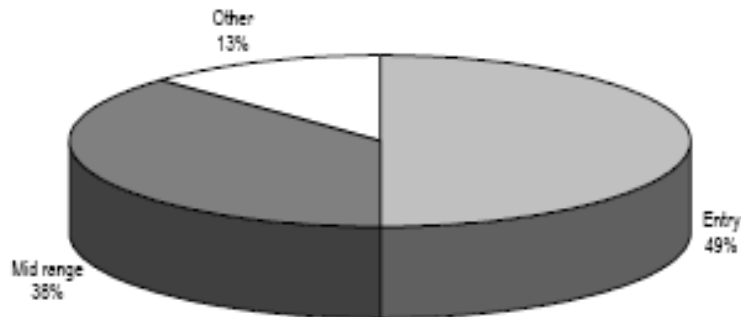


Figure 4: Volume and gross profit by category. Data source: SEB ENSKILDA Financial Analysis Report

The key business drivers for entry level voice phone products are time to market, low cost, ease of use, reliability. For the other three product groups, the key drivers are enhanced features/functionality, time to market, technology leadership, style, and combined services. For these three phone categories, R&D efforts are critical for product

portfolio success with respect to market timing and feature set. This analysis will focus on the product creation process and the associated operation processes in Frontier's handset R&D organization, to find out the critical success factors for a successful product development project, to evaluate the strengths and weaknesses of the product creation process, and to provide recommendations on how to improve the weaknesses to achieve the key success factors.

3.3 The New Product Creation Process

3.3.1 Introduction to the new product development process

In order to address the dynamic nature of the market, Frontier has developed a new common product development process to develop and commercialize new products. This process is cross-functional with a mandate to create, deliver and support new products. The purpose of having a common development process across the corporation is three-fold:

- To ensure that the life cycle management of a product is consistent across the corporation and uses best practices;
- To enhance the program review process so as to focus on the business evaluation of new product concepts;
- To ensure common planning target and execution across all R&D, business and support functions e.g., everyone “talks the same language”.

The new product creation process evolved from the old product development process that used technical checklists as the major criteria for programs to pass milestone

reviews. The technical checklists however, over time, bogged down the cross-functional planning process leading to a cumbersome series of technical reviews even at the highest business decision levels. The new product creation process pushes these technical checklists to the product line teams. Instead, business concepts and common planning evaluation guide the internal planning and milestone approval procedures.

The new product creation process divides the whole product life cycle into six road map stages:

- Product Abstract
- Product Story Definition
- Product Concept
- Product Definition
- Product Development
- Product Delivery and Maintenance

To progress through the above program stages, the product creation team needs to complete and pass the following milestones:

- CM - Approved business plan and possibility to achieve planned schedule;
- M0 - Commitment to product specification;
- M1 - Commitment to program plan;
- M2 - Manufacturing purchase release;
- M3 - Sales start;
- M4 - Program termination and transfer to product engineering.

Figure 5 illustrates the different stages of the product creation process and the dynamics of the project milestones and the product life cycle.

Product Creation – Total Lifetime View

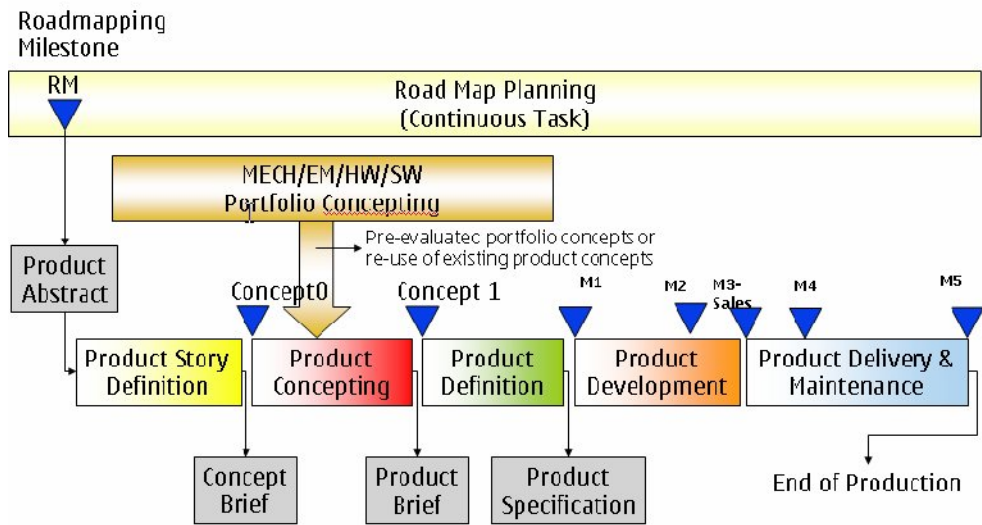


Figure 5: Product Creation Process. Data Source: Frontier Mobile Corporation

The product creation process starts from product story and concept creation. Based upon research of leading edge products in the market and technology development trends, the product creation team brainstorms potential needs from the market and puts them into product concepts. A product creation team consists of a project manager and members from SW, Mechanics, Electronics, Manufacturing, Logistics, Product Marketing and Sourcing.

Once the product's concept gets approval, the product project team will finalize the product definitions as the blueprint of the product. Even during the product definition phase, early supplier engagement will begin with major partners, such as camera, plastics and chip providers. This is vital to ensure the product configuration and technology

selections align with the supply chain. Such co-operation also provides better quality planning of new products in subsequent product creation stages.

After the approval of product definition, the product development phase starts and the project will arrange manufacturing to build prototypes for hardware (“HW”) and software (“SW”) testing.

Each development phase requires prototype builds until all checkpoints are qualified for commercialization. Once the product is ready for mass production and marketing through major sales channels, the R&D team will hand over the product to the Production Engineering team in the factory and the R&D program is complete.

3.3.2 Other processes associated with new product development process

The product creation process associates with the following operation processes:

- Project Management
- Hardware design and sourcing management
- Material planning and management
- Supply chain management
- Software development and testing
- Quality assurance and quality control
- Performance measurement

Project management acts as the “thread” (leading process) that pulls together all the other processes and functions. To find the key success factors residing in the product

creation process, the internal analysis will also be based on each of the above categories that are associated with the product creation process.

3.3.3 Program management

According to a study conducted by Imai, Nonaka, and Takeuchi (1985), there are six critical factors that encourage efficient and innovative development:

- Top management as catalyst;
- Self-organizing project teams;
- Overlapping development phases;
- Multi-learning;
- Subtle control;
- Knowledge management.

