STRATEGIC ANALYSIS OF THE IP PERFORMANCE TEST PROFESSIONAL SERVICES INDUSTRY FOR THE DATA NETWORK OPERATION OF AGILENT TECHNOLOGIES

by

Nazy Alborz
MASc, Simon Fraser University, 2001

MASTERS OF BUSINESS ADMINISTRATION

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Faculty of Business Administration
(Management of Technology MBA Program)

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APPROVAL

Name: **Nazy Alborz**

Degree: **Master of Business Administration**

Title of Thesis: **Strategic Analysis of the IP Performance Test Professional Services Industry for the Data Network Operation of Agilent Technologies**

Examining Committee:

_____

Dr. Sudheer Gupta
Senior Supervisor

Assistant Professor

_____

Dr. Elicia Maine
Second Reader

Assistant Professor

_____

Date Defended/Approved: _____

ABSTRACT

This paper contains a strategic analysis of the IP Performance Test Professional Services industry of the Data Networks Operation of Agilent Technologies Inc. The increasing complexity of network test equipment, as well as the technology involved, has given rise to customer needs for more in-depth technical consultancy services. To keep up with the market, DNO's two major competitors have recently been investing heavily in more detailed product-focused professional services departments. The current post-sale services provided through various functions of Agilent corporate have a number of issues and limitations that prevent DNO from fulfilling its customer needs properly. In order for DNO to stay competitive, it should consider providing more structured, product focused consultancy services for its products.

This report provides an analysis of strategic fit of a dedicated consultancy operation for DNO. Three potential alternative solutions are provided and examined based on interviews conducted with customers and internal Agilent resources that have direct client experience. The alignment of these alternatives is evaluated against DNO's strategic goals. Finally, a recommendation for a DNO consultancy model with high-level implementation steps is provided.

DEDICATION

To my husband, Farzad, for standing by me with his support, dedication and love during completion of this work and throughout my entire MBA program.

ACKNOWLEDGEMENTS

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GLOSSARY

AE   Application Engineer

API   Application Programming Interface

ATC   Advanced Technical Consulting

ATM   Asynchronous Transfer Mode

BDE   Business Development Engineer

CTS   Conformance Test Suite

DNO   Data Networks Operation

DUT   Device Under Test

EMEA   Europe Middle East Africa

EMG   Electronic Measurement Group

FE   Field Engineer

GPS   Global Positioning System

GUI   Graphical User Interfaces

HP   Hewlett-Packard

IP   Internet Protocol

IDR   International Designated Reseller

IPTV   Television over Internet Protocol

Marcom   Marketing Communications

NEM   Network Equipment Manufacturer

NDS   Network and Digital Solutions

NSD   Network Solution Division

NSP   Network Service Provider

PA   Productivity Application

POC   Proof of Concept

QA   Quality Assurance

QoS   Quality of Service

R&D   Research and Development

RE   Resident Expert

SAN   Storage Area Networks

SSA   Software and Support Agreement

POS   Packet Over Sonet

UNH-IOL   InterOperability Laboratory

1: INTRODUCTION

The purpose of this report is to perform a strategic analysis of the wireline IP Performance Test Professional Services industry for Agilent Technologies Inc., Data Networks Operation (DNO). The objective of this strategic analysis is to provide guidelines and recommendations for DNO to offer professional services specific to its products to assist the operation meet its profitability goals. In order to achieve sustainable profitability and growth, DNO is constantly seeking solutions to differentiate itself from its competitors, accelerate profit growth, and maintain its market leadership by increasing customer satisfaction and hence encouraging customer loyalty. Since DNO's main product (N2X) and the technology involved are complex, providing consulting services is of tremendous value to both customers and DNO due to the following reasons:

1. It allows customers to gain confidence in the product by using it more efficiently and to its full capabilities which leads to increased equipment sales revenue.

2. It helps with creating strong relationships with customers, which will lead to customer lock-ins and greater profits.

3. It assists DNO with a better understanding of customers' needs and scenarios. An early and comprehensive insight will help design products

that will best fit customer needs and requirements and are faster to market.

The current consultancy service model provided by Agilent corporate field organization has a number of weaknesses limiting DNO in achieving its objectives in the most efficient manner. A few examples of these limitations include lack of specialized N2X knowledge, non-systematic customer feedback loop, and orientation towards pre-sales activities. Section 6 provides a detailed discussion of these limitations.

This project will attempt to answer the following questions:

1. Is the DNO dedicated consultancy business aligned with current Network Digital Solutions (NDS) and DNO strategies, competitive advantages, internal resources, and market needs?

2. How can consulting benefit DNO? Can it assist in achieving sustainable profitability and growth in its current IP Performance Test market?

3. What are the limitations of the current professional services model?

4. What are the alternative solutions for providing DNO dedicated consultation services?

5. What is the recommended solution for DNO to provide professional services? Is this solution sustainable?

The paper first provides a background overview of Agilent Technologies, the corporate parent of DNO, followed by a discussion of DNO's internal characteristics. Analysis of internal environment identifies the strategic fit of consulting services with the existing internal resources and capabilities. Next, the

external environment of DNO including industry, market segments and outlook,

as well as the competitive environment is analyzed in section 4. Section 5

provides three alternative solutions for DNO to provide professional services and

examines the alignment of these solutions with Agilent corporate's and DNO's

strategic objectives. Finally, section 6 presents a recommended solution followed

by high-level implementation steps for the suggested solution.

2: COMPANY BACKGROUND

This section provides an overview of Agilent Technologies, the corporate

parent of DNO. Since Agilent produces a wide variety of products in multiple

industries, its corporate structure is multi-layered. In order to better analyze the

strategic fit of consulting business for DNO, it is important to learn more about

the corporate parent and its organizational structure and to understand where

DNO fits within this structure and the objectives and strategy of its parent sub-

groups and divisions in the organizational tree.

2.1   Agilent Technologies

Recognized as an industry leader, Agilent Technologies Inc. is the first

company worldwide in the test and measurement market, providing solutions to

the communications, electronics, life sciences, and chemical analysis industries

(Yahoo Finance, n.d.). The company, which is a spin-off of Hewlett-Packard

(HP), broke records in Nov. 1999 as the largest initial public offering in Silicon

Valley history (Agilent Technologies, n.d.). Agilent is headquartered in Santa-

Clara, California, and has facilities in 30 countries around the globe. There are

two primary businesses that Agilent operates in. These businesses include

Electronic Measurement Group (EMG) and Bio-Analytical Measurement

segments supported by Agilent Laboratories, its central research group.

The firm had net revenue of $5.4 billion in fiscal year 2007. More than half this revenue was generated from outside the U.S. The company has 19,000 employees serving customers in more than 110 countries. These customers include many of the world's leading hi-tech firms relying on Agilent products and services to increase profitability and competitiveness from R&D through manufacturing, installation, maintenance, and marketing (Agilent Technologies, 2007).

2.2 Corporate Mission, Values, and Culture

Agilent's mission is to help turn customers' dreams of human advancement into reality. Agilent is making those dreams real today by helping to build a sustainable future (Agilent Technologies, 2007). For this purpose, Agilent has employed new strategies to improve efficiency and effectiveness after its spin-off from HP, while it still maintains the best parts of HP's values, culture, and practices that have made HP a successful company including dedication to innovation; trust, respect, and teamwork; as well as uncompromising integrity. In addition, the company's rich corporate culture is built around three newly added values: speed, focus, and accountability, in order to meet customer needs and to create performance that draws on the full range of people's skills and aspirations (Agilent Technologies, n.d.).

Built into Agilent's values is its customer-focused culture, which in fact is one of its key differentiation factors from its competitors. Customers often comment on and appreciate the fact that every single employee will put in extra effort to satisfy their needs in a timely manner (Agilent Technologies, n.d.).

Additionally, Agilent has constantly been working to make the company a "best place to work" for its employees in order to keep them motivated to create innovative solutions for customers. The company has been successful in achieving this objective and is recognized among the top 100 employers of choice. Agilent is aiming to further improve its rank to provide employees with a working environment that is challenging, enjoyable, and encourages open communication and feedback with management.

2.3   Corporate Goals and Strategy

At a corporate level, Agilent senior management sets high-level broad goals and guidelines. For example, the strategic intent of Agilent is to provide key enabling technology products to assist its customers in achieving their business results by speeding up their time to market, increasing volume production, and improving high quality precision manufacturing. However, more specifics of what products to make or how to improve time to market is left to the business level strategy set by others lower in the organizational tree.

Agilent's objectives are set to serve its four key constituencies: customers, shareholders, employees, and community. These objectives are summarized below:

1. To strengthen its position as the number one test and measurement company in the world.
2. To leverage its existing technology to provide components and services to attractive new markets.

3. To achieve sufficient profit to finance company's growth and to provide superior return to its shareholders.

4. To provide products and services of the highest quality and the greatest value to its customers, thereby gaining and holding their respect and loyalty.

5. To help its employees share in the company's success.

6. To foster initiative and creativity by allowing individual freedom to achieve employees' objectives.

7. To honor obligations to society by being an economic, intellectual and social asset to the communities in which it operates.

2.4 Corporate Structure

Because Agilent produces a wide range of products within a variety of industries, its organizational structure is multi-layered. As such, the company is organized as a set of autonomous divisions, each defining its own business strategy. As of 2008, the divisions are grouped into six business units, which in turn are grouped into two major segments: Electronic Measurements (EMG) and Bio-Analytical Measurement. EMG provides standard and customized electronic measurement instruments, services, and test solutions for communication and general purpose electronics test markets. Bio-Analytical Measurement segment provides application-focused solutions that include instruments, software, and services that enable users to identify, quantify, and analyze the physical and biological properties of products.

Each division may consist of one or several operations, which are responsible for their own portfolio planning. Divisions are financially independent entities and operations should adhere to both financial criteria and strategy of the divisions they function within.The six business units are electronic instruments, network and digital solutions, wireless, life sciences, materials sciences, and chemical analysis.

Above the division level, the management team at the business unit level acts like a venture capital team: it decides which businesses look promising and should receive additional investment for future growth, and which businesses should be treated as slow-growing cash cows or sold off (Wvong, 2007). Figure 2-1 below shows where DNO fits into Agilent's corporate structure. Cells in green which are located in direct hierarchy are businesses by which DNO's strategies and operations are influenced.

DNO is part of the Network and Digital Solutions (NDS) business unit. As of November 2007, NDS has been re-organized into two divisions, the Digital Test Division and the Network Solutions Division (NSD). DNO is part of the Network Solutions Division.
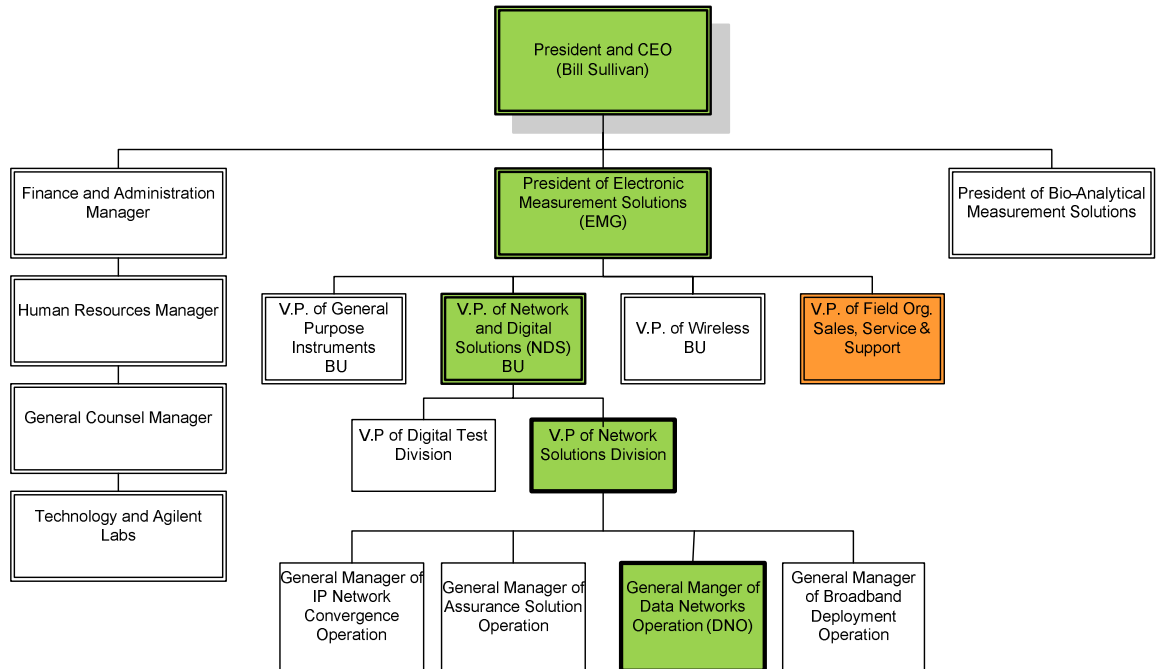
Figure 2-1 Agilent Technologies Organization Chart

Administration, Information Technology, and Human Resources functions are provided at corporate level and are shared by all divisions within Agilent. The field organization is shared by business units within the EMG segment. This organization provides sales and pre-sales technical services to all product lines in EMG. Field Engineers (FEs) are sales force that work directly with customers to close deals. Application Engineers (AEs) provide pre-sales technical services such as trainings and demos. In addition, they provide limited post-sales consultation services to maintain existing relationships with customers and help drive additional sales.

2.5 Corporate Revenue Distribution

Figure 2-2 below illustrates Agilent's revenue break-down in fiscal year 2007 by market (a) and geography (b). Figure 2-3 shows a further break-down of communication market into sub-segments. The communication market is served by products from WBU business unit and Network Solutions Division of NDS business unit (Agilent Technologies, n.d.).
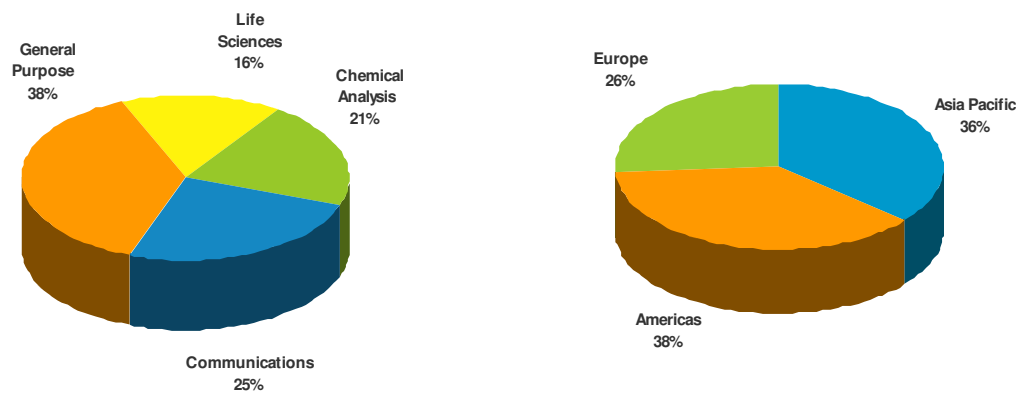
Figure 2-2 Agilent's Revenue Break-down by (a) Market and (b) Geography [1]
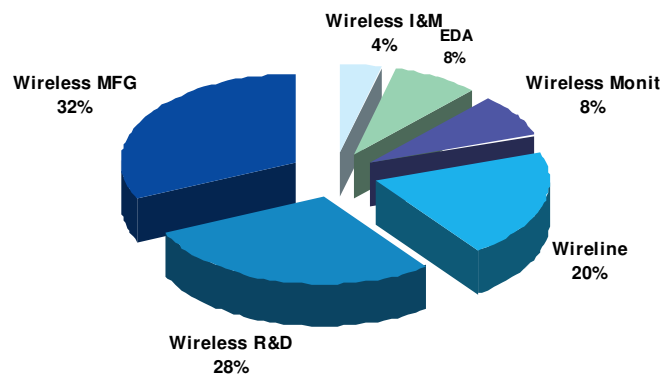
Figure 2-3 Agilent's Communication Segment Revenue Break-down by Market [2]

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[1] Agilent Technologies. (2008). Internal Profile Slide Set.

