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Product Structure Optimization for the Network Management System Software

Case Study

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Tämän tutkimuksen tarkoituksena on optimoida yrityksen myymän verkonhallintajärjestelmän tuoterakenne. Tuoterakenne ja tuotteiden määrä on laajentunut vuosien saatossa kehitettyjen uusien ominaisuuksien sekä tuettavien verkkoelementtien myötä. Tämän johdosta nykyinen rakenne nähdään monimutkaiseksi ja vaikeaksi myyntirajapinnassa.

Tutkimus käsittelee ongelmaa tuotehallinnan kannalta. Ehdotus uudeksi tuoterakenteeksi perustuu niihin ohjelmistoliiketalouden sekä tuotehallinnan kirjallisuudesta löydettyihin käytäntöihin, jotka parhaiten sopivat kyseiseen tutkimuskohteeseen. Nykytilan kartoittamiseen on käytetty sekä määrällisen että laadullisen tutkimuksen menetelmiä. Ensiksi tehdyllä määrällisellä tutkimuksella selvitettiin tuotteiden menekkiä. Saaduille tuloksille haettiin tämän jälkeen tarkempaa selvitystä nykytilasta haastattelemalla asianosaisia. Näin saatua kokonaiskuvaa nykytilasta on käsitelty teoriasta valittujen parhaiden käytäntöjen kautta, ja tämän perusteella on rakennettu ehdotus uudeksi tuoterakenteeksi. Ehdotuksen toimivuuden tueksi se katselmoitiin asianomaisten kanssa ja testatiin käyttäen aikaisempaa tilauskantaa referenssidatana.

Tutkimuksen lopputuotoksena on ehdotus yritykselle uudesta tuoterakenteesta verkonhallintajärjestelmälle. Ehdotus täyttää vaatimukset nykytilan yksinkertaistamisesta sekä soveltuvuudesta tukea erilaisia asiakasratkaisumalleja. Lisäksi referenssidataan perustuva testi osoitti mahdollisuutta suuremmalle liikevoitolle uuden tuoterakenteen myötä.

Avainsanat	Verkonhallintajärjestelmä, (NMS), tuotehallinta, tuoterakenteen optimointi

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The objective of this Thesis is to optimize the product structure of the case company's network management system (NMS). Over the years the product structure of NMS in the case organization was expanded and the amount of items has increased as a consequence of the new features and network element types developed. As a result, the NMS product structure, the licensing has been seen as difficult by sales.

This Thesis approaches the problem from the product management point of view. The proposal for new product structure is built based on best practices found from the software business and product management literature. The status of the current product structure is analyzed by using quantitative and qualitative methods. First, the quantitative method is used to gather information on the product items prevalence in the current customer deliveries. Then, the qualitative analysis is applied to gain a deeper insight into this issue. The findings from the current state analysis are then reflected against the existing best practices. The new product structure is subsequently defined and reviewed by stakeholders, and also tested with reference to the data.

The outcome of this research is the proposal for optimizing the product structure of the case company's NMS. The proposed product structure provides the simplicity required and still retains the capability to match against various business cases. The test run in the Thesis also reveals a possibility for higher achievable revenue with the proposed product structure.

Keywords	Network management system, NMS, software product, product structure optimization, product management

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ABBREVIATIONS/ACRONYMS

APAC	Asia and Pacific
ARPU	Average Revenue per User
ASP	Application Service Provider
BU	Business Unit
CAPEX	Capital Expenditure
CPU	Central Processing Unit
EMEA	Europe, Middle East and Africa
FCAPS	Fault, Configuration, Accounting, Performance and Security - a general description of the high level functionalities network management systems
HW	Hardware
ICT	Information and Communication Technology
IP	Internet Protocol
IT	Information Technology
KPI	Key Performance Indicator
LAC	Latin American Countries
MEA	Middle East and Africa
NA	North America
NE	Network Element
NMS	Network Management System
OPEX	Operational Expenses
OSS	Operating Support System
OTC	One Time Charge
R&D	Research and Development
RTU	Right to Use License
SaaS	Software as a Service
SCM	Supply Chain Management
SW	Software
SWOT	Strengths, Weaknesses, Opportunities and Threats Analysis
TDM	Time Division Multiplexer/Multiplexing
USW	Unit Software Application
VPN	Virtual Private Network

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1. Introduction

The objective of this Thesis is to optimize the product structure of the case company's software product, the network management system (NMS). The product structure can have a significant influence on the success how the product is perceived on the market. Especially with the intangible products such as software, the value needs to be clearly exemplified to the customers. The optimal product structure would meet the customers' needs in the way the customers could understand the value of it. This challenge makes the focus of this Thesis.

1.1 Overview of the Topic

The complexity of the telecommunication networks has increased significantly during the technological migration from the circuit switched to IP packet based networks. In addition, the amount of data increases constantly, which causes more pressure on the operational centers to provide and maintain services 24 hours, seven days per week. At the same time the focus on costs, especially to OPEX, has increased, which means that work efficiency also needs to improve continuously. The NMSs across Telecom are made to respond to those challenges the network operators are facing. As a result, NMSs are being developed constantly to meet the new technological requirements, and so are the operational requirements to support the network operators' processes. Even though the role of NMSs has grown to become the business critical component in the network service providers' ICT, NMSs as a business segment have stayed in the shadow of telecom equipment business.

The function of NMSs is to provide a user friendly toolset for network operators to configure and maintain the telecommunication equipment and networks efficiently. The efficiency is achieved by hiding complex logic behind a simple sequence of tasks which can be used through a logical and easy graphical user interface. For example, the data path between the end points can be described as a logical connection even though it consists of a group of configurations made into individual network elements. At the network, which consists of tens of thousands

network elements and millions of access points, the structured information model which NMSs provide is crucial. In addition to the graphical user interface and structured information, NMSs provide functions which reduce dramatically the need for human interaction in provisioning services and making maintenance operations to the network equipment.

At the most of the cases, NMSs are typically made by the equipment vendor only for the network elements they provide. Each network vendor has their own propriety solutions which secure the role of the NMS in the whole system setup, but it also limits the NMS role as a business creator – even though it can be considered a business critical tool for network operators.

Thus, the tight bondage of NMSs to the specific network elements limits the business prospect to the customers having the network elements. In addition, the legacy of business models in the telecom business, where the business model is based on the network equipment and the functionalities, positions the network management system to be a complementary product. This causes a contradictory situation where the value of NMSs has not always recognized in financial terms.

It leads to the situation in which the product structure can have a great influence to the success of the product in the market, especially with the intangible products such as software, but its value needs to be clearly exemplified to the customers. The optimal product structure would meet the needs customer values and understands.

This thesis studies a product structure of NMSs of a telecom equipment vendor operating globally. The objective is to define a product structure to serve customers, sales and supply chain with the optimal number of network management product items. The optimal product structure can be assumed to improve the achievable revenue. This study is made by evaluating the status of what and how the network management systems are currently sold. The findings are compared with the research and knowledge available on SW business and SW product structures.

1.2 Context of the Research

Telecom business can be categorized as an infra business since the investments made there are large – usually counted in tens of millions – and the duration of network implementation can take several years. The average lifecycle of a network can be estimated between 10 to 15 years, which means that the relationship between a supplier and a customer is typically long lasting.

From the historical perspective, the telecommunication business has evolved dramatically in the 1990's, not only because of the cellular technology and the broadband services, but also business wise. The business has become consolidated by both parties, the network service operators as well the network equipment vendors. The change for the network operators' consolidations was initiated by the global opening of regulation. Previously, the network operators were, at least partly, owned by governments. In addition, the business was very strictly controlled, which limited the size of companies as they were allowed to operate on the given domain.

Disassembling the regulation opened the telecom business for free competition. That drove small operators to merges, and large companies started to grow to outlands. As an example, in Finland alone there used to be several hundreds of local operators aside from the state phone monopoly. The largest number registered in Finland was 815 local telephone companies (Ficom 2012). Currently, there operate only a couple of remarkable companies, Sonera, Elisa and DNA, which do have 89% market share of Finnish telecommunication business (Ficora: Viestintämarkkinat Suomessa 2010). A similar effect has happened globally: Telecom operators from big countries did come under pressure to grow, and they aimed at outlands. As a result, operators such as Vodafone (originally Spanish) and Orange (subsidiary or France Telecom) are now global companies having direct operations in several countries. The large global companies have founded alliances with smaller national companies and expanded their services footprint as well business.

Similar consolidation has happened to the network equipment vendors. Alcatel and Lucent, for example, merged in the late 2006 (alcatel-lucent home page; 18.11.2012). A new company, Alcatel-Lucent, gained a considerable market share in the fixed network market.

There were also many acquisitions between the largest equipment vendors. Ericsson bought Marconi in 2006, for example. Marconi Communications used to be the largest vendor for transmission network equipment in the 90s, but they did not managed to follow networks emoluments to IP technology and for that reason the company basically lost their position in the markets. For the companies which did not manage to find a partner or were not otherwise interesting, ended up in bankruptcy, such as Nortel in 2009.

The consolidation in the telecommunication market still continues. There are two drivers that can be found for that. First of all, the competition on prices declines the revenue. Secondly, at the same time the amount of data that subscribers are using is increasing constantly, which drives operators to invest more capacity into their networks. As a result, the revenue diminishes, but the costs to capacity ratio increases.

Over the last few years, for the network service operators the average revenue per user (ARPU) has declined, even though the number of services used has increased dramatically based on mobile phones and broadband accesses. Consequently, the competition for the customers is extremely tough between the operators. The price pressure and customers churn caused by easy change of the service operator significantly impacts the revenue. At the same time, the operators are struggling with the costs. The constantly increased usage of the fixed and the mobile broadband services enforces the network operators to invest even more into their networks. New technologies, such as the mobile broadband provided by the 4G technology, drive the capacity requirements to the new level. Research companies, such as OVUM and Infonetics Research, have illustrated that the capacity growth in networks has reached two digit numbers in telecommunication business segment. As a result, the current dilemma for the network and service operators is that the costs of covering the increased capacity requirements are not in

balance with the growth of the services usage as the chart in Figure 1 below shows.

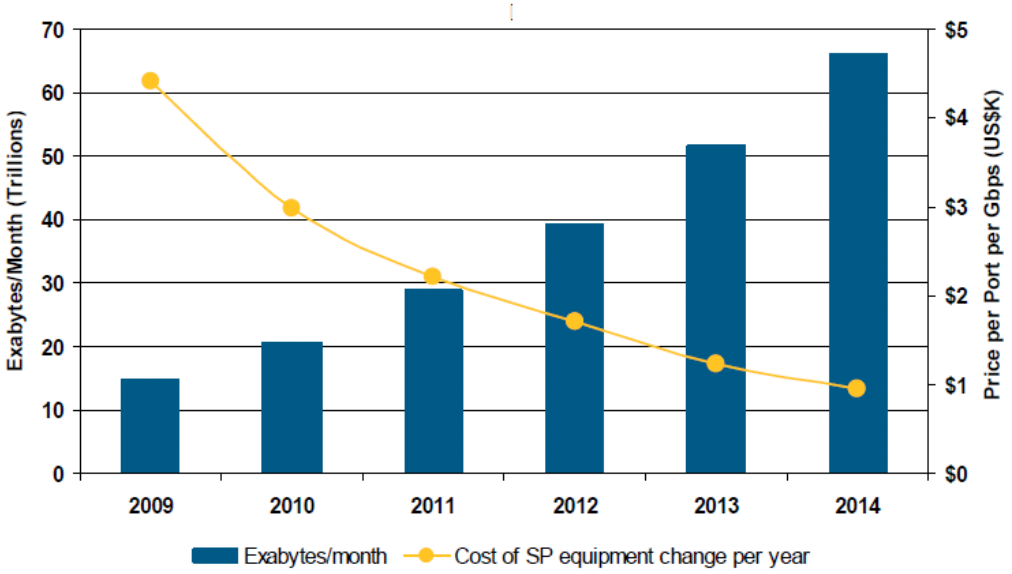


Figure 1. Telecom equipment price erosion versus capacity growth.

(Infonetics Research 1G/10G/40G/100 Network ports, Biannual Market size and Forecasts, October 2011; Cisco Visual Networking Index (VNI) Global Forecasts, 2009-2014).

Figure 1. demonstrates the price erosion versus capacity growth by Infonetics Research. As Figure 1. shows, the amount of delivered data is predicted to grow in the size of exabytes. Even though the costs per port declines, it still cannot compensate for the costs the data growth causes. Moreover, the costs of the equipment are not the only challenge with the service operators. Infonetics Research trends for 2012 (Infonetics 2012) has estimated that 65% to 85% of the service operators' revenue is spent on OPEX. That means the overall profitability can be very challenging. To stay profitable, the operators should be able to transfer more bits with less money and manage it more efficiently.

The network operators push the price pressure to the telecommunication vendors. In practical term it means that more efficient equipment are now required to carry more data with cheaper price. In the 2G and 3G mobile networks, the typical access interface from the base station was *n* times

2Mbit/s connection and the backhaul network was based on 1Gbit/s network. Broadband services, and especially the Mobile broadband services, have increased their capacity requirements to a totally new level. The connection from the base station is now required to be 1Gbit/s and the backhaul network should be tens of gigabits. That drives equipment vendors to develop new and more efficient equipment to meet new requirements. As can be seen from Infonetics Research results in Figure 1, the annual growth of the data amount is very high. This means the research and development cycle need to be relatively short, only some months. This forces equipment vendors to have more resources to meet the deadlines, which also means more costs for the already expensive R&D.

To add to this pressure, traditional Telecom equipment vendors have also faced an aggressive rivalry from new Asian vendors. New Chinese vendors, such as Huawei and ZTE, have risen to an eminent role in the telecom market. For example, Chinese vendor Huawei has over 20% of the market share in LTE business (Dell'oro group 2011). Remarkably, Huawei was founded only in 1987 and now the company is ranked in top five of global telecom vendors. As the tool for entering the market, the Chinese vendors used extremely low prices, which added to the overall high competition with prices in the industry. The high rivalry drives network equipment vendors to find new ways to secure their competitiveness and finally their profitability.

According to Infonetics Research trends for 2012 (Infonetics 2012) report, 20% of the service operators' OPEX is used to operate the network and 40% is spent on customer management. By having efficient NMSs, the operator may cut its costs quite significantly. Certainly, the network operations are the main part where savings can be done, but customer management can also be intensified by using network management tools to improve customer experience in service availability and quality.

Even though the value and the benefits which NMSs can bring to network operators are recognized, NMSs have been perceived as an extra cost for the system. This because the benefits NMS provides is hard to measure. As a result, the business models for NMSs are typically

undervalued. The common approach is to bind the value of NMS to only one parameter – the size of the network to be managed. Although being a true measurement, it does not represent all the benefits of using NMS, as there are no estimated values for other functions needed in the networks life cycle. For example, network planning, deployment, service provisioning and monitoring, etc. are difficult to measure in financial terms.

Another reason for the undervaluation of the NMS is the complexity of software components and pricing used. Over time, more innovative ways were found to productize management software to meet the required pricing trends of the current era. Commonly utilized “pay as you use” and “pay-as-you-grow” methods were found feasible as they support the business models generally used in the telecom business. The drawback of using them is that these models have driven the software product structures to be scattered into so many pieces that they are difficult to manage and understand by both customers and the sales forces. In the worst case, products are categorized to so small pieces as to make them unprofitable because maintaining a complex structure costs more than the product yields.

For that reason, the product structure of NMSs, as any other software product structure, need to cover the principles of simplicity, scalability and the most important thing, it should support the company’s business strategy.

1.3 Business Problem

The trigger for this study was the feedback received from the sales force concerning the NMS product structure. This structure was perceived as too complex, with items that are mandatory and which are optional. As a result, in the ordering phase there were confusions what items need to be included in orders. In addition, a large number of sellable items caused confusion and mistakes in supply chain, which caused extra work and delays in deliveries. Finally, the management system presently serves several network element business units. This causes a challenge in terms of sales as one product structure should be able to support different

business models. As a result of the previous difficulties, there was also a challenge to achieve the revenue which meets the value of the NMS.

Thus, as the management system's product structure has been perceived as complex. The price book of the management systems consists of over 500 orderable line items. Based on the statistics of the delivery data in 2012, almost half of those items were not delivered at all. From the financial point of view, 10% of the product items generate the 80% of the revenue. The unbalanced situation between available product items and the items used in business gives a rationale to review the current product structure. Most of the NMS items are not necessary from the business point of view.

Currently, the NMS software consists of application packages and network element adapters as described in Figure 2 below.

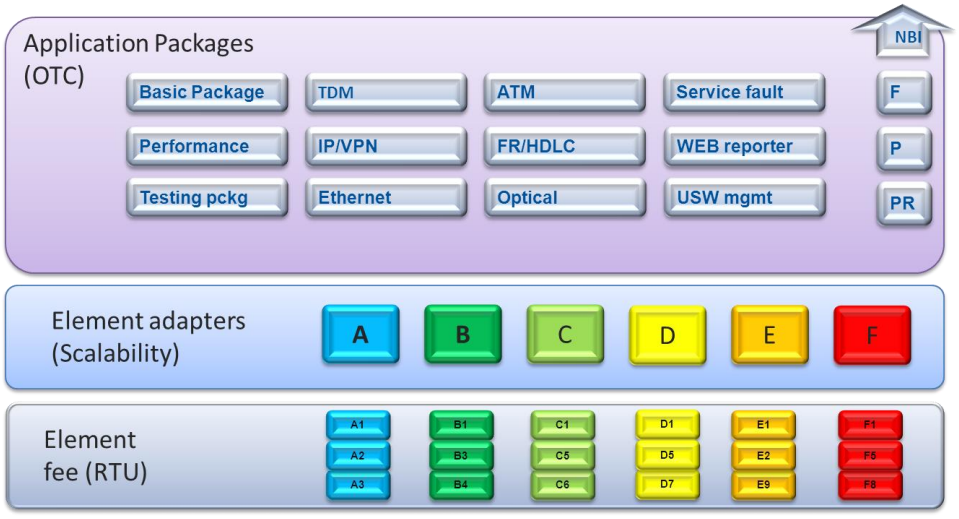


Figure 2. NMS's license model.

As shown in the NMS's license model consists of application packages and network element adapters. The applications provide certain functionality such as technology specific provisioning function. The adapters are used to control the managed network element types. Adapters have capacity dimension inbuilt in the product structure. The adapter license is attached to the physical server, which can manage a certain number of network elements. This can be used as a scalability factor, the "pay-as-you-grow" component in the network management

licensing model. The element fees at the bottom of Figure 2 show the right to use licenses (RTU). Those are fees propagated from applications to each network element or other quantifiable hardware entity. In principle, RTUs can be described as an entitlement to use the NMS application to manage the NE.

Even though the product structure is hierarchical and as such is relatively easy to categorize, the large number of its items can cause confusion. The sales force perceives it as complex to make appropriate proposals to customers. From the customer perspective, there are similar challenges: the layered structure causes confusion as for which licenses they need; which licenses are needed to purchase at once and which need to be applied with network element; and what is the correlation and difference between the applications and the RTUs. This confusion leads to misplaced orders, which cause unnecessary work for the supply chain process. As a consequence, the sales force has found their own shortcuts to simplify the product structure by having their own, unofficial NMS items. That has made the product structure even more complex, as the total number of NMS items supply chain needs to manage has increased.