In Frontier, the project management team takes overall responsibility of the product program. The Product Program team interacts with other functions such as HW, SW, supply chain management, quality and product marketing. Those functions also provide support to other product programs. Due to the nature of the handset product programs, communication and change management are two areas that create many challenges to the project management team. One typical challenge is that the project team cannot always get enough capable resources from the engineering team in a timely manner, which often results in project delay. Another challenge is that components ordered from the third parties cannot meet the project specifications in certain situations. Such challenges not only delay the project schedule, but also may put the entire project at risk.

3.3.4 HW development and sourcing management

In addition to the in-house hardware engineering specification and design, the HW Sourcing process includes the following:

- Vendor selection process;
- HW specifications communication;
- Sample testing and verification;
- On-site supervision of manufacturing procedure.

During the product creation stage, sourcing team takes care of supply line preparation (e.g. vendor selection and qualification), supply line implementation, and supply line control. When the product definition is fixed and product program enters product creation stage, the sourcing team will start material planning and execution. The following diagram illustrates the sourcing process of Frontier:

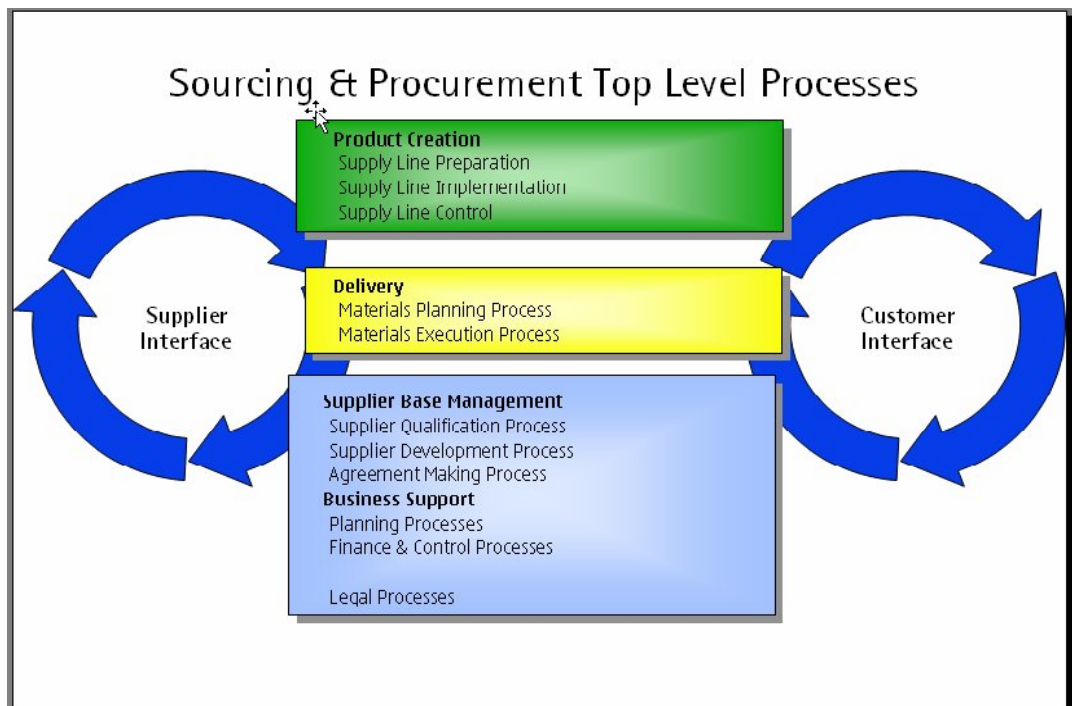


Figure 6: Sourcing & Procurement process. Data Source: Frontier's Mobile Corporation, 2006

As the quality of hardware has a direct impact on the success of final products, vendor selection and vendor management are key control points for this process. Vendor selection is based on cost consideration, competence level and their product quality history. Although lower cost is one of the selling points for most vendors, product quality consideration could outweigh the cost factor as poor quality has long-term cost implications. One example is the vendor selection for plastic parts such as covers of the handset. Compared with other costs of other components, the cost of covers is only a small portion of the overall cost. However, these are highly visible parts, which can be prone to wear, discolouration and visual defects. Test results and tolerance alignment for covers from different vendors may vary dramatically even when their price is close. Tolerance is a product quality parameter reflecting the accuracy of measurement and fit of different components. Even slightly unnoticeable variance from the original design can result in assembly issues, reliability and visual quality problems resulting in substantial warranty cost or re-tooling costs coupled with program delays.

Other phone components such as boards and chips are the core engine of the phone, which directly affects the performance of the phone itself. For such parts, the company deals mainly with their long term strategic partners. During the manufacturing stage of those main parts, Frontier sends highly capable engineering resources to supervise the production in the vendor's sites to assure quality and resolve ad hoc issues during the manufacturing stage.

Another issue in hardware sourcing dimension is the adoption of new technologies. As stated earlier, innovation and leading technology are key success factors for super value goods or even for consumer durables. New technologies mean both opportunities and risks to the product. Successfully applying the new technology will help manufacturers to earn market share and enhance their brand as market/technology leader. Failing to manage and source these new technologies in a controlled manufacturing environment will cost the company on all fronts (time to market, market share, user loyalty, R&D costs).

3.3.5 Material planning and management

Material planning starts from the product concept stage. The material team will propose and evaluate the materials planned for the new product. As new materials and new designs are fixed, the material plan team will work with the project team to create a specific material planning, delivery schedule and communicate such plan to the component vendors. As the project schedule and product design are revised over time, the material plan needs to keep up with such changes. However, due to the necessary lead-time to validate changes, substantial scrap can still occur during the product creation stage when product design parameters are changed too close to the next prototype/factory run. In that situation, there is no way for the business to cancel the order at low/no cost, thus it results in cost and waste. This highlights the need for fast communication and visibility across all the functions in the process. In addition, there is the need for plan accuracy. Similar to above challenges, the plan accuracy resides in two folds: one is timing of delivery; another is the accuracy of the planned factory volumes and their cost implications. Although Frontier has mature processes and tools to support material planning, some other factors

such as how the processes and tools are applied will affect the plan accuracy. As highlighted above, a gap in communication between the material planning team and the program management team need to be closed to avoid inaccurate planning and extra costs.

3.3.6 Supply chain management

Good supply chain management ensures the project has the requested components and testing materials on time so the project can proceed as planned. Due to the complexity of the R&D project, most of the purchase/shipping requests are quite urgent. That requires the supply chain team to maintain constant communication with the project team to be able to forecast purchase/shipping requests and be well prepared for project needs. As the R&D project usually deals with companies in different countries, the supply chain team should also have expertise in different trading/tariff regulations of different countries. For Frontier, it outsourced most of its supply chain management to major global carriers. The supply chain of phone products has tremendous connection points among different entities, such as vendor to R&D site, local R&D to global R&D, vendor-to-vendor and so on. In addition, phone assemblies or components shipped can be at different stages of assembly/test or with different variants/versions. Such complication requires prudent planning and administration during its execution.