2.6   Network and Digital Solutions (NDS)

The Network and Digital Solutions (NDS) business unit has two divisions: Digital Test Division (DTO) and Network Solutions Division (NSD). NDS provides test solutions that support the development of computer and communications devices, elements, systems, and services that enable high-speed computation and communications. Each division is focused on its specific customers, markets and applications and on generating technology and market synergies among their product lines. The primary goal of NDS is to achieve sustained profitable growth.

Digital Test Division (DTD): Total addressable Market for DTD is $2.4B. The products of this division enable the design validation and verification of high-speed digital devices. Tek is DTD's biggest competitor in this market and the benchmark for NDS competitiveness. A key market within digital is oscilloscopes.

Network Solution Division (NSD): Total addressable Market for NSD is $4.2B. NSD's customers are telecom service providers and network equipment manufacturers such as AT&T, Sprint, Cisco, etc. Products of this division enable these users to design, deploy, and manage next generation multi-service communications networks by providing performance monitoring and service-aware performance tests. Assurance Solutions is the Network Solutions Division's largest product line, focused on network monitoring (>$3B market). After the telecom downturn, this division has restructured to deliver sustainable profitable growth. DTD and NSD have several common customers and

competitors. A list of major competitors and customers of these two divisions is
shown in Table 2-1 below:

Markets	Competitors	Customers
· Digital Test	· Tek, R&S, LeCroy, Fluke	· Intel, Cisco Systems
· Network Solution	· Tek, Spirent, JDSU- Acterna, Ixia	· AT&T Mobility, Sprint Nextel, Cisco Systems

Table 2-1 DTD's and NSD's Major Competitors and Customers

2.6.1 NDS Revenue

NDS's total revenue for fiscal year 2007 was $844M. This accounts for
15% of Agilent's total net revenue of $5.4B or 24% of EMG's net revenue for this
year (Morris, 2007). Within NDS, Network solution division (NSD) accounts for
63% or $531M of the revenue of this business unit.
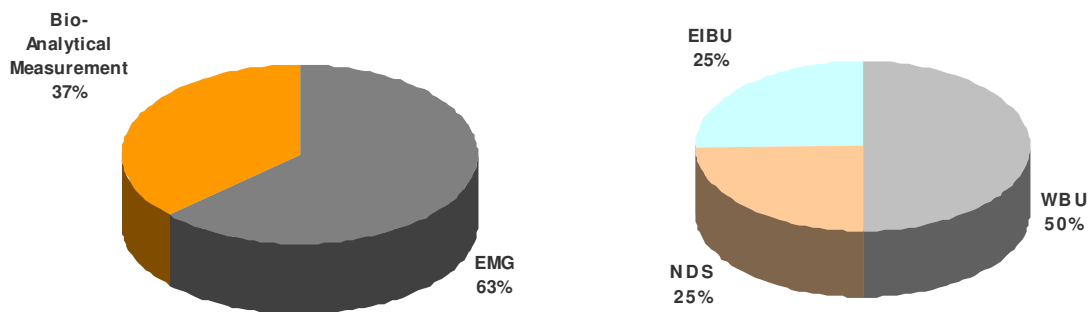
Figure 2-4 (a) Agilent's Revenue Break-down by Operation Group and (b) EMG's Revenue Break-down by Business Unit [2]

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[2] Agilent Technologies, Internal NDS Web Site

2.6.2 NDS Strategy

NSD's strategic intent is to accomplish profitable growth. The three major enablers of this strategy are shown in Figure 2-5 and are summarized in below section (Churchill, 2007). These enablers are based on improvements to skills, processes, and behaviors within the business unit.
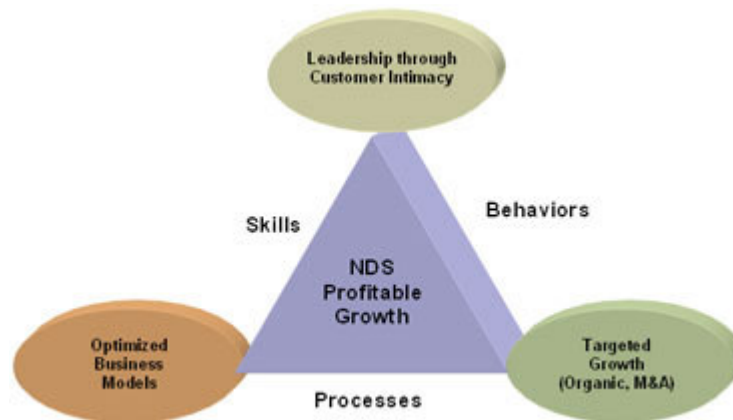
Figure 2-5 Structure of NDS Strategy[3]

1. Target addressable markets that are high-potential and high-growth through organic as well as M&A moves. To address this intent, each division will need to identify high-growth markets to go after. In addition, for challenging and highly dynamic markets where NDS cannot quickly provide solutions or expand to new markets, inorganic M&A should be considered to plug in product and market gaps.

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[3] (Churchill, D). (2007). Agilent Internal Broadcast message.

2. Attain undeniable product leadership through customer intimacy. To achieve

   this, the goal is to obtain an in-depth understanding of customers' current and

   future needs in order to innovate the solutions and technologies that deliver

   on these needs before competition. For fiscal year 2008, the aim is

   developing processes and structures to further increase customer intimacy

   and speed to market solutions.

3. Business model optimization to deliver a high return for the company. This

   can be done through gross margin improvement initiative and division-specific

   moves. The fact that NDS's markets are dynamic and changing also means

   that internal investment profile and internal structures will need to be dynamic

   as well. Change and continuous improvement will be the norm in NDS.

2.7   DNO

DNO sells IP Performance test equipment, called N2X multi-services test

solution. Network equipment manufacturers (NEMs) such as Cisco and Juniper

use the N2X to test and debug their products during development, quality

assurance, and production as well as Proof of Concept demonstrations to their

customers. Network Service Providers (NSPs) use N2X to track down network

problems during benchmarking, field trials, and acceptance testing. In addition, a

small percentage of DNO's customers are software and hardware component

manufacturers who use N2X to test conformance of their components with

industry standards.

DNO has around 190 employees and revenues of about $50 million/year. DNO's offices are in Melbourne, Australia; Vancouver, Canada; and Bangalore, India. Vancouver and Melbourne sites have employees both in R&D and Marketing while India is dedicated to R&D operations. DNO's general manager and marketing manager are located in Vancouver. Bangalore office has started its operation in 2007 and is expanding its number of employees at a high speed. DNO's manufacturing is performed by an outsourced company in Malaysia and Scotland.

Field organization is an important function in DNO's strategy as it is the liaison between customers and factory. Sales force and business development functions are divided into regional categories and employees are located around the world to help serve customers in a more efficient manner. The structure and responsibilities of these functions will be looked at in more detail in section 3.

3: INTERNAL CHARACTERISTICS OF DATA NETWORKS OPERATION (DNO)

This section reviews the internal characteristics of DNO. First it provides an overview of DNO's strategy, decision-making process, and its resources and capabilities, which are the essence of its competitive advantages. Next, an analysis of the strengths and weaknesses of this business is provided based on DNO's internal attributes.

3.1   Products and Services

Since the beginning or its operation in 1990, DNO has introduced several products targeted at the Telecommunications Network Industry. These products were either developed in-house or obtained through acquisitions of other companies. A list of DNO's past products includes: ProtocolTester, BSTS, MegaScope, QaRobot, Boomer, NetworkTester, and RouterTester. The first product of DNO was "RouterTester" which was introduced in 1997 during the golden, fast growing period of networking industry. This product, which was targeted at Carrier Core routing market, quickly took share away from its competitors (Dyke, 2001). The only current product of DNO is "N2X Multi-service test system" which is a result of cumulative improvements and sustained innovation done to "RouterTester".

N2X supplies test systems for IP-based infrastructure and provides solutions for measuring the performance, scalability, functionality, service quality,

and conformance characteristics of next-generation Internet Protocol (IP)
equipment and networks for multi-play (TV, voice, video, and data) services. The
focus of N2X is on testing Layers 2-3 of network. NetworkTester, which was a
DNO product covering Layer 4-7 of networks is now transferred to the IPNC
operation under NSD.

The N2X solution allows capturing, characterizing, and analysis of high
volumes of realistic network and application traffic, identifying problems,
assessing performance, ensuring functionality and interoperability, and verifying
conformance to industry specifications. The type of networks that N2X analyzes
include ATM, FrameRelay, Packet Over Sonet (POS), and Ethernet, operating at
speeds of up to 40 Gigabits per second, which carry data traffic over optical fibre
or electrical cable. N2X is differentiated from competing products by:

- o Accurate hardware based measurements

- o High scalability and performance capabilities, and

- o Full integration of Network protocols with traffic.

N2X product consists of a hardware platform (chassis) with
interchangeable interfaces (modules), utilizing a common set of software
applications as well as Application Programming Interfaces (APIs) that allow
users to create integrated and automated test environments. The N2X chassis
which is developed by DNO is shared by modules from other EMG products such
as Storage Area Network (SAN) Tester and Fibre Channel Protocol Analyzer.

Included with the base application, N2X also offers a free open source package of test suites called "QuickTest" which allows users to further tailor N2X to their specific test needs. In addition, N2X provides different sets of software packages called Productivity Applications (PA) such as IPTV and IPTVv6 PA, which enable users to automate their complicated test scenario using Graphical User Interfaces (GUI) efficiently. Moreover, Conformance Test Suites (CTS) are separate software packages designed and built according to industry standards to test the conformance of customers' network equipments.

N2X software package can only be run on supported PC controllers, which should be purchased by customers separately. Each N2X new system is delivered with the basic "Packets and Protocols" application software license. However, separate licenses should be purchased for individual protocol software packages as well as PA and CTS applications.

Additionally, every new system is provided to customers with a comprehensive system based warranty and SSA (Software and Support Agreement) for a full year. Through a valid SSA the customer will be provided with services such as software warranty and support, hardware warranty, repair service, and web-based support. Additional services such as calibration, repair services for out-of-warranty product, and extended duration warranty are also provided by Agilent for N2X product and should be purchased by customers separately[4].

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[4] Agilent N2X System Support & Warranty

3.2   DNO Objectives and Strategy

At the DNO level, the overall strategy is obtaining competitive advantage over industry rivals (Dyke, 2001). Because DNO competes in a highly dynamic market, its strategy for achieving this competitive advantage evolves constantly. For 2007, DNO's strategy was to focus on edge and access router market while maintaining its industry leadership in the core routing market.

DNO's strategic intent for 2008 is to continue its focus on the edge/access market and to grow faster than market in High Scale Service-Aware Performance Test solutions targeting multi-play service by differentiation through subscriber Realism, Scalability, Test Efficiency and Test Insight. To achieve this, DNO's strategy focuses around the following two objectives (Unverrich, 2007):

1- Providing customer solutions: This objective can be achieved through:

 i. Focusing on extending product leadership in high scale service-aware solutions.

 ii. Formalizing customer intimacy programs and establishing Advanced Technical Consulting (ATC).

iii. Delivering sustained product differentiation.

2- Increasing speed to opportunity: Achievable by leveraging DNO solution with NDS common platform, improving product generation execution by adopting PLC 8.0, and further improving its strategy formulation and product definition process.

The goal is to further align DNO with Agilent's business model in order to:

i. Increase two-year revenue target to $70M.

ii. Improve annual operational profit by 15% to meet financial requirement of corporate parent.

iii. Focus on continuous improvement in gross margins, reduction in inventory, and creating flexible cost structure.

Being first to market with new products and solutions is a necessary element of differentiation in the network lab test equipment. However, because of the complexity of the technology involved, achieving competitive advantage is not possible without creating customer lock-ins and establishing strong position with major customers through differentiated pre- and post-sales services and technical consulting.

3.3   DNO Performance Metrics

A balanced scorecard method is used by Agilent corporate and all its operating modules (Groups, Business units, Divisions, and Operations) in order to measure its performance success. Although operating modules along the hierarchy tree share the same high-level objectives, targets are more general for units higher in the hierarchical level. These targets become more specific as we move down on the tree. The four perspectives considered in Agilent's balanced scorecard are: 1) Customer satisfaction; 2) Employee, leadership, and culture; 3) Markets; and 4) Financials (Agilent Technologies, 2007). Figure 3-1 shows DNO's measure of success for fiscal year 2007.
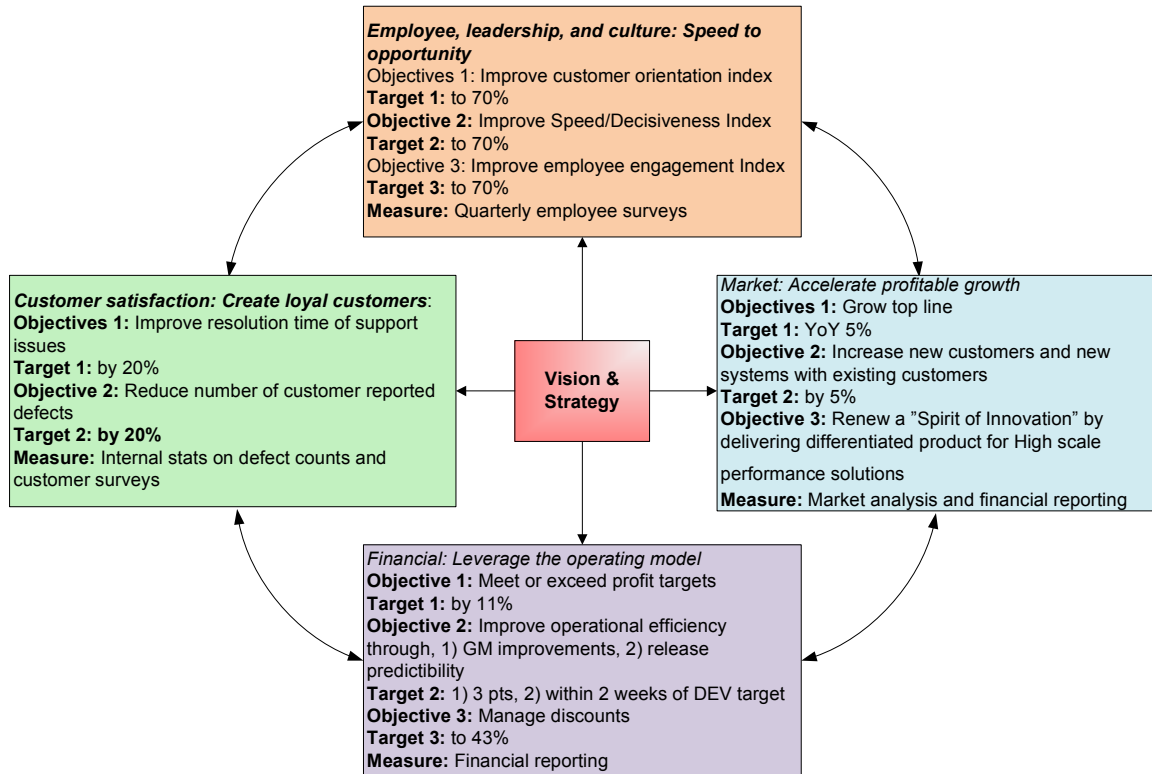
Figure 3-1 DNO's Measure of Success for Fiscal Year