The second rationale for the Thesis is the revenue recognition model. The management system supports all the network element types the case company is selling. From the organizational point of view, this means the management system is shared amongst other Business Units (BU). The revenue that the management system generates is also allocated to other BUs aligned with the element fee that each BU sells. The business responsibility of management system sales is thus delegated to NE BUs. Each BU can sell the NMS as they see best. For business cases of single node type the model accommodates well, as there is a comprehensive business case analysis covering all aspects of building the optimized solution for covering the network elements, the NMS as well the maintenance and other services. Deprivation on the sales models appears when the NMS software is sold through several BUs. Each BU unit has their own methods and Key Performance Indicators (KPI) to measure financial performance. The pricing models may differ between business units. For example, the strategy of achieving the NMS revenue from applications or RTU’s may vary between BU’s.

The third rationale comes from the profitability perspective. As mentioned at the beginning, the telecommunication business is hardware (HW) oriented business. This fact makes the situation for NMSs challenging because the management system is based on pure software (SW). As the legacy of HW oriented business, the value of SW is not recognized and the prices of SW are easily squeezed down. One commonly used argument for that is that "there are no manufacturing costs, so why cannot it be free of charge?". As the real costs, such as R&D or venue are not included in profitability costs. In accounting terms, this means that all business is profitable by 100%, which is not true. This leads to additional business problems since KPI utilized for HW sales are not usable for SW sales.

1.4 Objectives

The objective of this study is to provide a proposal for new product structure of the NMS for the case company. The new product structure should be able to respond to the issues present in the current product structure. Thus, the objective and the outcome of this study is to define the optimal product structure for NMS and reduce the number of product items in NMS compared with the current situation. To be able to define the groundings for the three challenges described in Section 1.3, this study needs, first, to identify the current status of usage of the product items by investigating the key indicators of the present NMS product sales. The target is to find: a) which kind of product items and combinations of those are sold through a certain period of time; b) if there any typical characteristics that can be defined, and if possible, c) are there some obsoletes or otherwise non-effective items used. The results of this analysis will be fed into the next phase of research which evaluates how the product structure could be changed to improve the sales.

The key topic to improve the product structure is to establish the reasons why the sales force regards the management system as challenging to sell. The qualitative research will be conducted to investigate how commercial managers and sales engineers are making proposals and quote them. This qualitative analysis will be based on the previous quantitative analysis made at Phase 1 on the current product item sales.

The purpose is to find the most critical issues as well to get feedback on both NMS product structure and the business models used with NMS.

The target of this Thesis would be to find an optimal NMS product structure to support both the hardware and the management system sales. Based on the results of this quantitative analysis on the current state and the qualitative research of current challenges, a proposal for new, simplified product structure will be made. The overall target is to improve the value of NMS in network element oriented business.

Thus, the focus of this Thesis is to improve the product profitability by having optimal product structure which supports business and, at the same time, has its own value in the telecommunication ecosystem.

1.5 Topics Excluded from Research Scope

The focus of the research is on product management: How to improve the product profitability by having optimal product structure which supports the whole business and at the same time elaborates its own value in the telecommunication ecosystem.

One key factor to bring up in the outcome of the proposal for the Thesis is the value of the network management system. Argumentation is one important factor in discussions in value, especially with immaterial topics like software. Even though, in this research target is not to define a value argumentation for the network management systems. The value argumentation will be done for proposed business logic and items it consists of.

The research will neither take up any technical aspects, for example, those which kind of features or applications the NMS should include. The research would neither comment on any process related to R&D or the supply chain processes.

The outcome of this Thesis is limited to introducing the proposal for simplifying the NMS product structure and having more straightforward pricing methodologies, so that the product value and the revenue can be increased.

2 Research Process and Methods

The research process in this Thesis consists of three main phases. Phase 1 compares the current status of products usage and revenue with the best practices. Phase 2 analyzes the reasons and addresses the key issues to be improved. Phase 3 reviews the feasibility of the new product structure proposed. Figure 3 below summarizes the research process in this Thesis.

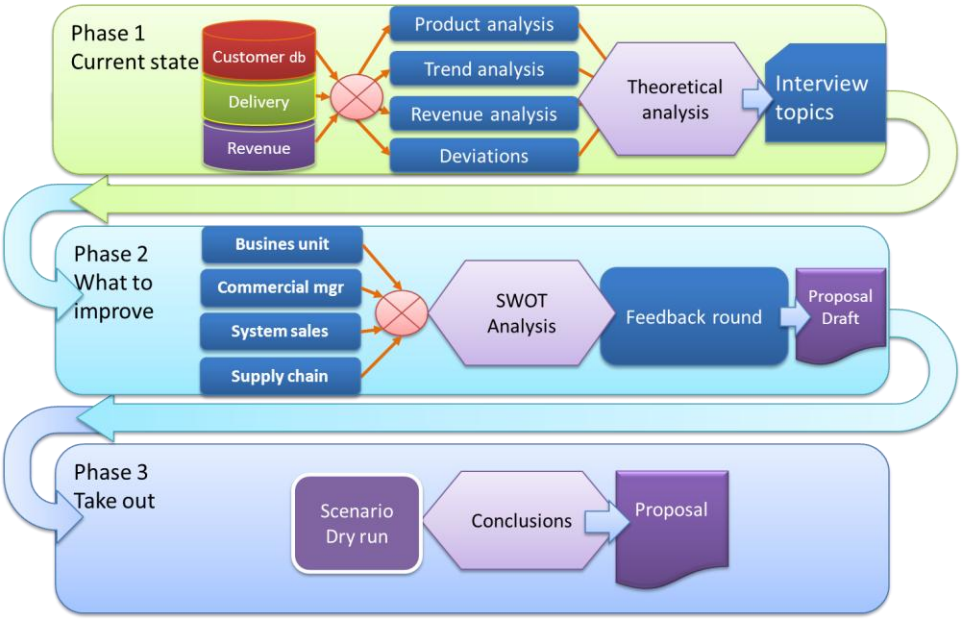


Figure 3. Research process.

Figure 3. summarizes the three main sections of the research process in this Thesis. Phase 1 contains the current state analysis based on data available from the CRM systems. Phase 2 gains the knowledge from Phase 1 and evaluates the explanation for current situation. At the Phase 2 the key strengths and weaknesses of the product structure are addressed. The Phase 3 focuses on final adjustment to ensure the feasibility of the proposal for new product structure.

The focus in *Phase 1* is to determine the current status of the product structure. As the objective of the research is to optimize the structure, the state analysis is conducted by collecting the data on customer information databases. This data includes detailed information on the applications and the releases of each customer network entitled to use NMS.

The data collected from the customer license database, includes all the NMS licenses customers has purchased and delivered between January 1, 2011 and December 31, 2012.

The revenue report retrieved from SAP includes details about financial values of customers' purchases, and the types of products purchased. Revenue reports are used mostly for general reference, since business cases may vary significantly depending on the network type or the overall project scale. In such cases, a strict comparison of revenue may lead to wrong assumptions. Therefore, the revenue data are utilized as evaluating the pricing models between business units as well as to evaluate the product structures.

The delivery data is used to analyze the trend of the product structure at an item level. This data is used to reveal the common combinations if application items used as well the declining items. Also the obsolete items may be identified via delivery analysis.

The customer licenses install base is used to evaluate the type of configurations the customers are selecting. By comparing the configurations of existing customers with the new configurations, this Thesis creates interpretations for a trend of the applications currently in demand with the customers.

In Phase 1, the following types of analyses were used to complete the view of the current status of the product structure:

- *Product analysis* – the quantitative analysis of the product distribution examining which items are delivered and how items are generating the revenue. The target here is to evaluate the importance of each sellable item compared with the whole product portfolio.

- *Trend analysis* – The quantitative analysis focusing on to find the structure of applications customers are currently selecting. Data of new customer cases will be compared with the overall install base. Purpose of this analysis is to find the combination of the most important applications new customers select. The other

target is to find applications which are not so important anymore and could be combined to others to simplify the application portfolio. The outcome of this can be also used to evaluate the overall necessity of applications.

- *Revenue analysis* – the quantitative analysis from revenue recognition perspective. At the product item level the reports is used to evaluate the importance of product group to the overall revenue NMS generates. The results are used as the reference data for testing the new product structure.

- *Deviation analysis* – the quantitative analysis of revenue and delivery data targeted to pinpoint possible discontinuity points, or other erroneous points, in supply chain from offer to delivery.

The target of the analysis is to address the key areas to be focused in building the next steps. As the product management and software business scopes are very wide, the scope of theory discussed in relation to these types of analyses will be limited to only the key characteristics of NMSs as a product. The findings from the analyses in Phase 1 and the theoretical study of the related best practices are used for Phase 2.

In Phase 2, the stakeholders influencing the product sales and pricing are interviewed to acquire the knowledge what to improve. The phase one provides information from statistical point of view. Phase two gains that information by providing knowledge how the product structure is perceived in the real commercial cases.

The interviews are based on open discussion, so that each interviewed person can bring his or her own perception of the current situation and how he or she would improve it. The results of Phase 1 analysis are used as a guideline to bring up questions or to challenge the interviewed persons' opinions and elicit strong argumentation for those. The structure in the qualitative analysis is based on the interviews of the commercial managers, who are responsible for pricing for the customer case and targeted to get feedback about the pricing methods and the challenges they face. The sales, which are responsible for customer communication and the value argumentation for customers, are targeted

to get feedback about issues with customer communication and how product structure is interpreted in the field, as well as their preferred methods for selling the management system. The product managers of business units are asked for feedback about the overall product structure. The supply chain representatives are interviewed for comments about complexity.

The interviews are made in two phases. In Phase 2, the focus is on how the current model is used, in which way the configurations are built and how they are quoted. In the interviews, the comments are asked about the issues seen and how the product structure could be changed. The feedback received is used as a part of source data for new product structure. The outcomes of the interviews are mapped to SWOT analysis, which can be used to identify the key characteristics of the current software product model. The strengths and weaknesses of the current model as well risks and opportunities are targeted to map and evaluate against the selected business models. Together with the current model, new ideas how the product could be changed are used as guidance for the proposed new model.

The findings and the available knowledge are used to build a new model for the software product structure. The test run is targeted to evaluate the feasibility of the proposed structure and performance of the new model.

In the Phase 3, the feasibility of the new product structure is tested by using the existing customer data as reference data. The delivery and price information retrieved is reassigned to the new model, and the impact on the supply chain is analyzed. The performance of the research results are evaluated by comparing the product items needed to complete the same customer delivery. If needed, the structure may be adjusted based on the results of the test run. Reasons for reshaping the proposed model could be, for example, that all the customer cases could not be handled with the proposed model, or improvement of the new model is not adequate to initiate the change process.

3 Best Practices in Software Earning Logic

This section discusses the best practices influencing in the software product structure including strategic, positioning structural, pricing and trend aspects.

3.1 Software as a Strategic Component

A software product, as any other product, is something which is developed and sold as purpose to generate revenue. The software product can also be an instrument in generating profit from other activities, especially in cases where the main business is based on other goods or services. Thus, the choice of software is the key choice an organization needs to make.

The strategic decisions of the company concerning its software products have a significant impact on all parts of the organization's software-related processes. The SW products influence the product portfolio; they are related to the company's core competencies and reflect into the business plan and the overall product strategy. In practice, the product strategy defines the way the company does its business (McGrath 2001: 92) As strategic decisions are made for long term and those are not easy to change, the strategic planning should be made carefully to maintain the organization's profitability (Kittlaus et al. 2009: 55). Thus, Positioning the SW product as either a strategic or supportive product is one of the fundamental strategic decisions to be made. This decision will have a consequential influence on the product earning and the pricing strategies.

For *the core products* of the company, the profitability of the product at all circumstances is crucial for the company's sustainability. For that reason the company should maintain a sufficient price level of the product and avoid such a tactical pricing which would lower the overall price levels of the core products. Misinterpretation with the value may cause losses in revenue (Nigel 2010: 6). As discussed in Section 1, in the telecommunication business, software is often interpreted as an uplift parameter, which can be used dynamically as a price adjuster.

For *the supportive, or complementary, category* of products, which are used to improve the value of the core products, the way of differentiation

is based on different pricing strategies. The profitability of the supportive product may be sacrificed, if the total profitability can be secured. Business practice suggests that it is easier to utilize tactical pricing with the supportive than the core products (Kittlaus et al. 2009: 58; Piercy 2010: 38).

From the pricing perspective, as the manufacturing costs of the software are typically zero, it drives the NMS products into the supportive category. For SW, the flexible pricing model is often used to adjust price levels in various customer cases in order to support the hardware sales, which have manufacturing costs.

Position in the value chain has an impact on the earning logic and how the SW product optimizes the company revenue. Several approaches of charging SW products are used depending on the business segment product and the life cycle, as well as the price customers are willing to pay for it.

The *"Once Off"* approach of licensing is one commonly used strategy where the product is sold to the customer at a certain price and there are no other bonds between the customer and provider. The model is straightforward and easy for all parties as the product versus the price is clear. From the SW manufacturer point of view, this model is challenging as all the profit should be received at the front end of the product life cycle. The customer's willingness to pay for future enhancements may be unclear and risky, as it opens the door for competitors to swap the product out (Kittlaus et al. 2009).

The *"pay-as-you-grow"* method is another commonly used licensing model built to adapt to the customers' own business models. In this approach, the costs are divided into small pieces, which are related to the number of goods or functions the customer is purchasing. For example, in user-based licensing, the costs are divided based on the number of users using the software, or a new functionality that can be purchased later on with the value and aligned to the benefit it can provide. This approach allows to avoid the high front end payment and the risk of losing the customer later, when upgrade or new functionality is needed.

Another commonly used approach for selling large software systems is to sell *consultancy* instead of the product itself. Profitability of the product may not be significant, but the consultancy service sold on top of the product can create considerable and stable profit to the SW company. Additionally, it has another advantage if compared with a release selling. The consultancy services typically improve the customer loyalty. A satisfied customer is crucial to the SW vendor as it ties the customer to the vendor's products and generates more consultancy work. SAP is a good example of the system having a dominant market share which utilizes consultancy in a strategic way to ensure customer commitment to its products. SAP owns about 80% of the market share of the Business management systems of the largest companies listed in Forbes 500. Overall, there are than ten times more SAP consultants than what there are employees in SAP Finland (Huurinainen 2013). In those cases where consultancy services cannot be used, this strategy is used to give or sell the software at a relatively low price and then retrieve the revenue from maintenance services.

The current era of software business is turning from buying SW packages to the service model business. Instead of selling the software itself, SW companies are selling access to the software functionality for a certain period of time. Benefit to the customer is that they do not need to invest into buying the software, yet they will always have the latest version available. (Ojala 2012) In addition, cost saving in the operational costs can be achieved as maintenance people are not needed to run the system. To the service providers, this brings the benefits of a constant flow of revenue and the optimized system setup and support personnel.

3.2 Product Positioning as a Complementary Product

As mentioned in the previous section, NMSs fall into the category of complementary product as they are used to support the network equipment sales.

The literature introduces several definitions for a complementary product, depending on the context and the benefit to be achieved. If summarized,

the complementary product can be defined as an item sold and used together with the main product to improve the value of the main product.

In a well-defined business model, where the value chain is identified, the complementary product business model can be used as part of the success factor to increase and protect the business (Nambisan 2002).

In the telecom business, complementary products are often utilized from several perspectives. First, complementary products are used to improve *the customer loyalty*. In this industry, to be swapped out of business is always a big loss to the vendor. The impacts are not limited to the new sales only, but also to the services, release sales and the possibility to expand the sales portfolio to the other products. To minimize the risks to be swapped out of the operator's network, the vendor can utilize complementary products to improve the customer loyalty. The complement product can be, for example, the software used to integrate the main product into the customers other systems. The higher the integration level with the customer, the higher is the probability of the customer's remaining in the system, as the swap costs are an extra burden to the business (Kittlaus 2009).

The complementary products can also be used as a strategic tool to secure *the price level* of the main product. As the company's target is to maintain the maximum achievable sales price of its products, the complement product can be used for the price adjustment. At the system solution sales, such discounts can be done without much impact on the main product and switch the price pressure focus away from the main product. Literature introduces several models to optimize correlation between the main and complementary products. Especially in the consumer markets, there are theories proposed to sell the main product relatively cheap and then to get the profit form the complement products. For example, at the printer business the machine itself is sold with cheap and the profit is retrieved from color cartridges. This is done to strength the positioning in the market by increasing the install base at the cost of the core product. The profit is based on complementary products, which will be sold in addition to the core product (Gürtler 2009; Arora 2008). The theory of such positioning is based on a strong *protection* capability of the

complement products to prevent competitors taking over the value part of the main system (Gürtler 2009).

In the NMS business protective approach does not apply as the cost balance between the core and complementary products are significantly unequal. Typically, the network equipment value amounts to 90% to 98% of the overall cost of the network compared with NMS; with the main value is concentrated on equipment. In addition, the telecom industry is heavily based on standards, which also means a risk that a certain part of the value chain can be implemented by another vendor. The NMS could be purchased from the third party, even though the functionality would not be as comprehensive as NMS of the initial equipment vendor. So the strict *protectionism*, as Arora (2008) refers to, does not exist. On the other hand, high integrity between the core and complement products and a continuous need for development creates the kind of protective ecosystem around the system, which may be utilized for the NMS business.

Finally, complementary products are commonly used in both B2C and B2B segments, to increase *the company's overall sales.* This can be achieved, for example, by combining them with the core product or solution as a bundle. Different tactics are used but typically the idea is to provide more value to the customer with less money, compared with that customer would purchase as singular items separately. As the ultimate purpose of the bundling is to attach two or more products together in one larger solution, there is an open question of how to select the subcomponents for the bundle in the optimal way. An optimal bundle would consist of only those sub-items which are relevant and valuable for the specific customer. In practice this could be done quite easily at the software industry, but then the feasibility of the bundling depends on the operational and managerial costs of these flexible bundles.

Thus, from the supplier perspective, there are three main positioning strategies used for the complementary products in the Telecom industry:

- Complementary products targeting to develop customer loyalty and commitment to the main products.

- Complementary products utilizing the price or market protection approach.
- Complementary products aimed at increasing the overall sales.

From the NMS point of view, the bundling seems to be the most often choice, in spite of the challenges of bundling. At the case targeting to increase the overall sales, there is a risk of over bundling. The content of the bundle may be too comprehensive related to the company's product portfolio. That may end up in the situation in which there is nothing to sell on top of the initial bundle package.

The other risk is that the variation and linkages of bundles are built so complicated that the value and difference of the bundles start to fade. This may end up in a situation that the sales force cannot sell the value of different bundles, which, in turn, may lead to the circle of discounts (Docters et al. 2006). If the sales forces do not have good value argumentation for the differentiation of the bundles, they may end up into the situation of offering the all-inclusive bundle. After all, what matters, is the value to the customer he understands. That means complementary products bundled together with company's core product should have a clear value argumentation customer understands. That makes the product structure as the crucial factor for the successful bundle.