3.3.7 SW development and testing

For consumer centric software products, the development starts with a customer requirement study. Typically the product marketing and sales channels define the user experience and customer requirements (marketing requirements). These are then translated

into technical requirements by a team responsible for requirements management. These requirements are analyzed by system specialists and architects who propose feasibility approaches and approved system architecture. These requirements and architecture are planned into work packages for the development team who then starts designing the software components that make up the feature set, UI, etc.

As part of the implementation, each component must be tested against a set of test criteria to ensure that the component functions as per the requirements at a component level (component verification). These components are then integrated into the larger software package as per the architecture and again verified using test cases (system integration). The entire software system package is then further tested against the technical requirements and use case requirements (software verification). Finally the deliverable is verified against the marketing requirements and user expectations. This involves in-house test teams as well as customer feedback (product verification).

All of these phases are not purely sequential but in fact involve feedback loops as errors found further up the test chain are fed back to implementation, design and even the architecture levels.

3.3.8 Quality assurance and quality control

The quality team is a major part of the program management team. Quality team members are experienced engineering experts from different areas. Along with their engineering background in specific areas, this team also understands the best practises of the industry in different processes.

Quality is essential throughout the entire product creation process. Failing to identify the issues and weaknesses in any parts will increase the risk of the project failure. Superior quality management will help to reduce operation costs and improve customer satisfaction thus helps the organization to create better products with lower costs.

Another major challenge for Frontier is to apply the best practices extensively within the organization. This is part of the knowledge management of a business. Although this can be enforced through standard processes, procedures and rigid gate approval practice, it's still a major challenge for a huge organization to ensure that best practices are applied at all levels of the organizations. This becomes more challenging when the organization and its market are geographically dispersed and local standards vary.

3.3.9 Roles and responsibilities of program management teams

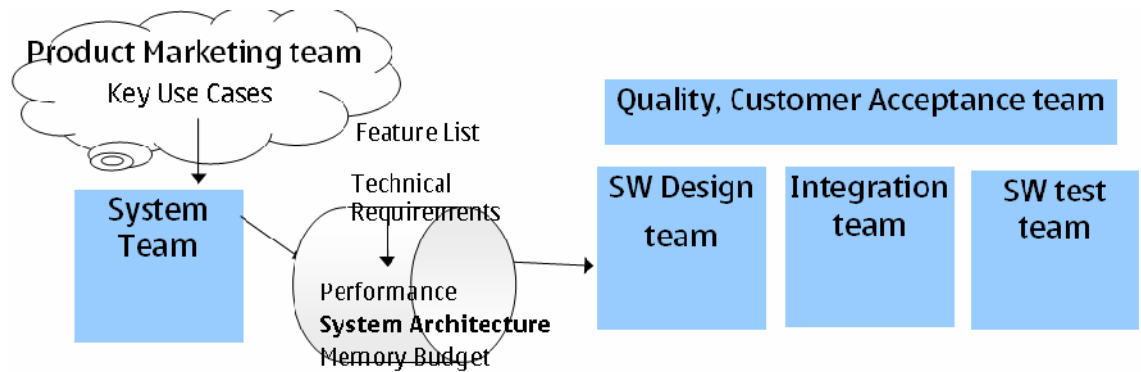


Figure 7: Product Program Team Roles And Responsibilities. Data source: Frontier Corporation

Product Marketing: The product marketing team creates marketing requirements and works closely with quality and customer acceptance teams on final Product release

criteria. They “own” the product, and interface with the system team in defining the technical requirements.

System Team: This function “translates” user and marketing requirements into technical requirements, performance targets and a system architecture which will meet these requirements within any constraints on the program (Time to Market, Quality, and Cost etc).

SW Design Team: This team handles component design, component implementation and verification.

The Integration Team: They bring the components together and test them against the system requirements and test cases.

The SW Test Team: Tests the complete product against a wider set of test cases cross referencing the results with technical and marketing requirements.

The Quality and Customer Acceptance Team: This team oversees the whole product creation process. Along with marketing and business stakeholders, they define the approval criteria as part of the requirements process. Quality metrics, customer approval procedures etc are built into the product requirements and design such that during the verification phase the “readiness” for public release and product maturity is measured and visible throughout the development process.

3.3.10 Program approval procedure

When all requirements including functional, performance, customer acceptance, quality, and user expectations are met, the product is ready for approval by the

stakeholders steering group. The relationship between software working procedures and program approval can be illustrated in below diagram:

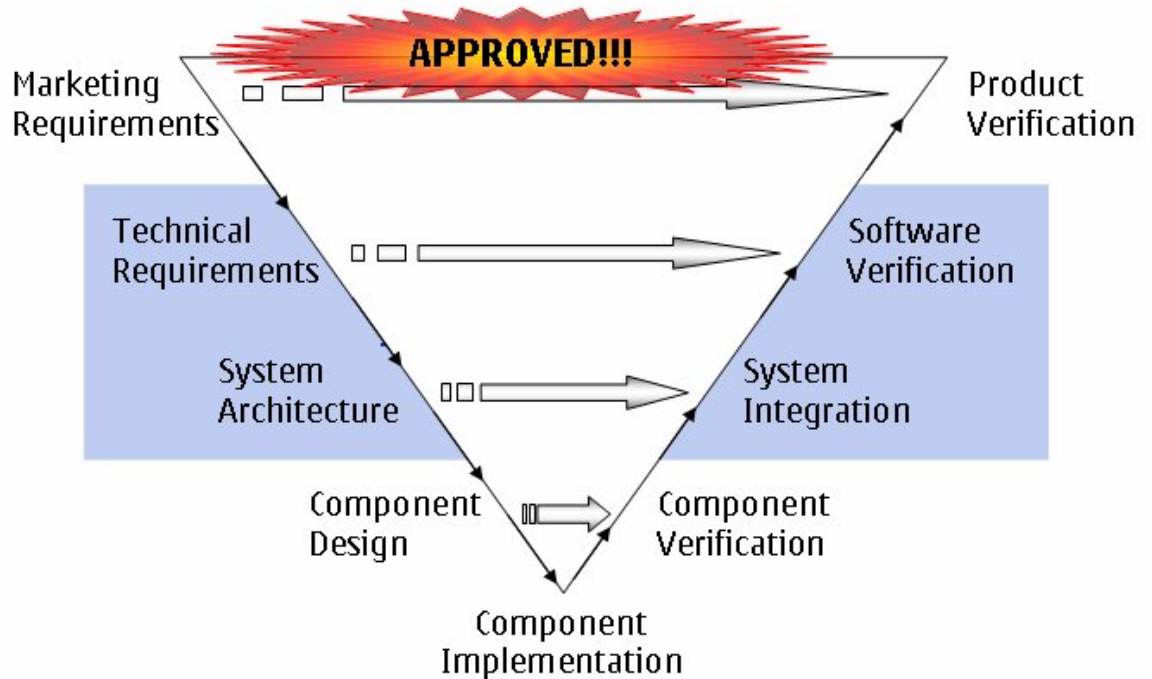


Figure 8: Software Product Creation diagram. Data Source: Frontier

3.3.11 Performance Measurement

3.3.11.1 Balanced scorecard system

Frontier started to apply the Balanced Scorecard (BSC) system in its Telecom division in the late 1990s. Financial measures are extensively used as part of the business evaluation system for Frontier R&D. The key financial measures used are Total R&D cost, product program cost, capital investment, number of headcount etc. If only focusing on financial measures, the organization may lose the holistic view and portfolio targets from a user experience perspective so a balanced scorecard is used. The balanced scorecard system provides Frontier's management with a comprehensive framework to translate the

company's vision and strategy into a coherent set of performance measures. The BSC system organizes the business measures into four different perspectives: financial, customer, internal business process, and learning and growth. This tool helps the organization to synergize efforts from different dimensions to achieve the common strategies.

Each function groups within Frontier uses Balanced Score Card to evaluate its performance. As the BSC system should be customized for business needs, business functions that adopt this system need to go through below steps:

- Clarify strategy & targets of the organization;
- Identify Critical Success Factors;
- Choosing business measures in different perspectives;
- Implement the BSC system;

3.3.11.2 Strategy & targets of the R&D organizations

According to the Complexity Grid analysis, mobile communication products are super value goods and commodity durables. Such mapping helps the company to understand the expectations from the market for new products, namely: great functionality, compelling features and styling, affordability, and with good quality. R&D organizations strive to meet such expectations in a timely and cost efficient way.

3.3.11.3 Critical success factors

To be able to achieve the above targets, the organization needs to understand the critical factors that drive success. The R&D organization performs certain cause and effective analysis to define the relationships of the Critical Success Factors (CSF) and its

performance. The following table lists the major Critical Success Factors and their corresponding Key Performance Indicators (KPI) for the R&D organization:

	CSF	KPI
Financial	High Return on Investment	Net Sales
	Efficient use of capital investment	Gross Margin
Customer	On-time delivery	Total R&D Operation expenditure
	High Quality Products	Product Project Cost
Process	Innovation & constant renewal	Customer Satisfaction
	Technology Know-how	Sales volume
	Flexibility	Growth of Market Share
	High Quality	Error Fixing time
	Motivated, capable people	Field Test Failure Rate (FFR)
People	Employee turn over	Project milestone delays
	Number of Headcount	Time to market
	IIP completion	# of Errors leaking to market
	Employee Satisfaction	Employee turnover rate
		IIP Completion Rate
		Employee Satisfaction

Table 2: Critical Success Factor and KPI. Data Source: author

3.3.11.4 Balance the business measures

Based on above Critical Success Factor analysis, the organization selected and balanced the key performance indicators/business measures into four business perspectives that form the organization's BSC system:

Business Measures

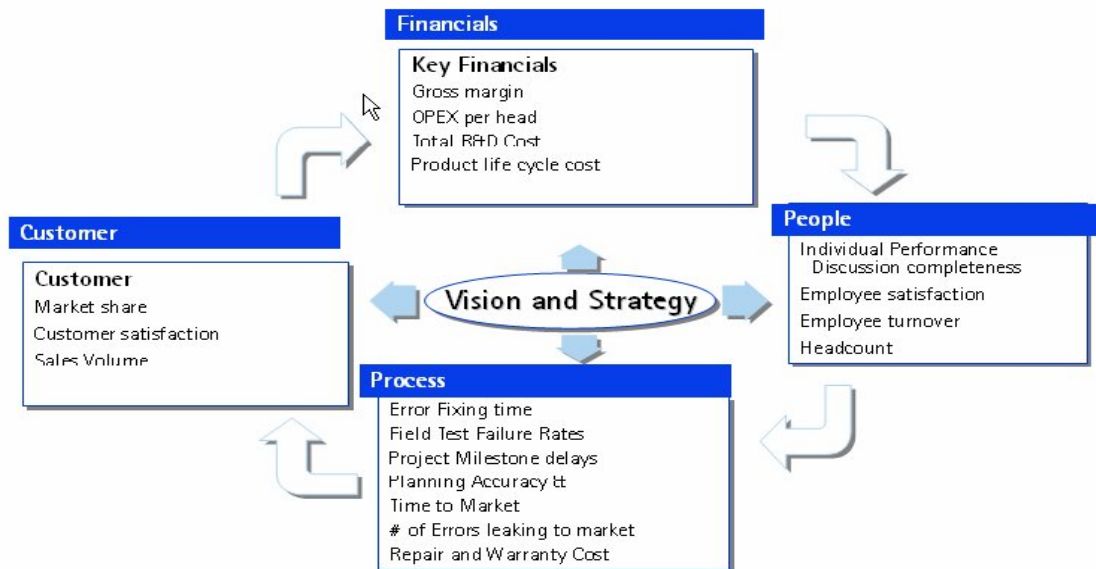


Figure 9: Balanced Score Card. Data Source: Frontier Corporation BSC System Presentation

The BSC measures apply within the entire organization. During each reporting cycle, management will consolidate and review the results of the measures under their control.

3.3.11.5 Linking the BSC to team and individual goals

The balanced score card system is not just used for Frontier's organization level performance measurements. The scorecard's framework of linked cause-and-effect relationships is also applied to guide the selection of lower-level objectives and measures that need to be consistent with high-level strategy. Based on the organizational level targets, teams under the organization and team members match their targets and activities to meet the organization targets. In this way, local improvement efforts will align with overall organizational success factors.

Table 3 is a template for individual scorecards that align with Frontier’s organization level BSC.