3.4 DNO Structure, Resources, and Capabilities

A firm's resource and capabilities are the basis of its competitive

advantage. The role of internal resources and capabilities of a firm rather than

external industry and market environment is becoming increasingly important in

formulating its strategy, especially for firms that compete in dynamic and

unstable industries such as telecommunication networks industry (Grant, 2008,

pp. 125-139). For this reason, a closer look at DNO's resources and capabilities

will help better identify potential sources and barriers that help in achieving

superior profitability through strengthening DNO's competitive advantage. The

links between resources, capabilities, and competitive advantage is shown in Figure 3-2.
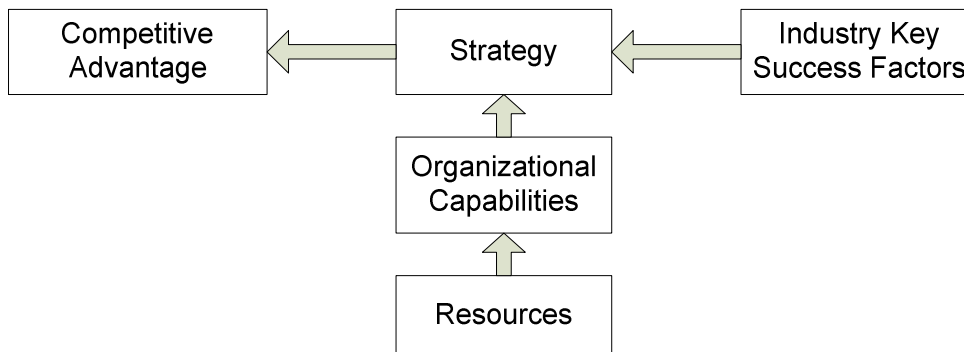
Figure 3-2 The Link Between Resources, Capabilities, and Competitive Advantage of DNO[5]

This section provides an assessment of DNO's internal environment that can be exploited to analyze the strategic fit of consulting services with the existing resources and capabilities to help better achieve sustained profitability and a competitive position against its competitors. For this purpose, the value chain analysis method, which is proposed by Porter (Porter, 1985, pp. 11-15), is performed to classify DNO's activities into sequential chain to represent the flow of goods within an organisation. The concept behind value chain is based on process view of a firm, where each organisation is seen as a system, made up of various sub-systems each with inputs, transformation processes, and outputs. Depending on size of organization, these sub-systems involve a large number of activities to convert inputs to products and services, which are divided into primary and supporting activities.

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[5] Grant, R. (2008). *Contemporary Strategy Analysis.* Malden MA: Blackwell Publishers Ltd.

For DNO, primary activities involve transformation of inputs to products as well as customer delivery services. These activities are performed by development, marketing, sales, and post-sales support functions. DNO's support activities include firm infrastructure, Human resource, R&D, and Procurement which facilitate the execution of primary activities.

Supportive Activities

| Firm Infrastructure (IT, Culture, Financial) |
| HR Management |
| Technology Development (R&D) |
| Procurement |

Primary Activities

Inbound Logistics → Production → Outbound Logistics → Marketing → Sales → Post-sales services
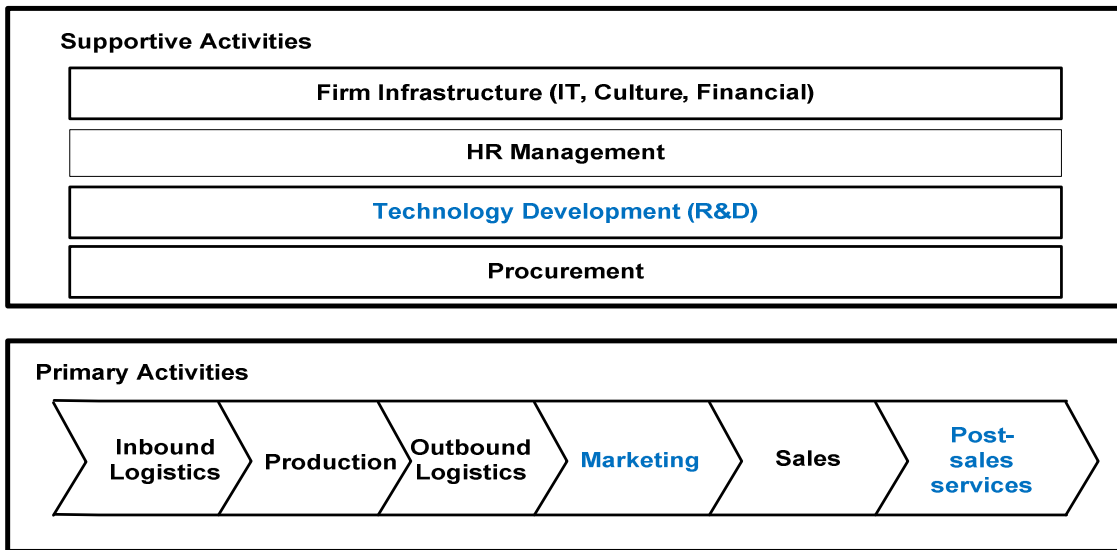
Figure 3-3 The Porter Value Chain for DNO

Figure 3-3 is an illustration of Porter value chain for DNO. The activities in top box are supportive and the ones in the bottom box are primary activities. The activities shown in blue are the ones directly provided by DNO, and the rest are activities that are supplied and supported by Agilent corporate, business units, or divisions located higher in the corporate hierarchy.

3.4.1 Marketing

DNO has a dedicated marketing group which consists of four main functions: Business Development, Marketing Communications (Marcom), Product Management, and Customer Support. Business development is divided into three geographical groups (Americas, Europe, and Asia). Each group is led by a regional manager. Typically, there is one Business Development Engineer (BDE) dedicated to each major strategic customer account. The primary responsibility of this group is assessing market opportunities as well as developing and maintaining business relationships with existing and prospective customers. Product marketing takes ownership of products and is responsible for defining new products or features of existing products based on customers' needs and feedback and introducing these products to the market. Marcom has turned into a small group after recent restructuring of DNO's marketing organization and is responsible for performing product advertisements and promotions, participating in trade shows, and preparing press releases.

3.4.2 Post-sales Services

Because of the complex nature of N2X product, support for this product is provided using a combination of Agilent regional support centres (Tier-1) and DNO's factory-based support team (Tier-2). Regional support centres are located in the major geographies in which Agilent does business. Issues are reported by customers to their local call centre and are addressed by an engineer in their region wherever possible. Complex issues requiring more expertise or resources than can be provided at a regional call centre are passed to the factory

support team. This team, which is part of DNO, is located in Melbourne and Vancouver so that they can work closely with R&D and marketing for a faster and high quality service.

Because N2X is a fairly complex and highly technical product, DNO has been trying to differentiate itself against its major competitors through extensive post-sales service including:

a. On-site customer visits. For example, for complex customer-reported issues where remote investigation is not possible, DNO sends customer support or R&D experts on site for a fast resolution of these issues.

b. Wide geographical distribution of both Tier-1 and Tier-2 support allows short technical response time to worldwide customers, which other competitors cannot provide.

c. RE programs: As part of the "Resident Expert" (RE) program initiated in 2001, DNO provides experienced R&D engineers to its major customers, "Cisco system". These engineers would rotate through the program for a number of months. The initial intent of this program was not only strengthening the relationship with this customer and increasing customer lock-ins, but also providing a feedback mechanism to R&D to better understand customer needs and requirements and consequently design more customer-focused products. The initial responsibilities of these REs included providing training and demonstrating the strong capabilities of N2X through assisting customers in setting up and executing their test plans. However, REs became involved in non-value-added services over time and

the program ended up being a big cost to DNO without providing the

expected benefits.

d. AE post-sales services: "Application Engineers" (AEs) which are part of field

organization are technical engineers that provide pre- and post-sales

technical consultancy to customers. Depending on the geographical region

and size and importance of customer accounts, AEs are assigned to one or

more accounts. Some AEs are responsible only for N2X, while others are

responsible for multiple EMG products.

In the past, AEs and sales were part of two separate functions within the

field organization with different objectives and performance measurements.

Thereby AEs were more involved in post-sales consultation activities such as

assisting customers with problem solving, test setup, and test automation.

However recent changes to the field structure mostly in North America (AEs and

FEs report to the same manager, resulting in a shift towards sales-driven AE

objectives and performance measurement) as well as increasing number of N2X

customers, has resulted in limited post-sales consulting services provided by AEs

to customers. Geographical distribution of AEs is shown in Table 3-1.

3.4.3   Sales and Pre-sales Services

N2X provides a mixture of direct and indirect sales. The direct global sale

is provided through field organization at EMG level. EMG field organization is a

world-wide function which is divided into regional sales groups and has many

sales office locations in North America, Europe, Asia, and Middle East. Sales

people, called Field Engineers (FEs), are dedicated to specific products for larger
and strategic (Tier-1) customer accounts and support multiple EMG product lines
for smaller Tier2 and Tier3 customers.

N2X uses indirect sales through IDRs (International Designated Resellers)
and indirect channel components called channel partners to complement its
direct sales and marketing efforts in certain international markets such as United
Arab Emirates and United Kingdom. IDRs generally sell a full range of Agilent
products exclusively in countries where Agilent has no direct channel.

Channel components are mostly used in some western European countries, for
instance Phoenix in the UK, or Ayscom in Spain. Channel components are
characterized by their coexistence with the direct channel in a particular country.
They sell a narrow range of Agilent products exclusively, while Agilent's direct
channel sells the rest of the Agilent range.

Region	Sub-region	# of AEs	Focus	# of FEs	Focus	# of Indirect AEs	# of Indirect FEs
North America	N/A	10	Dedicated	8	Dedicated	0	0
EMEA	W. Europe + Israel	6	Shared	10	Shared	0	0
	E. Europe + ME	0	N/A	0	N/A	6	10
Asia Pacific	China	2	Dedicated	0	N/A	0	?
	Japan and Korea	4	Dedicated	3	Shared	0	0
	India + Rest of Asia	1	Dedicated	1	Shared	?	?

Table 3-1 Geographical Distribution of Direct and Indirect AEs and FEs

Field Engineers (FEs) and Application Engineers (AEs) work closely together on pre-sales activities. In their joint efforts, AEs help with providing pre-sales technical demos or trainings and FEs focus on building and maintaining relationship with existing and future customers and closing deals. Typically, the ratio of FE to AE is 1:1, but this may differ for customers and geographical regions.

3.4.4   Research and Development

Technology Research and Development (R&D), which is an important activity in DNO's value chain is an integral part of DNO's core competency. It is through R&D that DNO can add value to its product and differentiate from its competitors. DNO has a total number of 29 R&D members. This is about 15% of total DNO employees. The importance of this function is evident when comparing the size of DNO R&D to total size of DNO. R&D works closely with other functions of DNO such as product marketing and customer support to design and develop products with high usability that fit customers' needs as closely as possible. Product development responsibilities are spread to different sites. Vancouver R&D focuses on Access/Edge technologies and Melbourne on core routing technologies as well as general product features such as traffic, statistics, capture, etc.

3.5   Decision Making and Planning Process

Since Agilent is a multi-layered company, various decisions are made at different levels in the organization. The business unit management at the highest

level makes decisions on the amount of budget allocated to different divisions based on their outlook. Within a business unit, each division is a financially independent entity and is responsible for its own financial reporting to the business unit it operates under (Foster, 2007). Therefore decisions such as changes in the operation structure or new hire positions need to be approved by management at the division level. Divisions are measured based on their bottom line. Although DNO as an operation is responsible for defining strategy and portfolio planning of its own products, it needs to assure it follows the strategy and financial requirements of NSD.

3.6　DNO Strengths

DNO's strengths are attributed to the advantages of its products against competing products as well as its core competencies. Advantages of N2X are discussed first in below section. Next in the section, DNO's core competencies stemmed from its resources and capabilities as well as Agilent organizational structure will be reviewed.

3.6.1　Product Advantages

Some of the major advantages of N2X over the products from two major competitors, Ixia and Spirent, are listed below (Jang, 2006):

- Strong GUI for router, access and QoS testing.
- Support for running all protocols concurrently on the same application.
- Integrated traffic and routing protocols.
- Accurate hardware based measurements.

- Strong Application Programming Interface (API) capabilities.

- Scalable hardware and software (routing protocol sessions and traffic streams).

- Current products align well with Service Aware Testing: Reality, Integration, GUI, Measurements.

- Products run on common integrated linecards and chassis.

- Productivity Applications

- Strong market position in core routing protocols (patented core routing software).

3.6.2 Core Competencies

DNO benefits from Agilent's trusted brand which is one of its major core competencies. Customer perceived attributes of "trust" and "value" are important measures for Agilent Technologies. This brand is partially inherited from Agilent's former parent company HP and has been maintained and nourished over the years. So Agilent is perceived as world's premier 'Test and Measurement' company which enables users to measure test results accurately and precisely.

Agilent's global presence offers a distinct competitive advantage to DNO, with R&D, manufacturing, sales and support capabilities serving customers around the world. Another competitive advantage that allows a wide customer reach is the field organization which is shared by Agilent corporate and provides DNO with direct sales force and technical consultants all around the world. It is not easy for DNO's smaller-sized competition to offer similar services.

Decentralized portfolio planning and strong customer engagement are other competitive advantages of DNO. Decentralized portfolio planning and

strategy definition at DNO level allows the business to operate like a small firm.

This works to the advantage of DNO by enabling it to respond quickly to dynamic

and fast-changing needs of customers in the industry. Additionally, DNO has

been successful in establishing strong customer relationships through its various

customer intimacy programs such as RE services, on-site resolution of urgent

customer issues, regular customer visits by R&D and marketing members, and

limited consultancy services for strategic customers.

3.7   DNO Weaknesses and Challenges

The existing weaknesses of DNO are related to disadvantages of its

product (N2X) compared to competing products, as well as challenges

encountered by the operation. These challenges are related to both DNO's and

Agilent's corporate internal processes and structure. The next two sections will

discuss these disadvantages and challenges.

3.7.1 Product Disadvantages

Below is a list of N2X disadvantages relative to its competition (Jang,

2006):

- N2X price per port is perceived high.

- N2X has low share in Enterprise and Manufacturing segments.

- For simple traffic blasting, software GUI is too complicated (for more complex
  tests, GUI is a strength).

- N2X is CSP router-focused, unable to competitively address Enterprise and
  Manufacturing segments today.

- N2X software is low on the usability front.

- Lack of integrated L4-L7 test capabilities.
- Lack automated test configuration using API.
- Lack of remote control (GPS).

3.7.2 DNO Challenges

Sustaining profitability is one of DNO's major challenges. Due to centralized financial reporting of Agilent, DNO should meet the financial requirement of the business unit it operates under (NDS) and show quarterly profitability in order to get allocated with required budget to keep up with the fast-growing market. For example, for 2007 and 2008 DNO is required to improve its annual operational profitability by 15%[6]. Since the communication network industry is very dynamic, unpredictable, and cyclic in nature, it is not easy to constantly remain profitable. Additionally, a large percentage of DNO's revenue is attributed to a very small percentage of its key customers, which makes the operation very vulnerable to the purchasing decisions of these customers. As a result of DNO's inability to remain profitable, it is required to cut resources by the business unit during the down cycles, which makes it even more challenging for DNO to keep up with emerging trends of the telecommunication market with insufficient resources.