3.3 Software Product Structures

The software product structure stands for the deliverables of the company as sellable functions. From the business point of view, the key factor for the efficient software product structure is that the customer and sales forces understand the value of the product for the indicated price (Kittlaus 2009). Otherwise the argumentation for pricing cannot succeed. To become so, the product structure of the software should be able to meet a set of requirements influencing it.

Figure 4. Factors influencing the product structureshows the combination of those key factors impacting to the product structure in SW products.

Figure 4. Factors influencing the product structure.

As Figure 4. demonstrates, there are several factors influencing the product structure. This vision is suggested by according to McGarth (2001) and reflects the factors influencing product structures in general, including the software product structure. On the example of the SW field, these factors mean:

First, *the company strategy.* The product structure should be aligned with the company's strategic decisions of generating the revenue, as well as the business model and financial targets. In addition to the aspects of how the company would like to set its product structure to optimize the revenue, there are also other factors influencing the structure, including:

Customer requirements define the functions the customers are willing to pay for. The product structure should align with requirements to be able to optimize the value for customers.

The number of the items, or the granularity of the product items, in the product structure should be sufficient to meet the requirements stated by customers. In case a solution consists of large number of items, the sales may find it difficult to give a good value argumentation for each separate entity. The missed value argumentation may end up in the lump sum deals. Vice versa, the overwhelming content of features packed into one product may end up in the situation of outraged discounting and the unexploited possibilities to upselling value add features.

Pricing for can be interpreted as a foundation block for the effective product structure. Pricing is used as a tool to state the value in financial terms, paying special attention to the valued functions identified by the customer and productized into sellable items.

The Supply chain makes another key factor, and it needs to be designed to support the product structure. Considering the delivery process, all the items supply chain manages, including new deliveries, SW updates, application additions purchased etc. should be managed efficiently. It means that the product structure needs to be straightforward, without having unstructured dependencies between items, which supply chain would need to evaluate during the delivery process. For example, to be able to complete a customer order, the supply chain needs to check the existing configuration to ensure the feasibility of the order. The efficiency means also that the product items are valued to such a level those are profitable. Even though the costs of the product are nearly zero for SW, managing the licenses and delivery cause costs which shall be covered.

Delivery model influences the product structure as it defines the model how the software is distributed and charged. New business models, such as Clouding, renting and SAAS, as compared with the legacy packetized media, require different approaches. Each delivery model has its own specific characteristics and for the product structure it means that a different kind of structure to be managed. Usually, the delivery model is not freely selectable for each product, since the product needs to adapt to the models available in the company. Changing the delivery model requires a business case analysis to evaluate profitability.

External factors such as third party subcomponent providers used in or with the software have influence the product structure. Traceability and other obligations to the third party, for example, possible royalty payments, may have a significant influence on the price of the product. Therefore, items in the product structure, including the third party products, may be feasible to separate and offered as optional to the company's own SW products.

The platform systems for the product, such as the operating systems and database, play a significant role for the product structure not only from the functionality perspective, but as a certain cost factor, which need to be considered as part of the total cost of the software solution. Especially with complete system deliveries, in which these platform products are included, the cost factor and discounting may directly affect the SW provider's margin. For these reasons, the platform products may be feasible to exclude totally from the SW product structure. The platform systems, such as OS and database products, may also have their impact, since customer's IT may prefer specific platforms, for example, due to corporate policies or direct contracts between the platform product vendor and the customer.

Competitors and their product structures influence the market and customers. Each player would emphasize their strengths and understate the weaknesses they might have. To be able to deal with this challenge, the product structure should be able to overtake the competitors' message, or suggest effective comparison to competitors, but at the same time it should be able to differentiate from others.

Standards and regulations: At standard based telecom business this is a kind of dilemma between functionality and operability. The Functions are well defined by organizations like TMForum and IEEE. Every vendor provides support for those functions and processes. Way to differentiate at the network management business is typically based on the value argumentation of efficiency NMS can provide to the network operator's business. Standards and regulations provide a kind of frame work which functionalities need to be included in to the NMS. Typically

these functions are adapted directly to the product structure as sellable functions.

3.4 Applicability of Pricing Models

The purpose of the pricing models is to turn the value provided by the product into the economic form. The choice of the pricing model is based on internal and external factors such as strategic decisions, positioning and product structure, discussed in the previous sections. Other factors could be scalability and the current technological and market trends, among other things.

Common to the Software pricing models over the time is that those are related to current technological capabilities available at that time. At the early phases of software business, the software pricing models were built around the technical characteristics; servers, the amount of centralized processing unit (CPU), or memory to limit the usage of software. The license bounded to the HW correlated to the achievable system performance. The same approach was adapted to the users, as licensing used to be aligned with the usage of the system. In the network management industry, this same approach adapted to the number of network elements managed by the system.

Method based on network elements is still commonly in use as it is straightforward and supports the business objectives of both parties. The benefit of the license model is the capability to follow the growth of the network and share the costs according to the volumes managed with the NMS. This model, however, has challenges in cases where the growth is difficult to forecast as the NE based licensing may cause budgetary challenges to both directions. The customer may end up to overbuying licenses, or if the growth is faster than budgeted the licenses may run out of stock. Since the customer may not have a budget for the needed licenses, they may need to wait or the license fee will be reduced. (Ray 2012) According to Ray’s survey of licensing, over 50% of 1500 network professionals responded about having difficulties to match licensing level, while over 67% of those responded exceeding the license level

purchased (Ray R 2012). The results of the survey illustrate the difficulty of achieving the balance in licensing model to meet the actual need.

One-time-Charge (OTC) model the software has been purchased once and there are no other obligations or payments related to the product (Kittlaus 2009). The model is commonly used for applications providing a certain well-defined functionality. Vendors are commonly pushing the maintenance service on top of this model, hoping to get continuity in product business. In the OTC model, the customer gets a permanent right to use the software, while maintenance can be interpreted as a guarantee for a bug fixing and continuity. The outcome of combination of OTC and maintenance creates variations in selling software releases.

In the OTC together with the release model, the customer purchases a certain SW product release and can use it as long as he wishes. In practice, as technology life cycles are getting shorter and shorter, upgrades are needed for new features and functions. To meet this need, vendors purpose to extend the life cycle of the product is to introduce new features more rapidly to cover customer requirements. Instead of trying to sell the enhanced software package as new to the customer, the vendor can use the release model instead. With this model there is no need to convince the customer to change the existing software. There is also no need for a detailed evaluation of value of the release compared with the new product, when offering the new release through the maintenance service (Kittlaus 2009: 130).

Another effective combination is OTC together with the maintenance model, which is good for applications having relatively short development cycle and no tight integration to the customer's processes. Additionally, the short development cycle enables a good response to the customer requirements, which helps to improve the customer satisfaction. Finally, the maintenance support with the new releases diminishes the risk of rivals' entry. By nature of the OTC model extended with maintenance, the product revenue can be recognized at the transaction of buying the first release. The coming release upgrades may be recognized as service revenue. This, however, can also be seen as a problem as all the product revenue should be received at the beginning. The combination of

application and maintenance requires adaptation to the vendor's internal structure to divide release revenue between the product and services.

In the network management business the OTC model may be challenging. This because the projects usually start with a certain limited amount of NEs and the costs of the network management portion out of the total costs of the initial project could be far beyond any achievable value. The combination of application and maintenance requires adaptation to the vendor's internal structure to divide release revenue between the product and services.

Software releases can also be determined as a way to resell software to the customer. The new releases may consist of bug fixes, enhancements to the existing features, new features or combination of these. In the telecommunication business, although the release sales are commonly used together with maintenance service, which includes bug fixing and new releases, in practice, the maintenance agreement is sold as a mandatory component of the software (Slinger et al. 2006). In maintenance, the customer is more or less buying insurance to secure the business continuity depending of the software used.

Direct release selling confronts resistance to the SW vendor's desires to purchase and deploy new releases. Brinkkemper et al. (2006) introduce an upgrade cost / value function to illustrate the misconceptions of reasons for upgrading the software. The simplified formula is used to compare the costs of upgrade with the achievable value perceived by the vendor and customer. A wrongly defined upgrade package may not drive the existing customers to upgrade their software. Instead, a correctly defined upgrade package which introduces new value to the existing customers has a possibility to generate revenue from the upgrades much better. Even though the achievable price would not be the same as what it is for new customers, the most difficult barrier, the customer relationship, has already been achieved.

3.5 Current Trends at the Software Earning Logic

Bontis et al. (2000) predicted that the software business is going to transfer from the box licensing model, RTU and Once Off licenses to the application service provider model (ASP). Bontis et al. (2000) was partially correct since the pricing as a service models have found new, more innovative models, such as renting, Software-as-a-Service (SaaS) and other models.

Several authors, for example, Bontis et al. (2000), Chunhua (2006), Petracca (2007), emphasize in the product pricing trends that the model should align with the recognizable value, as well as the way how it can be introduced and argued for to customers. On the other hand, what is less emphasized is that the current pricing models are used to adapt the current organizational models and the costs divided between them. Based on Graham's survey (2012) to operational costs in Network service operator domain, it was found that among the costs of acquiring and maintaining the Operational Support Systems (OSS), 41% of the costs were assigned to IT personnel maintaining the OSS (Graham 2012).

For example, an IT organization maintains the software to the operational organization which provides the services to one or more business units in the company or, in a more complex case, outsources them to the external service provider. SaaS and renting models may provide feasible solution for such business environment. Those would not necessarily bring the value to the product itself. Instead customer may find those as an effective tool for cost savings as there is no need to take care of releases, maintenance tasks, security updates, etc. In practice the whole system maintenance could be outsourced to optimize the operational expenses. In such a case, when the customer transfers the costs to the Service provider, the service provider can gain the benefit of scale of economics achievable through the volumes.

Renting the software is a way to transfer the barrier of the high front end payment of the OTC licensing model to the long term. Instead of getting a permanent right to use the software, the customer will pay for the right to use the products for a certain period of time (Ojala 2012). The software can be installed on the customer premises and maintained by the

customer or the software can be provided over the Internet. Ojala (2012) defines the periodic need for the SW application as a key motivation for renting the software. It might be a project lasting a limited time, a test session or a way to acquire more knowledge about the system before purchase. The benefit of renting to the vendor is that it may attract more customers to use the application and thus gain the revenue.

By nature of renting, the software contracts are made for a certain period of time. Short renting periods cause challenges to the vendor to keep the business model profitable, as the actual usage may not meet the targeted utilization. In addition, the customer may be able to gain more negotiation power related to pricing as the changing the provider may be relatively easy. The renting model has other negative side effects on how to get the customer to commit to the vendor. For example, the product customization may be unfeasible as the costs of customization are not corresponding to the costs of rental. From the customer perspective, the charge of modification could be perceived too expensive. Another challenge the SW vendors have, is how to get the revenue of the new releases as the customer after the rental period can return the old release and rent the new release to be used at the next rental period (Johnson 2012).

Software-as-a-Service (SaaS) is an enhanced variation of software renting models reflecting the current era technical capabilities available. SaaS can be defined as “the software is hosted in the data center of the service provider or third party and delivered to the customer via the Internet as a Service” (Ojala 2012: 1) SaaS has become an effective business model for certain applications, especially with the companies which need the software only occasionally or the usage varies widely over the time. Benefit is that that the licensing, or in this case, renting can be adapted according to the real usage. Compared with the purchasing model, this creates a real advantage as there is no risk of overinvestment.

In Saas, the maintenance costs are another important factor. As the service includes the servers, platforms, backup systems, data center, licensing and IT personnel costs etc., the SaaS model may offer a cost efficient solution for customers. The total costs of SW ownership may

rise too high compared with the achievable value of application, especially with the applications used occasionally. According to the study by Petracca (2007), the SaaS customers' operational savings over 5 year period varied from 22% to 81% depending on the size of the customer and overall usage of the application used (Petracca 2007). Benefits to the vendor found are the steady revenue, simplified sales, support and R&D.

In Saas, steady revenue is appreciated as it helps the company to make long term planning. Cash flow can be forecasted more accurately compared with the pure OTC mode (Kittlaus 2009). Sales can be simplified by reducing the number of products included in the system sales. This can be done as revenue targeted can be achieved during the long time, compared with up-front sales, in which the revenue should be achieved at the beginning. Even though the pricing could be simplified, the pricing model needs to include new sub components such as a platform for service, maintenance and delivery costs.

The SaaS model also includes some risks to the vendor as service availability may cause the loss of revenue in form of sanctions. Also the SaaS usage may be lower than expected. Also the preferred cost allocation model between CAPEX and OPEX may cause confusion in the SaaS model. Or the customers may still want to own the software and allocate it under CAPEX (Petracca 2007).

As the SaaS in principle is another mode of delivering the software and how the customer can allocate the costs of it, the key goal for SAAS pricing structure is to make it affordable for the customer (Chunhua et al. 2006). Certainly the SaaS model needs to be affordable in comparison with the product ownership. In addition to that, there was an interesting idea, the service may be given for free, if the external benefits are big enough. Thus, although that may not match the NMS business model, but the idea of providing the SW free of charge and having the charging only for usage may be worth to study more carefully.

Product tailoring is the way to enable the flexible structure to match the various customer specific needs. Petracca (2007) and McGarth (2001) emphasize flexibility for product platforms which can be interpreted as

the modifiability of the system. In practice it means that the system is tailored to adapt to the customer processes. This can be feasible to a certain level, but requires the platform to be adaptive, so that maintaining the tailored solution will not be too heavy for both the customer and the vendor. In practice the SW tailoring can be categorized as a service.

Another approach to adapt to customer specific needs is to divide the functionalities of the software to such small pieces that customer can select only the necessary items. That raises another problem for the vendor because the software model needs to support such small piece functionality. In addition, the back office systems need to be capable of supporting the setup, and the whole scheme should be profitable. There is always a risk that achievable revenue of small functionality applications will not cover the costs of the back office systems needed to maintain the structure.

Finally, another important factor in pricing is managing the people working with the business interface. Both, the customer and sales should understand what the product functionality of each component brings for the system, what is needed and what is optional. (Petracca 2007) Otherwise there is a risk of all-inclusive method from both parties when the customer requires all options with the same price as he or she wants to make sure there no critical component is going to be missed. A similar approach may be used on the sales side. Thus, it is better to make the lump sum of everything and avoid any unpleasant situation of pricing negotiations about missed subcomponent.

3.6 Conceptual Framework

Conceptual framework for defining the new product structure in this Thesis is based on the best practices found relevant for software earning logic and the product structure discussed above.

Figure 5. illustrates the resulting conceptual framework for the study.

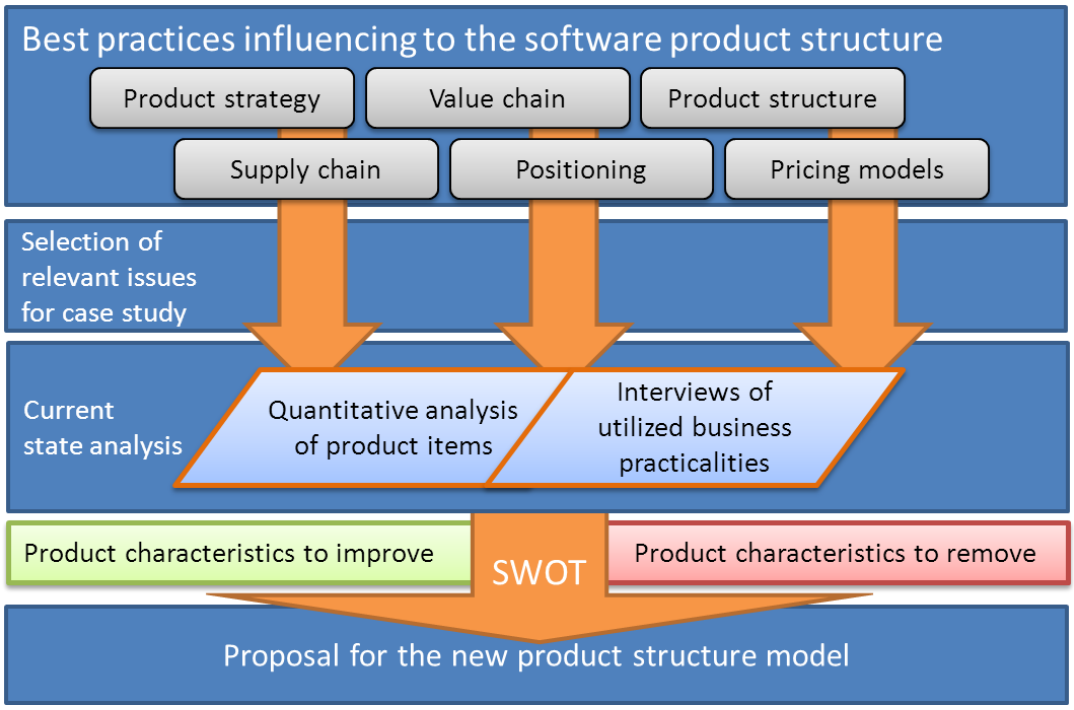


Figure 5. Conceptual Framework for defining the NMS product structure.

As Figure 5 shows, the earning logic of the software product structure is influenced by several factors. The company's *Product strategy* defines how the deliverable software is going to be sold and its financial targets. *Supply chain* impacts how software items are charged and delivered. *Value chain* and *Positioning* define the chargeable value and how product structure should support the value argumentation. *Best practices* suggest several models for Product structures for different business domains. The different *Pricing models* are used to turn the functionality of the software to the financial benefit.

To build the current case, the information is collected from several different business domains, which corresponds to the second layer in Figure 5, a *selection of relevant issues.* This layer selects which issues

should be covered in the use case study in NMS business domain and establishes a chain between best practices and the current state analysis. It allows to explain the phenomena by using findings from best practices.

The current state analysis utilizes two methods to reflect on the current state of the case company NMS product structure against the best practices found. The *quantitative analysis* is used to reveal the details how the current product structure is executed in real business environment at the product item level. The *Interviews of utilized business practicalities* are used to acquire rationale for the current state of the product structure.

In the next phase, the current state analysis is converted into form of *SWOT analysis* and addresses the key factors to be improved and corrected, so that the new product structure should have the optimal earning logic. Based on the findings from SWOT, a proposal for new NMS product structure is developed.

4 Current State Analysis

This section focuses on evaluating the current state of the case study through the theoretical aspects found important to the problem.

The current state is studied from the strategic point of view, and analyses how the case company is utilizing the product to create revenue. It also discusses the positioning and its impact on NMS, methods of selling it; software product structure, the software pricing models, and finally brings all the findings together for the SWOT analysis.

4.1 NMS as a Strategic Component

NMS has strategic importance for the case company. The main focus is to improve the sales of hardware equipment. This can be achieved utilizing three possible ways.

First, from the system perspective, the NMS can be elaborated to bring extra technical advance to the network system, which would help the HW equipment sales. For the case company, the NMS provides a technical tool to differentiate. The competitors have similar management systems for their own equipment, but either the functionality is limited to the network element layer only or the system can manage only one type of network elements. In contrast, the NMS of the case company provides in addition to network element management layer support also to the network layer support for services and over several technologies.