The personal scorecard			
Organization level objective			
Improved productivity		Improved profitability	
Be the market leader		Improved product quality	
Customer satisfaction			
	Organization level targets	Scorecard measures	Individual Objectives
Financial	120m	Overhead and operating expenses	1
	800m	Expected Sales/product	2
	6%	Rate of return	3
Process	24 hours	Error Fixing Time	4
	2%	Field Failure Rate	5
	12 mons	Time to Market	6
Customer	90%	Customer Satisfaction rate	7
	24 hours	Respond time for customer inquiry	8
People & Learning	100%	Individual Performance Discussion	9
Name:			
Location:			

Table 3: Example of Individual Scorecards. Data Source: Frontier Corporation

3.4 Assessment of the Product Creation Process

Frontier has established an improved product creation process based on internal lessons learned to address the challenges described earlier. However, a look at the strengths and weaknesses associated with this process is useful in identifying any key improvement areas. The key strength and weaknesses below were compiled after the Frontier product creation process was reviewed by the senior process and program manager at a global telecommunication firm in 2008. For privacy reasons, the names are not referenced here. The feedback is outlined as below:

3.4.1 Strengths of the product creation process

- The process has a clear split between when a product is being defined (RM-M1) and when the program is in focused execution mode (M1-M5). This avoids a continuous definition cycle and provides clarity as to the timeline in which fundamental changes can be accepted by the program team with minimal impact on time to market.
- The product definition phase itself is broken down into phases that address the different levels of focus and differing stakeholders during product definition. Road-mapping(RM) is driven by portfolio management team, this stage defines a product's high-level place within the overall device roadmap. "Concept 0" (CM0) is mainly product marketing driven where user/customer expectations narrow down specifics on the devices. "Concept 1" (CM1) is now more R&D intensive where different technical solutions are investigated and into M1 (pre-commercialization stage) the focus is on maturing the concept and starting production. This staged definition phase enhances the early stage program review process to focus on the business evaluation of new product concepts well before commitment to execution, which helps the organization to position its product and increase the chance of creating successful products for the market.
- As the process progresses into more focused stages (concept to execution), the operating processes outlined above (project management, hardware design and sourcing management, material planning and management, supply chain management, software development and testing, quality

assurance and quality control, Performance measurement) are able to be ramped up accordingly. This allows the right number of people and planning be phased in.

- It can easily adapt to different product concepts thus enables a process that can ensure common planning targets and execution across all R&D, business and support functions (e.g., everyone “talking the same language”) and can adapt to changes in the portfolio direction faster.

3.4.2 Weaknesses of the new product creation process

- The product story or soul is basically the original purpose and product vision created by road-mapping and concept activity. Over time, this vision can be lost as various issues lead to compromises. Frontier’s cascading process which can involve different teams and stakeholders can lead to the loss of the product story and soul, especially if stakeholders and team members change significantly throughout.
- Furthermore, since this process also involves cross-functional teams and support structures, there is the risk of communication and planning gaps as each stage progresses and cross-functional activities expand and operating processes ramp up.
- Performance measurement at each stage is in place, however, again a process divided in segments may result in lack of ownership and accountability during the road-mapping (RM) to mass production (M5) stage, which can lead to quality issues, project delays etc.

4: MAJOR CHALLENGES IN THE PROJECT

MANAGEMENT AREA

Upon completion of each milestone stage, the program management team in Frontier will run lessons learned workshops to brainstorm and identify major learning from that project phase. Some of the key findings from those workshops are outlined below:

4.1 Challenging project scope management

One of the major roadblocks for the handset R&D project is scope management. Although the new product creation process restricts fundamental scope changes within the RM-M1 stage, there are still significant scope changes at the activity detail level, for example, the software error fixing lists or new features.

From an R&D perspective, adding a new feature, while on the surface seeming harmless, can trigger change of architecture or software design. Such changes can quickly result in exponential cost and add complexities to the project. A well-known study shows that there is a fine balance between features set and Return on Investment (ROI). The study of the exponential cost vs. the ROI of the project shows that there is a point at which the introduction of new features starts to have a negative effect on the ROI. The additional costs of these features can quickly overwhelm returns from the product. The following chart illustrates the dynamics of exponential costs vs. feature change:

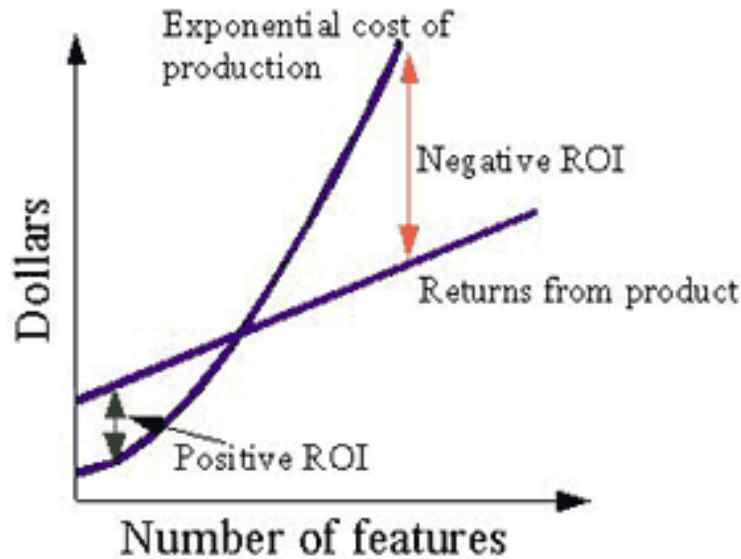


Figure 10: Exponential costs of change can quickly subsume the worth of any product. Data source: <http://www.cioupdate.com/reports/article.php/1563701/Software-Project-Failure-The-Reasons-The-Costs.htm>

4.2 Complicated project planning and resource management

The handset product program interfaces with many other technical and non-technical functions. The technical functions include internal technology platforms, HW design, HW validation, HW qualification & testing, SW design, SW qualification etc. Non-technical functions include product marketing, sourcing, logistics etc. Due to the complexity level of the handset R&D project, these interfaces require a project management team to have superior communication skills to understand and communicate the requirements and scope of the project. During the project planning stage, the project manager needs to work closely with other related functions for resource planning, and make sure to get best available resources that can fit into the program schedule. A misunderstanding in major execution, dependencies or key events could lead to major project budget overrun, delay of the program or even failure of the program.

4.3 Project budget over run

Project budget over run is a major risk in handset R&D projects. One root cause is the complexity level of the project: there are so many uncertainties during the project plan stage. For example, the time it takes to mature a software code line and the numbers of software errors that need to be addressed are often optimistic in the early planning stages. The result is that the man-hours spent maturing the software and servicing the software bugs are well above the budget and schedule.

Another reason for budget overrun is that not all program costs are directly under control of the program manager (exchange rates, internal company policy changes, supplier pricing changes etc).

As the investment decision was based on the business case projected at the product definition stage, when the project spending significantly exceeds the original budget in the execution stage, a project could become less profitable than original plan or potentially bring loss to the company, which may trigger project cancellation.

4.4 Project schedule slippage

At the project planning stage, the project schedule is a cross functional plan based on a Work Breakdown Structure (WBS) that is aligned with each function's plans and meets the product program targets. During the implementation stage of the project, as mentioned earlier, the project scope may and likely will change and unexpected problems may occur. Both create gaps in an existing plan. As a result, a project schedule needs to be re-defined and resource allocation re-adjusted. A common mistake a project team makes is to automatically attempt to counter project schedule slippage by adding extra resources to

the project. In some cases this may help, however a large-scale resource increase tends to have diminishing returns quite quickly and may actually slow things down and add cost to the project. Ultimately, before any corrective action is taken, the cause for any delay must be fully understood.