Field organization is considered as both strength and weakness for DNO. Having shared FEs and AEs among multiple Agilent products makes these resources general purpose when more dedicated and in-depth technical expertise is required to support such a complex and highly technical product.

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[6] Interview with DNO management

Additionally, field resources are reluctant to sell N2X due to the complex nature

of the product.

Strengths	
Product Advantages	**Core Competencies**
- Strong GUI - Support concurrent execution of all protocols - Integrated traffic and routing protocols - Accurate measurements - Strong (API) - Scalable hardware and software - Current products align well with Service Aware Testing - Products run on common integrated linecards and chassis - Productivity Applications - Strong market position in core routing protocols - Support concurrent execution of all protocols	- Agilent's trusted brand - Agilent's global presence providing wide customer reach - Decentralized portfolio planning and strategy definition - Customer intimacy and engagement
Weaknesses	
Product Disadvantages	**Challenges**
- High price per port - Small share in Enterprise and Manufacturing markets - Complex GUI for basic tests - N2X is CSP router-focused - Low software usability - Lack of integrated L4-L7 test capabilities - Lack automated test configuration using API - No remote control (GPS)	- Sustainable profitability - Centralized financial reporting - Insufficient resources - Keeping up with emerging telecommunication market - High revenue dependency on small number of customers - Shared field organization services - Narrow N2X product breadth (L2-3) - Low synergy between NSD products

Table 3-2 Summary of DNO's Strengths and Weaknesses

N2X's product breadth is very narrow and focused on L2-L3 testing

compared to other competitors that provide a broader solution. While industry is

moving towards network convergence and support for integrated L2-L7

capabilities on a single product is a key requirement for customers, this is

considered a major weakness of N2X. Currently Agilent provides solutions for L2-L7 testing and competes against Ixia and Spirent with several of its data communication network products. Agilent is moving towards providing an integrated solution by linking these various products together through recent restructuring. As part of the restructuring, all the data network test equipments have moved under the umbrella of a single division called NSD. However, there is low synergy between these products at the moment which gives competition a window of opportunity to dominate the market.

In summary, Agilent's trusted brand and its global presence as well DNO's tight relationships with its customers have put DNO in a stronger position relative to its key competitors. However, meeting the requirements of Agilent corporate has brought DNO several limitations preventing it to respond quickly to dynamic trends of telecommunication industry. Table 3-2 provides a summary of DNO's strengths and weaknesses.

4: INDUSTRY ANALYSIS

This discussion first reviews the characteristics and attractiveness of the 'IP Network Test Equipment Professional Services' industry which is a sub-industry of 'IP Network Test Equipment' in which DNO participates. The competitive environment of this industry is then further analyzed using Porter's five forces model. This model will help identify the best ways consulting services can be structured in order to increase the profitability of firms within this industry.

4.1 Industry Analysis

Figure 4-1 shows the relationships between Telecom, Telecom Professional Services, Network Test Equipment, and Network Test Equipment Professional Services industries. IP Network Test Equipment Industry is the one DNO operates in. Currently DNO offers limited professional services through its technical support group, field organization, and RE program. Because the Network Test Equipment is a sub-component of Telecommunication Industry, this chapter first describes the dynamics and trends of Telecommunication Industry and its value chain. This will help with a more in-depth analysis of Network Test Equipment and Professional Services as a sub-component of this industry, which are presented next in the section.
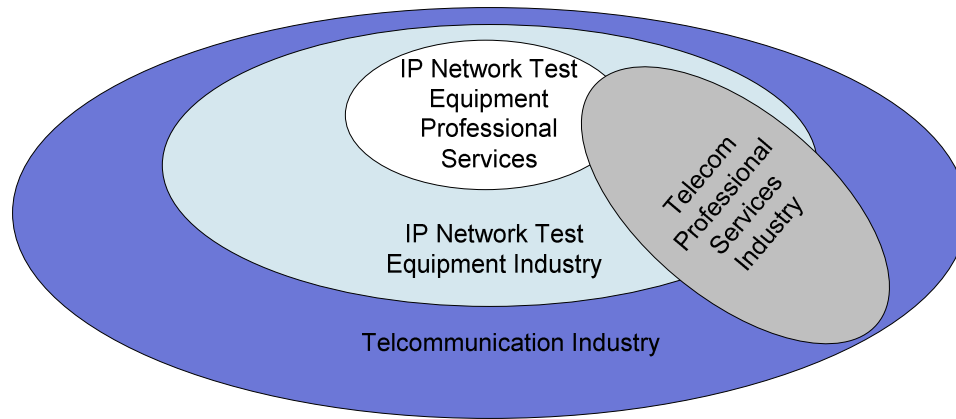
Figure 4-1 Telecom Industry and Its Sub-industries

4.1.1 Telecommunication Industry

The Telecommunications industry involves the delivery of voice communications, data, graphics, and video at ever-increasing speeds and in various numbers of ways. Whereas wireline telephone communication was once the primary service of this industry, data and video services over both wireline and wireless communication make up an increasing share of the industry in recent years. Value chain shown in Figure 4-2 illustrates the main players in this industry: Component Manufacturers, Network Service Providers (NSPs), and Network Equipment Manufacturers (NEMs). At the end of this chain are end users including consumers, enterprises, or government organizations that pay for services offered by NSPs such as Internet, telephone, IPTV, etc. NSPs provide these services by operating networks. These networks require deployment of NEM's equipments such as routers, switches, hubs, and multiplexers. NEMs use

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components built by component manufacturer firms including communication

chips and processors in the design of their equipments.
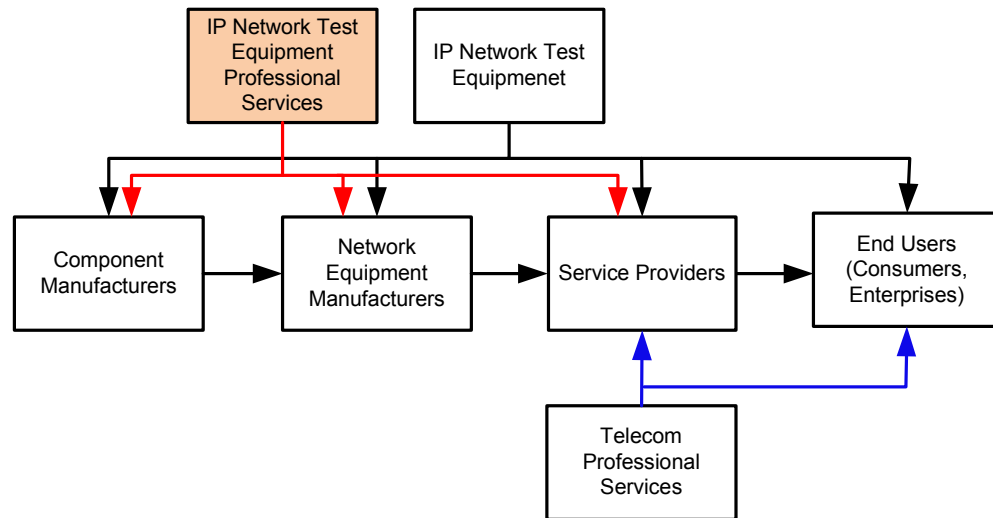
Figure 4-2 Telecommunication Industry Value Chain

The Telecommunication Industry has become increasingly dynamic during

recent years. Firms within this industry have to create and deliver attractive IP-

based services quickly in response to rapidly changing business and consumer

needs. They will also require to advance their networks to an architecture that

can deliver such services in a cost-effective manner.

One of the recent trends in this industry is its fast move towards

converged IP communication services. Convergence is the confluence of three or

more prime services of the telecommunication industry, namely voice, video, and

data. These services are delivered over a single pipe to a larger number of users

in real-time (Yagya, 2007).

Additionally, convergence allows fixed and mobile communications infrastructure to be tied together into a single managed solution. Broadband Multi-play or Triple-play is the marketing name for service convergence depending on the number of services added to the bundle. The two main drivers behind IP convergence for Service Providers are to increase revenues from bundled packages and the need for improved mobility (Elhamy, 2005).

Consolidation among firms is another trend in this industry in recent years that is creating a new telecommunication ecosystem. These consolidations are happening through mergers and acquisitions at two levels:

- **NSPs:** NSPs are consolidating in order to achieve network efficiencies through economies of scale and scope and to be able to compete more effectively on a global scale (Continuous Computing, 2008). These consolidations have been happening among Tier 1 NSPs so far; however, it is forecasted that they are likely to continue at Tier 2 and 3, and also across different sizes to either fill a gap in a product portfolio or do an expansion in the near future (Infonetics, 2007).

- **NEMs:** With all the consolidation happening among NSPs along with revenue declines resulted from telecom bubbles, there will be increased pressure on NEMs as they stand a greater chance of being either big winners or big losers. As a result, NEMs have also increasingly been joining forces in recent years. Alcatel/Lucent, Cisco/Scientific Atlanta, Nokia/Siemens, Redback/Ericsson are examples of these consolidations. These mergers allow for economies of scope where NEMs specializing in different parts of network can create devices with integrated capabilities that are more scalable and faster.

4.1.2 IP Network Test Equipment Industry

Due to increasing competition in the Telecommunication industry and the
fact that end users have many alternatives to choose from, telecommunication
companies are required to constantly improve quality of their service offerings to
remain competitive. As a result, the network test equipment is an essential part of
the telecommunication value chain. These equipments are needed by all
elements of the eco-system to assure performance, scalability, functionality, and
quality of their networks and network equipments. The quality of networks is a
critical factor for NSPs as they need to assure their networks run on a constant
basis and will not fail under high traffic load and long up-time. Using third-party,
trusted name network test equipment is important to NEMs as they need to
differentiate themselves against competing products by showing their customers
(NSPs) that their products are higher in quality and performance.

The recent consolidations in the market are increasingly setting
requirements for Network Test Equipments that are more sophisticated and
higher in scale and performance than Device Under Tests (DUTs). This is
particularly important for consolidated NEMs that produce equipments which are
now faster, larger in scale and more complex. An important characteristic of
these equipments is that they have support for a portfolio of protocols and
services from L2 to L7.

The IP Network Test Equipment market is Cournot Oligopoly where there
are several firms competing in the market, and market share of these firms is
dependant on the number of competing firms. As this industry is very dynamic

and new technologies are introduced to the market in a rapid pace, being faster

to market than competition with high quality testing solution for new technologies

is the essence of differentiation. Price is not the major decision-making factor for

users in this industry.

□ Agilent ■ Tektronix □ Spirent □ Empirix ■ Catapult □ Anritsu ■ JDSU □ Ixia ■ Others
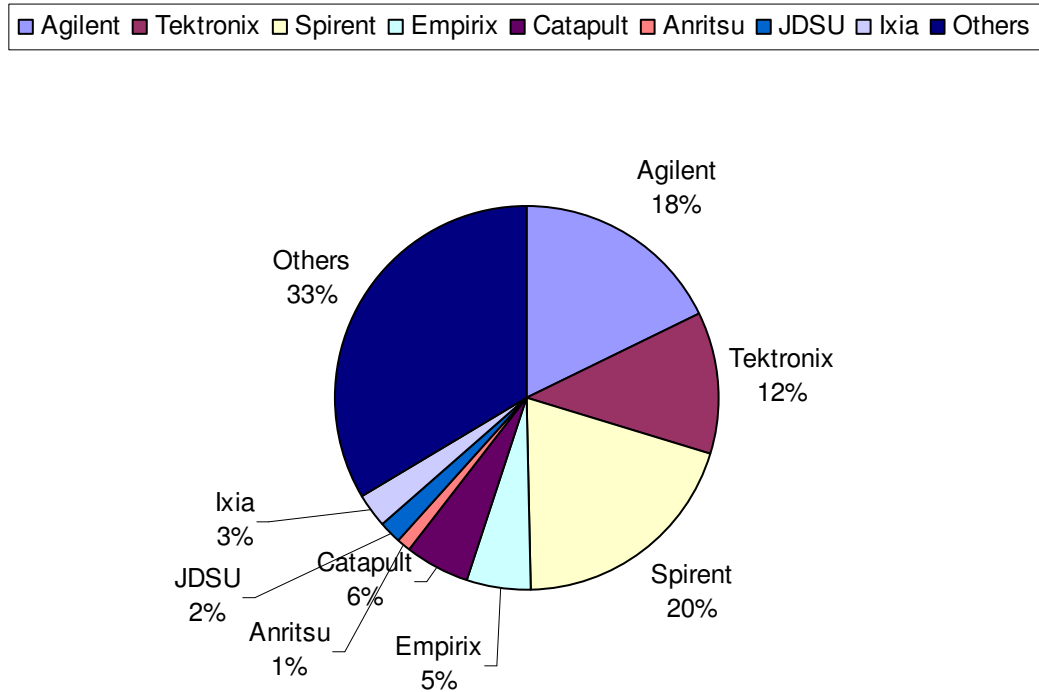
Figure 4-3 Network Test Equipment Market Share by Company in FY07 [7]

4.1.3 IP Network Test Equipment Professional Services Industry

There are two types of consultancy services provided to

Telecommunication firms: general consultancy and Network Test Equipment

specific consultancy. General consultancy is typically offered by independent

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[7] Morris, M. (2007). *Agilent Company Relative Market Share Analysis, Q407*. Retrieved June
   2008

consultancy firms such as IBM and Accenture and is mostly provided to NSPs

and enterprises. These services include network maintenance, assessment,

design, application and function (e.g., billing, ordering) management, and new

service areas such as management of site activities as well as managing a major

part of field operation activities for service providers.

The Network Test Equipment consultancy includes services related to

training, set up, and automation of network test equipments. These services are

provided through various sources including Network Test Equipment firms, the

Test labs that provide test equipment together with the consultancy services and

to a smaller extent the general consultancy firms. The overlapping area between

general and test equipment consultancy in Figure 4-1 indicates where

independent consultants provide both general and test equipment consultancy

service. Because of the complex nature of the technology involved, providing

consultancy services to help users employ the equipment more efficiently is

extremely important in this market. This type of consultancy is required by all

elements in the Telecommunication value chain that use Network Test

Equipments such as Component Manufacturers, Network Service Providers

(NSPs), and Network Equipment Manufacturers (NEMs).

4.2 Porter's Five Forces Analysis of the IP Network Test Industry

This section examines the attractiveness of the professional services

business by looking at external factors influencing the competitive position of

firms competing in the 'IP Network Test Industry'. The Porter Five Forces is a

useful tool developed by Michael Porter (1979) that examines the effect of five industry forces on the behaviour of an organization in the competitive market. These forces include Supplier Power, Buyer Power, Threats of New Entrants, Rivalry among Existing Firms, and Threats of Substitutes (Porter, 1985).

4.2.1 Supplier Power

Suppliers to consulting services are highly technical, customer savvy engineers who have a few years of working experience with the firm's test products. These consultants will need to be selected from firm's R&D engineers, technical marketing engineers, or product managers. These resources are rare and precious as there is normally a shortage of skilled engineers and there are a large number of projects waiting in the queue for development in this highly dynamic industry. Therefore, the decision of whether to allocate these engineers to the core business of a firm or to complementary consultancy services will remain a challenge for management. The current industry trends of outsourcing technical work to China and India, where labour is more abundant and less costly, have enabled offloading some of the project work. This will free up some experienced resources of main R&D sites, allowing firms to engage their resources in customer-facing consultancy tasks.

4.2.2 Buyer Power

The bargaining power of buyers is the customer's ability to negotiate for price setting. If significant buyer power exists, industry returns can accrue to buyers in the form of lower prices (Grant, 2008). The 'IP Network Test Equipment

Consultancy' industry shares the same buyers with the 'IP Network Test Equipment industry'. These buyers are highly concentrated for DNO and its two major competitors. Therefore, more than 42% of DNO's revenue is generated from the top 5 customers in 2007. The top 2 customers, Cisco and Juniper, account for 33% of this revenue.