Secondly, the hardware sales can be support by using NMS as a tactical price adjuster. As the NMS is *positioned* as a *complementary* product and the manufacturing costs are zero, the pricing for the NMS can be used flexibly.

The third strategic approach to support hardware sales is the glue factor, which means that the network operator can utilize the same management system for different parts of networks, mobile backhauling, metro, transmission and optical networks. That brings significant benefit to the operator in the total costs of ownership wise. The value is not limited only

the savings of acquiring the system, but also the costs of maintenance, training and operating the networks.

In addition, customers having the network elements from the several product business units will have a strong glue factor which secures the customer to use case company's products in the network. Threshold to change part of the network elements to the other NE vendors one is high because of the overall costs are high (McGarth, 2001). Furthermore, the networks operations will perish the advantage of the unite management system in terms of operability but also with the maintenance costs, if they need to deploy the second NMS for the same purpose. This strategic advantage of the glue factor can be shown in Table 1. Customers deployed node type extensionbelow.

		Network element type					
Customer	**year**	**A**	**B**	**C**	**D**	**E**	**F**
Customer A : MEA	2011	O			O	X	
Customer B : LAC	2011	O	X	X	O		
Customer C : LAC	2011	O	X	O	O	O	O
Customer D : LAC	2012	O	O	X	O	O	O
Customer E : LAC	2012	O	O	X		O	
Customer F : APAC	2012	O	O	X	O		O
Customer G : LAC	2012	O		X	O	O	
Customer H : MEA	2012	O		X	O	O	O
Customer I : EMEA	2012	O			O	X	

Table 1. Customers deployed node type extension.

Table 1 shows the customer cases of having one or more NE types and selecting some new NE type in 2011-2012. The customers used to have legacy transmission equipment A and/or access system D have previously extended their network with the case company's other equipment products. The character O illustrates the network type customer had before. The character X illustrates the new, additional network element type customer deployed. During 2011 and 2012, there were nine customers extending their network with the new product family. At the same period, there were 39 NMSs delivered to new customers.

Approaching this from all cases of the new networks types to be managed with NMS, 19% of new cases were utilizing the same NMS. In addition to those, it is noticeable that all extensions deployed, the customer had products at least from two other network element product families already. Actually, at the most of the cases, the customers manage four network element types with the NMS. Compared that to the whole install base, in which 36% of all customer networks were managed at least two NE types. That illustrate the strategic strength unite management system provides to the case company.

The strategic importance of the NMS's glue factor gets more visible when the historical dimension is included in the information about supported node types. In the case company, the previous version of the NMS supported node types D and E. Support for the other network element types was implemented later in the following order; A, F, B and C. Figure 6 below shows the percentage of customer networks having certain type of network elements.

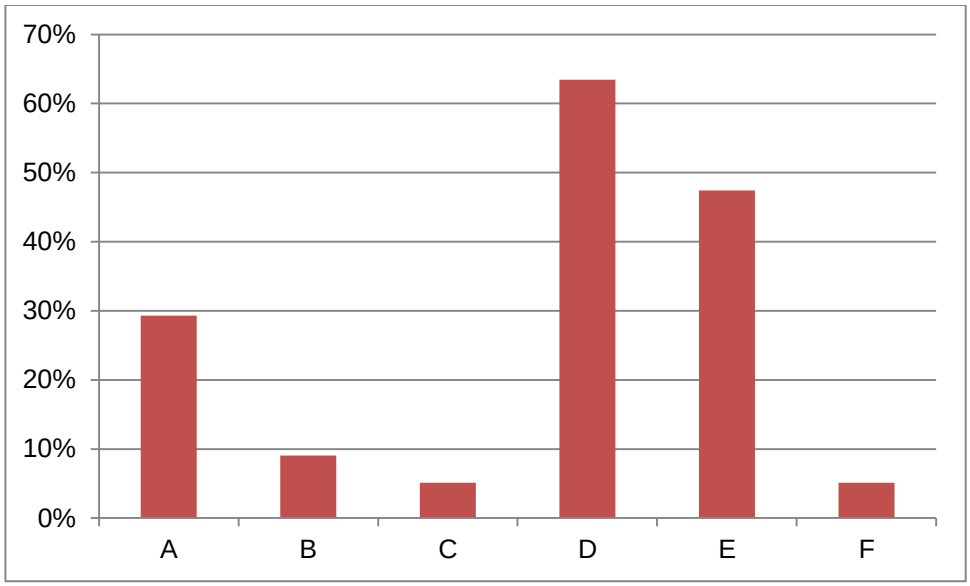
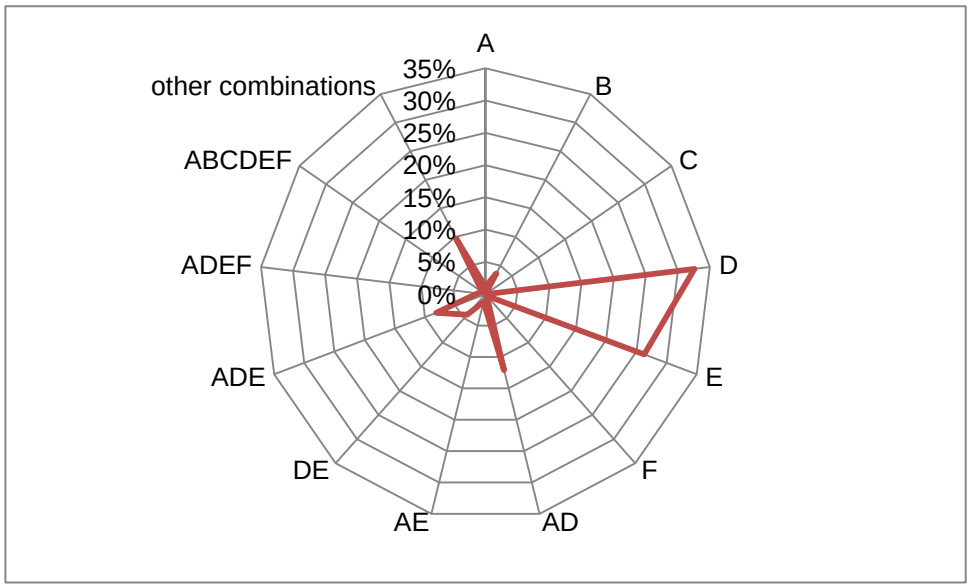


Figure 6. Distribution of NE types managed by NMS.

Figure 6 illustrates the customer networks having certain type of network elements, based on the network element adapter report from the customer inventory. It shows the dominance of those first supported network element types. Since NMS was originally made for Access system (D), over 60% of the NMS installations are used for it. The next one, Node E, is following with almost 50% coverage of the install base.

Support for node types B, C and F was introduced in 2010, which explains the gap to the D, E and A networks.

A deeper view of the glue factor can be seen by studying the NE combinations managed per deployed system. Figure 7 represents the combinations of NE types that customers deployed by the end of 2012.



A	Transmission NEs
B	Optical NEs
C	Metro Ethernet NEs
D	Access NEs
E	Data Networking NEs
F	Multi service NEs

Figure 7. Distribution of the NE combinations in the deployed systems.

Figure 7 demonstrates the distribution of the NE combinations in the deployed systems based on the customer install base information. As seen from Figure 7, the NE types D and E have a clear dominance in combinations because of the history reasons as explained in previous section, but the difference is not so wide compared with the total install

base report. The access systems (D) as only NE type deployed is only in 33% even though it is deployed over 60% of all networks in the install base. Transmission equipment (A) is deployed in 26% of the networks, but as only NE type it is deployed only in 1% of the install base. Several customers appear to have combined access systems (D) with the transmission (A) as AD in the picture. Other common combination is the combination of all previous as ADE. Instead of implementations of having only the transmission (A) are rare. The dominance of combinations illustrates the meaning of having several NE types supported.

The NE type expansions to the existing networks customers made during 2011-2012 were mainly related to NE types B and C. Those represented 37% of the new NE type deployments, which is a significant sign of the customer perceived value the unite management system can provide. When considering also the time perspective, that the optical networks are supported since 2010, there can be seen as growth potential in multi NE networks managed with unite NMS. Overall, the other combinations of the network element types present 10% of the install base. That can be interpreted as a sign of glue factor effect to include in several network element types to the unite management system. The meaning of this comes over historical perspective as the functionality to support several NE types was introduced at the middle 2010.

In the NMS business, in addition to the glue factor, other meaningful factors are the value of *customer references* and *the release need*. In the B2B model, the meaning of the reference by customers has a great marketing value. Citing large customers as a reference can be interpreted as a sign of good technical capabilities and good quality of the product (MC Garth 2001). With the NMS of the case company, this strategy has been utilized well and there has been achieved a significant increase in the customer base in terms of quantity as well with the reference value. The NMS is used by most of the world's largest network operators. In addition, there are over 300 deployments over the world. In that way, the strategic reference components are successfully achieved. Strategically, it may be wise to target to achieve *the large install base* for reference purposes. The large install base brings several benefits to the software in

forms of continuity. But from product perspective, the case is not so obvious due to the challenges in the product life cycle.

At a certain phase, *the product life cycle* will achieve the maturity phase, where the growth will slow down. There is going to be fewer new customers to acquire because the many of the customers either have the system or the competitors' system already, or the existing customers have purchased the applications they need. The portion of extensions compared with new deployments will increase. The new NE types are example of that, but also the NE size expansion supports it. During the study period 39 new NMS deployments were made. At the same time, 195 NE adapters were delivered, which illustrates the change moving from the new cases to the capacity expansions. In that sense it could be interpreted as the NMS product, as it is now defined, having achieved its mature life cycle phase.

The change in the life cycle causes the product to face challenge to find new ways to stay profitable. As the sales of new features declines, the revenue flow turns into the services (Petracca 2007) and the maintenance and services are going to be the most important revenue flow in the future (Cusumano 2008).

Figure 8 below illustrates this view showing the case company deliveries in 2012. The chart is normalized so it shows the main categories of the delivered product groups, support agreement, release upgrades and applications to the new deployments.

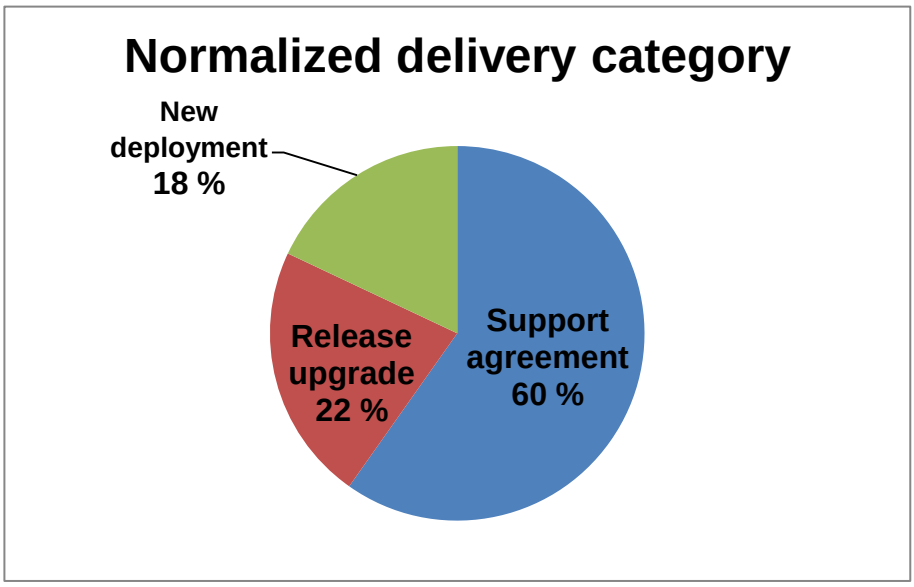


Figure 8. Normalized NMS delivery categories in 2012.

Figure 8 shows that out of the NMS delivery categories, the support agreement covered 60 % of all NMS system deliveries. In practice that meant the new software releases for customers having support agreement. Purchased upgrades can be categorized as a limited service; The customer purchases the new release to achieve a new functionality or support for the new network element version. Together the release upgrades covered 82% of the deliveries. New customer deliveries amounted to only 18%. Overall, the portion of services revenue is significant and corresponds to Petracca's (2007) and Cusumano's (2008) predictions.

However, remembering the life cycle logic, even though the support and the new releases together with element license fees generate revenue for the future, there is a high risk the stabile mature state will start to derogate those revenues as well. After the growth and network deployment phase, when the system and functionality are stabilized and there is less need to upgrade the system, the customers' willingness to pay for maintenance services will decrease. The price pressure for

license fees and maintenance service is getting higher as the risk of failure diminish align with the project and product maturity. Further, the proportions of costs those are generating are getting larger part of the overall costs of the network.

Additionally, the life cycle, especially the product maturity phase, impacts the network management business also in another way. Network management business is highly defined. Processes and methods are based on standards and common practices, which make it difficult to make a clear differentiation. The overall maturity pushes the differentiation focus to the prices and other arguments such as services (McGrath 2000: 163).

The NMS provides several strategic benefits to the case company. Way to differentiate from competitors as well a tactical component for system pricing improves the case company's competitiveness on the market. The glue factor the united NMS provides for all network element business units can be perceived the most important as it improves the customer commitment to the vendor and also lowers the threshold of the customer to deploy network elements from several product groups.

4.2 Product Positioning

From the case company's *product portfolio* point of view, NMS is sellable product which always needs some network elements to argument its existence. Based on this, the NMS can be positioned as a complementary product, which purpose is to support the sales of the main products.

The *complementary* position places the network management software is in a challenging position. The NMS as a product should be capable to create profit to the company and maintain via economic success the product's sustainability at the long term (Kittlaus 2009).

In the case company, the NMS *pricing model* is based on the targeted percentage of the network equipment hardware sales prices. The percentage can vary depending on the network equipment type. This because of the complexity of the NE types to be managed differs. In addition, the geographical regions have impact on the pricing levels used.

The sales use various methods for pricing the NMS. According to the discussions with commercial managers, some commercial managers are using the discounting model from list prices, but the most commonly used pricing model for the NMS is to calculate the NMS part on top of the HW. By having the model based on the HW goods, this gives advantage to secure the sufficient price level and margin of the main products, hardware. Another objective for *complementary* positioning of the product is to improve the overall sales. In this case, the evaluation of improvement focuses on the NMS product portfolio. There should be possible to make additional sales to the existing customers, as the product portfolio includes several applications and scalability factors.

In the evaluation of the content of the NMS applications customers have selected from the product portfolio, it revealed that in many cases the customer has received most of the available value added applications, even though those may not be needed for their purposes. Examples of those found were such ones that the customer had an application, which is feasible for only certain NE type, but customer does not have such NE type in the network.

The new applications to be introduced in future will suffer from “on the top” pricing model. As the pricing model is bonded to the network element hardware and NMS element fees, it will be difficult to add the price for existing, agreed prices based on new applications to be introduced. The customers’ resistance to approve higher prices will come difficult, especially with cases where the applications are sold extremely cheap, or given free at the first phase. In such a case, the value argumentation for the feasible price of the application may be worthless. Attaching the new feature to the element fee price may be acceptable, but also that model includes some challenges. For example, the price impact of the new application may be difficult to charge for the existing NE install base.

The current trends of which applications customers are selecting is retrieved from applications install base. Based on the review of expansions made during the evaluation period, nine customers purchased additional applications to the existing NMS system. Figure 9. Distribution of applications in the customers' configurationsbelow

Illustrates the overall distribution of NMS applications and shows the strong presence of typical combination of applications.

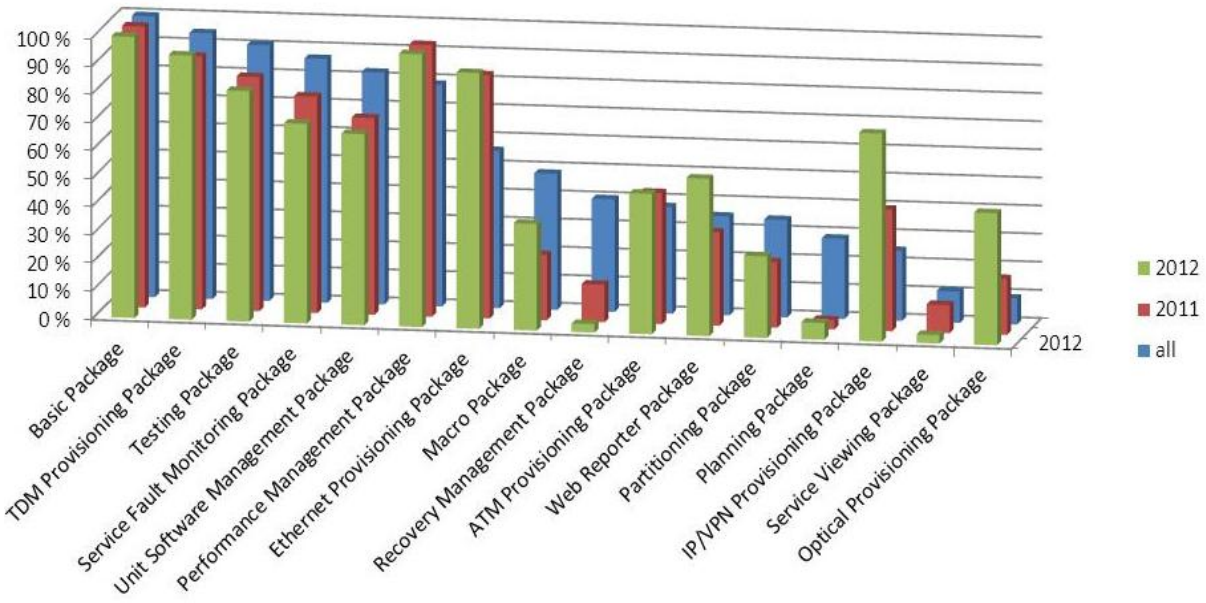


Figure 9. Distribution of applications in the customers' configurations (2011, 2012).

Figure 9 shows the distribution of applications in the customers' configurations. As seen from Figure 9, Basic Package is the foundation of the system and mandatory for every installation. The other packages, TDM Provisioning, Testing, Service Fault Monitoring, Unit Software Management and Performance Package share 80% of all NMS systems. Partially, that kind of *de facto* setup is a result of the NMS history and the applications which were introduced at the earlier NMS releases. During the 2011 and 2012, the Performance data collection and Ethernet provisioning were included almost every new NMS configuration. The Performance management package was included in 97% and Ethernet provisioning near to 90% of new NMS installations. At the same time, the Unit software management tool share declined to 68% of the new installations in 2012, but it is explained by the fact that the Unit software application (USW) was not supported at the beginning, when new network element types, such as NE types C and D, were supported. As the support was added at the later release, some USW application

extensions to the existing installation could be found later. Overall, at the evaluation period there were no such cases.

In 2011-2012, the following applications were purchased as expansion for the existing network:

Performance monitoring	Frame relay provisioning
Optical provisioning	TDM provisioning
IP VPN provisioning	Web reporter
Ethernet provisioning	

In practice each provision application is used to improve the functionality of the existing NMS deployment, which elaborates the possibility to achieve additional sales thorough NMS applications. The challenge of selling the expansions is illustrated in revenue side. Less than 10% of application expansions sold was managed to charge.