4.5 Quality Cost

The pressure to maintain budget targets, incorporate a high number of features and hit the market to maximize ASP and early adopter market share can often lead to a compromise in quality. Not only is it critical to build quality into every stage of the project (product concept, requirements, implementation, supply chain, etc), it is also critical to have a systematic way to measure the quality and maturity status of the program throughout the project. Performing regular quality evaluations and taking corrective actions when required is essential to keep quality under control. If a project lacks a systematic approach, the risk is that quality problems will be uncovered too late in a program to implement effective counter measures and the project could be cancelled. Even worse, inadequate measurements may lead to fundamental quality problems being missed and not found until the mass production stage. The eventual warranty costs, lost brand loyalty/retention could be extremely costly to the company.

4.6 Strategic Alternatives

Based on the external and internal analysis, Frontier has certain core competencies that enhance its leading position in the market. However, as the new entrants and competitors are adopting competitive rivalry strategies, Frontier needs to adjust its strategy

by maximizing the utilization of its knowledge assets and its resources to create differentiated products. Under current market environment, doing nothing means offering market share to competitors. The new product creation process is one of the major steps the company is taking for this new defensive strategy. The following section will provide recommendations on how to improve the weaknesses of the new product creation process and reduce the risk of R&D projects through proper process management.

5: RECOMMENDATIONS

5.1 Recommendations on Product Creation Process

Frontier is moving to a new product creation process. In general, Frontier management believes that the new process is well suited for the dynamic nature of the market (section 2) and is aligned well with their organization structure. However, the company has also identified some key weakness areas. This section provides some recommendations to address these weaknesses:

- Cascading process can lead to a loss of the original product goal;
- Risk of communication and planning gaps as each stage progresses and cross functional activities expand;
- Process may result in lack of ownership and accountability that can lead to quality issues and delays.

5.1.1 Recommendation 1 - Strong “Vision” ownership needed from RM-M5 stage

The weakness identified is that the staged process can lead to a loss of the product story and soul especially if stakeholders and team members change significantly. This can result in fundamental change in the product that the original value propositions and business case are no longer valid during program execution.

When looking at how Apple deals with this problem (Alain Breillatt, 2008), “A cohesive vision describes the storyline for your products and services. That storyline needs to state decisively what is in bounds and what is out-of-bounds over an 18-month to 3-year period. Everyone in the development process who matters must be in lockstep with this vision, which means you need to have open lines of communication that are regularly and consistently managed. This storyline or strategic vision needs to be revised according to market changes and the evolution of your new product pipeline.” It helps that Apple tends to approach their products with a systemic frame of mind, looking to develop the “total solution” rather than just loosely joined components.” In addition, the same study (see reference above) identifies the need to ensure the business stakeholders’ expectations are managed early on and throughout the project via regular stakeholder meetings. “The meetings achieve this purpose and give a sense of control to senior management, so that they have visibility into the process and can influence the direction. Again, the purpose is to save the team from pursuing a line of direction that ultimately gets tossed because one of the decision makers wasn’t on board.” (Alain Breillatt, 2008)

The portfolio management task along with stakeholders provides the product vision but it must have a stronger ownership beyond roadmap definitions. For example, the BSC needs to ensure the original soul of the product is maintained with review points back to the portfolio planning and business stakeholders. A product “Champion” who ensures that this cohesive vision is kept throughout the product creation stages is crucial. It could be as simple as an empowered product manager that plays a lead role and stays in the process from RM (milestone) to M5 (milestone). This Champion needs to have regular meetings

with the senior management to ensure the vision and developments are aligned throughout the development (not just in concept phase).

5.1.2 Recommendation 2 -Communication plan and knowledge collaboration

This process also involves cross-function teams and support structures, thus increases the risk of communication and planning gaps as each stage progresses as cross-functional activities expand and operating processes ramp up. The root cause of these gaps is that there are too many communication points within the structure, which can lead to miscommunication or delays.

The Program manager must focus on connecting the different functions through a proper communication plan. A communication plan that outlines the channels, types and frequency of communication across functions is not only a good way to share information and issues of the project, but also is an effective tool to foster collaboration to resolve problems in a more efficient way.

In addition to ensuring regular and comprehensive communication, the project team must ensure that key information and data is readily available to team members and stakeholders. The project team, for example, could use public drives, intranet, certain databases, on-line collaboration tools (Wiki, etc) to document and share information like product designs, working procedures, project progress, technical and market studies, requirements tracking, meeting minutes and action plans etc. Such information must be kept relevant and up to date. Above recommendations are in effect key enablers for three of the six critical factors that encourage efficient and innovative development (Imai,

Nonaka, and Tekeuchi (1985)) namely - self-organizing project teams, multi-learning, and knowledge management.

5.1.3 Recommendation 3 – Dynamic BSC across entire lifecycle

Another weakness identified is that even though the performance measurement at each stage is in place, the segmented process may result in lack of RM-M5 ownership and accountability, which can lead to quality issues, delays etc. The program manager, product champion and senior management, must define a BSC that is linked directly to the product vision (product brief, etc) and business targets. This BSC may need to change as the environment changes to ensure the BSC reflects goals and expectation at all times. Senior management, as the major stakeholders, needs to endorse this practise.

When applying the BSC system, the following factors also need to be considered:

- Only key performance indicators should be included in the BSC system, too many business measures may result in lost focus.
- Once defined, stick to the business measures - refine, drop or add measures, but do not constantly change. Ideally, amendments and changes can be managed on a half-yearly (and quarterly) basis;
- Competitor and other industry benchmarks are effective for getting people's attention and for setting the right levels of targets;
- Successful deployment of business measures requires true management commitment, and top-management sponsorship & support;

- The scorecard provides a tool for structured dialogue, but it's also a management philosophy and mission;
- Measures can and should be used for performance appraisal and rewarding, but be aware of the kind of behaviour you are trying to achieve.

5.1.4 Recommendation 4 –Strong project management

These recommendations target at addressing lessons learned challenges related to project management areas.

5.1.4.1 Project planning & project progress control

During the business case preparation stage, the program manager needs to work closely with all related parties to propose an accurate investment plan and calculate a complete profitability forecast to support the continuation of the project.

The Program manager needs to have proper control over the project scope in that any changes of the project scope need to follow predefined authorization procedure. Proper tools (e.g. a change control process) and active communication channels should be in place to document and share the approved project scope change to relevant parties.