Customer	% 2001 Revenue	Customer	% 2006 Revenue	Customer	% 2007 Revenue
Cisco Systems	12.70%	Cisco Systems	20.50%	Cisco Systems	18.60%
Juniper Networks	12.30%	Juniper Networks	12.80%	Juniper Networks	15.10%
Lucent Technologies	10.30%	NTT	9.10%	NTT	4.10%
Alcatel	6.40%	Redback Networks	3.10%	Redback Networks	2.30%
Nortel Networks	3.20%	Deutsche Telekom	3.70%	AT&T	2.20%

Table 4-1 DNO's Top Five Customers 2001[8], 2006 [9] and 2007 [10]

Table 4-1 shows that revenue generation is becoming more concentrated on these two customers. What this means is that these Tier-1 customers have high bargaining power and they normally negotiate deep discounts on equipment, software licence, and technical services. As such, DNO and its competitors provide post-sale consulting services free of charge or with low prices to these customers.

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[8] Dyke, T. (2007). *The Future of AND's Optical Internet Business in an Industry Slowdown,* Project submitted to the Management of Technology MBA Program, Faculty of Business Administration, Simon Fraser University.

[9] Foster, C. (2007). *Strategic Analysis of the IP Network Performance Test Market.* Project submitted to the Management of Technology MBA Program, Faculty of Business Administration, Simon Fraser University.

[10] DNO Internal YTD order report

The two major types of customers for firms in 'IP Network Test' industry include NEMs and NSPs. Table 4-1 shows that in 2001 the top five DNO customers were NEMs. However, it can be seen that DNO's revenue share from NSPs has been increasingly growing; therefore two NSPs (NTT and AT&T) are among the top five customers in 2007.

The bargaining power of Tier-2 and Tier-3 customers is low relative to Tier-1 customers. This is because of lower degree of revenue concentration among these buyers. As such, consultancy services can be sold to these customers at less discounted prices.

On the other hand, the power of test equipment vendors over their customers is high due to switching costs of users as well as differentiation of the test equipment. Customers' switching costs are high, as they should largely invest in purchasing the test equipment and learning it once they select their preferred vendor. The learning curve is steep because of the complexity of the technology involved. The mentioned factors mitigate the bargaining power of buyers to a certain extent. Moreover, it is most efficient for customer to purchase the consultancy services through their selected test equipment vendors rather than test labs or independent consultants that have less experience with selected test equipment. In addition, the test equipments can be largely differentiated through their features, time-to-market, usability, quality, and post-sales services offered by their vendors. Post-sales service is becoming increasingly important, especially for NSPs whose employees may have relatively lower technical expertise and knowledge of the technology they are testing compared to NEMs.

4.2.3 Threats of Substitutes

Substitutes to consulting services for test equipments are alternative solutions that can facilitate customer test setup, execution, automation, and report generation resulting in increased test efficiencies at lower costs. These substitutes introduce the risk of stealing profit generated by these services. Potential substitutes for consulting services of firms competing in 'IP Network Test' industry are companies that develop tools running on top of test equipments to simplify device testing for users of all skill levels. An example is Fanfare Group that has claimed to have partnerships with companies such as Ixia, Spirent, and Agilent Technologies (Le Maistre, 2007), which is a false claim. Although companies such as Fanfare are complements to test products and benefit firms in 'IP Network Test' industry by increasing demand for their equipments, they are considered a threat to professional services provided by these firms. However, these substitutes are currently of relatively weak strength, which may change as these companies have the potential to become industry standards in the near future.

4.2.4 Rivalry among Existing Firms & Threats of New Entrants

This section provides an overview of both industry rivalry and threats of new entrants. Integration of the two topics in one section is because the power of rivals and new entrants both vary based on the type of firms competing in the Network Test Equipment Services industry, i.e., Network Test Equipment vendors, Network Test labs, and independent consultants. This section analyzes rivalry forces and entry barriers for each competition category separately. In

summary for firms in the 'IP Network Test' industry, rivalry among competing firms is high; however, threats of new firms entering the market is relatively low, as will be described in detail below.

4.2.4.1 Network Test Equipment Vendors

The strongest competition over providing consultancy services specific to IP Test Network Equipments exists between the Network Test Equipment vendors. These firms look into consultancy as complementary service to their core product and as means of further penetration into their market and creating customer lock-ins. As such, they tend to provide such services at minimal costs.

Rivalry among Existing Firms: Network Test equipment is a highly competitive industry, which follows a Cournot oligopoly model. With rapid introduction of new network technologies, IP convergence, and consolidation trends in the industry, firms in this market compete on being first to market with new and differentiated features that are required to meet the testing needs of the fast-paced industry. However, sooner or later all competitors catch up, leaving them all with similar features. What becomes a competing factor at this time are additional professional services provided by the Test Equipment firms. These services benefit users and improve their operational efficiencies by allowing them to better understand and utilize full capabilities of test equipment and provide them with custom-tailored solutions specific to their test requirements. This will leverage and maximize the impact and adoption of the test equipment and create customer lock-in that allows test equipment manufacturers to generate more profit from sales of their equipments.
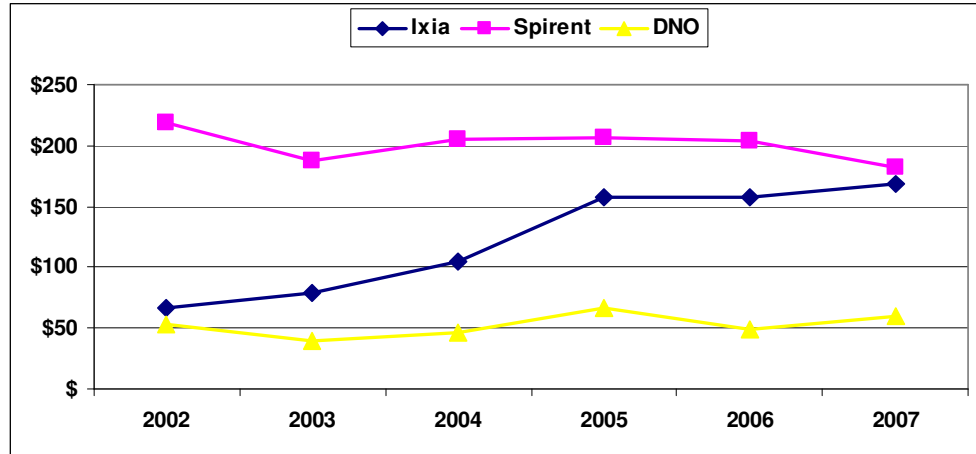
Figure 4-4 Market Share of DNO vs. Ixia and Spirent

The two major competitors of DNO are Spirent Communications and Ixia. Spirent holds the first position, Ixia, the second, and DNO the third. Figure 4-4 shows the market share owned by DNO compared to its two major competitors.

Ixia and Spirent compete with other NSD products in the IP network market as well. Ixia and Spirent provide integrated pure consulting services as part of their Global Services and Professional Services operations, respectively. Spirent's global services consist of three types of functions: Educational, Professional, and Support services. The purpose of educational services is to bring customers up to date with latest features, methods, and services. Professional services are further sub-divided into Consulting and Engineering activities that offer equipment-specific recommendations and custom solutions tailored to internal customer development needs ("*Spirent Global Services*", *n.d.*).

Services offered by Ixia's Professional Services function include project management, test process optimization, script conversion, test automation, jump-

start training and Resident Experts. Through the project management services, a QA manager is assigned to the customer to ensure all phases of test efforts, including test plan and test development, regression, automation, and reporting are managed properly. Process optimization services enable Ixia to provide targeted solutions to specific needs of customers and thus allow users to get most out of Ixia equipment. Script automation services are aimed to enable customers perform repeatable life cycle testing. And script automation services assure customer with a smooth upgrade from non-Ixia to Ixia scripts. ("*Ixia Professional Services"*,n.d.).

Although both companies have a revenue model for the services they offer, they use differentiated pricing for different clients. Depending on size and strategic importance of customers, they offer these services at various prices. For example, because there is intense competition between Ixia, Spirent and DNO over Tier 1 customer accounts, these companies tend to offer huge consultancy discounts to these strategic big accounts. In addition, thus far these companies have been mostly looking into consultancy as complimentary services to their core business, and to a lower extent as a separate revenue generating business. These services have been offered bundled with their product offering as a means of differentiation that allows them to remain competitive in their main business.

Threats of New Entrants: Firms in the 'IP Network Test" industry face high entry barriers from new entrants to this category due to various factors, including high

initial investment, high switching costs, steep economies of learning, strong brand identity affects, and economies of scale.

Initial investments:

Entering the test equipment industry requires large investments in manufacturing facilities, skilled R&D employees, equipment, and sales and marketing.

High switching costs:

These high switching costs encountered by customers of network test equipment are due to several factors. One factor is related to the high price of test equipments. Customers cannot easily switch back and forth between equipments once they make a purchase from a specific vendor. Another factor is that customers normally develop automation test scripts or software to control test equipment. These scripts are specific to a single test platform and take a long time to be developed. This creates customer lock-ins as switching to another test platform will require developing these scripts from scratch. Another factor is a steep learning curve. Due to the complexity of product it takes time and effort for users to learn all features and capabilities of the product as well as the Application Programming Language (API) required to automate test executions. Therefore users resist switching to another product once they get familiar with one.

Economies of learning:

Developing high-end successful network test equipment is not only dependent on knowing the complex technology involved, but also requires deep customer

knowledge. This knowledge includes how the tester is being used by different customers and what users' requirements are in terms of functionality, performance, and usability. This valuable information has been gained and accumulated by incumbent firms (DNO, Ixia, and Spirent) over years of experience and direct interaction with users, and is the basis of their product design.

Strong brand identity affects:

Brand identity is an important factor in the network test equipment industry as customers associate brand with quality. As specified in section 4-1-2 quality is a critical factor for NEMs and NSPs to stay competitive in the industry. These customers want to prove to their own customers that the quality of their devices or networks have been tested with an industry recognized brand test equipment. Brand generation by new entrants takes time, which will introduce entry barriers to them.

4.2.4.2   Network Test Labs

These labs own a large variety of network devices and test equipments and sell memberships that allow users access to their test equipments bundled with consultancy as part of the same package. The memberships, which are offered at various levels, allow customers to participate in interoperability activities as well, where each member contributes a representative piece of equipment to a shared test bed of equipment through which other members can perform interoperability testing (University of New Hampshire, n.d.).

Rivalry among Existing Firms: There are a large number of test labs around the world. Examples of these test labs include University of New Hampshire InterOperability Laboratory (UNH-IOL), Iometrix, Isocore, etc (UNH-IOL, n.d.), (Iometrix, n.d.), and (Isocore, n.d.). Ixia and Spirent also run their own test labs providing similar services as the independent test labs, supplying their own test equipments rather than devices from different competing vendors. Spirent's Test Automation lab was launched in 2006. This lab is a proof-of-concept lab that enables customers to accomplish more testing in less time with fewer resources. It combines test management tools, physical infrastructure, a library of test cases, and expertise to helps users complete their tests (Spirent, n.d.). Ixia's Proof-Of-Concept (POC) lab, iSimCity, was just opened in January 2008. The main goal of this lab is reducing customers' in-house resources by making available expertise, methodologies and hardware. The lab provides consultancy as part of their services as well (Ixia iSimCity, n.d.).

Threats of New Entrants: Barriers to entry for new test lab entrants is relatively high due to high capital investments, economies of learning, and network externalities effects.

High capital investments:

One of the major barriers to new entrants for test labs is high capital investments on lab facility and equipments. These labs are required to provide a large number of network equipments from various NEMs and test vendors in order to provide their customers a test environment that resembles real network conditions as

closely as possible. In addition, these labs need to invest in hiring technical expertise to provide lab members with consultation services.

Economies of learning:

A large percentage of lab members are smaller start-up NSPs or NEMs which use lab facilities to save on high test equipment costs. Being new to the business, these customers are typically dependent on the technical knowledge and expertise provided by the labs to run their tests. Due to complexity of technology and large variety of network equipment used in the labs, the employees of these labs have to go through a broad and steep learning curve. In addition it takes time and customer interaction for lab consultants to learn this technological knowledge, which creates high entry barriers for new entrants.

Network Externalities:

Network externality is an important factor for test labs as they involve in an interoperability test to verify end-to-end functionality between multiple network equipments. Therefore the benefit for customers increases as more users attend these test events. Building this customer base is a challenge for new test lab entrants.

4.2.4.3 Independent consultants

These consultants are indirect competitors with a different focus than test equipment specific consultants. These firms can vary from large incumbents providing consultancy in many different areas to small firms focusing on niche markets. These firms typically provide general consultancy services to NSPs and

Enterprises so the area where they compete directly with professional services offered by Network Test Equipment vendors is test equipment specific consultancy as part of network maintenance services to NSPs (overlapping area between ovals representing Test equipment and Telecom professional services in Figure 4-1).

Rivalry Among Existing Firms: In summary, rivalry among existing competitors is high and becoming increasingly stronger as NSPs and NEMs are facing rising pressure to quickly and cost effectively bring next-generation converged networks and services with ever changing technology to market. Therefore professional services such as training, test set up and automation, and streamlined lab management is critical to these customers, helping them reduce their test time and ensuring right delivery of their products and services the very first time.

Major competitors Ixia and Spirent are already providing professional services through their dedicated consultancy teams. The services that these companies provide are differentiated from Agilent's services as these companies are smaller than Agilent and specialize in Networking test equipment. Therefore their professional services are more focused in comparison to Agilent's field organization which typically supports a wide range of products in different areas. However, Agilent's professional services through field organization provide world-wide coverage for N2X customers, something that competitors cannot provide.

Threats of New Entrants: Barriers to entry for independent consultants are of medium strength. These consultants do not require large capital investments.

Also, customer switching costs are not high as long as independent consultants can provide consultancy services for specific test equipments used by their customers. However, two factors introducing obstacles to new entrants are economies of learning and brand equity.

Economies of learning:

Independent consultants are required to gain knowledge and keep up with ever-changing networking technology as well as details of the specific test equipment used by their customers.

Brand Identity:

Brand identity of large incumbent consulting firms is an important factor as customers associate it with the quality of their service.

4.2.5 Summary of Industry Forces

In summary, the supplier bargaining power in the 'IP Network Test' services industry is medium, as obtaining highly skilled engineers will require internal reallocation of these resources and involve management prioritization. The power of suppliers is decreasing overtime due to technical resources outsourcing trends in the industry. The bargaining power of customers varies among customers of different tiers. Tier-1 customers that are more concentrated have higher bargaining power. However, less concentrated Tier-2 and Tier-3 customers which have historically not been the main target of this industry have medium bargaining power. The threats of substitutes (test tool development companies) are relatively weak. However, these threats are getting stronger with

increasing possibilities of these companies becoming industry standards. The industry rivalry is high especially from the Network Equipment vendors. These firms offer consultancy services at minimal charges in order to differentiate themselves from their competitors. Threats of new entrants are recognized medium to low. Key common factors preventing new firms of various types (Network Test Equipment vendors, Test Labs, or independent consultants) from entering the market are brand identity and economies of learning. Table 4-2 provides a summary of five industry forces discussed in previous sections.