The service assurance functions appear to get more attention in the *de facto* configurations, as the high utilization of the performance package in the NMS system configurations shows. Instead the utilization of the packages related to the legacy technologies has declined. In practice some of those have dropped from the start applications. Packages such as recovery or planning are specific products for node type D. As there was no new NE type D networks, either the applications are not purchased. That indicates that configuration is defined at reasonable granularity and full packages are not used. From the product portfolio perspective, such obsolete items, which are not sold anymore, could be included into a larger product entirety.

As a result of “on the top” pricing model and *de facto* setups, the NMS is over bundled as one package offered to the customer. As an outcome of that, the real value of each individual application is not identified. The achievable revenue of the value-add application is lost as all applications are managed as one system. The model refers to the over bundling dilemma (Docters et al. 2006: 3) and proves the prediction that “the over bundling will end up to the situation where the price is the only parameter counted, as the value of sub components are hard to define”.

The issue with the *de facto* configuration bundles was notified and, to address this issue, three level predefined bundles were defined to help sales in value argumentation. The predefined bundle packages were introduced at the beginning of 2011. The predefined bundle packages were build based on customer information collected based on license database and network applications how the network elements were utilized. These predefined package compos are:

BASIC – provides element management functionality, targeted as a simple entry level centralized management concept.

EXTENDED – element and network layer management functionality including the value add applications for the service provisioning and maintenance. In most of the operations network operators, sophisticated tools are using the NMSs.

ADVANCED - element and network layer management functionality including all applications except special components such as northbound interface adapters. Targeted for mobile network operators having both 2G/3G/4G networks and multi-technology backhaul networks. The other target was to create the difference between extended and advanced packages to meet different customer requirements and the price targets. For operators having only a few network elements to be managed, it would be a mistake to have the whole application bundle, since the price and features would not match the use case.

On the other hand, three layered packages give a possibility to set differentiation in price wise. For sales purposes, there are also other options than having all items bundled. The third benefit achievable with predefined bundling was the simplified supply chain. Bundle packages enable a simplified order management as the group of applications can be bundled under one main item.

4.3 Product Structures

The current product structure of the NMS is based on three layered categories. The layered product structure is aligning with the software structure and the hardware components involved. The model is illustrated in Figure 10. Layered product structure.

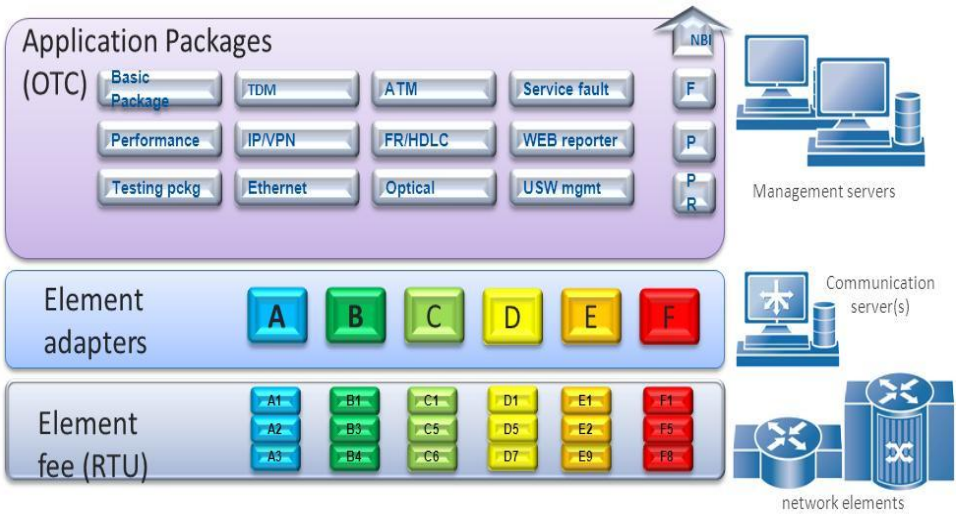


Figure 10. Layered product structure.

As seen from Figure 10, *the application packages* provide the highest layer. The items on this layer are single applications which include certain functionality, for example, the provisioning tasks or service fault monitoring. Special products, such as northbound interfaces belong to this category. The application packages are Once Off type products, and the customer will get a permanent license to use these. The north bound interface applications include typically some consultancy work and those are quoted together with the professional services to provide that.

The element adapters provide the scalability aspect of the NMS system. Each network element type group has the specific element adapter. The adapters are installed in the communication servers, which have a certain capacity to manage a certain number of network elements. The capacity can be increased by adding more communication servers. Each communication server is attached to the management system and the amount of communication servers is controlled by the element adapter

licenses. As the element adapters are productized as licensed products, they can be used as a scalability category of the system.

The element fees (RTU) are Right To Use type products, which are propagated accordingly to applications packages selected. Each element, or unit at some cases, is charged at the order phase with RTU. This method is straightforward as it is managed purely on the ordering process.

The layered model is based on the strategy to retrieve the revenue mainly from the element fees. Application packages and element adapters can be used to adapt the business case to small projects where element fee based charging would not be feasible. Table 2. The NMS revenue distribution between product groups below shows the revenue shares of each product group.

	2011	**2012**
applications	10 %	9 %
element adapters	5 %	4 %
element fees	85 %	87 %

Table 2. The NMS revenue distribution between product groups (2011-2012).

Table 2. The NMS revenue distribution between product groups shows the percentages of revenue each product group has generated in the NMS revenue distribution between product groups. The dominance of the element fees is obvious. Over 85% of the SW revenue comes from element fees.

Actually, the original revenue model included only the element fees. The ideology of the element fees aligned with the value NMS provides to the network operator. The value of the NMS gained with the growth of the network. The larger the network is more operations and monitoring need to be done and NMS can help on that.

For the network operator, the benefit of the pay-as-you-grow element fee model is that the cost follows the real growth of the network and the upfront costs of NMS were minimized.

For the case company, the benefit of the model from large customers as the achievable revenue will be higher than if the price would be in Once Off products, such as application packages. With Once Off model the initial price would be overpriced, which would turn down the NMS business case. The negative effect is that element fee RTU is not effective with small customers as the element fee would not generate adequate revenue. To correct the issue, the element adapters and applications can be used to set the price level for small or medium size projects, where the estimation of growth is limited. With very small cases, the dominance would be at the application packages, as any revenue is not expected later.

For the intermediate size customer cases, the element adapters also could be used. The element adapters works with cases where the growth is unsure and pricing with only applications or element fee RTU's would not be feasible. In that model, the customer cost of the growth of the network can be addressed in upfront basis.

The reflection of the selected strategy can be clearly seen in the Table 2. The clear dominance of the revenue comes through the element fees. The application layer, new customer networks in practice, has a significant role as a revenue generating product. The impact was surprisingly larger especially when considering the balance between NE fees generated through the existing install base and the new applications. In the case company, the annual growth of the new customer networks was approximately 5% during the evaluation period.

In the total NMS revenue, the application fee could be expected to be quite minor. The element adapters have a minor role at this context. Reason for that can be found the capacity of how many network elements one NE adapter can manage. One NE adapter can be managing up to 2500 network elements, which is enough for most of the small or medium size network operators. Product wise, it means small quantities of the

element adapter products, which may influence to the revenue that adapters generate.

Each product group includes several product items providing the higher granularity for the functions. Applications have a user based variable for dimensioning. Element adapters have dimensioning aspects through the capacity per one adapter. In the element fees group, each element type is modeled separately. As a result of combining the functionalities to each node type, the product granularity has exceeded the feasibility level. The current product portfolio includes 504 item codes. The outcome of the layered model together with the large number of items has caused the problems described in Section 3.3. As stated above, the product structure has been found too complex and a lump sum deals are used to cover the NMS product quotations.

From the supply chain point of view, the product structure is divided into two categories, items to be shipped and items to be charged only. Applications and element adapters are shipped; the RTU items are charged only. Challenge with the RTUs is the mismatch with customer orders and what they should order. As the RTU items do not make any impact on system functionality and there are no gates to pass in supply chain, there is a risk that some items are missed from the order and those are not invoiced. To find these mismatches is the goal of an observant of the order management person, who verifies orders against the customer license configuration. Through the manual work, all necessary items may not be recognized in the ordering process. As any mismatch would cause an order renewal and review, which takes time and costs more than the value of a single missed element fee, there has been defined several methods of improving the throughput of the supply chain.

One method that some accountants defined is that they have their own ordering codes to cover the customers' RTUs. Another method used is that element fees are agreed to be included in specific hardware automatically. The order management extracts the items from such order to get the pricing model to match. In practice the method works fine, but it causes issues in tracking and reporting. As the element fees are bundled to one or with some other code, the reporting results at the product level

are distorted. In the case described, the invoiced NMS revenue is shared to the license items according to the list price. Mathematically, this is an accurate and adequate approach, but with the cases where the purchased configuration includes all applications, also those ones which the customer has not purchased on purpose, the model causes distortion. Thus, being unable to define the correct price, it would be quite difficult for future applications to be developed and sold as the value argumentation between the really used and obsolete applications have not been made.

The product structure has a limited impact on the delivery model of the NMS software, but the number of products items has a significant meaning instead. Applications and element adapters require activation in the license key. For that, each item needs to go through the supply chain. The customer order is processed and the customer specific license key is generated to activate the required items. The software is delivered as a whole package, including all the applications and necessary SW components to run the system. As the licensed applications can be activated with the relevant license key, it is the most efficient to include the whole SW package in delivery and minimize the handling costs of the SW package.

The external components such as third party components utilized, do have an impact on the delivery model instead. Many of those need to be tracked and reported because of the royalty fees. At the product structure used, the 3rd party products are included under the certain specific licensed application. Thus, those can be tracked by the CRM system and the customer inventory database.

The latest generally available software release is used as default for deliveries. All the deviations from the default procedure are managed manually by the supply chain. This because the software releases are excluded from the product structure. For the new customers the latest release is usually the best option, but there are also some exceptions. Typically, these exceptions are related to the platform component customer is going to utilize. The available hardware or database release may not be a supported with the latest NMS release.

The release information of the SW release delivered to the existing customers is managed in the supply chains customer inventory database. The new release is delivered to the customer according to the support agreement. The new releases are delivered automatically based on the support agreement. That causes mismatch to the customer install base information as all the customers are not necessary upgrading their systems align with the published releases. The gap between information in the install database and the real situation may be several releases. There might be various reasons customers are not upgrading their system to the latest releases. If the current release provides the functionality needed, there may not be seen reasons to upgrade the system. The inaccurate perceptions of releases customers are using may contort the decision making of the software releases. Maintenance releases may be introduced on wrong version or the judgment of discontinuing release may impinge widely used version if the decision is made based on the install base information.

The customer requirements are crucial source for developing new features to ensure the competitiveness of the product. Usually the new features are implemented under existing products. In principle the application products are structured to according to certain functionality customers are using the NMS for. In that sense, the application products are optimized according to the customer focus.

The competitors influence the NMS product structure can be interpreted through common practices at the network management industry. At the product wise, the target is to align the NMS with the value it presents. The key components of the structure associated to the scalability how NMS can be measured are the number of the users and the network elements.

The number of users reflects well to the usage of the software and for that reason, it is a very easy parameter to value the NMS software. The number of entities managed by NMS provides the other common factor used. Depending on the NMS vendor, the measured entity can be a node, interface, capacity or end customer services managed by the NMS system. The competitors may try to differentiate behind the granularity to use in product structure, but the final outcome is a normalized structure

reflecting the size of the network to be managed. Also the case company's NMS application part is based on this structure. The comparability provides benefits as the NMS providers can be evaluated against each other in the matter of scalability.

The case company's license model differs from other vendors by the way network dimension factor is implemented. Most of the competitors use fixed steps to expand the NMS capacity to manage network elements. The licensing model for the network size dimension is built based on capacity blocks of nodes or other entities to be managed. The capacity blocks need to be purchased beforehand to enable the node activation to the system. Details and the number of steps vary according to vendors and type of nodes.

The element fee licensing in the case company is based on the floating model, in which the NMS license aligns exactly with the amount of the hardware purchased. The customer does not need to purchase licenses at the front end for the capacity he plans to implement. The floating model can be interpreted to be better as it follows the network growth. The operators' benefit is the capability to optimize the system utilization as there is no need to purchase licenses for stock. In addition, supply chain benefits from this structure as there is no need to maintain a separate license management inventory system for scalability.

The NMS functionalities are typically categorized according to the common term FCAPS. In practice all the NMS providers states their NMS solution to support those functions. Also the product structures and the applications sold attempt to follow the same FCAPS structure. The challenge is how to provide more value on top of the common practice. The differentiation would require a distance between the basic NMS system and those specific value add functionalities. The product structure should be capable to correspond to the competitors FCAPS features, which enable customers to compare items equally. On top of that, the differentiated products should offer superior functionalities.

4.4 Software Pricing Models

From the commercial perspective, the NMS have a meaningful role in sales activities. As the SW product without manufacturing costs, the profit is 100% in theory. This can be used as price adjustment factors for the HW equipment and thus ensure a reasonable profit for HW. Opposite to SW, this may cause some unpleasant situation for the NMS SW revenue.

The pricing model for the NMS product is based on a certain percentage of the hardware value of the deal. The target share from HW varies between the product types based on the level of functional support, and the complexity of the NE to be managed. This model aligns with the NE hardware value. The advantage of the model is that it adapts to the customer cases of different kinds and is understandable for the customer. That is a powerful strength, as the price can be defended over the time and project (Dver 2003) as the priced entity and network element remains the same over the time. The complexity of managing the network aligns with the number of the network elements, which gives solid groundings for defending the price. Another benefit of attaching the pricing model to the HW is that, in principle, there is no up limit for the total NMS price. Certainly that is in theory, but as long customer purchases new pieces the hardware the NMS part is getting the revenue and the total value of the NMS increases. In practice, the price erosion and the network size saturation set the limit.

The strength of the pricing model is also its weakness. The revenue achieved relies on the hardware sales, if customer stops or withdraws the purchase before the planned project is finished; the estimated revenue targeted from NMS is diluted. This is a risk especially with the cases where the applications are given out for cheap, because the planned revenue was from the element fees. In such a case the revenue achievable from the start applications is lost. Overall, the combination of element fees and OTC type applications provides a toolset to adapt different customer cases. From customer perspective, the NE based licensing model is also efficient and convenient, because overbuying the SW licenses can be avoided. According to Ray (2012), the balance

between the adequate and overbuying licenses has been found difficult by network professionals.

During the research period, the element fee based NMS pricing model was utilized at 62% of the new customer cases. In those cases, the applications was discounted extremely aggressively or given for free of charge. In addition, considerable founding from those extremely discounted cases was that, in seven out of eight customer cases the NMS configuration included 10 or more applications of sixteen. The average was seven during 2011-2012. That supports the theory of including all applications as there is no strict correlation to the price of the NMS system.

Price wise, the NMS serving several NE business units causes challenge to the sales. Each business units have their own targets and methods of creating sales and profit. That may cause a contradiction in the customer case if the NMS SW pricing methods used in business units differs considerably from each other. In the worst case, it means losses in achievable revenue as the price level with the NMS is diminished to a lower level. That may reflect both the application items as well element fees generating revenue over a long period of time.

Too low price level causes challenges to possible new sales, as the price level for new components cannot deviate too much from the price level utilized before. The way the guideline of the pricing model is utilized in practice varies depending on the network element offered and the commercial manager who builds the quotation for the customers. Based on the discussions with commercial managers, most of them utilize the model of pricing for the NMS as a certain percentage of the hardware value. The variation of how much value to the start application (OTC) is placed varies also with product houses.

During the interviews two groups of commercial managers and sales engineers was found. The first group, which had a good knowledge of the NMS product structure, used the minimum configuration model. In such a case, the quotation included only those applications which needed to meet the customer requirement. By quoting only the items to match the

minimum requirements of the customer, the excluded items were used as a tool in further negotiations to defend a certain price level, or as an option for upsales in future.

The second group of commercial managers and system sales engineers was not so familiar with the NMS product, and used a more holistic approach by including the most of the applications into the customer quotation. The reason for this was mainly targeting simplicity and “not to forget anything”. Another reason was that renewing the quotation would be unpleasant for both parties and cause unwanted opening of the price discussions. In addition, as the price of the NMS was determined based on the network element hardware value, without the link to the content of NMS structure, it was the most straightforward approach to include most of the items in the quotation.

The response to this all-inclusive model, the product management defined a three level predefined application packages for sales. The target was to help the selection of applications, but still keep the possibility of sophisticated product tailoring to meet the customer specific requirements. Another reason to keep granular product structure was to remain the possibility for upsales. The content of the discussed applications can be seen in Figure 11 below.

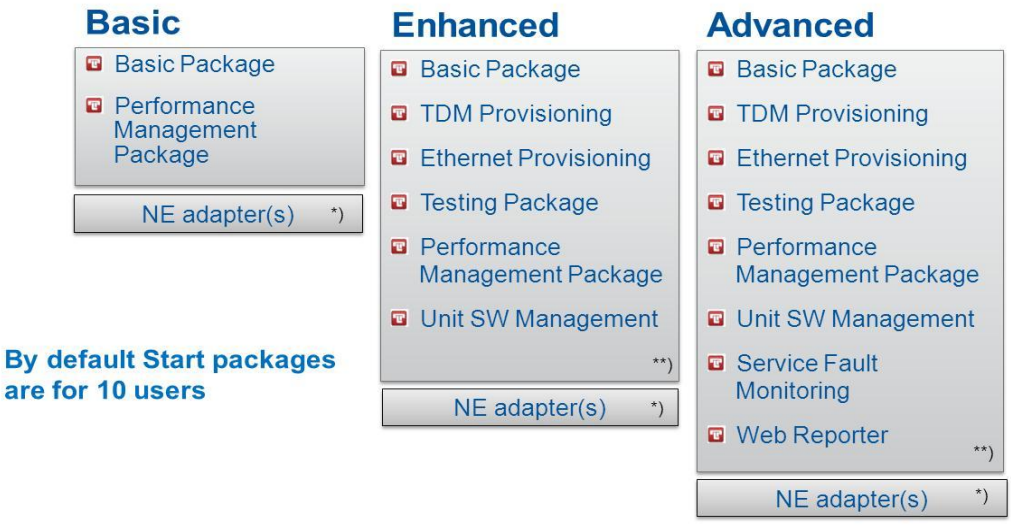


Figure 11. Predefined application packages.

Three level configurations include:

- Basic Package – entry level element manager functionality
- Advanced package – suitable for most of customers
- Enhanced package – suitable for mobile operators having 2G/3G/4G networks and common backhaul network for those.

The success of the predefined packages is hard to estimate because those are still ordered based on individual applications. In addition as the provisioning packages are reflecting the technology and applications used in the network, the mixture of optimal package variations cannot be covered with three packages. Overall, by analyzing the new installations during 2011 and 2012, there was found that with one swap or additional application, approximately 40% of the new networks configurations, followed the predefined packages.