During the project execution stage, the product program manager must track the project progress and benchmark with the official project budget to ensure the project is executed according to the plan.

Project progress reports should be communicated in a timely manner (e.g. weekly). The variance between current progress and the planned targets must be visible, analyzed and corrective actions initiated to correct any deviation.

5.1.4.2 Quality management

In the early stages of studying market requirements, it is critical that user expectations are fully understood. Even a well-executed product can lead to “quality” issues if it falls short of user expectations. It is also critical that the technical requirements capture key user features and users’ performance expectations (UI speed, etc).

Best Practices: Throughout development, the team must follow the industry’s best practices for code structure, code reviews, test case development, test specification and verification, and Six Sigma quality control, etc.

Quality management for supplier side: Although Frontier has a set of processes to select appropriate suppliers to assure product quality, the company requires rigorous policies to ensure robust supplier performance. Frontier should insist key component suppliers are involved at product concept stage and that samples are evaluated and tested in a critical manner. During the prototype stage Frontier usually provides senior resources to vendor sites for on site support for critical parts. Accordingly, vendor relationship management is essential to ensure consistencies and commonality of goals.

Comprehensive testing and Metrics: During the testing phase there must be solid test coverage at every level, which is visible and accepted release criteria and producing fast field responses to issues. Performance metrics must be tracked against requirements at all times.

5.1.4.3 Accurate Prototype build planning

Timing and volume of prototypes may vary from different product projects. Careful planning is needed to ensure there is enough test time between hardware builds to ensure that design corrections can be incorporated into the next build. Otherwise, poor planning can lead to an excessive quantity of prototypes. To keep development costs under control, the quantity of prototypes per build should be optimized during the project planning stage to ensure the minimum numbers of prototypes are built to meet each cross-functional team's testing needs.

Prototype volumes and timing should be realistic. The team should try to avoid an overly aggressive/unrealistic schedule that results in overlapping builds in which suppliers often then have difficulty catching up with the build plan before major design changes.

5.2 Recommendations for other associated areas

5.2.1 Supply Chain Management

As per previous analysis, supply chain management could directly affect the project schedule and increase the project cost when materials ordered cannot meet the project requirement. Following rules should be followed for this area:

- Ensure dependability & improve cost efficiency: During the material requirement planning (MRP) process, communication within the organization for product specification is quite critical. Reducing scrap resulting from poor product specification to “0” should be one of the targets for the supply chain team.

- Be flexible and fast: Any changes to the specifications and volume or timing of the demand should be updated in the material plan, and should be communicated with the supplier immediately. Supply lead-time and yield targets should be agreed and ensured to avoid project delay due to missing components.
- Control the quality: Critical quality assurance procedures and pass/fail criteria should be in place and agreed upon by HW experts and product marketing (e.g. visual quality, look and feel) in the project team. The supplier should be able to produce parts and materials in a predictable and controlled manner (i.e. yields and tolerances within targets) in high volume.
- Be cost effective: The production plan should also take into consideration optimizing order volume size and shipping lots to reduce cost per order. Inventory management procedure should be in place to facilitate the order-timing forecast and obsolete materials should be scrapped to free warehousing requirements and reduce the load of material management.

5.2.2 Software development and testing

As mentioned earlier, a technology platform approach that advocates re-use of software and HW across many devices is one way to deliver a portfolio of products across multiple segments in a timely and cost effective way. In particular, in the area of software, a proper architecture re-use can be achievable on a large scale. A product family concept will maximize the re-use of common software features across different products. The

development of many software features for a product family can be done well before the programs have been fully defined to save time to market.

The software development and testing process within the new product creation process should also follow below guidelines:

- Optimal use of resources through planning and resource allocation tool;
- Avoid duplicate work, maximum re-use where possible;
- Make sure there is only single interface with suppliers for requirements, avoid confusion and miscommunication;
- Comprehensive system and feature test coverage is needed with metrics that clearly show the software maturity of a product at any time;
- Continuously look to automate testing to decrease the verification cost, improve error detection and overall turn around time.

5.2.3 Partnership strategy

The new product creation strategy with its multi-interface approach is well suited to selective partnership strategy. Successful partnership could help the company to:

- Gain the advantages associated with vertical integration while still maintaining organizational independence;
- Take advantage of “best in class” expertise;
- Improve operational efficiencies;
- Combine strengths to better respond to the competition.

5.2.3.1 Partnership opportunities & recommendations

5.2.3.1.1 Partnership with upstream suppliers

It is impractical for R&D organizations to try and ‘do it all’ and maintain expertise in all aspects of product creations. Rather, it should remain focused on its value added, and core capabilities. Partnership with the components providers, manufacturing houses and test subcontractors allows for this focus while improving cost efficiency.

Frontier strives to maintain its technology leadership in the market while understanding that the quality of the components is critical for business success. So once again, it should be stressed that there is a need of strict quality control plan when choosing the suppliers and during the co-development phase.

5.2.3.1.2 Partnership with downstream operators

Mobile handset R&D organizations can also benefit from partnership with their downstream customers, such as the major mobile operators. One successful case is the partnership between RIM & Rogers. By customizing its products according to the operator’s requirements and co-branding, RIM has achieved great success for specific products and applications while benefiting from Rogers sizeable marketing. Partnership with operators also streamlines the type/operator approval process to open the regional market to the new product.

5.2.3.1.3 Partnership with science institutes and universities

In order to build a solid mindset within the community, and help to attract the top talent to the R&D teams and to stay close to leading edge research, Frontier should

develop and maintain relationship with public research institutes and universities in relevant areas.

5.2.3.1.4 Partnership with related businesses

Again, in today's world one company cannot "do it all". In recent years, many small companies have focused on specific mobile communication applications, such as companies that develop games, digital maps etc. These applications provide a means to differentiate and create value for the device. The R&D organization should partner with these companies for new features and functions of the product where it make sense and ensure there is a delivery chain/integration process built into the new R&D process to accommodate these 3rd party developments.

Note since such alliances may relate to legal issues (e.g. IPR ownership etc), legal support is necessary when setting up the licensing agreements.

6: CONCLUSION AND RECENT CHALLENGES

Frontier has a reasonably strong position in the handset industry. The company also has processes and resources to maintain a competitive edge. Their new R&D product creation process is a good step in addressing some of the ongoing fundamental changes in the market. By adopting the recommendations in this study, it is this author's belief that the organization can improve its position, and further develop a new business model to address the new services and customer expectations.