Industry forces	Power	Trend
Industry Rivalry	High	⬆
Supplier's power	Medium	⬇
Buyer's power	High/Medium	➡
Threats of new entrants	Low	➡
Threats of substitutes	Low	⬆

Table 4-2 Summary of Porter's Five Forces Analysis

In conclusion, the attractiveness of consultancy services for the 'IP Network Test Equipment' industry is identified as medium. In order for firms to remain competitive in this industry, they require to differentiate themselves against their rivals by providing first-to-market test solutions for cutting-edge technologies as well as creating customer lock-ins by offering hand-holding and in-depth technical consulting services.

5: MARKET ANALYSIS

This section provides a detailed analysis of the IP network test services market. First a suitable customer segmentation model is presented and different segments are identified. Later in the section, the current market size, DNO's market share, and future market outlook by region and customer type is further analyzed.

5.1 Market Segments

Although IP Network Test Equipment is segmented in many different ways by various firms, the most appropriate market segmentation scheme for IP Network Test consultancy services is the one that takes into account different customers' needs for consultancy services such as users' technical knowledge as well as their testing patterns, behaviours, and needs (Ulwick, 2005, p. 70). For this reason, our segmentation of the market below is based on customer types.

Large-Medium Size NEMs (R&D and QA):

Network Equipment Manufacturers (NEMs) provide infrastructure network equipment to Network Service Providers (NSPs) and end users and are required to meet the high expectations of these customers. In order to remain competitive, NEMs should deliver high quality devices to assure their users with performance and functionality of their networks under different conditions. These users will use IP Network test equipments to test their products during various phases of their

equipment lifecycle: R&D, Quality Assurance (QA), Manufacturing, and Marketing. The following items describe characteristics and usage behaviour of end users in the NEM R&D and QA labs:

a. They have a high degree of technology knowledge. However, these users need to go through a steep learning curve to use detail features of the test equipment for their test purposes.

b. Development groups need small number test port count for the purpose of functionality tests and QA groups need medium to large port count as they run scalability and performance tests in addition to functionality tests. Both these groups need to run their tests on a regular basis.

c. This group are not heavy GUI users. They typically run their own software or "test scripts" to automate their regression tests. These scripts are used to control their devices as well as test equipment platform. Therefore, users need to learn test equipment specific API to develop their software and constantly upgrade it with new features.

Large-Medium Size NEMs (Marketing and Proof of Concept labs):

As part of their marketing activities, NEMs run Proof Of Concept (POC) labs to allow their customers to evaluate and test their devices as well as other networking equipment in real-word environment. NEMs' customers need to use POC labs to run tests on third-party devices with known industry brands that are also used by themselves in their environment in order to assure consistency of test results. Below is a list of test behaviours of users in this segment:

a. Time is an important factor for these users as they get their customers' test requirements on short notice and need to prepare and set up their own devices as well as test equipment with features they may not be familiar with.

b. These users are heavy GUI users and do not run API scripts. For this reason, usability is an important factor to this group.

c. They have medium level of technology knowledge. Their expertise is broad, but less detailed as they involve with a large variety of test scenarios.

d. Their needs for type and number of test ports varies based on their customers test requirements. In order to be able to accommodate their customers' needs and show off their solutions, these labs should own large number of test ports of different variety, although they may not use them frequently. Therefore, this segment invests large amounts in equipment that may remain idle in their lab for a long time.

Large-Medium Size NSPs:

The main objective of users in this segment is to provide network users with high quality network services. To compete effectively NSPs must verify the performance of the network equipments as well as their system prior to development and during operation. Testing needs and behaviours of these users are described below:

a. Technical knowledge of users in this group can be rated medium to low. Larger NSPs have medium level of in-house technical expertise as they

invest more in their test labs and the level of technical expertise shrinks as the size of NSPs get smaller. Due to recent convergence of services and dynamic nature of industry, more and more complex network features and protocols are developed and implemented everyday, which requires these users to keep up with the knowledge in order to be able to test their networks. As a result, the willingness of NSPs to outsource more network operational, assessment, and maintenance processes is rapidly increasing, as they want to focus on their core business. Figure 5-1 below shows the increase in revenue from general professional services to NSPs.

Professional Services to Service Providers Revenue
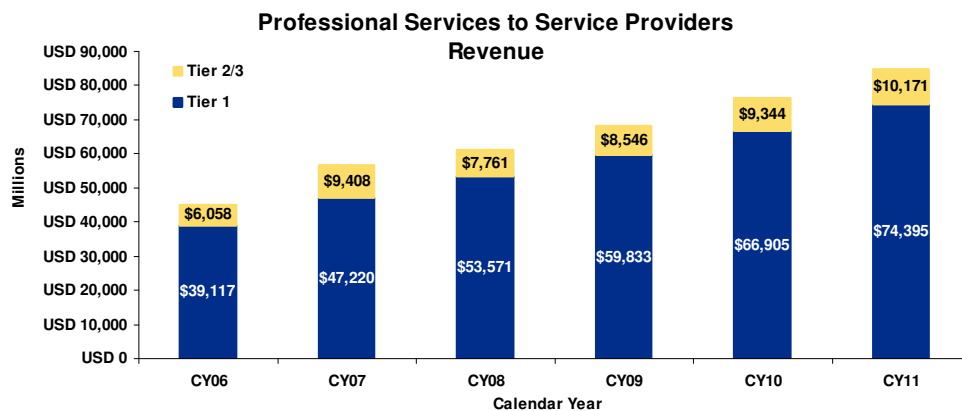
Figure 5-1 Projected Revenue from Professional Services to Service Providers[11]

b. This segment requires to use large to medium test port counts to test network performance and scalability of networks that resemble real networks as closely as possible. These ports are heavily used during design and pre-

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[11] Infonetics Research (2008). *Professional Services to Service Providers.* Annual Worldwide Market Share and Forecasts.

development, and maintenance phases, which are run for intense, short-period tests every few months.

Small/Start-up NEMs and NSPs:

The main characteristic of this segment is their price sensitivity. Considering that high prices of network equipment and limited budget of these companies, they cannot afford to invest money in test equipment, let alone consultancy services for this equipment. These companies normally prefer a leasing option for this equipment. Additionally, due to economies of learning, this segment's knowledge of the test equipment is superficial and they can hardly differentiate capabilities of different test equipment vendors[12]. For this reason providing on-site consultancy and training services is an important factor for these small companies which leads to customer lock-in, especially for customers with high growth potential.

Component Manufactures:

This segment is the one that uses test equipment to verify the conformance of their component (chips and processors) with industry standards only during development phase. This is the smallest and least frequent test equipment user market segment. Table 5-1 provides a summary of different market segments and their behavioural characteristics.

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[12] Interview with customer

Market Segments	Main Characteristics/ Requirements
Large-Medium Size NEMs (R&D and QA)	- High degree of technology knowledge - Steep learning curve to utilize detailed features of the test equipment - Development group requires small number of test ports - QA group requires medium/large number of test ports - Run test on regular basis -> need to own equipment - Heavy script users -> need to learn API
Large-Medium Size NEMs (Marketing and POC labs)	- Need to prepare for customer tests with short-notice - Heavy GUI users - Medium level of technology knowledge (broad, less detailed expertise) - Varying need for test port #/ type - Need to show off their lab -> required to own equipment
Large-Medium Size NSPs	- Medium/low level of technical knowledge - Willingness to outsource network operation to focus on core business - Require medium/large port counts - Equipment used for intense, short-period tests -> don't need to own equipment
Small/Start-up NEMs and NSPs	- Price-sensitive -> cannot afford test equipment - Superficial knowledge of test equipments - Can hardly differentiate capabilities of different devices
Component Manufacturers	- Random, low frequency usage of equipment - Do not need to own equipment - Specialized testing -> required specific features - Require conformance test suites

Table 5-1 Summary of Customer Segments and Their Characteristics

In addition to the above segments, another important factor to consider is the geographical location of customers to better target the market for consultancy services because of two factors. The first is the degree of presence and concentration of similar services being provided by the competition and by Agilent's field organization in a specific region. The second is the cultural

influence on a customer's perception and willingness to pay for these services. For example, Americas is the region where the Agilent field organization as well as Ixia and Spirent's have the strongest presence of pre- and post-sales technical services. Therefore, providing these services free of charge or at extremely low costs has become an industry standard in this region especially for Tier-1 customers (Cisco, Juniper, AT&T and Verizon) who are driving a big chunk of the market (Infonetics, 2008). Changing the mindset of these customers to pay for such services will remain a challenge for test equipment vendors.

As discussed in section 3-4-3, in Asia Pacific and EMEA (Europe, Middle East, and Africa) regions, direct AE presence by Agilent is low. These services are provided through Channel Partners or distributors who generally do not have strong technical expertise of N2X. In addition, in contrary to the European market, customer culture in Asia Pacific is based on getting deep discounts. Internal DNO's revenue data shows 50% average discount to these customers while this number for EMEA is only 34%[13]. So, for Asian customers, complementary consultancy services are considered as an alternative way to extract further discounts. However, it should be noted that strong activity in India is creating a large opportunity for professional services to carriers in this region (Infonetics, 2008). A few other characteristics of the EMEA market are described below.

EMEA is an attractive market for professional services. This is due to two factors. The first factor is the existence of developing countries in this region

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[13] DNO Internal YTD order report

such as UAE, Russia, and Kuwait. These countries are investing heavily in their network infrastructure and telecommunication companies in these countries are competing against each other to attract more customers.

The second factor is that because of small districts in Europe and Middle East, there are many Tier-2 NSPs serving different countries in this region as opposed to the U.S. where there are only a few Tier-1 firms dominating the market. This decentralization decreases bargaining power of customers and makes EMEA an attractive market.

5.2 Market Outlook and Growth

IP Network Test Equipment professional services market is a sub-component of the IP Network Test Equipment market. As such, IP Network Test Equipment will be the focus of this section. The first part provides an overview of the Test Equipment Market size. The following section will look at DNO's current and forecasted market share by region and customer type is provided.

In 2007 total IP Network Test market was $374M. A significant portion of this growth is the result of IP convergence and consolidations among Tier 1 and 2 NEMs and NSPs which is discussed in section 4.1.1. As shown in Figure 5-2, DNO is estimating the total addressable IP Network Test Market to grow by over 4% to $389M in 2008 and by over 16% to $450 in 2011[14].

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[14] Source Internal CMO Market Forecast
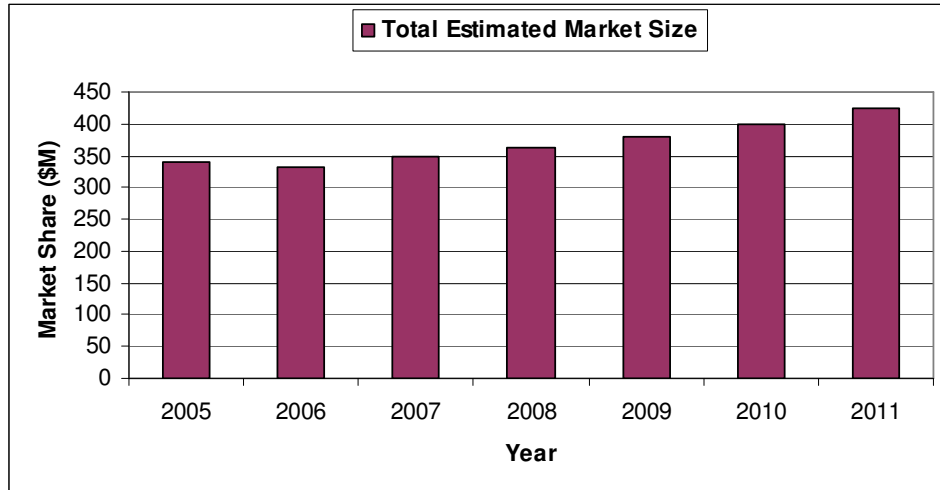
Figure 5-2 DNO vs. Total IP Performance Test Market Estimated Revenue[9]

Figure 5-3 shows the IP Network Test estimated market share broken down by customer types (NEMs, NSPs, Enterprises, and others). Among these customers, NSPs are the biggest target for professional services. As the recent market study by Infonetics shows[10], the worldwide service revenue from general telecommunication professional services to only service providers has increased 25% to hit $56.6B in CY07 and is expected to hit $84.6B by CY11. This significant growth is driven by service providers' needs for technical expertise they typically do not have in house, in order to support them with design, setup, and maintenance of their services. As a result, they require outsourcing more technical consultancy tasks so they can focus on their core business.
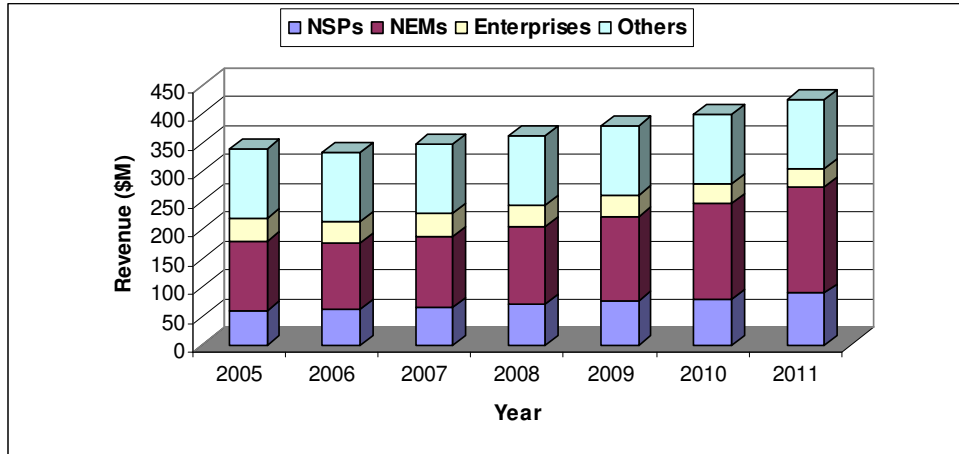
Figure 5-3 IP Performance Test Market share ($M) by Customer Type[16]
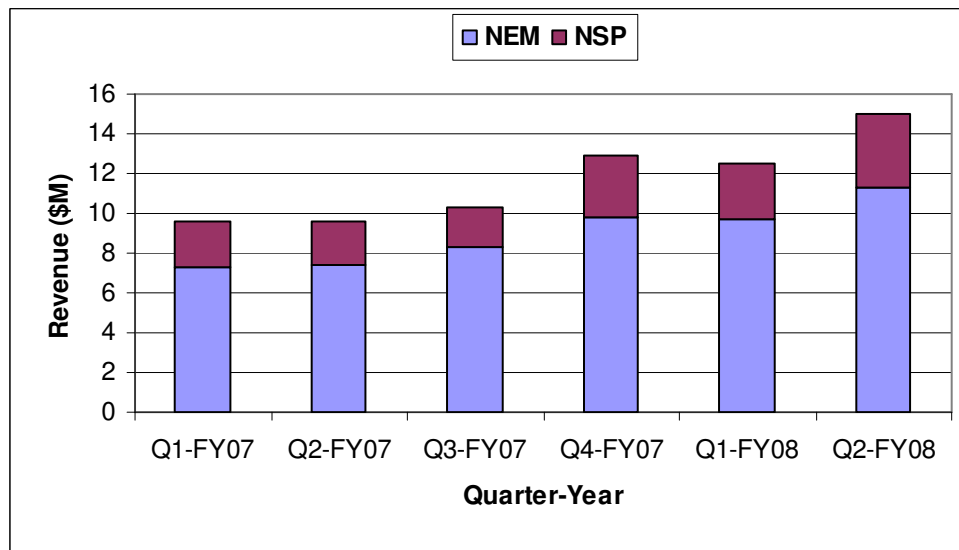
Figure 5-4 DNO FY07 Revenue from NEMs vs. NSPs[17]

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[15] Source Internal CMO, 2007 and 2008 YTD order spreadsheet