The influence of predefined packages was found by comparing the new installations with the whole install base, especially with the items which were not related to any specific node platform or technology. Macro package was not included in any predefined package. The share of the new installations, including Macro package, has declined to 38% in 2012, even though the utilization of the Macro package was 48% of all installations. At the same period of time, the Web reporter was included in the predefined extended package. It was selected for the 56% of new installations, when its total portion of all installations amounted to 35%. The change is quite dramatic in a short period of time, especially as the product itself has been available already for several years and it has not been promoted otherwise.

The use cases described in previous sections illustrate the symptoms caused by loose connections between pricing models used and product structure. As the pricing model is based on other variables than the product itself, the value of individual product items is lost as the product is defined as a generic system. The generic argumentation can be used such as savings in operational costs, but that is correlated to the system, not to single items of the NMS.

The software releases of the NMS are priced based on the major releases. The case company introduces approximately one major release

per year. The pricing models used vary between the customer cases. A common model to use is a certain lump sum, which is related to the value of the network and how many releases the price should include. The main driver for upgrades is the support for the new NE release and the release itself, or secondary functions, for example, improved performance or functional enhancements do not have such a driver. This causes extra challenge to NMS to defend the prices of its releases.

4.5 SWOT Analysis of the Current Situation

To start the building of new product structure, the first phase is to summarize the current status. The SWOT analysis adapts well for this purpose as it can be used to analyze the business strengths and weaknesses of business as internal factors. Opportunities and threats can be interpreted as external factors influenced by the position and business environment (Atrill et al. 2007). This method helps to identify the success factors which may be used to secure the success in future, but also the weaknesses which need to be changed.

The SWOT analysis can thus be used as a tool for strategic decision for future actions (Nellis et al. 2006). The outcome of the SWOT analysis can be used as groundings for the new product structure. The strengths and opportunities could also be used as a guideline for variables to be supported in the new model. Weaknesses and threats need to be evaluated, how the impacts can be minimized or turned to the strengths or opportunities in the future.

The SWOT analysis of the current NMS product structure was done by inspecting the issue from *strategic, positioning, product structure* and *pricing* perspectives. The main issues revealed by SWOT in the product structure are listed at Table 3. The more detailed findings of the SWOT analysis of the current product can be found Appendix 1.

Priority	Strengths	Weaknesses	Opportunities	Threats
Core	Capability to adapt to different business cases	Loose connection between pricing models used and product structure	Additional sales through multi NE support	The meaning of applications and product items is missed. Only variable in NMS product value argumentation is the price
Major	Glue factor to improve customer commitment	Complexity of the license model	Secure overall profitability	The general SW business changes from package sales to services
	Way to differentiate from competitors	No new items to sold	Sales model changes to Services	Sales to existing customers missed
Minor	Help main products profitability	Unbalanced revenue structure	Selling new features to the existing customers	Profitability to be scarified for core products
	Unite licensing model for all Nes	Value of NMS missed	No uplimit for NMS license revenue	Inbuilt erosion to ruin new application sales

Table 3. Main findings from the SWOT analysis of the current product in the case company.

As seen from the SWOT analysis shown in Table 3, the main strength of the current product structure is the capability to scale all kind of business cases. Additionally, there is no low or up limit where the NMS would not be feasible to implement because of the costs. From the customer perspective, the element based fee can be interpreted positively as the costs of the NMS are aligned with the size of the network managed. The low entry cost allows small deployments to utilize the NMS.

The glue factor is important as it increases the customers' commitment to use system. It also lowers the customer resistance to deploy new NE types as the same NMS can be utilized.

The most critical weakness in the current NMS product structure is the loose connection to the actual pricing model used with NMS. Presently, single items on the product portfolio have minimal impact on the practical pricing. As a result of that, the model has the layered structure and several items to be included in the configuration are overlooked. The sales and customers have found the product structure complex, with the current structures being ignored and other ways used to simplify the NMS products in sales and supply chain. To overcome these difficulties, the

new structure should be built so straightforward and simple for both, that sales and customer can evaluate the value of NMS. In addition, the product structure should support the pricing models used.

On the other hand, the fact that the current product structure supports all the company's network element types can be perceived as a strong opportunity in the future. From the NMS perspective, those can be interpreted as prospects for new revenue source. The new structure should support the model existing customer is taking a new network element type under the management system.

Positioning the NMS as a complementary product enables several benefits to the company. The profitability of the main product can be secured as there is NMS variable involved in pricing. The low front end cost model lowers the level to implement the NMS, which can be seen as a large NMS install base. The company benefits from that via the glue factor that NMS creates.

The complementary position has a contradictory impact on the product. The real value of the NMS is not measured as the product is sold on top of the main products. As an outcome of that, the NMS applications are bundled together as a system, without the evaluation of each value applications. The real value of the NMS may not be recognized which may influence the achievable revenue. In turn, it is quite difficult to measure the negative impact from the whole business case. As the value of the NMS without network to be managed is zero, that asserts the NMS positioning as a complementary product.

Another weakness identified in the SWOT analysis is the lack of new sales. According to Fricker (2012), the business model of the software as a product is dependent on the capability to sell products to the new customers instead of selling upgrades and services to the existing customers. Rationale for this is to target for growth and maximal revenue. In principle, the release upgrades and maintenance services cannot provide such a path of growth as new sales can. In turn, Petracca (2007) forecasted the software business turning from the products package sales to the service model. As a combination of those, the optimal business

model of the existing SW product needs to be observed through sales, services and the lifecycle. Based on the revenue reports, the services share of the overall NMS revenue are growing, which illustrates the transition to be started also in the NMS business models.

The change of the revenue turning to the services can also be perceived as a threat. The pressure on services will increase with the existing customers at the phase when the network and NMS achieve a stable, mature phase. New releases are needed less frequently; the overall system quality has been improved, so there are not needed maintenance releases for bug fixes either. Customers need to upgrade the software mitigates, which causes the pressure to reduce the maintenance fees they are willing to pay.

The risk impacting to the product structure is the low front end cost. This can be seen as strength when acquiring new customers, but for existing customers the low price of applications can be perceived as a risk. Due to the low initial price, any new application to be developed confronts difficulties in achieving a reasonable price. In addition, for existing customers having large networks, the element fee based model may receive a strong resistance as the total number of element fees charged at once may be perceived as too high. For that reason, the new applications should be productized in such a way that they can be sold to the existing customers with an optimal and reasonable price.

Finally, as can be seen from the SWOT analysis, the capability to sell new value applications to the existing customers comes is under risk because of over bundling, as if the customer is receiving most of the applications at the initial phase. The sales of the additional packages become difficult. Thus, the product structure should support the difference between the applications included in the product portfolio. The differentiation should be clear to argument and easy to customers to understand. With that way, the over bundling packages can be avoided and the value of each application is achievable.

5 Building the Proposal for the New Product Structure

This section gathers the best practices applicable to the NMS product and applies them to improve the current status of product structure. Each group of the current product structure, earlier evaluated in SWOT analysis, and findings from them are used as the characteristics to be improved. The summary of improvements is used as a basis for three proposals for the new product structure.

5.1 Approach to Building the Proposal

To be able to solve the business problem of this Thesis, the new structure needs to give a response to challenges identified in the current NMS product structure. The new NMS product structure should be not only simpler, but it should also be capable to support strategic targets, network element sales and to optimize the achievable revenue. One key requirement for the new structure is the capability to illustrate the value for the customer and sales. The proposal is built on the findings from SWOT analysis which are used to determine the advantages to be gained and the disadvantages to be fixed. The final model for the proposal is based on the feedback collected from the three possible options.

The new NMS product structure is defined as a three dimensional vector based on the outcome of the SWOT and interviews made. With those grounding points, the NMS product structure provides earning logic, where the value of the NMS can be evaluated as the length of the vector of those three variables, as show in Figure 12. NMS value factors.

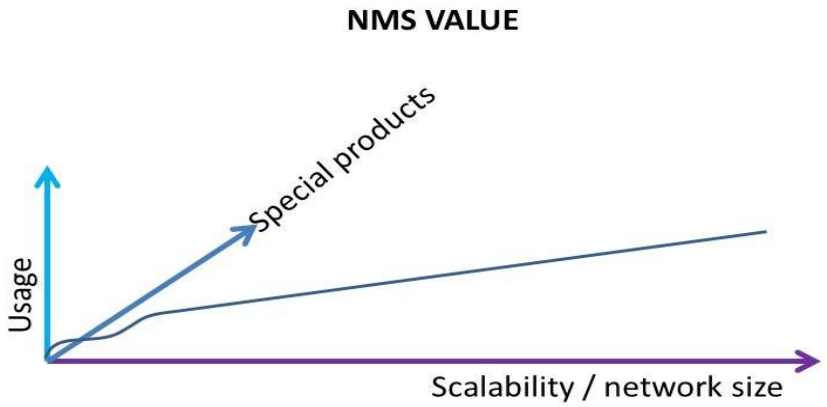


Figure 12. NMS value factors of the new NMS product structure.

As shown in Figure 13, the NMS value factors include:

- *Scalability:* the flexibility to adapt to any kind of network size managed with NMS. The element fee based model has been perceived as a good solution to support both, the customer and the company business models.

- *Usage of the NMS:* since the key function of NMS system is to provide tools for the network operator to configure and maintain the network, the value should be bonded to it. The functional usage may be complex to define. For that reason the approach needs to be straightforward.

- *Special products and Services,* or the crucial characteristic of the special products aimed to differentiate from the normal NMS functionalities. Clear distance from those FCAPS features help the value argumentation to keep them separate from the bundle deals.

Services can also include other components than release upgrades and maintenance services. For example, customer specific modifications to the product or other specific products can be included into this category. Specific products should be made as the Once Off type licensing model for the customer and those should include the maintenance as part of those.

The advantage of having only three dimensions in the structure is that there are no overlapped products having similar characteristics among each other. For example, the network size is not productized with Once Off applications (Usage) and with the element fees (Scalability). The length of the vector illustrates the total revenue of the NMS achieved.

The special products are Once Off type products and have the impact to the costs at the beginning of the implementation.

The scalability factor provides the pay-as-you-grow model, which will take the dominance as the network grows. Benefit of the model is that it is possible to use different strategies with the pricing. In addition, the model

provides the way to differentiate from the competitors, which are using the Once Off type licensing also for dimensioning.

5.2 NMS Applications

Based on the current install base and the NMS application configuration of the new customers, the product structure can be perceived to have two categories in applications based on their prevalence. The applications providing legacy FCAPS functionalities for the system are present in most of the customers' configurations. In practice those are included over 70% of the deployed configurations as found in Section 4.1. The second group of the applications is specific for certain product family only, which limits the prevalence. There are also applications which can be categorized as customer specific applications as the implementation requires a customization of the product to adapt to the specific need. The northbound interfaces to the OSS typically present these kinds of applications.

To simplify the structure of the sellable applications, it should reflect the value of the applications based on the usage of the NMS. The definition of the NMS usage includes several variables related to the functions served and the number of operations to be done. According to the findings of the system configurations and the used practices of bundling items together, the conclusion can be made for larger sales packages. Furthermore, as the NMS is positioned as a complementary product, the product structure could be simplified so, it would become easy to find value arguments and thus support the main product in the best way. In case of the NMS, the applications providing FCAPS functionality are easy to argue for as it can be perceived as a *de facto* configuration.

The simplified product structure causes challenge also pricing wise. Even though the structure is easier to manage, it should be able to be priced for various business cases. The size and type of the network to be managed have a significant impact on how many transactions need to be made to the network. The access network including several thousands of network elements, compared with the core network having only some tens or hundreds network elements, the type of operations needed to be varied

significantly. In addition, the profile of those networks differs. The access network can be considered quite dynamic, where the number of configuration changes made daily is large. The core network is instead typically quite static, with the number of changes limited, but the monitoring of the network having more effort.

Overall, the correlation of the number of NMS users is not linear with the size of the network, but it can be used to estimate the need for operations to be done to the network and the number of users needed.

The usage profile of the NMS varies depending on the network operator's organizations. The operational tasks such as configuration changes are typically done during normal office hours. In turn, the service assurance, the network monitoring and maintenance are typically done continuously. Help desk personnel may need to have access occasionally, but they will need this access instantly when service request has arrived. Functions such as planning, network optimization and quality organizations, may need the information from NMS only intermittently. That means the number of concurrent users who would need access to the NMS may vary from a few to several tens during the day.

To normalize the user based licensing, the floating license model can be used that responses well to different needs. By settling the maximum number of concurrent users for the system, the complexity of the different user profiles can be covered with the unite license model.

To convert the floating user licensing model to the optimal product structure form, the appropriate numbers of users need to be defined. From the system perspective, there are two threshold values to respect:

- The maximum number of concurrent users supported by the system (150), and
- The maximum number of concurrent users per server (40).

To define the optimal steps between the entry level number of users and the total maximum number of users, the intermediate licenses should be settled with a reasonable distance from each other. Too fine granularity

will lead to the unnecessary burden in the supply chain and license management. Too coarse granularity instead may not match the customer needs and will drive sales to emphasize large user licenses. That would diminish the value of small user licenses and the growth path in terms of user licenses.

Murtojärvi et al. (2007) have researched a mathematical approach to define a proper number of licenses needed. The Engset model they utilized, determines the minimum number of the licenses needed in such environment where the sessions are relatively long and where the queuing is not accepted. The Engset model also took into consideration the usage of the system, so that it adapts well to the use case of the NMS. By utilizing the model, Murtojärvi et al. (2007) define the following minimum number of licenses need for a certain number of potential users (shown in Table 4 below). The approximations for Table 4 are:

- The NMS is used in certain periods equally during the work day (8 hours).
- There is 1% NMS system availability blocking probability used.
- “P users” states the number of the probable concurrent users. The Minutes per session is the estimation of the duration per session the software is used, meaning how long the license is reserved.

	Minutes per session					
P users	**10**	**15**	**20**	**30**	**40**	**50**
5	4	4	5	5	5	5
10	10	7	7	9	10	10
20	8	10	12	16	19	20
40	13	17	21	28	35	40
80	22	29	37	52	66	79
100	26	35	45	63	63	98
150	36	50	64	91	81	145

Table 4. Minimum number of licenses needed based on utilization.

The green cells in Table 4 show the minimum number of licenses needed to ensure the licensing will not be the limiting factor for the system availability. As it can be seen, the number of user licenses aligns with the number of probable users, no matter how much users are using the NMS during the work day. With large number of users, the needed number of the licenses diminishes. The brown cells describe the number of needed licenses if a small delay in the system availability is allowed. At the red area, users will most probably undergo the lack of system availability.

Murtomäki et al (2007) suggests a mathematical model that the number of needed licenses is slightly greater than the half of probable users. That information can be used as a guideline for defining the intermediate steps between the entry level setup to the maximum number of supported users.

The licensing steps for the new structure could be picked between the green and the brown area, which follows the findings of the research made by Murtomäki et al. (2007). As stated above, with the low number of licenses, the license and usage match. In this sense, the granularity needs to be fine. With the large setups, the question is more like stating the maximum capacity that the system can provide. For that reason the maximum capacity could be used as the highest license.

5.3 Element Fees

The element fee model has been considered as an efficient way in which NMS can support scalability from licensing perspective. As it supports the model of the pay-as-you grow, it is easily accepted by customers. The licenses are aligning with the real situation and there are no risks of under or over licensing NMS. In addition, as the license can be tight to the case company's key products, network elements and the supply chain can be kept lean. As a result, it is not necessary to build a heavy license management system to support the license model.

At the current product portfolio, there are 426 element fee items to cover all the NEs and the applications. Based on the findings from the current state analysis, in the vast majority cases the system configuration is fixed

at the beginning of the project, so that any possible extensions impacting the element fees are extremely rare. In addition, most of the element fees are already bundled under one item code to simplify the supply chain process.

According to these findings, the element fees can be restructured in such a way as to limit the applications and adapter element fees to a few element type specific fees. The granularity needs to be kept at the element level, because the pricing model is based on the percentage of hardware which needs to be supported. As the price of the network element can vary greatly, the element fee should not be too generic. In practice there should be an element type specific fee to supports pricing for different network elements.

5.4 Value add Applications and Services

The value-add applications and services existence have two purposes. First, to be able to provide an extra value on top of the basic FCAPS functionality that customers are willing to pay. Secondly, to be able provide a method for charging possible new developments done in future. This is necessary to secure the revenue in case the release sales and maintenance services would not provide effective tools to charge for high value features.

The value-add applications differ from the normal FCAPS functionality of the NMS. Those are sold separately and the target is to cover customer specific needs of gaining the operational efficiency of NMS functionalities. Good examples of these kinds of products are north bound interfaces, which are used to integrate NMS to the OSS. The customers goal with the NBIs is to improve the operational efficiency and thus to achieve savings and better service quality. The integration usually requires some customer specific tailoring to software, which needs to be projected. That makes it possible to evaluate the value of NBI products via projects, which can be used as a pricing tool.

Other groups of special products may respond to demand of other functionalities of network operator functions. As found in best practices, the value of the product can exist in other parts of value chain than in the

product itself. Typically, the NMS's are used by network operation centers to configure and maintain the networks. There are also other functions, such as planning and service teams, which utilize the information retrieved from networks. The reporting functions which provide the data of network inventories, service availability, traffic behavior etc. are also getting more attention as the network operators increase the pressure to optimize the network capacity because of the constantly increasing amount of data to be transferred. That opens a possibility to new usage groups of NMSs' which can be productized, and their functionality can be converted into value.

The third group of special products could be considered to be customer specific and tailored for special features. These products could be provided as a service, which could be sold as a project work. This model, however, includes some negative effects in form of maintenance. The customer specific features cause extra burdens to R&D, as the backward compatibility of the features need to be ensured through releases.

The nature of the value-add products is to sell those with Once-off model. The value is defined at the first phase of the SW acquisition, and there are no additional impacts on the existing network. That makes them simple to value by customers, as there is no need to evaluate the costs of existing either the future size of the network. Even though there were earlier arguments to avoid the high front end payments, in this context, these payments could be beneficial for two reasons. It keeps the product structure simple as there are no dependencies between the product groups. Secondly, the initial price can be used to ensure the profitability of the project. In addition, it would create a natural priority for projects for both parties, the customer to evaluate the importance of the project and the vendor to evaluate the usage of the resources.

5.5 Proposal for the New Product Structure

By collecting the characteristics of the applications, element fees and value add products together; the product structure could be based on three layers providing the tools for value argumentation and the scalability which could be used in pricing. As an outcome of theoretical research and

the current state analysis, the following three models were chosen for further evaluation, which were introduced to the commercial managers for collecting feedback.

a) Extremely simplified structure in where all applications are packetized to one NMS and only one element type specific fee would be used. The pricing would be based on the percentage of the hardware value.

b) Two level NMS which consists of the basic package and the optional value add package. The advantage of this would be the possibility to have more negotiation power in pricing, but still keep the structure as lean as possible. The basic NMS would include the FCAPS functionalities. The advanced NMS would include selected special applications such as testing and the network element software management tool.

c) The opposite approach compared with the current application definition. The element fee would be the only dimensioned item. Those would be differentiated by the number of users. In this model the basic NMS functionality would be given for free. Business logic relies on the size of the network and the usage of the NMS.