6.1 Recent Financial Crisis

Due to the recent global financial crisis, the handset market is seen to suffer some contraction into at least the first half of 2009. Growing pressure for lower revenue and more fierce competition for market share will force the organization to re-evaluate even more critically certain investment strategies and the operation models to further decrease cost. The new R&D process coupled with the recommendations is well suited to address this. However, careful attention is needed now to the portfolio mix and any assumptions made even a few months ago with respect to customer expectations and profitability. This may mean a temporary adjustment to the BSC targets, for example, until the visibility and uncertainty is improved.

6.2 Further data collection and Analysis

Although the recommendations presented in Chapter 5 are based on broad study of Frontier's R&D operation and the market as a whole, the analysis performed was not exhaustive. Thus, Frontier also needs to constantly scrutinize its product creation process, update its research and analyze any potential risks and weaknesses that may hinder the organization's development.

APPENDICES

Appendix 1: Handset Shipment Forecast (2007-2011)

Fig.1 Handset Shipment Forecast (2007-2011) Unit: Thousand

	2007A	2008F	2009F	2010F	2011F
Gartner	1,144,369	1,237,063	1,367,496	1,506,431	1,651,276
Growth Rate	14.7%	8.1%	10.5%	10.2%	9.6%
Smartphones	102,315	159,019	271,692	399,766	539,632
Growth Rate	39.57	55.42	70.85	47.14	34.99

Source: Gartner Research

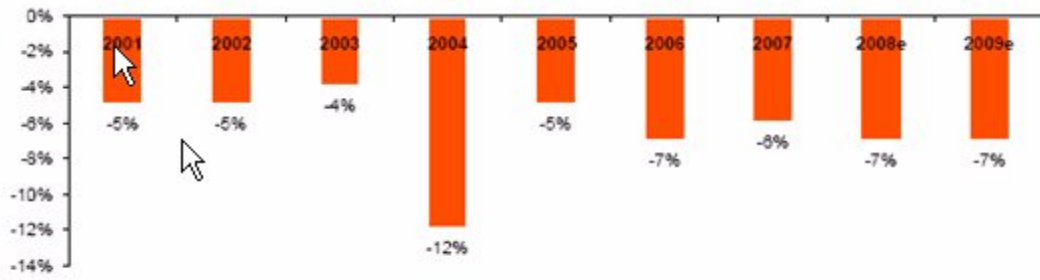
Connie Chen, SinoPac Securities, (886 2) 2382-8169, connie.chen@sinopac.com

Appendix 2: Global Handset Forecast (2005-2010)

Technology	2005	2006	2007	2008	2009	2010
GSM/GPRS/EDGE	594.9	703.4	772.5	790.2	616.3	475.7
WCDMA	49.4	101.9	172.9	291.0	550.0	735.0
CDMA	161.2	196.0	209.0	221.8	219.1	218.5
TD-SCDMA	0.0	0.0	0.1	0.6	8.2	31.0
WiMAX	0.0	0.1	0.1	0.9	0.5	11.2
iDEN	15.3	15.9	10.0	5.9	4.8	2.8
PDC	12.0	7.7	1.5	0.0	0.0	0.0
TDMA	11.2	4.2				
Analog	0.7	0.1				
Total Unit Sell-in	845.8	1,028.4	1,167.3	1,310.6	1,405.0	1,474.4

Based on: Frontier Industry Analysis Data

Appendix 3: Annual ASP decrease for Frontier Corporation's Handset

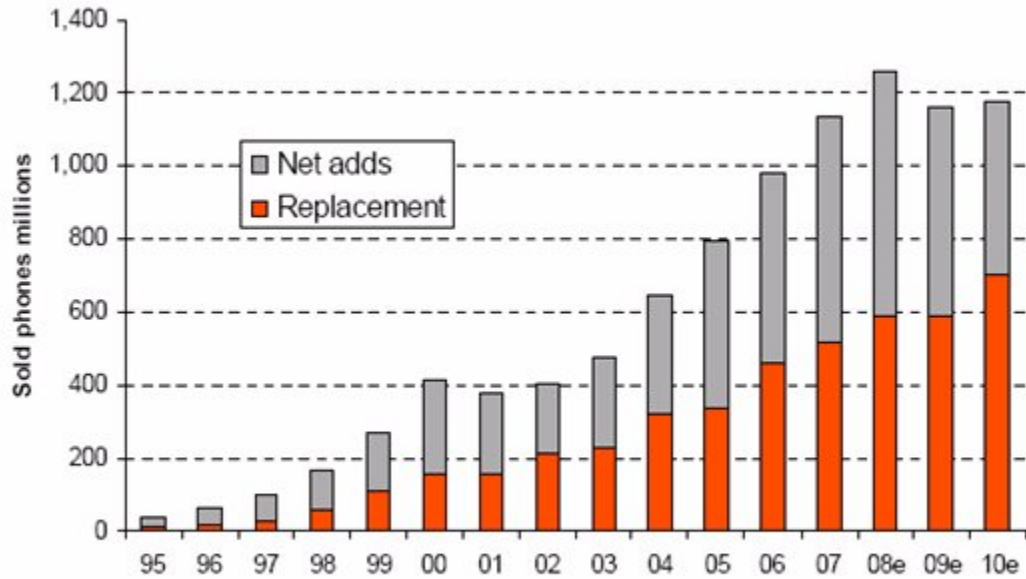


Based on: Frontier Marketing Data

Appendix 4: Handset Net Adds and Replacement Forecast

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Total phone market: net adds and replacements



Source: Global Mobile and Swedbank Markets (Weak market scenario)

REFERENCE LIST

Alain Breillatt “Pragmatic Marketing” Volume 6, Issue4, 2008

http://www.pragmaticmarketing.com/publications/magazine/6/4/you_cant_innovate_like_apple

From Project to Process Management:

<http://iew3.technion.ac.il/serveng/Lectures/FromProjectToProcess.pdf>

Information Distortion in a supply chain: The bullwhip Effect:

<http://faculty.math.tsinghua.edu.cn/~jxie/courses/SCM/HauLee1997.pdf>

Barney, J.B., “Looking Inside for competitive Advantage”, Academy of Management Executive, Vol. 9, No.4, 1995.

Day, George S., “What Does it Mean to be Market-Driven?” Business Strategy Review, Volume 9 Issue 1, 1-14, 1998

Duncan J.W., Ginter P.M., Swayne L. E., “ Competitive Advantage and Internal Organization Assessment”, Academy of Management Executive, 1998, vol.12, No.3

Internet. Sep. 20, 2008. Available: <http://www.nokia.com>

Kaplan, Robert S. and Norton, David P., “The Balanced Scorcard: Measures That Drive Performace” Best of Harvard Business Review, July-August 2005

McGrath Michael E., “Product Strategy for High-Technology Companies- How to Achieve Growth, Competitive Advantage, and Increased Profits”, 1995

Porter, M.E. (March-April 1979). “How competitive forces shape strategy”, Harvard Business Review