[16] Source Internal CMO Market Forecast

[17] Source Internal CMO, 2007 and 2008 YTD order spreadsheet

In 2007, DNO's revenue was $60M, which was 15% of total addressable market. Figure 5-4 and 5-5 show DNO's revenue breakdown by customer type and region, respectively. DNO's YoY revenue growth is projected to be 15%, up to $69M in FY08. Therefore, in 2008 DNO is expected to capture 19% of total IP Network Test market (Infonetics, 2008).
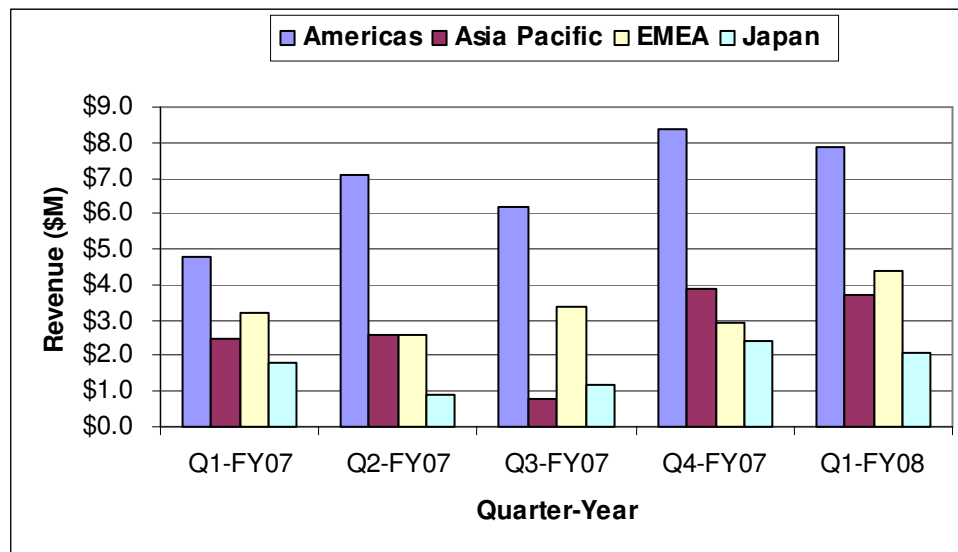

Figure 5-5 DNO FY07 Revenue by Region [18]

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[18] Source Internal CMO, 2007 and 2008 YTD order spreadsheet

6: ALTERNATIVE SOLUTIONS FOR DNO CONSULTING SERVICES

This section first examines the current situation with professional services provided for N2X through the Agilent field organization, in order to determine the existence and nature of any issues with the current structure. Next, several alternative solutions for providing consulting services at DNO level are suggested, followed by a discussion on advantages and disadvantages of each alternative. Later, several criteria for evaluating these proposed solutions are suggested, and alignment of each solution with these criteria is examined.

6.1 Issues with Current Situation

Technical consulting services for DNO's product are currently provided through a model which involves a combination of resources involving field organization, REs, and sporadic on-site customer visits by R&D engineers as described in detail in section 3-4-2. A large portion of these services is provided through AEs. RE services are limited to DNO's biggest customer, Cisco system. R&D visits happen very infrequently only when a major customer issue is recognized. Additionally, there is a single dedicated DNO engineer that provides pure consulting to all N2X customers world-wide. This engineer is part of the Business Development Group of DNO's marketing organization and serves strategic customers or accounts that have high revenue potentials based on the request of regional BDEs or FEs. Table 6-1 provides a summary of services

provided by various functions and the pieces missing with the current professional services model.

AE	RE	Customer Support	Sporadic DNO Customer visits	Missing piece
• Pre-sales demos • Training • Limited on-site troubleshooting • Very limited scripting • Limited feedback to DNO	• Long term on-site support • Some training • Scripting • Custom solutions • Troubleshooting • Today, mostly a tactical role: not what was intended • "Free service" and expensive for DNO • Limited customer coverage	• Issue resolution • No training • No scripting • No training • Some feedback to R&D	• Free service and expensive for DNO • Not enough to serve large customer install base • Customer solutions • System re-engineering • Scripting	• Dedicated RE-like consulting service for smaller accounts • Creation and improvement of knowledge base • Improve ongoing relationship with customers • $ for DNO from equipment sales and consulting

Table 6-1 Current DNO's Professional Services Work Distribution[19]

Although this model has its own advantages such as broad geographical customer reach of the direct sales force and technical consultancy services through Agilent's field organization, it introduces some limitations and issues as listed below:

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[19] Dufour A. & Ruta, R. (2005). Internal DNO Slide Set. *Selling Professional Service.*

1. The majority of AEs who provide a large portion of technical consultancy support several Agilent products and are not dedicated to N2X. This raises issues as AEs cannot specialize in N2X, which is necessary to support such a complex and high technology product. DNO's competitors, Ixia and Spirent are both smaller companies compared to Agilent with smaller range of product offerings. Consequently, they offer more focused consulting services for each of their product lines as described in section 4.2.1.

2. The current model does not provide a systematic way of providing feedback on collected customer experience and knowledge from consultancy. Because of the lack of interaction between the field organization and DNO, this valuable information, which can be used to help design more customer-focused products is lost[20].

3. With the current structure of field organization, FEs and AEs are integrated under field district units and report to the same regional field manager. This means that both pre-sales and post-sales services are managed though a single unit making AEs tasks driven by sales objectives. These resources are mostly involved in pre-sales activities such as training and demonstrations rather than post-sales consultancy services[21].

4. With AEs being more focused on pre-sales services, DNO has assigned a single full-time consultant to help with post-sales consulting activities. The scarcity of resources can raise conflict of interest between sales force and

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[20] Interview with DNO consultant.
[21] Interviews with DNO Business Development Managers

business development on whether priority should be given to strategic or revenue-generating customers.

5. The existing model is not efficient. Currently various R&D engineers are sent to customer site based on their availability. These engineers need to create experience and customer knowledge from scratch where a dedicated group could use an already established knowledge base which can be improved over time towards a more competent and effective consultancy team (Atanasovski, 2006).

6. DNO provides resources for consultancy services free of charge. Due to scarcity of R&D resources and the fact that these valuable resources are taken away from high priority R&D development projects, the current model is not sustainable.

7. The RE program is costly and non-practical. Because this program is provided free of charge, customers devalue REs' services, involving them in non-value-added activities.

In order to address the existing limitations and issues with the current consultancy model, we recommend three alternative solutions that allow DNO to provide integrated and dedicated consultancy services for N2X. The three alternatives include service offering, creating a test lab, and product offering. Each of these alternatives is described in more detail in the following sections.

6.2 Alternative 1: Service Offering

Service offering means providing pre- or post-sales pure consulting services to current or potential customers by sending highly technical engineers to customer sites. The type of services offered by these consultants include detailed product training, test implementation, test automation, test planning, script conversion, and assisting with solving customers' test challenges. Another aspect of the consultancy work involves managing solution development through R&D resources based on customer needs.

Part of these services is currently offered through the existing professional services model. For example, AEs provide product training (mostly for potential customers/groups within existing customers) and limited high level test implementation and troubleshooting services. However, the major differentiation between services offered by this team and AEs' work is script automation/conversion as well as identifying and providing custom solutions for customers' test challenges. The goal is to expand on existing work of REs and form a dedicated regional team of consultants that can create and grow a knowledge base towards a more efficient model.

6.2.1 Target Market

Target market for this type of services covers a wide range including NSPs and some groups within NEMs. Since QA and development groups of NEMs are heavy script users, the script automation services will be beneficial to these users. Although these groups have a high degree of technical knowledge, they typically spend a relatively large portion of their time upgrading their scripts

in order to incorporate test cases for the new functionality of their devices. Scripting services will therefore allow these groups to focus on their main job which is product development and test execution by allowing a test equipment expert to automate their test cases in the most efficient manner. This will help these customers accelerate their product and network development cycles. As these customers run their tests on a frequent basis, they will need to own their test equipment so service offering is their preferred alternative as opposed to a Test lab solution (discussed in the following section).

The service offering solution will benefit users from NEM POC labs with a relatively lower level of technical knowledge to prepare test configuration for urgent, short notice customer proof of concept demos. Additionally, consultants can assist these users in using full capabilities of test equipment to generate better results from testing their equipments. Enhanced and accurate results will make their product more appealing to their clients.

Finally, NSPs are the target market that benefits the most from professional services. Service offering allows these users who typically have low to medium level of technical knowledge and need to test their network with increasingly complex technologies to focus on their core business. This market is more willing to pay for consultancy services as they are already paying large amounts of money to general network consultants.

6.2.2 Pros

Advantages of the service offering solution are listed below:

1. Increase in sales revenue, which is a result of two factors. First factor is that consulting services will help show full capabilities of DNO products leading to maximization of the impact and customer adoption of N2X. The second factor is related to customer lock-ins, so once customers invest in learning and getting familiar with a specific product, they will be unlikely to switch to different test equipment. Below are a few of many examples where direct DNO consultancy involvement has contributed to increased equipment sales revenue:

   - Cisco Boxborough, MA, USA: 3 weeks of DNO R&D engineer's onsite services for script conversion work was contributed to about 33% or US $2M deal[22].

   - Cisco DUBU, USA: 20% of a US $1M was a result of 1 week of DNO consultancy work.

   - AT&T, USA: Joint work of AE and DNO consultant work to provide a customized solution led to winning a US $450K. Approximately 50% of this deal was attributed to the consultancy service.

   - Ericsson, Genoa, Italy: 50% of an immediate US $80K deal and potential deal size of US $500 was related to a 3-day DNO consultancy work to provide script automaton and test plan optimization services.

   - Ericsson, UK: 50% of a 50K deal was directly related to a 4-day consultancy work for script training [23].

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[22] Interview with DNO Business Development Managers

2. Collection of customer feedback: The direct consultancy work with customers will allow DNO to learn customer needs, scenarios, and use models leading to fast-to-market customer-focused products. This will help DNO both improve its product leadership and meet its revenue targets.

3. Low capital intensity: The costs are limited to consultant wages and travel costs, and advertising without the need for possession of expensive test equipments.

4. Minimal risk: The solution can be implemented as a pilot project with a small team focusing on a specific region and get expanded gradually once its benefits are proved.

5. It offloads responsibilities of the field organization. The solutions will allow field to focus on pre-sales activities while leveraging the work consultants to further increase customers' penetration and sale revenue. This solution will allow DNO to provide a portfolio of specialized services to its customers such as support services, educational services and professional services.

6. Enable DNO to stay competitive in the market as providing in depth technical consultancy services is a necessity for this high-technology industry and competitors are already providing it. DNO dedicated consultancy services will help accommodate lack of technical depth of services being offered by field organization especially for regions that do not get much attention from AEs or REs such as EMEA and Asia Pacific.

7. Hand-holding during customer test set up will decrease the load of usability issues reported through customer support down the road.

8. Script automation services allow users to best take advantage of strong API capabilities of N2X.

9. Script conversion services facilitate customers' switchover from non-N2X test equipment to N2X. Users who invest time in learning and tailoring their test environment with particular test equipment are normally hesitant to switch to new test equipment.

6.2.3 Cons

Here is a list of disadvantages to the service offering alternative:

1. Similar services are provided by competitors free of charge or at minimal price, specifically to Tier-1 customers in North America. Hence, complementary consulting service has become an industry standard. Changing customers' mindset to pay for these valuable services is the major challenge of this alternative[23].

2. Human resource is another challenge for this solution. Consultants should be individuals who are well familiar with N2X, have deep technical knowledge, and thus should preferably be selected from DNO organization. Therefore, taking these talented resources away from product development, which is the main business of DNO, needs to be justified by high ROI numbers generated

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[23] Interview with DNO Business Development Managers

by business. A large portion of this return is related to increase in sales

dollars, which can hardly be associated with provided consultancy services.

3. Willingness to pay for such services, especially from customer groups with

   higher level of technical knowledge, is low. This is related to human nature, as

   these customers are hesitant to purchase services when they can do in-

   house.[24]

4. Internal political issues: A paid model for service offering that provides

   overlapping services with what is currently being provided by AEs can

   introduce political issues and conflict of interest between DNO and field

   organization. A successful solution should consider a well-managed sharing of

   work and revenue between the two organizations.

6.3 Alternative 2: Test lab

This alternative involves setting up a Test Lab facility with large and wide

variety of N2X chassis, interfaces, and test applications. The revenue model of

the test lab will be based on selling memberships at different levels that gives

users access to the lab's test equipment, assigning dedicated full-time

professional services engineers to their work, and participation in interoperability

test events hosted by this lab, all as part of the same package. The type of

professional services provided in the bundled package is similar to pure

consulting services, including start-up detailed training, test implementation, test

automation, test planning, and script conversion. The test lab can benefit users

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[24] Interview with DNO Business Development Engineers

and DNO in different ways as is described in more detail in the following sections.

6.3.1 Target Market

1- Small/start-up NEMs and NSPs:

Due to budget constrains, this group of users typically cannot afford high capital investment on costly test equipment. Based on the interviews performed with customers in this group, they highly value the existence of such test labs particularly if they are located in the same geographical region as their offices. Currently, some of these users get access to test equipment through leasing companies. However, a test lab solution will more be valuable as they can benefit from test efficiencies the consulting services will provide.[25]

2- POC labs/marketing department of medium/large size NEMs and NSPs:

This alternative benefits this group of customers in two different ways:

- **Cost saving:** This enables customers to perform their infrequent, high-scale tests without purchasing the equipment. It also enables clients to accomplish more testing in less time with fewer resources. This reduces the amount of dedicated person-hours necessary for testing which leads to further cost saving.

- **Increased publicity:** Attending interoperability tests performed in these labs allows NEMs and NSPs run tests in a real environment with presence of equipment from multiple vendors and deliver validation reports, something their customers want to see, but they alone cannot provide.

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[25] Interview with DNO Start-up customers

3- Component manufacturers:

This group typically runs infrequent conformance tests so using equipments of test lab facilities rather than investing high capital in purchasing equipment will benefit these users as well. However, due to the specific and low-complexity nature of these tests, this group would not highly value the bundled consulting services.

6.3.2 Pros

Advantages of a test lab alternative include:

1. The bundled consultation services provided by lab are perceived as a differentiated package by customers, which address the issue of low willingness to pay encountered by service offering alternative.

2. The test lab solution has high revenue potential, as it is attractive to a broad range of customers in targeted geographies.

3. The test lab is an advertising tool for DNO products as it can accommodate POC types of testing for N2X where users can test the functionality and performance of these devices before making a purchase decision[26].

4. High future equipment purchase potential from current growing start-up customers of the lab. Lab memberships create customer relationships and also introduce rich capabilities of N2X which result in customer lock-ins due to investment in learning which increases the chances of future sales revenue from these customers.

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[26] Interview with DNO's former strategist

6.3.3 Cons

Some of the main disadvantages of the test lab alternative are listed below:

1. A test lab is a high capital-intensive solution for DNO as it requires the lab to own a large stack of test equipment.

2. The test lab cannibalizes N2X's equipment sales, therefore defeating the main goal of consulting services which is an increase in equipment sales. Willingness of target customers to purchase equipment will be diminished if they have an option of using the lab equipment.

3. Geographical constraint is a major disadvantage of this alternative. Proximity of lab to customers is an important factor, as distant customers will incur high travel costs in order to be able to use the lab facilities.

4. The DNO lab will be N2X biased. Customers typically prefer to use independent labs that not only provide them a variety of test equipment from multiple vendors to choose from, but also help generate independent validation reports. The challenge for DNO is that competition from independent interoperability labs is very strong as there are a large number of well-established independent labs on the market[27].