Based on the network element types the NMS is supporting, the element specific fees can be determined with 30 line items on the option a) and c). Option b) would require 60 element fee items to cover all the supported network elements.

Based on the feedback received from commercial managers located in the United States, Europe, Middle-east and APAC, the option b) as illustrated in Figure 13 was perceived to be the most attractive for the new product structure.

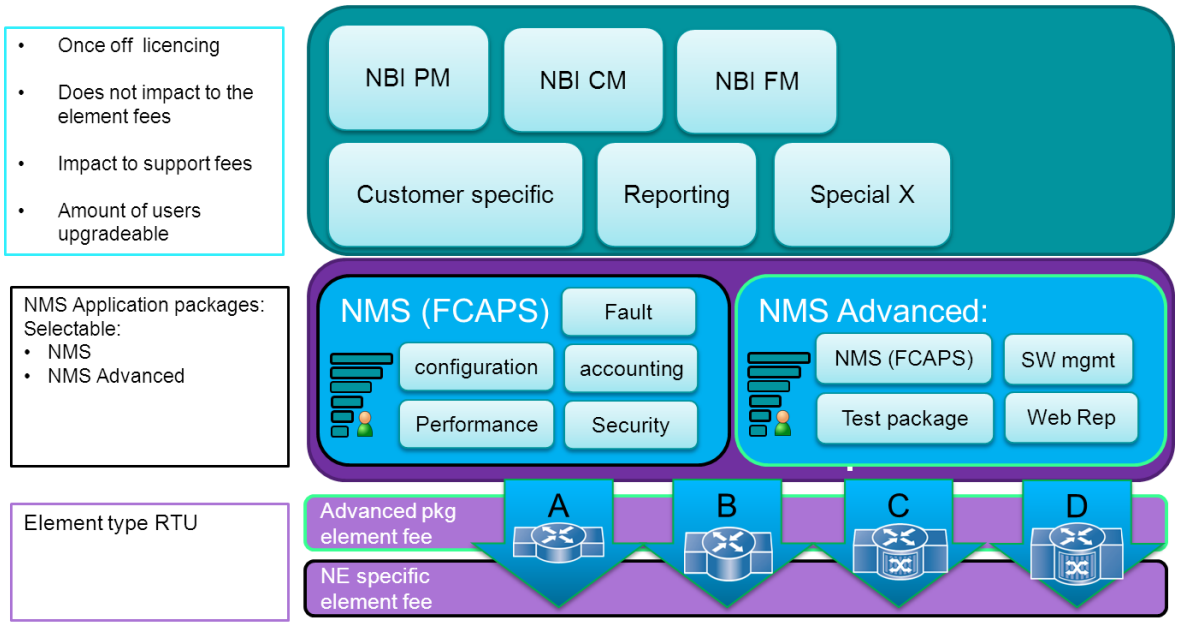


Figure 13. The proposed new product structure.

Figure 13 illustrates the product structure selected for the final proposal. The NMS applications are divided into two packages. The NMS (FCAPS) package includes all the FCAPS functionalities and the Advanced package includes value-adding functionalities in addition to the NMS (FCAPS) package. The customers need to select one package and the number of the users for the applications.

In the current model, the network size was dimensioned through the number of NE adapters. In the proposed structure, the dimensioning is managed through the number of concurrent users. Due to the improved system capacity, the weight of the NE adapters as a dimensioning factor is diminishing. For that reason the dimensioning at the network element part can be leaved out. Overall, as each network element family could interpret to require their own management system, the new product structure would correspond to that. The NE type specific adapter is used to enable certain NE types connect to the NMS. Those are described as A, B, C and D in Figure 14.

As the NMS applications are bundled under two selectable application packages, the high granularity for element fee structure is not needed. The element fee can be aligned with the element model. The element fee structure is propagated from the NMS applications. The NMS (FCAPS) and NMS advanced packages are their own type element fees.

The group of special products is selection of items which typically require some customer specific adjustment and consultancy work. In practice it means that products are quoted to the customers as case basis depending of the size of the project.

The new product structure can be defined by using following quantities of product items.

- 6 to 10 items for special products. This group will cover the NBI products as well other products which differs from FCAPS functionalities.
- 7 items for levels of concurrent user licenses. User licenses are used as a scalability factor of the NMS.
- 6 items to define manageable network element product group. One for each element type supported
- 60 items for element fees (RTU). Two items for each network element; NMS and Advanced. To be able to adapt for NE pricing, each NE model requires its own items.

The summary of the key arguments for the suggested product structure from interviews include:

Simplicity was perceived very positively. The reduction of applications was seen generally positively. Especially the change in element fees was interpreted as dramatic. The greatest benefit is that there is not needed to define the element fee configuration based on applications selected at the initial phase. The second advantage is that the line items in supply chain can be reduced. Handling the sales and purchase orders would be easier.

Remaining possibility to use tactical pricing between the applications and element fees is also found as an important attribute to be able to adapt to the different size of business cases. The element fees are found to be a strategically important component as a price adjuster for hardware business. The element fees can be used to secure the profitability of the hardware.

Higher granularity for the number of the user licenses received two kind of feedback from interviews. In general the granularity was seen as good since it also provides other options than offering the unlimited license.

That can be intercepted that 5 and 10 user licenses were not adequate for customer cases and for that reason the unlimited license was offered. The critic received concerned mostly the number of the steps proposed. Several user options were perceived to bring unnecessary complexity to making the proposals. The challenge to define a adequate number of user licenses for quotation was issued as a problem. In addition, the growth path in license terms was perceived problematic.

There was also some criticism about the lack of possibility for additional feature sales. In fact, that was the main reason why the structure having optional value pack took advantage from the simple NMS structure. The one NMS was preferred because of its simplicity, but based on discussions about upsales and a possibility to have more pricing tools available, it was turned down. In addition, the concern of high entry level price level was brought up as all applications are included in the package. Based on those, the application layer including the value pack was raised as the most feasible solution.

The third model introduced, where the business model was based fully on element fees, was turned down as too simple. Even though the initial NMS SW would be easy to sell, the possible feature upgrades or changes were perceived as quite difficult to charge the customers. In addition, the model does not support for sales of possible new innovations.

By simplifying the structure of element fees under NE specific fee may be interpreted as a risk of over bundling. The risk can be avoided by categorizing applications clearly into those which are core NMS items based on FCAPS functionality, and those which have specific value add applications.

6 Pilot Test of the Proposed New Structure

The purpose of the pilot test is to ensure the feasibility of the proposed new product structure. The efficiency of the proposed model is evaluated by testing the needed number of line items to complete the reference number of orders. The change on pricing is tested to get a view of impact on different NMS configurations customers are or may use. To acquire confidence and reason for the change, the impact on the revenue is tested.

Tests are done by using 2011 and 2012 delivery and revenue information as a reference data.

6.1 Overview of the Pilot Test

The improvement of the new structure is tested in terms of the number of line items needed to complete the orders and the impact on the revenue. The data of the 2011 and 2012 deliveries and the revenue are utilized as a reference data. The new structure is tested in such a way the customer orders are converted to the new structure. The new line items needed to complete the deliveries are compared with the reference data.

The impact on the revenue is estimated based on the weighted averages of revenues each item has generated during the reference period. Exact figures are difficult to explore because of the real business cases vary greatly in terms of pricing models used. Wide variation was noticed between business units and even with single items. For such a case, the revenue has been shared accordingly to the portion of the retail prices, which gives acceptable average value to each application used in the configuration.

6.2 Impact to the Product Items

The main objective of this study was to find a simplified product structure for network management software. As a part of that target, the number of product items should be able to reduce. According to the structure defined based on criteria’s found, the total number of items could be reduced from 503 to 84. From the supply chain perspective, the number of the element fee line items processed through order to invoice is the

most significant. By comparing the node type specific structure with the current one, the total number of element fee line items processed in supply chain could be reduced by 78% to 92% compared with line items used for deliveries done in 2011 and 2012. The change varies between network element types. Details about the comparison of needed line items for orders between the current and proposed structure are listed in Appendix 2.

At the application level the change of the number of line items needed to complete the NMS configuration is not so significant. At there, the main benefit achievable is the improved simplicity of defining the NMS configuration. That will help both parties define the needs of NMS and the value for those. The statistical comparison is not relevant as the number of users could be mapped nearly one to one between the current model and the new proposal. Overall there need to be evaluated the behavior of customer cases where unlimited licensing is used. Only a very seldom customers actually uses the maximum capacity the NMS system can provide. On the other hand the, user limits of 5 and 10 may be perceived too small for medium or large size networks. The unlimited user license can also be interpreted as a tactical pricing tool for argument price level.

6.3 Impact to the Configuration Price

Profoundly simplified product structure could be interpreted that the price of the NMS configuration need be increased dramatically to get the same revenue. Other perception could be that the achievable revenue is totally lost as the NMS include all sellable functions at the first phase.

To evaluate the possible impacts on the configuration price, there was used the average prices of the configurations delivered during the study period. As the pricing models had a quite wide variation, the tests are made by using weighted average prices based on the number of NMS's used to manage certain types of the network element families. . Price levels for new model applications are derived targeting to match between the low and high level of the configurations made with the current system. NMS revenue was also noticed to vary inside the product

families on quite a wide scale. Low and high level prices can be perceived to elaborate better response to the real business cases.

As the new entry level NMS includes all FCAPS functionalities and the cost of the scalability is removed, there was added a 25% premium to the initial price for five users compared with the most common start configuration used with product group D (The cost of next step scalability aligns with the premium cost). The target price can be estimated to be achievable as the value customer receives is higher and the total cost of the NMS applications are lower compared with the typical configurations of including one element adapter.

The unlimited user level of the current application structure is aligned to the license level 40 users accordingly to the definition described in Section 5.2. Otherwise, the steps between the numbers of users are aligned so the target price is divided by the number of users. The cost per user is reduced by 15% on odd steps and 25% on even steps. The price reduction per user is not linear per user on purpose. The higher steps are aligned with steps new hardware is required. Intermediate steps are easy to make by upgrading the number of users license only. Smaller price steps are used to encourage the customers to select the maximum user level license supported with the hardware used. The target is to minimize the need for upgrade only the license of the number of users.

The scalability factor provided by element adapters is simplified in the new structure by having only the node type license; the quantity parameter would be discontinued. From the product structure point of view, there is one scalability factor less to be considered, which corresponds to the objective set for this study.

The element type managed with the NMS impacts on the system price of the NMS application. For this study pilot, the similar approach as the one used with application will be utilized. The average prices during 2011 - 2012 of the element adapter revenues are used as the price for the new NE adapters. As the scalability factor is included already into the NMS application premium, the element adapter prices are not adjusted.

Figure 14. below illustrates the NE adapter price of each network element type and how it correlates to the target prices for each user license of the NMS application.

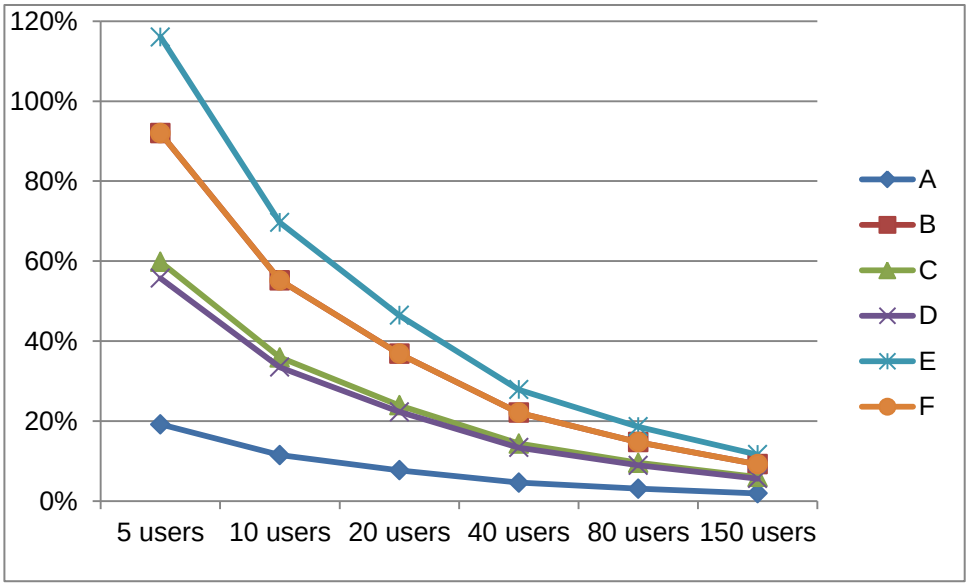


Figure 14. NE adapter price compared to the NMS application target prices.

As Figure 14 shows, for certain element types, the element adapter price almost equal the NMS application price with five users as the chart below illustrates. With higher user levels, the portion of node type in NMS configuration price is quite nominal. Which actually gains the benefit to use the unite management system for several network element types.

The reason for such a high difference between NE adapter prices comes from technological reasons and how NMS supports the specific NE type. Also the capacity of one NE adapter varies with the element types. That has an influence on the NE adapter prices used in the current structure and that is why it is also shown in this scenario. With the new structure the capacity per adapter dependency is removed, which could be turned in such a way that each network element type could be priced equally or at least the deviation could be decreased. As there are business related variables which could not be interpreted from statistics, the element type specific prices are used to be able to compare the new structure with the current one as equally as possible.

The summary of application and the NE adapter price is shown in Figure 15. below.

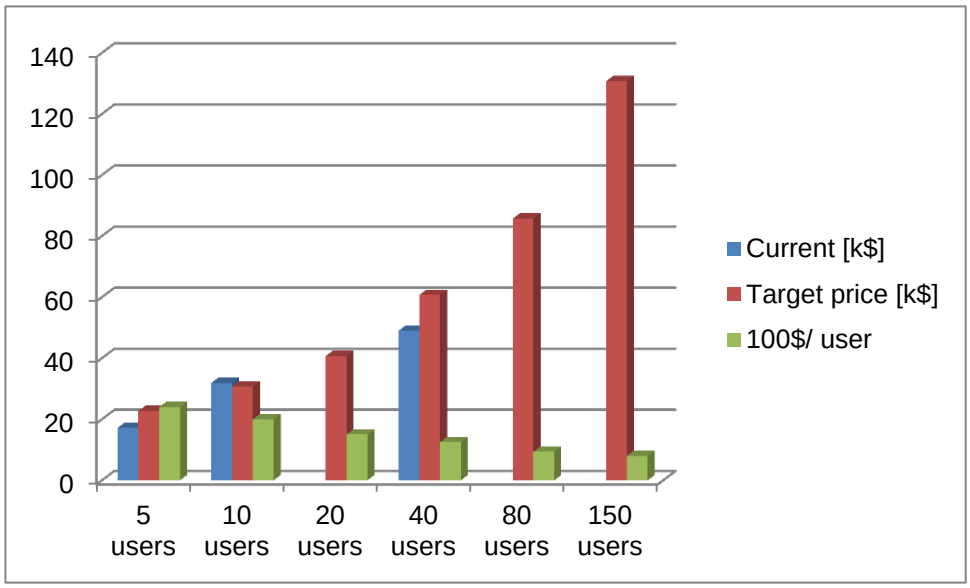


Figure 15. Target price level scenarios of the NMS applications.

As Figure 15 shows, the target price is based on the weighted average price of the NE adapters. As the chart shows, the target price follows the current model at the small user licenses. Instead at the high level licenses, 80 and 150 users, the growth of the system price is quite steep. Compared the new model with the current model, the target price for the highest user license is double. The level is much higher than achieved at least during the study period. That may raise the question of achievability of such price level. On the other hand, the growth of the price can be interpreted to be a part of the network growth, which could be achieved on the long term via license, at this case upgrade of the user level.

The more detailed comparison of the NMS application prices made at the system level by having similar product setup with the current and new structure. Both configurations are based on the average NMS price and one NE adapter fee. The configuration illustrates the real deployment as the most of the new cases includes the one NE adapter. Values are normalized by using the weighted average method. With this way, the difference between the node types as well the impact of the number of the delivered systems can be taken into the count. There was noticed a

wide variance of application prices between the years 2011 and 2012, so those are evaluated separately.

By stating the new structure to be as a reference level (100%) for comparison, the impact of the new structure on the cost change can be estimated to the customer. The overall results of the configuration price comparison correlates with the initial set of the premium factor at the entry level NMS. Overall, the premium is not 25% above the high level as set for applications. The Figure 16. Impact of the product structure change to the NMS configuration price illustrates the cost comparison of the NMS based on new structure compared with the existing structure.

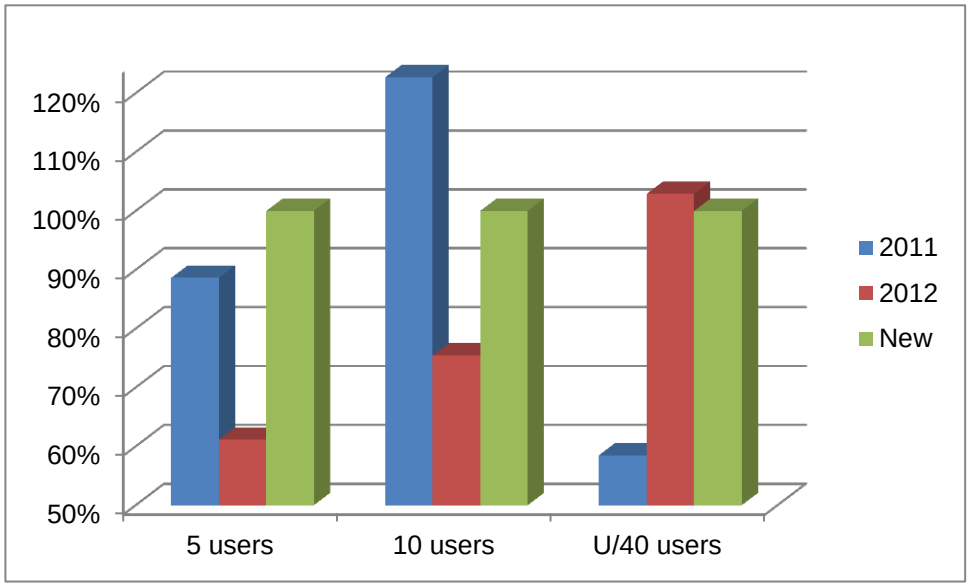


Figure 16. Impact of the product structure change to the NMS configuration price.

As the comparison of the proposed model on the reference data shows in Figure 17 illustrates, the new structure ten users license shows to settle in the midpoint between low and high prices of the current license structure. That can be received the target pricing model fits to the pricing model used with the current license structure. That is also important in that sense that most common start up licenses would be the five and ten user licenses. Similar results were also received with the configuration of the unlimited users configuration. The price of the configuration based on the current license model would be more expensive. Almost 50% deviation at the unlimited user license to the lower limit is the result of free given installations for large network deployments.

6.4 Impact to the Revenue

The Impact on the company's revenue is the most critical factor for the decision making to initiate change to the product structure. Even though the main objective of this study is to optimize the product structure and reduce the number of product items, the change should not reduce the achievable revenue of the NMS system.

From the revenue perspective, the most significant product group in the new structure is the element fee. The pricing model for the element fees is based on the percentage of the hardware price to be managed by NMS. The same model is continued with the new structure. Only the number of the element fee items per network element is decreased. In practice, such a reduction has already been implemented with several existing customer accounts. Therefore the interpretation is that the change of having only two element fee items per element fee does not have impact on the revenue. There is a risk that higher entity fee faces stronger price pressure, but that is part of tactical pricing. For that reason there is an optional item defined in new structure, to remain the level of element fee prices.

The application product portfolio reconstructed to have only two options, instead of individual applications. The missed value structure is compiled to the simple user number based structure with one value option. To evaluate the impacts on the achievable revenue, the new product structure is tested by using the delivery and revenue data as described in previous section 6.3.

The impacts of certain special products, such as north bound interfaces, are excluded from comparison between the current and the new model. Even though those have a significant impact on the total revenue the special products generate. This because the quantity wise the NBI items represents the minority in sales and any speculation with the NBI would distort the results. In addition, as the new model does not have an impact on the NBI items the evaluation would be interpreted being equal between the current and new structure.

To evaluate the impact of the optional value package, there were selected three applications for optional value package. The criterion is to deliver extra value in addition to FCAPS functionality of the NMS. Those products are

- Web reporter
- Unit software management
- Macro manager

The overall impact of the optional package on the revenue is approximately two per cent at the application level. Impact is not high, but the importance comes through differentiation. The optional package provides an extra value to the NMS, which can be used as a tactical tool for pricing. In addition, it provides an option to sell additional features as a part of solution in the future.

The type of NMS licenses are distributed so the dominance would be on the lower user level licenses. The number of new NMS deployments purchased during the evaluation period is distributed to the new structure as listed in Table 5. below.

User license	2011	Pilot 2011	2012	Pilot 2012
5	52 %	42 %	74 %	42 %
10	9 %	27 %	4 %	29 %
20		15 %		17 %
40		9 %		8 %
80		3 %		4 %
150	39 %	3 %	22 %	0 %

Table 5. NMS user licenses for pilot testing.

That is natural approach as in the beginning of network deployment; a few users can manage the network configuration. When the network grows the number of users, licenses can be upgraded to the higher level. The licenses for large user number can also be considered as a pricing tool, so there is reason to assume to have some high user number licensing for new customer cases as well, even though those may not be needed for new customer cases.

Comparison of the revenue between the current and the new product structure in Table 6 below.

	current 2011	new 2011	current 2012	new 2012
Start 5	XXXXX	XXXXX	XXXXX	XXXXX
start 10	XXXXX	XXXXX	XXXXX	XXXXX
start 20		XXXXX		XXXXX
start 40		XXXXX		XXXXX
start 80		XXXXX		XXXXX
start 150	XXXXX	XXXXX	XXXXX	XXXXX
NE adapters	XXXXX		XXXXX	
Type of NE		XXXXX		XXXXX
optional pkg		XXXXX		XXXXX
Total	XXXXX	XXXXX	XXXXX	XXXXX

Table 6. The licensing change impact to the NMS revenue.

As Table 6 shows, the overall improvement of applications revenue to be over 37% with the new structure. The Reason for this licensing to move from unlimited users licenses to lower user level licenses as listen in Table 5 above. At the current model, the price difference between five users and unlimited users license is not vast. In addition, the unlimited license in the current model was adapted to 40 user license in the new structure. The movement gives more room for the high priced licenses of the 80 and 150 users. The large user licenses 40, 80 and 150 user, even though having the minor part of configurations, have a significant impact on application revenue. According to the scenario, those items generate the difference between structures.

With the proposed new structure, the network element adapter group has been changed such a way the scalability factor has been discontinued. That will have impact on large networks as revenue cannot be gained from additional adapters.

The NE type based licenses covers the NE adapter fees equally at the initial phase where one adapter or different NE types are used. For large networks, where several NE adapters are used, the discontinuity of the NE adapters at the new structure causes negative

impact to the revenue achievable. In turn, those large networks require more maintenance which means more users. The overall summary can be estimated to be positive even though the revenue through scalability factor NE adapters represents is lost.

6.5 Conclusions of the Pilot Test

The purpose of the pilot testing was to evaluate the performance of the new product structure proposed. The objective of this study was to optimize the product structure and the number of NMS product items. The feasibility of the new structure was also tested to get an assessment of the impacts in financial terms. The price of the configuration illustrates the cost to the customer. The change in costs to the customer can be elaborated as a feasibility factor of the new structure. As there are certain general practices and assumptions about the NMS prices, the deviations could not be too dramatic the new model could success. The impact on the company's revenue is crucial aspect to evaluate and to find the judgment for proposal. Even though the target is to optimize the product structure, the change should also be beneficial in the financial terms.

To measure the performance of the new product structure, the deliveries made during 2011 and 2012 were converted to use the new product structure. According to the pilot test, there was found that the mass of item codes needed to complete the reference orders was able to reduce 78 to 92% depending on the network element types ordered.

To improve the accuracy of the financial analysis, the weighted averages were used in NE type and item level pricing definitions. Thus, the impact of wide price variation could be harmonized. The results of the current data analysis were used groundings for the target prices of the new items. The entry level configuration aligned close to the average price of NMS applications. The increased content of the NMS configuration and the included scalability was valued as 25% premium. The pricing of the application part was adjusted by using the theory of (Murtojärvi 2007 et al.) about the number of needed licenses. Based on that the previous unlimited user license was aligned with a middle level 40 users license in

the new structure. The change gave more room for high priced items for NMS applications.

The evaluation of the configuration price can be used as illustrative purposes only because the price variation used in reference data was quite wide. As expected the price at entry level was higher than used with the current model. Instead the configurations with higher number of users, the price of new structure took up the position between the low and high level of the current model. That proves the new structure could be feasible in value wise, which customers have paid for NMS applications.

The impact on revenue is a crucial factor for decision making to implement the change. According to test, the new structure could generate over 37% more revenue compared with the currently used model. The improvement could be achieved by minimizing the overlooked configurations including complete item set. Improved granularity on user level could be used to secure prices achievable with each application.

7 Conclusions

This section summarizes the research process from the problem setting to the proposal for the product structure. The executive summary describes the root cause of the problem and how it appears in practice. The research methodologies used in research are described. The results of the research are introduced and how the proposed model could be implemented.

The validity and reliability section discusses about how well the research has followed the methods of good research.

7.1 Executive Summary

The objective of this Thesis work was to improve the product structure of the case company's NMS product. The product structure was expanded over the time as new features and support for network elements were implemented. Currently, there are over 500 orderable product items for NMS licenses. Based on the feedback received from the sales and supply chain, the structure was perceived as a complex to be operated. Sales forces neither customers were not sure which items should be ordered at in which phase.

As a workaround to fix the issue, unofficial shortcuts were used to simplify the NMS product items to fit better to customer cases. As a result of workarounds, the NMS applications were packetized as all inclusive solutions to minimize the NMS influence on the quotations and ordering process. Especially with the cases where the NMS was sold with the extremely price the large amount of license items was perceived annoying. In addition the simple item dedicated to for customer ensured fluent throughput in ordering-delivery process, as the risk of misplaced order was minimal.

The case study was based on the combination of quantitative and qualitative analysis. The groundings for analysis were retrieved from the current state of the NMS product structure by using the delivery and revenue reports from the years 2011 and 2012. The customer information details were completed with the customer inventory data base. Findings

from the reports were utilized with the interviews of commercial managers, system sales engineers and supply chain representatives. The target was to acquire knowledge how NMS is sold and what kind of challenges there have been faced. The received information was reflected to theory research, where the SW products were studied from several angles. The strategic positioning, structural and pricing approaches were used to provide the frame concept for the new NMS product structure. SWOT analysis was used to identify the characteristics from the frame concept which could be gained and which one would require attention to be fixed changed.

As a result of the theory investigation and the current state analysis, three models were derived for further analysis. The commercial managers and system sales engineers were interviewed again to get feedback and confidence for the most feasible solution. The feasibility of the preferred solution was tested against the reference data used for the current state analysis. The data was converted to form of proposed product structure and the performance of it was tested in terms of number of line items needed in supply chain as well in terms of finance. The results showed that the reference data could be managed with 78% - 92% less line items in supply chain. By utilizing the weighted average prices at the pilot test run, the results indicate the possibility of 37% improvement in the applications revenue.

7.2 Instructions for Further Actions

The proposed model follows the main idea of the current product structure: The cost of the NMS is engaged to the growth to the network. With the new structure, the possibility of easy transition was also taken into account. The application licenses having the user parameter include similar steps and also the element fees, even though the structure is simpler. In practice the proposed model could be taken in use with the existing customers with moderate effort as the migration can be done by agreeing with the customer about using the new ordering codes. The existing configuration of the NMS applications can be mapped to the new structure if there are changes needed.

The obligations to third party components used in the NMS software need to be reviewed before the change. Possible restrictions in usage limits or royalty payment terms may require adjustment to the contract or the final product structure.

The change in product structure does not require any changes into the NMS software itself. Instead the license management control function is feasible to change to adapt to the new structure.

The highest effort implementing the change is required for the process change in the supply chain. Also the CRM systems would require the update of new items. A positive thing is that there is not needed any new structures or processes to be defined.

Training all the sales, supply chain and relevant technical personnel would be needed before launching the new structure.

The software earning logic has followed a certain technological era over the history. Several references during the literature research pointed out the software business changing from the package sales to services sales. The research of the NMS revenue data supported the same trend the service part of the total revenue illustrates the signs of growth. For that reason, it would be necessary to research the possibilities of new earning logics such as Software as Services (SaaS) and Cloud computing. Those may open totally new opportunities for the NMS business logic.

7.3 Evaluation

7.3.1 Results Achieved

The objective of the research was to optimize the product structure and minimize the number of the product items. The research process went as planned, the collection of data and theory research were combined as an outcome for the new optimized product structure. The results of the research were the success. The structure was simplified and the number of the product items were managed to decrease significantly. In addition, the pilot run based on reference data elaborated the new structure to be feasible also in financial terms.

7.3.2 Validity and Reliability

The validity and reliability of the action research need to be evaluated through the controlled research process. The focus on action research is to solve a specific problem identified. That may lead the research to situation where the results are not empirical and repeatable. for that reason the reliability of the data as well the source of it should have a special attention (Tuomi & Sarajärvi 2002).

The action research made inside the organization may face challenges with validity and reliability. This because the internal forces of the company may influence the outcome of the research (Coghlan 2010). To have a pragmatic approach to action research inside the organization (Coghlan 2010) introduced a method of the continuous research process. Each cycle has four phases to from constructing the research phase, planning and executing it and finally evaluating the outcomes. The results of one research cycle are used to feed the next cycle and thus the knowledge of solving the research problem has been improved from cycle to cycle.

This research utilizes the cyclic model to provide a pragmatic research process. At the first phase, the quantitative analysis methods were used to get accurate data for the current state analysis. The outcome of quantitative analysis was used to reflect the theory study to address the relevant issues to be solved. The outcome of quantitative analysis was utilized as an input for the next cycle.

The next cycle was made by using qualitative method to collect the data for gaining the understanding for reasoning of the current state. Relevant stake holders were interviewed about the current practices used and their opinions about improving the product structure.

The next cycle of research focused on developing proposals for the new product structure. Based on the current state analysis, best practices learnt and the feedback from relevant stake holders, three models of product structures was defined. Those three models were introduced to the stakeholders to collect feedback about the feasibility. The feasibility of the strongest candidate for new product structure was tested also with the

pilot run. The capability to serve the existing customers and the impact to revenue was tested by using actual data retrieved from the case company's CRM system.

To be able to ensure the validity of the research (Tuomi & Sarajärvi, 2002) refers to the methods of data collection and the reliability of the information source. Coghlan, (2010) refers to the internal forces influencing to the research made inside organizations. The interests of the stake holders as well the researcher may impact to the validity of the research.

To ensure the validity of the research the quantitative data used was retrieved from the case company's ERP/SCM system. Data included all delivery and revenue data of all product related items from two calendar years. The period and the volume of data can be perceived to be adequate for analysis purposes.

The interviews of the stake holders were made by using the open method. To be able to gather comparable data, the interview session followed similar structure and the same agenda points were covered. The reliability of the interviews was improved by having each session one to one. Thus the bias of the common opinion could be avoided and the opinion of each participant was recorded. This ensured each stake holder got an equal weight for his/her opinion. To ensure the overall validity of interviews for the research there was interviewed people from several geographical regions. Thus the model used in a certain region did not get predominance which would distort the results.

The researcher has several over ten years' experience of the telecom and NMS business and product management. The achieved competence was used to address the key issues to include in the research. The Theory part, best practices of the research focused on the product management and the earning logic of the software business. The data utilized was industry independent. The pieces of research made earlier were utilized to address the topics the software needs to cover.

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APPENDIX 1.

SWOT Analysis of the Current Status of Product Structure

The Key attributes at the SWOT table below are placed accordingly to the severity for the category. The middle point at the graph illustrates the most important focus points to be evaluated for new product structure. Major are is for next important issues to be evaluated, Minor level issues are such ones which need to be notified, but which not have great impact. SWOT analysis also included the information of the categories impacting to the product from Section 3. The utilized categories are Strategy, positioning, pricing and structure.

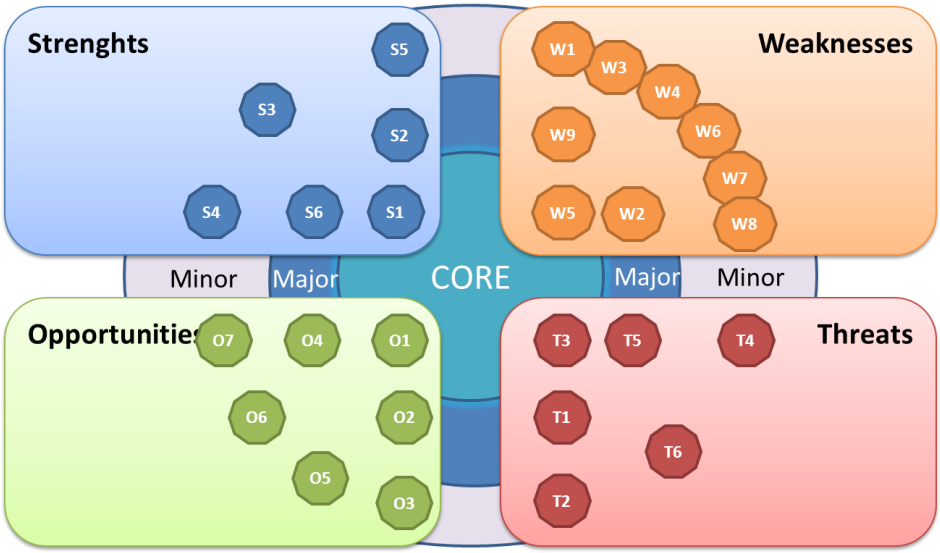

Figure 17. SWOT analysis.

1 Strengths

S1(Structure): Scalability, the product structure supports all customer cases from quite small to extremely large.

S2 (Strategy): Glue factor: Capability to manage the network elements of every business unit lowers the customers' threshold to adapt new network element types. Customers having several network elements benefit the unite management system. That will increase the commitment to the vendor.

S3 (Strategy): Differentiation on the market. The major part of the total costs of ownership consists of operational costs. Efficient NMS can provide a method how to differentiate in the heavily standardized telecom market.

S4 (Position): A complementary product, used to help securing the main product profitability.

S5 (Structure): Similar licensing structure for all network element types benefits the supply chain.

S6 (Pricing): The pricing fits to business cases of all kind, NMS can be sold to very small setups as well to quite large deployments covering several tens of thousands of network elements.

2 Weaknesses

W1 (Strategy): The structure of the revenue is unbalanced. The dominant part of the sales revenue comes from element fees.

W2 (Strategy): The lack of the new items to be sold. The sales of the new applications rely on the NE type expansions. The sales of new applications to the existing customers are quite rare.

W3 (Position): The real value of NMS is missed. As the NMS is positioned as a complementary product, the achievable revenue is not seen as a critical one.

W4 (Position): The positioning as a complementary product causes over simplification to the sales models. The content of the sales package is defined as a secondary variable.

W5 (Pricing): A loose connection between used pricing model and product structure undermines the value of individual applications. The NMS is sold as a system, not as a collection of value add functionalities.

W6 (Structure): Too many line items to cover the NMS licenses.

W7 (Structure): The system scalability is charged at several layers. The element fees, network element adapters and the number of users all refers to the scalability.

W8 (Structure): Selling new applications to the customers is difficult because of the licensing model. The value for the existing network inventory is hard to define.

W9 (Structure): The complexity of the license model. Sales as well customers find the current license model too difficult to manage. Bundle codes and other customer specific arrangements cause confusion in the supply chain.

3 Opportunities

O1 (Strategy): The support for multi business unit equipment can help the sales forces with selling additional product groups to existing customers.

O2 (Strategy): The revenue of NMS changes to services.

O3 (Strategy): Sales of new enhancements to the existing customers

O4 (Position): Secure the overall profitability of NE sales

O5 (Structure): Charging the NMS according to the network growth.

O6 (Pricing): Tactical pricing to optimize the NMS revenue

O7 (Pricing): In theory, no upper limit for NMS total price.

4 Threats

T1 (Strategy): Missing the transition of SW business model. The services part of the total revenue is getting higher portion. The product settlement, such as releases should support the drive of services, why the customer would be ready for paying new releases and maintenance.

T2 (Position) – As a complementary product, the profitability may be sacrificed for the NE business.

T3 Structure): The customers and accounts do not understand the product structure. The content and purpose of applications are missed and the only variable is the price.

T4 (Structure): Over bundling items. Bundles including all applications ruin the opportunities for value selling for further applications.

T5 (Structure): Selling the new applications to the existing customers is difficult as the model is based on NE fees. The existing install base may even influence as a barrier to purchasing the new value add applications as the entry fee would may be too high.

T6 (Pricing): Cheap application pricing cause inbuilt erosion for any new applications to be launched. The business case for implementing any new product is difficult.

APPENDIX 2.

Pilot Test Results: Comparison of Line Items Needed for Delivery

node type	2011 line items delivered	2011 new model Pilot	2012 line items delivered	2012 new model Pilot
A1	377	35	430	39
A2	3	3	19	19
B1	12	0	484	49
B2	4550	407	5899	482
B3	55	5	1	
B4	20	2	370	33
B5	136	13	756	62
B6	231	23	138	14
B7	53	9	0	0
B8	1621	300	672	65
C1	744	83	563	63
C2	8	1	0	
C3	4		4	
C4	1142	34	198	24
C5	83	7	240	24
C6	0	0	4	0
C7	41	5	12	1
D1	35	2	174	21
D2	27	5	1486	237
D3	0	0	0	0
D4	0	0	0	0
D5	3	1	18	3
E1	363	51	488	98
F1	36	8	47	8
F2	47	10	29	4
F3	47	9	36	5
F4	54	12	35	5
F5	444	94	557	71
F6	0	1	0	
F7	0	0	0	