5. Similar to the service offering, human resources is another challenge for this solution. A test lab requires locking-up of highly technical staff while they can be involved in development work, which is the core business strategy of DNO.

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[27] Interview with DNO Business Development Managers

6.4 Alternative 3: Product Offering

This alternative solution involves offering pre-sales services that will custom-engineer an N2X product or will provide the detailed solution architecture of the system to meet unique customer development needs. The main purpose of such services, which are currently provided by expert R&D engineers, is to address the limitations and lack of functionality of the current N2X solutions. Currently these services are provided as part of pre-sales services and free of charge. The suggested alternative differs from the current model such that it includes a more extensive level of these services using a pay model.

6.4.1 Target Market

The target markets for these services are large and medium size NEMs and NSPs that fall into two categories:

- They produce devices or implement networks with leading edge technologies.

- They are consolidated firms and create devices that are extensively high-scale with integrated capabilities or have expanded their existing networks that support larger selection of services.

Customers in both categories will benefit from tailored solutions that allow them to reduce their development risk and shorten time to market.

6.4.2 Pros

The major advantages of this alternative are listed below:

1. It has a strong impact on increasing sales revenue. Solutions that are uniquely suited to specific needs of customers will create lock-ins.

2. It enhances customer relationships.

6.4.3 Cons

1. It is not viable to generate direct revenue from this alternative since these offerings are provided as part of pre-sales services to cover existing holes in the product. It is not easy to convince customer to buy services for a product they have not purchased yet.

2. The changes done to product as part of the customization work make the product unsupportable through the regular support channel. The system will need to be supported by a consultant team during its lifetime, which is a big investment of valuable time of these engineers.

3. Amount of feedback provided is low as the consulting work is typically focused on a particular area of product which does not give consultants broad understanding of customer scenarios.

Table 6-2 below provides a summary of analysis of the three suggested alternatives for DNO consultancy services.

Market Segments	Pros.	Cons.	Target Markets
Alternative1: Service Offering	- Lead to increase in sales revenue - Strong customer feedback loop - Positive impact on customer relationship - Low capital intensive - Minimal risk - Allows field focus on pre-sales activities - Allows DNO to stay competitive - Reduce customer reported usability issues - Allows users take best advantage of N2X's strong API - Facilitates customer switch to N2X	- Hard to generate direct revenue from these services - Human resource scarcity - Challenges related to internal political issues	Wide range including: - Development and QA group of NEMs - NEM POC labs - NSPs
Alternative 2: Test Lab	- Bundled consultation is perceived as a differentiated package - High direct revenue potential - Advertising tool for DNO products - High future sales revenue potential from Start-ups	- High capital-intensive - Cannibalizes N2X equipment sales - Geographical constraints - Lab will be N2X biased - Human resources scarcity	- Small/start-up NEMs and NSPs - POC labs/marketing department of medium/large size NEMs and NSPs - Component manufacturers
Alternative 3: Product Offering	- Big impact on increasing sales revenue - Enhances customer relationships	- Hard to create direct sales revenue - Support for re-engineered product requires long-term consultancy engagement - Limited customer feedback	Large and medium size NEMs and NSPs under two categories: - Implement leading edge technologies - Consolidated firms

Table 6-2 Summary of DNO Consultancy Alternatives: Pros, Cons, and Target Markets

## 6.5 Criteria for Evolution of Proposed Alternatives

This section presents goals that will be used to evaluate proposed alternative solutions for DNO consulting services. Figure 6-1 below lists these goals and their assigned relative priorities. These goals and their priorities are set based on the business objectives of DNO as discussed in section 3-2 of this document. The goals with higher priority are considered more important to the future success of DNO. Each alternative is then evaluated to determine the degree to which it will meet each of the established goals using five levels, Very High, High, Medium, Low, and Very Low to determine an optimal final solution for DNO consultancy business.

Goals	Priority
Increase indirect revenue from leveraged equipment sales	1
Provide customer feedback	2
Strengthen customer relationships	3
Increase direct revenue from sales of consulting services	4

Figure 6-1 Goals of DNO Dedicated Consultancy

The correlation between the DNO's overall business objectives and DNO's consultancy business objectives are also shown in Figure 6-2 below and are further described in the following section.

Increase indirect revenue from leveraged equipment sales: This goal supports DNO's sales growth objectives of increasing two-year revenue target and improving operational profit.
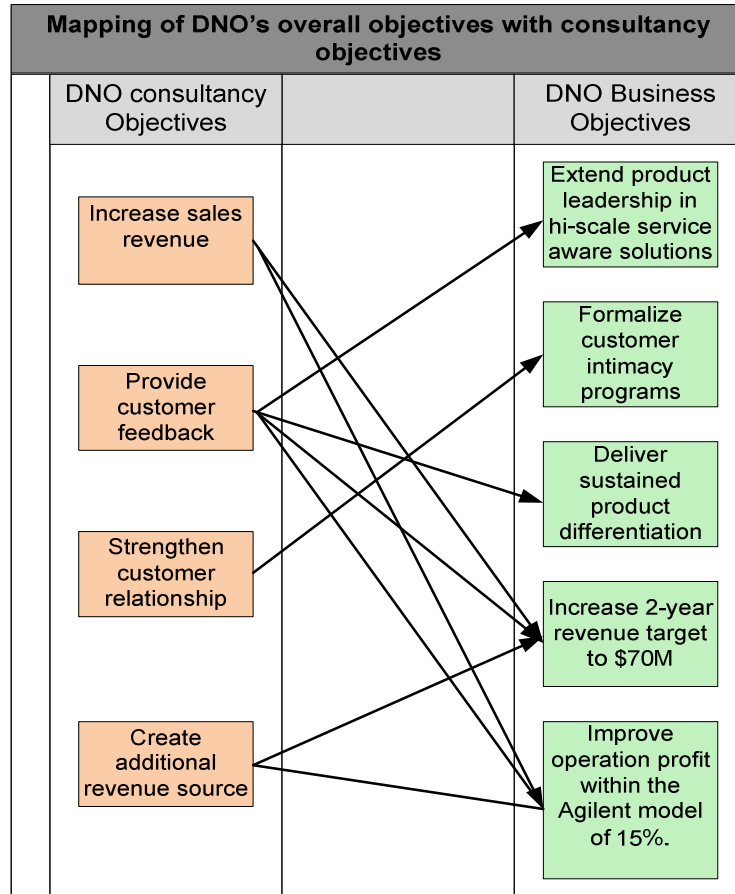
Figure 6-2 Mapping DNO's Overall Objectives with Consultancy Objectives

Provide customer feedback: Consultancy is a way for DNO to differentiate

against competitors. Early customer knowledge allows fast-to-market users'

required products and features leading to market dominance and high sales

revenue. Although being first to market with new features is important to

differentiation in the test equipment industry, competitors will catch up with these

new features rapidly. However, due to fast introduction of features and

complexity of technologies involved, what remains a significant competing factor

for test equipment vendors is the degree of hand-holding and in-depth technical consulting services offered.

Strengthen customer relationships: This goal is aligned with DNO's customer intimacy objectives as quality technical post-sales services will create customer lock-ins by improving customer loyalty.

Increase direct revenue from sales of consulting services: A pay model for DNO professional services will help increase DNO's revenue targets.

6.6 Evaluation of Alternatives

Based on the analysis of pros and cons of each alternative provided earlier, this section presents an overall evaluation of the proposed alternatives to determine how closely they fit with established goals of dedicated DNO consultancy initiatives. The results of the evaluation analysis which are summarized in Table 6-3, show that alternative 1(Service Offering) is the preferred solution. This is largely because of the high score of first three priority goals. Service offering has a high impact on increasing equipment sales revenue derived from revealing full capabilities of N2X to users as well as customer lock-ins. This alternative also enables DNO learn users' needs and scenarios leading to creation of customer-focused products. And lastly the direct interaction of consultants with users reinforces customer relationship which allows DNO meet its customer intimacy objectives.

Alternative 3, which is the next preferred solution, is inferior to first solution as it scored low on "Provide customer feedback goal" due to focused, narrow

coverage of the customer information. Least favoured solution is alternative 2.

Although it has high direct revenue potential, this solution is very costly due to

high capital costs and scored relatively low on goals with high priority.

Goals	Priority	Alternative1	Alternative2	Alternative 3
Increase equipment sales revenue	1	H	VL	H
Provide customer feedback	2	H	M	L
Strengthen customer relationships	3	H	M	H
Create additional source of revenue	4	L	H	VL

Table 6-3 Multi-goal Analysis of Consultancy Alternatives

7: RECOMMENDED SOLUTION

Based on the multi-goal analysis results of proposed alternatives, the suggested solution for DNO is to pursue a DNO-specific pure consulting strategy. The recommendation for DNO is to use a progressive implementation plan, starting the activity in a particular region and expanding to other regions once it proves successful. The strategy will require forming a structured and dedicated team of highly technical and customer savvy R&D engineers (Atanasovski, 2006). The benefit of a dedicated team is a growing technical knowledge base, over time resulting in efficiency improvements, something that addresses deficiencies in the current model. In addition, the DNO dedicated consultancy will need to be changed from the current reactive model where services are provided to requesting customers to a more proactive framework. DNO will be required to promote these services through marketing communications, collaterals, press releases, and Webinars.

This approach involves joint activities with the field organization through a work-sharing, revenue-sharing model. Partnership with the field organization is critical to the success of this strategy because of the field organization's established relationships with customers and familiarity with regional language and culture. However, since the field organization is already billing customers for the extensive consultancy services it provides, and because of the overlapping work of AEs and DNO consultants, these partnerships should be carefully

planned and managed. During the planning, it is important to take into consideration the conflict of interest that might arise due to differences in objectives and performance measures of the two operations.

7.1 Implementation Plan

In short-term it is recommended that DNO initiates a pilot project focusing on EMEA region. The pilot project will help gauge the solution's impact on sales revenue increase in order to provide justification for a further expansion of the solution to other geographical regions in the longer term.

Attractiveness of EMEA comparing to Americas and Asia Pacific region is due to several factors. The firs factor is that there is a good market potential especially from less developed countries in this region such as UAE, Russia, and Kuwait. The second factor is the abundance of Tier-2 Telecommunication Service provider serving many countries in this region. And the last factor is the need for more in-depth technical expertise in this region as direct AE services coverage is low, specifically for Eastern Europe and Middle East. These factors are described in detail in section 4.3.1.

The short term strategy should be implemented in two phases:

Phase1: As an initial trial, the services should be available to a broad range of customers in EMEA for 3 months.

Phase 2: Based on the result of trial phase and customers demands, DNO should continue with a narrower and targeted group of customers.

As part of this strategy, DNO should form a small team of 3 R&D engineers that will need to function under the "Regional Business Development" group of the marketing function. Functioning under business development will assure that the activities of this group are aligned with DNO's business objectives, which are to capture market opportunities and improve business relationships with existing and positional customers. A team lead should be assigned to take over additional responsibilities of coordinating and prioritizing team tasks and be the main interface for R&D, Product Marketing and field organization.

7.1.1 Performance Measurement

Financial criteria should not be the focus of performance measurement for pure consultancy as some goals such as "providing customer feedback" or "increase in customer satisfaction" can not be easily measured in monetary values. In addition, the amount of revenue generated from a deal cannot be accurately associated with consultancy services offered. Customer equipment purchases happen due to several factors such as product feature, customer relationships, price, discounts, etc, while some of these purchases would not happen without offering consultancy services. Initially, direct revenue targets should be set such that the service pays for costs such as employee wages and benefits, travel costs, advertising, and administration.

7.1.2 Revenue Model

Consultants should bill customers based on a per day charge model. Originally, they should provide a rough estimate of the total number of days required to finish the job based on the scope of work and delivery requirements during a free initial meeting with customer. The price should be approximately US $2K per day, which is the same as the price of field extended consultancy order code. This price will assure the service will pay for its costs. Refer to Table 7-1 below for a cost-revenue analysis:

Costs/Year/Person		Direct revenue/Year/Person	
Salaries and Benefits	200,000	Total # of Weeks/Year	52
Travel	40,000	60% utilization	312,000
Training, Advertising, & Administration	60,000	10% Revenue Sharing	31,200
Total costs	300,000	**Total DNO consultancy revenue**	308,880

Table 7-1 DNO Consultancy per Year, per Person Cost-revenue Comparison

7.1.3 Work-sharing Model

Regional Business Development Managers and Field District Managers should set clear boundaries between the type of services offered by AEs and DNO consultants. Below is a suggested task assignment between the two organizations:

AE organization: Product training, Pre-sales demonstrations, and short term post-sales tasks requiring less than one-day customer site visits such as troubleshooting, and test set-ups.

DNO consultancy: Test implementation, test automation, test planning, script

conversion, test solutions and long term tasks requiring more than one-day

customer involvement.

7.1.4 Revenue-sharing Model

The RE program has proven that the field organization perceives value in

DNO-provided services as these services are expected to increase the

equipment sales on which the field organization is measured. However, the

recommendation for DNO is that a fixed percentage (recommended 10%) of the

revenue from the DNO professional services work should be shared with the field

organization in order to provide them with incentive to assist the DNO

consultancy team with their customer connections and language. For areas with

no direct field coverage, currently a fixed percentage of revenue earned by the

field organization is shared with distributors and CPs. For DNO professional

services, the same percentage of field portion should be shared with these

partners.

8: CONCLUSION AND FUTURE WORK

This paper provided a strategic analysis of the IP Performance Network Test equipment professional services. The external analysis section of this paper revealed that the telecommunication market is highly competitive. Players in this market need to constantly improve the quality of their devices or services in order to remain competitive. This makes Network Test Equipments an essential part of this industry. To keep up with emerging trends of the telecommunication market, test equipment vendors need to be ahead of the game by introducing new complex technologies and features for their devices. The increasingly complicated nature of these technologies is boosting up the demand for in-depth and highly technical test equipment consultancy services.

The study of internal characteristics of DNO indicated that the current professional services model provided by Agilent corporate for DNO products imposes some limitations and obstacles to effectively meeting customers' needs. This paper presented an overview of these limitations and provided three alternative solutions for DNO to provide more detailed and product-focused professional services at DNO level. These alternatives are examined based on how they affect DNO's ability to achieve various business goals and a recommended solution is proposed.

The suggested solution for DNO is to provide pure consultancy services through a structured and dedicated team. The team should be operating under

the Business Development function of DNO. This solution will require minimal changes to the existing model and low investment, while allowing DNO to achieve its main business objectives.

In order to gauge the success of this solution, DNO is required to implement the solution as a pilot project in a specific region. The implementation should be started with EMEA, the most attractive region due to lack of direct field presence and existence of developing countries. The group can gradually be expanded to other regions once it is proved successful.

In order to achieve a successful implementation for this solution, there is future work to be done and challenges to be overcome by DNO management such as:

1. Additional headcount required to replace the DNO engineers moving to consultancy group needs to be approved by NSD. This may introduce some challenges for DNO management as performance of the pure consulting solution cannot be immediately measured with direct revenue numbers. Long-term benefits and goals of this solution will need to be made visible for NSD by DNO management.

2. Internal political issues with field organizations need to be carefully planned and be discussed with field management before proceeding with the solutions.

3. The performance of the consulting business will need to be constantly monitored and its success will have to be measured. Further expansions will need to be revisited and carefully planned.

4. Future expansion of consulting activities to broader geographies will require

   additional investment in resources from R&D and Marcom. An effective

   implementation plan will require allocation of team members in DNO factory

   sites, close to R&D resources. The close connection with R&D will enable the

   consultancy team provide accelerated services to customers. Further

   advertisement will require joint activities with Marcom which may not be

   possible with current limited resources in this function.

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